NATURE

SATURDAY, AUGUST 23, 1924.

CONTENTS.

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. 2860, VOL. 114]

Problems of the Coal Mining Industry.

WHEN Mr. Lloyd George was in power about 1919, various proposals relating to the mining industry were put forward by him; and it may be remembered that they were rejected successively by all the interested parties. The essential points of these proposals have now been re-stated in a report entitled "Coal and Power,"[1] just issued as a slender volume. We are not concerned here with the political aspect of Mr. Lloyd George's suggestions, but it may be worth while to consider the technical and economic sides. As regards coal mining, the suggestions fall into two main groups, namely :

1. The acquisition by the State of mineral royalties. (Incidentally it may be noted that the authors of the report have not decided how far they should go in this respect; in the introduction, the summary of the proposals suggests "purchase of all minerals and royalties by the State," whereas in the body of the report we find the following sentence : "Further, it is to be considered whether the State, when acquiring its coal resources, should at the same time acquire all the mineral resources of the country." Surely the author or authors of this report ought first to have made up their minds as to what they really want to do.)

2. The formation of consultative bodies consisting of miners and mine owners, who are apparently to discuss the problems of the industry. (Throughout, the author or authors of the report overlook the importance of the mining engineer and the mine manager; whenever the technical staff is casually referred to, it is looked upon as part and parcel of the mine ownership; any discussion of the future of the industry that fails to recognise that there are at least three separate bodies to be considered, namely, miners, mine owners, and technologists, must necessarily be imperfect.)

The report examines at some length the reasons for the present disturbed state of the industry, but fails to recognise one of the most serious. A small but active section of the miners' leaders appears to have determined to get the whole of the coal mining industry into its own hands, an operation which these men designate as nationalisation, and apparently they have come to the conclusion that the best way of attaining their object would be to wreck the industry as it now exists.

It is pointed out quite clearly in the report that nationalisation of the coal resources is a matter which can legitimately be undertaken by the State, whereas the nationalisation of the industry cannot. It is well known that there are two forms of mineral ownership. In one, which is adopted by most Conti-

[1] Coal and Power: the Report of an Enquiry presided over by the Rt. Hon. D. Lloyd George. Pp. xiv+139+16 plates. (London: Hodder and Stoughton, 1924.) 1s. net.

nental nations, the State owns the minerals and leases them to the mine owners; in Great Britain and the United States, the minerals are the property of individuals who may deal with these minerals as they see fit. Both systems operate and operate successfully, but it is a curious fact that the two countries where the minerals are privately owned are those where mining has reached its highest pitch of development, and, incidentally, where the miners' wages are the highest. The present report proposes to purchase the coal royalties, and shows a series of advantages which it claims would result from such change of ownership. Curiously enough, not a word is said about the fact that the Crown already owns quite important mineral areas; for example, it owns all the under-sea coal, and it owns practically all the coal in the Forest of Dean Coalfield. This State-owned coal, however, is leased and dealt with in precisely the same way as the privately-owned coal in the country, and none of the advantages which are claimed for the State ownership of minerals are apparent in the quite considerable tracts of State-owned coal already in existence. Incidentally it may be pointed out that wages in the Forest of Dean coalfield are about the lowest in the whole country.

No reference is made in this report to the very important lessons to be learnt from the United States. In the United States the minerals were originally the property of the State, and at first the Federal Government attempted to lease its minerals, but after something like half a century of experimenting on these lines it was found far better to get the mineral lands as soon as possible into private hands. The author or authors of this report might study with advantage the evidence given by Dr. R. W. Raymond before the 1889 Royal Commission on Mining Royalties upon the methods adopted in the United States. One sentence alone from his evidence may be repeated here: "I have been accustomed to say at home over and over again that it would be better for the United States to-morrow to give up all its mineral land and deliberately convey it to individuals for nothing in order to have somebody own it instead of the Government." In the face of such an emphatic pronouncement, based upon experience, it would surely appear to be a risky experiment to desire to revert in Great Britain to the method of State ownership of royalties. It may be freely admitted that the method is quite workable, seeing that it is in operation in most Continental countries, but there is no evidence that any advantage would accrue from it.

Another point which is emphasised in the report before us is the possibility, if all the minerals were State-owned, of doing away with barriers. Any experienced coal miner knows that some barriers are indispensable for the safety of the mines; the report also overlooks the fact that power to have unnecessary barriers removed is given under the Mines (Working Facilities and Support) Act 1923, but so far not a single application for the removal of barriers under this Act has yet been made, which shows that the evil, if it exists at all, is certainly not a very pressing one.

The method suggested for the purchase of royalties is to divide all minerals into three classes, those which are known to exist and are actually under lease, those the existence of which is highly probable although they are not actually under lease, and those as to the existence of which nothing definite is known. It is proposed to deal forthwith only with the first named of these, and that they should be purchased for bonds issued by the Treasury, bearing interest, the rate of which the report conveniently omits to give. It is stated, though no basis of calculation is given, that the actual value of these minerals is approximately 70,000,000*l*. The total known coal reserves of Great Britain have been estimated at something like 150,000 million tons; assuming an average coal output of 300 million tons, the coal reserves would give a life of 500 years. For actuarial purposes this may be looked upon as a perpetuity, and the calculation in this way simplified. The amount of royalties paid on coal in 1923 was 6,300,000*l*., so that unless royalty owners are to be deprived of a portion of their income, these bonds ought to bear 9 per cent. interest. These points are not considered in the report.

The second suggestion, which again is by no means fully worked out, is to appoint a series of bodies which are apparently to take a sort of paternal consultative interest in the mining industry. It is proposed to have three bodies, a National Mining Council to deal with the industry as a whole, District Boards for dealing with questions in each individual district, and Pit Committees to be "established in connexion with every pit, to consist of equal numbers representing the management and the workers." The report does not make it clear whether "pit" committee is meant or not. There are individual colliery companies having a dozen different pits; is it suggested that there shall be such a committee for each one of these pits? The idea of pit committees was decisively rejected by both the miners and the mine owners, and rightly so. The first essential for the safe and economic administration of a colliery is strict discipline throughout the pit, and it is obvious that there would be an end of such discipline if every petty question that arose had to be referred to a pit committee, while practical men do not need to be told that, in everyday colliery working, problems arise which must be dealt with on the spot and cannot be left to stand over

for discussion in a fortnight's time by the pit committee. District boards would probably do no harm, and a National Mining Council would probably be quite useful. Indeed, something approximating to this already exists in the Advisory Committee of the Mines Department.

A detailed discussion of all the statements in this report would demand far more space than is here available; the reader not versed in colliery matters should, however, be warned not to take all that he finds here as gospel truth, an unfairly coloured picture being presented in many cases, Thus to take one example, a number of photographs of miners' houses are shown, obviously with the intention of exciting the reader's sympathy. Three of these are of a block of cottages at Leadgate in Co. Durham. As a matter of fact, these cottages are now being pulled down by the colliery company which owns them in order to be replaced by more modern accommodation; surely the writer of the report ought to have known this fact, and if he knew it he ought surely to have stated it! It is difficult to understand how any one who knows the miner at all can write such a sentence as this: "Habituated with the conditions he (the miner) is not impressed with the imminence of danger, but he is aware of it; it is at the back of his mind always and affects his outlook on life." The miner rarely thinks of danger when he goes to his daily work, and would probably feel deeply insulted if any one suggested to him that he did. A couple of Durham pitmen who had been called up to London to give evidence in connexion with a mining case were heard on their return to be congratulating each other on being once again safe down the pit and away from the dangers of the London streets, and this represents the true attitude of the miner towards his daily occupation. As a matter of fact, their estimate of comparative danger was not really so far off the mark, seeing that there were *two-and-a-half times* as many fatal accidents (in 1922) in the streets as there were in the collieries of Great Britain. Great play is usually made in the discussion of coal mining, especially by those who are ignorant of the subject, with the dangers supposed to attend this work. It is unquestionably one of the more dangerous occupations, but its dangers are immensely exaggerated, and it may be hoped that the above simple statement of fact may help to put the problem in its proper perspective.

It need scarcely be said that there is only one real remedy for the difficulties with which the coal industry is struggling to-day, and that one, being unpalatable, as many salutary remedies are, is never mentioned in the report. It is summed up in the two words "MORE WORK."

H. LOUIS.

Theories of Growth and Senescence.

The Chemical Basis of Growth and Senescence. By Prof. T. Brailsford Robertson. (Monographs on Experimental Biology.) Pp. viii + 389. (Philadelphia and London: J. B. Lippincott Co., 1923.) 12*s.* 6*d.* net.

THE physicist who theorises is more fortunate than the biologist. He may elaborate theoretical considerations for the whole of his life and still be talking sense at the end of it. It is hard for the biologist to theorise for five minutes without talking nonsense. Yet biologists, in spite of all the warnings of the past, find the theoretical impulse irresistible, and sometimes it is useful for them to give way to it. Not that their theories are likely to be true, but that they usually raise such acute opposition on the part of other biologists that the others devise experiments to refute them, and much valuable information is obtained. Not all theories have this salutary effect. Some act as intellectual soporifics providing attractive names, the frequent repetition of which hypnotises the hearers and stops all further inquiry. Of all the words that possess this "virtus dormitiva," there has been none greater than Weismann's "germ plasm." The "germ plasm," so far as we understand it, is a hypothetical substance with magical properties, which exists in living cells and enables them to divide. Some of it is infinitely divisible, and the possessors of this sort are germ cells; some of it resembles ordinary matter in being finitely divisible, and cells that possess this sort are somatic cells. Perhaps this statement is erroneous and the theory is not quite so bad really, but if so the difference is too subtle to have been grasped by its adherents or opponents.

Prof. Robertson's own theories are of the beneficent type just mentioned, but he has the misfortune to be haunted by the germ plasm, and at times the incubus is demoralising. The main theory which he advocates in this book is definite and capable of being put to experimental test. If it does not agree with all the facts, that is not surprising in the present state of knowledge. We may legitimately applaud Prof. Robertson for having found a theory which accounts for any of the facts, without therefore being expected to believe in it or to refrain from criticising it.

The fundamental facts on which the theory is based are, in brief, that the rate of growth of animals and plants follows a logarithmic formula that is the formula for the progress of an autocatalysed chemical reaction. Among the mammalia three growth cycles can be distinguished. Where, as in man, the cycles are definitely separated, the formulæ for each cycle show excellent agreement with the average curves of growth. In

some animals the cycles overlap and the results are therefore not so clear cut. On the assumption that growth is essentially an autocatalysed reaction, or rather that a reaction of this kind regulates its rate of progress, and assuming also that the autocatalyst concerned has certain special properties, the author proceeds to explain a large number of facts concerning differentiation of structure, regeneration, senescence, and so on. Let us first consider the significance of the growth curve itself.

The rate of growth of an organism, measured as increase in mass per unit time, first of all increases and then diminishes, giving a symmetrical S-shaped curve. This curve might be obtained either if we had an autocatalysed monomolecular reaction which came to a stop by the exhaustion of the material undergoing change, or if the reaction was reversible with both forward and backward reaction behaving as monomolecular, while the material supplying the forward reaction was maintained at a constant concentration. The second alternative is the one Prof. Robertson considers most probable, because in most organisms the supply of nutrient material for the cells is kept constant and the growth of animals certainly does not come to a stop at maturity for lack of nourishment. From the chemical point of view, there are two chief criticisms to be made to this theory. In the first place, it appears to be assumed that the reactions concerned in growth are all going on in homogeneous solution; an assumption that is not at all probable. The materials used for cell synthesis are certainly in aqueous solution, but some at least of the final products are not.

To this criticism Prof. Robertson would probably reply that whatever the nature of other chemical reactions concerned with growth, the particular one he is interested in occurs in homogeneous solution. Indeed, for the purposes of his theory he assumes that the autocatalyst itself, which must be a synthetic product, is diffusible and can pass from the cells to the body fluids, and therefore is likely to be in solution. If this be so, there is a further and more damaging argument to bring up.

All known processes of synthesis of organic cell constituents from organic food materials are processes of "condensation"; they consist in the elimination of the elements of water from between two or more molecules; and the reverse process is a hydrolysis. According to Prof. Robertson's own statement (p. 14) his autocatalysed reaction is likely to be of this type, because the only reverse reactions that could behave as monomolecular are oxidations and hydrolyses. As the animal body does not synthesise by reduction, the reactions must consist of condensation and hydrolysis respectively. On his view, however, they must go on in aqueous solution. The chief cell constituents, proteins, polysaccharides, fats and lipins, can all be shown to be unstable in the presence of water at the reaction of living tissues. The position of equilibrium is one of almost complete hydrolysis; this can be demonstrated by the action of the common hydrolysing enzymes. Therefore, cell synthesis must either take place in a non-aqueous medium, or else by some process not reproducible in the laboratory that carries a reaction away from the equilibrium position, against the thermodynamic gradient as it were. In either case the simple laws of catalysis in homogeneous solution are not applicable.

It is possible to imagine some soluble diffusible material being produced as a by-product of cell synthesis and acting as a catalyst of further synthesis; but it is almost impossible to see how such a substance could control the rate of growth in the way that Prof. Robertson supposes. What plausibility his hypothesis possesses at first sight, vanishes when any attempt is made to describe in detail from the physical point of view how an autocatalyst of growth would operate.

The autocatalyst of growth is supposed to be present in the body fluids, and its concentration there is supposed, among other factors, to regulate the rate of growth, accelerating it at first, and later, as it accumulates, bringing growth to an end. If this be the case, then blood from an adult animal ought to stop the growth of the tissues of a growing animal, and repeated bleeding of an adult animal with replacement of the blood by washed blood corpuscles in a suitable artificial medium might be expected to start growth again. Recent experiments by Carrel and Ebeling (*C.R. Soc. Biol.*, 1924, vol. 90, p. 170) suggest that the blood of young and of old animals differs in some such way, though the results are not exactly what Prof. Robertson's theory would lead us to expect. Moreover, if the theory is correct, it must be supposed that the placental membranes alone among tissues are impermeable to the autocatalyst, otherwise the mammalian embryo would never grow.

The evidence that the autocatalyst is soluble and diffusible is based, not upon any evidence from the higher animals, but solely on studies of infusoria, bacteria, and yeasts. In cultivating these organisms, it has frequently been observed that multiplication is stimulated by some dissolved substance which results from the presence of other organisms. (It is a pity that in this connexion Prof. Robertson makes no reference to the important work of Dr. E. J. Allen on the growth of marine algæ (Jour. Marine Biol. Assoc., vol. 10, 1914, p. 417).) The growth-stimulating substance appears to be common to several different types

of organism, but it is rather rash to assume on this account alone that an exact parallel can be drawn between the culture medium in which infusion organisms live and the body fluids of the higher animals.

There is no direct evidence on this point as to the higher animals, but some indirect evidence that goes strongly against this assumption. In their powers of chemical synthesis, living things seem to fall into three well-marked groups—the green plants, the "infusion organisms," and the higher animals. At the one extreme the green plants can synthesise all their body material from inorganic sources; at the other the higher animals, who have specialised in a different direction, have very largely delegated the business of synthetic organic chemistry to humbler creatures on whom they feed. The mammalia, for example, cannot synthesise the benzene or indole ring, but have to get them ready made in their food. The infusion organisms, such as yeasts, ciliate protozoa, and probably bacteria, moulds and other saprophytic plants, occupy an intermediate position rather nearer to the green plants than to the higher animals. They cannot live without ready formed organic material, as the green plants can, but they only need comparatively simple carbon compounds. Ciliate protozoa, as Prof. R. A. Peters has shown, besides inorganic salts, need only ammonia and an organic substance, such as lactic acid or glycerol, with a chain of three carbon atoms (*Jour. Physiol.*, vol. 55, 1921, p. 1). When the chemical processes underlying processes of growth are so different in the two groups, sweeping analogies appear to be out of place.

Prof. Robertson embodies in his theory certain subsidiary hypotheses, namely: (1) That growth is regulated by the cell nucleus in which the autocatalyst is found; (2) that it is only during mitosis that the autocatalyst escapes into the cytoplasm and body fluids; (3) that, in any given cell, division is regulated by the relative volumes of nucleus and cytoplasm; (4) that in the life-history of somatic cells there is a progressive change, a process of senescence, whereby the nuclear-cytoplasmic ratio at which division can take place gets smaller and smaller. The last change is supposed to be irreversible, and it is there that the trail of the germ plasm becomes evident. These hypotheses are, to say the least, not very firmly grounded on fact, and it is doubtful whether they increase or diminish the plausibility of the theory as a whole. They do, however, enable the author to give a detailed, if fanciful, explanation of the process of senescence and of phenomena such as the growth of cancer cells.

Leaving these questions aside, let us consider how the author deals with the facts of regeneration of lost or injured parts, for they are likely to prove crucial for any theory which partakes of Weismannism. Although there is considerable discussion about regeneration in the book, it is not easy to find a precise statement as to how the process is supposed to come about, but we get some information on p. 264. The view apparently is that in the adult organism cell division stops because of the accumulation of autocatalyst, but the stoppage is only relative to a given concentration of nutrient materials, so that anything which raises the concentration of nutrient material may start cell division going again. Injury is supposed, by removing competing cells, to cause a local increase of nutrient material, which acts as the stimulus for proliferation. Once the cells have started dividing, the rest of the process is explained in terms of nuclear-cytoplasmic ratios.

This part of the question need not concern us at present, except to point out that regeneration must, on Prof. Robertson's theory, be an irreversible process of senescence and therefore not capable of indefinite repetition. The really startling part of the theory is the suggestion that it is a local increase of nutrient material which first stimulates growth after injury. It must be confessed that no alternative theory is forthcoming, but one is not compelled to accept a false theory because there is no other to put in its place. When a lizard drops its tail there cannot be more than a momentary increase in the nutrient materials in the blood and body fluids, and what increase there may be will be quickly equalised all over the body. Suppose there is an increase that provides the stimulus to cell division, why does growth take place only at the stump and not throughout the whole of the animal?

The regeneration of a lost part is not the result of simple division of the functional cells *in situ*, but is the work of special cells which are in appearance embryonic. These cells appear to arise by de-differentiation of some of the cells of the region of growth. Thus it is found that the lizard's tail is regenerated by embryonic cells in the stump which persist at the growing end, until a tail which is functionally equivalent to the original has been produced. But structurally the new tail is not altogether similar. Bone is not regenerated, but cartilage takes its place and there are no new nerve cells. The new tail is innervated by nerve fibres growing out from some of the intact segments of the spinal cord. (See Dr. C. Powell White, British Assoc. Report, 1915, p. 472; more detailed information is in course of publication by the same author.) Another fact to be kept in mind is that many of the invertebrates can regenerate lost parts an indefinite number of times.

These facts show that the ordinary progression from youth to age can be reversed under certain conditions by some of the somatic cells. Immortality and rejuvenation are not a prerogative of the germ cells only. Somatic cells can, in many cases, take on the functions of germ cells by giving up their special function and reverting to a younger type. This fact has been notorious among the green plants, but it is also evident among the animals, even among the vertebrates. Any remnant of the germ plasm theory, however attenuated, is directly contradicted by these facts. One seems to be driven to take up some sort of position akin to Prof. C. M. Child's, who considers growth, senescence, and rejuvenescence in terms of the metabolic activity of the cells and not in terms of their visible structure or of hypothetical invisible components. One of the defects of Prof. Robertson's book is that he never once mentions Child's theory though referring several times to Child's experiments. In politics it may be often advisable to treat opponents with silent contempt, but men of science are expected to demonstrate the falsity of other theories before establishing their own.

Unworkable as Prof. Robertson's theory is in its present state, it has the merit of emphasising certain important facts which have got to be explained somehow or other. Apart from germ plasm complications, which are really extraneous to the main part of his views, the definiteness of the theory that makes it possible to subject it to experimental test is a great merit.

There is one final point of criticism that is perhaps worth making, though it concerns something outside the author's main line of argument. In the final chapter, in which general questions of evolution are discussed, the statement that variation always takes place by loss of characters reappears once again. It is quite true that under domestication the vast majority of heritable variations that have been observed, both in animals and plants, consist of the loss of a Mendelian factor. But it is also true that the conditions of domestication are physiologically peculiar and that the observed variations do not resemble the type of difference that normally distinguishes wild species from one another. Finally, there are a few cases among domestic animals that cannot be attributed to any cause other than the gain of a Mendelian factor: the most familiar of these are the White Leghorn plumage, and the Rose and Pea Comb among fowls. These are all dominant to the wild type, which in this species can be identified. That variation by gain of Mendelian factors occurs but rarely is no reason for denying its existence.

A. D. R.

Rockets to reach Planetary Space.

Die Rakete zu den Planetenräumen. Von Hermann Oberth. Pp. 92+2 Tafeln. (München und Berlin: R. Oldenbourg, 1923.) 1*s.* 6*d.*

THE prospect of propelling a body from our earth to one of the heavenly bodies, notably the moon, has excited certain types of individuals for some time, and many romances have been built up round the idea. Scientific attention has been given to the matter in recent years, and in particular Prof. Goddard, of Clark University, in the United States, has examined the question theoretically and experimentally. His plan is to send a rocket to the moon, more or less as suggested by Jules Verne, with the important difference that the rocket is not to be left to the mercies of air resistance and gravitational forces, but is to be propelled continuously by means of firing successive charges of smokeless nitrocellulose. Herr Oberth claims to have obtained the results given in the present volume quite independently of Prof. Goddard. He says that he commenced working at the problem in 1907, and that the main ideas were evolved in 1909: the calculations and proposals of this book were made during the years 1920–22.

Herr Oberth is more ambitious than Prof. Goddard: his object is to obtain sufficient financial support to be able to send off a rocket large enough to hold human beings. For fuel he suggests liquid hydrogen and a mixture of water and alcohol, the liberated gases escaping through small holes at the back of the rocket, and thus forcing the rocket forwards. He calculates that an initial speed of 11 km./sec. would suffice for getting out of the earth's field of gravitation. The calculations are simplified by introducing the assumption that while the rocket is still in the earth's atmosphere, the fuel is used at such a rate as to give at each instant what is practically the "limiting velocity" at the instant.

The author discusses the theoretical as well as the chemical, physical, and even physiological aspects of such a venture. He examines the economic possibilities, but he does not appear to be very sanguine about his scheme being carried out. He estimates that a rocket for two persons would weigh 400 tons, would need 25 tons of alcohol and 4 tons of liquid hydrogen, and would require an initial outlay of 50,000*l.* on the basis of pre-War prices.

A voyage to the moon would be an attractive trip to many adventurous spirits; and in these days of unprecedented achievements one cannot venture to suggest that even Herr Oberth's ambitious scheme may not be realised before the human race is extinct.

S. B.

Our Bookshelf.

Handbuch der Zoologie: eine Naturgeschichte der Stämme des Tierreiches. Begründet von Prof. Dr. Willy Kükenthal. Herausgegeben von Dr. Thilo Krumbach. Band 1: Protozoa, Porifera, Coelenterata, Mesozoa. Lieferung 2. Pp. 193-416. 10.50 marks. Lieferung 3. Pp. 417-512. 4.50 marks. (Berlin und Leipzig: Walther de Gruyter und Co., 1923–1924.)

