NATURE

SATURDAY, AUGUST 9, 1930.

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Editorial and Publishing Offices:

MACMILLAN & CO., LTD.,

ST. MARTIN'S STREET, LONDON, W.C.2.

Editorial communications should be addressed to the Editor.

Advertisements and business letters to the Publishers.

Telephone Number: GERRARD 8830.

Telegraphic Address: PHUSIS, WESTRAND, LONDON.

No. 3171, Vol. 126]

Science and Food Supply.

In a celebrated address to the British Association in 1898, Sir William Crookes, discussing what he called the "Wheat Problem", predicted a world shortage of 17 million bushels of wheat in 1931, and went on to assert: "it is the chemist who must come to the rescue of the threatened communities. It is through the laboratory that starvation may ultimately be turned into plenty." The warning was dramatic, and created something of a sensation at the time. The anxiety, it is true, was not shared by such agricultural authorities as Sir John Bennett Lawes and Sir J. Henry Gilbert, but they would have been the first to endorse all that Sir William Crookes said about the importance of the scientific worker in securing the maximum return in agriculture.

This historic address was mentioned by Dr. Levinstein in his recent presidential address to the Society of Chemical Industry. Dr. Levinstein pointed out that if a shortage of wheat is unlikely in 1931 it will be due, not to better fertilising and increased yields per acre, but to a larger acreage under cultivation. The enormous production of nitrogenous fertilisers during the last thirty years has had little effect upon the wheat supplies, and has gone instead to produce sugar, potatoes, rice, and other commodities. The difficulty has been met by extending the zone within which wheat can be profitably cultivated. This has been done partly by the development of new varieties of wheat better adapted to difficult conditions than those previously known, partly by the better utilisation of moisture reaching the soil, and partly also by improved agricultural implements. Thus not only the chemist but also the biologist and botanist, the soil-physicist and the agricultural engineer, have played their part in averting the food shortage which Sir William Crookes believed to be impending.

In this period agricultural chemists have produced no spectacular successes like those obtained with artificial fertilisers in the middle of the nineteenth century. The new methods of crop production have been made possible by an immense amount of scientific research, the practical importance of which was often not apparent at the time. For this reason, although agricultural science stands in higher repute with farmers than ever before, the contribution which science has made towards the improvement of agriculture is far from being appreciated by the community. Lord Melchett was undoubtedly right when he asserted recently that the importance of the chemist as a prime con-

tributor to the progress of civilisation is not yet realised, and this is notably true in the matter of food supply.

Even those who are aware of the part the chemist has played in developing the supply of artificial fertilisers by the fixation of atmospheric nitrogen, for example, or of his work as an analyst in detecting and preventing adulteration and in securing the purity of all kinds of foodstuffs, are unaware of the contribution of the biochemist and the important results of his study of the soil bacteria. In recent years the contribution of the chemist in the sphere of insecticides and fungicides has become as important as in the provision of fertilisers. At the last Imperial Agricultural Research Conference the need for a greatly extended chemical investigation of possible insecticides and fungicides for the control of diseases and pests was realised, and a resolution of the Conference recommended that an investigation of the whole chemical field should be undertaken by chemists working in collaboration with entomologists and plant pathologists. With the growth of intensive cultivation the control of plant pests assumes great importance, and the continuance of civilisation's power to feed the growing population of the world is largely dependent on the ability of the chemist and his fellow workers to protect our crops from such pests.

In a country such as Great Britain the adequacy of a food supply involves not only questions of production and protection of foodstuffs, but also their storage and transport, often for considerable periods. For the past ten years the Department of Scientific and Industrial Research has directed a number of investigations into the changes which occur in foodstuffs during cold storage. These investigations have already been of practical value in improving conditions of transport and storage of fruit and in checking wastage during long voyages from overseas. Success in the storage of fruit is now known to depend upon a close knowledge of chemical changes which follow severance from the tree and the effect upon them of temperature, humidity, age when gathered, soil, climate, etc. A relationship has been established between the chemical composition of an apple and its susceptibility to disease, and the first step has thereby been taken towards enabling the grower to control soil conditions so that the fruit possesses both better storage properties and greater resistance to disease.

Similarly, investigations at the Low Temperature Research Station at Cambridge have upset the accepted view that chemical reaction in tissues is almost completely inhibited in freezing and indicated the existence of a definite temperature zone within which the living muscle may be frozen and revert to its original condition on thawing. Other work on the conditioning of meat has indicated that the prejudice against frozen beef may be due to the use of inferior beef rather than to the effects of freezing, and researches carried out at sea in special trawlers have demonstrated the possibility of so improving the handling and transport of white fish that a higher proportion of the total catch can be handled in a 'fresh' and marketable condition after 10-11 days storage than was possible after 6-7 days by the old methods.

In such investigations not only the chemist but also other scientific workers have played their part. The majority of important advances in applied science under modern industry are the result of team work in which all kinds of scientific workers have co-operated, and equally with the chemist other classes of scientific workers are overlooked by the community. Thus scientific workers have already quietly averted a world shortage of foodstuffs which appeared to threaten us a generation ago. Until, however, the importance of their contributions are fully realised, the business or government of a country is unlikely to take the long range or scientific views of agricultural policy which Dr. Levinstein outlined.

For this position scientific workers are themselves at least in part to blame. With a wealth of material at their disposal—to take the report of the Empire Marketing Board as one example—they have done little to educate the community as to the contribution that science makes to the food supplies of the world, or to remove some of the pressing problems of food production out of the arena of political prejudices and debate into an atmosphere of impartial and scientific examination. Scientific workers must assume to a much greater extent the responsibility of leadership which their knowledge thrusts upon them, if mistakes of policy are to be avoided which prejudice the well-being of future generations. While there may be different opinions as to the precise manner in which science should exert a full and right influence on public affairs, there is little doubt that the recently revived Parliamentary Science Committee offers a valuable line of advance. Support of that Committee may not only provide a form for the expression of scientific opinion upon public affairs, but may also promote the participation of men of science in public life and their representation in Parliament, and even lead to the creation of the Ministry of Science which we have often advocated.

Natural History of New England.

The Boston Society of Natural History, 1830–1930. Edited by Capt. Percy R. Creed. Pp. xii + 117. (Boston, Mass.: Printed for the Society, 1930.)

FEW societies of natural history can boast such a fine record of achievement both in the encouragement of research and in public education as that of Boston, which recently has celebrated its hundredth anniversary. Boston in 1830 was the centre of a populous seaboard, through which most of the foreign commerce entered the United States, while it possessed a large fleet of clippers, merchantmen, and whalers. The land behind was settled by an industrious population, who feared only God and the devil. The Almighty gave such animals and plants as were beneficial, while Satan was responsible for the rest, about which it were safest to be incurious. The farmer's existence was unspeakably hard and his amusements were few. In the ports, however, there was great interest as to foreign lands, and skippers took a pride in bringing curios to deck such local museums as that of New Salem. The museum 'instinct' thus started began to spread to Nature in the country behind them, from which the Indians had already disappeared, but ideas were chaotic.

It was in these circumstances that about twenty Boston men banded themselves together to found their Society of Natural History. They included no one who even knew the birds, fishes, or mammals of their neighbourhood. The public was indifferent to their aims and regarded them as 'busy triflers'. There was no museum that could help them. Yet they dared to get themselves incorporated by the Commonwealth of Massachusetts, thereby undertaking the responsibilities of a national institution. They appointed fifteen office-bearers, including eight 'curators' whose duty was to collect the animals and plants of New England. They induced the legislature to appoint six persons to survey the natural history of the home State, these working largely under their advice. A small legacy overcame many difficulties and enabled their first hall to be acquired in 1848. Here they developed their collections, while they gave the only instruction in biology in Boston. The Society claimed with Louis Agassiz that the study of Nature should be made "an indispensable part of all education", and its classes were expressly designed to help teachers to acquire the necessary knowledge. In 1861 the Commonwealth recognised its position and gave a noble site in the 'west end' of Boston, whereon was erected a museum and library of natural history. In 1834 publication of the *Boston Journal of Natural History* was started, and this has been added to by Proceedings, Memoirs, and Bulletins, the contributors to which have comprised many of the best-known naturalists in America. These were used largely for exchange purposes, and the result is a library of 100,000 catalogue entries, nearly complete in all that concerns North America.

In 1871 practical steps were taken to develop New England collections of rocks, plants, and animals, all to be arranged on the logical background of relationship. Later, with the foundation and development of the Harvard University collections in the Agassiz Museum, these were further developed, and afterwards the two museums made such an exchange that the local collections became concentrated in Boston and the exotic in Cambridge. Thus the two museums, the world institution of Harvard and that of the local society of New England, have come to bear a peculiar relationship to one another, the authorities of one being equally interested in the other. Pupils from the State schools visit one and demand to be taken to the other. They do not understand what they see, but they have an insatiable curiosity to see—and one visit is not enough. Sunday afternoons with their 2000 visitors to these museums is interesting, the present writer having once been requested to explain exhibits to a group of about twenty who had motored in thirty miles with the thermometer below 0° F. expressly for this visit.

To mention the names of the more distinguished naturalists of the Boston Society of Natural History would recall the story of the development of natural history in America, since Boston is its true metropolis of this study. Amongst the foundation members are found Amos Binney and A. A. Gould, leading conchologists of their day. The former gave his collection of plants, and later were added the John A. Lowell flowering plants with other collections of lichens and algæ, these having the sympathetic interest of Asa Gray. To Jeffries Wyman and F. W. Putnam were owed the genesis of a fine fish collection, the basis of Humphreys Storer's "Fishes of Massachusetts", 1867. Marine invertebrates were largely given by the elder and younger Agassiz, but this section looks for a great development in the new museum that is now imperatively necessary. Dr. Thaddeus W. Harris gave lectures in 1831, preaching the need of a proper study of insects in connexion

with agriculture. In 1841 he published "The Insects of Massachusetts injurious to Vegetation", which passed through several editions. His collection of insects, made a hundred years ago, is the oldest general collection in North America, and his 4700 species comprise about half the present known species of New England. The fossils are not spectacular save for reptilian footprints. They are mostly primary invertebrates, especially trilobites and brachiopods. Mammals, birds, and reptiles are the work of many hands, but Barbour and Allen may be trusted to have made their groups as complete as they well can be.

John James Audubon was a visitor to the Society in 1832–33 when preparing his superb "Birds of America", and the great Humboldt was a close correspondent, as might be expected, since it was his financial loan that enabled Louis Agassiz to become a biologist. Amongst the active workers, sympathisers, and helpers we find the names of practically every one of the older families of New England. There are, too, noble eulogies of their fellow-members, who devoted their lives to the natural history of their State, by Longfellow, Oliver Wendell Holmes, and James Russell Lowell, men distinguished by their art and ennobled by that love of natural history which they deemed to be a vital factor in the programme of all well-educated persons.

J. STANLEY GARDINER.

The Expansion of Consciousness.

The Ascent of Humanity: an Essay on the Evolution of Civilization from Group Consciousness through Individuality to Super-Consciousness. By Gerald Heard. Pp. xiv + 332. (London: Jonathan Cape, Ltd., 1929.) 15*s.* net.

THIS remarkable book will attract deep, if not wide, attention for several reasons. In the first place, it gives an entirely new setting to the doctrine of progress which was generally believed in the last century and has lately fallen into temporary disrepute; the author moves the centre of discussion from the external and mechanically organised world into the evolution of man's spirit itself. Secondly, it appeals strongly, and, as we think, too exclusively, to the psychological interest of the present day; it attempts a psychological explanation of some of the greatest movements and most famous characters in history, and this, even when not convincing, is always interesting and suggestive. Thirdly, it fits in admirably with the growing interest in world organisations and especially with the ideas underlying the League of Nations. It is a striking proof of the strictly scientific, or at least theoretical, point of view of the author that such obvious applications of his theory are not even mentioned. It would have made the book easier to read and attracted a wider public had he allowed himself more popular and topical illustrations of this kind.

The general thesis, however, though difficult and at times doubtful in its development, may be quite shortly and simply stated: "Man's consciousness was once pre-individual, a group-consciousness; it is now individual and is becoming super-individual." Combining this main doctrine with the 'spiral' idea of human progress, Mr. Heard has many brilliant *aperçus* in his review of anthropology. As we advance in a spiral up the steep ascent, we are able at certain points to stand over our primitive ancestors, and, looking straight down upon them, understand them better than intermediate generations have done, who went off in another direction. This, in fact, is the main argument, or at least suggestion, in Mr. Heard's interpretation of the primitive mind. The individualist psychologist of the eighteenth and nineteenth centuries went astray in studying early man by treating him as a small and undeveloped example of the same sort of mind as he had himself. We now, gradually acquiring, at a higher level, a 'co-conscious' mind, more similar in that respect to his own, can understand him better.

It will be clear from this—a typical and frequently repeated argument in the book—that Mr. Heard makes no pretence to a final or comprehensive judgment on any of the questions he discusses; he is, on the contrary, extremely modest and tentative throughout. But the issues involved are of such supreme moment, and his goal and the spirit in which he approaches it are so fine, that his book deserves careful reading and the criticism for which he pleads. "All efforts to interpret human events in economic terms have failed to produce a philosophy of history. The real advance, consistent but elaborate and concealed, is in man's spirit." With that general doctrine we may heartily agree.

One or two criticisms may be added, such as the author desires. His matter is much more complete on the psychological and anthropological side than on that of history or the philosophy of history. He has thought deeply and read widely on psychic questions and primitive psychology, but, when he comes to a review of theories about progress and the evolution of civilisations, Vico, Flinders Petrie, Spengler, and Henry Adams are the only authors he

names. To mention only one omission, he would have found in Comte's philosophy of history much that fits in and fortifies his own. To Comte also the present age is *par excellence* that of revolution, and this revolutionism is due to the bursting out of a growth of 'individuals' who have not yet learnt to subordinate their selfishness to the new form of co-consciousness on which both Mr. Heard and Comte substantially agree. For what else is the new super-consciousness except the sense of a common humanity of which we are all, individuals and nations, only subordinate and inseparable organs?

On one other point, a question of substance and vital moment, many readers will feel that Mr. Heard does not do justice to the 'individualism' which must pass away, if society is to advance. This cannot be regarded as a wholly evil thing. Not only was it the necessary condition of rising to a higher plane at all, but also it must be fulfilled and sublimated by the higher consciousness and not abolished. If the humanity of the future were to consist of a species of higher ants, acting only through the group-instinct, however large the group may be, all the most valuable achievements of the intermediate stage would have been lost. No doubt Mr. Heard would accept this amendment of his general argument; to work it out in detail and in practice is the supreme moral task of the future. "Self-knowledge is self-creation"—one of the best of his many good sayings—conveys his consciousness of it and his idea of the right line of approach.

F. S. MARVIN.

A Source Book in Mathematics.

A Source Book in Mathematics. By Prof. David Eugene Smith. (Source Books in the History of the Sciences, Vol. 2.) Pp. xvii + 701 + 8 plates. (New York: McGraw-Hill Book Co., Inc.; London: McGraw Hill Publishing Co., Ltd., 1929.) 25*s.* net.

THIS is a very entertaining volume, a surprisingly successful attempt to do what nearly all good judges would have declared to be impossible. Its aim is "to present the most significant passages from the works of the most important contributors" to mathematics "during the last three or four centuries".

It is easy to think of a dozen excellent reasons why such an attempt is sure to be a failure. Any compilation of this kind is bound to be scrappy, and in many ways unrepresentative, and no two competent mathematicians will ever be found to agree on principles of selection. The original presentation of an important idea is usually by no means the best, either logically or for purposes of instruction. The passages selected must be translated (if the book is to sell in the United States), and, however competent the translators, a great deal of the savour of the originals must be lost in translation. In short, it is very difficult to imagine any class of students or teachers to whom the book can possibly appeal except as a curiosity, and the time and money spent on its production might be used much more profitably in other ways.

The fact remains that Prof. Smith's volume is a very definite success; it is interesting to read and pleasant to possess. The translations are accurate and vigorous, the printing and illustrations excellent, and the general level of scholarship shown by the contributors is very much higher than is usual in scientific compilations. Among them are prominent researching mathematicians such as Bateman, Bell, and Tamarkin, as well as historians like Archibald, Cajori, and Smith; and Prof. Smith, as editor, has combined the activities of his collaborators with quite remarkable skill.

It is interesting to see what mathematician scores most freely, and no one will be surprised to find that it is Gauss. Gauss has five contributions; on congruences, on the law of quadratic reciprocity, on the fundamental theorem of algebra, on regular polygons, and on the conformal mapping of surfaces. Three of these at least would probably have been unanimous selections of any editorial board. Fermat also scores five, but one is merely the famous 'marginal comment' concerning the impossibility of $x^n + y^n = z^n$; Abel and Euler each score three. There is little Newton; but the volume is limited to pure mathematics. It is surely a mistake to have omitted Cantor and Weierstrass entirely, and Riemann is represented only on the geometrical side. I should have preferred to go without Horner's method or nomography, but I can see that a great many people would disagree with me. On the other hand, I was particularly pleased to find Tchebichef's work on primes, and the early writings on non-Euclidean geometry are particularly well represented.

I may conclude by mentioning a few historical curiosities chosen at random. The first use of π occurs in "Synopsis Palmariorum Matheseos: or, a New Introduction to the Mathematics" (1706), by William Jones, who seems to have been quite a good mathematician (p. 346). The addition formulæ for the sine and cosine seem to be due to Dithmarsus and Clavius (Christopher Clavius, "Astrolabium", 1593);

Clavius's 'method of prosthaphæresis' is almost an anticipation of calculation by logarithms (p. 459). Continued fractions are first found in Bombelli's "L' Algebra parte maggiore dell' aritmetica divisa in tre libri" (1572, p. 80); Cataldi (1613) gives what is practically the usual symbolism. G. H. HARDY.

Welsh Folk-lore.

Welsh Folk-lore and Folk-Custom. By Prof. T. Gwynn Jones. Pp. xx + 255. (London: Methuen and Co., Ltd., 1930.) 7*s.* 6*d.* net.

PROF. GWYNN JONES'S little book on Welsh folk-lore is a welcome companion and supplement to Miss Hull's "Folk-lore of the British Isles" in the same series. The author is able to deal in greater detail with topics on which Miss Hull could do little more than touch in covering the larger area. Here we have presented within a relatively small compass a much fuller statement of the chief features of the lore and custom of the Welsh people.

The composite character of English folk-lore and custom has often been pointed out. The same character is to be attributed to Welsh folk-lore in even a greater degree, where indeed it would seem probable that more of the earlier phases of primitive custom and belief have survived. This, perhaps, might have been expected from the cultural history of the principality. Settlers seem to have absorbed the tradition and culture of the earlier population to a greater degree than in England. It will be remembered that Giraldus Cambrensis noted this as characterising Norman invaders in Ireland, who became "Hiberniores ipsis Hibernicis".

The survival of very early tradition is exemplified in the stories of the Mabinogion, in which elements of a most primitive character are to be found side by side with features characteristic of the chivalrous civilisation of Norman times. Fairies and giants both figure prominently. As the late Sir John Rhys pointed out, the former are often of a pre-iron or even pre-metal age, as for example in the stories of the fairy-wife who vanishes on being struck accidentally by iron.

Prof. Gwynn Jones has devoted himself in the main to a record of fact; theories as to origins and parallels are mostly avoided. This is no doubt wise in view of the importance of securing a record of facts as extended as possible before they vanish entirely. But in a few cases a consideration of parallels found elsewhere would be of assistance to the reader who is not a specialist. As an example, the *Mari Lwyd*, the custom that at certain times a person known as *Mari* should carry round a horse's skull, should be compared with the similar traditional practice in the Isle of Man and at Ramsgate. It is suggested here that the custom may be connected with marriage; but more probably it is a general fertility rite which has been adapted to special occasions and seasons.

Among the many other topics with which the author deals, attention may be directed to the valuable account of holy and wishing wells. The book is a record of great value which, it may be hoped, will stimulate others to add to the material before it is too late.

Our Bookshelf.

Organic Syntheses: an Annual Publication of Satisfactory Methods for the Preparation of Organic Chemicals. Editorial Board: Hans T. Clarke, Editor-in-Chief; Roger Adams, James B. Conant, Henry Gilman, C. S. Marvel, C. R. Noller, Frank C. Whitmore, C. F. H. Allen. Vol. 10. Pp. vii + 119. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1930.) 8*s.* 6*d.* net.

AMONG the more familiar of the thirty-one preparations contained in this volume are benzenesulphonic chloride, benzophenoneoxime, methyl oxalate, and anhydrous oxalic acid. Useful practical details will be found under all these headings: thus, benzophenoneoxime is gradually converted into a mixture of benzophenone and nitric acid when kept under ordinary conditions, and a method of inhibiting this decomposition is given. The less common preparations include durene, duroquinone, and pyromellitic acid. The last-named compound is made by oxidising finely powdered pine or spruce charcoal with sulphuric acid in presence of a little mercury, and it is remarkable that ordinary willow charcoal failed to yield this benzene derivative when treated in a similar way. A useful apparatus for the application of superheated alcohols in the formation of various high-boiling ethyl and methyl esters is described under the heading of ethyl fumarate.

Of biochemical interest are the preparations of casein (from milk), *l*-tryptophane and *l*-tyrosine (from casein), taurine (from ethylene dibromide through sodium 2-bromoethanesulphonate), erucic acid (from rape seed oil), and lauryl alcohol (from cocoanut oil). There is also a noteworthy series of preparations departing from acetone and proceeding through bromoacetone and acetol to *l*-propylene glycol; the latter process affords an example of the biological method of asymmetric reduction by means of yeast reductase. An appendix contains later references to preparations in preceding volumes, but the index covers the current volume only. A revised collection of the contents of the first nine volumes is to be issued in due course. J. R.

American Geographical Society. Special Publication No. 11: *Brief History of Polar Exploration since the Introduction of Flying.* By W. L. G. Joerg. To accompany a Physical Map of the Arctic and a Bathymetric Map of the Antarctic. Pp. v + 50 + 2 maps. (New York: American Geographical Society, 1930.) 5 dollars.

BOTH these are layer coloured bathymetrical maps on a scale of 1 : 20,000,000. The Arctic map is a revised version with insets and names in English of the map in Andree's "Handatlas" (1924). It is an excellent map with much detail. A slight misuse is made of the name Svalbard. It is the name for all the islands, except Jan Mayen, under Norwegian sovereignty in the Arctic Sea and not a synonym for the island of Spitsbergen itself.

The Antarctic map is new and gives a new version of the bathymetry of the Southern Ocean, though Mr. Joerg avoids that name. We note that the soundings of the *Discovery* between Tristan da Cunha and South Georgia do not seem to be included and of course those of the *Discovery* in her present expedition were not available. It was perhaps a pity to bring out a new map of the Antarctic at a time when several expeditions are at work in the south. A delay of a few months would have allowed the addition of the important discoveries of Sir Douglas Mawson in the *Discovery* and Capt. Riiser Larsen in the *Norvegia* in the region of Kemp, Enderby, and Coats Land. The American work in the Ross Sea region is shown.

It is to be hoped that the omnibus name of Antarctic Archipelago for all the islands between Clarence Island and Charcot Island will be abandoned. It is neither explicit nor necessary. The practice of British cartographers of using Coats Land for all the land on the east of the Weddell Sea with differentiation into various 'coasts' has not been adopted. The old tendency on polar maps to multiply 'land' reappears. The notes accompanying the maps are chiefly useful for their account of Admiral Byrd's recent work, accounts of which have not, so far, been readily accessible except in American newspapers. R. N. R. B.

The Organization of Knowledge and the System of the Sciences. By Henry Evelyn Bliss. Pp. xx + 433. (New York: Henry Holt and Co., 1929.) 5 dollars.

DR. BLISS'S book makes a twofold appeal. It is written by a librarian as a guide for librarians, and it also has a philosophical purpose. It criticises, in the latter part of the volume, all the better-known systems of classification of knowledge, and Dr. Bliss maintains that it is necessary for a librarian, as for anyone else dealing with the instruments of knowledge, to have a correct idea of its natural articulations in order to serve and co-operate to the best advantage with others working in various parts of the field. We are therefore inclined to turn first to the later chapters, although the earlier contain an impressive account of the increasing complexity of functional organisation of all kinds in practical life. The need of right organisation of thought to secure right organisation of action is the keynote of the book. It is a serious and very suggestive compendium.

Turning to the later chapters, which will be of most interest to the scientific reader, we notice that Dr. Bliss gives the first place among his 'almosters' to Ostwald, for his classification of the sciences into three main groups, with three or four main subdivisions in each. We are inclined to agree with him, mainly on the ground of clearness and simplicity. The three main groups are: (1) The formal sciences, under the concept of order; (2) the physical sciences, under the concept of energy; (3) the biological, under the concept of life. It proceeds, as all these systems do, from Comte's original, but it corrects and completes it. As knowledge grows, the boundaries will no doubt be again corrected in future. Dr. Bliss deserves our thanks for directing attention to the importance of the subject and spurring everyone to improving it. F. S. M.

