NATURE

SATURDAY, SEPTEMBER 3, 1927.

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. 3018, VOL. 120]

Man and his Ancestry.

SIXTY-NINE years ago, at the British Association assembled in Leeds, Sir Richard Owen, the first anatomist of his age, poured scorn on the theory of man's descent from an anthropoid stock, a theory which the president of to-day, another distinguished anatomist, regards as unshakable. Since the publication of "The Descent of Man" in 1871, we have come to know more than a little of the precursors of *Homo sapiens*, and this direct evidence of anthropoid ancestry has been corroborated on many sides. Thus the blood of man and that of the great anthropoid apes gives almost the same reaction; in the anthropoid brain are to be recognised all those parts which have been magnified in man; we find the same vestigial structures or 'evolutionary post-marks' in apes and in ourselves; the embryos of the two stocks develop along the same main path; the anthropoid mother fondles, nurses, and suckles her young in the human manner. "The fundamentals of Darwin's outline of man's history remain unshaken."

With his characteristic frankness, Sir Arthur Keith admitted, in his carefully restrained and vividly phrased address, that we have to correct some of the early blunders. Thus man's descent has not been in a straight line; one offshoot has given rise to another after a fashion that might be compared to a cymose inflorescence. "It is among a welter of extinct fossil forms which strew the ancient world that we have to trace the zigzag line of man's descent." We no longer expect to find an orderly file of extinct stages in which every part of the body becomes, as we advance, a little less ape-like, a little more man-like. For we know that this *en bloc* orderly advance is not usually disclosed in evolutionary series. While one part of the body moves forward, another often lags behind.

The distinctiveness of man, even of tentative men, Hominids before Homo, is in his big brain. Is there any light on the conditions of this advance? Being, as became a president, in a cautious mood, Sir Arthur Keith declared that there is not as yet any explanation to offer, yet he proclaimed with no uncertain voice that "Man has reached his present state by the action and reaction of biological forces which have been and are ever at work within his body and brain." Much depends on what is meant by "biological forces," and we wish to linger over the crucial question: How did man get his big brain?

Sir Arthur referred to Sir Ray Lankester's observation that an increase in the size of the brain

occurred not in the ancestors of man alone, but in diverse branches of the mammalian stock in the Miocene period. Was there at that time some environmental stimulus prompting cerebral advance, or was it the outcome of an age-long evolutionary trend in the course of which brains had largely superseded brawn? Also, is there not some elucidation in Prof. Elliot Smith's view, supported by an eloquent series of brains, from tree-shrew to ape, that the arboreal habit put a premium on variations in the direction of an increased neopallium, with special enlargement of particular areas, such as those concerned with visualising and manipulating, with a corresponding decrease of others, notably the olfactory centre? When, also, the uplift of the Himalayas and the shrinkage of forests brought the precursors of man back to solid earth, enriched by an arboreal apprenticeship, would there not be many a reason why variations in the direction of better brains should be fostered? For these tentative men would find themselves in a new environment, with new competitors, and therefore with increased need for standing by one another in little troops. But the beginning of society served as a shield over variations which had much less chance under an each-for-himself regime, and over helpless stages of early infancy and old age, the former ensuring a better future through education, and the latter a conservation of traditional wisdom.

Would it not be in these groups of families that the transition was made from words to language, that is to say, to the expression of simple judgments by means of socially significant imitated sounds. As these auditory symbols were added to visual ones, an incalculable addition was made to the capacity for ideation. Thinking became much easier with words as counters. So gradually the meshes of the selective sieve were altered to favour variations in cerebral capacity. That the origin of these variations remains obscure is true enough, but that is not a particular puzzle affecting the ascent of man; it applies to all emergences of the distinctively new. The frequency of cerebral variability in man is obvious in almost every family; the problem of the origin of variations is relevant throughout the whole of animate Nature.