PROF. M. HARTMANN, who is responsible for the account of the Sporozoa, has separated the Amœbosporidia (Neosporidia)—with its two subclasses Cnidosporidia and Acnidosporidia—as one of the six main classes of Protozoa, so that the class Sporozoa now includes only the Gregarinida, Coccidia, and Hæmosporidia. The morphology and life history of the principal members of these orders are carefully described, an outline classification showing the position of the chief genera is given, and a list of the more important memoirs on the subject is appended. The value of the many excellent figures would have been enhanced if the magnifications had been indicated; without these the student is apt to form an exaggerated idea of the size of many of these organisms.

The Ciliophora and the Suctoria are described by Prof. L. Rhumbler.

Prof. E. Hentschel contributes the chapter on Porifera, treated in five orders—Calcarea, Triaxonida (Hexactinellida), Tetraxonida, Cornacuspongia, and Dendroceratida. To compress the account of this large phylum into 100 pages necessitates strict selection of the material available, and no two authors would agree as to the matters to be included, but we would suggest that in the account of reproduction, reference should have been made to the observations of Dendy and Gatenby on the origin of oogonia from collar cells in Grantia, and to Gatenby's account of the peculiar method of transportation of the sperm to the egg.

The third Lieferung is devoted to accounts of the Hydroida and Trachylina by Dr. Hj. Broch and of the Siphonophora (part only) by Dr. Fanny Moser. Dr. Broch gives two maps showing respectively the distribution of some of the marine hydroids and of the Trachylina and freshwater medusæ. The occurrence of Limnocnida in India is not noted here or in the text, though reference is given in the literature list to Annandale's papers on this medusa.

The "Handbuch" is trustworthy, clear, and orderly in its method, and is adequately illustrated with good figures. It provides sound information on the morphology, systematics, development, and ecology; histology, however, is only briefly considered.

The Brain and Golf: Some Hints for Golfers from Modern Mental Science. By C. W. Bailey; and a chapter on Theory and Practice by Bernard Darwin. Pp. xv+96. (London: Mills and Boon, Ltd., 1924.) 2*s.* 6*d.* net.

THE theories of a science often appear to students quite intelligible until it becomes necessary to express them in terms of practical problems; the question of application is always difficult no less in science than in ethics. This little book comes as a welcome relief from the wearisome mass of ill-assorted oddments frequently dignified by the name of applied psychology. It is an amusing, light-hearted account of the laws of physiology and pyschology in so far as they apply to the playing of golf. The game is treated with serious humour; the psychology is not merely appended but is used to explain, to illustrate, to vitalise, the game. The psychologist familiar with the principles and accustomed to applying them in certain fields will find them vivified by their new setting. The golfer will find reasons for many inexplicable troubles and will be taught why such and such a habit is desirable or otherwise; he will be saved much unnecessary depression if he really grasps the laws of habit as here explained, and in particular the reference to the "plateau of habit."

The writer might with advantage have invoked still further the aid of the newer psychology and discussed types of golfers as illustrated by Jung's psychological types, and the revelation that is made of the golfer's own character by his behaviour to superiors, equals, and inferiors on the links. The various "complexes" concerned with the "ego" are more evident than the writer shows, for it is in games that people usually display their fundamental characteristics. A writer of Mr. Bailey's capacity might make a fascinating study of this aspect.

The book can be heartily recommended to all intelligent golfers, to students of psychology, and above all, to those concerned with the application of psychology to education.

A Bibliography of Eugenics. By Prof. Samuel J. Holmes. (University of California Publications in Zoology, vol. 25.) Pp. iv+514. (Berkeley, Cal.: University of California Press, 1924.) 5 dollars.

THE literature of eugenics has grown in a most haphazard way. While the number of scientific journals primarily devoted to the subject is a limited one, yet the medical journals teem with papers having a eugenical bearing, and a widely scattered multitude of books and journals contain information biological, anthropological, psychological, and sociological, which the eugenist must needs consider. There has also been a great amount of popular and semi-popular writing on this subject from widely differing points of view.

It is obviously impracticable to bring an index of all this literature within the covers of one volume. Prof. Holmes has attempted the somewhat more limited task of producing a bibliography which would include all the main sources and items of eugenical literature. In doing so he has produced a volume which will be of great service, not only to students of eugenics but also to all who are concerned with the biological evolution of man. That the field is a modern one is shown by the fact that the great majority of the titles are dated later than 1900, and very few are so early as 1860.

The bibliography is arranged under about 40 different headings, ranging through such topics as heredity and evolution, genealogy, inheritance of deafness, the hereditary factor in crime, the birth rate, the racial influence of religion, the sex ratio, consanguinity, and the selective influence of war. Titles on the inheritance of feeble-mindedness occupy 12 pages of the bibliography. One would like to have seen extended

the sections on the heredity of human traits and human defects. Many additions might have been made here even without encroaching on the medical literature. But although completeness is obviously impossible, and the topics of the author's special interest are naturally emphasised, yet this work will occupy a useful place as a first book of reference on any topic connected with eugenics.

The Road-Books and Itineraries of Great Britain, 1570 to 1850: a Catalogue with an Introduction and a Bibliography. By Sir Herbert George Fordham. Pp. xvi+72. (Cambridge: At the University Press, 1924.) 7*s.* 6*d.* net.

ROAD-BOOKS and itineraries are dear to the heart of the collector, but, unlike most collectors' books, they have a wider interest, and their value to the antiquarian and the topographer is considerable. Many, however, and especially the earlier, are rare and difficult to obtain, and Sir H. G. Fordham's bibliography, which is a revised and amplified reprint of a paper published in the Transactions of the Bibliographical Society in 1916, will be of considerable assistance to those who wish to make use of the material to be found in these guide-books of our ancestors. In this catalogue, road-books are taken to include only such as set out individual roads, with distances and stages all grouped together as a book or atlas, and prepared for the use of travellers. They may vary from a mere enumeration of stages to a full descriptive text. The earliest entry is John Leland's Itinerary published in or about 1535–1543. In the later part of the sixteenth century tables of the principal British highways based on the old British mile of 1500 Roman paces, equivalent to 2428 statute yards, were associated with lists of fairs for commercial purposes. Tables of highways of a similar type were published by Charles Etienne in 1552, while in Germany the earliest would appear to be a publication of 1597, containing 187 roads on the Continent and eleven from London to various parts of England and Wales.

Principles of Electroplating and Electroforming (Electrotyping). By William Blum and George B. Hogaboom. Pp. xii+356. (London: McGraw-Hill Publishing Co., Ltd., 1924.) 20*s.* net.

THE work under notice has been written mainly to help those employed in the industry to understand and apply results which have been obtained in research laboratories. The authors have taken a leading part in the investigation of electrotyping and electroplating processes at the U.S. Bureau of Standards. They divide electrodeposition into four main fields: Electrorefining, electrowinning, electroplating, and electroforming. The last is a new word and is defined as "the production or reproduction of articles by electrodeposition." It is suggested as a substitute for the archaic word "galvanoplasty" which is still sometimes found in text-books.

The very extensive use of iron and steel for constructional purposes, and the fact that they rust when exposed to air, has led to numerous investigations as to the causes and methods of preventing corrosion. Many of the investigations were carried out during the War and the general results obtained were summarised in Circular 80 of the Bureau of Standards. It appears that of all commercial metallic coatings, zinc is much the best protector. It is very desirable that zinc plating should be applied much more extensively in industry than it is at present. Unfortunately zinc coatings have not a pleasing appearance. When a bright metallic lustre is essential, nickel is superior to any other material. This book contains a great many valuable hints and can be recommended to those technically interested in the subject.

The Growth of Civilization. By W. J. Perry. Pp. viii+224+8 maps. (London: Methuen and Co., Ltd., 1924.) 6*s.* net.

IN this volume Mr. Perry restates in a more popular and abbreviated form the arguments put forward at length in his earlier works, "The Megalithic Culture of Indonesia" and "The Children of the Sun," for the diffusion of culture from one common centre, namely Egypt. It forms a companion volume to his book on "The Origin of Magic and Religion," which indeed is essential for the complete grasp of the argument here stated, as in the latter he expounded the theory of the magical influence of gold and other substances which supplied the motive for the wanderings of the people by whom the "archaic culture" was carried to various parts of the world. This book is, however, not merely a condensation of earlier work. It embodies much evidence not previously considered, especially in the later chapters, in which he deals with the coming of the warriors by whom the archaic civilisation was overthrown in various parts of the world, and discusses the theory that traditions of royal descent from deities derive from contact with Mediterranean culture and ultimately from Egypt. Mr. Perry's statement of what is undoubtedly a difficult and highly controversial case, leaves little to be desired in point of lucidity.

Faune de France. 7: *Pycnogonides.* Par Prof. E.-L. Bouvier. (Fédération française des Sociétés de Sciences naturelles: Office central de Faunistique.) Pp. 70. (Paris: Paul Lechevalier, 1923.) 8 francs.

PROF. BOUVIER points out in his introduction that the pycnogonids of the French fauna have never been studied in systematic fashion. There are memoirs by Hoek on the species found at Roscoff, by Grube on those of S. Malo, and a recent account by Cuénot of his observations on pycnogonids at Arcachon. The author has turned to G. O. Sars' well-known monograph and to that of Dohrn for further information, and from these and from Hoek's work he has borrowed most of the figures used in the present volume. He gives an account of the external morphology, the internal anatomy, and the development and biology, and in a brief discussion of the affinities states his view that the pycnogonids are arachnids. In a short reference to the forms with five pairs of legs, *e.g.* Decalopoda, he concludes that these are primitive relatively to Colossendeis. Keys are given for the orders, families, genera, and species, and with the help of these and the clear illustrations the determination of any given specimen is fairly easy. This concise memoir will be very useful to collectors on the shores of Great Britain who have an interest in this group.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Mass Spectra of Zirconium and some other Elements.

AFTER repeated failures I have now succeeded in observing the mass rays of zirconium. Their detection is only possible under very favourable conditions with the most sensitive schumannised plates. Zirconium gives mass lines 90, 92, 94 and a doubtful one at (96), with relative intensities, very roughly, 10, 2, 4, (1) respectively. The masses of the first three can be determined with unusually high accuracy, owing to the incidental presence among them of a faint doublet 93, 95 due to CBr. There is no appearance of asymmetry in the spacing, so that the masses of the isotopes of zirconium must be very closely integral with those of bromine; that is to say, less than whole numbers by about one-tenth of a unit. The atomic weight may therefore be roughly estimated as 91·4 or 91·2, according to whether the mass number 96 is included as an isotope or not.

Successful mass spectra have been obtained with cerium (at. wt. 140·25), which indicate that it consists of a strong component 140 and a weak companion 142. Further experiments with neodymium (at. wt. 144·27) establish its principal isotopes as 142, 144, 146, with a possible (145).

Continuous work with anode mixtures not containing iodide has reduced the intensity of the iodine line sufficiently to warrant a further search for light isotopes of barium. Its principal line 138 has been obtained of great intensity, but there is no trace whatever of any mass number less than 136. There is some evidence of a faint component at 136, and, since the great intensity of the 138 line makes resolution impossible, 137 may also be present. It seems quite certain, however, that, even if both exist, they can only do so in quantity quite inadequate to account for the low value of the atomic weight (137·37) at present in use.

Incidentally, during this work I have obtained mass spectra of silicon under conditions affording satisfactory confirmation of the presence of Si^{30}, previously in some doubt. Its line is a little less intense than that of Si^{29}, in excellent agreement with Mulliken's observations on band spectra (NATURE, March 22 and April 5, pp. 423, 489).

It will be noticed that the above results are on the whole in fair agreement with the predictions made by A. S. Russell. F. W. ASTON.

Cavendish Laboratory, Cambridge,
August 8.

The Zeeman Effect in Strong Magnetic Fields.

IN a recent paper (Proc. Roy. Soc. A, vol. 105, p. 691, 1924), one of us has given an account of a method for the production of intense magnetic fields, with the limitation, however, that the field only lasts for a time of the order of 1/100th sec. We are now investigating the Zeeman effect in these intense fields. These fields allow the use of a quartz spectrograph in place of the usual large concave grating or interferometer, etc.

For the source of light, we have been using a spark produced in a special way from a large high tension condenser battery, and the intensity is sufficient for one spark to produce a spectrum photograph, while most of the emission lines remain quite sharp. The spark takes place in a coil of 5 mm. internal diameter in which the field is produced, and the spark and the current in the coil are timed to occur together.

We have so far investigated mainly the "longitudinal" Zeeman effect (observation in the direction of the lines of force) in fields of about 130,000 gauss as being technically easier than the "transverse" effect. The accompanying photograph (Fig. 1), enlarged from the original six times, shows one of the results. The lines are the first members of the principal series of doublets of ionised calcium (Ca II) and of the sharp series of doublets of aluminium. It is feared, however, that the latter may not show clearly in the reproduction, though they are quite obvious in the original. The magnetic separation is about 3 Å.U.

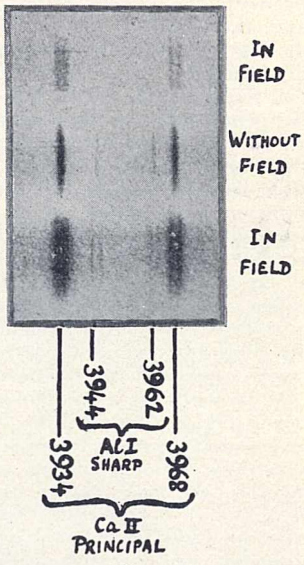

FIG. 1.

Generally speaking, the results so far obtained on lines of various elements indicate that the magnetic splitting is, except for the larger scale, identical with that obtained in ordinary cases. We have, however, observed some interesting cases of the Paschen-Back effect, partial and complete. We may mention in particular the case of the Be group 2650, given by Paschen-Götze as the p, p' group of Be, and as consisting of six extremely close lines. We have found that this group taken as a whole shows the normal Zeeman effect.

We have observed some interesting cases of lines appearing strongly in the spectrum taken in the field which do not appear in the comparison spectrum, and other cases of lines disappearing in the field. A further effect observed is that the lines produced in the field are shifted towards the red by varying amounts. It is possible that this is a kind of pressure effect, due to the production of the spark in the field, and to investigate the matter further, and for other reasons, we hope shortly to deal with absorption spectra. We have also a project for the production of still higher fields (probably up to 250,000 gauss) by cooling the coil with liquid air in order to be able to use more turns in a coil of given resistance.

P. KAPITZA.
H. W. B. SKINNER.

Cavendish Laboratory, Cambridge,
July 20.

Biology and Sociology.

I SHOULD like to direct attention to a point connected with the above topic which Dr. Malinowski does not mention in his article in NATURE, July 19.

What is of importance is not the transference of ready-made biological theories to the field of sociology, but rather that the problems of cultural evolution should be approached from the same detached and objective point of view as that of the biologist. Natural selection, for example, can be strictly said to operate

in the latter case only where competition may result in the extinction rather than the modification of whole groups, where, alone, a particular cultural element has a definite survival value in the biological sense. But it is none the less true that the process of what may be termed "bio-economic adjustment" is still everywhere proceeding, and the character of the culture-milieu of a particular society at any moment must be regarded, in the main, as a reflex of the whole complex of primary and secondary environmental factors which operate upon the group-members, in addition, usually, to a number of functionless or residual characters of historical interest, which were evolved in relation to anterior conditions.

Perhaps the most important lesson that sociology can learn from biology is the fundamental distinction between the purely *historical* problem in evolution and the question of the *machinery of variation*, a distinction which, in sociology, is unfortunately often disregarded. We desire to know, not only what has happened, but also how it happened, and why it happened only in this particular time and circumstance. It is too often tacitly assumed, especially by the "new" anthropologists, that to point out a possible derivative origin of a certain cultural element is a sufficient explanation of its existence in a particular society. The conditions which govern *assimilation* are of equal if not greater importance. To give a homely example: if Dr. Malinowski were to appear in his class-room wearing a Malayan kris, this would introduce a new cultural element into British academic life; but it is very doubtful if it would afford any research problem for the future historical sociologist.

Moreover, just as in biology the problem of variation is being most usefully attacked by concentrating upon small definite changes in organic characters, which are actually taking place now under observational conditions, rather than upon the historical background of evolution: so we must hope to make most progress in the study of cultural variation by observing and correlating small specific changes in contemporary civilisation, rather than the character of past or primitive societies. It is more useful to analyse carefully the conditions which are associated with the incidence of prohibition or divorce reform than to speculate about the origin of totemism.

To contrast the instinctive and physiological dispositions of an insect colony with the "culture" of human society does not take us very far, unless we have a clear understanding of the factors upon which cultural changes depend. This latter question cannot be discussed here, but it may be pointed out that whereas the *limiting conditions* of social changes are bio-economic, the machinery of variation is psychological. The psychological factors involved are partly rational, but mainly in the nature of specific emotional dispositions in relation to particular social facts. Dr. Malinowski's suggestion that these definite but variable ethical and æsthetic attitudes are due to the secondary modification of primary instincts does not help very much. To say, for example, that humanitarian sentiment is a secondary derivative of the parental instinct does not explain why the *average* emotional reaction of successive generations of the same society towards specific questions (*e.g.* slavery, criminal punishment) should often be so markedly different. From the point of view of cultural evolution, it is the exact character, sequence, and correlations of these specific reactions which is of principal importance.

C. W. SOAL.

Scratton Lodge, Prittlewell, Essex.

IN the article referred to by Mr. Soal, I have tried, on a parallel between an insect aggregate and human society, to trace the breach of continuity between biology and the science of human culture, as well as to establish their points of contact. I have also criticised certain illegitimate attempts at transference of methods and concepts from the study of living organisms to that of culture and social organisation, notably the society-organism simile, the theory of "herd instinct," and certain crude applications of Darwinism in sociology. In the above letter it is suggested, obviously in criticism of the last-mentioned contention of mine, that I have neglected to discuss the applicability of natural selection to the study of human culture.

It is now a commonplace for any competent sociologist that natural selection, as we know it from biology, cannot in any way operate on human individuals within the community—and this is made clear to any one who reads my above-mentioned article. Nor can the principle be applied to any struggle or competition of groups within society. (For searching criticism, see J. Novicow, "La Critique du Darwinisme sociale," Paris, 1910, and III. Abteilung, "Die allgemeine biologische Soziologie," in P. Barth's "Die Philosophie der Geschichte als Soziologie," pp. 260-437, 4th ed., 1922.)

But there remains the question: Can natural selection or Darwinism in general be applied to varieties of the human species, to races, or to entire populations, or to types of human culture taken as a whole? Here also there is no new ground to break, for the "struggle of races" (Rassenkampf) has been used, abused, and rejected as a leading principle of social science, while laws of growth, culmination, and decay of nations and cultures have been constructed and demolished more than once. Again, what could be called "the struggle of cultures," the contact, mixture, and transmission of whole types of civilisation or elements thereof, is really the fundamental principle of the "new anthropology" mentioned by the above correspondent. How far the adherents of this school will succeed in explaining everything by this principle, or in constructing a new theory of universal advance by contact of cultures, remains to be seen. At present they are clearing the ground, amassing material, and working out particular questions.

Thus the problem which Mr. Soal recommends *en passant* to the attention of anthropologists is, as a matter of fact, the fundamental problem of the science of man, inspiring all the general theories and entering into all detailed work on concrete subjects. It is, of course, recognised to be so by all anthropologists who reflect on the aims of their science. So that generalities such as that "natural selection . . . can be strictly said to operate . . . where competition may result in the extinction rather than the modification of whole groups"; and again, about "bio-economic adjustment" or about "a reflex of the whole complex of primary and secondary environmental factors which operate on all the group members," etc., will be of little use even to those who can grasp their somewhat cryptic meaning.

I think it is obvious that in this connexion biology cannot help us very much, for natural selection, as we see it at work in the world of plants and animals, cannot be applied to the study of societies. Natural selection operates on individual organisms, directly at grips with their environment, competing with other creatures who need the same food, every individual struggling by its own efforts, pursuing its own ends, and having to rely on its own anatomical and physiological endowment. A human society is not an individual organism; it possesses no anatomical or physiological equipment, it has no biological aim or needs of its own. It exists only by its own members and for their benefit. The type, the aim, and the

value of its organisation and culture must be gauged by the manner in which it ministers to the wants of the individuals which constitute it. Here then are problems so absolutely foreign to the biological theory of natural selection as to preclude any borrowing by sociology from biology.

Mr. Soal's kind exhortation to anthropology that it should become "detached and objective," and that it should give up troubling about the "character of past or primitive societies," and study "prohibition or divorce reform" instead, will no doubt be humbly and hopefully received by other anthropologists as it is by the present writer; though I fear that my experience in discussions about problems touching liquor and sex seems to show that they do not lead to an "objective or detached" frame of mind. In the attempt to follow his advice, we might realise Mr. Soal's "homely example" of an anthropologist appearing "in his class-room wearing a Malayan kris," a tendency of which he seems to suspect me. I do not think there is any hope, either, that the science of primitive man should give up studying primitive man, any more than that astronomers should give up studying stars, when advised to turn their attention to turnips and potatoes, since this "is more useful."

BRONISLAW MALINOWSKI.
Department of Ethnology,
London School of Economics,
University of London.

Solubility of Phosphates in Relation to Hydrogen Ion Concentration.

WITHIN the last few years statements have appeared in various journals giving the P_H values at which certain salts yield precipitates upon being rendered less acid. Some of these also record the lower limit of acidity at which precipitation is said to be complete. It accordingly appeared to be of interest to determine the form of the solubility curve. This was done for certain phosphates, using samples purchased as pure and washed with distilled water repeatedly to remove traces of more soluble phosphates, etc. The determinations were made at air temperature, about 10-12° C., upon solutions cleared by the centrifuge, using the cœruleo-molybdate reaction of Denigès. Nine determinations were made upon a sample of tricalcic phosphate (B.P.), between $P_H 7{\cdot}0$ and $P_H 5{\cdot}1$, hydrochloric acid being used to increase the acidity.

Over this range the solubility increased from 114 to 786 parts per million. When P_H values are taken as ordinates (the higher values being at the bottom of the paper) and concentrations as abscissæ, the nine points give a curve which at first ascends steeply and then becomes more nearly parallel to the concentration axis; thus a small change in the P_H value is accompanied by a large change in solubility. Accordingly the precise P_H value at which a precipitate is first obtained depends on the concentration of the phosphate and precipitation is never absolutely complete with the pure salt, even at $P_H 7{\cdot}0$. The phosphates of strontium and of barium give curves which are qualitatively similar. The phosphate of magnesium is more soluble 450 p.p.m. at $P_H 7{\cdot}7$, and the curve rises somewhat less sharply at the start; it reaches the value 1233 p.p.m. at $P_H 5{\cdot}8$.

$CaHPO_4$ is much more soluble than $Ca_3(PO_4)_2$, and the solubility of the latter is increased if it contain any of the former as an impurity. $CaH_4(PO_4)_2$ was found to dissolve readily, a slight deposit only being left; this does not appear to be the original salt. The reaction given by the sample used was markedly acid, $P_H 3{\cdot}6$.