Sleep and the Treatment of its Disorders. By Dr. R. D. Gillespie. (Minor Monograph Series.) Pp. ix + 267. (London: Baillière, Tindall and Cox, 1929.) 7*s.* 6*d.* net.

DR. GILLESPIE, who is a member of the younger school of British psychiatrists, is to be congratulated on producing a most readable and at the same time stimulating book on what is one of the most interesting problems of modern physiology—sleep. The author provides us with a wealth of clinical material and discussion. He wisely points out that the effects of loss of sleep are by no means so serious as are generally presumed; at the same time there is no question that in the mentally disordered, loss of sleep is a serious question. Experience in a mental hospital soon provides confirmation of this. His discussion of the theories of sleep is well balanced and well set out. In discussing the treatment of the psychoses by means of prolonged sleep, we should prefer to see somnifen described as a mixture of the diethylamin salts of diethylbarbituric acid and allylisopropyl barbituric acid and not as a single substance.

Intermediate Dynamics and Properties of Matter. By Dr. R. A. Houstoun. Pp. ix + 139. (London, New York and Toronto: Longmans, Green and Co., Ltd., 1929.) 3*s.* 6*d.*

THIS book, which is of intermediate examination standard, deals very ably with those branches of physics that border on applied mathematics, and which present considerable difficulty to elementary students. The subject offers little scope for novelty of treatment, but has nevertheless been presented in an interesting manner, whilst the book also includes sections on various important branches such as rotational motion and gravitation, which are often omitted, although with little justification. The chapter on pumps has good accounts of the modern Hyvac pump and the McLeod gauge, and the chapter on the properties of matter a few paragraphs on diffusion, osmosis, and absorption of gases. One wishes that there were more equally good elementary texts in existence.

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.*]

Constitution of Chromium.

THE first mass-spectra of chromium were obtained by means of accelerated anode rays. The results were very feeble and only showed one line of mass number 52 (NATURE, Sept. 22, 1923, p. 449). I have now been able to make experiments with a volatile compound of this metal, the solid carbonyl, $Cr(CO)_6$, kindly prepared for me by Dr. A. v. Grosse, of Berlin. The vapour pressure of this is low but sufficient for use in the ordinary discharge tube when suitable arrangements are made. The intensity of the beam of mass-rays has been so increased that not only has it been possible, by the use of fine slits, to obtain a value for the packing fraction of Cr^{52} but also, by the use of coarse slits and long exposures, to reveal no less than three new isotopes, and to determine their relative abundance photometrically as follows :

Mass number . .	50	52	53	54
Percentage abundance	4·9	81·6	10·4	3·1

The packing fraction of Cr^{52} is -10 with a maximum possible uncertainty of ± 3 (pts. per 10,000, $O^{16} = 0$) a large negative value, as was expected from the curve. Correcting for this and for the change to the chemical scale we get

Atomic weight of Cr $= 52{\cdot}011 \pm 0{\cdot}006$,

a value identical with that in use.

It will be noticed that the lightest isotope is isobaric with the doubtful Ti^{50} and the heaviest with Fe^{54}.

F. W. ASTON.

Cavendish Laboratory,
Cambridge, July 26.

Hydrogenised Iron of High Magnetic Permeability.

SINGLE crystals of iron produced some time ago in this laboratory by high temperature treatments in hydrogen [1] were found to have higher permeabilities than crystals grown by other methods.[2, 3, 4] Experiments soon showed that these high permeabilities were not the result of the large crystal size, but of the hydrogen treatment at the high temperature. As a result of further experiments great improvements in the permeability of iron have been obtained by heat treatments in hydrogen not resulting in large crystals, and values of initial and maximum permeabilities now repeatedly obtainable are 6000 and 130,000 respectively. For such specimens the coercive force is 0·05 gauss and the hysteresis loss for $B_m = 14{,}000$ is 300 ergs/c.c./cycle. The magnetisation curves and hysteresis loop are shown in Figs. 1 and 2. For comparison, similar curves for ordinary annealed iron are also shown. Mechanically, this is the softest iron yet produced, having a hardness about the same as that of annealed copper.

These results have been obtained in cylindrical specimens of Armco iron one inch in outside diameter, $\frac{3}{4}$ inch in inside diameter and $\frac{1}{4}$ inch high, heat treated in moist hydrogen at between 1400° C. and 1500° C. for 12 hours. The specimens are then cooled to 880° C. or to room temperature, after which they are annealed at 880° C. for 2 hours. As a result of this treatment the specimens are etched as if by evaporation and have a grey colour probably due to a thin film of oxide. The grain diameter ranges from 0·1 to 2 mm. The magnetic properties are quite sensitive to mechanical strain but it has been found that deleterious effects due to overstrain, occurring at any time after the high temperature treatment, may be wiped out by a subsequent annealing at 880° C. This fact has been used to advantage where mechanical operations are desirable in the preparation of the specimens, the low temperature annealing being given after severe hard working of the material already treated at the high temperature. Experiments have also shown that the hydrogenising process may be applied in the melt.

Various experimenters have reported improvements in the magnetic properties of iron by heat treatments in hydrogen,[5, 6, 7] but the results obtained have not been so good as for specimens treated in vacuum [8, 9, 10] or nitrogen [6] or slightly oxidising atmospheres.[11] Such improvements as have been obtained have usually been ascribed to the removal of absorbed gases, reduction of the oxides, or decarburisation. Recently Yensen [12] reported high permeability in a specimen of carefully purified and vacuum treated iron. More recently Zeigler [13] reported similar results for a specimen consisting of several large crystals, from which he concludes that high permeability in iron is obtained only in single crystal specimens. Rogers has obtained

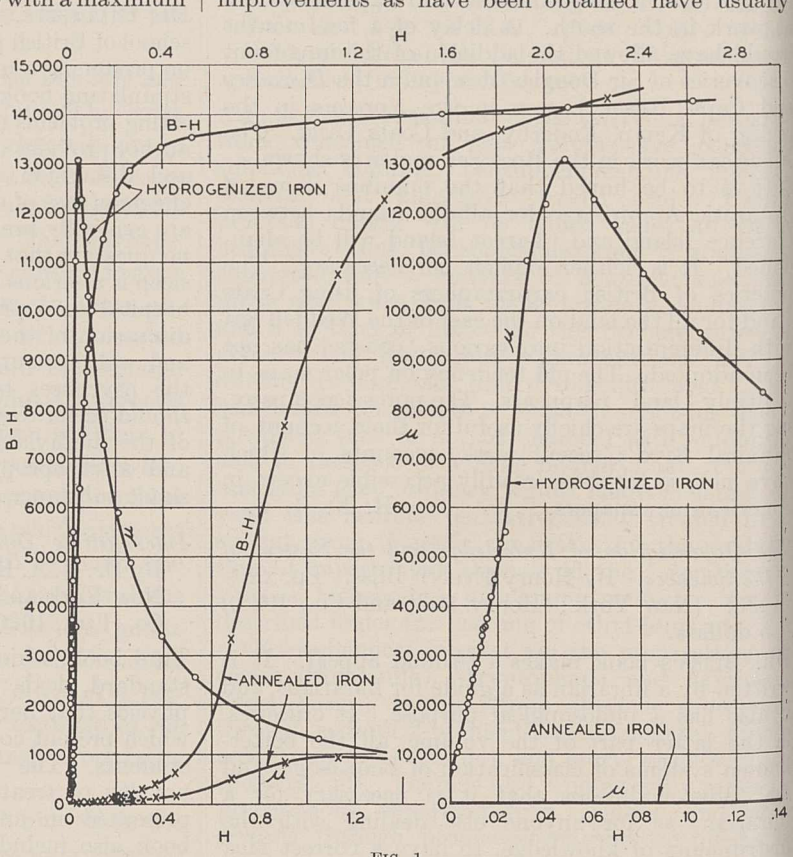

FIG. 1.

higher permeability than Yensen or Zeigler by melting iron in a low pressure carburising atmosphere, but makes no mention of the crystal grain size.[14]

It is believed that the high permeabilities obtained with hydrogenised iron are at least partly due to the absorbed hydrogen. This is shown by the fact that hydrogen treated iron of high permeability, when retreated at a high temperature and in a good vacuum (about 10^{-8} mm.), assumes the permeability of ordinary iron treated in the high vacuum only. The drop in permeability of the hydrogenised specimen is presumably due to the loss of absorbed hydrogen. In other experiments the gas given off by the hydrogenised specimen was collected and analysed and found to be principally hydrogen. Determinations of the degree of deoxidation and decarburisation in hydrogenised iron are as yet incomplete.

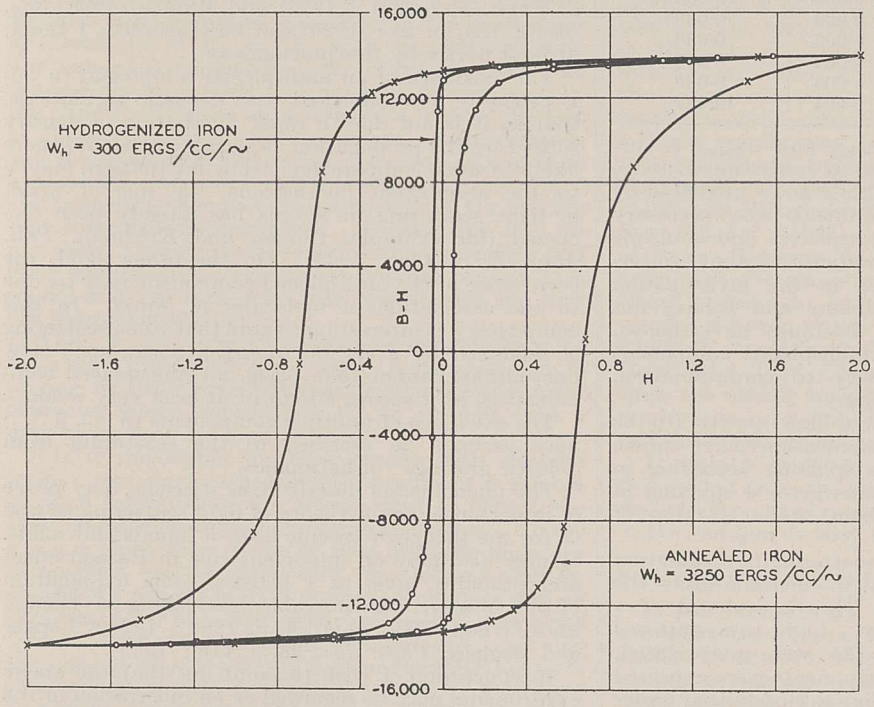

FIG. 2.

The factors which determine the results are temperature and time of treatment, pressure of hydrogen, and thickness of the metal. These are the factors which enter into Richardson's equation for diffusion and absorption of hydrogen by metals.[15] If the large magnetic improvements are dependent upon the absorption of an optimum quantity of hydrogen, it should be possible to obtain the same results by any suitable combination of the factors satisfying Richardson's equation. Experiments indicate that this is so.

P. P. CIOFFI.

Bell Telephone Laboratories, New York, June 16.

[1] L. W. McKeehan: NATURE, **119**, 705-706; 1927.
[2] W. Gerlach: *Zeit. f. Physik*, **38**, 828-840; 1926.
[3] K. Honda and S. Kaya: *Tôhoku Imp. Univ. Sc. Rep.*, **15**, 721-753; 1926.
[4] D. D. Foster: *Phys. Rev.*, **33**, 1071; 1929.
[5] W. E. Ruder: U.S. Patent No. 1,110,010, Sept. 8, 1914.
[6] E. Gumlich: *Electrician*, **83**, 494-495; 1919.
[7] F. P. Wilson, Jr.: *Gen. Elec. Rev.*, **30**, 544-550; 1927.
[8] E. Gumlich: *Stahl u. Eisen*, **41**, 1249-1254; 1921.
[9] T. D. Yensen: *Trans. A.I.E.E.*, **34**, 2455-2495; 1915.
[10] F. S. Tritton and D. Hanson: *Jour. Iron and Steel Inst.*, **110**, 90-121; 1924.
[11] T. D. Yensen: *Trans. A.I.E.E.*, **43**, 558-567; 1924.
[12] T. D. Yensen: *Jour. Frank. Inst.*, **206**, 503-510; 1928.
[13] N. A. Zeigler: A.I.M.E., *Tech. Pub.* No. 273.
[14] This result was reported by Anson Hayes in discussing a paper by T. D. Yensen, *Trans. Am. Electrochem. Soc.*, **56**, 215-229; 1929.
[15] O. W. Richardson, J. Nicol, T. Parnell: *Phil. Mag.*, **8**, 1-29; 1904.

Change of Wave-length of Light due to Elastic Heat Waves at Scattering in Liquids.

SOON after the discovery of the Raman effect, I attempted to find out whether in light scattered in various organic liquids the Raman lines, due to frequencies of the rotation spectrum, are present. These lines should be situated very close (probably within some fraction of an angström) to the incident line. In the course of these experiments a very interesting phenomenon was observed.

When the light λ4358 A. of a mercury lamp scattered at an angle of 90° by the liquids was examined by means of a highly resolving instrument (30 steps echelon grating), it was observed that besides the radiation with a wave-length equal to the incident one there were also other radiations of nearly the same intensity, the wave-lengths of which are symmetrically displaced relatively to the incident wave towards greater as well as smaller wave-lengths by a value depending upon the kind of liquid, but not differing greatly from 0·05 A. for all the liquids studied. The spectrogram of the scattered light has thus the shape of a triplet with a distance between the components of about 0·05 A. In the case of highly scattering liquids, such as toluene and benzene, I observed also some lines displaced by a multiple of this value. In the last-named liquids, up to three displaced lines on each side of the unmodified line, that is, 7 components in all, could be discerned, so that the farthest of them were at a triple distance, namely, *c.* 0·15 A. (The exposures could be so chosen that the components of hyperfine structure of line 4358 A. did not hinder the observations.)

These results were obtained last summer but their interpretation remained for some time not clear. Some considerations and further experiments (which will be published elsewhere) have led me to the conclusion that it is scarcely possible to regard the displaced components as Raman lines due to the rotational quanta.

Another explanation of the observed splitting of the scattered light is that this splitting is due to acoustic oscillations like those used by P. Debye (*Ann. d. Phys.*, **39**, p. 789; 1912) for explaining the variation of the specific heat of solids at lower temperatures. These elastic heat waves propagate in the medium with the velocity of sound and produce periodical variation of the amplitude of the scattered light, thus giving rise to two new frequencies:

$$\nu = \nu_0 \pm 2\nu_0 \frac{v}{c} \sin\frac{\theta}{2}. \quad . \quad . \quad . \quad (1)$$

Here ν_0 is the frequency of the incident light, v is velocity of sound and c that of light in the medium, and θ is the angle between incident and the scattered rays.

This equation was given by Brillouin (*Ann. de Phys.*, **17**, p. 88; 1922) and also by Mandelstam

(*Jour. Russ. Phys.-Chem. Soc.*, **58**, p. 831; 1926), who has derived it from somewhat different considerations. The possibility of a change in light frequency according to equation (1) was also pointed out by Bogros and Rocard (*Jour. de Phys. et le Radium*, **10**, p. 72; 1929). However, their conclusion as to the absence of the phenomenon referred to seems to be erroneous.

The observed and calculated values of the splitting of two adjacent components are given in Table 1.

TABLE 1.

	$\Delta\lambda$obs. in A.	$\Delta\lambda$calcul. in A.
Aniline . . .	$0{\cdot}050 \pm 0{\cdot}005$	0·056
Toluene . . .	$0{\cdot}047 \pm 0{\cdot}003$	0·039
Benzene . . .	$0{\cdot}047 \pm 0{\cdot}003$	0·036
Water . . .	$0{\cdot}045 \pm 0{\cdot}004$	0·040
Ethyl alcohol . .	$0{\cdot}039 \pm 0{\cdot}004$	0·033
Ethyl ether . .	$0{\cdot}035 \pm 0{\cdot}004$	0·027

The agreement between $\Delta\lambda_{obs.}$ and $\Delta\lambda_{calcul.}$ is surprisingly good, and it remained to verify the existence of the connexion between angle θ and ν predicted by the theory. Such an experiment was necessary because the presence of undisplaced and multiple components seemed to contradict the above interpretation. (The liquids used in the investigation were from the firm of Kahlbaum and I have not purified or distilled them. I think, nevertheless, that the occurrence of the undisplaced component cannot be ascribed exclusively to contamination, dust, or stray light from the arc.)

The experiments with crystalline quartz (to be described in a separate communication) have shown that a crystal, in which the splitting according to equation (1) is mostly probable, gives a splitting of the frequency of scattered light similar to that of liquids.

It was found also that the scattering of a radiation of a mercury lamp λ4047 A. in benzene gives the same splitting as λ4358 A. The dependence of ν on θ was checked with benzene. Light rays scattered at the angles $\theta = 45°$ and $\theta = 135°$ were investigated. With $\theta = 45°$ the displaced components were expected to approach the undisplaced line so closely that under actual experimental conditions they could not be resolved. The spectrogram showed only a broadening of the undisplaced line. But with $\theta = 135°$ not only could the components predicted by equation (1) be observed, but also those displaced at multiple distances. All the components (the undisplaced one included) are equidistant and more separated one from another than at the angle 90°. The position of the undisplaced line remained unaltered at $\theta = 45°$ (the middle of the broadened line) and at $\theta = 135°$.

Table 2 gives averaged experimental values of $\Delta\lambda_{135°}$ and those calculated by equation (1), as well as ratios $\Delta\lambda_{135°}/\Delta\lambda_{90°}$ observed and calculated.

TABLE 2.

θ.	$\Delta\lambda$obs.	$\Delta\lambda$calcul.	$\left[\frac{\Delta\lambda_{135°}}{\Delta\lambda_{90°}}\right]_{obs.}$	$\left[\frac{\Delta\lambda_{135°}}{\Delta\lambda_{90°}}\right]_{calcul.} = \frac{\sin 67° 30'}{\sin 45°}$.
90°	$0{\cdot}047 \pm 0{\cdot}003$	0·039	1·32	1·31
135°	$0{\cdot}063 \pm 0{\cdot}002$	0·050		

The agreement between observed and calculated values is quite satisfactory.

It may be concluded from the above that a close connexion between the splitting of wave-lengths of the scattered light and the elastic heat waves in the given medium does exist. These results may be regarded as a demonstration of the reality of Debye's waves and at the same time suggest a new 'spectroscopic' method for the determination of the velocity of sound in liquids and solids.

Equation (1) in the case of light scattering in liquids is to be replaced by the equation

$$\nu = \nu_0\left(1 \pm 2n\frac{v}{c}\sin\frac{\theta}{2}\right), \quad \text{where } n = 0, 1, 2, 3, \ldots$$

and the theory of light scattering by elastic waves is to be modified accordingly.

The number of components I could observe with my apparatus corresponded to $n \leq 3$, yet it is probable that components corresponding to $n > 3$ are also present. The broadening of the scattered line observed by Cabannes, Daure et Salvaire (*C. R.* **186**, p. 1533; 1928; **188**, p. 907; 1929), Gerlach (*Ann. d. Phys.*, **5**, p. 301; 1929) and Raman (*Proc. Roy. Soc.*, ; **122**, p. 23; 1929) can be explained, I think, at least partly by this phenomenon.

The existence of an undisplaced component ($n = 0$) is probably not connected with acoustic oscillations, that is, it is not due to rapid fluctuation of density caused by the propagation of elastic waves, but more likely to some comparatively slow fluctuation, maybe to the orientation fluctuations, the rôle of which in light scattering in liquids has already been discussed (for example, Raman and Krishnan, *Phil. Mag.*, **5**, p. 498; 1928). On the other hand, the occurrence of the undisplaced component may be due to the association of molecules in liquid. In this connexion it is interesting to note that when scattering is produced by a crystal (quartz), where such slow fluctuations cannot take place, an undisplaced component is, as it seems, absent or at least very weak.

The existence of multiple components ($n = 2, 3 \ldots$) may perhaps be ascribed to the scattering from 'elastic gratings' of harmonics.

The phenomenon described, as it seems, may prove of importance for the theory of light scattering as well as for the theory of specific heat of liquids and solids. It may also play an important rôle in Raman effect and probably give, as I believe, some explanation of the observed considerable broadening of Raman lines (Wood, *Phil. Mag.*, **6**, p. 1282; 1928; Langer and Meggers, *Phys. Rev.*, **33**, p. 115; 1929).

In conclusion, I wish to point out that the above experiments may be regarded as an illustration of the change of wave-length of light produced by the modulation of the amplitude of oscillations—a problem which has attracted attention of physicists for a long time (Wood, "Physical Optics", p. 407; 1905; Cotton, *Le Radium*, **8**, p. 404; 1911; Rupp, *Zeit. f. Phys.*, **47**, p. 72; 1928).

E. GROSS.
Optical Institute,
Leningrad, June 20.

Tercentesimal Temperature and the Kelvin Absolute Scale.

IN NATURE of July 19 a review entitled "Discursive Meteorology", meaning as I think 'discursive physics', asks a question to which I ought if possible to find an answer. The reviewer writes: "Some of his own usages arouse criticism, in particular, that of *tt* to denote absolute temperature (not only in the form 300° *tt*, but also in formulæ); why should not meteorologists adopt the now growing physical practice of writing 'K' to denote the Kelvin absolute scale, just as 'C' and 'F' are used for the Centigrade and Fahrenheit scales?"

To begin with, the answer is categorically in the negative.

(1) I have never used *tt* to denote absolute temperature. (2) So far as I know I have never used the form 300° *tt* and never shall; if it is in any one of my volumes it is a misprint; it shocks my æsthetic sense to see

it printed in NATURE. (3) I have never known a meteorologist use the Kelvin absolute scale to express the temperature of the air numerically.

What many of us use is the temperature as read on an ordinary thermometer with 273 added, either by the instrument maker, the observer, or the computer. The result is often loosely called absolute temperature, and may be so called anywhere except at one's writing-table. With rather surprising emphasis, the most incisive of my scientific friends insist upon drawing a very marked distinction between it and the absolute scale, a distinction which I find it impossible to repudiate or ignore though numerically (about a tenth of a degree) it is of no importance.

Equally I find it impossible to regard the so-called absolute temperature as something of the same order as a scale, be it 'C' or 'F' with an arbitrary zero. The one connotes energy; the others connote only the reading on a scale and have no dimension. To my mind there is the same difference betwen the two as there is between volts, amperes, or microfarads and the number of degrees of deflection of a spot of light on the screen of a galvanometer.

I have called the measure of energy by C + 273 the 'tercentesimal temperature'. To-day, for the atmosphere, I would prefer to call it the thermancy and leave temperature to retain its popular usage; but, so far as I am concerned, the opportunity for that has been allowed to go by.

While I was writing discursive meteorology or discursive physics, I came upon a paragraph in a preface by Prof. Ernest Barker of a book on national character which appealed to me so strongly that I may be excused for quoting it.

"It is impossible to think clearly with Protean terms; and the first necessity of argument is the use of clean words which are always used to denote the same things and connote the same attributes. To use a single word when three or four different ideas are in question and to use it now for one and now for another of the ideas, is a confusion of ideas and of argument." From that point of view I was quite pleased with 'tercentesimal temperature' as distinguishing what I was using from veritable absolute temperature as well as from 'C' or 'F'. I thought it a clean, crisp note direct from the International Bank of Scientific Intelligence, Ltd., which still keeps my small account. It never occurred to me to regard it as a bit of old newspaper picked up from the scrap-heap of abortive science, and criticism notwithstanding, I do not so regard it even now.

As to *tt* for a symbol of quantity, I have only to say for that, that it is new and crisp and quite useful. So is another piece of apparent duplicity, namely, *bb* for pressure-gradient in absolute units. Any other symbol that is used for either has been overworked for years. If the reviewer or any other of my scientific friends who have to face the terrible discursiveness of the physics of the atmosphere will give such suitable double letters a trial, with the understanding that always and everywhere they will carry exactly the same meaning, he will find them, as I have done, extraordinarily convenient. NAPIER SHAW.

July 21.

Isotope Effect in the Spectrum of Boron Monoxide: Intensity Measurements and Structure of the β-Bands.