As animals become cleverer, it is increasingly possible for them to have smaller families; other things equal, an economy in reproduction has survival value. But the reduction of the number of offspring, made possible by quickened wits and enhanced parental care, favours family life and creates an atmosphere which is selective towards variations in the line of affection, kin-sympathy, and conversation. All these evolutionary processes of the subtler type work round in virtuous circles. Again, we cannot but inquire, on a more physiological level, whether there was not much shrewdness in the old suggestion of Robert Chambers, that prolonged gestation was a factor in evolution. If the conditions of life, such as sociality or seclusion, as in elephants and Peripatus respectively, allow of prolonged gestation, there is obviously an opportunity for the offspring being born at a relatively advanced stage, able very soon to fend for itself if need be. One may contrast the new-born foal with the new-born kangaroo. This shunting back of the developing period into the antenatal arc of the life-curve allows of a safe and sequestered differentiation of the nervous system without very much being asked of it, allows of a suppression of much of the repertory of instinctive capacities, so necessary when the creature is born at a less finished stage, and allows of the more successful development of plastic intelligence.

The prolonged infancy, so characteristic of Primates, would operate like the prolonged gestation in allowing a longer period for brain development before responsibilities intrude. Even if the number of cerebral neurons does not increase after birth, there are ramifications and linkages to be established. The prolonged infancy, increasingly ensured by the incipient sociality with its division of labour, would react on the parents and help to form a sieve that favoured the wiser and kindlier variants. There is much truth in Rousseau's saying: Man did not make society; society made man.

These are some of the suggestions that might be made towards an elucidation of the problem of man's big brain. If we may argue from Pithecanthropus, with his small and simple brain, the advance was not initial, but after a footing in the struggle for existence became surer. It may of course be said that variations in the regulative system—in hormone production in particular—stimulated brain development, and were associated with temporal variations in the relative length of the antenatal and infantile arcs in the trajectory of life; and Sir Arthur evidently looks to hormone-keys to open locks to which they have not yet been fitted by the evolutionist. But our suggestion is that more must be made of the psychical and social factors in man's emergence.

What seems to us most distinctive in Sir Arthur Keith's position is his suggestion that racial evolution will become more intelligible when it is

seen in the light of individual development. It is traditional to consider ontogeny in the light of phylogeny, and that illumination cannot be dispensed with; but there has not been adequate consideration of phylogeny in the light of ontogeny. "When we have discovered the machinery of development and of growth we shall also know the machinery of evolution, for they are the same." Slight changes in developmental rate and rhythm, slight oscillations in the co-ordinating and regulating influences, slight relaxations and tightenings of hormonic control, and the developing organism is altered, as we know, both for good and ill. We understand Sir Arthur to suggest that these developmental variations have furnished the raw material which the processes of selection have sifted.

There we must walk warily. Is it not the case that variations often appear in embryos before there is any differentiation of endocrinal glands, and in many organisms where hormones are experimentally unknown? Moreover, all the wobblings in developmental regulation, whether hormonic or otherwise, have themselves to be accounted for. If they are environmentally induced, will it not imply postulating the hereditary transmission of acquired modifications, or a remarkable persistence of the same environmental influence during the ages in which a particular trend of evolution—such as the differentiation of the neopallium—has been in progress?

It may be suggested that a deeply saturating environmental influence, climatic for example, may affect the germ cells along with the body in such a way that the regulative system is perturbed. But unless we can define these environmental influences, we are almost back to Darwin's confession of ignorance, unless, indeed, we are led to an almost providential view of what has been called 'the fitness of the environment.'

It cannot be doubted that a deepened knowledge of development—especially through experimental embryology—will throw light on evolution, but it is going a long way to say that their problems are the same. The germ cell starts with a repertory of initiatives, including not only factors but also regulations of these, and this repertory presupposes evolution. Again, if an individual embryo suffers some regulative perturbation in a non-fatal degree, it can within limits effect automatic adjustments, but this is very different from the active way in which many an organism plays its hereditary cards in relation to alterable circumstances. There is more than machinery when a higher animal shares in its own evolution, even sometimes selecting its environment. In the evolution of the higher animals at least, the personality of the creature counts; and though the personality may doubtless be influenced by the hormones, this does not alter the fact that the organism plays its own game for better or worse. This is what Prof. James Ward was driving at in his emphasis on what he called 'subjective selection.'