The phosphates of lead and zinc were found to be highly insoluble, lead only giving phosphate equivalent to 0·97 p.p.m. of P_2O_5 at $P_H 6{\cdot}75$ and zinc 1·11 at $P_H 6{\cdot}85$, nickel follows with 11·9 at $P_H 8{\cdot}9$. The readily hydrolysed ferrous and ferric phosphates appear to have solubility minima in the acid region, and the addition of alkali to bring the solutions to neutrality results in more phosphate becoming available in solution. These relations, being of importance in studies on plant nutrition, are being worked out, and it is hoped that the results may be published in more complete form within a year.

W. R. G. ATKINS.
Marine Biological Laboratory,
Plymouth, July 16.

The Phosphide Eutectic in Cast Iron.

THE accompanying photomicrograph (Fig. 1) shows the phosphide eutectic in a grey cast iron at 5000 diameters. This shows that the constituent which appears as dark markings at ×1000, and is still commonly described as iron carbide, is actually duplex, and in fact very similar to pearlite, consisting of alternate laminæ of iron carbide and iron.

FIG. 1.—Phosphide eutectic in cast iron. ×5000.

It is recognised from the research of Stead that there would be present the three constituents of the triple eutectic, namely, iron phosphide, iron carbide, and austenite, or their transition products. Thus the presence of laminated pearlite, from the transformation of austenite, is accounted for. The pearlite thus associated structurally within the phosphide masses may conceivably be richer (it probably is, but may even be poorer) in carbon content than obtains in the normal pearlite ratio, Fe_3C 21Fe. Prof. Desch,

to whom I have shown several similar photographs, confirms the foregoing explanation. The photograph was taken at 5000 diameters by means of the super-microscope. F. ROGERS.

5 Hicks Lane, Westbar, Sheffield.

"Bitumen" in Meteorites.

THE statement that is currently repeated as to the existence of bitumen in meteorites does not bear examination. It is based on a number of investigations that were made between 1834 and 1885 on the alcohol- and ether-soluble material obtained by extracting meteoric matter, but no recent work appears to have been done to throw further light on the subject. The weights of the samples examined were so small that quantitative analyses are not very convincing, but an undoubted uniformity of results can be traced.

There has been obtained a hydrocarbon (possibly containing sulphur and oxygen), melting about 114° or 120° C., accompanied by free sulphur and graphite —and this is the material, present in an extra-terrestrial body, that is quoted to-day as evidence for the inorganic origin of terrestrial petroleum.

The suggestion now made is, that the presence of the hydrocarbon is due to the action of water on carbide after the arrival of the meteorite on the earth. The evidence for this is the following :

1. Iron-nickel carbide is found in meteorites.
2. Water poured on to powdered meteorite causes the production of "an alliaceous odour."
3. Phosphide is also present.
4. The water that is usually found in meteorites is considered by authorities not to be original, but to have been taken up at some subsequent time.
5. Soluble carbon compounds have been stated to be completely removed by solvents without preliminary pulverisation of the meteorite sample; that is, they exist in cracks and pores which are just the positions into which water could percolate.
6. Solid hydrocarbons are formed by the action of water on carbides of metals of high valency. These carbides are actually present though in small quantities and not often ; these hydrocarbons are also present in small quantities and not often.

This explanation, if correct, dissipates the present contradictory evidence of the presence of, on one hand :

(*a*) graphite, suggesting crystallisation from an iron magma ;

(*b*) carbide and phosphide, suggesting high temperatures of formation ;

(*c*) an outer skin, indicating the attainment of a high temperature on reaching the earth's atmosphere ; and, on the other hand,

(*d*) of a hydrocarbon of low melting point, absolutely precluding the possibility of a high temperature after its formation. PERCY EDWIN SPIELMANN.

The Athenæum,
Pall Mall, S.W.1, August 6.

Comparison of Wave-lengths with a Fabry and Perot Étalon.

IN the issue of NATURE for June 28, p. 926, Prof. Robertson, discussing the "Comparison of Wave-lengths with a Fabry and Perot Étalon," points out that for determining fractional orders of interference it is sufficient to measure only the linear diameters of the interference rings. This practice has been used extensively at Mount Wilson Observatory for ten years. It was described in Mount Wilson Contributions, No. 137, *Astrophysical Journal*, 46, 138, 1917, and No. 202, *Astrophysical Journal*, 53, 42, 1921, where full details will be found. It was shown that the method offers marked advantages, such as (1) reduction of labour, (2) smaller probable errors, (3) convenient numerical checks which diminish the chances of mistakes in computation.

It is unfortunate that, on account of the form in which Prof. Robertson expresses the idea of the method, he has committed, inadvertently no doubt, the error of deriving six values of the fractional order from only four observations, and in consequence he finds an incorrect result with too small a probable error.

It seems to me preferable to write the fundamental equation in the form

$$\alpha = 1 - n + cd_n^2$$

where α is the fractional order, n is the number of the ring of diameter d_n, counting the innermost as the first, and c is a constant for all the rings of a given line, depending on the integral order of interference, the focal length of the projector, and the magnification in the spectrograph. It is evident that the two unknown quantities α and c may be evaluated if at least two diameters are measured, and that if q diameters are measured only $q - 1$ independent values of α may be found.

In the practical use of the method for extended investigations, the constant c is derived from a combination of the measurements on many lines, and it becomes legitimate to obtain q independent values of α from q diameters measured on a given line.

HAROLD D. BABCOCK.

Mount Wilson Observatory,
Pasadena, California,
July 23.

A Substitute for the McLeod Gauge.

THE results of our experiments do not confirm Mr. Fleuss's statements (NATURE, July 5, p. 12). Even if the water vapour is always at a pressure less than its equilibrium vapour pressure at room temperature, the McLeod gauge reads low and usually inconsistently. The reason is, of course, to be found in the absorption of water by glass. Water vapour will condense on glass when its pressure is raised, even when the final pressure is no greater than 0·001 mm. ; the amount that condenses increases with the time, so that the reading of the gauge depends on the rate at which the mercury is raised. All this is quite familiar to those who work with modern high vacuum apparatus ; but Mr. Fleuss's statements, if unchallenged, might mislead some who are only beginning to acquire their experience.

NORMAN R. CAMPBELL.
JOHN W. RYDE.
BERNARD P. DUDDING.

Research Laboratories of the General
Electric Company, Ltd., Wembley,
July 28.

Life History of the Pearl Mussel.

DOES any one know what happens to the pearl mussel (*Margaritana margaritifera*) between the glochidium falling off the trout, etc., and the big adult mussel ? No one seems to have seen young individuals, and the ordinary specimens which are found are never less than about 3 inches long and must be several years old. I have lately had another vain hunt for young ones in the Herefordshire Wye, so far as it is accessible by paddling ; presumably they live somewhere in deep water, and not in the shallows where the adults are. The revival of the pearl fishing in recent years may have led some one to work out the life history : its investigation might be a grateful occupation for summer holidays. A. E. BOYCOTT.

17 Loom Lane, Radlett,
July 31.

A Hundred Years of Electrical Engineering.[1]

By Prof. G. W. O. HOWE.

IF any one event can be regarded as the birth of electrical engineering, it is surely the discovery by Faraday in 1821 of the principle of the electro-motor; that is, that a conductor carrying a current in a magnetic field experiences a force tending to move it. It is noteworthy that ten years elapsed before Faraday discovered, in 1831, the magneto-electric induction; that is, the principle of the dynamo. Four years later, Sturgeon added the commutator or "uniodirective discharger," as he called it, and in 1845 Cooke and Wheatstone used electromagnets, which Sturgeon had discovered in 1825, instead of permanent magnets. It was during the years 1865–1873 that the shunt and series self-excited dynamo, using a ring or drum armature and a commutator of many segments, finally evolved.

The early workers in the field do not appear to have realised the intimate connexion between the dynamo and the motor, for, although the principle was discovered by Lenz in 1838, it only appears to have become generally known about 1850 that the same machine could be used for either purpose. The principle underlying the whole modern development of electrical engineering, namely, the generation of electrical power by a dynamo, its transmission to a distant point, and its retransformation to mechanical power by an electric motor, appears to have evolved about 1873.

The development of the dynamo during the 'seventies and the simultaneous development of the incandescent lamp led to the general introduction of electric light during the 'eighties. Attempts to make incandescent electric lamps had been made so early as 1841, when de Moleyns patented one having a spiral platinum filament; and in 1847 Grove illuminated the lecture theatre of the Royal Institution with such lamps, the source of power being primary batteries; but it was not until 1878 that the commercial development of the incandescent electric lamp was begun by Edison and Swan.

One of the earliest complete house-lighting installations was put in by Kelvin in 1881. A Clerk gas-engine was used to drive a Siemens dynamo, a battery of Faure cells was fitted up, and every gas-light in his house and laboratory at Glasgow University was replaced by 16 candle-power Swan lamps for 85 volts. He had to design his own switches and fuses, etc., for such things were almost unknown.

For about twenty years the carbon-filament lamp held the field without a rival for interior illumination, and, although attempts were made to improve its efficiency by coating the filament with silicon, the plain carbon filament only gave way finally to the metal-filament lamp. One of the most interesting developments in the history of electric lighting was the Nernst lamp, which was introduced in 1897; the filament consisted of a mixture of zirconia and yttria, and not only had to be heated before it became conducting but also had to be connected in series with a ballast resistance in order that it might burn stably. The way in which these difficulties were surmounted and the lamp, complete with heater, ballast resistance, and automatic cut-out, put on the market in a compact form occupying little more space than the carbon-filament lamp was, in my opinion, a triumph of applied science and industrial research. The efficiency was about double that of the carbon lamp. About this time, however, a return was made to the long-neglected metal filament. The osmium lamp invented by Welsbach in 1898 was put on the market in 1902, to be followed two years later by the tantalum and tungsten lamps. The latter was greatly improved by the discovery in 1909 of the method of producing ductile tungsten and by the subsequent development of gas-filled lamps in which the filament can be run without undue volatilisation at such a temperature that the consumption is reduced in the larger sizes to 0·6 watt per mean spherical candle-power. This improvement of eight times as compared with the efficiency of the carbon-filament lamp has led to the gradual replacement of the arc lamp even for outdoor illumination. The arc lamp was introduced at about the same time as the carbon-filament lamp, the Avenue de l'Opéra having been lit with Jablochkoff candles in 1878. The open arc was developed during the 'eighties; the enclosed arc, giving long burning hours and thus reducing the cost of recarboning, was introduced in 1893, and the flame arc in 1899. During the first few years of this century the flame arc was brought to a high stage of development and the consumption brought down to about 0·25 watt per candle-power, but the necessity of frequent cleaning to prevent the reduction of efficiency by dirt, and the labour of recarboning, have led to its abandonment in favour of the less efficient filament lamp.

Before leaving the subject of electric lighting I would point out that it is remarkable that the first great application of electric power should have been for the production of electric light, since it is probably the least efficient of all its applications. The overall efficiency of a small power station supplying a lighting load and having therefore a very poor load factor would not be greater than about 6 per cent. from coal to switchboard, the steam-engine being, of course, the principal offender. Of the total power supplied to and radiated from a carbon-filament lamp not more than about 2 per cent. was radiated as light, so that the overall efficiency from coal to light was 2 per cent. of 6 per cent., which means that of every ton of coal burned at the power station with the object of producing light all but about 3 lb. was lost as heat at various stages of the transformation. Even now, with up-to-date steam plant and gas-filled lamps, the overall efficiency from coal to light is not equivalent to more than 40 to 60 lb. of coal out of each ton. The electrical engineer may derive a little comfort from the knowledge that the purely electrical links are the most efficient in the chain.

Whilst on the subject of efficiency I might point out that the difference between the prices at which coal and electrical energy can be purchased by the ordinary citizen corresponds to the losses incurred in the power station; that is to say that the cost of the generation and distribution of the electrical energy is covered by

[1] From the presidential address to Section G (Engineering) of the British Association, Toronto, August 7.

the better terms on which the power station can obtain fuel. In Glasgow the writer pays 5*l.* per ton for anthracite to burn in a slow-combustion stove; taking the calorific value of anthracite at 9000 kilowatt-hours per ton, which is equivalent to 14,000 British thermal units per lb., this works out at 7½ kilowatt-hours for a penny. For electrical energy for heating and cooking purposes the writer pays a penny per kilowatt-hour. This ratio of 1 to 7½ will correspond fairly closely to the overall efficiency of the power station. In view of the high efficiency and convenience of slow-combustion stoves, it is evident that electric heating cannot be expected to compete with them for continuous operation; for intermittent heating the question is very different.

Returning from this digression to the development of the direct-current dynamo, it may be noted that the drum armature now almost exclusively employed was invented in 1872 by von Hefner Alteneck, and gradually displaced the ring armature of Pacinotti and Gramme. Although Pacinotti's original ring armature was slotted, smooth armatures were preferred for many years, until the mechanical superiority of the slotted armature caused the disappearance of the smooth core with its wooden driving pegs which were employed to transmit the turning moment from the conductors to the core. The commutator and brushes were a great source of trouble, but by the gradual elimination of unsuitable material and by better design and methods of manufacture the commutator has been made a most trustworthy piece of apparatus. The difficulties of commutation, and especially the need of continual adjustment of the brush position, were largely overcome by the invention of the carbon brush by Prof. George Forbes in 1885. It should be pointed out that the commutating poles, which have come into use so much in recent years, were originally suggested in 1884, and are therefore older than the carbon brush.

The realisation of the idea of supplying electric current from a power station for lighting houses in the neighbourhood owed much to the energy and business ability of Mr. Edison. He exhibited his first "Jumbo" steam-driven dynamo in 1881, and installed two sets at Holborn Viaduct in the following year to supply current to neighbouring premises. The output of these sets was about 90 kilowatts at 110 volts, which was so much larger than anything previously constructed that the name "Jumbo" was applied to these sets. About 1890 the multipolar type began to replace the bipolar type for the larger sizes. The size of the single units employed in power stations gradually increased with the increasing demand, and by 1895, dynamos of 1500 kilowatts had been installed.

Ferranti was apparently the first to suggest that the power station should be outside the city, at a point convenient for fuel and water supply, and that the power should be transmitted into the city by high-voltage alternating currents. In 1890 he built the Deptford Station for the London Electric Supply Company, and installed 1000-kilowatt 10,000-volt alternators. This was the pioneer high-voltage underground cable transmission, and much was learnt concerning the peculiarities of alternating currents when transmitted over cables of considerable capacity. The following year, 1891, saw the first long-distance transmission by means of overhead conductors in connexion with the electrical exhibition at Frankfort-on-Main; three-phase power was transmitted, at 8500 volts, from a water-power station at Lauffen to Frankfort, a distance of 110 miles.

This development of the use of high-voltage alternating currents followed the development of the transformer. Gaulard and Gibbs patented a system of distribution involving transformers in 1882, and, although their patent was upset in 1888 on the ground of its impracticability, the present method of using transformers for the distribution of electrical power was introduced in 1885, and shown at the Inventions Exhibition in London in that year. Although from 1890 onwards there has been a steady increase in the size of alternators and transformers and in the voltage employed for long-distance transmission, the last few years have seen a really amazing increase in the size of the units employed. In 1913 the largest 2-pole turbo-alternators had an output of 3000 revs. per minute of about 7500 kilowatts; such machines are now made up to 30,000 kilowatts, and 4-pole alternators are running at 1500 revolutions per minute, with an output of 60,000 kilowatts. This increase in size and in peripheral speed has been made possible by improvements, both in the material and in the design. With a bursting speed 25 per cent. above the running speed, the peripheral speed can now be raised to 150 metres per second. Improved methods of cooling and a better understanding of the various causes of loss in the armature have enabled the materials to be used at higher current and flux densities.

This great increase in the size of units is not confined to the steam turbo-generator, as can be seen from the water-turbine sets recently added to the Niagara installation. Whereas the original Niagara turbines were of about 5000 horse-power, the new ones have an output of 70,000 horse-power at the low speed of 107 revolutions per minute.

The importance of cheap electric power has led to this great increase in the size of the units in the generating stations. Any slight difference of efficiency between a 10,000-kw. and a 60,000-kw. alternator is of little importance, and would certainly not counterbalance the decreased factor of safety due to concentrating the whole power supply in three or four large units, instead of distributing it between a dozen or more units. The reason for the adoption of the smaller number of large units lies almost entirely in the decreased capital cost per kilowatt of plant. In my opinion, however, there are many cases in which too much consideration has been given to this factor, and too little to the importance of a guaranteed continuity of supply.

Until recently, the only means of producing a large amount of high-voltage D.C. power was by connecting a large number of carefully insulated dynamos in series, as in the well-known Thury system of power transmission. Within the last two or three years another method has been developed, viz., the so-called transverter, which consists of an arrangement of transformers and a system of rotating brushes, whereby a three-phase A.C. supply is converted into an almost steady continuous current. The first apparatus of this type to be exhibited is installed at the British Empire Exhibition at Wembley, and is designed to deliver

continuous current at 100,000 volts. It can also be used for the reverse process. It would thus enable a three-phase generating station and a three-phase sub-station to be connected by a direct-current transmission line, thus avoiding not only the maximum voltage of 1·4 times the effective voltage, which was one of Lord Kelvin's objections to the A.C. system, but also all trouble due to the capacity and inductance of the line.

Electric traction represents one of the most important branches of electrical engineering. It shares with the petrol motor the distinction of having absolutely revolutionised the methods of transport within a single generation. In its origins it is nearly a century old, for attempts were made in the 'thirties to apply Faraday's newly discovered principle to the propulsion of vehicles, but, with very primitive motors and primary batteries, these attempts were doomed to failure. The development of the dynamo and motor in the 'seventies opened the way to further experiments, and at the Berlin Exhibition in 1879 a line one-third of a mile long was shown in operation, a locomotive drawing three cars. The first regular line was opened to traffic near Berlin in 1881; it worked at 100 volts and the current was collected from an insulated rail. Toronto was the scene of one of the earliest experiments in America; C. J. van Depoele, after some experiments at Chicago in 1882 and 1883, ran an electric locomotive in 1884 between the street-car system and the Exhibition in Toronto.

The difficulties were enormous. The carbon brush was not invented until 1885, and commutation in a reversible motor with copper brushes caused great trouble; armature construction and winding was in its infancy; the suspension of the motor and the method of gearing it to the car axles were problems which were solved only after much experience. Rapid progress was made after about 1887, and the closing years of the century saw an enormous development, the elimination of horse tram-cars throughout the world and the electrification of a number of city and suburban railways.

Of the various systems of collecting the current, only two have survived for street-cars, namely, the usual overhead wire and the exceptional underground conduit; in the case of railways there is no necessity for a conduit, and the conductor rail is carried on insulators above the ground-level.

Although 500-volt D.C. supply has been standardised for street tramways, the relative merits of D.C. and A.C. for electric railways has been a burning topic for more than twenty years, and is now perhaps more burning than ever. It is somewhat akin to the battle of the gauges in the early days of steam railways, for it involves in many cases the problem of through-running, if not now, in the not very distant future. Although the three-phase system was successfully installed in Northern Italy, it has grave disadvantages, and the battle now is confined between direct current at an increased voltage of, say, 1500 to 2000 volts, and single-phase alternating current. In the latter case there is, moreover, a further question as to the best frequency to adopt, this being usually either 25 or $16\frac{2}{3}$. The development of the A.C. commutator motor to the stage where it was applicable to traction took place during the first few years of this century, and, although in itself it is inferior to the D.C. motor, it introduces so many simplifications and economies in the transmission of the power from the generating station to the train that experts are very divided as to the relative merits of the two systems for main-line electrification.

I can only refer briefly to the applications of electrical power to chemical and metallurgical processes. Some of these are purely electro-chemical, others are purely thermal, while in many processes the electric current performs the double function of melting and electrolysing. The possibility of electroplating was discovered so early as 1805, but the commercial application of electro-chemistry on a large scale was impossible before the development of the dynamo. Within the last thirty years the provision of an abundant supply of electrical power has led to the creation of enormous electro-chemical industries; I need only instance the production of aluminium, carborundum, and calcium carbide. These industries have usually been established near a hydro-electric plant and provide a load of very high load-factor.

I turn now to what may be called both the earliest and the latest application of electricity; that is, its use for transmitting intelligence. One of the greatest factors in the development of our modern life has undoubtedly been the network of wires and cables which has spread over the whole earth, making possible an almost instantaneous transmission of intelligence and interchange of opinions. In the early days of electrical science the discovery of a new property of electricity was followed by attempts to utilise it for this purpose. So early as 1746 there are records of the use of frictional electricity for the purpose, and distances up to four miles were tried. In 1774 Lesage of Geneva proposed 26 wires in earthenware pipes with pairs of pith-balls at the end of each wire, which flew apart when the conductor of a frictional machine was brought near the other end of the wire. A current of electricity was unknown until Galvani's discovery in 1789, and Volta's pile was first constructed in 1792. Carlisle in 1800 found that water was decomposed by passing the current from a Volta pile through it, and this was the basis of the telegraph proposed by Sömmering in 1809, in which 26 wires ended in 26 metallic points arranged in a row along the bottom of a kind of aquarium. By means of a lettered keyboard at the sending end the current could be applied to any wire, and a stream of bubbles caused to rise from the appropriate point, each point being duly labelled with its appropriate letter. The magnetic effect of the electric current was discovered in 1819, and immediately replaced the previous methods in efforts to develop an electric telegraph; except for the attempts to make a high-speed chemical telegraph, all subsequent telegraph systems have employed the magnetic effect of the current. A great many of the fundamental inventions of telegraphy were made in the 'thirties; the list includes the needle instrument of Cooke and Wheatstone, the sounder of Henry, the dot-and-dash inker of Morse, and the use of the earth as a return by Steinheil. Although the needle instrument is now obsolete, the sounder and Morse inker are still commonly employed. Many have been the devices for increasing the amount of traffic which can be worked over a single line, either by the simultaneous use of the line by a number of

operators, as in the quadruplex and multiplex systems, or by punching the messages on paper tapes, which can then be fed into an automatic transmitter working at a speed ten to twenty times that attainable by a manual operator. In the most up-to-date systems the perforation of the tape is done by the operators working an ordinary typewriter keyboard, and the received message is printed in ordinary type, a single wire carrying eight messages simultaneously, four in either direction, at a speed of 40 words per minute.

The need for telegraphic communication between countries separated by water was so much the greater because of the slowness of other means of communication, but the difficulties in laying and maintaining 2000 miles of insulated wire on the bottom of the sea must have appeared almost insuperable to the early workers; fortunately, however, there were men who had the necessary vision and courage. The flimsiness of the early cables suggests that the pioneers underestimated the magnitude of the problem which faced them, which was perhaps fortunate. A cable was laid between Dover and Calais in 1850; it lived only a single day, but it was replaced in the following year by a successful cable.

The first cable was laid across the Atlantic in 1858, and, although in the light of our present knowledge we know that it could not have had a very long life, its failure after a few weeks of preliminary communication was primarily due to misuse owing to the ignorance of those in charge. Although much costly experience had been gained in the laying of cables in various parts of the world since this first attempt to span the Atlantic, the success of the second Atlantic cable in 1866 was largely due to the scientific ability of Kelvin and to his untiring application to the project at every stage of the manufacture and laying of the cable.