MEASUREMENTS of the intensities of the lines in four bands in the β system of boron monoxide excited by active nitrogen have enabled the intensity ratios of the $B^{11}O$ and $B^{10}O$ bands to be determined. Each band has been measured on two plates, and the intensities of the corresponding lines in the two isotopic bands compared. The following table gives the mean ratio of the lines for each of the bands, for each of the two plates:

Band.	1→5.	2→5.	2→6.	3→7.
Intensity $B^{11}O/B^{10}O$	3·36 3·46	3·34 3·22	3·50 3·17	4·30 4·38
Mean . . .	3·41	3·28	3·34	4·34

The first three agree quite well, but differ from the result for 3→7 by an amount considerably greater than the probable error; it is most unlikely that the discrepancy is due to 'blending' with lines of other bands. The result appears to show a real difference in the intensity ratios of the isotopic bands for different vibration transitions. It is possible that the difference is due to some selective excitation properties of active nitrogen.

These results may be compared with the isotope ratio calculated from the atomic weight of boron. Taking 11·0110 and 10·0135 for the atomic masses of B^{11} and B^{10} respectively (F. W. Aston, *Proc. Roy. Soc.*, **115**, 487; 1927), and 10·82 for the atomic weight of boron (German Atomic Weights for 1927), the calculated abundance ratio of the isotopes is 4·22 : 1. There appears to be a possibility that the atomic weight of boron varies according to the source from which it is obtained (H. V. A. Briscoe and P. L. Robinson: *Jour. Chem. Soc.*, **127**, 696; 1925), and since the atomic weight of the boron used in the intensity measurements has not been determined, the calculated isotope ratio must be regarded as uncertain.

It appears from the above measurements that, in this case at least, the intensity ratios of isotopic bands do not give a true measure of the relative abundance of the isotopes as they occur in nature.

STRUCTURE OF THE β-BANDS OF BORON MONOXIDE.

It has been known for some time that only one series of lines occurs in the β bands of boron monoxide excited by active nitrogen, whereas in the same bands excited in the arc, a second series of approximately equal strength appears (R. S. Mulliken, *Phys. Rev.*, **25**, 259; 1925). It was suggested by Mulliken (loc. cit.) that the *P* branch was missing in both cases, that the two series in the arc were electronic doublets constituting an *R* branch, and that only one member of the *R* branch doublet was excited in active nitrogen.

The arc bands have been examined with a Hilger *E*1 quartz spectrograph, and it was found that the lines in both series are very close doublets, the doublet separation increasing with distance from the head. The frequencies of the lines in the 0→1 and 0→2 bands have been measured (neglecting the fine structure), and good agreement of the combination differences for the excited state of the two bands is found, if the two series are assumed to be *P* and *R* branches, the *P* branch being the series which appears only in the arc. The lower state combination differences for the 0→2 band then agree very well with those for the 0→2 band in the a system (W. Scheib, *Zeit. f. Physik*, **60**, 74; 1930), which has the same final state as the β bands.

From these considerations, it appears practically certain that doublet *P* and *R* branches of approximately equal strength occur in the arc β bands, whereas (see Mulliken, above reference, for possible exceptions) only the *R* branch occurs in the bands excited in active nitrogen; it is not known whether this branch is double or not, as the rotation structure is not sufficiently developed in this case to enable the doublets to be resolved with the instrument employed.

From the above measurements, a preliminary value of $B'_0 = 1{\cdot}53$ cm.$^{-1}$ is obtained. The values of B'' are already known from the work of Scheib (loc. cit.), since the α and β bands have the same final state.

A. ELLIOTT.

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Sputtered Nickel Films and the Synthesis of Ammonia.

I HAVE recently found that when a film which has been sputtered from a nickel cathode in an atmosphere of nitrogen is afterwards heated to 150° C. or more in hydrogen, ammonia is produced. The process undoubtedly consists in the reduction of a nitride of nickel formed in sputtering: the quantity of ammonia —10-20 mgm. for a film of perhaps 200 sq. cm.—checks reasonably well with the amount of nitrogen absorbed in sputtering. Heating in a large excess of hydrogen, with added nitrogen, has not as yet been found to increase appreciably the yield of ammonia, so the process does not appear to be catalytic in the ordinary sense—for the pressures and temperatures tried so far.

Of course, the production of ammonia from nitrides is common (cf. the Serpek process), and the nitride of nickel is not unknown (see, for example, Beilby and Henderson, *Jour. Chem. Soc.*, **79**, 1251; 1901: Vournasos, *C.R.*, **168**, 889; 1919). The chief novelty in the present work, aside from the method of production of the nitride, is the comparatively low temperature at which the reaction takes place. This is probably due to the nitride being produced in sputtering in a very finely divided form (although doubtless still crystalline, cf. Ingersoll and Hanawalt, *Phys. Rev.*, **34**, 975; 1929).

It may be pointed out that the sputtering process—when used under conditions such as the present, of relatively high gas pressure and low voltage—offers a method, hitherto little used, for the formation of many unusual compounds or quasi-compounds. With the metal (probably) in the vapour state and the gas largely excited, combinations are certainly to be expected (cf. v. Hippel, *Ann. d. Phys.*, **81**, 1072; 1926), if they are at all possible. Conditions of current density and gas pressure are likely to be somewhat critical. In the present case nitrogen is most rapidly absorbed in sputtering when the pressure is about 0·5 mm., with a current density around half a milliampere per sq. cm. of film surface, at 1500 volts. Too high a current, or insufficient cooling, breaks down the compound as fast as formed. Heating to 300° C. decomposes this nitride, driving off the gas and leaving a crystalline film of metallic nickel. If pure compounds are to be formed in this way, the cathode should be in a thin strip form which can be given a preliminary heating to redness for some time, as otherwise the gas released from the metal in sputtering forms a serious source of contamination.

L. R. INGERSOLL.

Department of Physics,
University of Wisconsin,
July 9.

Spitsbergen Whale Fishery of the Seventeenth Century.

As is well known, in the seventeenth century a right-whale fishery was prosecuted in the inlets of West Spitsbergen, the whales being caught by boats launched from the shore. Were the whales caught at this fishery Greenland whales, as is asserted, or were they, as seems more likely, Atlantic whales?

In 1827, on May 14, Parry [1] found Mauritius Bay, on the shore of which Smeerenberg, the Dutch whaling station, stood, still frozen over, the edge of the land ice or land-floe extending across its mouth from Hakluyt's Headland to Vogel Sang; in 1880, on July 20, the late Mr. Leigh Smith [2] found Fair Haven blocked with ice; and last year in June, according to a Danish Meteorological Office report,[3] Foreland Sound was still frozen over.

Taking the foregoing and certain other facts connected with the ice into consideration, the inshore fishery of the seventeenth century must have been prosecuted in July and August, months in which the inlets of West Spitsbergen are usually free from 'land ice', that is, the ice that forms *in situ* in the winter months. Until this kind of ice breaks and drifts away, the fishery could not be prosecuted by boats launched from the shore.

The Greenland whale is a migratory animal, keeping amongst or in the near vicinity of the polar ice and in water having a temperature never much above its freezing-point. According to the log-books of Scoresby, senior, it was only seen near Spitsbergen in April. In May and June it had to be looked for amongst or near the ice half-way between Spitsbergen and Greenland, and even this situation it usually deserted in the latter month. In July and August it had usually to be looked for in a lower latitude near the Greenland coast, but in that situation it was seldom seen except in limited numbers and only when there was plenty of ice.

The Atlantic whale is also a migratory animal, migrating north in summer and south in winter, but it prefers ice-free waters with a temperature well above their freezing-point. In recent years it has been seen so far north as Iceland and Bear Island; and west of Spitsbergen, where the temperature of the water is unusually high, it may quite well have gone still farther north.

ROBERT W. GRAY.

Exmouth, July 14.

[1] Parry. "Narrative of an Attempt to Reach the North Pole."
[2] Voyage of the *Eira*; *Proc. Roy. Geo. Soc.*, p. 140, 1881.
[3] "The State of the Ice in the Arctic Seas, 1929."

Distribution of the Pigmy Hippopotamus.

UNTIL Major Hans Schomburgk's search in 1911–12 for the headquarters of the pigmy hippopotamus (*Choeropsis liberiensis*), little was known of its distribution except that it hailed from the country to which it owes its specific name. Schomburgk found that it extended from the coastal belt of Liberia back to the boundary of French Sudan, but how far it spread along the coast into Sierra Leone and French Ivory Coast he could not discover ("Distribution and Habits of the Pigmy Hippopotamus", in 17*th Ann. Rep. New York Zoo. Soc.*, 1912 (pub. 1913), pp. 113-120). His farthest east record is from Du Queah (Dukwia) River, on the boundary between the Mamba and the Bassa Country, about 10° 15′ W. long.

Two skulls, recently presented to the Royal Scottish Museum by Mr. J. B. I. Mackay, were given to him in 1928 by the chief of Abo. The animals to which these skulls belonged lived in marshy ground of limited area not far from the banks of the Niger and within a hundred miles of its mouth, more than a thousand miles west of previous records. I do not specify the locality more definitely, because, although the animals are sufficiently numerous to warrant the attentions of a professional native hunter who spends most of his time in the dry season hunting them, they might readily be exterminated owing to the circumscribed area inhabited, and in spite of the moderate protection granted by law.

There is a possibility of geographical differentiation in such a colony, especially if it be a very isolated outpost. I add, therefore, the chief dimensions of the skulls, in mm. :

Length along face, premaxilla to occiput, 310, 311 ; condylobasal length, 297, 299 ; zygomatic breadth, 185, 196·5 ; least inter-orbital breadth, 93·5, 96 ; nasal, 152·5, 147·5 ; greatest combined breadth of nasals, 38·5, 40 ; occipital depth (median), 89, 86 ; mandible, 242 ; mandibular tooth row, including canine, 180·5 ; ditto excluding canine 144 ; maxillary tooth row, including canine, 164, 166·5 ; ditto excluding canine 136·5, 142 ; 3rd upper molar, 21, 22 ; 3rd lower molar, 27.

In the above list the first number refers to skull 1929.176.1, the second to skull 1929.176.2, of which the lower jaw is missing. JAMES RITCHIE.

Royal Scottish Museum,
Edinburgh, July 7.

X-Ray Spectra and Chemical Combination.

THE element sulphur offers a very interesting case for the effect of chemical combination on X-ray spectra. Lindh has already established remarkable changes in the K-absorption edges of this element with varying valency (see Siegbahn : " Spectroscopy of X-rays ", pp. 146-147). The $K\beta$ lines of this element also show peculiar changes, especially regarding relative intensity and structure of β_1 and β_χ lines in various chemical compounds of sulphur. In the course of a study of the X-ray spectrum of sulphur and its compounds, I have made the surprising observation that one line, with the wave-length 5043 X.U. (apparently identical with the $K\beta_3$ line listed by Hjalmar), is emitted by certain sulphur compounds, but not by pure sulphur or by certain other chemical compounds of this element.

It has been found that sulphates of lithium, sodium, potassium, rubidium, cæsium, silver, and mercury, as well as the sulphides of sodium, potassium, strontium, barium, and cadmium, give quite an intense $K\beta_3$ line, whereas in the sulphides of copper, silver, magnesium, zinc, mercury, lead, and molybdenum this line is entirely suppressed. For sulphates of copper and magnesium and the sulphide of calcium a faint indication of this line is obtained. In all cases a copper anticathode was used.

The ordinary spectral lines so far known are all of atomic character, that is, they are emitted on transitions between levels belonging to the atom of the free element. In some cases, especially with light elements, an influence on the wave-length and the structure of the lines by adjacent atoms has been found. The observations here reported seem to indicate the existence of a new type of X-ray lines arising from transitions within a *molecule*.

Details of this communication will be published elsewhere. G. B. DEODHAR.

Physical Laboratory,
University of Uppsala, July 11.

Mortality amongst Plants and its Bearing on Natural Selection.

IN a communication in NATURE of May 31, p. 817, Prof. E. J. Salisbury describes some exact quantitative observations on the mortality which takes place in the seedling condition of flowering plants, and he points out the bearing of these facts upon natural selection. The sycamore furnishes another good instance of this high infant mortality, since almost every year the tree produces an abundance of viable seeds. The winged indehiscent fruits provide a very efficient means for seed-dispersal, and seedlings bearing the first pair or two of young foliage leaves are plentiful in almost every situation throughout the summer. It is well known from experience that only a very small fraction of these seedlings will ultimately survive, or even pass beyond the two-leaved stage, and grow into trees.

Some light might be thrown upon the problem as to which, if any, characters possessed by the seedlings are of help in bringing about this apparent survival of the fittest, if observations were made upon the *causes* of this excessive mortality. Is it due, for example, to unfavourable climatic conditions, too much or insufficient light, overcrowding, insect or other animal enemies, fungus pests, etc. ? Information upon this point, which so far as I am aware has not previously received attention, cannot fail to be of interest. A. W. BARTLETT.

Armstrong College,
Newcastle-upon-Tyne,
July 14.

Simultaneous Electronic Transitions in X-Ray Spectra.

IN a letter to NATURE of Oct. 26, 1929, by D. Coster and M. Wolf, the results were published of some investigations on the fine structure of X-ray absorption edges of copper and zinc.

Whereas with copper a very complicated fine structure was easily obtained, in the case of zinc, in the beginning, no fine structure at all could be observed. Mr. Suekichi, however, recorded a fine structure of the zinc-K-edge of zincblende when this crystal was used as analysing crystal (NATURE, Mar. 29, 1930, p. 509). In the meantime, in continued experiments, I have succeeded at last in observing also a fine structure in the case of zinc, when metallic zinc foil was used as absorbing screen. This fine structure of zinc, however, seemed to be less pronounced than that of copper.

Experiments are in progress to measure the variations in the absorption coefficients in the fine structure range of the K-edges of copper and zinc in order to draw more definite conclusions about the probability of simultaneous electronic transitions in both elements. M. WOLF.

Natuurkundig Laboratorium der
Rijksuniversiteit,
Groningen.

The Quantum Theory of Chemical Valence.

DR. J. C. SLATER has shown in a most valuable paper (*Phys. Rev.*, Vol. 34, p. 1293 ; 1929) that one can develop the complete theory of atomic states (multiplets) in a simple way without the application of the methods of the group theory. This is of considerable importance ; for the difficulties of these methods interfere greatly with the understanding of the simple relationships which are derived. I should like to point out (no doubt Slater has already done so himself) that one can treat the theory of the interaction of several atoms in the same simple way and indeed more exactly than merely to the first approximation. One obtains the results first obtained by Heitler and London with help of the methods of the group theory and, furthermore, the valence forces between atoms in all various excited states. In the interest of the further propagation of Slater's ideas, I shall in the near future publish these considerations in greater detail in the *Zeitschrift für Physik*. M. BORN.

Institut für theoretische Physik,
Göttingen, July 11.

The Great Barrier Reef of Australia.*

By Dr. C. M. YONGE, Leader, Great Barrier Reef Expedition.

AUSTRALIA possesses in the Great Barrier Reef the largest and most impressive series of coral reefs in the world. The realisation of the unique opportunities so presented for scientific research—geological, geographical, and biological—led in 1922 to the formation of a Great Barrier Reef Committee with headquarters at Brisbane. Its chief promoters were the Right Hon. Sir Matthew Nathan, at that time Governor of Queensland, and Dr. H. C. Richards, professor of geology in the University of Queensland. Valuable work of a geological and geographical nature was carried out, and then, in 1927, following representations by Sir Matthew Nathan on his return to Great Britain, a British Association Committee was formed to organise an expedition for the biological investigation of the Great Barrier. To the expedition, which sailed in May 1928, was attached a geographical section organised and largely financed by the Royal Geographical Society.

The position of the coral reef controversy at that time can best be realised by a study of Prof. W. M. Davis's book, "The Coral Reef Problem", published in 1928. From the time of Darwin it has been regarded as essentially a geographical problem. As a matter of common experience it is known that reef-building corals live only in water 30 fathoms or less in depth and in temperatures at or above 20° C. Although Madreporarian corals flourish even to the fringe of the polar oceans and in the deep seas, they never form true reefs—unless we include the banks of *Lophohelia prolifer* in the deep waters of the Norwegian fjords—except in the tropics. Where in these regions they occur depends on the presence of a suitable substratum, namely, a platform not deeper than 30 fathoms, and where there is never any serious admixture of fresh water or extremely heavy fall of silt. Cold currents from the poles or the upwelling of cold water from the deep seas inhibit their growth and are responsible for the absence of coral reefs from the western coasts of the great continents.

Darwin divided coral formations into fringing reefs, barrier reefs, and atolls. The first develop in the shallow waters round the coasts of continents and continental or volcanic islands, and their origin is clear and undisputed. The others grow up far from land, though in the case of the former in clear connexion with it, and the mystery of the origin of the platform on which they have developed *is* the coral reef problem. Little is known of the biology of corals; few have been examined when alive, and the long-continued and careful investigations necessary for the full elucidation of their life histories, growth, food and manner of functioning, and the numerous factors which control these, have seldom been attempted. It was to fill in some degree this great gap in scientific knowledge that the expedition worked. The results it obtained from investigations into the nature, organisation, and

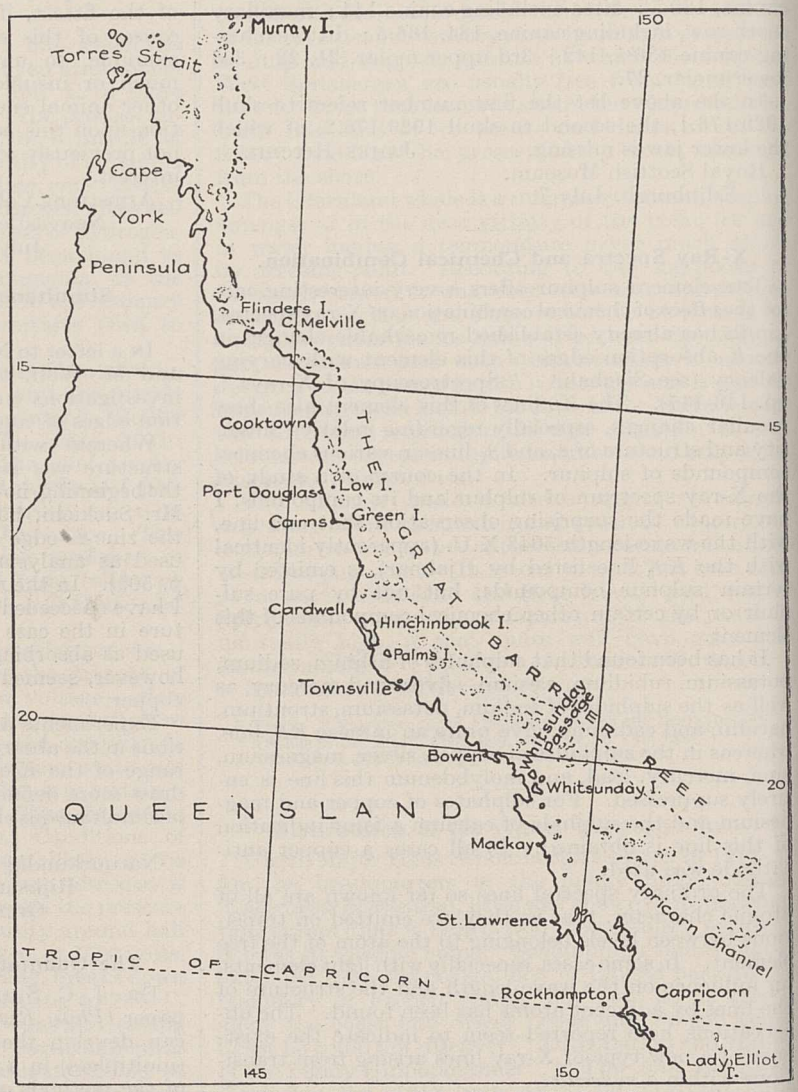

FIG. 1.—Map of the Great Barrier Reef. (Map by Mr. J. A. Steers, by kind permission of *Discovery*.)

* Friday evening discourse delivered at the Royal Institution on May 16.

life of the unique marine communities known as coral reefs will constitute its main contribution to the science of marine biology.

The series of reefs which are grouped together as the Great Barrier Reef of Australia run roughly parallel to the north-east coast and, in the words of Jukes, one of its early investigators, "may be said to commence with Breaksea Spit, in S. lat. 24° 30′, and extend to Bristow Island, on the coast of New Guinea in S. lat. 9° 15′". Measured in a straight line, this is 1260 statute miles (Fig. 1). It must clearly be understood that these reefs do not form an unbroken chain, like a gigantic breakwater, although they certainly possess the function of one by sheltering the coastal waters from the Pacific storms. The term Barrier Reef is here one of convenience rather than accurate description. We are dealing with a vast series of reefs which have grown up on a shallow submarine platform of immense length and, in its southern portions, of great width.

The most southern reefs, immediately north of Breaksea Spit, are a series of isolated islands, first Lady Elliot Island and then the Bunker and the Capricorn Groups, all in the region of the Tropic of Capricorn. The reefs are oval in outline, each with a sand cay covered with dense vegetation upon it. Although they extend so much as 60 miles from the coast, none of the islands is on the edge of the platform. The Capricorn Group is separated from the remainder of the Barrier Series by the Capricorn Channel, which is considerably deeper than the waters between the Barrier and the mainland (which seldom exceeds 20 fathoms) and through which vessels pass to enter the steamer channel within the Barrier which leads to Thursday Island and the ports of the Far East.

The Barrier Series proper may be said to begin with Swain Reefs, a confused mass of reefs fifty miles wide and separated by a distance of about one hundred miles from the mainland. These reefs are little known; they are separated from one another by intricate channels, shallow and full of coral patches. They are in no sense barrier reefs. Similar reefs, but not extending over such wide areas and coming gradually closer to the coast, and separated by occasional channels wide and deep enough for ocean-going vessels to negotiate, comprise the southern half of the Great Barrier.

North of Cairns, about latitude 17°, the reefs really do begin to assume the character of a true barrier. The submarine platform becomes narrower and the reefs extend to its outermost margin, so that in places depths of 1000 fathoms are reached only a few miles beyond the reef. This was the region in which the expedition worked, the headquarters, Low Isles, being some fifty miles north of Cairns. The lagoon channel narrows from twenty miles at Cairns to a little more than five opposite Cape Melville, 200 miles farther north, beyond which it becomes much wider owing to the deep inlet of Princess Charlotte Bay. The reefs, however, continue to run roughly parallel to the coast for another 150 miles, but north of Cape Direction the coast runs north-north-west to Cape York, but the reefs almost due north, so that they are separated by a channel eighty miles wide from the far north of Cape York Peninsula.

Within the Torres Strait, itself a shallow water area, the Barrier forms the outer margin of the vast series of reefs which extend between the coasts of Cape York Peninsula and New Guinea.

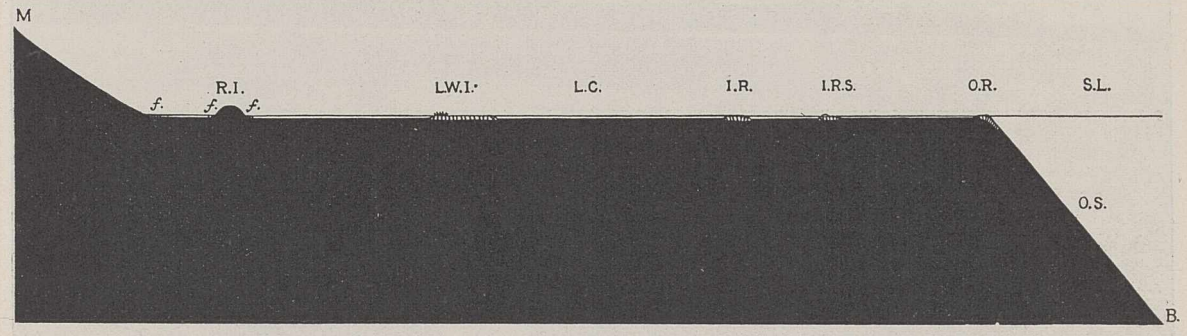

FIG. 2.—Diagrammatic section across the platform on which the barrier reefs have developed, showing the typical conditions in the northern half. Vertical scale four times the horizontal scale. *B*, sea bottom, 1000 fathoms; *f*, fringing reefs; *I.R.*, inner reef; *I.R.S.*, inner reef with sand cay upon it; *L.C.*, lagoon channel 16-20 fathoms; *L.W.I.*, low wooded island with vegetated sand cay; *M.*, mountain, 2500 feet high, on mainland; *O.R.*, outer reef, true barrier; *O.S.*, outer slope of platform; *R.I.*, rocky island, 400 feet high with fringing reefs; *S.L.*, sea level.