Sixty-nine years ago Sir Richard Owen told his Leeds audience that mankind required an altogether separate order in the animal kingdom, but what Sir Arthur Keith followed Darwin in emphasising was man's solidarity with the rest of creation. Few, we think, will read the presidential address of 1927—dignified, responsible, and pithy—without admitting the convincingness of the evidence that "Man began his career as a humble primate animal." There is danger perhaps lest we underestimate the magnitude of this hard-won conclusion and its mysteriousness. For we must think not only of man primitive and tentative, but also of man as minister and interpreter of Nature, man as poet and painter, discoverer and saint. We must estimate everything by its best, and then what a piece of work is a man!

Using the word emergence does not solve any problem, but it expresses a mode of becoming that has often occurred. A combination of two gases, oxygen and hydrogen, results in the production of water with entirely novel and in some measure unpredictable properties; so there has been in organic evolution a repeated origin of new types, now an insect and again a bird—resultants that seem too big for their components. Lloyd Morgan uses the word 'emergence' to emphasise the difference between an additive resultant and an outcome that is a new synthesis.

Without going back to the position of Alfred Russel Wallace, Darwin's magnanimous colleague, that man's higher qualities demand "some origin wholly distinct from that which served to account for his animal characteristics—whether bodily or mental," without seeking for this dualistically in some special 'spiritual influx,' such as operated also at the origin of living creatures and of consciousness, we may see some truth in the idea of man's 'emergence' and apartness. He was an organic genius, a new synthesis, if ever there was one; no mechanical additive resultant, but a vital new creation, though coming but slowly to his own; not involving any breach of continuity, but making a fresh disclosure of the riches of reality—and continuing to do so. Into the fabric of humanity

came many strands of many mammals, but some threads were new and the pattern was new, and it continues to evolve. But this 'emergence,' it may be said, savours of the magical,—an outcome too big for its antecedents! Yet is this not one of the commonest of fallacies? We are not slow to regard man in the light of evolution, but we have scarcely begun to envisage evolution in the light of man.

To return to Sir Arthur Keith's address: it stands out as a discourse instinct with the scientific spirit; it is a fine piece of scientific tactics—to abstain, except once, from speculative discussion of factors, so that the facts might stand forth in their stability; and it is a beautiful piece of English prose, as one knew beforehand it would be, for "Le style, c'est l'homme même."

Mechanics of the Atom.

The Mechanics of the Atom. By Prof. Max Born. Translated by Dr. J. W. Fisher and revised by Dr. D. R. Hartree. (International Text-Books of Exact Science.) Pp. xvi+317. (London: G. Bell and Sons, Ltd., 1927.) 18*s*. net.

WHEN Prof. Born published his "Vorlesungen über Atommechanik" two years ago, atomic theory was beset with difficulties which, as one writer has remarked, were strongly suggestive of the epicycles of Ptolemaic astronomy. It was obvious that there was some inherent defect in the theory and nothing less than a radical change of outlook was required. It seemed impossible to make a quantitative determination of intensities of spectral lines on the basis of accepted mechanical pictures of atoms. Nor could the theory of dispersion be considered satisfactory, as it depended on a transcription of the various steps in the ordinary classical theory and was not built up logically on the fundamental postulates of the quantum theory.

The fundamental step in resolving these, among other, difficulties was taken by Heisenberg soon after the appearance of Prof. Born's book. He abandoned the usual methods of calculation in terms of mechanical frequencies and such features of mental pictures as were not amenable to observation; in fact, he virtually abandoned the usual pictures in space and time whereby an electron is here and here only at one instant, and there and there only at the next. He introduced instead a quantum mechanics involving manifolds of quantities—matrices as they were afterwards shown to be—which depended on observable *transition* frequencies and not on unobservable *mechanical* (or orbital) frequencies. The atom must henceforth be considered as a whole and not as a collection of individual particles each with a separate identity. The importance of the new step was immediately recognised and led to a rapid development of a rational, self-contained system of quantum mechanics with a remarkable simplification of the essential quantum conditions.

The theory was only a few months old when a new and independent set of investigations was published by Schrödinger, who introduced another point of view. Schrödinger re-emphasised the analogy between dynamics and geometrical optics, already pointed out by Hamilton in his first researches on dynamics. But he went further than Hamilton in that he attempted to extend the analogy between mechanics and optics to take in the concept of waves, which had proved so necessary in optics to explain interference and diffraction phenomena. Schrödinger found the appropriate generalisation of ordinary Hamiltonian dynamics, and, beginning with the simple hydrogen atom, applied it with astonishing success to a number of atomic problems.