Turning to another branch of electrical communication, it is no exaggeration to say that modern business life has been revolutionised by the telephone, which will shortly celebrate its jubilee, for it was in 1876 that Graham Bell invented the magnetic telephone receiver, although others, notably Reis, had been working at the problem since 1861. Bell showed his telephone in operation at the Philadelphia Centennial Exhibition in 1876, and Kelvin, who was one of the judges, brought one back with him and demonstrated it to Section A of the British Association, at its meeting in Glasgow in the autumn of 1876.

A successful telephone system requires much more than efficient transmitters and receivers, and the great development which has taken place has been largely a matter of improvement in the design of the many elements that go to make up a telephone exchange. The modern manual central-battery exchange, in which one has only to lift his receiver to call the operator and be connected in a few seconds to any one of 10,000 other subscribers, is a marvel of ingenuity and construction. But this is now gradually being replaced by the greater marvel of the automatic system, in which the operator is eliminated and the subscriber automatically makes his own connexion to the desired subscriber. Attention should be directed to two outstanding inventions in the actual transmission of telephony over long distances, namely, loading and repeaters. It was Oliver Heaviside who in 1885 proposed to improve the range by increasing the inductance of the line. Although this revolutionary suggestion fell on deaf ears for fifteen years, it ultimately proved to be one of the great inventions of telephony; it is of special importance in underground and submarine telephone cables, the electrostatic capacity of which otherwise seriously limits the range. The other outstanding novelty is the introduction of repeaters at intermediate points in long telephone lines. These repeaters are specialised types of low-frequency amplifiers; they were made commercially possible by the invention and perfection of the three-electrode thermionic valve. The attenuated speech currents arriving at the end of a section of line are amplified and thus given a new lease of life before being passed on to the new section. By using a large number of such repeating stations, telephonic communication has been established between New York and San Francisco.

Turning now to radio telegraphy and telephony, one cannot but marvel at the rapidity of its development and the inroad that it has made during the last two or three years on the domestic life of the whole civilised world. The theory of Clerk Maxwell in 1864 and the laboratory experiments of Hertz in 1888 found their first practical application in Marconi's Italian experiments in 1895 and his demonstrations in England during the following year. Much of the rapid progress was due to his perseverance, vision, and courage in perfecting apparatus for short-distance work, and simultaneously experimenting over long distances, and thus, in the year 1901, settling by actual demonstration across the Atlantic the vexed question as to whether the waves would pass around the earth over distances of several thousand kilometres or go off into space.

The accomplishment of long-distance communication bristled with difficulties, largely due to unsuspected atmospheric effects which are still little understood; but such progress has been made and is continually being made that one dare not now adopt an incredulous attitude to the wildest dreams or forecasts of what is to be accomplished by "wireless." The commonplace facts of to-day would have appeared beyond the bounds of possibility ten or twenty years ago.

By the aid of electricity the energy of the coal or of the lake or river a hundred or even two hundred miles away is transmitted noiselessly and invisibly to the city, to supply light and warmth, to cook the food, to drive the machinery, to operate the street-cars and railways. By its aid one can flash intelligence to the most distant part of the globe, hold conversations with friends hundreds or even thousands of miles away, or sit in one's home and listen to music and lectures broadcast for the entertainment or instruction of all who care to equip themselves with what may almost be regarded as a new sense. Whereas thirty years ago a ship at sea was completely isolated from the life and thought of the world, it is now in continuous communication with the land and with every other ship within a wide range. In no branch of electrical engineering, however, is there any suggestion of having reached finality; on the contrary, rapid development is taking place in every direction, and we can look forward with confidence to an ever-increasing application of electricity to the utilisation and distribution of the natural sources of energy for the benefit of mankind.

The Frequency of Birds over the High Atlantic Ocean.

By P. JESPERSEN, Copenhagen.

THE Danish Commission for the Study of the Sea has, during the years 1913 and 1920–1922, under the direction of Dr. Johs. Schmidt, made a series of marine-biological investigations in the northern part of the Atlantic Ocean and in West Indian waters. The following four expeditions have been carried out: in 1913 with the schooner *Margrethe*, in 1920 and 1921 with the motor-schooner *Dana*, and in 1921–1922 with the research steamer *Dana*. So far as circumstances permitted, ornithological observations were also made on these expeditions, and it is on the diary of these observations, in combination with notes made on various voyages to the United States of America and to the West Indies, that the present account is based. In this I shall endeavour to give, on general lines, an idea of the frequency of birds over the various parts of the Atlantic.

In what follows I deal only with observations made on the ocean, and as such I consider those made at places where the distance from land was at least 50 miles. We have in all, observations on the high seas on 462 days, covering an area from the Faroes (about 62° N. lat.) to about 5° N. lat. In the area between 10° and 50° N. lat. the observations cover the whole breadth of the Atlantic from the coasts of Europe and Africa right across to the coast of America, whereas north of 50° N. lat. observations were available only for the eastern part of the Atlantic. Of the total number of days of observation the greater part, namely 254 days (about 55 per cent.), were spent in the area between 20° and 40° N. lat. and 40°-70° W. long., thus chiefly in the Sargasso Sea. Observations were made at all times of the year, the majority (about 62 per cent.), however, having been made in the six summer months, and there are few observations for the winter months north of 40° N. lat.

It is well known that the frequency of birds differs greatly in the various parts of the Atlantic. In general, it may be said that the frequency decreases greatly with the distance from land, but there are also other circumstances which may have an influence in this respect.

In order to be able to form an opinion as to how far the frequency of birds varies for the different parts of the Atlantic, I have, on the basis of the daily observations mentioned, calculated the average number of birds observed *per diem* in the various areas. Of course these figures can by no means claim to be in any way accurate, in particular for areas where the number of birds is large, but they appear to be sufficient for giving an idea whether the frequency of birds is great or small in the various parts of the Atlantic. On the accompanying chart (Fig. 1) the average number of birds observed *per diem* within an area of 10 degrees longitude and 10 degrees latitude has been given. The figures in parenthesis give the number of days on which observations were made within the respective areas. As mentioned above, only observations have been included which were made on the high sea (at a distance from land of at least 50 miles), and only such birds have been considered which may be assumed as generally living over the high sea. Characteristic coast birds and all inland birds have been excluded from these calculations.

I have employed the following method in making my calculations: so far as possible, the number of all birds seen in the course of a day was noted down. In areas where birds appear in large flocks, the number could, of course, only be estimated, and the figures given for such areas, therefore, make no claim to great accuracy. I have in such instances placed a > before the number. When an average number is given for a certain area as, say, >13, this signifies that the average number of birds observed *per diem* within the respective area should be taken as, at the least, 13 birds. In many instances the actual number will probably be considerably higher. Birds which had followed the ship steadily for the whole day were counted once only, and the maximum number of birds seen together at one time during the day is, in such cases, given as the number of birds observed that day. Of course, there is always the possibility that the same individual bird is counted several times a day, and I have tried to avoid this so far as possible, but, particularly where individual birds of the same species are concerned, there will always remain the possibility of a repeated observation of one and the same individual. When a bird has been observed several times a day about the ship, I have considered it to be the same if at least six hours had not elapsed between the individual observations. Naturally fractions have resulted in these calculations, but all such fractions have been neglected. The average figure may therefore be understood thus: the number 1 means that the average

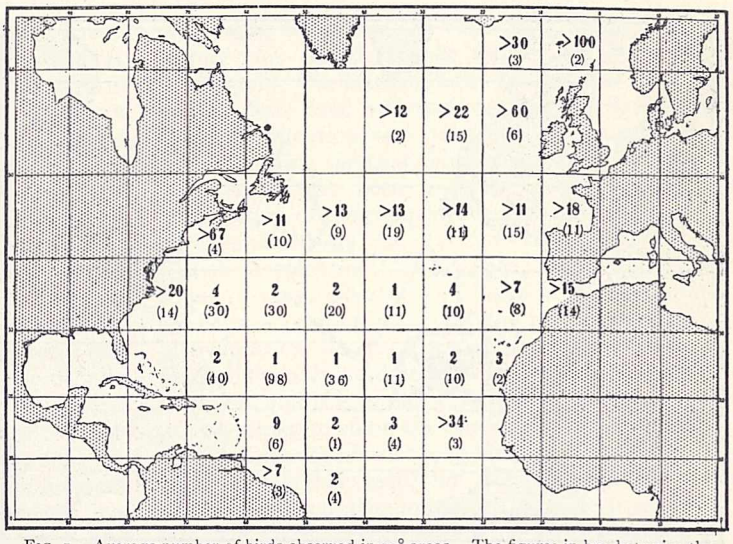

FIG. 1.—Average number of birds observed in 10° areas. The figures in brackets give the number of days on which observations were made in each area.

number of birds seen lies between 1 and 2, the number 2 that the average number lies between 2 and 3, and so on.

It is thus clearly seen in the accompanying chart that the frequency of birds is relatively larger the shorter the distance from land. Let us first consider the frequency of birds north of 40° N. lat. Here we have the largest number in the neighbourhood of the Faroes and to the west of Ireland. In the Bay of Biscay the frequency of birds is, however, considerably lower. The birds predominating in quantity here were fulmars, shearwaters, skuas, and kittiwakes.

Along the coast of America we have a high average figure south of Nova Scotia (>67). This is, in particular, caused by the large number of Wilson's petrels (*Oceanites oceanicus* Kuhl) which appears in the Gulf Stream area during the summer.

It will be observed that the frequency of birds decreases considerably with the distance from land north of 50° N. lat., but that we have quite considerable numbers over the middle of the ocean. The same applies to the area between 40° and 50° N. lat. Across the whole breadth of the Atlantic Ocean we, everywhere, meet birds in large numbers. It appears that the average figure is nowhere less than 11 birds a day. We are here chiefly in the Gulf Stream area, and the birds predominant are shearwaters, kittiwakes, skuas, and petrels.

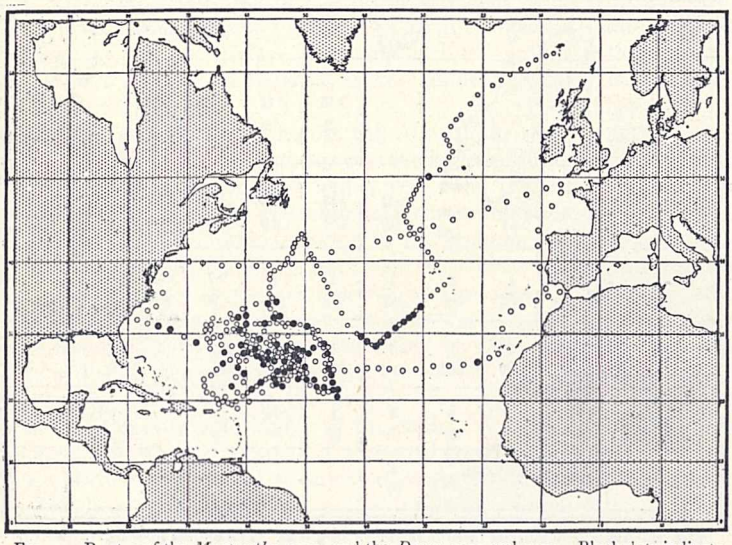

FIG. 2.—Routes of the *Margrethe*, 1913, and the *Dana*, 1920 and 1921. Black dots indicate positions in which no birds were observed during the day.

South of 40° N. lat. we notice that the frequency of birds decreases greatly. We have, particularly, ample data on bird life between 20° and 40° N. lat., and it will be seen that the number of birds is particularly small within those parts of the northern Atlantic which is generally termed the Sargasso Sea. Regarding the area between 30° and 70° W. long., it will be observed that, with the exception of the Bermuda area, the number of birds, on the average, does not exceed 1-2 *per diem*. The most characteristic bird for the Sargasso Sea is the tropic-bird (*Phaëthon americanus* Grant), but besides this bird we also observed in smaller numbers various petrels, shearwaters, and kittiwakes.

Between 30° and 40° N. lat. we have, however, a high frequency along the east coast of the United States and about Madeira, and in the Bay of Cadiz. Between 20° and 30° N. lat. the average numbers are particularly low across the whole ocean. South of 20° N. lat. we find a surprisingly high average figure about the Cape Verde Islands, owing to the sooty-tern (*Sterna fuscata* L.) appearing in flocks. The number of days on which observations were made here is, however, so small that no particular importance can be given to the individual figures.

The great difference between the number of birds on the high sea north and south of 40° N. lat. is thus striking. For still further illustrating this difference we shall, in what follows, consider another circumstance. During the various voyages it happened repeatedly that, on some days, not a single bird was seen from the ship, and it is of interest to have a look at the geographical position of such days of observation on which no birds whatever were seen. In the following chart (Fig. 2), showing the routes taken by the *Margrethe* in 1913 and by the *Dana* in 1920 and 1921, the days of observation are marked. The black dots indicate the positions in which no birds were seen during the day.

It thus clearly appears that almost all days of observation on which no birds were seen were south of 40° N. lat., being 1 day and 73 days respectively north and south of this latitude. The percentages are 1·3 and 28·1 respectively of all days of observation. This circumstance, furthermore, shows how small is the number of birds south of 40° N. lat. compared with the parts of the Atlantic north of this latitude.

The longest period during which the Danish expeditions did not see any birds was four days, and the longest periods during which no birds were seen were all within the range of the Sargasso Sea, where the distance from land is considerable.

According to the available observations, it appears that the number of birds within the range of the Gulf Stream is at least ten times as large as in the Sargasso Sea, and the question arises: what is the reason that birds are so scarce in the Sargasso Sea as compared with the area of the Gulf Stream? In large portions of the Sargasso Sea the distance from the nearest land is very great, and it is therefore possible that this fact is one of the reasons for the scarcity of birds, but this can scarcely be the real reason. In the central parts of the Atlantic, between 40° and 50° N. lat., where the distance from land is very considerable, the frequency of birds is, relatively, much larger than in any part of the Sargasso Sea.

The reason for the scarcity of birds in the Sargasso Sea is far more probably to be found in the small amount of food in this part of the ocean as compared to the Gulf Stream area. It seems reasonable to assume that the special fauna (fishes, crabs, etc.) belonging to the large quantity of drifting "Gulfweed" (Sargassum) must afford nourishment for more extensive bird life, but it is questionable whether this fauna plays any part as food for birds in the Sargasso Sea.

I have thus, in examining the contents of the stomachs of birds from the Sargasso Sea, never found the slightest trace of the characteristic fauna from the Sargassum, and it is therefore possible that it is difficult for the birds to catch the fishes and crabs hiding in these dense masses of drifting sea-weed. Examinations of the stomachs have, on the other hand, always shown that the birds, at least the majority of them, live on flying fishes and cephalopods. This shows that the birds in the Sargasso Sea do not avail themselves of the special Sargassum fauna but seek their food amongst fishes, cephalopods, etc., living free in the water.

It is therefore interesting to study the quantity of macroplankton to be found in the Sargasso Sea and the Gulf Stream respectively. In a previous paper[1] I have drawn a comparison between the quantity of macroplankton in various parts of the Atlantic, and it appears from this comparison that the quantity of macroplankton in the central parts of the Atlantic between 40° and 50° N. lat. is at least ten times as great as that in the Sargasso Sea.

The reason for the scarcity of bird life in the Sargasso Sea, as compared to that in the Gulf Stream area and, on the whole, in the northern Atlantic, may, therefore, safely be sought in the much smaller quantity of food to be found in the Sargasso Sea as compared to the parts of the Atlantic lying farther north.

[1] P. Jespersen: On the Quantity of Macroplankton in the Mediterranean and the Atlantic. Rep. on the Danish Oceanogr. Expeditions, 1908–10, vol. iii. 3. Copenhagen, 1923.

The Planet Mars.

By Dr. W. H. STEAVENSON.

THIS year's favourable opposition of Mars, which on August 22 is nearer to the earth than at any time between the eighteenth and twenty-first centuries, would seem a fitting occasion for a brief review of our present knowledge of the planet, together with an estimate of the prospects and probable direction of future research.

The object aimed at in physical observations of Mars may be considered as twofold. First, it is desired to determine, so far as available means will allow, the true appearance of the features presented to our view on the planet's surface; and, secondly, it is hoped, by careful and repeated observation of these features and the changes that occur in them, to reach some definite conclusions as to their real nature. Both of these objects have been kept in view from the earliest days of the telescope, but it is only in recent years that the second of them has begun to show reasonable prospect of fulfilment. The fact is, of course, that the one object is dependent on the other, so that the first must be attained, approximately at least, before the second can be pursued with any confidence of success. Thus it comes about that the history of Martian observation naturally divides itself into two stages, which we may term respectively that of cartography and that of interpretation. One, of course, is but a development of the other, and there is no sharp dividing line between the two.

From the earliest days of the telescope, it was recognised that the "spots on Mars" were relatively permanent features of the planet's surface, but the first attempts to construct even a rough map of them did not meet with much success. The drawings made by Sir William Herschel late in the eighteenth century are among the first on which we can recognise a number of markings that have since become familiar to us, and it was this great astronomer who, by his study of the polar caps, contributed the first piece of intelligent interpretation of Martian phenomena. But the first map of Mars, properly so called, was not produced until 1840, when Beer and Mädler gave to the world the results of their systematic work with a refractor of less than four inches aperture. This first map was followed, during the succeeding fifty years, by many others of increasing completeness and accuracy, each being in general the work of a single observer. During this period, thanks largely to the work of Schiaparelli, the areographical positions of the main features were fixed with some approach to finality, and a firm foundation was thus laid for future work. Finally, during the past thirty years or so, progress in cartography has been notably accelerated by the introduction of the co-operative system in observation, as exemplified by the work of such bodies as the British Astronomical Association. Meanwhile, as a result of these advances, we have begun to feel ourselves in a position to attack the problem of rational interpretation, based on the data so far accumulated. Much has, in fact, already been accomplished in this direction, and it is satisfactory to find that the theories are beginning to stand the crucial test of prediction.

To summarise all that is so far known with certainty is not altogether easy, for many of the results of observation, doubtless in most cases quite trustworthy, still lack that general confirmation which would justify us in accepting them with complete confidence. However, the following would probably be accepted on all hands as a fair statement of the present condition of definite knowledge concerning Mars.

(1) The fact of the general permanence of the larger dark markings has been established, and their positions and outlines have been determined with considerable accuracy. In other words, we are in a position to construct a very recognisable map of the planet, as regards its main features.

(2) As a result of the above, it has been possible to ascertain the inclination of the planet's axis within a few minutes of arc, and to determine the rotation period within less than a tenth of a second of time.

(3) The size and rate of diminution of the polar caps has been shown to bear a definite relation to (*a*) the progress of the Martian seasons, (*b*) the distance of the planet from the sun, and (*c*) the extent of solar radiation as indicated by the sun-spot cycle. There is now general agreement that the caps must represent frozen water, the alternative of carbon dioxide, suggested some years ago, being for many reasons untenable.

(4) The large dark markings, while in general permanent in position and outline, are known to

undergo changes in intensity, both general and local. Some of these changes of intensity are clearly seasonal and regular, while for others no definite period can yet be assigned. They are probably of a secular or irregular nature. Some typical examples are shown in Figs. 2-4. Changes of colour, of seasonal origin, undoubtedly occur, but the regularity of these has not been satisfactorily demonstrated, and all the markings do not appear to share the same changes.

(5) Both dark and light regions of the planet are subject to temporary obscuration by patches of (*a*) white and (*b*) yellow material. The former, which occur most frequently near limb or terminator, have been variously ascribed to cloud, fog, snowfalls, or hoar-frost; the latter to cloud, dust-storms, or blown sand. We are, however, not yet justified in definitely attributing a particular obscuration to any one of these causes, though probably all are in operation at some time or other.

(6) Apart from the larger markings, the existence has been established of an intricate system of finer details, the exact form of which is still uncertain, though there is not the least doubt as to its objectivity.

(7) Finally, satisfactory photographic confirmation has been secured of practically all the above results.

Further elaboration here of all the sections of this summary is not necessary, but special reference should be made to the sixth, since under this is included the so-called "canals," which have loomed so large in the more recent history of Martian observation. There seems to be a widespread impression, among those not in direct contact with the subject, that the existence of fine linear markings on Mars has been definitely and finally disproved. Actually, the question still remains entirely open in the opinion of those best qualified to judge. In the case of objects which lie so near the limits of visibility, factors of a climatic, instrumental, and personal nature are bound to enter very largely into the matter, and there is consequently room for much difference of opinion. The "canals" having been seen and drawn as fine lines by experienced observers using apertures of 36 and 40 inches under good climatic conditions, the failure to see them with a somewhat smaller aperture in a less favourable position does not carry an overwhelming amount of weight; and in any event such evidence is purely negative. On the other hand, it does not seem that the linear character of the markings in question has yet been completely demonstrated. No doubt the decision must ultimately come from the large apertures, but it is an unfortunate fact that the ideal combination of a large and perfect instrument, a first-rate climate, and a thoroughly efficient and trustworthy observer, who is also a finished draftsman and entirely free from the bias of preconceived ideas, has never yet been attained. The evidence of photography cannot be regarded as conclusive in either direction, though it has at least proved the objectivity of detail that is approximately linear. Since, however, it is impossible as yet to obtain a distinct photographic image of any features that are beyond the visual reach of an eight-inch telescope, it follows that a really narrow line, if recorded at all, can only appear as a diffuse marking on the plate, so that we are still left in doubt as to its true structure.

It is, perhaps, unfortunate that so much time and effort has been expended on this difficult question of the finer detail, especially with instruments that are in any event inadequate for a final decision. Observers

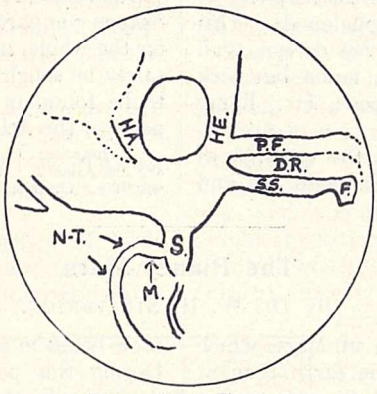

FIG. 1.—Key to Figs. 2-4.

HA. = Mare Hadriacum. S.S. = Sinus Sabæus.
HE. = Hellespontus. S. = Syrtis Major.
P.F. = Pandoræ Fretum. M. = Lacus Moeris.
D.R. = Deucalionis Regio. N-T. = Nepenthes-Thoth.
F. = Sinus Furcosus.