Such, then, is the general disposition of the Great Barrier. The origin of the great submarine platform on which it stands is, and is likely to remain so for many years to come, a great geographical problem. Mr. J. A. Steers, the leader of the Geographical section of the expedition, has summarised elsewhere [1] the various opinions that have been held. Some have thought that it has been cut by the seas, possibly when the level of the sea was lowered during the glacial periods, others that it has been formed by a sinking of the land. Upholders of the latter—and more probable—view are divided into those who regard the platform as having been built up by corals, that is, a fringing reef which has grown outwards owing to a sinking of the coast, as Darwin postulated, and others who think that the coral forms only a thin veneer over the surface of a pre-existing platform formed by the submergence of a coastal plain. There are various views as to the manner in which this submergence may have taken place, but Mr. Steers, with the majority of recent workers on the subject, ascribes it to faulting.

The shallow lagoon channel contains innumerable islands. Many of these are rocky, high, richly vegetated, and of great beauty. They show every indication of having originally formed part of the land mass near them and constitute important evidence in favour of land subsidence. Most of them are close to the coast, but Lizard Island, seventy miles north of Cooktown, is sixteen miles from the land. These islands, like the mainland coast wherever suitable, are usually bordered with fringing reefs.

In the far north of the Barrier lies a small group of extinct volcanic cones, the three Murray Islands and Darnley Island. They have no connexion with the continental mass, and in general character and richness of vegetation resemble much more the volcanic islands of the Pacific, such as Samoa, Tahiti, or Hawaii.

The northern half of the lagoon channel is dotted with coral islands, of which Low Isles was a typical example. Trees are abundant and are responsible for the name, Low Wooded Islands, which is given to them in the "Admiralty Pilot". Owing to their protected position and proximity to the land, they have many unique features. The contours of the reefs are influenced by the South-easterly Trade wind which blows with steady force for nine months in the year. They are crescent-shaped with the point of the convexity facing south-east, the reef on this side descending quickly into deep water. On the lee side the water deepens much less quickly. As a result of abrasion by the waves on the weather side, fragments of coral are broken off and carried round the reef to be accumulated in the area of 'dead' water behind it. Here in time a sand cay is formed which, at first entirely at the mercy of any change in winds and currents, gradually becomes consolidated by vegetation and the formation around it about low water mark of a thick zone of beach rock. This is sand cemented together by calcium carbonate precipitated among it when rain water which has fallen on the surface of the cay seeps through it at low tide and is evaporated at its surface.

On the windward side great banks of shingle accumulate and frequently form northward projecting spits. Behind the cover of these shingle banks mangroves have established themselves until, as on Low Isles, an almost impenetrable forest of *Rhizophora mucronata*, fringed at a slightly higher level with *Avicennia officinalis*, is formed. Infrequent openings amongst the tangled mass of strut roots give passage into central lagoons the black mud bottoms of which are exposed at low tide. On the outer side the mangroves are being destroyed by the advancing line of shingle, on the inner side they are advancing over the reef flat towards the sand cay, and in certain islands, notably the Turtle Group, the two seem to have fused, the mangroves growing round the central sand cay.

The shallower water on the lee of the reefs is full of coral patches, flat-topped pinnacles of living coral. Sudden storms from the north, sometimes of cyclonic fury, which occur during the summer months, break away this coral and throw great boulders high on to the reef surface, forming a boulder tract along the northern shores. Boulders are also carried on to the south-easterly side of the reef, but not to the same extent. The general

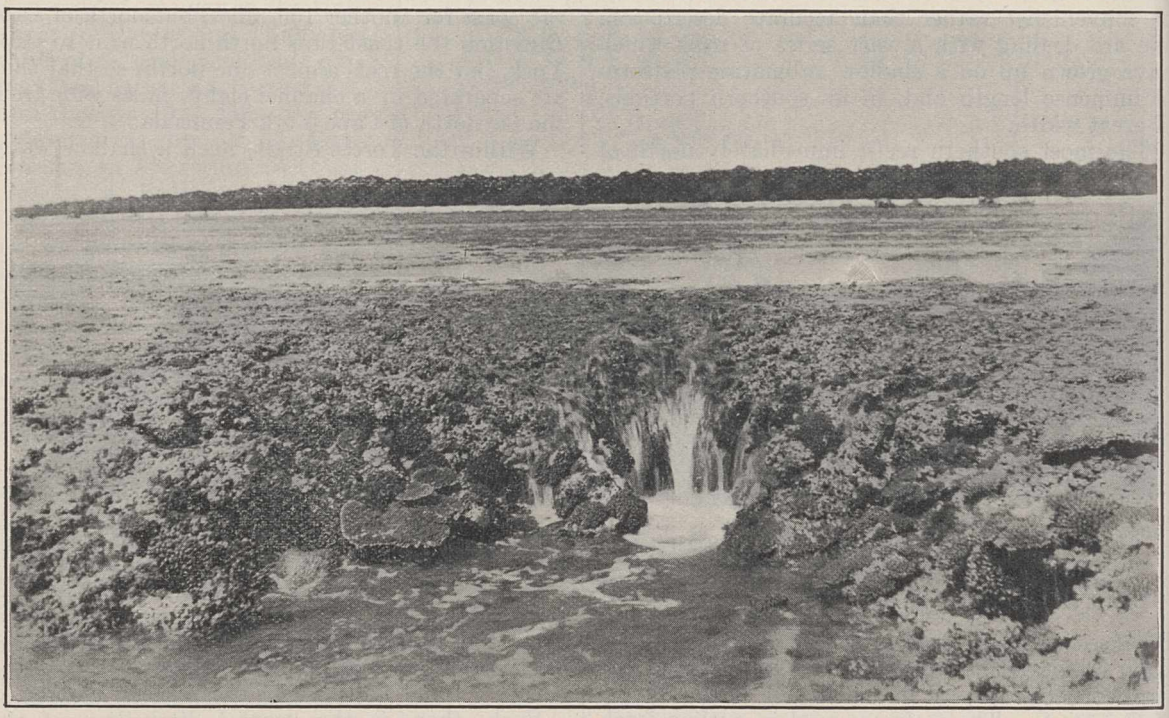

FIG. 3.—The reef edge at Northwest Island, Capricorn Group, exposed at low water spring tides. The surface of the reef is cemented with *Lithothamnion* and has little living coral, which flourishes on the outer slopes. (Photograph by M. J. Yonge.)

surface of the reef flat, which is some four feet above datum line, is composed for the greater part of dead coral, but there is an abundance of animal and plant life in the numerous pools and particularly in the wide moat which is enclosed by the shingle rampart. Around the sand cay there are wide sand flats, while the mud of the mangrove, which supports a fauna and flora totally different from that of the reef flat proper, extends for some distance westward of the swamp itself.

The Barrier reefs may be divided, in the northern half in particular, into an inner and an outer series. The inner ones are a little higher than the outer reefs and not infrequently have sand cays, smaller and seldom vegetated, upon them. The vegetation consists of coarse grass and creeping convolvulus, and such cays are often the haunt of vast flocks of sea birds, sooty terns, or wide-awakes, and noddies predominating. Even at half-tide the outline of such reefs is frequently indicated by the great boulders which fringe them. These 'nigger' or 'negro heads' have been the subject of much controversy, early workers on the Barrier considering that they have grown *in situ* and were thus the evidence of reef elevation. There can be no doubt, however, that, like the boulders on Low Isles, they have been cast up by cyclones. Although present on the southern and central reefs, they are absent from the reefs about Murray Island, which is north of the cyclone belt.

The outer reefs are exposed to the full force of the Pacific, on which there is usually a great swell even in the calmest weather. Their outer slopes, clothed with living coral for the upper 30 fathoms, descend at a sharp angle to hundreds of fathoms. The reef crest, never exposed except at the lowest spring tides, is cemented by *Lithothamnion*, which always, apparently, flourishes best in regions where the surf breaks, into a solid rampart, on which only a few stunted corals, sessile molluscs and the like, manage to lead a precarious existence. Boulders of a gigantic size are occasionally to be seen; smaller ones will be rolled over the crest into the shallow water in the lee. Here, as in the lee of all reefs, there is a great abundance of coral growth, the size of the coral-covered boulders increasing as the water deepens.

These outer and inner reefs of the Barrier Series all show the same moulding by the South-easterly Trade winds, though in the case of the former it is not so apparent; they frequently stretch almost due north and south along the edge of the submarine platform, sometimes, as in the case of Ribbon Reef, for a length of fourteen miles, with only a curling back at the ends to show the effect of the prevailing wind. The reefs of the Capricorn Group, south of the Trade-wind belt, are not moulded in this way. The occasional deep channels between the outer reefs which give passage for large vessels from the Pacific into the lagoon channel, are kept open by the effect of tidal currents which run in and out with the flood and ebb tides like a mill-race, with a speed of not less than 8 knots.

The accompanying section (Fig. 2) across the platform shows the distribution of the fringing reefs, Low Woody Islands, rocky islands, and inner and outer 'Barrier' reefs, and the sudden descent into deep water off the edge of the platform.

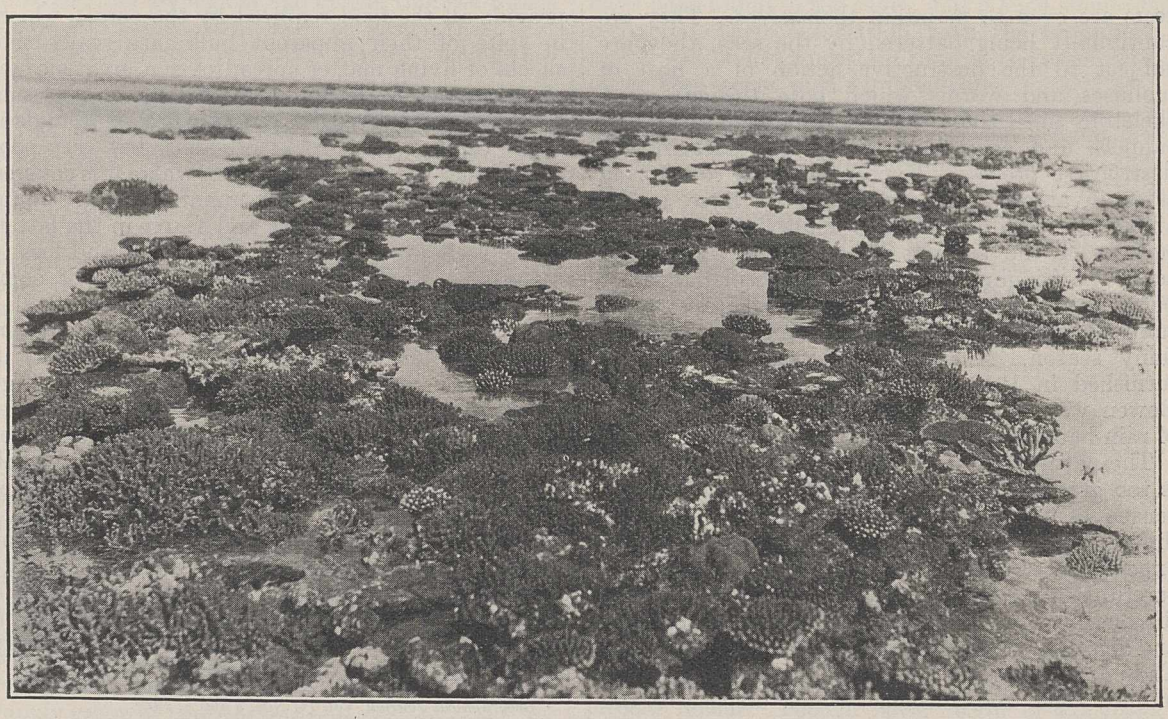

FIG. 4.—Living coral exposed at low water spring tides in the 'anchorage' at Low Isles, showing the wealth of coral which grows in the shallow water in the lee of reefs. (Photograph by M. J. Yonge.)

Between thirty and forty genera of corals and well over one hundred species are concerned with the formation of these reefs. Probably no region in the world is so rich in coral species. They are assisted in their building action by coralline algæ, *Lithothamnia*, and by the minute calcareous skeletons of foraminiferans, and also to a smaller extent by the dead shells of molluscs—foremost amongst which is the giant clam, *Tridacna gigas*, which may attain a length of four and a half feet and a weight of four or five hundredweight. The growth of corals, the study of which formed an important part of the programme of the expedition, is greater than might be expected, certain species doubling their size in six months. Such powers of growth are necessary, however, if the reefs are even to maintain themselves. They are continually being battered by the seas, they are subject to the destructive action of a host of molluscs and worms which bore through their skeletons until these are honeycombed with their tunnels, and even algæ play some part in this destructive process. Exposure during low spring tides invariably kills corals which have grown above a certain height, thus maintaining the level surface of the summit of the reefs. Near the coast the fringing reefs are in constant danger of being destroyed by great floods of fresh water running off from the land during the summer rainy season. A striking example of this was furnished in 1918 when Stone Island Reef near Bowen was completely destroyed after 36 inches of rain had fallen in eight days.

The nature of communities known as coral reefs is too great a subject to discuss here; a detailed census of the population of different reefs and different zones of them was undertaken by the expedition. Corals themselves, it was found after careful studies, live on the minute floating animal life of the seas—the zooplankton—for the capture and digestion of which they are admirably equipped. They contain within their tissues vast numbers of minute algæ, zooxanthellæ, which dispose of the waste products of coral metabolism, and provide, as a result of their photosynthetic activities, abundant supplies of oxygen (possibly of vital importance in view of the density of the population on a typical reef), but do not, as has been thought, play any great part—if any at all, the matter is still *sub judice*—in the nutrition of the coral.

The conditions in the seas which bathe the reefs are of primary importance; they control the food supply and the 'climate'. The changes in the physical condition and in the principal chemical constituents—notably those which can be utilised as food by plant life—are far smaller than occur in temperate seas. The plant and animal plankton is also much poorer and shows fewer fluctuations, but there is no reason to doubt that the latter provide all the food required by the corals, which, in spite of their apparent bulk, are really thin sheets of living matter spread over a great surface of calcareous skeleton. Life on the sea bottom, as revealed by dredging and trawling, is abundant where the bottom is rocky or sandy, but very poor in the inner parts of the platform where it is covered with a soft mud. Fish, not unnaturally, are abundant in the former regions and scarce in the latter.

The reefs are a source of both profit and loss to Australia. They are rich in a number of commercially valuable animals, notably pearl shell—the smaller black-lip (*Pinctada margaratifera*) everywhere and the large gold-lip (*P. maxima*) in the Torres Strait and farther west—the large *Trochus* shell from which pearl buttons are made, edible oysters of various kinds, bêche-de-mer (Holothurians), both edible and tortoise-shell turtles, dugong, many kinds of fish, while sponges of some commercial value are present. In its capacity as a breakwater the Barrier Reef has gained for the enclosed steamer channel the title of Australia's Grand Canal, but it is a canal full of dangers from reefs and, in the summer, from cyclones, and loss from shipwreck forms a very serious item in the debit account.

[1] *Geographical Journal*, vol. 74, Nos. 3 and 4, 1929.

The Discovery of a Second Braincase of *Sinanthropus*.

By Prof. G. ELLIOT SMITH, F.R.S.

AT a meeting of the Geological Society of China in the last week of July, Prof. Davidson Black announced the discovery of another skull of Peking man.

In NATURE of Mar. 22, 1930 (p. 448), an account was given of the discovery of a series of remains of *Sinanthropus* culminating in the recovery of an almost complete braincase by Mr. W. C. Pei on Dec. 2, 1929, while clearing a sheltered recess of the main deposit at Chou Kou Tien. Some days (Oct. 28) before this skull was found, five human teeth were recovered from a spot higher up in the shaft (locus *D* of the excavators' report), where they were associated with the skull of a large deer and some pieces of fossilised bone and blocks of stone, which were brought to the laboratory in Peking for examination.

This material was 'developed' during the third week in June by the technical assistants working under Prof. Davidson Black's supervision, and he found that there were enough fragments, which fitted together, to form the greater part of another uncrushed skull of *Sinanthropus*. He waited until the return to Peking of Dr. Wong (Wong Wen Hao), the Director of the Survey, before making the public announcement of his important discovery.

For reasons which are not yet clear to those who have not seen the actual specimens, Prof. Davidson Black regards the skull found on Dec. 2, 1929, as that of a young woman, and the calvaria the discovery of which is now reported is in his opinion that of a young adult male. It conforms to the same general type as the skull previously found, and its proportions are similar. But the braincase is not so thick and the frontal eminences not so pronounced. The most interesting new fact revealed in this

discovery is the nature of the root of the nose, which is broad and flat and quite unlike that of Piltdown man.

The newly discovered skull was found in association with a number of teeth which can be assumed to have belonged to the same individual. This fact adds to the interest of two mandibles found in 1928 in association with the crushed parts of the respective braincases.

The remains of four skulls of *Sinanthropus* and teeth of at least six other individuals have so far been found. Thus there is available for study in China a much richer material of early Pleistocene man than the fragments of the individual specimens of *Pithecanthropus* and *Eoanthropus* provide. Moreover, the geological age of the Chinese fossils can be established with more certainty than that of the other two primitive genera, which are assumed to be roughly contemporaneous.

The fossils from Java and Sussex were found in gravels, where they had been deposited by running water. Although there is little doubt which of the heterogeneous fossils found in these gravels were contemporaneous with the human remains, in the case of the men of Peking, who left their bones in the cave where they lived, there is less room for doubt that the bones of animals deposited alongside them provide more certain data for the estimation of their geological age. Thus the claim made by Pére Teilhard de Chardin and Dr. C. C. Young that *Sinanthropus* lived in Lower Pleistocene times rests upon a surer foundation than the similar claims that have been made in the cases of *Pithecanthropus* and *Eoanthropus*.

Further, the conditions under which the discoveries are being made at Chou Kou Tien hold out a greater promise of further evidence than in the cases where the fossils have been scattered by running water. Thus a series of fragments have already been recovered every autumn since the type tooth was recovered in 1927, and it is not unreasonable to expect that much more still remains to be found in this cave, and possibly in other fossil beds in the neighbourhood. So far no worked tools have been found in the cave ; but if such should be recovered, their association with the human remains will be less uncertain than in the case of the other Pleistocene men's implements.

For these reasons, in addition to the intrinsic interest and morphological significance of the skulls of *Sinanthropus*, the discoveries in China have an importance which is unique. It is a matter for congratulation that the investigation of this site should have fallen into such competent hands and that ample facilities and skilled assistance should be available for the work, which is being conducted with great thoroughness and insight.

News and Views.

PROF. ELLIOT SMITH'S announcement in another column of this issue that Dr. Davidson Black has reconstructed still another skull of Peking man from material obtained from the now famous cave of Chou Kou Tien is assuredly welcome though perhaps not entirely surprising. Four skulls and teeth belonging to probably six individuals have now been obtained from this source, and it is therefore evident that the fortunate explorers have lighted upon what must have been the final resting place and perhaps the home of a family group or horde of this type of early man. So far, no implements have been found which would determine the cultural horizon of Peking man, but the conditions of discovery are such as to afford grounds for hope. It is at any rate fortunate that the association of the remains with fossilised bones of animals assigned with some confidence to the Lower Pleistocene appears to place the date beyond question. Dr. Davidson Black has pronounced his latest skull to be that of a young adult male, while that found in December last is said to be that of a young woman. Comparative study of the two will no doubt be fruitful of results. A first inspection of the new skull has already yielded a new character of the nose in which it presents a marked difference from the Piltdown skull. A more detailed examination of the two skulls than is yet possible will be necessary before it can be determined what are the precise relationships of Peking man and other early types. It is already clear, however, that these remains will make possible a further advance in the reconstruction of man's ancestral forms. Prof. Elliot Smith is sailing for China on Aug. 14, and in this connexion the results of his personal examination of the material will be awaited with the keenest interest.

IN the interesting little church at Longfield, Kent, close to Fawkham Station, is to be seen the memorial window erected by some members of the University of Cambridge to the memory of Dr. Thomas Plume, the founder of the Plumian professorship of astronomy, of which Sir A. S. Eddington is the present holder. Though never rector of Longfield, Plume for many years lived at Longfield Court, just behind the church, and he died there on Nov. 24, 1704. At his death Plume was seventy-four years of age, having been born just three hundred years ago, in the summer of 1630. The exact date of his birth does not appear to be known, but he was baptised on Aug. 18, 1630, in All Saints' Church, Malden, Essex, of which place his father was an alderman. Educated first at Chelmsford Grammar School, Plume entered Christ's College, Cambridge, and at the age of nineteen took the degree of M.A. Entering the Church, in 1658 he was made vicar of Greenwich, a living then in the gift of Richard Cromwell, and both Pepys and Evelyn speak of his excellent preaching. This important living he held for the remainder of his life, but from 1679 onward was also Archdeacon of Rochester.

LIKE Lucas and Lowndes, the founders of two other famous professorships at Cambridge, Plume did not add to mathematical or astronomical knowledge, but he lived in an age when among men of education

some acquaintance with science was considered a desirable acquisition. Moreover, as vicar of Greenwich when the Royal Observatory was built, he became known to Flamsteed, and it is said that on Flamsteed's recommendation he read Huygens' "Cosmotheoros". It is also said it was the perusal of this work which induced him to leave a part of his fortune to found a professorship and erect an observatory at Cambridge. Newton and Flamsteed were both connected with the arrangements made to carry out Plume's wishes, and when Roger Cotes was appointed to the Plumian professorship in 1707, the King's gate of Trinity College was appropriated to his use, while the observatory erected over the gateway was described by Bentley as "the commodiousest building for that use in Christendom". In spite of the provision of the observatory, little was accomplished in the eighteenth century, and a report of 1792 said that "the professor had neither occupied the said rooms and leads nor fulfilled the conditions for at least fifty years". Instruments and observatory alike had fallen into disrepair, and a few years later the observatory was demolished. A new observatory was built in 1822; with the appointment of Airy as Plumian professor in 1828, astronomical studies at Cambridge were pursued with greater energy, and under his successors much has been done to add prestige to the chair which perpetuates the name of its generous and enlightened founder.

THE Earl of Harewood performed a useful service to the agricultural community by initiating the discussion in the House of Lords on July 22 on the position of the Royal Veterinary College, Camden Town. He pointed out that the position of the College was so desperate that unless further substantial guarantees of capital and income from Government and private sources were immediately forthcoming, the governors would have no alternative but to give notice of their intention to close and to refuse to accept any new students. The annual deficit of the College is a diminishing one owing to the fact that students' fees are increasing year by year and private subscriptions are also bringing in a larger yearly income; but the College buildings are in an irreparable state of disrepair and their entire reconstruction is an imperative necessity. An appeal for the necessary funds to make the College worthy of its cause was made three years ago, but of the £350,000 needed only £30,000 had been raised from those who have most to gain from the maintenance of the supply of adequately trained veterinarians, namely, the great breeders of pedigree cattle, small farmers, sportsmen, and animal lovers generally. The governors of the College had asked the Ministry of Agriculture and Fisheries for advice and a Departmental Committee was appointed. This Committee reported a year ago and recommended that the governors should purchase for £20,000 the freehold of the land in Camden Town from the Ecclesiastical Commissioners, spend £280,000 on new buildings, provide £25,000 for a research laboratory outside London and affiliated to the College, and guarantee an income of £21,000. No reference was made in this report to the financial help the Government might be expected to give, although the offer of £100,000 made by the Government in 1918 presumably still held good, although this offer had been contingent upon the College removing to Cambridge.

A FURTHER appeal for financial assistance was recently made to the Government by the governors of the College, whereupon a further Departmental Committee was appointed which modified the above proposals by suggesting that the purchaser of the freehold was unnecessary, that £250,000 instead of £280,000 be spent on new buildings, towards which the Government would be prepared to contribute £70,000 in addition to pound for pound of the subscriptions raised from private sources. Further, the Government was prepared to make a final grant of £50,000 when the sum collected by the governors from all sources had reached £200,000. This offer Lord Harewood, Lord Ernle, and others characterised as not sufficient to justify the governors committing themselves to keep the College open. Lord Ernle suggested that the British Government lagged behind those of other countries in its encouragement of veterinary education, citing the case of Germany, which provides £280,000 a year for this purpose. After Lord Phillimore had pointed out that he had been asked, as the chairman of a veterinary subcommittee on the 'pig', to emphasise the need for more attention to be given by pig-breeders to research, but that it was useless for him to do so unless there were enough veterinary experts adequately trained to make use of the results of such research, Lord De La Warr, on behalf of the Government, invited to a conference those interested in veterinary education and the future of the Royal Veterinary College, in order that the governors of that institution might reconsider the position. Since then, a further powerfully worded appeal has been made to the Government by Sir Merrik Burrell, chairman of the governors of the College, in a letter to the *Times*. Apparently these appeals have not been fruitless, for Lord Harewood, in his address to the eleventh International Veterinary Congress, which he opened on Aug. 4, expressed the hope that the position of the Royal Veterinary College would soon be remedied.