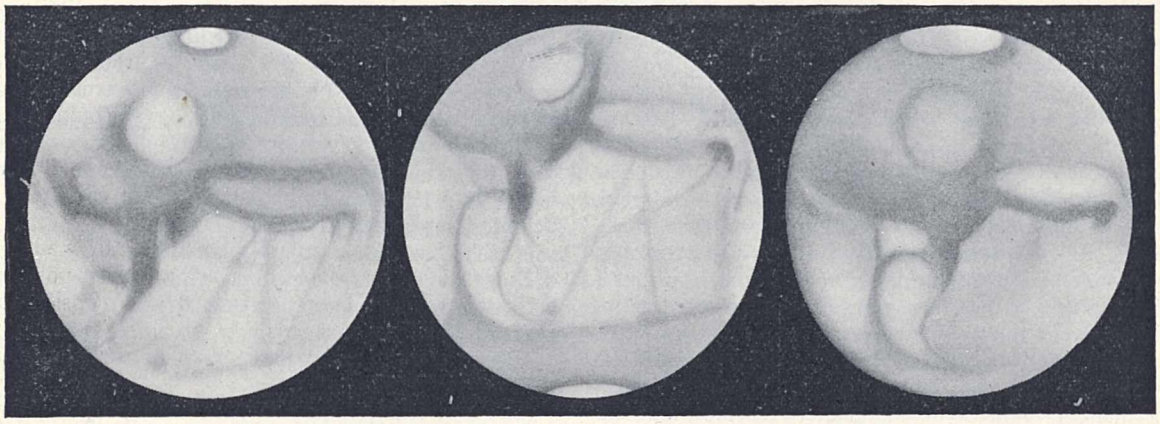

FIG. 2.—Mars. September 1909.
Note great development of Lacus Moeris, considerable breadth and intensity of Pandoræ Fretum, and darkness of M. Hadriacum as compared with Hellespontus. North end of Syrtis Major pointed.

FIG. 3.—Mars. July 1922.
Lacus Moeris only moderately developed as a mere continuation of Nepenthes-Thoth. Pandoræ Fretum narrow and faint, being far less prominent than Sinus Sabæus. Sinus Furcosus darker than the latter. Hellespontus very dark. North end of Syrtis Major blunt.

FIG. 4.—Mars. July 1924.
Lacus Moeris poorly developed. Pandoræ Fretum scarcely visible as a separate marking. Deucalionis Regio very pale as compared with area to the south of it. Hellespontus darker than M. Hadriacum. North end of Syrtis Major more pointed than in 1922.

are apparently beginning to realise this, and more attention is now being paid, and that more profitably, to the less doubtful subject of changes in the large markings. This work is well within the compass of the instruments generally to be found in the hands of amateurs, who would do well, in the present writer's opinion, to leave the finer details to the larger apertures. In thus getting back to the partially neglected study of the more conspicuous features, we shall be correcting the mistake of attempting to run before we can walk. A good beginning has been made, but it is well to realise that it is no more than a beginning, and it will probably be many years before sufficient data have been accumulated to enable us to judge of the soundness or otherwise of current theories.

In recent years there has been much speculation as to the possible climate and temperature of Mars, and the density and composition of its atmosphere. This sort of thing is apt to blind us to the cold fact that our actual knowledge of these things, if knowledge it can be called, is still exceedingly vague, uncertain, and even contradictory. In view of this, the free and confident use of such definite terms as "cloud," "fog," "hoar-frost," and "vegetation" would seem to be somewhat premature, and liable to check progress by giving rise to a false impression of finality in our deductions. However eager we may be for a quick explanation of observed appearances, we cannot better serve the interests of research than by keeping an open mind.

Obituary.

PROF. JAMES SETH.

IN Prof. James Seth, who died of failure of the heart on July 24, at the age of sixty-four years, Edinburgh has lost one who belonged to the great race of Scottish professors. Educated at George Watson's College and the University of Edinburgh, he went through a complete course of training for the ministry at the Free Church College. Turning from his original intention to his true vocation, he studied philosophy at Leipzig, Jena, and Berlin. In 1883 he became assistant to Prof. Campbell Fraser in his own University, and two years afterwards was appointed professor of philosophy at Dalhousie College, Halifax, Nova Scotia. In 1892 he accepted a chair in Brown University, Providence, Rhode Island, and four years later the Sage professorship of moral philosophy in Cornell University. From Cornell he was recalled in 1898 to succeed Prof. Calderwood in the chair of moral philosophy in Edinburgh.

During his twenty-six years' tenure of this post, Seth made a place for himself in the life of the University and the city that would bear comparison with the most distinguished in the long line of his predecessors. Not so well known as his elder brother and colleague, Andrew Seth Pringle-Pattison, he had the same high standard of scholarship in philosophy and much of the same distinction of style in his written work. The writer of the "appreciation" in the *Scotsman* on the day after his death, remarked on "the unique partnership so fruitful in good results" between the brothers. For the rest, his methods as a teacher and the place he took in the life of the University and the city were entirely his own. Endowed with great readiness of speech and a singular power of entering into the minds of his students, he was able in spite of the size of his classes to perfect a form of catechetical instruction which was the delight of his students and made "Prof. Jim" for a quarter of a century one of the most popular teachers in Scotland.

On the other hand, related by his subject of moral (which, on his interpretation of it, meant also political) philosophy to the civic life of the community, Seth took the warmest practical interest in all advanced movements. He held that "it is for the State to emancipate from the slavery of social conditions the toiling masses of society, to endow those who are citizens only in name with a real ethical citizenship—the franchise of a complete and worthy human life," in a word, "to co-ordinate the industrial with the ethical life." It was in such a "regulative socialism" that he found the *via media* between individualistic and communistic extremes. In the same spirit he interested himself in the Settlement and kindred movements and took a leading part in the establishment of a course of study in social science with the view of linking these more closely with the University. His wide connexion with America and the Continent and his generous hospitality made the bachelor home, which he shared with his younger brother John, a rendezvous of scholars from all parts of the world as well as of his more intimate friends in Britain. It was altogether in harmony with the genius for friendship that was so marked a feature of his character that he died in the course of a round of calls upon acquaintances who were themselves in trouble. *Sic vivamus ut sic moriamur.*

Seth's chief contributions to philosophy were his book upon "Ethical Principles" (1894), now in its fifteenth edition, and the volume in the series Channels of English Literature on "English Philosophers and Schools of Philosophy" (1912). In the former of these he expounds in a masterly way and with a fine sense of the power of the English language the sober form of idealism with which, by his own teaching not less than that of Campbell Fraser, Simon Laurie, and his brother, philosophy in Edinburgh has been identified. It differs, as the student of philosophy knows, from that associated with the great sister University in the West under the influence of Edward Caird and Henry Jones, chiefly in the emphasis it lays on separate will and personality as an ultimate category and its more definite teaching on the subjects of theism and individual immortality. This is not the place for comparison and criticism, but we touch here on what is probably the main issue between Idealistic philosophers at the present time and we can ill spare the help which so open-minded and "synoptic" a thinker as Prof. Seth might have rendered in clearing it up in the greater leisure of the retirement to which he had been looking forward. We may hope that he has left behind him some record of his maturest thought upon it that may yet be published.

J. H. MUIRHEAD.

DR. R. H. JUDE.

MUCH regret was felt in scientific circles at the death of Dr. R. H. Jude on June 1. Until his retirement during the War, Dr. Jude was for more than thirty years in charge of the Mathematical and Physical Department of Rutherford College, Newcastle-on-Tyne, and he played a very prominent part in the higher education particularly of young engineers on Tyneside, many of whom now occupy prominent positions in the engineering world. For several years he had been a victim of diabetes, but, in spite of ill-health and progressive deafness and blindness, he retained to the end a brave fortitude in his outlook, an active and a clear mentality, and his letters rarely lacked in that spark of dry humour so characteristic of him in earlier years.

Dr. Jude was born on December 31, 1853, at Camberwell, and after receiving his early education at King's College School, Strand, he gained a scholarship and proceeded to Christ's College, Cambridge, where he took the B.A. degree. In 1876 he was bracketed 18th Wrangler in the Mathematical Tripos, and the following year he obtained a first class, with a special mark of distinction, in the Natural Science Tripos. One year later, in 1878, he gained the degree of D.Sc. of the University of London, and for a short period after graduation he also studied at the University of Heidelberg.

During his long association with Rutherford College, Dr. Jude played a large part in the development of the scientific side of that institution. In the words of one of his former colleagues, he had "a profound and ready grasp of his subjects, and a singularly lucid power of exposition"; but above all he wielded "a quickening influence over his students, based on a lively sense of sympathy with both their difficulties and their aspirations, and he so mingled these qualities with a forestalling courtesy as to combine in a rare degree all that gives efficiency and charm to a lecturer." Whilst he took a keen and helpful interest in and had unbounded patience with his elementary students, Dr. Jude was untiring in his efforts to develop the advanced work of his department. In addition to advanced courses in mathematics, he also instituted courses in higher mathematics for engineers and a tutorial class for advanced students, held on Saturday afternoons. Those of us who were privileged to attend these classes saw him at his best, and found in him a friend to whom no labour was a trouble, so long as it might benefit his students. Not merely content with solving his students' difficulties, he often pursued their problems and derived interesting and original results, and although Dr. Jude did not publish many original papers in mathematical and physical subjects, this was undoubtedly due to the monopolisation of his time by teaching duties and problems arising from them. Nevertheless, we owe a great debt to him for his admirable treatise on physics, and for his books on elementary and advanced electricity and magnetism, all of which have been favourably reviewed in these columns. By their clearness and originality of treatment these books have done inestimable service to British students of science. Much of the apparatus described in them was of his own design.

In his youth, Dr. Jude acquired proficiency in French and German, and could converse freely in either language. Moreover, in addition to Greek and Latin, he made a study of Arabic. Quite late in his active career, and in connexion with the translation of one of his books into Russian, he took up the study of that language so that he might be able to look over the proofs of the translation. But perhaps the most remarkable of his linguistic achievements took place after his retirement. Living in Wales, and constantly hearing it spoken, he obtained a considerable knowledge of Welsh, in spite of failing vision, and was able to converse freely with the villagers.

By his kindly, unobtrusive, and gentlemanly bearing, Dr. Jude was endeared of all with whom he associated. His active life was spent in the service of others. He had much to give, and gave of it unstintingly. Our sympathy goes out to his widow, for whose unfailing encouragement and help he was ever grateful, especially in later years of failing sight and hearing.

ROBERT W. LAWSON.

PROF. ALBERT HESSE.

THE issue of the *Chemisches Zentralblatt* for May 28 announces the death at Berlin—Wilmersdorf—of Prof. Albert Hesse, who was editor of that journal from 1902 until 1923. He died on May 10, after a long and painful illness, at the comparatively early age of fifty-seven. The systematic co-ordination and abstracting of pure and applied chemical literature was the main achievement by which Dr. Hesse is known, and his great success in this field has been and is still of great service to the chemist. The fusion of the *Chemisches Zentralblatt* with the abstract journal of the *Zeitschrift für angewandte Chemie* in 1919 was a great achievement for Dr. Hesse, and this union will help also in the solution of the problem, yet unaccomplished, of including an abstract of the current patent chemical literature of the world.

Before concentrating on editorial work Dr. Hesse was an active chemist both from the academic and industrial aspects. He was a pupil of Wallach, and made a close study of the ethereal oils. His studies on sesquiterpene alcohols and the odoriferous constituents of flowers, including jasmin, rose, ylang, tuber, and orange-blossom, and the synthesis of camphor were among the problems which at different times occupied his attention. He was associated for some time with the famous firm of Heine and Co. of Leipzig, and his name occurs in many patents connected with essential oil.

In addition to his editorial work and his contribution to patent literature, reference may be made to two publications of a more economic character. Jointly with Prof. Grossmann he wrote a report entitled "England's Trade War and the German Chemical Industry," and in 1909 in the Wallach-festival publication he dealt with "The Development of the Ethereal Oil Industry in the last 25 years in Germany."

J. REILLY.

Current Topics and Events.

ANYTHING that will cheapen the cost of the electrification of our railways deserves serious study at the present time. In the United States, a continually increasing number of automatic sub-stations are being employed in electric traction. It is interesting, therefore, to notice that in the extension of the London Electric Railway from Hendon to Edgware, which opened for traffic on August 18, there is a completely equipped automatic sub-station. Although there are several of these stations in Great Britain in connexion with lighting networks, this is the first to be used for traction purposes. The building has been designed for three 1200-kilowatt rotary converters with all the necessary control gear and accessories. The sub-station gets a 10,500-volt three-phase supply from the Lots Road Generating Station at Chelsea, the frequency being $33\frac{1}{3}$. It is situated at Burnt Oak, which is one mile from the Edgware terminus and four miles from the manually operated sub-station at Golder's Green. To start a rotary converter at Burnt Oak, it is only necessary to close a switch at Golder's Green, all the subsequent operations being automatic. Cooling air for the transformers is supplied by a centrifugal blower. The automatic devices protect the machines in all conditions of overload. For example, when the load is too heavy, the circuit breaker opens and a resistance is inserted in the machine circuit and the rotary is disconnected from the supply mains. After a short interval the circuit breaker closes again and connexion is re-made. If the fault has been cleared, normal operation is resumed, but if not, the same sequence of operations happens again. If this happens a fixed number of times, the breaker is automatically locked and an engineer must be sent to investigate and remove the fault.

AT the conversaziones of the Royal Societies of Western Australia and New South Wales, held on June 28 and July 2, fitting celebrations were made of the centenary of the birth of Lord Kelvin. At the former there was an extensive exhibition of Kelvin apparatus and relics, including a series of photographs and engravings of the Old College at Glasgow. Lecturettes were given illustrating various phases of Kelvin's life and work. Their titles were "Gyroscopes," "The Atlantic Cable," "The Age of the Earth," "Glacier Motion," and "Solar Heat." At Sydney, Prof. H. S. Carslaw—an old pupil of Kelvin's—gave a memorial oration. He recalled the fact that two of the most famous periods in the history of mathematics in England were the age of Newton and the years during which the school of mathematical physics arose and flourished in Cambridge. Of the great names of that period without doubt the greatest was Kelvin. He had made valuable contributions to almost every branch of mathematical physics, and was the greatest pioneer of the age of electricity. It was peculiarly fitting that Australians should commemorate Kelvin, for his work on navigation made it much safer for them to cross the 12,000 miles of ocean which separated them from the homeland. The age of steam has done much for Australia, but the age of electricity has already done more.

SCOTLAND has never yielded, nor is it likely to yield, the range of prehistoric civilisations which successively flourished in southern Britain, for the incidence of the Ice Ace markedly reduced the habitable period in the northern kingdom. Yet it is possible that Scotland may furnish evidence on an important and obscure stage in the more recent history of prehistoric man, namely, on the transition from Azilian to neolithic culture. So far, the shell-mounds and kitchen middens of Oransay and elsewhere have given clues to one culture or the other, but none has shown a continuous habitation throughout the critical period. It is our belief that the places most likely to reveal such are the caves, and since these have been very imperfectly surveyed in Scotland, each new cave-excavation not only deserves commendation and encouragement, but raises hopes of outstanding discoveries. On the Mull of Kintyre, about four miles south of Campbeltown, the Kintyre Antiquarian Society has, with the assistance of Mr. L. M'L. Mann, set about excavating St. Kieran's Cave. Their findings, recorded in the *Glasgow Herald* of July 31, included an incised symbol clearly of Christian origin, flint implements, bone objects, and a human skeleton, buried in a short cist, and accompanied only by a worked flint. The skull is compared conjecturally with the famous dolichocephalic skulls of the Oban caves. The digging revealed the presence of several layers of habitation, but the details given are not sufficient to indicate the ages of the deposits, and the results of expert examination of the relics will be awaited with interest.

MR. J. H. MAIDEN, who for nearly twenty years has been government botanist of New South Wales and director of the Sydney Botanic Gardens, has recently retired under the age-limit. Born at St. John's Wood, London, in 1859, Mr. Maiden went to Sydney about forty-five years ago. Before leaving England he had studied botany under Prof. R. Bentley and Prof. D. Oliver, and shortly after settling in Sydney was employed in the Technological Museum there, becoming curator and secretary in 1882, after a year's service as acting curator. While holding these offices his botanical work was chiefly connected with economic plants, on which he contributed numerous papers to journals. In 1889 he published his well-known book: "The Useful Native Plants of Australia," and in 1890 appeared the first of the three editions of his "Wattles and Wattle-barks." During Mr. Maiden's directorship of the beautiful Botanic Gardens, Sydney, to which he was appointed in 1896, many improvements in them have been effected, and he had the satisfaction of seeing the erection of the fine new building in which are accommodated the Botanical Museum and Herbarium; this was completed in 1901. Holding important administrative and advisory posts it might be supposed that he would have had little time for authorship. Yet by his writings he has won a world-wide

reputation and a high position among the greatest botanists of his adopted country. "A Critical Revision of the Genus Eucalyptus," now in its seventh volume, is in itself a fine achievement. "The Forest Flora of New South Wales," of which seven volumes have been completed, is another. Mr. Maiden is also the author of several other independent works and of a multitude of papers in journals of societies and other publications. He has served a number of the scientific societies of Australia in various offices, and was president of the Royal Society of New South Wales in 1896–97 and again in 1911–12. Mr. Maiden became a fellow of the Linnean Society of London in 1888, and in 1915 received its Gold Medal. He was elected a fellow of the Royal Society in 1916, and in the same year was appointed to the Imperial Service Order. We look forward to the completion of his valuable Revision of the Genus Eucalyptus during the coming years.

IN a circular letter dated July 10, M. Sampaio Ferraz, director of the Meteorological Service of Brazil, urges the publication of reports of abnormal weather or abnormal wind circulation in some central publication, say the *Meteorological Magazine*. The abnormal wind and excessive rain experienced in Brazil during April and May of this year are quoted as a type of the information which might be collected in this manner. M. Ferraz suggests that all information for a particular month should appear in the same number of the *Meteorological Magazine*. The scheme put forward appears to us to be highly desirable, and it is to be hoped that either the *Meteorological Magazine*, or the Royal Meteorological Society, through its Quarterly Journal, will be able to make arrangements to publish such reports as are suggested from all the meteorological services and institutes of the world, two or three months in arrear. In the past, the publication of reports of abnormal weather conditions has been left largely to the *Meteorologische Zeitschrift*, but it is highly desirable to make a more systematic collection of such data, and to make them available in an English periodical.

THE August issue of the *Scientific Monthly* contains the address of Dr. Arthur D. Little to the Engineering Division of the National Research Council of the United States, under the title "Research: the Mother of Industry." After a short account of the great advances in industry during his own lifetime, he directs particular attention to the developments of the decade 1890–1900, during which Hall brought out the aluminium process, Acheson made carborundum, Willson calcium carbide, Diesel invented his engine, Cross and Bevan made artificial silk, Little himself produced cellulose acetate, Röntgen discovered the X-rays, Becquerel radioactivity, Madame Curie radium, and Marconi sent a wireless message across the Bristol Channel. On nearly every one of these discoveries an industry has been founded, and Dr. Little points out that while in the past the United States has prospered because of its cheap land and abundant raw materials, it can only maintain its position in the future by making use of every assistance science can afford, and that industry must in its own interest support research generously.

THE value of chemical evidence in archæology is generally known, and there are many examples of mistakes which have arisen from lack of chemical knowledge; for example, the description of early metal objects from Mesopotamia as "bronze," whereas in reality they are almost pure copper. In a very brief note in the *Cairo Scientific Journal* for July, Mr. A. Lucas gives some further examples. The black appearance of mummies is generally attributed to the use of bitumen, whereas it is either the result of a change of the flesh itself or of resin, or gum-resin, which has blackened by natural processes. No evidence has yet been found of the use of bitumen or mineral pitch, although they may have been used in Ptolemaic times. Castor oil has been described as honey and as natron, alkali used in glass-making has been described as potash though it was generally if not always soda, and the presence or absence of cobalt as a blue colour for glass and as a pigment has been asserted and denied without any chemical evidence. Most of the archæologists who have made really valuable progress have paid attention to the assistance which can be given by chemistry, and in future it may be assumed that the services of the chemist will be called in even more extensively than in the past.

IN the *Empire Review* for August, the problem of the mentally defective is raised again. It is a problem which is always with us, but which for that very reason is likely to be overlooked. Discussions on the subject usually resolve themselves into heated opposition to all the suggested schemes for dealing with the defective, or into a fatalistic resignation to the futility of all schemes. Miss Nelly Burdett pleads for the reanimation of public interest in the subject, which shall lead to more earnest efforts to put these people into such a position that they can be useful members of their own society, since by their defect they are debarred from adapting adequately to general society. She points out the disquieting fact that with our present system of half-hearted treatment, the ranks of the mentally defective are being increased. In 1906 it was estimated that one person in every 250 was mentally defective. Now it is one in every 200. A Royal Commission appointed in 1904, after four years' work, made recommendations which have not yet been realised. A point of considerable interest, not dealt with in this article, is that emotional conflict may mask itself in some form of mental defect, and much later trouble could be spared by suitable treatment and understanding from the beginning.

AT the conference on Illuminating Engineering held at the British Empire Exhibition on August 12, a paper was read by Mr. L. Gaster summarising developments at the International Conference on Industrial Hygiene, and the meeting of the International Illumination Commission recently held in Geneva. The former afforded a good opportunity of interesting experts on hygiene in illumination, and the importance of good industrial lighting in the interests of the

health and safety of workers was freely recognised. It was suggested that the International Illumination Commission should bring before the International Labour Bureau of the League of Nations problems in industrial lighting, etc., with a view to their being studied by the Governments of the respective countries. Industrial lighting also formed the subject of much discussion by members of the International Illumination Commission. A feature of interest is the large number of scientific and industrial bodies which co-operate with the American Illuminating Engineering Society in the revision of their codes of school and factory lighting. Arrangements have been made for the National Research Council to supervise researches on the results of better lighting. These facts were mentioned to illustrate the desire for co-operation in the United States and the recognition by manufacturers and gas and electricity supply undertakings that researches, in order to carry weight with the public, must bear the impress of scientific and impartial authority. After describing the methods adopted in America for promoting public appreciation of the benefits of good lighting, Mr. Gaster urged the need for a comprehensive scheme in Great Britain, in which all interested in illumination could join. A resolution approving the proposal of the Illuminating Engineering Society to initiate such a scheme was passed unanimously. A paper on "Illumination of Highways from the Motorists' Point of View" was read by Mr. E. H. Fryer, and there was also an interesting discussion on the methods of lighting adopted at the British Empire Exhibition.

A FULL report of the International Meteorological Conference of Directors and of the meeting of the International Meteorological Committee at Utrecht, September 1923, an account of which appeared in NATURE of October 6, 1923, p. 523, has recently been issued as Publication No. 112 of the Koninklijk Nederlandsch Meteorologisch Institut. The volume consists of 191 pages. At the meeting in London, September 1921, it was arranged that the next meeting should be held at Utrecht. The president was Sir Napier Shaw, and the assembly represented 20 countries, including, in addition to Europe, Argentine, Brazil, India, Japan, and New Zealand. There was a very copious agenda, the rapid progress of meteorology of late years rendering international understandings and arrangements essential to its further advancement. Land and marine meteorology over the whole globe were considered as well as upper air observations, and the general collection and distribution of obtained results. The Appendices give a large amount of information, considered internationally, and afford much material for quiet study. The discussion includes terrestrial magnetism and electricity of the atmosphere, solar and terrestrial radiation. Special consideration is given to the exploration of the upper air, the arrangement of dates for international ascents of pilot-balloons and ballons sondes, and a time-table of issues by radio-telegraphy in connexion with weather telegraphy and weather forecasting. The subjects include marine meteorology with its important considerations of world-wide interest, réseau mondial, agricultural meteorology, the propagation of sound by means of explosions, and the study of clouds. These international meetings lead to essential uniformity in methods of observation and discussion and aid much in the extension of observations for land and sea areas. For weather forecasting and for considerations of physical meteorology on land or sea as well as in the air above the surface of the globe, trustworthy and comparable data are available—the aims and objects being arranged by personal contact among those interested and responsible for the world's meteorology.

THE *Chemiker Zeitung* announces that Prof. W. J. de Haas, of Groningen, has been appointed to succeed Prof. H. Kamerlingh Onnes, of Leyden, who has resigned.

AT the annual autumn meeting of the Institute of Metals to be held in London on September 8-11, Mr. W. M. Corse, of the National Research Council, Washington, D.C., will lecture on "Recent Developments in Non-Ferrous Metallurgy in the United States, with Special Reference to Nickel and Aluminium-Bronze." Visitors' tickets for the meeting can be obtained from the Secretary of the Institute, Mr. G. Shaw Scott, 36-38 Victoria Street, Westminster.

AT the monthly General Meeting of the Zoological Society of London held on August 13 it was reported that the number of visitors to the Society's gardens during the month of July had been 266,559, showing an increase of 85,538 as compared with the corresponding month last year. The total number of visitors to the Gardens since January 1 had been 1,079,608, an increase of 249,239. The number of visitors to the Society's aquarium since its opening on April 4 had been 316,347.

A SURVEY of the Great Barrier Reef area has been undertaken by the Commonwealth Government of Australia, and the naval sloop *Geranium* has been detailed for the work. The vessel will have a seaplane attached for general help and work in the survey, and a preliminary flight around the coastline of Australia was recently completed with the view of deciding the kind of assistance which can best be afforded from observations in the air. The commander of the *Geranium* is a member of the Barrier Reef Committee of the University of Queensland, and he will take with him two scientific investigators attached to the Committee.

A PRIZE for the physiology and pathology of altitude has been founded by the Alpine Sanatorium of Semmering, Austria. One thousand gold krone are offered to the author of the best work accomplished or published in the last two years, which has extended our knowledge of the action of alpine climate on man. The prize is intended in the first instance for Austrians, but foreigners can also be considered if their work has been carried out in Austria. Printed or typed papers should reach the Kanzlei of the Akademie der Wissenschaften, Wien I., Universitätsplatz 2, before December 31, 1924. Some notable English reports both from the Andes and the Himalaya deserve to be laid before the commission of judges, even if they may have to be marked not for competition.

THE communications of the Society of German Men of Science and Physicians—Gesellschaft Deutscher Naturforscher und Ärzte—are now distributed monthly with *Die Naturwissenschaften*. The *Mitteilungen* give general information about the Society. Subscriptions have been reduced to a minimum of three marks; those who can are asked to give more. The 88th meeting is to be held at Innsbruck, Austria (Sept. 21-27). The president-elect, Dr. Richard Paltauf, professor of pathology in Vienna, died on April 21. Some of the chief addresses at Innsbruck will be by Dr. Hoche on the body-mind problem, Dr. Hess on the physiology of work, Dr. Frisch on the senses and language of bees, Dr. Sommerfeld on atomic researches, Dr. Penck on the aspect of the Alps. Those intending to take part in the Innsbruck meeting should communicate with Prof. D. A. Defant, Büro der Naturforscher Versammlung, Physik. Institut, Schöpfstr. 41, Innsbruck.

THE Castner-Kellner Alkali Co., Ltd., has issued recently a number of informative pamphlets dealing with some of the chemical products which it manufactures. Among these is sodium perborate, which is used for bleaching textiles, oils, fats, waxes, and foodstuffs. In the solid state this substance is quite stable, but on solution in water it yields hydrogen peroxide, caustic soda, and borax, the last named acting as a water-softener. The formation of caustic soda might be harmful, but can be readily obviated by adding sodium phosphate or bicarbonate, or a pure mineral acid. The pamphlet entitled "Chlorine and Chlorine Products in relation to Public Health" describes the manifold applications of liquid chlorine, bleaching powder, and sodium hypochlorite. Liquid chlorine is being used increasingly for sterilising potable water, and it is not generally known that a large proportion of the London water supply is now treated with this substance in the ratio of 0·5 part of gaseous chlorine to one million of water, whereby the water is improved bacteriologically about one thousand times. It is well known that diseases may be contracted from the water in public swimming-baths; 1-3 parts of chloride of lime per million of water, applied every 1-2 days, will effectually sterilise the water. Other applications are for sterilising canal or river water before use in condensers at power-stations, and for disinfecting streets, sewage, the farm and the kennel. A third pamphlet contains, *inter alia*, directions for using bleaching powder, calcium hypochlorite and sodium hypochlorite solutions to bleach textiles (other than wool), artificial silk, and paper pulp, with or without previous scouring with alkali and a solvent such as trichloroethylene. Bleaching agents containing chlorine are now in use for bleaching and desulphurising mineral oil, and for converting unsaturated hydrocarbons in such oil into saturated hydrocarbons.

Our Astronomical Column.

THE PERSEIDS OF 1924.—Mr. W. F. Denning writes: "From observations made at various stations, it appears that the shower has been less abundant than usual. On the important night of August 11, the weather was unfavourable and only enabled a few meteors to be seen through breaks in the clouds. At Ashby, Lincolnshire, Mr. King, watching occasionally a partially overcast sky between $10^h\ 29^m$ and $13^h\ 58^m$ G.M.T., saw 28 meteors, of which 19 were Perseids, from a radiant well defined at $46° + 57°$. At $13^h\ 20\frac{1}{2}^m$ a splendid Perseid several times brighter than Venus was observed shooting from $30° + 52\frac{1}{2}°$ to $26° + 50\frac{1}{2}°$. A brilliant Perseid was also seen from Warwick Road, London, S.W., and from Greenwich, S.E., on August 12 at $9^h\ 42^m$ G.M.T. It was about three times as bright as Venus and left a luminous trail for about ten seconds. The direction of the flight was from α Ursæ Majoris towards α Comæ Berenicis, so that the object was evidently a very fine Perseid. Further observations of the two large meteors referred to above would be valuable."

AN ANTI-RELATIVITY THEORY.—Articles in the July and August numbers of *Scientia* by Prof. La Rosa contain a daring suggestion as to the cause of variability in stars, including the outburst of Novæ. Few are likely to accept the author's suggestion as a *vera causa*, but the articles are worth reading as a study of the consequences that would follow from his assumptions as to the laws governing the speed of light.

Prof. La Rosa rejects not only the Einstein postulate as to the constancy of the measured speed of light, but also the previous postulate that the speed is conditioned by the medium conveying the light-waves. In fact, he reverts to the corpuscular theory, supposing that the speed of the corpuscles is the resultant between the speed of the luminous body and that of the emission of corpuscles. Taking, for example, a star moving with a speed of 60 miles per second in a circular orbit the plane of which passes through the sun, the difference between the speeds of emission at the two elongations is 1/1500 of that of light, and if the time between the elongations were (say) 2 months, and the star 250 light-years from the sun, the light emitted at the two elongations would reach us simultaneously. There would thus be a rhythmic increase and diminution in the amount of light received during the revolution. Novæ are explained by supposing very eccentric orbits of cometary form so arranged as to give a great concentration of light in the neighbourhood of perihelion.

PROPER MOTIONS OF THE HYADES.—Memoir No. 35 of the Kapteyn Laboratory at Groningen, by the Director, Prof. van Rhijn, deals with the proper motions of the Hyades stars, based on photographs taken at Helsingfors. It contains a full discussion of the measures and reductions and a catalogue of 395 proper motions. The final mean annual proper motion of the cluster is given as 0·102″ in Position Angle 102°. It is not difficult to separate the cluster stars from the non-cluster ones by their motion; this appears clearly when the motions are plotted as a series of dots the abscissæ and ordinates of which indicate the motion in x, y respectively.

The density of non-cluster stars is found to be somewhat less than in other regions of the same galactic latitude, and it is noted that the same peculiarity has been found in other cluster regions. We may conjecture that the cluster stars are surrounded by dust-bearing regions, which absorb some of the light of stars in the background. The presence of such dust round the Pleiades stars is shown by their accompanying nebulæ, the spectra of which appear to indicate that they are dust-clouds reflecting the star light.

Research Items.

POISONS AND WITCHCRAFT IN PAPUA.—In the August issue of *Man* the Rev. R. Lister Turner describes the methods in the use of poison in witchcraft in Papua, which exhibit a close resemblance to those practices recorded by Dr. Codrington as being followed in the island of Florida by the Melanesians. This Papuan custom, which is known by the name of "Vada," consists in stunning the victim with a club and then forcing poison plants down his throat. A magical formula is repeated over the victim and he is gradually brought back to consciousness. Later he dies. It is said that an alternative method is to place the poison in a cut in the thigh, which is healed magically so as to leave no trace of the wound. Three poisons are believed to be employed—"Matua" and "Tua," which are plants, and "Gavroa," a worm with yellow stripes; but owing to the secrecy which is essential to the success of the "Vada," it is not possible to say more than that there is a probability that poisons are used. A method in which poisons are not used has come under the notice of the authorities. In this the abdomen of the victim is pummelled with cobble stones after he has been rendered unconscious. The result in one case was death from a broken spleen.

THE INHABITANTS OF NEW CALEDONIA AND NEANDERTHAL MAN.—Prof. Fritz Sarasin has made a detailed comparative study of the osteology of the New Caledonians and Neanderthal man, of which the results are published in *L'Anthropologie*, xxxiv., Nos. 3-4. He finds that in a large number of their skeletal characters the New Caledonians show a closer affinity to Neanderthal man than do Europeans; but, on the other hand, in certain features they are even more primitive than the Neanderthal group. Among these are irregularities in the region of the pterion, a more pronounced prognathism and the more simian conformation of the nasal skeleton. There are, however, a number of divergences in the two groups. The New Caledonians, for example, have a more vaulted cranium, rectangular orbits, and the radius shows little or no curvature, while all the bones of the skeleton are less robust. The general conclusion is that the New Caledonians form one of a closely-related group, including Australians, Tasmanians, and other Melanesians, which is more primitive than the fossil representatives of *homo sapiens*, Piltdown man being set aside as still indeterminate. It resembles closely the primitive ancestor of existing races, Rhodesian man possibly being the proto-Australian type, and the connecting link between the Austro-Melanesian group and a pre-Neanderthaloid ancestor.

PRECURSORS OF THE JAPANESE EARTHQUAKE.—In two earlier papers the late Prof. Omori described semi-destructive earthquakes at Tokyo in 1921 and 1922, and, in a posthumous paper (*Seismological Notes*, No. 4, 1924) he refers to the strong earthquake of January 14, 1923. The focus lay some distance to the north of that afterwards in action on September 1, being about 30 miles N.N.E. of Tokyo. From the duration of the preliminary tremor he assigns to the focus the unusually great depth of about 30 miles. In an appendix dealing with future earthquakes in Tokyo (written before the great earthquake) he ventures on some predictions which, unfortunately, have not been verified. "Tokyo," he says, "may be assumed to be free in future from the visitation of a violent earthquake like that of 1855, as the latter shock originated right under the city itself, and as destructive earthquakes do not repeat from one and the same origin, at least not in the course of 1000 or 1500 years," and "a great suboceanic earthquake off the coast of Izu or Awa-Kazusa peninsula . . . is not likely to occur for at least some 60 or 70 years to come." Yet it was in the latter district that the recent earthquake had its origin.

THE ACTION OF PITUITARY EXTRACTS.—In a recent paper in the *Quarterly Journal of Physiology*, L. T. Hogben and W. Schlapp (vol. xiv. p. 229) have studied the effects of pituitary extracts on vertebrates other than mammals, with the view of finding whether there is any evidence of the existence of independent components showing vascular activity in the extracts. Adrenaline produces a rise of blood pressure in all four classes of air-breathing vertebrates, but pituitary extracts in physiologically significant doses have no such effects on the blood pressure of the reptile or amphibian, there being in fact a fall of pressure in birds and reptiles, though corresponding doses of the same preparations produced pressor effects in mammals.

INSULIN FROM THE COD-FISH.—Dr. H. W. Dudley, in the current number of the *Biochemical Journal* (xviii. p. 665), shows that insulin may be obtained in large amount from the islet tissue of the cod-fish. The yield, even under unfavourable conditions, was as high as 13·12 rabbit units per gram, and probably more would have been obtained from absolutely fresh islets. It is estimated that the islet tissue of the cod contains, weight for weight, about ten times as much insulin as is present in mammalian pancreas. The material was collected from the Yorkshire shore fisheries in February and March, and placed in picric acid solution, which fixed the tissue and converted the insulin into a picrate. The insulin-containing picrate fraction was extracted with watery acetone, and the picrate converted into the hydrochloride by the method previously described by the author. The finding of such large yields of insulin in the islet tissue, which is structurally identical with the islets of Langerhans of the pancreas in mammals, furnishes us with very good proof that it is really in the islets of the pancreas that insulin is normally produced.

SOUTH AMERICAN NON-MARINE MOLLUSCA.—Dr. H. A. Pilsbry (Proc. Acad. Nat. Sci. Philad., vol. lxxvi.) has, under a common title, united four notes on South American non-marine Mollusca. The first deals with shells from Lake Titicaca, whence very few mollusca are known and nearly all of species confined to the lake. The varieties of *Planorbis andecolus* are specially described and figured photographically on an excellent plate. There are, further, four species of Littoridina, two being new, and a new species of Pisidium (*P. titicacensis*) which, if correctly figured, exhibits hinge characters differing from those usual to the genus. The second note, on South American genera of Ancylidæ, discusses four out of the five genera known from that continent, including a new genus, Anisancylus, founded with *Ancylus obliquus*, Brod. and Sowb., as type. Descriptions of two Brazilian Amnicolidæ, being new species of Idiopyrgus and Potamolithus, form the third note. A note on Pupillidæ collected by Dr. Baker in Curaçao and its dependencies in 1922 concludes the series. A new species and new sub-species are described. Text figures accompany all four notes.

WEATHER AT HONGKONG.—A report of the Royal Observatory, Hongkong, for the year 1923, prepared by the director, Mr. T. F. Claxton, has recently been

issued. In addition to the annual report, a Monthly Meteorological Bulletin is issued. Automatic records are obtained for most elements, and considerable care is exercised to secure the greatest accuracy. The monthly and annual values of the several elements are given in the December Bulletin, and in lesser detail in the Annual Report. The mean temperature for the year was 72°·5 F., which is 0°·6 above the normal for the past 40 years; the absolutely highest temperature was 92°·9 on August 4 (the highest on record for the 40 years is 97°); the lowest temperature was 45°·7 on January 4, whilst for the 40 years the lowest reading is 32°. Temperature was considerably above normal in March, November and December, and moderately above in April and May; in the remaining months it was nearly normal. The total rainfall for the year was 106·74 in., which is approximately 22 inches more than the normal for 40 years, the greatest fall in one day was 11·50 in. on October 31, when in a single hour the fall was 2·82 in. The maximum wind velocity for one hour was 106 miles on August 18, which is only 2 miles less than the highest on record; the maximum squall velocity on the same day was at the rate of 130 m.p.h., the highest on record. Tracks of typhoons and depressions in the Far East during the year 1923 are given, and the centre of the memorable storm of August 18 is shown to have passed over Hongkong, travelling westward from off the sea. The seismograms show that 141 earthquakes were recorded in 1923. In connexion with upper air research, 49 flights with pilot balloons were made during the year. Daily weather reports from surrounding stations are given in each Monthly Meteorological Bulletin.

A THEORY OF SUPER-CONDUCTIVITY.—Herr E. Kretschmann, in the *Annalen der Physik* for June, develops a new mathematical theory of electrical conduction, and uses it to explain the phenomena near the absolute zero of temperature. He rejects the idea that the conduction electrons are moving in any kind of quantum orbit, and deals with them as a swarm, moving under the influence of an infinitely small e.m.f.; he concludes that the specific conductivity of a homogeneous isotropic metallic conductor is infinite, for a swarm with given velocity in the direction of the current, when and only when the mean retardation in this direction vanishes. This will be the case, according to the quantum theory, if none of the conduction electrons spring into the closed quantum orbits of the molecules of the substance. He supposes that near the absolute zero all the quantum orbits are occupied, so that the conduction electrons cannot spring into them. When the temperature rises above a certain critical point the exterior orbits "are broken up" by the thermal vibrations of the molecules; this apparently means that electrons in these orbits are thrown off in haphazard directions, and conduction electrons fall into the orbits after an interval, so that the average velocity of the swarm is diminished.

THE CRYSTALLINE STRUCTURE OF SOLIDIFIED ARGON.—Herr F. Simon and Fräulein C. von Simson describe, in the *Zeitschrift für Physik*, July 2, an X-ray investigation of solid argon, in which they employed the method previously used by them for hydrogen chloride. Liquid hydrogen was passed through the capillary tube of the apparatus to cool the surrounding argon to its freezing point. The lattice is cubic, face centred, with closest spherical packing; at $T=40°$ abs. $a=5{\cdot}42\pm0{\cdot}02$ Å, and the density is $1{\cdot}62\pm0{\cdot}02$. The density of the liquid at the melting point, 84° abs., has been found by Baly and Donnan to be 1·42. The atomic radius (Bragg's formula) is 1·92 Å, while the mean ionic radius of K^+ and Cl^-, which have the same electron arrangement as argon, is 1·52 Å. It appears then that the atomic radius depends on the forces acting between the atoms, and is smaller the larger the forces of attraction. The authors make use of their results to study argon from the point of view of the theories of Mie, Grüneisen, and Born. Only approximate results can be obtained, as the data are incomplete; but it appears that the behaviour of argon is different from that of the metals, in which the exponent of the term representing attractive force at close range is $m=3$, while for argon it may be about 9.

THE INTERVALS BETWEEN THE OPTICAL DOUBLETS AND TRIPLETS.—Prof. A. Landé contributes a paper to the *Zeitschrift für Physik*, June 24, in which he deals with the relationship between the optical doublets and the X-ray relativity doublets. It cannot be expected that the former should show the same exactness in satisfying Sommerfeld's simple approximate formula as that author has found in the case of the X-ray spectra. In the latter case the processes take place in the inner electronic spheres, where the conditions alter in the simplest (linear) manner with increase of the nuclear charge, $+Ze$. The optical terms, on the other hand, depend on the motion of a photo electron, which for the greater part of its path is outside the atomic kernel; but which enters the kernel, and approaches very close to the nucleus; this last part of the orbit is of the greatest importance in determining the distance between the components of the doublet, which depends on the screening s at this position. Sommerfeld found for the L doublets, from Nb (41) to U (92), $s=3{\cdot}5$; for the optical doublets of elements with large atomic numbers s varies about the number 4, for all p terms; only with the first elements of the first period is s equal to 2. The difference between the value 4 and Sommerfeld's value 3·5 for the L doublets may be due to the fact that in the latter an L electron has been removed, which diminishes the screening. The paper directs attention to the difficulties involved in the explanation of the doublet distances by the relativity theory, both for X-rays and for light; and also to those involved in the alternative magnetic explanation.

SEDIMENTARY ANALYSIS OF PHOTOGRAPHIC EMULSIONS.—Mr. F. F. Renwick has devised a new method of attacking some of the problems connected with photographic emulsions that promises to give results of great interest (Journal of the Royal Photographic Society, August). He has constructed a water bath with regulators so that its temperature falls very slowly but with great regularity, 0·4° C. an hour. The melted emulsion is thus brought to its setting point without appreciable interference from convection currents. The block of emulsion obtained is about 15 cm. high, and slices are cut parallel with its base from various parts of it for examination. It is found that passing from the top layer downwards the particles of silver salt increase in size, the percentage of silver salt increases, the proportion of silver iodide to the total silver haloid increases, the turbidity decreases, and the sensitiveness increases. The sensitiveness in one case of the emulsion being 65, the layers gave as results 16 at the top increasing to 110 at the bottom. By putting a clear gelatin layer under the emulsion, the larger particles fall into it and are thus more completely separated than by the other method, or the sedimentation may be repeated on any given layer if a more complete separation is wanted. Seven photomicrographs are given to demonstrate the results.

Imperial Botanical Conference.

THIS conference, the first of its kind, was held at the Imperial College of Science and Technology, South Kensington, on July 7-16, under the presidency of Sir David Prain. It was attended by a large number of overseas and home botanists, and many interesting topics were discussed.

PLANT PHYSIOLOGY.

In the Section of Plant Physiology, Dr. F. F. Blackman organised an extremely illuminating discussion on "The Physiology of Crop Yield." In the general introduction to this discussion he indicated the five chapters of modern scientific investigation which combine to illuminate the problem of crop yield. The first dealt with the experimental study of the factors and conditions affecting growth, and was illustrated by papers from Dr. F. G. Gregory on the study of plant growth with controlled artificial light, and from Prof. V. H. Blackman on the results of electro-culture experiments. The second chapter concerned the ontogeny of the crop and duration of the development sequence. It was pointed out that crop-yield covers a wide range of special cases, the desired crop being either the whole plant, its wood, fibre, or bark, or some special morphological part, such as the petals, stamens, fruit, or seed hairs. The desired part comes at the end of a long development sequence, and, for this aspect of crop yield, detailed studies are required of the normal sequence of development of each crop plant combined with an exploration of its plasticity under natural and artificial variations of environment. Other problems arise out of the varying duration of the development sequence in the individual crop plants. These were illustrated by Dr. W. L. Balls' account of his method for analysing the development of the cotton plant by collating records of the significant stages prior to the production of cotton. The next chapter dealt with the quantitative relations between the final yield and the various "factors" which affect the development of the crop plant. Several investigators, notably Mitscherlich, have tried to formulate a general law governing the relation between the plant yield and the magnitude or intensity of all outside factors, but Mr. G. E. Briggs showed the inadequacy of such formulæ.

The fourth phase of this symposium treated of the complexity of the plant's spatial environment, namely, the soil, and was illustrated by Mr. E. J. Maskell's account of critical pot-culture work at Rothamsted. Lastly, the influence of the weather on crop yield was considered, and the great difficulty of disentangling the effects of the various components of the weather was pointed out. Dr. R. A. Fisher showed that by the methods of statistical analysis significant relations between weather factors and yield can be computed where a sufficient mass of data is available. In the general discussion which followed the presentation of the main thesis, Mr. F. L. Engledow drew a comparison between a tillering plant, such as wheat, with a non-tillering plant, such as cotton, as regards development sequence and its effect upon crop yield. Dr. H. M. Leake directed attention to the enormous influence of rainfall upon plant growth in monsoon countries, owing to the elimination of temperature as a limiting factor.

GENETICS.