A RECENT Order in Council directs that the Lord President of the Council (Lord Parmoor), the Minister of Agriculture and Fisheries (Dr. Addison), the Home Secretary (Mr. Clynes), the Secretary of State for Scotland (Mr. W. Adamson), and the President of the Board of Education (Sir Charles Trevelyan) shall be a Committee of the Privy Council for the organisation and development of agricultural research. It is also ordered that during His Majesty's pleasure the Lord President of the Council shall be the chairman, and the Minister of Agriculture and Fisheries vice-chairman of the Committee. No information is vouchsafed regarding the relationships between this new body and the Development Commission, the Agricultural Research Council, and the Empire Marketing Board, all of which are concerned with the promotion of agricultural and fisheries research. Presumably this new committee, the personnel of which is exclusively political, will undertake the task of co-

ordinating the efforts of these other important bodies, although the further announcement made in the House of Commons on Aug. 1 by the Chancellor of the Exchequer (Mr. Snowden) creates the impression that it will be concerned mainly with the appointment of *ad hoc* committees for advising the Government on schemes for the prosecution of research on urgent problems confronting the agricultural community. It is to be hoped that the Government will make a further announcement or issue an explanatory memorandum defining more precisely the functions of this new Committee of the Privy Council, and why it differs so radically in constitution from those already in existence for the prosecution of medical research and scientific and industrial research.

THE visit of H.R.H. the Duke of York on July 30 to the works of the British Aluminium Company at Fort William, N.B., may be said to mark in a quasi-formal way the inauguration of the very notable hydro-electric undertaking known as the Lochaber Power Scheme, which has been promoted by the company for the purpose of supplying power to its factory for the production of aluminium. The portion of the undertaking which is so far completed has been in operation for the past few months, but the plant at present installed, with a capacity of 50,000 horse power, represents only about half the energy available when the sources of supply are developed to their full extent. As it stands, however, the installation is of a remarkable character, being the most important of its kind in Great Britain and ranking high among similar undertakings throughout the world. The scheme is designed to utilise the impounded water contained in Loch Laggan and Loch Treig, at a height of about 800 ft. above sea level, to drive turbines in the power house at Fort William a few feet above the same datum. In order to connect the two lochs and convey the water therefrom to Fort William, tunnelling through the intervening mountain rock is necessary for an aggregate distance of 19 miles, and of this, a length of 15 miles, constituting the portion connecting Loch Treig with the Power House, has been completed. The Lochaber Tunnel, as it is designated, is one of the longest tunnels in the world, and far longer than any other in Great Britain. Its nearest rival on the Continent is the Simplon Tunnel between Switzerland and Italy, which is 12¼ miles in length. The Shandaken Tunnel for the water supply of New York is slightly more than 18 miles long, but in cross sectional area it is less than the Lochaber Tunnel, which is approximately circular and 15 ft. in diameter. The Power House at Fort William contains, at present, five main turbo-generator units each of 10,000 horse power. The inception of the Lochaber scheme is due to Mr. Murray Morrison, director and general manager of the British Aluminium Company, which in 1921 obtained powers under the Lochaber Water Power Act for its realisation. The engineers are Messrs. Meik and Halcrow of Westminster.

A CEREMONY of striking appropriateness took place at Inchnadamph, in the wilds of the north-western highlands of Scotland, on July 25, when a memorial to Drs. B. N. Peach and John Horne was unveiled by Sir John Flett. Mr. H. M. Cadell of Grange, who presided over a company which included many well-known Scottish scientific workers, recalled the days when with Peach and Horne he commenced the final survey of the much discussed structure of the Western Highlands, and gave a summary of the dispute which had centred upon that complicated region, and had at length been settled through the labours of his former colleagues. In dedicating the memorial, Sir John Flett described its site as properly selected in the centre of a remarkable area to which the discoveries and interpretations of Peach and Horne had given world-wide fame, a temple of geology to which geologists from all parts of the earth made pilgrimage. He paid a warm tribute to the work of his friends, to their spirit of co-operation and goodwill, and to the single-mindedness of their scientific endeavours. The memorial, a massive pillar of stone set on a height overlooking Loch Assynt, carries a bronze tablet with the inscription: "To Ben N. Peach and John Horne, who played the foremost part in unravelling the geological structure of the North-West Highlands, 1883–1897: An international tribute. Erected 1930."

UNDER the title of "The Organisation of Mosquito Control Work" Mr. John F. Marshall, Director of the British Mosquito Control Institute, Hayling Island, Hants, has issued a useful practical pamphlet. Its contents formed his presidential address in the Zoology Section of the South-eastern Union of Scientific Societies at the Portsmouth Congress held in May last. The object of this pamphlet is to describe, in simple language, the best methods of suppression of mosquitoes in England. It is pointed out that these insects must be dealt with during the larval or pupal stages of their existence, and that the most satisfactory method is to do away with the water in which such stages are passed. This may be a simple matter in so far as water butts or small ponds are concerned. With ditches, large pools, or marshes, drainage is required, but this procedure, for various reasons, is often quite impracticable; in such cases the problem is best dealt with by covering the surface of the water with oil, or by mixing chemicals with the water so as to poison the larvæ. In the case of ornamental ponds or lakes, fish, water bugs, and various other creatures which devour the eggs or larvæ are to be encouraged, and the addition of oil or chemicals to the water is then undesirable or harmful.

MR. MARSHALL gives a list of the British mosquitoes grouped according to their habitats or, in other words, according to the nature of the environment in which each species lays its eggs and where, in consequence, its larvæ are to be found. The first step to be taken is to find out what species are present, and when this has been done the anti-larval campaign is simplified. It then becomes possible to seek out their breeding places and take necessary measures at the right time. Indiscriminate oiling of all and sundry collections of water is wasteful and of little use. As an example it is mentioned that at a children's hospital where sleeping out of doors was part of the treatment, mosquitoes rendered this procedure impossible at certain times of the year. All tanks and butts were regularly sprayed

with paraffin in the hospital grounds, without result. Afterwards specimens of the offending insects were sent to the Mosquito Institute, and the species was found to be *Aedes punctor*, which breeds chiefly in pine woods. A number of small pools occurred in the neighbouring woods, and since these have been abolished further annoyance from mosquitoes has been avoided. Methods of identifying mosquitoes either from the larvæ or adults are briefly described. It is further pointed out that adequate control work needs the services of an inspector who, after identifying the species concerned, examines their breeding places and advises whether the collections of infested water shall be oiled, poisoned, or abolished. The pamphlet, it may be added, can be obtained at the British Mosquito Control Institute, price 9*d*.

IT is now generally admitted that the radiation of the sun varies when periods of a month or more are considered, and the comparison of data from different stations is justifying Dr. C. G. Abbot's view that there also exist variations from day to day. In a paper entitled "The Atmosphere and the Sun", published as No. 7 of vol. 82 of the Smithsonian Miscellaneous Collections, Mr. Clayton sets out his grounds for adopting two further conclusions, namely, that these solar variations are periodic, and that they provoke definite reactions in terrestrial weather, which behave in a complicated but still predictable manner. The first element of weather to be affected is naturally temperature, but this is complicated by changes of cloudiness, and for the most part the author deals with waves of pressure. As a result of a somewhat superficial discussion, he concludes that there are systematic differences between the pressure distribution over the northern hemisphere associated with high solar radiation and that associated with low radiation, the effects changing from one latitude to another, from season to season, and from land to sea. The differences found are small, however, and as no criteria of reality are given, it is impossible to tell to what extent they are accidental. The disturbances once set up travel like ordinary barometric systems, and since the solar changes which cause them are periodic, the results are series of supposedly regular waves of pressure in all parts of the world. Mr. Clayton thinks that when the sudden changes of phase and amplitude which mar these 'cycles' are understood their use will supplant all other methods of forecasting, but one fears that this day is very distant. Nevertheless, this is an interesting study, which opens out a distinctly promising line of investigation.

FURTHER light has been thrown on the development of the circle in Britain by recent excavations carried out by Captain and Mrs. Cunnington on a site known as "The Sanctuary", on Overton Hill, between Marlborough and Devizes. Stukely records that the double circle on Overton Hill was destroyed in 1724; but nothing was known of it beyond the fact that it had consisted of two circles of sarcens, until Captain and Mrs. Cunnington succeeded in locating its position by ingeniously making use of a clue afforded by Stukely's theory that Avebury and "The Sanctuary" were connected with serpent worship, and that Avebury was the body and Overbury the head of the serpent. An account of their excavations was presented at the annual meeting of the Wiltshire Archæological Society, of which a report appeared in the *Times* of Aug. 1. The excavations revealed not only the position of the stones of the double circle, but also holes in which had stood wooden posts forming six rings concentric with the stone circles. This site, being so closely connected with Avebury, thus links up the latter with "Woodhenge" (Durrington Walls), the forerunner of Stonehenge. One burial only was found. With this was associated a small vessel of 'beaker' type. It is, therefore, suggested that the original construction took place in the early Bronze Age, and that when later—still in the early Bronze Age—Avebury was constructed and the two sites connected by an avenue of standing stones, the wooden posts of "The Sanctuary" were replaced by two circles of standing stones. Captain and Mrs. Cunnington have added further to their great services to British archæology by purchasing the site on Overton Hill, and they now propose to reconstruct the wooden and stone circles by erecting concrete pillars as they have already done on their previously purchased site of Woodhenge.

IN an article published in the *Times* for July 31, Dr. C. Davison gives a new estimate of the average annual loss of life by earthquakes. During the last century covered by Milne's great catalogue of destructive earthquakes (1800–99), there are recorded by him 364 earthquakes of the highest degree of intensity and 510 of the second degree—those of the lowest degree do not contribute sensibly to the loss of life. From 1601 to 1900, the number of persons killed by the most destructive earthquakes in Italy was 4222 per earthquake, and by those of the second degree 8·3, so that, if the same rates governed all earthquakes, the mean annual loss for the whole world would be 15,410. The stronger Japanese earthquakes of the eighteenth and nineteenth centuries give an average of 3892 deaths per earthquake or of 14,169 every year for the whole world. Dr. Davison thus concludes that, on an average, fourteen or fifteen thousand persons are killed by earthquakes every year, a number that is much less than the number killed by motors annually in the United States, and not much more than twice the number killed in Great Britain.

THE three expeditions which Dr. Johs. Schmidt describes in the "Introduction to the Oceanographical Reports" (Danish *Dana* Expeditions, 1920–22, Copenhagen, 1929) were the post-War continuation of the researches on the development and breeding of the European eel begun in 1903 with the *Thor* and *Margrethe*. As soon as possible after the War, three cruises were made to the Sargasso Sea, two of which were undertaken in the auxiliary schooner *Dana I.*, and were confined mainly to the study of pelagic fauna. The third and most extensive voyage was made with the Royal Danish R.S. *Dana*, a steam trawler of the Lord Mersey class, adapted for marine research. The programme on this occasion was

augmented by physical observations, notably hydrographic sections across the North Equatorial Current and the Gulf Stream. Some of the results then obtained in the Gibraltar straits were published in NATURE of Jan. 12, 1922. A seasonal periodicity in the biological phenomena of the Sargasso and Caribbean Seas was demonstrated, and a number of very young larvæ of the European eel (and possibly the ova also) were taken in the Sargasso Sea at between 200 and 500 m. depth, thus completing the series of developmental stages. Dr. Schmidt and his colleagues have now returned from a two years' expedition, the most ambitious so far undertaken with the *Dana*, to the Pacific Ocean, where the breeding habits of the eels common to those waters have been found similar, though with less extensive migrations, to those of the Atlantic forms.

The announcement has just been made that the whole human population of St. Kilda is to be evacuated from the island in September next, 27 to Mull, 8 to Skye, 1 each to Glasgow and Inverness; and thereafter St. Kilda will take its place with North Roma and others of the Scottish isles, which, once inhabited, have become derelict. In this connexion a short article in the *Scottish Naturalist* (p. 69), by Dr. James Ritchie, discusses some of the unique features of the fauna of St. Kilda, its indigenous wren, field-mouse, and house-mouse, and its Soay sheep, the most primitive of surviving races of domesticated sheep. He also endeavours to show how the change in the feeding habits of the human population when it was brought in regular contact with mainland civilisation, first in 1877, affected the numbers of fulmar petrels breeding on the islands. This was ultimately responsible to a great extent for the extraordinary exodus of fulmars which has resulted in the colonising of many of the islands and of the mainland cliffs so far south as Flamborough Head.

SEARCHLIGHTS are usually associated with naval and military operations. It is not generally realised that there is a great demand for them for commercial purposes, such as canal lighting, the flood lighting of buildings, and cinema studios. There are manufacturing firms which are mainly if not solely engaged in making searchlights and projectors of all types and sizes. In the *British Engineers' Home and Export Journal* for July, a description is given of very large searchlights manufactured by the London Electric Firm, Croydon, for a continental government. The candle power of each searchlight was rated by the National Physical Laboratory as 3500 million. This means that if the horizon were sufficiently far away and meteorological conditions were suitable, the lights would be visible for hundreds of miles. These lights are to be used for frontier defence, and although they are seven feet in diameter can easily be controlled electrically by an operator at any distance away. By means of a signalling shutter mechanism, morse signals can be sent by the beam. The same firm has also made searchlights for use in navigating the Suez Canal at night. They send out a divided beam illuminating each side of the canal and leaving a dark patch in the centre so as to avoid dazzling the eyes of the pilot of a ship coming in the opposite direction. The electric carbons burn for 6½ hours, thus obviating the necessity of trimming the lamp when in the canal. The lamps used in cinema studios give either 'spot' or wide angle lighting. Searchlights are also used in aerodromes for fog penetration and for 'writing' on the clouds.

THE "Bulletin de l'Union des Sociétés Savantes Polonaises de Léopol (Lwow)" for 1927–1928 records the successful attempt of a local bureau to bring together the work of the local branches of Polish learned societies. It has been edited by Prof. Sigmond Czerny, (15 rue Tarnowskiego) of the University of Léopol. One hundred pages comprise reports from some three dozen societies. Contacts are maintained with a wider world through Paris and America, by exchanges of periodicals and by representatives to international congresses. The interests of the bureau include much recording of unhappy histories, some care of orphans and widows, cemeteries ancient and modern, excursions to historic monuments, the collection of books and archives into museums and libraries, archæology, jubilees and centenaries of brighter moments, folklore, regional survey, heraldry, classical studies, school geography, local natural history, Slavonic philology and ethnology, the glacial epoch, reorganisation of finances, economic discussions in collaboration with the ministry, publications in Polish with abstracts in French, English, Latin or German, international law in relation to Chorzow and Dantzig, echoes of western science, some medical and mathematical research. The general picture presented by these reports is that of a struggle out of confusion and towards the light. The particular device of a local bureau of local branches of national societies is one that might be useful elsewhere, if only as a clearing-house for harmonising time-tables.

IT is announced in the *Journal of the Society for the Preservation of the Fauna of the Empire* for 1930 that in future the *Journal* will be issued more frequently, and an appeal is made to members for articles on any matter relative to the conservation of wild life. The present number, apart from recording the activities of the Society during the past year, contains some interesting extracts from faunal reports dealing with various parts of the Empire. In Uganda the "astonishingly small number of young gorillas in the troops" is attributed to the attacks of leopards; in Victoria it has been found that the complaints of fishermen regarding the serious menace of seals to fisheries have not been substantiated; and the success of the inoculation of domestic stock in Southern Rhodesia against trypanosomiasis is a matter of first-rate importance to the wild life of the country, as well as to the farmer.

THE Arctic archipelago of Franz Josef Land, now within the realm of Soviet jurisdiction, is seldom visited except by Norwegian walrus and bear hunters, although the scientific knowledge of the group is due chiefly to British, Austrian, Italian, and American expeditions. It is useful to have a summary of what

is known. This has been prepared by Dr. G. Horn and appears as No. 29 of *Skrifter om Svalbard og Ishavet* (Oslo, 1929). The paper includes a fairly complete bibliography and a sketch map showing the routes of the chief expeditions. Dr. Horn antedates the discovery which is generally attributed to J. Payer in 1873 to two Norwegian sealers in 1865. He cannot, however, adduce any written evidence of the discovery of North-East Spitsbergen in that year or proof that the land called by this name was Franz Josef Land, although the identity is not impossible.

THE Medical Research Council has appointed Major A. G. Church, M.P., Col. F. E. Fremantle, M.P., and Sir John H. Parsons to be members of its Industrial Health Research Board.

SIR CHARLES MARTIN, who will shortly retire from the directorship of the Lister Institute, has accepted a pressing invitation from the Commonwealth Council for Scientific and Industrial Research to take charge of its Division of Animal Nutrition for at least two years. This Division was established in 1927 under the late Prof. T. Brailsford Robertson, and has been concerned mainly with problems of wool production. The central laboratory is in the grounds of the University of Adelaide, while there are eight field stations scattered over the more important pastoral areas. Sir Charles Martin will probably leave England towards the end of December and will break his journey at South Africa in order to visit the veterinary research station at Onderstepoort.

THE thirty-sixth annual report of the governing body of the Lister Institute of Preventive Medicine has recently been issued. It contains a brief but useful and interesting survey of the researches which are, or have been, in progress during the year in the various departments of the Institute. Sir Charles Martin, the Director, and Prof. Arthur Harden will be retiring under the age limit towards the end of this year, and the governing body has appointed Prof. J. C. G. Ledingham and Dr. R. Robison to fill the vacancies thus created, the appointments to date from Jan. 1 next.

THE fact that cancer occurs with some frequency in human beings, for example, mule-spinner operatives, as a result of contact with lubricating mineral oils, has caused some alarm among those taking mineral oils for medicinal purposes. We learn from a recent *Science News Bulletin* (Science Service, Washington, D.C.) that Dr. Francis Wood of the Institute for Cancer Research, Columbia University, has tested several makes of medical mineral oil for the presence of carcinogenic properties upon mice, of a strain known to be liable to the development of cancer, by painting the skin and by internal administration. The results were negative, so that mineral oils of the type used for medical treatment may be regarded as being free from any risk of producing cancer.

CATALOGUE No. 13 of second-hand books (543 in number), on mammals, birds, insects, shells, etc., geology, fossil plants, botany, and horticulture, has just been issued by Mr. J. H. Knowles, 92 Solon Road, S.W.2.

THE Cambridge University Press announces the publication in September of vol. 3, in 2 parts, of Prof. Karl Pearson's "Life, Letters and Labours of Francis Galton"; IIIA will deal with "Correlation, Personal Identification and Eugenics", and IIIB with "Characterisation, especially by Letters".

THE latest catalogue (No. 528) of Messrs Francis Edwards, Ltd., 83 High Street, Marylebone, W.1, deals with books, pamphlets, engravings, maps, and original drawings relating to Latin America, the British colonies of the Falkland Islands, Honduras, and Guiana offered for sale by the firm. The catalogue, which is an interesting one, contains upwards of a thousand items.

UNDER the title of "Principles and Practice of Geophysical Prospecting", and edited by Mr. A. Broughton Edge and Prof. T. H. Laby, the Report of the Imperial Geophysical Experimental Survey will be published by the Cambridge University Press in December. The work is in two parts, one dealing with the actual field results obtained in Australia, and the other giving a more theoretical discussion of the subject, which, is is hoped, will be of service to students of practical geophysics in English-speaking countries.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant at the Road Experimental Station of the Ministry of Transport Roads Department at Harmondsworth, near Colnbrook, Middlesex—The Establishment Officer, Ministry of Transport, Whitehall Gardens, S.W.1 (Aug. 11). An engineer in the Midland Division of the Ministry of Transport Roads Department—The Establishment Officer, Ministry of Transport, Whitehall Gardens, S.W.1 (Aug. 11). An assistant lecturer in agricultural biology (bacteriology, botany and zoology), at the East Anglian Institute of Agriculture, Chelmsford—The Clerk of the County Council, Shire Hall, Chelmsford (Aug. 12). A lecturer in engineering at the Plymouth and Devonport Technical College—The Secretary for Education, Rowe Street, Plymouth (Aug. 16). Four technical assistants (either sex) at the Manchester Royal Infirmary, for clinical laboratory work—The Chairman of the Medical Board, Royal Infirmary, Manchester (Aug. 16). A horticultural instructor for Norfolk County Council—The Horticultural Superintendent, 30 Cattle Market Street, Norwich (Aug. 21). A professor of physics, and head of the department, in the Muslim University, Aligarh, U.P., India—Vice-Chancellor S. R. Masood, Box 24, c/o NATURE Office (Aug, 23). A general secretary of the Eugenics Society—The Honorary Secretary, Eugenics Society, 20 Grosvenor Gardens, S.W.1 (Sept. 15). A Norwegian professor of marine engineering in the Technical University of Norway—Kirke-og Undervisningsdepartementet, Oslo, Norway (Oct. 1). A medico-physicist to organise and take charge of the Sheffield National Radium Centre—The Secretary, Royal Infirmary, Sheffield.

Research Items.

Composition of Ancient Glassware.—Most people are familiar with Pliny's story of the discovery of glass, but modern researches have shown that it must be regarded as apocryphal, for glass-making has been found to antedate the Phœnicians by many centuries. Glass beads, for example, are plentiful in the excavations of a cemetery of the Third Dynasty of Ur (2450 B.C.). In a discussion of ancient glassware, G. M. Morey shows that the oldest analysed glasses, including specimens from the tombs at Thebes dating from 1500 B.C., have much the same composition as the common glass of to-day (*Art and Archæology*, Dec. 1929). All have silica, lime, and soda as their essential ingredients, and the composition range is remarkably narrow. Only three types of mixtures are known which possess the glass-making property of passing through their freezing points without transformation to crystalline solids; these are characterised by the presence of phosphates, borates, or silicates. Moreover, only the latter can resist successfully the attack of atmospheric agencies. The reason for the restricted composition range is that, of all possible mixtures, only those near the composition represented by $Na_2O \cdot 3CaO \cdot 6SiO_2$ can give a glass with the desired properties. With variation in silica either way the melting-temperature rises and the resulting 'glass' is opaque. Too much lime also gives opaque material; too little makes a readily weathered glass. With too much soda the resulting glass is not durable. In primitive glass-making a low melting-temperature was an important feature and in consequence the older glasses carry more alkali than would to-day be considered good practice.

Transformative Protective Coloration.—Complaint has often been made of the assumptions on which cases of protective coloration are founded, and this complaint would appear to be based on good grounds in the case of the so-called 'transformative protective coloration', described by Karny, by which he means the capacity of an insect or other animal to transform its juvenile protective coloration to a further and different protective coloration in adult life. A searching criticism is made by F. Heikertinger (*Biol. Zentralbl.*, vol. 50, p. 193, 1930) of the work of Karny on transformative protective coloration in the Bornean species of *Asthates*, one of the Longicorn beetles. Karny, he says, founds his work on the uncritical and hypothetical work of Shelford, curator of the Sarawak Museum, on the mimetic insects of Borneo. The latter regards the case of the Asthates as typical protective coloration, the models belonging to the sub-family Galerucinae. Shelford writes with no positive knowledge as to whether Asthates is tasteful or repulsive to its enemies, ignoring the modern biological requirements essential to a discussion of the question, namely, a really exact knowledge of the perceptions, tastes, and food of the enemies against which the animals are supposed to be protected. On the other hand, Heikertinger now contributes practical or positive data relating to the food of local birds, whence it appears that both models and mimics are devoured with equal impartiality. Karny's new case of 'transformative' coloration has therefore no scientific ground, and the author pleads for a more critical treatment of the whole ecological problem of so-called mimicry.

Arctic Birds of Historic Interest.—In the last two numbers of the *Scottish Naturalist*, Admiral J. H. Stenhouse continues his accounts of the birds of historic interest in the Royal Scottish Museum. In the second paper of the series he discusses the birds of Parry's voyages: from the second voyage (1821–23) thirty-five specimens, representing nineteen species, survive, from the third voyage (1824–25) ten, and from the fourth voyage (1827) twelve. The third paper deals with the birds of Franklin's Overland Expeditions, of which the second is best represented by fifty-eight birds, some being type specimens described by Swainston and Sir John Richardson, and the *Tetrao franklinii* of Douglas.

Chromosome Cycle in the Actinomyxidia.—In the epithelium of the intestine of *Tubifex tubifex*, Naville (*Quart. Jour. Micro. Sci.*, May 1930) discovered a new species and genus of an Actinomyxidian which he has named *Guyénotia spherulosa*. It is characterised *inter alia* by the possession of a spheroidal spore with three suture lines 120° apart, three polar capsules, and three digitiform appendages. The female germ line shows a marked meiotic inertia as compared with the male. Each shows three successive divisions in the formation of the gamete; the first is homotypic with four diploid chromosomes; the second is heterotypic reducing the four to two diploid chromosomes; and the third again homotypic. Fertilisation is accompanied by a restoration of the diploid number. The formation of the spore nuclei is somewhat like that in *Triactinomyxon legeri*, but residual nuclei are not formed. It is claimed that the results obtained are homologous with those found by the author in the Myxosporidia. Sex differentiation is more precocious in the Actinomyxidia and leads to the immediate formation of male and female germ lines. It has been shown in the Myxosporidia that increasing precocity in sex differentiation gradually leads to a dioecious condition, although this does not seem to have occured in the Actinomyxidia.

History of the Rhône Delta.—In the *Quart. Jour. Geol. Soc.*, vol. 86, pp. 64-93, 1930, Mr. R. D. Oldham presents the results of his researches into the historic changes of level in the delta of the Rhône. At the opening of the Pleistocene period, the whole area was covered by a deposit of gravel and well-rounded boulders. A period of subsidence then set in and an alluvial delta was built up, the lower part being arenaceous and the upper of finer sand and silt. A period of uplift followed and the land rose not less than 14 metres above the level to which it had previously sunk. The settlements and structures of the Romans were erected on the weathered surface of erosion then developed, but before the Roman occupation a period of intermittent subsidence had already begun. One of the episodes of movement probably occurred between the years 1000 and 1500 B.C. The next change took place in the eighth and ninth centuries A.D. and involved a downward displacement of 5 metres. Lastly, there was a fresh movement of subsidence of about a metre which was practically completed during the latter half of the eighteenth century. Thus, at the present time the total amount of subsidence has reached some 10 metres, so that the land still stands about 4 metres above the lowest level reached before the period of 14 metres uplift set in (see also NATURE, April 19, p. 601).

River Flow Records.—Two Reports on River Flow in the rivers Garry and Morriston, in the Ness Basin, Inverness-shire, which have been received from the offices of River Flow Records (Parliament Mansions, Victoria Street, S.W.1), continue for a further period of three months (that is, from October to December 1929) the observations which were initiated as a private enterprise by Capt. W. N. McClean in the

earlier part of the year. The first instalment of data for the period July to September 1929 was the subject of notice in NATURE of Mar. 1 last; and while this second series is unquestionably helpful in extending the record of exact measurement, and will on that account be cordially welcomed by all who are interested in river development work, it suffers from the disability of its predecessor in that obviously the observations have not yet been carried sufficiently far to render them useful to a higher degree than that of assisting to arrive at approximations of flow of a very general character. Time and continuity will, of course, remedy this deficiency. The fresh records during the three closing months of 1929 are confined to rainfall gauge and water level readings, with calculated deductions therefrom, and no further actual measurements of river flow were made, the hope being expressed in the reports that these may be resumed during the year 1930. The two pamphlets will be valuable for filing and reference. They are further of serviceable interest in indicating how records of river flow may be computed and compiled in an organised manner under some general supervision by a staff of local helpers, aided by occasional expert survey work.

Changes of Rock Temperature.—In the *Proceedings* of the Royal Society of Edinburgh, vol. 50, pp. 153-165, R. W. Wrigley writes "On Changes of Rock Temperatures and Irregularities of the Earth's Rotation". The work is based on the long and unique series of rock temperatures at depths of about 6, 12, and 25 feet made at Calton Hill, Edinburgh, 1838–1876, 1880–1929. These were used by Forbes and Kelvin for the discussion of the downward conduction of heat from the earth's surface; they are here used in a search for any indication of variability in the supply of heat to the earth's crust from below. It is concluded that, when freed from the influence of surface changes, the thermometers show real and distinct fluctuations, accordant with one another, and attributable to deep-seated causes; confirmation of this view is obtained from Greenwich measures of the temperature at 25·6 ft. depth, for the period 1868–1910. The course of these temperature changes is then compared with the 'minor' fluctuations of the moon's motion, according to E. W. Brown; the correlation is thought to be "too close to be the result of mere coincidence", and it is sought to relate both phenomena to crustal movements.

Infra-Red Radiation.—A good survey of the properties and applications of near infra-red radiation, based on two lectures by H. D. Babcock, of the Mt. Wilson Observatory, is given in a *News Service Bulletin* recently issued by the Carnegie Institution of Washington. It appears that the recent developments in the technique of infra-red photography, which have already been of the greatest value in spectroscopy, have come largely from the needs of the motion-picture industry; a daylight photograph taken by infra-red light appears not unlike a night scene, as is shown very well by two mountain photographs in the *Bulletin*. The present limit of sensitivity is put at 11600 A. A remarkable infra-red photograph taken from an aeroplane at an altitude of 17,000 ft., which is also reproduced, shows distinctly the peak of Mt. Rainier (14,400 ft.) at a distance of 227 miles.

Spectroscopy of Soft X-rays.—A spectrograph for the analysis of soft X-rays is described by Prof. M. Siegbahn and T. Magnusson in the *Zeitschrift für Physik* for June 18. It employs a plane grating, ruled with about the same spacing as for optical work, but used at almost grazing incidence. The grating itself, which is ruled only for a width of from one to three millimetres, replaces one slit in the collimating system for the incident beam. The spectra are recorded photographically on ordinary plates. The preparation of the grating is carried out with a new machine, in which the ruling point is brought down so gently at the beginning of each line that the usual pitting of the blank at this point is completely eliminated, and special care is also taken to avoid irregularities elsewhere on the prepared surface. The instrument is designed for use in the difficult region between about 10 A. and 100 A., where neither crystal spectrometers nor the new concave grating vacuum spectrograph — also elaborated at Uppsala—can be applied satisfactorily, so that instruments of good resolving power are now available for the whole of the far ultra-violet and soft X-ray sections of the spectrum.

Tests of Creep Stress.—The June issue of the *Transactions of the Institute of Marine Engineers* contains a reprint of the paper read to the Institute by Mr. S. L. Archbutt, of the National Physical Laboratory, on recent metallurgical research in relation to marine engineering. The reprint is accompanied by a report of the discussion which followed. Restricting his review to work done during the last ten years, Mr. Archbutt dealt in turn with materials for use at high temperatures; light alloys; corrosion; nitrogen case-hardening, and a new cutting tool material. In the design of turbines, boilers, and internal combustion engines there is an ever-increasing demand for materials which will not deteriorate at high temperatures, and one of the most important requirements in this connexion is ability to withstand prolonged loading; as for example in the walls of a steam superheater tube or drum. Extraordinary interest had been aroused by the phenomenon of creep which can occur when material is stressed for a long time at high temperature, the study of which led to the introduction of the term limiting creep stress, which is the upper limit of stress which a material will withstand without ultimate failure. To investigate creep under load, test pieces are hung vertically between shackles and surrounded by an electrically heated furnace. The importance of this study of creep is shown by the fact that, starting in 1921 with four creep furnaces, the number at the National Physical Laboratory has now been increased to twenty-five or more to cope with demands for tests. The report of Mr. Archbutt's paper is accompanied by many illustrations, among which is a view of the creep stress laboratory at Teddington.

Damage by Lightning to Telephone Cables.—In the March number of the *Europäischer Fernsprechdienst*, a journal for European international communication, published in Berlin, there is an interesting account by R. Wicar of damage done by lightning to a telephone cable connected with the Budapest-Vienna line. The lightning struck a large and flourishing acacia tree and severed the trunk completely in a transverse direction. The photograph given shows that the upper portion was partially buried in the ground and was left standing vertically beside the stump of the tree, giving the impression that two trees had been involved. From the trunk the lightning made its way at a depth of about a yard under the surface to the long-distance telephone cable. The path of the lightning was plainly marked by a channel about two square centimetres in cross section and six yards long. Notwithstanding the heavy rain, the earth round the tree was almost as dry as dust. The cable was bent and flattened for a length of about two feet where the lightning entered it. About two yards farther on, the cable sheath had been opened up and

partially deflagrated. During the repair work, it was noticed that the lightning had travelled along the lead sheath for several miles. It is instructive to learn that the insulation of the telephone conductors nearest to the sheath was damaged and even at a distance of more than a mile from the point of entry many broken wires were located. Photographs are shown of the damage done to the cable. Within forty-eight hours of the occurrence, the cable was again working satisfactorily. In 1929, southern Europe had unusually violent thunderstorms.

Efficiency of Telephone Transmitters.—The efficiency of a telephone transmitter varies largely with the distance of the mouth from it and also with the angle at which the air waves impinge on the diaphragm. It is not generally realised, however, that the loss in output for increasing distance between mouth and mouthpiece is greater than that due to the reduction in the air pressure. This is due to the fact that the sensitivity of the carbon granules diminishes rapidly as the amplitude of the vibrations diminishes. In *Electrical Communication* for April, L. C. Pocock gives an interesting account of progress in subscribers' transmission apparatus. He points out that transmitters used in handsets are like other transmitters spoken into from various distances, but are unlike fixed transmitters as this variation is unavoidable. The person using the telephone places the receiver on his ear and the transmitter is then automatically located at some distance from the mouth which depends on the shape and size of the user's head. If the handset is made rather small, people with rather large heads are not able to get the mouthpiece opposite their mouths at all, and so generally place it right underneath their chin, where it gives very bad transmission. On the other hand, if the handset is made larger the transmission will be poor except for the small number of outsize type of users who, owing to the increased length, can bring the transmitter opposite the mouth. To get over this difficulty, the Bell Telephone Laboratories made measurements on the heads of more than four thousand people. The result enabled them to construct a handset which the great majority of people will be able to use with the transmitter in the proper position with regard to the mouth. A description is given in detail of the new modern headset for automatic telephony developed by the International Telephone and Telegraph Corporation. The articulation gain with this instrument over the ordinary fixed set is about fifteen per cent.

Measurement of Interfacial Tension.—The previous measurements of surface tension by determining the pull necessary to detach a ring from the surface of a liquid have given results 30 per cent too high or too low in many cases, and in a paper in the May number of the *Journal of the American Chemical Society*, Harkins and Jordan show that this was due to the use of an inaccurate equation. The correct theory is given in a paper by Freud and Freud in the same journal, in which Laplace's differential equation is used to calculate the shapes of the surfaces upheld by rings. It is shown that the ring process could give results of the degree of accuracy of about 0·25 per cent, and is now an absolute method, since the surface tension can be determined by it without reference to any other method.

Distillation Products of Peat.—The commercial exploitation of peat, apart from its use as a crude fuel, remains as one of the challenging problems of applied chemistry of special interest to Ireland. J. T. Donnelly and J. Reilly have examined the carbonisation of peat at low temperatures (550°) (*Proc. Roy. Dublin Soc.*, February, 365; 1930). By carrying out the distillation in an atmosphere of coal gas, unusually high yields of tar (16·6 per cent) and ammonia (17·4 lb. per ton) were obtained. The peat itself contained 10 per cent of soluble wax and bitumen. Unfortunately, tars of all kinds are at a discount just now, and as these tars have the 'low temperature' character, their value at present is problematical. In the April number of the same publication, C. O'Sullivan and J. Reilly have recorded investigations showing that the yields of tar are increased by distilling separately the wax extractable from the peat.

Low Temperature Carbonisation Tests.—In accordance with the scheme in vogue whereby the Department of Scientific and Industrial Research makes official tests of plants for the low temperature carbonisation of coal, the staff of the Fuel Research Board has carried out a 6-days trial of the 'Babcock' plant installed at the Dunston station of the Newcastle Electric Supply Co. This plant is unusual in that it is specially designed for the pre-carbonisation of boiler fuel and works in conjunction with a power station steam-raising unit. The retort tested was worked at its rated capacity, 30 tons per day of Northumberland coal slack being treated. The coal is first pre-dried by products of combustion and then carbonised by 'internal heat' by a mixture of steam with flue gases containing some oxygen. The coke produced (14·6 cwt. per ton of coal) is led straight on to the chain grate of the boiler stoker while the gas, of very low calorific value, is also consumed under the boiler. Of liquid products the yields were 16·4 gal. of tar and 2·5 gal. of spirit, these being the only by-products. Some of the coke was large enough for use on the domestic grate, for which it was very suitable. The test showed that the plant was technically successful and would eliminate the production of smoke in power-station practice. It should be remembered that the low value of the main product, coke, which must be produced in competition with cheap boiler slacks, makes the economic problem very difficult.

Ekatantalum.—The May number of the *Journal of the American Chemical Society* contains a paper by A. V. Grosse on element 91, or ekatantalum. The existence of such a metal, between thorium and uranium, was predicted by Mendeléeff in 1871, and at present three isotopes of it are known, all radioactive, namely, brevium, protoactinium and uranium *Z*. Of these, protoactinium is most important. It was discovered by Soddy, and independently by Hahn and Meitner, in 1917, and is, as its name indicates, the parent of the actinium series. It occurs in Nature in considerable quantities, uranium ore containing about 0·6 gm. per gm. of radium. Up to the present, all attempts to concentrate and isolate protoactinium have been unsuccessful, and this has been due, according to Grosse, to a mistaken assumption that there would be a similarity in properties between the new element and tantalum. He arrived at the conclusion that it would be more basic than tantalum, and more analogous to thorium and uranium. This prediction has been verified, and Grosse has succeeded in extracting about 40 mgm. of the element. The experiments on its chemical properties were carried out by ordinary chemical methods, using 10 mgm. or more of material. The oxides of ekatantalum and tantalum have only one reaction in common, the solubility in hydrofluoric acid. Attempts by previous experimenters to concentrate protoactinium in tantalum are now known to have had the effect of removing from the tantalum preparations the last traces of protoactinium which they may have adsorbed.

Deep Sea Investigations by Submarine Observation Chamber.

ON June 11, 1930, in lat. 32° 16′ N., long. 64° 39′ W., in the Atlantic Ocean off Bermuda, Dr. William Beebe, accompanied by Mr. Otis Barton, descended to a depth of 1426 feet below the surface of the sea.[1]

This announcement marks a new era in the exploration of the sea. All previous diving records shrink into insignificance compared with this depth; it was with no wish for record-making achievements that the descent was undertaken, but a real explorer's desire to see the animals beneath the waters as they live and not at second-hand from the collections of deep sea nets.

The construction of the chamber was financed by Mr. Barton, and he and Dr. Beebe, working from the New York Zoological Society's Oceanographic Expedition's headquarters at Nonsuch Island, have now made several descents, of which three were to a depth of 800 feet and one to 1426 feet. The chamber is a steel sphere 57·3 in. in outside diameter and 1½ in. thick. Observations could be made through a 6 in. diameter port fitted with a quartz window. Outside the window was hung a bag of decayed fish and some baited hooks, and a strong electric searchlight could be used to illumine the surrounding water. Telephonic communication was maintained with the ship above and a supply of oxygen carried.

One of the most striking phenomena was the "blue brilliance of the watery light to the naked eye, long after every particle of colour had been drained from the spectrum". The visual degeneration of the spectrum was observed, in connexion with an intensity metre. In Dr. Beebe's own words:[2] "The red had gone completely a few feet down . . .; orange had been absorbed at sixty feet below the surface and yellow at less than 400. At our depth (800 feet) lavender, too, was non-existent, together with the two opposite ends of the spectrum, infra-red and ultra-violet, while green still persisted, but greatly diluted. All that remained to our straining eyes were violet and blue, but blue such as no living man had ever seen."

It proved quite possible to observe pelagic animals drifting and swimming past the window, such as medusæ, shrimps, and fish, and about a dozen true bathypelagic fish were identified. A very interesting result of these observations was the presence of certain species of fish and invertebrates in water layers well above the depth at which their occurrence is first indicated by net catches in the daytime.

Four descents have also been made in water up to 350 feet in depth along the shelving bottom of the Bermudian insular shelf as the vessel drifted seawards. Such exploration revealed a new fish fauna at these offshore depths, the recognisable shore fish also being of great size.

The observations will be continued another year, and it is to be hoped that this new weapon of marine research has come to stay and that similar submarine observation chambers may be built in time for a study of the floor of shallower seas and the habits of food fishes. Already shallow water diving has proved its scientific value. We shall await Dr. Beebe's and Mr. Barton's full reports with great interest.

[1] *Science*, vol. 72, No. 1854, July 11, 1930, pp. 27-28. "A New Method of Deep Sea Observation First-hand." By Henry Fairfield Osborn.

[2] *New York Times*, June 27, 1930.

The Leakey-Harper Drawing Machine.

IN many branches of science, and more especially in zoology, palæontology, anthropology, and anatomy, it is often necessary to make illustrations of irregular and intricate objects, which must be true to scale and accurate in detail. It has been found that photography does not fulfil the requirements, and the illustrations have in the past been made by accurate freehand drawings. Such drawings require a large number of measurements to be made, and if a high degree of accuracy is required the work entailed is very considerable. If the specimen being drawn is of a fragile nature, considerable risks are involved because of the amount of handling entailed.

The drawing machine illustrated in Fig. 1 has been especially designed by the Cambridge Instrument Co., Ltd., 45 Grosvenor Place, London, S.W.1, to enable true-to-size drawings to be made quickly and conveniently, with the minimum amount of handling. It further makes it possible for drawings to be made of any of the six different views which represent six projections on to the sides of a cube surrounding the object, without moving the specimen after it has been once put into position.

This fact is of special importance in that branch of work for which the instrument was originally suggested by L. S. Leakey, namely, making drawings of human skulls, where it is often necessary to make drawings of the profile, full face, base, etc., with the skull orientated on the Frankfurt plane. The instrument is very easy to use and combines both greater accuracy and greater speed in the drawing of any object. The outline drawing of a skull that is illustrated in Fig. 2, including the teeth, sutures, and orifices, took forty-five minutes. A similar drawing done by the ordinary measurement and freehand method would have taken approximately twelve hours, whilst the degree of accuracy obtained on a complete set of freehand drawings could not equal that obtained by the drawing machine.

The principle of operation of the Leakey-Harper machine (Fig. 1) is as follows: A telescope, *A*, fitted with crosslines and with a horizontal line of sight, is fixed rigidly to a carriage that is capable of horizontal and vertical movement in a plane normal to its axis but so that the line of sight remains accurately parallel to its original direction. The horizontal and vertical movements of the telescope are obtained by rotating two hand wheels, one on the left hand, *B*, effecting the horizontal adjustment and one on the right, *C*, the vertical adjustment. Rigidly attached to the hand wheels, and at right angles to one another, are two long screws, one on the left hand carrying the telescope carriage, so that any rotation of the wheel moves the telescope in a horizontal direction. Rotation of the wheel on the right moves the telescope vertically. Attached to the base of the telescope carriage is a pencil, *D*, that inscribes in one plane on a sheet of paper the horizontal and vertical movements of the telescope.

Attached to the pencil is a circular soft iron plate that is supported above a solenoid by a helical spring; the pencil itself is fed through the solenoid so that the point is supported immediately above the paper; when a current is passed through the solenoid the soft iron plate is magnetically attracted and the pencil pulled down until it is in contact with the paper. When the circuit is broken the pencil is automatically raised from the paper.

The object to be drawn is mounted on a square glass plate on which have been inscribed crosslines intersecting in the centre at angles of 90° to one another; this plate is then placed upon a glass shelf, *E*, similarly ruled, that is fitted in an open frame in a position opposite to the line of sight of the telescope. To obtain an alternative view of the object to the line of sight it is only necessary to rotate the subsidiary glass plate through an angle of 90°, as indicated by the ruled lines, and by rotating the plate in this way through a succession of right angles the four different views necessary for a complete set of drawings may be obtained. The plan views of the top and bottom of the object are obtained by two large plane mirrors, *F*, fixed to the frame at an angle of 45° to the horizontal, one above and the other below the specimen to be drawn. These mirrors reflect the desired images and it is only necessary to raise or lower the frame carrying

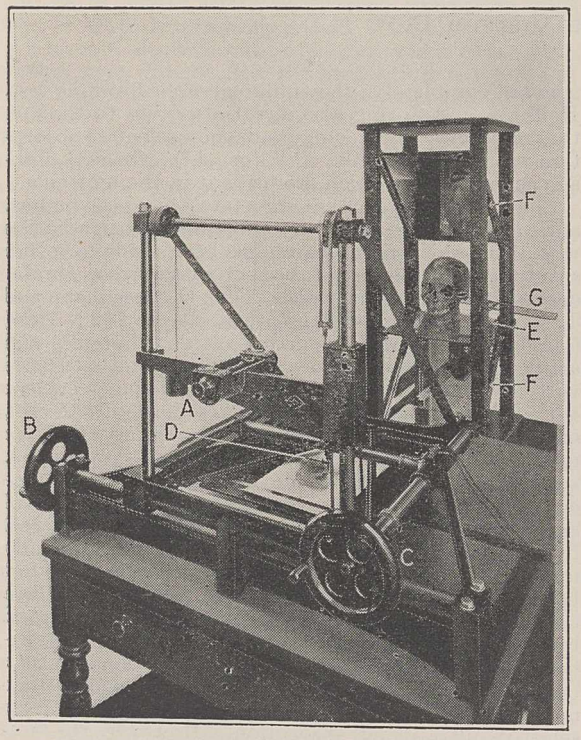

FIG. 1.

the object until the reflected image is in the line of sight of the telescope. The framework carrying the specimen is open, but a suitably coloured curtain may always be hung behind the object to give contrast when drawing edges of white or black objects.

To make a drawing of a skull, the specimen is set up on the glass plate on the Frankfurt or any other desired plane; the skull may be supported by a block and held in position by small pieces of plasticine. Fragile fragmentary specimens may be supported by a moulded block of plasticine, but it will be recognised that this will prevent a detailed drawing of the base view being made without resetting the specimen. The observer sets the telescope so that the intersection of the crosslines in the telescope coincides with the outer extremity of the skull; the right hand wheel controlling the vertical motion should then be rotated through the whole length of adjustment; this will cause a straight line to be drawn by the pencil on a sheet of paper that has been previously fixed to the drawing board. By suitably dividing this line a scale is obtained on which vertical measurements may be made. Similarly, the lowest extremity of the skull may be taken and a line drawn by means of the horizontal adjustment to provide the horizontal scale.

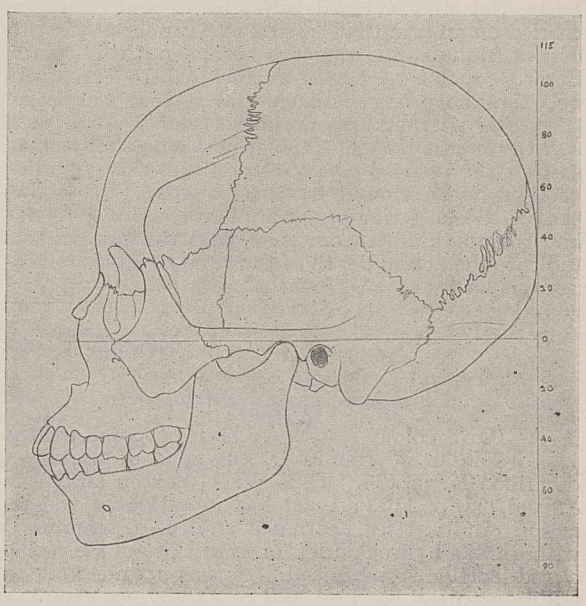

FIG. 2

The telescope is then focused and the crossline intersection made coincident with a point on the main outline of the skull; by rotating the hand wheels the observer may make the telescope traverse the

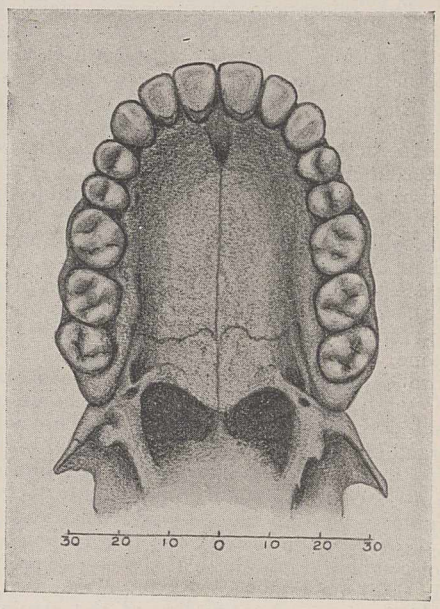

FIG. 3.

complete outline, and in this way make the pencil draw out the projection of the complete skull in this plane. Similarly the sutures, orbits, teeth, etc. can be drawn in detail.

A further attachment has been devised by Mr. E. Smith to enable the depths and contours of orifices or cavities in the specimens to be drawn. This is of

great service in connexion with drawings of skulls, as it is often desirable to show on profile drawings the depth and the shape of the orbit, palate, etc. The attachment for this work consists of a U-shaped metal pointer with parallel prongs, *G*, that is capable of horizontal and vertical adjustment and which is carried on an arm that is fixed in a runner at the side of the frame supporting the specimen; this runner is also capable of vertical adjustment. The width between the prongs is such that it is rather larger than half the maximum width of an average skull and the length of each of the prongs is precisely equal, so that the pointed tips are exactly in the same line of sight when viewed by the telescope. It follows that if the posterior prong is placed within a cavity and thereby hidden from view, then the anterior will indicate the actual depth of the cavity and by following the movements of the anterior pointer with the telescope an outline of the cavity may be drawn.