In the Section of Genetics, Mr. F. L. Engledow opened a noteworthy discussion on "The Economic Possibilities of Plant Breeding," Mr. W. Bateson being in the chair. Mr. Engledow confined his attention chiefly to the possibilities of hybridisation in the English wheat crop. He pointed out that the economic possibilities of breeding are measured by the prospects of producing new forms which will give better financial returns than the old. Enhanced returns may accrue from higher yield, better quality, and a number of other amenities, many of which indirectly affect yield and quality, and all influence financial return. Quality improvements, such as those exhibited by the varieties Yeoman and Yeoman II., produced by Professor Biffen, have great promise. Improvement of yield is more difficult, as the average yield of wheat per acre is already higher in England than in any other country. The best policy is to try to identify the plant characters which mainly govern yielding capacity, and then by synthetic breeding to produce optimum combinations of these characters suitable for different localities. Among "other amenities" are the qualities of disease-resistance, non-lodging, early ripening, and winter hardiness, all of which are of great importance, and the attainment of which seems reasonably possible. Dr. R. N. Salaman dealt with similar problems in potatoes, Mr. M. A. Bailey dealt with cotton, and Mr. J. M. F. Drummond with oats and turnips. In the other session devoted to genetics, Prof. J. Percival opened a discussion on "The Value of Selection Work in the Improvement of Crop Plants," to which contributions were made by Prof. R. G. Stapledon, Dr. W. L. Balls, Mr. G. O. Searle, and Mr. G. N. Sands.

PLANT PATHOLOGY AND MYCOLOGY.

Much attention was paid at the Conference to problems in plant pathology and mycology. Dr. A. W. Borthwick opened a discussion of much interest on the "Relation of Forest Pathology to Silviculture," in which an appeal was made for closer co-operation between the practical cultivator and the pathologist, and for the latter to confirm his laboratory investigations by further research in the forest. Mr. W. E. Hiley stressed the importance of the non-parasitic agencies which frequently cause severe mortality in seedling trees and loss of increment during later stages of growth. He urged the need of a careful study of the particular edaphic and climatic requirements of the various species used for forestry purposes, indicating that in the absence of complete suitability the trees often die or grow slowly, and are more than usually susceptible to parasitic attack. Dr. J. W. Munro and Dr. Malcolm Wilson also contributed to this discussion. Another session in this Section was devoted to a discussion on "The Relation of Plant Pathology to Genetics." This was introduced by Mr. F. T. Brooks, who summarised recent achievements in breeding disease-resistant varieties of crop plants, and pointed out the limitations of this method of disease-control. He stressed the importance of co-operative effort between plant pathologists and geneticists. Prof. Groom dealt with "Fungal Attacks on Timber," indicating the enormous losses which occur, and urging the need for more intensive research upon the problems involved. There were also interesting discussions on "Bud-rot of Palms," "Mosaic Disease of Sugar-cane," and "Brown Bast Disease of Rubber Trees."

SYSTEMATIC BOTANY AND GEOLOGY.

In the Section of Systematic Botany and Ecology, Dr. A. W. Hill opened a discussion on "The Best Means of Promoting a Complete Botanical Survey of the Empire." The present position of the Botanical Survey of the Empire was reviewed, and attention

was directed to the most pressing needs of the moment. It was pointed out that in some regions, such as India, Malaya, and South Africa, great progress had been made in the systematic study of their floras, but that in others, such as East Africa and some of the West Indian islands, little had yet been done to explore the vegetation resources. In urging that further facilities should be afforded to British botanists to go out and explore the floras of our overseas dependencies, Dr. Hill stated that at present we were indebted chiefly to foreign botanists for a knowledge of the plants of some parts of the Empire. A strong appeal was made for temporary interchanges of posts between overseas and home botanists. The value of a detailed botanical survey was emphasised, especially from the point of view of the economic resources and possibilities of the Dominions, Colonies, and Protectorates.

Another important and closely allied subject dealt with at the conference was the consideration of the best means of promoting the study of natural vegetation of the Empire in its ecological aspect. This was introduced by Mr. A. G. Tansley. It was pointed out that the modern study of vegetation regards each kind of plant covering, be it forest, scrub, or grassland, as having a natural life, economy, and history of its own. If a given type of vegetation is sufficiently well adapted to the local climate and soil, not threatened by the invasion of plants better adapted to all the conditions, and undisturbed by man, it will maintain itself indefinitely. Many kinds of vegetation are, however, mere transition phases to other types, which gradually replace the former covering by the natural invasion of individuals of different species, as, for example, when new soil, such as the alluvium of a river, blown sand, or the like, is occupied first perhaps by grasses, then by shrubs, and finally by trees. Again when forest is felled or burned, or when grassland is burned or overgrazed, new plants, often resulting in a different type of vegetation, invade and settle in the area. The original vegetation may or may not ultimately return. All these phenomena of the development of vegetation are referred to as "succession."

Such facts have, of course, long been well known to practical foresters and stock-raisers, but their systematic investigation is a modern study, vigorously pushed forward, especially in the United States, and also in some of our own colonies and Dominions, especially in New Zealand and South Africa, and to some extent in India and Burma. The results have proved most valuable as a practical guide to the treatment of the land. Overgrazing, for example, may greatly lessen or even destroy the value of a cattle range, by crippling the vegetative powers of the dominant pasture plants, and thus letting in less valuable or worthless herbs, "throwing back the succession" to an earlier stage. The range then has to be allowed time to recover by the natural succession of the grasses and other pasture plants which originally occupied it. A carefully regulated system of grazing or burning will maintain the most useful phase of the succession. The first step towards the discovery of the most scientific and therefore the most economical and productive treatment is the careful and thorough study, by trained investigators, of the natural composition, behaviour, and succession of the vegetation. This has been amply proved, to mention but two examples out of many, by the work of Sampson in the United States and of A. H. Cockayne in New Zealand. The laws of behaviour of forests, on which alone can be based the most scientific treatment, are subject to quite similar laws, and a marked feature of this part of the Conference was the hearty support given by men with long practical experience of forestry work, such as Prof. Troup, of Oxford, who was for many years a member of the Indian Forest Service, and by Mr. R. S. Hole, for some years botanist at the Forest Research Institute at Dehra Dun, to the proposals of the conference.

After very brief summaries of the present state of knowledge of the vegetation of the Crown Colonies and Protectorates, and of the Dominions, and a series of papers from representative men of experience of such work in different parts of the Empire, there was a general discussion, concluding with resolutions. These aimed at the creation of a small central body to superintend the preparation of a series of outline monographs on the vegetation of the different parts of the Empire. Though our knowledge is still, of course, very incomplete, it is of great importance to collect and present what we do know in accessible form, which will serve as a starting-point for further work. It is further proposed to arrange for the systematic record of future work uniform with the monographs. It is also proposed that the central body, when formed, should at once put in hand the preparation of a pamphlet or small handbook, co-operatively produced by the best available authorities in the Empire, dealing with the aims and best methods of field work in the study of different kinds of vegetation, so that a practical guide may be available for new workers in this field throughout the Empire. The conference also adopted a resolution that an adequate training for work on vegetation should involve a practical training in systematic botany and ecology by competent teachers in the field.

At the closing session of the conference Prof. F. O. Bower gave a striking address on the training of botanists, the possibility of effecting interchanges of staffs, and the need for further facilities for research, which was followed by an animated discussion.

The conference terminated with a hearty vote of thanks to Sir David Prain for presiding over its labours.

F. T. BROOKS.

The Maximum Recorded Temperature of the Air and its Circumstances.

IN the midst of the semi-desert plain of Jefara, between the coast of Tripolitania and the interior plateau, there exists an official Italian settlement situated about 25 miles south of Tripoli and 25 north of Gharian at some 300 feet above sea-level, known as Azizia. In 1913 Prof. Filippo Eredia, as a member of an agricultural commission, visited the locality, and wisely saw to the establishment of a meteorological station on the lines followed at many other points in the colony. He took great pains to ensure the accurate functioning of the instruments after approved methods, and has recently published the results for a period of seven, not, however, consecutive years: 1913, 1914, 1915, 1919, 1920, 1921, 1922. (Ministero delle Colonie. Sul Clima di Azizia (Tripolitania), Rome 1923.)

The mean yearly temperature for this period is 70·8° F. (21·6° C.), not an excessively high figure, but appropriate to the latitude well outside the northern tropic, the range being between 87·4° F. (30·8° C.) in July and 52·8° F. (11·6° C.) in January. Therefore, though the summer is torrid, there is a very decided cool season, slight frost being occasionally experienced with an absolute minimum for the period in question of 31·1° F. (−0·5° C.) in December. Maximum temperatures as high as 110° F. (43·3° C.), the figure

for each of the five months May to September, the absolute maximum occurring with cloudless sky and S.W. wind, on September 13, 1922, namely 136·4° F. (58·0° C.), during a period of extremely high temperature throughout Tripolitania, even the coastal city of Tripoli recording as high as 113° F. (45·0° C.). This appears, and is so represented by Eredia, to be the highest authentic temperature of the air ever recorded on the globe, exceeding by 2·3° F. (1·3° C.) the previous "record" of 134·1° F. (56·7° C.) in Death Valley, in the south-eastern desert of California, on July 10, 1913, occurring, that is, in a similar, or rather higher latitude, close to the summer solstice, when the sun is nearly vertical. Records exceeding 115° F. (46° C.) are stated to be common in Tripolitania, whilst other extremes from other regions, quoted for comparison, are 127·4 F. (53·0° C.) in the Wargla oasis of Algeria, on July 17, 1879, and 125·9 F. (52·2° C.) at Jakobabad in N.W. India, on June 13, 1897.

The remarkable circumstance connected with the Azizia "record" is, we think, not so much the extra-tropical location, since it is towards the dry sub-tropical belts, where the days are longer, that the most intense summer heats occur, but that the season of its occurrence there should have been equinoctial. The mean temperature of the month of September for the seven years in question is exceedingly high, surpassing not only that of May, which is usual in northern extra-tropical latitudes, but also that of June, which is quite abnormal. This anomaly appears to be a local accentuation of the common Mediterranean characteristic of excessive summer heat lingering to a later date than in higher latitudes, where the much greater difference in the length of the day between solstice and equinox usually permits a rapid decline in temperature when August is over. Yet we know that even in England there comes every few years, with a drift northward of warm Mediterranean air, a surprising development, or resumption, of severe heat in September, with afternoon maxima at about 90° F. (32° C.), which sometimes causes the climatological student to wonder how the oblique equinoctial sunshine in this latitude has enough strength to raise the temperature to such levels. It should be remembered, however, that apart from the large reserve of heat stored in the air and the land- and sea-surface in autumn, and its easy transport by air currents from heated southern regions, enabling a smaller amount of solar radiation to raise the temperature to 80° or 90° F. (27° to 32° C.) than is necessary early in the summer, the very fact that the equinoctial sunshine is feebler, implying a smaller amount of surface heating, involves in turn, in conjunction with the relatively warm upper air in the autumn, a shallower vertical temperature gradient, and lessened tendency to convection, than at the high solstice. The result of this is that the heat is kept more to the surface, and that September "heat-waves," when they do occur, are liable to be scarcely less severe than those of July and August, and rather more so than those of May and June, when the fierce insolation, coupled with the yet cold upper air in early summer, favours instability with removal of the warm air from the surface and a checking of the afternoon maxima.

The circumstances attending the highest temperature which has yet been "caught" by our observing stations, may be summarised as follows: It occurred during a period of cloudless sky with light winds from the heated regions of the Sahara, in the middle of a semi-desert plain well inland from the sea, in a latitude (32½° N.) which, astronomically at least, belongs to the temperate zone, at a date (Sept. 13) only ten days on the summer side of the autumn equinox, when the sun is nearly half-way between its extreme solstitial position. The time of year is a prominent illustration of the general climatological principle that the seasonal extremes of temperature, even in continental regions, tend to lag well behind the corresponding extremes in the intensity and duration of sunlight. The latitude, too, illustrates the somewhat paradoxical principle that in general it is not the equatorial or hottest climates, that is, those with the highest mean temperatures, that furnish the occasional extremes of heat, say above 120° F. (*circ.* 50° C.), but the cooler and drier climates, near the confines of the tropics, which are intensely hot during the summer months.

L. C. W. BONACINA.

Past and Passing Peoples of Polynesia.

SOME important studies of two Polynesian peoples are published by the Bayard Dominick Expedition in the Memoirs of the Bishop Museum at Honolulu.[1] In vol. ix. Mr. H. D. Skinner gives a comprehensive account of the almost extinct Morioris of Chatham Islands. Of these only two living representatives were found in a population of foreigners, most of whom were Maoris. One other was living in New Zealand. In vol. viii. Mr. R. Linton discusses the material culture of the Marquesans, and in vol. ix. Mr. L. D. Sullivan their somatology. These are also a dying and diseased race and Mr. Sullivan doubts whether there is a wholly sound physical specimen alive, while Mr. Linton considers that their language and portions of their culture may be preserved for several generations by their numerous half-Chinese or half-European descendants, who are more resistant to disease than the pure-blooded natives.

Mr. Linton's account of the Marquesans is restricted to their material culture, and other features having been dealt with elsewhere, only a short summary is given of social organisation and religion. But houses, canoes, stone artifacts, weapons and implements, clothing and ornament are described in detail and illustrated by forty-four full-page plates and eleven figures in the text. The few local differences in the islands are set out in a comparative table, which is repeated in greater detail to exhibit the relations of the Marquesan material culture to that of other Polynesian groups. Samoa and Tonga are found to have a closer cultural agreement than any other two localities. The Marquesas and New Zealand are almost equally close. The Society Island culture comes between the Samoan-Tongan and the Maori-Marquesan. Hawaiian culture resembles the Maori-Marquesan on the material side, but is more nearly related on the non-material side to the Society Islands and Western Polynesia.

The author gives the following hypothesis of the historic distribution of races and culture in the Pacific. The first arrivals in Central and South-east Polynesia were Negroid and Melanesian rather than Polynesian in culture. They settled in Tonga, Samoa, the Cook, Society, Austral, and Tuamotu groups. They did not reach the farther islands and came from Melanesia, probably Fiji. The next comers

[1] "The Material Culture of the Marquesas Islands." By Ralph Linton. Memoirs of the Bernice P. Bishop Museum, vol. viii. No. 5 (Bayard Dominick Expedition. Publication No. 5.) Honolulu, Hawaii, 1923.
"The Morioris of Chatham Islands." By H. D. Skinner. Memoirs of the Bernice P. Bishop Museum, vol. ix. No. 1. (Bayard Dominick Expedition. Publication No. 4.) Honolulu, Hawaii, 1923.
"Marquesan Somatology with Comparative Notes on Samoa and Tonga." By Louis R. Sullivan. Memoirs of the Bernice P. Bishop Museum, vol. ix. No. 2. (Bayard Dominick Expedition. Publication No. 6.) Honolulu, Hawaii, 1923.

were of the Caucasic race and came by way of Micronesia from Indonesia to Samoa. They produced a hybrid race and the south-east Polynesian type of culture. A fairly pure group of this Caucasic race reached the Marquesas and, mixed with the Negroids, arrived in Easter Island. Another group passed through Melanesia and modified the culture of the Eastern Melanesian Islands. The last comers were the Indonesians, who entered by way of Micronesia and thence passed to Tonga and, mixed with earlier people, to Hawaii. In Samoa they were resisted for a time by the earlier population, which in Niue survived into historic times. From Western Polynesia the Indonesians colonised New Zealand, spread over South-east Polynesia and reached the Marquesas. Later movements from the west have modified the culture and rendered it extremely complex.

In Mr. Sullivan's study of Marquesan, Samoan, and Tongan somatology, the distinctions of race are elaborated in a series of anthropometric tables based upon the examination of 84 adult men and 74 adult women of the Marquesan islands. These were compared with his similar studies of Samoans and Tongans in other papers. His estimate of the physical condition of the people has been already quoted. The measurements show the Marquesans to be "tall, with long, wide head, a high, wide face, and a high, wide nose. All of the dimensions of the head and body are large, indicating their massive size. They are on the verge of brachycephaly. But one cannot be sure that the heads are wholly undeformed."

According to Mr. Sullivan the "Polynesians" of the Marquesas, Samoa, and Tonga are a mixed people. He finds in them three racial types. In addition to the Polynesian population there is a second type resembling the Indonesian peoples of Malaysia, and a third extremely short-headed element. He has dealt mainly with the Polynesian and Indonesian types. The former are taller, with longer heads, higher faces, narrower noses, perhaps straighter hair, more beard and body hair, and lighter skin than the Indonesians. They appear thus to be the Caucasic people of Mr. Linton's hypothesis.

Mr. H. D. Skinner's monograph on the Morioris is exhaustive as regards the material culture of the people and their relation to the Maoris and other Pacific islanders. It is prefaced by an admirable summary account of the bodily and mental characteristics of the Morioris, their language, social organisation, and religion. This is derived partly from the very scattered accounts of earlier writers, but has been considerably extended by Mr. Skinner's own investigations in the Chatham Islands. As in the Marquesan papers, the illustrations are an important feature. The paper before us contains thirty-six figures in the text, and thirty-five full-page plates.

With regard to the origin of the Moriori, Mr. Skinner gives a summary of their own traditions as recorded by Shand and the Maori version of Whatatoro, which was accepted as accurate by Mr. Percy Smith and Mr. Elsdon Best. The Moriori account seems to show at least two principal immigrations from unknown lands, the last of which took place, if the genealogies may be relied upon, about thirty generations ago, or about A.D. 1175. According to the Maori account they were a portion of the original inhabitants of New Zealand, called Maruiwi, who had been driven by a storm while fishing from a great land south-west of New Zealand. Mr. Skinner points out the inherent improbabilities of this story: the presence of women in a fishing party, the food required for a thousand-mile journey, and the impossibility of people in the cultural stage attributed to the Maruiwi possessing ocean-going canoes. The Maruiwi, moreover, were the physical antitheses of the Moriori. They were tall, thin, dark-skinned, with flat noses and straight hair, whilst the Moriori are short and bulky, brown-skinned, with prominent noses, and hair often waved and sometimes frizzy. The Maruiwi lived wholly on forest produce, and knew nothing of fine weaving, but the Morioris had a traditional knowledge of cultivated plants, and made fine matting. Not one of the Moriori weapons described by Mr. Skinner is mentioned in the account of the Maruiwi.

Mr. Skinner's final remarks are important. The craniology of the Moriori shows close relationship with the Maori, and some social features are identical. The language is divergent, but Mr. Skinner suggests a likeness to the Kaitahu of South New Zealand. The evidence of material culture is decisively in favour of a Maori origin, though some evidence appears of a likeness with Easter Island and Melanesia in the conception of human and animal forms in art, and in some hooks and adzes.

Taken as a whole these three studies considerably increase our knowledge of the Polynesians. But their conclusions have yet to be compared with the evidence of language, sociology, and religion.

SIDNEY H. RAY.

Ancient and Modern Arithmetic.

THE special object of the papers referred to below[1] appears to be to establish one main thesis, namely, that there was no such thing as arithmetic in our modern sense before the sixteenth century. To quote the author's words: "Modern arithmetic, which is a peculiarly Western invention, is yet barely 400 years old. Prior to 1500, and during some 3500 years of unbroken mathematical continuity and evolution, the science and art of calculation differed absolutely from anything in vogue with us."

The sole direct argument by which the author supports this thesis is the occurrence, in two particular treatises on arithmetic which he quotes, of a method of multiplying two digits to which he applies the general term "calculation by deficients." The anonymous English author of "An introduction for to lerne to recken with the pen, or with the counter, accordying to the trewe cast of algorism, in hole numbers or in broken, etc," written in 1546, multiplies 7 by 5, and for this purpose substitutes $(10-3)$ for 7, arriving at the result by a process which is equivalent to $7\times5=(10-3)\,5=50-15=35$. The Frenchman Oronce Fine (not "Finé"), whose work was first published during the years 1530–32 (not 1525), uses an even more roundabout process equivalent to $7\times5=(10-3)\,(10-5)=15+(7-5)\,10$ [or $(5-3)\,10$] $=15+20=35$.

Now this "complementary" method of multiplication (as it has been called) is a familiar item in most histories of mathematics: there is nothing new in Prof. Brockwell's discovery. He says, indeed, that the anonymous English treatise "appears to have been entirely overlooked by all the more recent writers on the history of mathematics both in Europe and America"; but, if he had referred to David Eugene Smith's "Rara Arithmetica" (1908), he would have found (p. 244) a notice of this anonymous work and of the later edition of it published in

[1] "The Transition from Ancient to Modern Arithmetic, I. II." (reprinted from *The Teachers' Magazine*, Montreal, Dec. 1923 and April 1924); "Calculation by Deficients (a remarkable aspect of the Evolution of Arithmetic)," a paper read before the American Oriental Society, April 23, 1924; by the Rev. C. A. Brodie Brockwell.

1574. He would also have found in the same "Rara Arithmetica" (p. 76) a case of "complementary" multiplication from an earlier treatise (Huswirth, 1501). But the strange thing is that our author seems to infer from these cases that before 1546 such multiplications were never done in any other way, that "none of our tables of arithmetic had been invented as recently as 1500 A.D.," that "our multiplication-table had not been invented," and that, "while men could multiply, as we do, up to five times five by the fifteenth century, they could not go beyond this." There is, indeed, no trace of multiplication-tables in Egyptian records, but the Babylonians had not only multiplication-tables but also tables of divisions, of squares, of square roots and cube roots. The Greeks and Romans certainly had multiplication-tables: there is one in Nicomachus (about A.D. 100) and in Boëtius (about A.D. 500), and they must have been used much earlier. There are also multiplication-tables in a treatise on abacus-reckoning by Bernelinus (about A.D. 1020), in the "Liber abaci" (1202) of Leonardo of Pisa, and in Widman's Arithmetic (1489). So much for the multiplication-table. (The fact that Pepys had such trouble in learning the multiplication-table is of course no proof that schoolboys and others had then (1662) only just begun to use it, and that it was then little more than 100 years old; other great men have been without a gift for arithmetic.)

The story of the arithmetical operations is similar. Eutocius (5th century A.D.), in his commentary on Archimedes, gives various long multiplications differing from ours only in the arithmetical notation used. Theon of Alexandria (4th century A.D.) divides 1515° 20′ 15″ by 25° 12′ 10″ and extracts the square root of 4500° in degrees and sexagesimal fractions by a procedure which, allowing for the difference of notation, is the same as ours. Long multiplications in the Treviso Arithmetic (1478) are done in a way exactly equivalent to our method, and in some cases they are written out in exactly the same form. So with long divisions, which appear, in the same form as with us, in an Italian MS. of about 1460 (see D. E. Smith, *op. cit.* p. 462), and in printed works by Calandri (1491) and Luca Paciuolo (1494). It is true that some ancient systems of numerical nomenclature expressed certain numbers on a subtractive principle: cf. the Roman *undeviginti* and *duodeviginti* for 19, 18, etc., and the numeral signs iv., cxc., etc. The Babylonians, too, used the same principle commonly, if not so systematically: *e.g.* we find 118 written as 120 *minus* 2, and 27 as 30 *minus* 3. Possibly the "complementary" multiplication owes its origin to this feature of the Roman numeral system. But there seems to be no trace in India, Arabia, Egypt or Greece of the "complementary" method of multiplication.

Such being the facts, few, we imagine, will agree that arithmetic was dominated continuously from the earliest times to the sixteenth century by "calculation by deficients," and that our modern arithmetic was a Minerva-like offspring of that century.