It will be appreciated that all subsequent measurements can be made on the drawings instead of on the object. This is of great convenience, as it enables drawings to be submitted for examination rather than the actual object; in addition, any number of precisely similar drawings may be made.

Although the machine was primarily designed for drawing skulls, it can be used to advantage in making a series of true to size drawings of any object in any plane where accuracy of detail combined with speed are a consideration.

The illustrations show the complete apparatus with a skull mounted in position for drawing, and also two drawings—one of a skull (Fig. 2) and the other of a palate (Fig. 3)—obtained with the instrument.

Recent Work on Vitamin D.

II.

CHEMISTRY.

VARIOUS colour tests have been proposed for the detection of vitamin D, but none of those yet described is specific. Thus W. A. Sexton (*Biochem. J.*, vol. 22, p. 1133; 1928) has investigated the reaction obtained by heating a source of vitamin D with aniline hydrochloride in excess of aniline, when a red colour is produced. It was found that in addition to cod-liver oil and irradiated ergosterol, a similar colour was given also by unsaturated ketones, such as cholestenone, oxycholestenone, oxycholesterylene and carvone: with saturated ketones, such as cholestane-4-one or camphor, only slight darkening of the mixture was observed. The results suggest, however, that the vitamin, or an accompanying irradiation product of ergosterol, is ketonic in character. The phosphomolybdotungstic acid test is even less characteristic; though cod-liver oil gives a positive reaction, irradiated ergosterol is negative. Ergosterol itself, however, shows certain colour reactions which not only are useful for detecting its presence in mixtures, but also throw light upon its chemical structure as well as that of some other sterols.

O. Rosenheim (*ibid.*, vol. 23, p. 47; 1929) has found that when it is warmed with chloral hydrate or its chloroformic solution treated with a concentrated aqueous solution of trichloroacetic acid, an immediate red colour is produced which soon changes to a deep blue (passing through a green in the case of chloral hydrate). So little as 0·005 mgm. can be detected. The red colour is also given by cholesterylene, ψ-cholestene, allocholesterol, and allositosterol, and is therefore dependent upon the presence of the $\Delta^{1,2}$ (or $\Delta^{1,13}$) ethenoid linkage: it is probable that a coloured carbonium salt is formed. The colour is discharged by water or alcohol. The final blue stage observed in the case of ergosterol is presumably due to the presence of the third double bond. Oxycholesterol gives a gentian blue colour with the reagents, which, however, shows only the absorption band of oxycholesterol and not those of the ergosterol blue.

I. M. Heilbron and F. S. Spring (*ibid.*, vol. 24, p. 133; 1930), in further studies of the structure of sterols, have investigated the reaction with bromine: ergosterol and certain hydrogenated derivatives of this substance which do not give the red colour with trichloroacetic acid, when dissolved in glacial acetic acid show a green colour on addition of a solution of bromine in chloroform. It appears that this reaction depends upon the $\Delta^{10,19}$ (or $\Delta^{10,11}$) ethenoid linkage, which is inert to hydrogenation: all cholesterol derivatives, for example, are easily hydrogenated completely; they fail to give the bromine test. Heilbron and Spring also direct attention to the fact that only those sterol compounds show selective absorption which contain the $\Delta^{1,13}$ (or $\Delta^{1,2}$) ethenoid linkage as one of two which are present in the molecule.

Since the discovery that ergosterol shows the highest antirachitic potency of any substance on irradiation with ultra-violet rays, search has been made for other substances which could be activated to a similar degree, but without success. Thus O. Rosenheim and T. A. Webster (*Biochem. J.*, vol. 22, p. 762; 1928) found that naturally occurring saturated sterols and artificially reduced sterols, cholesterol and sitosterol with one double bond, stigmasterol and cholesterylene with two were not activated on irradiation. Again, other unsaturated compounds containing three or more double bonds such as squalene, certain terpenes, sphingosine, and phrenosine were unable to replace ergosterol as precursors of vitamin D. Isomers of ergosterol, fungisterol from ergot and zymosterol from yeast, iso- and neo-ergosterol were equally impotent. The work on zymosterol was carried out by E. M. Hume, H. H. Smith, and I. Smedley-Maclean (*ibid.*, vol. 22, p. 980; 1928) and was complicated by the fact that the sterol still contained, after purification, as much as 5 per cent ergosterol, the impurity being detected by spectroscopic examination, since neither zymosterol nor fungisterol possesses any selective ultra-violet absorption. However, the biological test on rats showed that daily administration of $\frac{1}{20,000}$ mgm. irradiated ergosterol prevented rickets almost entirely, whilst the same slight activity was shown by doses of $\frac{1}{100,000}$ mgm. irradiated ergosterol and $\frac{1}{5000}$ mgm. irradiated zymosterol: hence the effect produced by the latter can be ascribed to its ergosterol content.

In a further communication, Rosenheim and Webster (*ibid.*, vol. 22, p. 1426; 1928) give details of their examination of irradiated fungisterol for antirachitic potency as well as results obtained with two other sterols isolated from ergot. The fungisterol and one of the others contained small amounts of ergosterol as shown by spectroscopic examination and their biological activity after irradiation was low and certainly due to the presence of irradiated ergosterol. The third sterol showed no absorption bands, gave a negative colour test for ergosterol and was completely inactive after irradiation. All the evidence so far obtained, therefore, suggests that ergosterol is the only naturally occurring precursor of vitamin D.

In following the course of the reaction ergosterol→vitamin D, it has been found that other products be-

sides the vitamin are formed : in fact, under conditions of irradiation such as are frequently employed, the latter forms only a small proportion of these products. Observation of the changes in the absorption bands of ergosterol forms a convenient method of following the course of the reaction, but potency tests are necessary before any particular band can be assigned to vitamin D, more especially since the changes vary to some extent according to the conditions of irradiation. By following these changes, Heilbron and his co-workers were first led to suspect that 'pure cholesterol' contained a contaminating provitamin, and finally to suggest that vitamin D was characterised by a band at 2470 A. ; the ergosterol bands are at 2935 A., 2815 A., and 2700 A. Irradiation was carried out in alcoholic solution for 60 min. (I. M. Heilbron, E. D. Kamm, and R. A. Morton, *Biochem. J.*, vol. 21, pp. 78 and 1279 ; 1927 ; *J. Chem. Soc.*, p. 2000 ; 1927).

T. A. Webster and R. B. Bourdillon (*Biochem. Jour.*, vol. 22, p. 1223 ; 1928) found that irradiation with rays of wave-length longer than 2700 A., by the use of a filter of alcoholic cobalt chloride which cuts off the shorter rays, did not alter the equilibrium reached and that exposure of the solution of ergosterol during irradiation to temperatures ranging from −18° to 77·8° did not alter the potency of the final product, although at temperatures of −183° and −195° the preparations were markedly less active : these results suggest that the temperature coefficients of the changes causing production and destruction of the vitamin are similar and small and that both reactions are directly photochemical in Nature. A highly active preparation was obtained by a short irradiation followed by removal of the bulk of the unchanged ergosterol with digitonin, evaporation to dryness and extraction in ether to remove traces of digitonin and ergosterol digitonide. The product was a glassy solid, melting at about 30° and much more soluble than the original ergosterol in organic solvents. When the absorption spectra of the irradiation products were studied, it was found that the first change was a marked increase in the absorption below 3000 A., especially in the regions 3200-2900 A., 2650-2500 A., and 2900-2700 A. More prolonged irradiation decreased the absorption and, at the same time, the activity. The authors conclude that vitamin D probably has an absorption maximum at 2800 or 2900 A. and from it is formed a secondary product with an absorption maximum at about 2300 A. Still longer irradiation of the products first obtained leads to complete disappearance of both absorption and activity. They point out that the presence of a band together with some activity in a preparation does not indicate that the band is to be attributed to the vitamin, unless a quantitative relation between such absorption and activity can be demonstrated.

Bourdillon and Webster and their co-workers consider the absorption spectrum of vitamin D also in a later paper (*Proc. Roy. Soc.*, B, vol. 104, p. 561 ; 1929). Their evidence suggests that three substances are formed in succession by the irradiation of ergosterol : the first (which is vitamin D) shows increased absorption as compared with ergosterol in the region 2500-3100 A. with maxima at about 2800 A. and 2700 A. More prolonged irradiation results in decrease in the absorption in this region with a concomitant increase in that between 2300 and 2500 A. and finally in almost complete disappearance of any absorption in the ultra-violet region. Quantitative comparisons of absorption spectra and antirachitic activity showed a roughly linear relation between intensity of absorption at 2700-3100 A. and potency, so that presumably the substance first formed is the vitamin. The other two substances are inactive. When a filter cutting off all radiation below 2650 A. was used, there was a marked decrease in the formation of vitamin D, suggesting that shorter wave-lengths favour its production rather than its destruction.

The irradiation was carried out usually in alcoholic solution in the absence of oxygen : vitamin D was not easily oxidised in alcoholic solution, but very readily when exposed dry to oxygen at 100°. By calculations depending on the rate of destruction of ergosterol (determined gravimetrically) and the rate of production of absorption due to vitamin D, it was found that the purest preparations obtained probably contained about 55 per cent of the vitamin. The minimum dose detectable biologically was about $2{\cdot}5 \times 10^{-9}$ gm. or, in 14 days, $3{\cdot}5 \times 10^{-8}$ gm. If only half this was vitamin D, the smallest detectable dose of the pure vitamin would be $1{\cdot}9 \times 10^{-8}$ gm., a figure which agrees closely with Steenbock's and Coward's estimates.

E. H. Reerink and A. van Wijk (*Biochem. J.*, vol. 23, p. 1294 ; 1929) irradiated ergosterol in solution in hexane, exposing it to wave-lengths longer than 2750 A. and to the wave-length 2540 A. by interposing between the mercury arc and the solution filters of benzene solution or chlorine gas and potassium nitrate solution, respectively. Oxygen was rigidly excluded. With the long wave irradiation it was found that the absorption increased at first over the whole range, diminishing as irradiation proceeded in the long wave range. At 2820 A., absorption decreased from the beginning, but at 2715 A. it at first increased. It was possible to calculate that for the first 15 min. the conversion of ergosterol into vitamin D was the only reaction taking place and that in this time about half the ergosterol was converted. More prolonged irradiation resulted in slow destruction of the vitamin and disappearance of the above bands with the development of an ill-defined band at 2400-2500 A. The product of a short irradiation was highly active and was obtained in the crystalline state, free from ergosterol, provided that oxygen was rigidly excluded during all manipulations : the crystals had a melting point below 0°.

Irradiation at 2540 A. resulted in an increase in absorption over the whole range, including 2800 A., the increase being much more marked than with the long wave irradiation : the absorption at 2930 A. and 2820 A. increased much more than that at 2715 A. : further irradiation resulted in almost complete disappearance of the absorption. The vitamin was formed only during the first few minutes and was then rapidly destroyed : the most potent preparation had an activity of only about a tenth of that of the material obtained by long wave irradiation. In certain respects these results do not agree with those obtained by Bourdillon and Webster *et al.*, and it is obvious that further work is required before agreement is reached on the absorption spectrum of vitamin D, but the preparation of pure specimens appears now to be assured.*

It may be pointed out that the stability of the vitamin may be influenced by the presence of accompanying compounds in a similar manner to the parent substance ergosterol. H. King, O. Rosenbeim, and T. A. Webster (*Biochem. Jour.*, vol. 23, p. 166 ; 1929) point out that although ergosterol itself is labile, as a contaminant of cholesterol it appears stable : they have, in fact, found it present in the cholesterol esters isolated from the brain of a mummy 1400 years old, both by colour test and also by obtaining an antirachitic product of the same order of potency as irradiated 'cholesterol', by its irradiation.

* In a recent note in our columns (NATURE, vol. 125, p. 635 ; 1930), Bourdillon, Jenkins, and Webster state that they have now come to the conclusion that the absorption band at 2800 A. is not that of vitamin D, but of a decomposition product : the vitamin shows low absorption at this wave-length.

University and Educational Intelligence.

CAMBRIDGE.—The electors to the Woodwardian professorship of geology have elected Prof. O. T. Jones, professor of geology and mineralogy at the University of Manchester, to succeed Prof. J. E. Marr, who will vacate the post on Sept. 30 next. Prof. Jones, who was educated at Pencader Grammar School and the University College of Wales, Aberystwyth, took first class honours in both parts of the Natural Sciences Tripos at Cambridge, where he also gained the Wiltshire prize, the Harkness prize, and the Sedgwick essay prize. He has been professor of geology at Manchester since 1910.

The Vice-Chancellor announces that the annual Treasury grant payable to the University as from the beginning of the academic year 1930–31 will be £107,500, an increase of £14,000.

Dr. G. H. F. Nuttall has been re-elected into the Quick professorship of biology.

The Appointments Committee of the Faculty of Agriculture and Forestry has appointed H. E. Woodward to be University lecturer in agricultural chemistry, W. K. Hubble to be University demonstrator in agriculture, and Dr. Marshall to be director of the Animal Nutrition Institute. This Committee will shortly proceed to appoint a University lecturer in agricultural chemistry to give instruction in soil science. Particulars as to stipend and duties may be obtained from the Secretary, Appointments Committee, Department of Agriculture, University of Cambridge.

The Vice-Chancellor has appointed Sir Arthur Evans to the Frazer lectureship in social anthropology for the academical year 1930–31. The Managers of the Benn W. Levy Research Studentship in Biochemistry have elected L. H. Strickland, Christ's College, to the studentship.

LONDON.—Dr. J. M. W. Morison, lecturer in radiology at the University of Edinburgh, has been appointed to the University chair of radiology tenable at the Cancer Hospital (Free). Dr. H. D. K. Drew, lecturer in the Department of Chemistry at the University of Birmingham, has been appointed to the University readership in organic chemistry tenable at East London College.

The following appointments have been made to the staff of Birkbeck College: Mr. H. C. K. Henderson to be lecturer in geography; Mr. C. E. M. Joad to be lecturer in philosophy and psychology, and Mrs. M. E. Robinson to be lecturer in economics.

At a meeting of the Court of the University held on July 30, it was announced that the London County Council will, subject to certain conditions, make a total capital grant of £250,000 towards the erection and equipment of buildings on the Bloomsbury site, and a capital grant for the quinquennium 1930–35 of £150,000 towards the capital requirements of schools not connected with the Bloomsbury site.

MANCHESTER.—The Council, at a recent meeting, unanimously adopted a resolution expressing to Prof. F. E. Weiss its very deep regret on his retirement from the George Harrison chair of botany, which he has held since 1892. "During his tenure of the Chair, he has built up a great School of Botany, which bears a distinguished name both at home and abroad. It is renowned for the researches which have been carried out by the members of the School and for the unusually large number of men and women it has trained who now occupy positions of influence in many spheres of botanical work. . . . His singleness of purpose, inspiration, and exceptional abilities as a leader and administrator have been a constant source of strength, and have done much to place the University of Manchester in the position it now occupies."

Historic Natural Events.

Aug. 10, 1591. Atlantic Gales.—A fleet of 77 sail, which left Havana for Spain on July 17, encountered a terrible gale on Aug. 10, and the commander of the fleet with 500 men perished. Three or four days later, in another gale, five or six of the largest ships with all their crews and the vice-admiral were lost. About the end of August, in lat. 38° N., they experienced a third gale in which 22 sail perished. Finally, within sight of Flores, the survivors were scattered by a fourth gale on Sept. 6; very few reached Spain.

Aug. 10, 1893. Heavy Rain at Preston.—At Preston, Lancashire, 2·09 in. of rain fell in 35 minutes, but the observer was of opinion that 1·25 in. of rain and hail fell in five minutes. This storm did a great amount of damage.

Aug. 10, 1901. Hailstorm.—A series of very violent thunderstorms brought terrific falls of hail during the morning in Derbyshire, Yorkshire, and the south-east of Scotland. Great damage was caused to crops, especially near Galashiels, and thousands of panes of glass were broken. The violent storm was very brief, but the hail blocked up the drains and caused flooding.

Aug. 10-16, 1924. Aberrant Typhoon in the Pacific.—A typhoon which originated in the western Pacific, near the Marianna Islands, on Aug. 5, followed a most unusual track. The majority of these disturbances either travel steadily towards the west or north-west until they strike the mainland of Asia, when they fill up, or else follow a simple parabolic path, travelling first towards the west-north-west, then turning north and finally north-east. This particular example, however, a well-developed, violent typhoon, followed a looped track south-west of Japan, travelling south-west on Aug. 10, south and south-east on Aug. 11, and very slowly eastwards on Aug. 12-16. Finally on Aug. 17 it resumed its normal track and continued across the Sea of Japan. So unusual was the looped track that a steamer was wrecked because its captain believed that a typhoon could not possibly advance towards the south-west, and neglected to take the necessary precautions.

Aug. 12, 1582. Storm in Norfolk.—There was a great thunderstorm and whirlwind, with hailstones shaped like rowels of spurs, two or three inches in circumference. On the same night arose the greatest storm since the "Calais" storm on Jan. 7, 1558. Many houses, barns, and gates were blown down, and many vessels were lost.

Aug. 12, 1891. Record Rainfall.—At Campo, San Diego, Calif., on Aug. 12, 1891, a total of 11·50 in. of rain fell in one hour. This is the world's record for one hour's precipitation.

Aug. 13, 1868. Peruvian Earthquake Sea-waves.—The epicentre of the earthquake was near Arica on the coast of Peru. The resulting sea-waves were observed along the South American coast from the Chincha Islands on the north to near Valdivia on the south, places that are 2000 miles apart. They were also recorded in the Hawaiian Islands (6218 miles), Samoa (6633 miles), New Zealand (7047 miles), and New South Wales (8500 miles).

Aug. 14-27, 1873. Nova Scotia Cyclone.—A violent storm, after traversing the West Indies, travelled northward off the east coast of the United States, causing an immense amount of damage. It is said that 1223 vessels were wrecked, and at least 223 lives were lost. The storm played havoc with the fishing fleets of Canada and the United States, and was long remembered as the 'Nova Scotia Cyclone'.

Aug. 15, 1537. **Hailstones in Central Europe.**—At Gottwick, Austria, men and beasts were killed by hail. At Bologna the hailstones were said to have weighed 28 pounds. As this weight would give them a diameter of more than nine inches, it must be regarded as greatly exaggerated.

Aug. 15, 1905. **Thunderstorm over the West of England.**—A thunderstorm of exceptional violence occurred over Devon and Somerset during the evening, accompanied by heavy rain. There was much damage by lightning, buildings being set on fire and many cattle killed, but there is no record of the loss of human life.

Aug. 16, 1664. **Thunderstorm.**—Pepys wrote under this date: "Wakened about two o'clock this morning with the sound of thunder, which lasted for an hour, with such continued lightnings, not flashes, but flames, that all the sky and ayre was light; and that for a great while, not a minute's space between new flames all the time; such a thing as I never did see nor could have believed had ever been in nature. . . . And that accompanied by such a storm of rain as I never heard in my life; . . . it seems it has been here and all up and down the countrie hereabouts the like tempest, Sir W. Batten saying much of the greatness thereof at Epsum."

Societies and Academies.

PARIS.

Academy of Sciences, June 11.—P. Villard: The reduction of soda by hydrogen. Caustic soda, heated in a current of hydrogen at 800°-900° C., gives sufficient sodium vapour to reverse the sodium lines and to cut off all the light from a sodium flame. This result cannot be due to dissociation, since at the same temperature the replacement of the hydrogen by nitrogen causes the sodium vapour to disappear.—**Louis Roy:** The propagation of waves on elastic surfaces with three parameters.—**Paul Vuillemin:** A new species, *Corethropsis Puntonii*.—**O. Borúvka:** The surfaces represented by spherical functions of the first species.—**Ch. Sadron:** The ferromagnetism of the alloys of nickel and chromium. The study of the magnetic properties of nichrome alloys has been made by Safranck. On the same specimens the author has studied the saturations at the absolute zero and the ferromagnetic Curie points.—**Léon Bertrand:** The Trias of the neighbourhood of Betchat and of Salies-du-Salat.

June 16.—**Léon Lecornu:** Funicular surfaces.—**V. Grignard** and **J. Colonge:** The condensation of ketones. Extension of the classical method. The substitution of hydrochloric acid by hydrobromic and hydriodic acids gives higher yields, and some ketones which resist the condensing action of hydrochloric acid suffer condensation in the presence of hydrobromic acid.—**Léon Guillet** and **Marcel Ballay:** The influence of tempering on the electrical resistance and resistance to shearing of the silicon-aluminium alloys. The electrical resistance of pure aluminium.—**Jean Rey** was elected a member of the division of the applications of science to industry.—**L. Abélès:** The nomographic representation of analytical functions. Application to complex trigonometry.—**Mme. Julie Rózańska:** The continued decompositions of surfaces into Cantorian curves.—**André Roussel:** Functions the infinitesimal increase of which has a given expression.—**Marcel Winants:** Linear differential equation of the third order and the integral curve passing through three given points.—**M. Fekete:** The changes of sign of a continuous function in an interval.—**Vignaux:** A method of summation of divergent integrals.—**H. E. Bray:** Functions with finite deviation.—**P. J. Myrberg:** The existence of Green's function for a given plane domain.—**G. Maneff:** Gravitation and the energy at the zero.—**Al. Proca:** Dirac's equation.—**N. Stoyko:** The influence of the terms of the third and fourth orders in the use of E. Esclangon's method for the determination of the orbit of a star. Application to the trans-Neptunian body.—**Ernest Esclangon:** Remarks on the preceding note.—**Fernand Baldet:** The nucleus of the Schwassmann-Wachmann comet (1930*d*). The nucleus does not appear to have had a diameter much greater than 400 metres, and is at least as small as that of the Pons-Winnecke comet.—**L. Décombe:** The undulatory theory of quantic phenomena. New results.—**F. Holweck** and **P. Lejay:** A portable instrument for the rapid determination of gravity.—**H. Muraour** and **G. Aunis:** The agreement between calculated explosion pressures and experimental explosion pressures. The calculated explosion pressures, starting with the new specific heats of Nernst and Wohl, for the gaseous mixture obtained in the experiments, are in complete agreement with the experimental pressures corrected for cooling.—**R. Forrer** and **J. Schneider:** The production by annealing of two states of pure iron, stable at the ordinary temperature.—**Armand de Gramont** and **George Mabboux:** The comparison of piezoelectric quartz oscillating at slightly differing frequencies.—**L. Abonnenc:** The measurement of the magnetisation coefficient of aqueous solutions by the method of falling drops. The method has been applied to measure the diamagnetism of the halogen ions. The results are in good agreement with the values obtained by Hocart by a different method.—**A. Turpain** and **R. de Bony de Lavergne:** An ultramicroscope permitting the direct projection of ultramicroscopic tests and the Brownian motion.—**V. Fock:** The mechanics of the photons.—**F. Prevet:** The mode of action of boric acid on the phosphorescence of sulphides of zinc prepared by the explosion method. The use of boric acid in the preparation of phosphorescent zinc sulphide is known to increase the intensity and persistence of the phosphorescence. Attempts to replace boric acid by other substances have proved unsuccessful, and it is concluded that the boric anhydride acts by influencing the crystalline medium necessary for phosphorescence.—**R. Coustal:** Poisons and phosphorogens for phosphorescent zinc sulphide.—**E. Estanave:** Integral photographs obtained without objectives.—**Hubert Garrigue:** The passage of the continuous current in acetone.—**Georges Fournier:** A relation between the filiation capacity of radioactive atoms and the velocity of the α-rays which they emit.—**Augustin Boutaric** and **Mlle. Madeleine Roy:** The radioactivity of materials arising from old roofs. The radioactivity of substances exposed to the open air is not due to exposure to sun, but to contact with rain water. Rain water was collected on a roof and passed into a cistern containing a filter of sand and charcoal, the filtering material not being exposed to the sun: both the charcoal and the sand were clearly radioactive.—**W. Broniewski** and **J. Strasburger:** The structure of the copper-zinc alloys. The brasses were examined after long periods of annealing at 400° C. Curves are given showing the electrical conductivity, the temperature coefficient of the electrical resistance, the thermoelectric power with reference to lead and other physical properties. The compound CuZn appears on all the curves and there are indications of $CuZn_2$ and $CuZn_6$.—**H. Colin** and **A. Chaudun:** The complex between the enzyme and the products of hydrolysis during the diastatic inversion of sugar.—

Guichard, Clausmann, Billon and Lanthony: The hardness of cold-hardened and electrolytic nickel.—G. Dupont and J. Allard: The mechanism of the antoxygen action.—H. Forestier: The action of the magnetic field on the velocity of solution of iron in a solution of cupric chloride. The velocity increases rapidly with an increase in the strength of the magnetic field; with fields between 500 gauss and 4000 gauss the increase of velocity of solution is proportional to the strength of field. Above 4500 gauss the velocity of solution is independent of the magnetic field.—Alfred Molnar: New researches on the cold hardening of lead, tin, cadmium and zinc at different temperatures. A comparison of the hardening effects produced by slow and rapid extension. The latter presents all the characteristics of a cold-hardened metal.—Jean Cournot and Jean Bary: The treatment of siderurgical alloys with solutions of some metallic phosphates. A study of the effects of mixtures of various phosphates as regards the protection of mild steel against corrosion. Protection by phosphate of iron alone was unsatisfactory, the best results being obtained by using solutions of mixed phosphates, iron and zinc, or zinc and manganese.—F. Taboury: The action of sulphuric acid on mercury at the ordinary temperature. Sulphur dioxide is the only gaseous product and crystals of acid mercurous sulphate, Hg_2SO_4, H_2SO_4.—Picon: Mercury camphocarbonate and some derived mercurial products.—Charles Combaluzier: The limits of the Burdigalian deposits in Lower Provence.—H. Derville: Henriette marble, a reef constructed by calcareous Algæ.—Yves Milon: The presence of Globigerina limestones in the Bartonian of Sarthe.—E. Huguenard, A. Magnan, and A. Planiol: A method of measuring the turbulence of the atmosphere.—Guilliermond, Dufrenoy, and Labrousse: The germination of tobacco seeds in media containing neutral red: the coloration of the vacuome during the development of the seedlings.—Mlle. Eudoxie Bachrach and Mme. Pillet: The micro-incineration of diatoms without carapace.—Aug. Chevalier: The three periods of renewal of vegetation in Senegal.—G. Nicolas and Mlle. Aggery: A third example of generalised bacterial infection in plants.—Marcel Chopin: The additive mechanical properties of dough made of wheat flour.—C. Vaney and A. Bonnet: The phenomena of autotomy in *Spirographis Spallanzanii*.—Jean Régnier and Guillaume Valette: A study of the mode of fixation of cocaine hydrochloride on the nerve fibres. A comparison of the absorption of cocaine by animal charcoal and by nerve substance showed a close similarity as regards rapidity of fixation and shape of curves. These results indicate that cocaine is fixed on the nerve fibre by a normal process of adsorption.—L. Lutz: The soluble ferments secreted by the Hymenomycete fungi. The degradation of the ligneous material.—M. Lemoigne and P. Monguillon: The presence of acetylmethylcarbinol and of 2.3. butylene glycol in the higher plants. Formation during germination.—Claude Fromageot and Mlle. M. Watremez: Comparison between the buffering powers of glycocoll and glycylglycine.—Radu Codreanu: The nutrition and action on the host of *Symbiocladius rhithrogenæ*.

GENEVA.

Society of Physics and Natural History, June 19.—Leon W. Collet: Preliminary report on the geological expedition of Harvard University in the Canadian Rockies (1929). The Canadian Rockies, from their eastern border to Yellow Head Pass, are made up of seven 'blocks' thrust one over the other from west to east, and separated by 'clean cut thrusts' of the type of the Northwest Highlands of Scotland. The Athabasca valley, from the town of Jasper to the eastern border of the Rockies, follows an axis depression of the thrust masses. The quartzites forming the mountains to the west of Maligne lake, as far as the Tonkin valley, are of Lower Cambrian age and not of Mesozoic age. Ammonites found in the Jurassic black shales show that upper Lias and Bajocian are present in the interior of the Canadian Rockies in Jasper National Park.—L. Reverdin: The neolithic fauna of the station of Port Conty (St. Aubin, Neuchâtel) from material collected from 1928 to 1930. Two groups of deposits belonging to the old and middle neolithic yielded 273 and 73 specimens. These proved, from one group to the other, a variation from 70 to 50·8 per cent for the domestic species and from 30 to 49·2 per cent for the wild species.—G. Tiercy: The gravitational derivation of the solar rays and the thermal regime of the high plateaux. The author proposes a new theory capable of explaining the thermal advantage enjoyed by the high plateaux, especially the Asiatic plateau, as compared with other regions of the same latitude. The calculation allows the estimation of the order of magnitude of the age of the Asiatic protuberance, or 1400 millions, figures which agree with those based on radioactivity and relative to the time necessary for the terrestrial crust to have acquired its present chemical constitution starting with uranium and thorium.—N. Danoz: The free surface of the fluid stars. The author has applied Wavre's method to the study of the internal movements of the fluid stars, and has been able to establish the following: if the equator rotates more rapidly than the pole caps, the free surface is an ellipsoid compressed between the pole and the equator. In the contrary case, it will be an expanded ellipsoid.

ROME.

Royal National Academy of the Lincei, Mar. 16.—A. Angeli: Certain relationships between constitution and odour. Unlike the artificial musks (aromatic nitro-compounds) and violet ketones (ionone, etc.), the cyclic polymethylene carbonylic compounds described by Ruzicka, although having similar odours, are free from methyl groups. It is suggested that the presence in the molecules of these compounds of a large number of methylene groups may render possible deformations of the ring so as to produce lateral nodes able to act like methyl groups. Certain evidence in support of this view is advanced.—A. Angeli and A. Polverini: The oxidising power of diazohydrates and their analogies with nitrous acid. Reactions are described which justify the argument that the three molecules, O:O, (HON):O, and $(C_6H_5 \cdot N_2H):O$, are analogous in structure and behaviour.—A. Terracini: The projective quasi-applicability of a surface on a plane.—Luisa Pelosi: Generalisation of a theorem of F. Neumann on the calculation of certain integrals.—M. Calonghi: The mean curvature of surfaces. It is shown how the consideration of geometric elements connected with a surface along an infinitesimal cycle leads naturally to the notion of mean curvature of the surface itself. The procedure approximates the mean curvature to the total curvature, the rigid connexion of which with the properties of the infinitesimal cycles traced in the surface is rendered evident by the theory of surface parallelism.—G. Pfeiffer: The integrals of S. Lie.—G. Krall: Point loads for rods with moment of inertia variable with discontinuity.—W. Kusnetzoff: The regularisation of the general problem of three bodies.—G. Bargellini and Lydia Monti: 2:6-Dibromophenetidine and 3:5-dibromophenetidine. Various derivatives of these two compounds have been prepared and compared.—A. Baroni: Diphenyl

polysulphides, sulphodiselenide, and selenodisulphide. The melting-points and densities (at 20° : 4°) of the various compounds described are: $(C_6H_5)_2S$, 62°, 1·353; $(C_6H_5)_2S_3$, 30°, 1·418; $(C_6H_5)_2Se_2$, 59°, 1·743; $(C_6H_5)_2S_2Se$, 50°-51°, 1·593; $(C_6H_5)_2Se_2S$, 55°, 1·873.—S. Visco: Hysteresis of electrical conductivity in colloidal solutions. The electrical conductivity of solutions of granular gelatine of various concentrations exhibits distinct hysteresis.—Mario Betti: Optical resolution of racemic aldehydes (1). By means of β-hydroxynaphthylphenylaminomethane, which combines readily with aldehydes to form highly stable, crystalline compounds, the racemic form of *p*-methoxyhydratropic aldehyde has been resolved into the two optical isomerides. Other aldehydes may be similarly resolved.—G. Bini: A new method for the identification and determination of nitrates in waters. Quinosulphonic acid gives with NO_3 ions a coloration varying from pale green to brown according to the concentration of the ions, and serves as a satisfactory reagent for the detection and determination of nitrates in water. It is less sensitive than, and hence preferable to, pyrogallolsulphonic acid.—G. Checchia-Rispoli: A case of metamerism in an exocystic echinoid.—Fausta Bertolini: Regeneration of the digestive apparatus in holothurians. The emission of the whole of the intestinal tube, leaving in position the first tract of the œsophagus and the last part of the rectum, united by the thin mesenteric lamina, with subsequent regeneration of the digestive system, has been observed in *Stichopus regalis*, and appears to be relatively more frequent with this species than with the genus *Holothuria*.—G. Cannicci: Contribution to the study of glutathione in Teleostei (2). The proportions and variations of glutathione in various species are described.—G. Brunelli and N. Apolloni: Certain characteristics of Mediterranean lagoon associations.—V. Rivera: The biological action of penetrating radiation (cosmic or ultra-γ rays) on the development of seeds of land vegetables. Penetrating radiation has not only no positive influence on the germination of the seeds of land plants, but even exerts a slight depressive action, retarding the onset of germination or slowing the growth of seedlings.—Silvia Colla: Variations in the oxygen content of the hydrostatic bladders of certain brown algæ. The results of experiments on *Fucus serratus L.* show that oxygen is accumulated in these bladders on exposure to light and is consumed or eliminated in the dark, so that the accumulation of oxygen is to be regarded as a photosynthetic effect. A parallel phenomenon was noted by Stiles and Langdon with a species of *Neurocystis*.

VIENNA.

Academy of Sciences, May 8.—L. Haberlandt: Researches on the heart-hormone in invertebrates. Experiments were made on the excised hearts of snails, of *Helix pomatia* in Innsbruck, of *Aplysia* in Naples. Isolated hearts were put into Ringer's solution and kept until spontaneous or mechanically excitable pulsations ceased in a time which varied from some hours to three days. Extract of muscle from the foot (with Ringer) produced no pulsation when added; extract of heart muscle proved a stimulant. Heart-hormone preparation from vertebrates also proved exciting even in extreme dilutions. Also adrenalin stimulated *Helix* hearts, and extract of heart from cattle stimulated *Aplysia*.—F. Wessely and G. H. Moser: Synthesis and constitution of scutellarine.—L. Kober: Structural elements of the Apennines in Calabria and Sicily and of the Atlas in Algeria.—H. Gräven: A method for determining uranium, thorium and potassium in hand specimens of minerals and rocks.

May 15.—W. Knapp: The action of *o*-phthalylchloride on the methyl ethers of *p*-bromo-phenol and of *p*-bromo-thio-phenol.—C. Mayr and G. Burger: Potentiometric titration using mercurous nitrate and sodium oxalate as titration solutions.—P. Goldmark and F. Kammer: Methods for measuring the mobilities of ions in gases.—H. P. Cornelius and M. Furlani-Cornelius: The Insubric line from Tessin to the Tonale pass.—M. Radakovic: Determinants that can be made symmetrical.—F. Halla and E. Mehl: Fibrous structure of plastic sulphur.—F. Witt: The distribution of radium emanation between the liquid and solid phases of water and of benzol. Radium emanation is occluded not absorbed by ice.—J. Hoffmann: Coloration of glasses and some minerals by β- and γ-rays. Lead glasses are recognisable by characteristic fluorescence in ultra-violet light. Neutral atoms of the alkalis, also Pb, Ba and Zn may be causes of colour.—K. Marbach: The disturbance of the equilibrium of radium B and radium C in preparations freed from traces of emanation.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 16, No. 4, April 15).—Jan Schilt: The velocities of *B*-type stars.—C. R. Burnham: Genetical and cytological studies of semisterility and related phenomena in maize. Two new types of semisterile maize have been found and examined.—H. J. Muller and L. M. Mott-Smith: Evidence that natural radioactivity is inadequate to explain the frequency of 'natural' mutations. As measure of the intensity of radiation, the ionisation per cubic centimetre per second in air was used. The mutation rate in untreated *Drosophila* is about 1 : 150 of the highest rate artificially induced, whereas the intensities of natural and artificial radiations are in the ratio of 1 : 200,000. Thus the natural mutation frequency is at least 1300 times as high as it would be if caused by radiation normally received by the flies.—J. H. Hildebrand and J. M. Carter: The influence on the ideal solution laws of the distribution of polarity within the molecule. Using the data for benzene with nitrobenzene, the three dinitrobenzenes and 1-3-5 trinitrobenzene, it appears that it is the number and polarity of the substituent groups rather than the electric moment of the whole molecule which determine deviations from Raoult's law.—Wilder D. Bancroft and C. E. Barnett: Pentavalent nitrogen in organic compounds. The conditions under which organic nitrogen will add on hydrogen chloride stoichiometrically are brought together in eight generalisations.—Wilder D. Bancroft and Herbert L. Davis: The tautomeric form of malic acid. Changes in optical rotation and anomalous dispersion of *l*-malic acid in solution are due to two tautomeric forms in dynamic equilibrium; the lævo-acid is ordinary malic acid and the dextro-acid contains an ethylene oxide oxygen linkage and two hydroxyl groups attached to the same carbon.—J. L. Walsh: On the overconvergence of sequences of polynomials of best approximation.—H. S. Vandiver: Summary of results and proofs on Fermat's last theorem (fifth paper).—G. A. Miller: Groups generated by two given groups.—A. Adrian Albert: (1) On the structure of pure Riemann matrices with non-commutative multiplication algebras.—(2) On direct products, cyclic division algebras, and pure Riemann matrices.—Joseph W. Ellis: The near infra-red absorption spectrum of calcite. Three new bands with wave-lengths shorter than 1·7μ are reported and doublet structure has been observed in most of the bands in this region.—Richard C. Tolman: The effect of the annihilation of matter on the wave-length of light from the nebulæ. It is assumed that there is a general

transformation of matter taking place throughout the universe at a rate necessary to account for the radiation from stellar objects ; a non-static line element for the universe is derived mathematically and its implications examined.

Official Publications Received.

BRITISH.

Commonwealth Bureau of Census and Statistics, Canberra. Official Year Book of the Commonwealth of Australia. No. 22, 1929. Prepared under Instructions from the Minister of State for Home Affairs by Chas. H. Wickens. Editor: John Stonham. Pp. xxxii+1074. (Melbourne: H. J. Green.) 5s.

University College of Wales, Aberystwyth: Welsh Plant Breeding Station. Grazing and Manurial Trials on Permanent and Prepared Swards: and Factors affecting Seed Production of Red Clover. (Series H, No. 11, Seasons 1921–1929.) Pp. iii+91. (Aberystwyth.) 3s. 6d.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 68, No. 403, July. Pp. 801-944+xxxii. (London: E. and F. N. Spon, Ltd.) 10s. 6d.

Cambridge Observatory. Annual Report of the Observatory Syndicate, 1929 May 19-1930 May 18. Pp. 3. (Cambridge.)

Proceedings of the Malacological Society of London. Edited by R. Winckworth. Vol. 19, Part 2, July. Pp. 59-82. (London: Dulau and Co.) 10s. net.

The National Physical Laboratory. Report on the Physics Department for the Year 1929. (From the Report of the Laboratory for the Year 1929.) Pp. 58-94. (London: H.M. Stationery Office.) 2s. net.

Leeds University: Department of Pathology and Bacteriology. Annual Report by Prof. Matthew J. Stewart and Prof. J. W. McLeod; with Abstract Report on Experimental Pathology and Cancer Research by Prof. R. D. Passey. Pp. 15. (Leeds.)

Research Council of Alberta. Report No. 23: Preliminary Soil Survey adjacent to the Peace River, Alberta, West of Dunvegan. Pp. iv+33+6 plates. (Edmonton: W. D. McLean.) 50 cents.

Report of the Director of the Royal Observatory, Hong Kong, for the Year 1929. Pp. 16. (Hong Kong.)

The North of Scotland College of Agriculture. Guide to Experiments and Demonstration Plots at Craibstone, 1930. Pp. xii+58. (Aberdeen.)

Transactions of the Royal Society of Edinburgh. Vol. 56, Part 3, No. 24: The Carboniferous Sediments of Kintyre. By Dr. William J. M'Callien and Robert B. Anderson. Pp. 599-619+1 plate. (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.) 3s. 6d.

Transactions of the Optical Society. Vol. 31, No. 2, 1929-30. Pp. v+53-112. (London.) 10s.

University of Reading: the National Institute for Research in Dairying. Annual Report for the Year ending 31st July 1929. Pp. 87. (Reading.)

Department of Scientific and Industrial Research. Building Science Abstracts. Vol. 3 (New Series), No. 6, June. Abstracts Nos. 1122-1290. Pp. 197-235. (London: H.M. Stationery Office.) 9d. net.

Indian Journal of Physics, Vol. 4, Part 7, and Proceedings of the Indian Association for the Cultivation of Science, Vol. 13, Part 7. Conducted by Sir C. V. Raman. Pp. 541-589. (Calcutta.) 12 annas; 1s.

Air Ministry: Aeronautical Research Committee. Reports and Memoranda. No. 1290 (Ae. 439): The Equations of Motion of a Viscous Fluid in Tensor Notation. By C. N. H. Lock. (T. 2798, revd.) Pp. 28. 1s. 6d. net. No. 1306 (Ae. 446): Lateral Stability Calculations for the Bristol Fighter Aeroplane. By Dr. A. S. Halliday and C. H. Burge. (T. 2905.) Pp. 13+17 plates. 1s. net. (London: H.M. Stationery Office.)

The Scientific Proceedings of the Royal Dublin Society. Vol. 19 (N.S.), No. 40: The Nitration of substituted Diaryl Ethers:—Phenyl-p-tolyl Ether. By Joseph Reilly, P. J. Drumm and T. Gray. Pp. 461-465. (Dublin: Hodges, Figgis and Co.; London: Williams and Norgate, Ltd.) 6d.

FOREIGN.

R. Osservatorio Astrofisico di Catania. Annuario 1930. Pp. iv+50. (Catania.)

Koninklijk Nederlandsch Meteorologisch Instituut. No. 106a; Ergebnisse aerologischer Beobachtungen, 17, 1928. Pp. iv+41. 2.50 f. No. 108: Seismische Registrierungen in De Bilt, 15, 1927. Pp. ix+63. 1.00 f. (Amsterdam: Seyffardt's Boekhandel.)

Ministerio de Agricultura de la Nación, República Argentina. Memoria: correspondiente al ejercicio de 1928 presentada al Congreso de la Nación por el Ministro de Agricultura, Doctor Juan B. Fleitas. Pp. 105. (Buenos Aires.)

U.S. Department of Agriculture. Leaflet No. 61: English Sparrow Control. By E. R. Kalmbach. Pp. 8. 5 cents. Circular No. 117: The Asiatic Beetle, a Serious Pest in Lawns. By H. C. Hallock. Pp. 8. 5 cents. Circular No. 118: Calculating Waterfowl Abundance on the Basis of Banding Returns. By Frederick C. Lincoln. Pp. 4. 5 cents. (Washington, D.C.: Government Printing Office.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 82. Leeches (Hirudinea) from China, with Descriptions of New Species. By J. Percy Moore. Pp. 169-192+plates 7-8. (Philadelphia.)

Bulletin of the National Research Council. No. 75: Weather and Health; a Study of Daily Mortality in New York City. Prepared under the direction and with the advice of the Committee on the Atmosphere and Man, Division of Biology and Agriculture, National Research Council, by Ellsworth Huntington. Pp. 161. (Washington, D.C.: National Academy of Sciences.) 2 dollars.

Reprint and Circular Series of the National Research Council. No. 92: Report of the Committee on Sedimentation, 1928–1929. Pp. ii+122. 1 dollar. No. 93: Guide Leaflet for Amateur Archaeologists. Pp. 11. 25 cents. (Washington, D.C.: National Academy of Sciences.)

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 4, No. 6, June. (R.P. Nos. 176-182.) Pp. 737-874. (Washington, D.C.: Government Printing Office.) 40 cents.

Smithsonian Institution: United States National Museum. Bulletin 76: Asteroidea of the North Pacific and adjacent Waters. By Prof. Walter Kenrick Fisher. Part 3: Forcipulata (concluded). Pp. iii+356+93 plates. (Washington, D.C.: Government Printing Office.) 1.40 dollars.

United States Department of the Interior: Geological Survey. Bulletin 813-B: The Chakachamna-Stony Region, Alaska. By Stephen R. Capps. (Mineral Resources of Alaska, 1928.) Pp. ii+97-123+2 plates. 10 cents. Water-Supply Paper 618: The Green River and its Utilization. By Ralf R. Woolley. Pp. xv+456+35 plates. 1.25 dollars. Water-Supply Paper 621: Surface Water Supply of the United States, 1926. Part 1: North Atlantic Slope Drainage Basins. Pp. vi+274. 30 cents. (Washington, D.C.: Government Printing Office.)

Bulletin of the Earthquake Research Institute, Tokyo Imperial University. Vol. 8, Part 2, June. Pp. 91-319+11 plates. (Tokyo: Iwanami Shoten.) 2.70 yen.

Journal of the College of Agriculture, Imperial University of Tokyo. Vol. 10, No. 5, March 31st. Pp. 329-388. (Tokyo: Maruzen Co., Ltd.) 2.00 yen.

Statens Meteorologisk-Hydrografiska Anstalt. Årsbok, 9, 1927. iv, Meteorologiska iakttagelser i Sverige, Band 69. Pp. x+177. 7.00 kr. Årsbok, 11, 1929. ii: Nederbörden i Sverige. Pp. 160. 5.00 kr. (Stockholm.)

Jahresbericht der Hamburger Sternwarte in Bergedorf für das Jahr 1929. Pp. 30+8 Tafeln. (Bergedorf.)

CATALOGUE.

South and Central America: a Catalogue of Books, Pamphlets, Engravings, Maps and Original Drawings relating to Latin America with the British Colonies of Falkland Is., Honduras and Guiana. (Catalogue 528.) Pp. 80. (London: Francis Edwards, Ltd.)

Diary of Societies.

CONGRESS.

AUGUST 7 TO 15.

INTERNATIONAL HORTICULTURAL CONGRESS (in London).—*Papers to be read on Aug.* 8, 11, *and* 13:—

Prof. Priestley: Vegetative Reproduction from the Standpoint of Plant Anatomy.
Dr. Van der Lek: Anatomical Structure of Woody Plants in Relation to Vegetative Propagation.
Dr. R. Salaman: Vegetative Mutations.
Prof. E. Baur: Production of Mutations by External Stimulus.
Dr. F. E. Denny: The Excitation of Dormant Buds under External Influence.
John Innes Horticultural Institution: Graft Hybrids.
John Innes Horticultural Institution: Vegetative Production of Polyploids.
John Innes Horticultural Institution: Sterility.
G. E. Yerkes: Raising Root Stocks from Seed.
Dr. C. G. Dahl: Root Stocks from Seeds of known Parents.
Dr. R. J. D. Graham and L. B. Stewart: Special Methods of Practical Utility in the Vegetative Propagation of Plants.
Miss Mary E. Reid: The Influence of the Nutrient Conditions of Seeds and Cuttings upon the Development of Roots.
Prof. P. W. Zimmerman: Factors influencing Root Growth of Cuttings.
Dr. A. B. Stout: The Inter-relations between Vegetative Propagation and Seed Reproduction.
N. Esbjerg: Varieties grown on own Roots.
Prof. N. I. Vavilov: The Wild Progenitors of Fruit Trees in Turkestan and in the Caucasus.
R. G. Hatton: The Development of a Research Programme around the 'Build Up' of a Fruit Plant.
Dr. H. Faes: Vine Propagation.
L. Ravaz: The Influence of American Stock on French Vines.
W. G. Freeman: Vegetative Propagation of Cacao and the West Indies Citrus.
Prof. T. Tanaka and Y. Tanaka: Propagation of Citrus Fruits in Japan.
Prof. H. J. Webber: Studies on Rootstock Reactions in Citrus.
Dr. F. F. Halma: The Propagation of Citrus by Cuttings.
Dr. H. P. Traub: The Ripening Process in Fruits, with special reference to the Fig and the Grapefruit.
Prof. B. T. P. Barker: The Fruit Tree Complex in Relation to Environment: Some current Investigations at Long Ashton.
Prof. N. E. Hansen: Fruit Stocks where Mercury Freezes.
Prof. E. C. Auchter: American Experiments in Propagating Deciduous Fruit Trees by Stem and Root Cuttings.
W. T. Macoun: National Tastes in Apples.
Dr. L. Filewicz: The Frost Injuries of Fruit Trees in Poland in 1928–29, with special reference to the Influence of the Stock and Scion upon the Resistance of the Apple-trees against the Frost.
Dr. P. J. S. Cramer: Rubber Budding.
W. A. Orton: Propagation in Tropical Countries.
Prof. P. Work: Some Scientific Problems in connexion with Vegetable Seeds.
Eng. G. Jacobsen: Electric Heating of Soil in Hotbeds and Hothouses.
Prof. B. Fedtschenko: The Horticultural Work of Russian Botanical Gardens.
Prof. C. Regel: The Botanical Garden of the Present Day.
H. J. Rumsey: Horticultural Progress in Australia.