Prof. Brockwell finds indirect evidence for his theory in a multitude of allusions in literature which hint at odd systems of numeration and curious processes of calculation. He draws mostly from Hebrew and Biblical sources and states a number of interesting puzzles, *e.g.* "Why from time immemorial had *aleph*, the first letter of the Hebrew and Phœnician alphabet, the index both of 1000 and of 1?" "Why, when speaking of the seven days of the first creation story, did the mediæval Hebrew exegetes describe them as seven thousand days?", and so on. These puzzles may no doubt offer a considerable field for further research into primitive arithmetic.

We may observe incidentally that our author assigns Philolaus to the 5th century A.D. (instead of B.C.), making Isidorus, Bishop of Seville (A.D. 560–636), "a little over a century later." He also speaks of Proclus, the Neo-Platonist, as "the Egyptian mathematician"!

University and Educational Intelligence.

LIVERPOOL.—Applications are invited for the Derby chair of anatomy, the duties of which post will begin on January 1 next. The latest date for the receipt of applications by the registrar is October 1.

A DEMONSTRATOR is required in the department of mathematics of the City and Guilds (Engineering) College, South Kensington. The latest date for the receipt of applications and statement of qualifications, by Assist. Prof. Klugh, at the College, is August 30.

APPLICATIONS are invited for two research assistantships in the Physical Laboratory of the University of Toronto. Candidates must be university graduates with special training in physics. Applications should be sent to Prof. J. C. McLennan at the University.

APPLICATIONS are invited for the professorship of surgery in the University of Otago, New Zealand. Particulars of the appointment and a form of application may be obtained upon written request to the High Commissioner for New Zealand, 415 Strand, W.C.2. The completed form must be returned by August 31.

As part of the Vacation Course for Teachers arranged by the West Riding Education Committee at Bingley, Mr. Wilfred Mark Webb, general secretary of the Selborne Society, gave a lecture and demonstration on August 12 dealing with "The Cinematograph in Education." He considered two aspects of the subject, namely, the use of moving pictures in the ordinary curriculum in connexion with the definite teaching of various subjects in which it is recognised that they may be helpful, and during out-of-school hours for broadening the pupils' outlook. He strongly emphasised the need at present of superseding the lantern slide only when it is advisable to represent movements which are going on, or can be introduced as an improvement upon the still picture, and even upon the blackboard, in the building up of drawings, diagrams, or maps, or by making models work upon the screen.

IN continuation of the policy of training aircraft apprentices in the skilled trades of the Royal Air Force, two examinations for the entry in January next of more than 500 boys, between the ages of 15 and 16½ at the time of entry, will be held on October 17 and November 4 respectively. The closing date for the receipt of completed forms of application for the first examination, which is an "open" competition conducted by the Civil Service Commissioners, is August 28, and for the second "limited" competition, which is carried out by the Air Ministry in conjunction with the local education authorities, the forms of nomination must be received in the Air Ministry by October 7. For the former, forms of application can be obtained from the Secretary, Civil Service Commission, Burlington Gardens, London, W.1. For the latter, nominations can be obtained through headmasters of schools, Advisory Committees for Juvenile Employment, the Boy Scout Association, and officers commanding Territorial Cadets.

A "FEDERALISATION" of the London Institute of Historical Research in the interests of students in all British universities has for some years past been advocated by Sir Richard Lodge, and he was able to announce at the universities' conference of May 10 that the idea had been adopted by the Council of the Institute. In America a movement of a similar character has been set on foot with the object of utilising in the future more fully than in the past the material and scholarly resources at Washington for purposes of graduate study and research by students from all parts of the United States. The attitude of the leaders of the movement is summed up in a phrase used by Prof. Leuschner of California in a paper presented last November to the Association of American Universities: "Every graduate school should extend to Washington." Prof. Leuschner went on to say that American graduate students move about more and more freely and that this development is not merely due to the advice of deans and professors but is increasingly due also to the scholarly initiative of the students themselves. He admitted that this freedom is "impeded at times by a certain *local pride or provincialism of departments* and their representatives, who fear loss of students and of prestige by carrying it to its logical conclusion." He stated, however, that it is fully recognised that few universities can undertake distinguished work in many branches. On the important question whether fellowships are allowed to operate as impediments to free migration, he went no further than to say that he hoped no fellowships are being maintained that are not primarily established for the fullest enjoyment of great opportunities in the field of scholarship and research.

THE report of the Imperial Education Conference Committee on the use of the cinematograph in education has been issued recently (H.M. Stationery Office, 1924. 1s. net). Not the least part of the value of the report lies in the extracts from memoranda submitted by inspectors and secretaries of education who have watched experiments, by headmasters who have introduced films into their schools, and by teachers who have actually used the cinematograph in teaching. The positive conclusions reached are those which are fairly obvious: namely, that the cinematograph can be of real value as an adjunct to present methods, and that it should be recognised as part of the normal equipment of educational institutions, especially for use in teaching nature study, geography, science, and industrial processes. It is noteworthy that those who have had practical teaching experience with the instrument are much more enthusiastic than are others. Though nothing is said in the report, opinion seems to be swinging round to the view that the classroom rather than the picture theatre is the place for educational work with the film. Importance is rightly attached to the fact that projectors and screens now exist quite suitable for use in a classroom, and that the technical difficulties which used to prevent their use have disappeared, though the difficulty of cost remains. The absence of suitable films is, however, referred to again and again. One hint is given, that films should not take longer than ten minutes to run through; the writers of this note would say five; but this does not carry us very far. The crux of the problem is reached when the Committee says that the films "which are procurable are unco-ordinated and do not fit in with one another or with the ordinary school syllabuses." It is the well-thought-out teaching syllabus which dominates the situation, and film producers who desire to get the patronage of, or to help, teachers must take account of it.

Early Science at the Royal Society.

August 26, 1663. It being related by Mr. Oldenburg the secretary, that he had been desired by Monsieur Ludolf, councillor of the duke of Saxe-Gotha, to procure from the society, for a domestic of that prince, who was to be sent into Egypt and Ethiopia, some instructions of inquiries fit to be made in those parts; the society desired Mr. Boyle, Mr. Henshaw, and other members to draw up some queries for that purpose. [Among these was one, "Whether, tho' the plague be never so great before, yet on the first day of the river's increase, the plague not only decreaseth, but absolutely ceaseth; not one dying of it after?"]

August 27, 1662. Upon the occasion of the manuscript philosophical books, which were presented to the society for their examination, and received a good character from those members, who had read them, it was ordered, that no books presented to the censure of the society shall receive approbation from them; but only, if the society think fit to refer such books to one or more of the fellows, esteemed by them competent judges thereof, that the report made thereof to the society by such fellows, may be communicated to the authors of the books thus presented; and that it may be signed by one of the secretaries.

August 28, 1661. Dr. Clarke read a paper entituled "Observations on the humble and sensible plants in Mr. Chiffin's garden in St. James's Park, made August 9, 1661."—Mr. Boyle presented the book which he had published since the order was made, that every member, who should publish any book, should give one to the society's library.

August 29, 1662. In the afternoon of this day the president and council, with other members of the society, waited on the king, to return him the thanks of the society for the patent of their establishment. The president made a speech to his majesty [This extols the king's grace and favour, and expresses "our firm resolution to pursue sincerely and unanimously the end—the advancement of the knowledge of natural things, and all useful arts, by experiments."]

1678. His grace the Duke of Norfolk being present at this meeting, renewed the declaration of his gift to the Society of the Arundelian library; and gave his consent and direction for the removal thereof: and that they should have liberty to exchange such books thereof, as were duplicates, or which they should think not so proper for their use, for others of equal value. His grace added, that Sir William Dugdale had presented him with a catalogue of books of heraldry, as he in the name of the heralds had desired. But upon perusal of the same finding many of them to be such, as did not so properly belong to the business of heraldry, the duke was desirous, that Sir Robert Redding and Mr. Evelyn would peruse the said catalogue, and consider what were most proper for the college of heralds, and what might be more proper for the use of the Society, and to moderate and adjudge the matter between the Society and college. But it was his grace's further pleasure and desire, that in case the Society should be dissolved (which it was his desire and hope they never would be) the said library might revert to his heirs. The Society by the mouth of the president returned his grace their most humble and hearty thanks for this his truly noble present: and ordered Mr. Hooke to take care, that the determination of the matter between them and the college of heralds might be made with all convenient speed; and that thereupon the books should be forthwith removed to Gresham College.—Mr. Henshaw moved, that a fair catalogue of them might be made, to be delivered to the duke to remain in his grace's custody.

Societies and Academies.

PARIS.

Academy of Sciences, July 21.—M. Guillaume Bigourdan in the chair.—A. **Lacroix**: The grained eruptive rocks of the archipelago of Kerguelen. Complete analyses of twelve rocks collected by M. E. Peau; including nepheline syenites, phonolite, quartziferous syenites, biotite granite, trachyte, and eucrite. These rocks suggest the existence of much older volcanic formation than the lava constituting the main formation of the archipelago.—Paul **Appell**: The movement of a heterogeneous fluid mass, submitted to the mutual attraction of its particles, round its centre of gravity.—A. **Haller** and (Mme.) P. **Ramart**: The preparation of the monoalkylpulegones.—Ch. **Moureu**, A. **Lepape**, and H. **Moureu**: The radioactivity of some thermal springs of Madagascar (the Antsirabe basin) and of Reunion. Determinations of the radium emanation in the gases from seventeen springs in Madagascar and eight in Reunion have been made. Minute amounts of thorium emanation were detected in one spring only.—Gabriel **Bertrand** and Hirosi **Nakamura**: The comparative physiological importance of iron and zinc. Experiments on young mice show that a deficiency of zinc in the food produces a more marked effect on growth than a deficiency of iron.—Charles **Rabut**: The sounding of dams and chimneys.—E. **Mathias**: The terminal forms of flashes of lightning.—M. de **Séguier**: The isomorphisms of certain groups.—Emile **Jouguet** and Maurice **Roy**: The paradox of d'Alembert in the case of compressible fluids.—J. **Guillaume**: Observations of the sun made at the Lyons Observatory, during the fourth quarter of 1923. Observations were made on 56 days, and the results are given in three tables showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—R. **Jarry-Desloges**: Contribution to the study of the disaggregation of the southern polar-cap of the planet Mars.—Charles **Platrier**: Contribution to the study of various physical phenomena by transformation of linear differential equations into integral equations.—L. **Dunoyer** and P. **Toulon**: A remarkable property of the positive column of the mercury arc. Action by the influence of external sheaths.—L. **Vegard**: The luminescence of solidified gases and their application to cosmic problems.—G. **Bruhat** and M. **Pauthenier**: The absorption of ultra-violet rays by carbon bisulphide.—J. **Errera**: The solid state looked at from the electric point of view; dispersion in the Hertzian domain.—J. **Escher-Desrivières**: Polonium carried down by silver chloride. A quantitative study of the removal of polonium from solutions by precipitation of silver chloride, the solution containing variable amounts of hydrochloric acid, sodium chloride, and potassium chloride.—J. H. **Le Bel**: Small variations in the heat disengaged by various specimens of radium bromide. A specimen of radium bromide, placed in a Dewar tube in a cellar 20 metres below ground, gave a perfectly steady temperature rise, which, however, once or twice a month, showed a slight fall. A second apparatus, placed under the same conditions, indicated the same minima at exactly the same times. The phenomenon appears to have its origin outside the radium, and it would be desirable to repeat the experiment elsewhere, preferably in America.—James H. **Brennen**: The carrying down of polonium by colloids. The colloid is precipitated by an electrolyte, and the amount of polonium in the precipitate determined. It depends on two factors; the time that the polonium has been in contact with the colloid before precipitation and the time that the precipitate has been allowed to stand before filtration. Colloidal silver or ferric hydroxide retains practically all the polonium (97 to 98 per cent.).—D. **Yovanovitch**: An apparatus for measuring the heat disengaged by radioactive bodies.—Jean **Thibaud**: The γ-rays of very great quantum and the photo-electric origin of the natural β spectrum of radium.—André **Job** and Guy **Emschwiller**: The photochemical limit and the energies of linkages.—H. **Gault** and F. A. **Hessel**: The pyrogenic dissociation of hexadecane. The apparatus used has been described in detail in an earlier communication. Analyses of the gas and liquid produced are given for seven temperatures varying between 390° C. and 815° C.—P. **Langlais** and J. **Goby**: Contribution to the study of essence of iris. In addition to the constituents already known, the presence of six saturated fatty acids has been proved, caprylic, pelargonic, capric, undecylic, lauric, and tridecylic acids.—Marcel **Delépine**: The transformations of the pinenes by acids.—Max and Michel **Polonovski**: The degradation of the hydrogenated derivatives of eserine.—**Pastureau** and H. **Bernard**: Ethyl-trimethyl glycerol.—Alphonse **Mailhe**: The decomposition of animal wax. A study of the destructive decomposition of beeswax in the presence of catalysts.—Pierre **Viennot**: The boring of Abatilles, near Arachon.—Emile **Belot**: The application of the principles of the dualist cosmogony and of isostasy to the study of various geological problems.—J. **Cabannes**: The transparency of the atmosphere.—J. **Liouville**: The corals harmful to the trawlers of Morocco.—Mlle. Y. **Ménager**: The use of sodium chloride as a standard in analyses of sea-water.—René **Souèges**: The embryogeny of the Typhaceæ. The development of the embryo in *Sparganium simplex*.—Mme. Paul **Lemoine**: The distribution of the calcareous algæ (Corallinaceæ) according to depth in the Mediterranean.—André **Mayer** and L. **Plantefol**: The water exchanges of mosses with the atmosphere.—André **Charriou**: The absorption of potash by humic acid.—F. **Heim** and R. **Audubert**: The agglutinating power and coagulating power of coagulation agents towards rubber latex.—Ladislas **Smolik**: The influence of electrolytes on the total surface of the elements of the soil.—R. **Fosse**, Ph. **Hagene**, and R. **Dubois**: The gravimetric estimation of cyanamide as xanthyl-urea.—Jules **Amar**: The preservation of living tissues. The solution proposed contains sodium phosphate, 3·0, sodium bicarbonate, 3·0, and sodium chloride, 2·0 in water 1000. Advantages are claimed for this solution over the solutions of Locke, Ringer, and Biedermann.—Auguste **Lumière** and Henri **Couturier**: The toxicity of normal sera.—L. **Mercier**: *Geomyza sabulosa*, a microdiptera with reduced wings; loss of the faculty of flight in this species as a result of the drosophilian process.—G. **Athanassopoulos**: The geographical distribution of fresh-water fishes in Greece.—Mlle. **Kostritsky**, Mme. **Toumanoff**, and S. **Metalnikow**: *Bacterium tumifaciens* in the grub of *Galleria mellonella*.—M. **Weinberg** and A. R. **Prévot**: The use of anatoxins for the preparation of antigangrene sera.— — **Paillot**: The etiology and epidemiology of *grasserie* (a disease of the silkworm).—Mme. Jean **François-Pérey**: The influence of sunlight on the development of a soil protozoa, *Colpoda cucullus*.

SYDNEY.

Royal Society of New South Wales, May 7.—R. H. **Cambage**: Presidential Address, Australian resources of liquid fuels. Mr. Cambage expressed the opinion that it is imperative the most intense research should be undertaken to devise, on commercial lines, some method of treatment of coal by which a very much higher percentage of liquid fuel may be extracted or manufactured from this commodity than is obtained by present-day methods in connexion with coking, or that some other process, such as that of com-

bustion of finely divided particles, may be perfected, by which the power may be obtained direct from coal without converting it into oil.

June 4.—Dr. C. Anderson, president, in the chair.—C. **Hedley**: Differential elevation near Sydney. Two raised terraces of marine erosion situated on the ocean side of North Head are described. The highest is elevated about thirty feet. This pair of raised beaches again appears three miles to the westward. But there the highest is only about eight feet instead of thirty above the present level of erosion. The conclusion is drawn that this differential movement is the result of a fold or earth wave at least six miles wide and thirty feet high.—W. G. **Woolnough** and J. L. **Somerville**: A contribution to the geology of the Irwin River Valley of Western Australia. Two strongly unconformable Pre-Cambrian formations are distinguished. The well-developed Permo-Carboniferous system is zonally subdivided chiefly on a lithological basis. The glaciology is described in some detail. Reasons are advanced for regarding as Cainozoic (Plateau Beds) much of the formation previously described as Jurassic. Well-marked step-faulting towards the Indian Ocean is indicated. The probability of the existence of economically important deposits of coal and salt is considered remote.

Linnean Society of New South Wales, May 28.—E. C. **Chisholm**: Eucalypts of the Blue Mountains and their defined areas. Thirty-four species of Eucalypts have been observed by the author on the Blue Mountains and the distribution of those species in this region is recorded.—J. R. **Malloch**: Notes on Australian Diptera. No. ii. Notes on a number of species in the subfamilies Anthomyiinæ, Phaoniinæ, and Fanniinæ. Nine species are described as new, and a key is given to the three Australian species of Hylemyia.—R. **Veitch** and W. **Greenwood**: The food-plants or hosts of some Fijian insects. Part 2.—T. **Steel**: Observations on *Helix aspera* in Australia. This shell is usually considerably smaller and always lighter in weight in various parts of Australia and in New Zealand than is normally the case in Europe. It is identified with the var. *tenuior* Shuttl. Other varieties found near Sydney are vars. *depressa* Paul and *puncilulata* Bandon. A specimen distinctly approaching the cornute form was also found, but no sinistral examples have been met with. Marked diminution in size of the shell in the adult, following prolonged, dry, hot conditions, is noted.

June 25.—Mr. R. H. Cambage, president, in the chair.—W. Docters **van Leeuwen** and H. H. **Karny**: Two new thrips-galls and their inhabitants from New South Wales. Descriptions of the occurrence of *Euoplothrips bagnalli* on *Randia chartacea*, and of *Cryptothrips (?) intorquens* and *Euoplothrips bagnalli* on *Smilax australis*.—A. M. **Lea**: On some Australian Scarabæidæ. The paper deals with cockchafer beetles; notes on various species are given, and thirty-eight species, mostly of the subfamily Melolonthides, are described as new.—C. **Iredale**: Results of Roy Bell's Molluscan Collections. The collection here studied is only one of half a dozen made at important zoological points on and about the Australian coast for the purpose of elucidating geographical problems. The Twofold Bay Mollusca agree in species and genera with those from Sydney, but entirely lack a northern Australian element, and show a small percentage of southern Australian forms, a number of additions of such species being made to the N.S.W. fauna. A few new species were secured, while the fine series, in perfect condition, of many species have already furnished important results, such as the viviparous nature of some Turritellid molluscs and the polyphyletic nature of the Minolioid group of Trochoids. A most important feature of a few dredgings made in 50-70 fathoms is the great resemblance between the molluscan fauna at present living at that depth and the fossils of the Upper beds of the Muddy Creek deposits.

VIENNA.

Academy of Sciences, June 12.—L. **Lämmermayr**: On the dispersal of warmth-loving plants in the Mur district. Researches on the light- and climate-relations of the stone pine.—F. **Ris**: Odonata, describing 16 species, two from the White Nile previously undescribed.—H. **Spandl**: Freshwater Amphipodes including those of the Caspian Sea and of Lake Baikal and of subterranean waters, and a discussion of the migration of marine Amphipodes into fresh water.—V. **Brehm**: New Entomostraca from the Handel-Mazzetti expedition to China.—E. **Dittler** and A. **Kohler**: Experimental researches on disentangling potassium-sodium felspars. Reactions of this sort have been recognised for KCl – NaCl, but so far little has been done on the silicates. Diffusion in the solid condition can be shown to take place in thin sections. Perthite was heated in an electric resistance furnace for 500 or more hours to a temperature of about 1000°. After heating, the difference in the refraction of the two components of perthite had completely vanished. The capacity of albite and orthoclase to diffuse into each other at high temperatures, and whilst still solid, is favoured by the circumstance that these felspars can form mixed crystals.

June 20.—**Kerner-Marilaun**: Solar-climatic temperatures in palæozoic antiquity.—H. **Handel-Mazzetti**: Plantæ novæ Sinenses. More new plants from China, varieties and species of Juniper, Camellia, Lobelia, and Leontopodium.—L. **Kolbl**: The tectonic of the granite peaks in the High Tauern.—R. **Kremann** and R. **Gruber-Rehenburg** of Graz: Electrolytic conductivity in molten metal alloys, 6th communication. Researches on the electrolysis of some copper alloys—CuZn, CuSn, CuAg, CuAl. In Cu-Sn a small displacement of Cu to anode, of Sn to cathode; a somewhat greater displacement in Cu-Al, of Cu to cathode, Al to anode.—R. **Kremann** and O. **Benda**: Electrolysis of Ag-Pb alloys, Ag to cathode, Pb to anode.—R. **Kremann** and H. **Drazil**: On the influence of substitution in the components of binary solution equilibrium, 45th communication. The binary phase-diagram of benzhydrol with phenols and amines.—E. **Müller**: Calculation with Falt-products in its application to figures of the second degree in space. A new method of calculation having the advantage of great brevity, particularly with complex quantities.

Official Publications Received.

Malayan Agriculture, 1924. Handbook compiled by the Department of Agriculture, F.M.S. and S.S. (British Empire Exhibition edition.) Pp. v+301+iv. (Kuala Lumpur: Department of Agriculture.) 1s.

Agricultural Research Institute, Pusa. Bulletin No. 152: The External Morphology and Bionomics of the commonest Indian Tick (*Hyalomma ægyptium*). By Mohammad Sharif. Pp. 25+5 plates. (Calcutta: Government Printing Office.) 1 rupee.

Report on the Administration of the Meteorological Department of the Government of India in 1923–24. Pp. 16. (Simla: Government Press.) 2 annas.

Union of South Africa: Department of Agriculture. 9th and 10th Reports of the Director of Veterinary Education and Research, April 1923. Pp. 823. 10s. Reprint No. 18: Phosphorus in the Live Stock Industry. By Sir Arnold Theiler, Dr. H. H. Green, and Dr. P. J. Du Toit. Pp. 47. 6d. (Pretoria: Government Printing and Stationery Office.)

Forestry in Brunei and Labuan: a Statement compiled for the British Empire Forestry Conference, Canada, 1923. By G. E. S. Cubitt. Pp. 8. (Singapore: Government Printing Office.)

Federated Malay States. Report of the Secretary for Agriculture, Straits Settlements and Federated Malay States, for the Year 1923. Pp. 10. (Kuala Lumpur.)

United States Department of Agriculture. Department Bulletin No. 1223: The European Elm Scale in the West. By Frank B. Herbert. Pp. 20. (Washington: Government Printing Office.) 10 cents.

Jamaica. Annual Report of the Department of Agriculture for the Year ended 31st December 1923. Pp. 39. (Kingston, Jamaica: Government Printing Office.)

Board of Education. Regulations for Whitworth Scholarships 1925. 52nd edition. Pp. 15. (London: H.M. Stationery Office.) 2d. net.

The Development of the Hokkaido Imperial University. Pp. 79+3 plates. (Sapporo, Japan: Hokkaido Imperial University.)