After the essentially mathematical nature of the matrix mechanics, the new treatment by Schrödinger came as a pleasant relief to many physicists, as it, at any rate, held out some prospect of the re-establishment of physical pictures of atomic processes. Although in this theory material particles are replaced by wave systems, a definite localisation of electric charge in space and time seems possible, and this with the aid of ordinary electrodynamics accounts for the frequencies, intensities, and polarisation of the light emitted by atoms without the introduction of a number of correspondence and selection principles. Furthermore, the theory accounts for the phenomena of absorption, dispersion, and scattering in a more rational way than was possible with the old quantum theory.

The equivalence of the matrix and wave mechanics has now been established (principally by Schrödinger himself), and attention has latterly been directed to the physical and philosophical implications of these two aspects of atomic theory. The relation between the Schrödinger waves and electrons seems analogous to that between radiation and light quanta. On the wave theory, one cannot answer the question as to how a particular particle moves, but one can instead find the probability of its moving in any specified direction. Whether or not this means the abandonment of the law of causality in atomic problems is a question

which has received considerable attention recently, but is likely to remain for some time unanswered.

In the hands of Prof. Born the new theory has yielded a satisfactory explanation of the results of Franck and Hertz on electronic collisions with atoms, and has led to a qualitative explanation of the experiments of Dymond on electron scattering. While incompetent to deal with the life history of any single electron in collision, the new theory deals successfully with a stream of electrons and may be regarded as a singular fusion of mechanics and statistics.

In the light of the new work and the abandoning of cherished mechanical pictures of atomic processes, such terms as *position* and *velocity* of electrons require examining anew. Only when methods have been devised for their experimental observation will they be of physical significance. The possibility of making such determinations has recently been considered by Heisenberg, and has led him to important conclusions regarding the possibility of making simultaneous determinations of the position and velocity of a free electron. It seems that here, too, Heisenberg has opened up a new line of thought, and interesting developments may be expected in the near future.

In view of these recent developments in the mechanics of the atom, it may well be asked whether any useful purpose is served by the translation of Prof. Born's book published two years ago. The answer was given by Prof. Born in the preface to the original German text, when he said :

"This work is deliberately conceived as an attempt, an experiment, the object of which is to ascertain the limits within which the present principles of atomic and quantum theory are valid and, at the same time, to explore the ways by which we may hope to proceed beyond these boundaries. In order to make this programme clear in the title, I have called the present book 'Vol. I.'; the second volume is to contain a closer approximation to the 'final' mechanics of the atom."

The material for Prof. Born's second volume is now to hand, and students of theoretical physics will await with some impatience the completion of the task which Prof. Born has set himself. Meantime, the first volume serves as an excellent introduction to recent developments. It provides an account, at once concise and lucid, of the general dynamics of Hamilton and Jacobi, with just that special orientation towards atomic problems for which there has been a long-felt want. It introduces the reader to just those theorems of dynamics which have proved so essential in the recent developments of the new quantum mechanics.

The translation has been carried out with great care under the supervision of Prof. Andrade, who has himself contributed one of the most valuable of recent introductory treatises on atomic structure. The book shows signs of a painstaking revision, with the result that the reader is presented with a translation which is accurate without a too slavish adherence to the original text.

There are one or two minor departures from the German text, which have been necessitated by the publication of new experimental work since the appearance of the original edition. Some modifications have been made in the early paragraphs concerning the mechanism of radiation to take into account the experimental results of Geiger and Bothe, and of Compton and Simon, and there has been a modification of the derivation of the Rydberg-Ritz series formula on the lines suggested by Bohr.

The publishers are to be congratulated on their enterprise in producing a translation of this book, and on the efficiency with which they have carried out their task. The binding and printing are alike excellent. J. E. L.-J.

Cambridge Biographies.

Alumni Cantabrigienses : a Biographical List of all known Students, Graduates, and Holders of Office at the University of Cambridge, from the Earliest Times to 1900. Compiled by Dr. John Venn and J. A. Venn. Part 1 : *From the Earliest Times to 1751.* Vol. IV. : *Saal-Zuinglius.* With an Appendix containing additional Information relative to previous volumes. Pp. v + 538. (Cambridge : At the University Press, 1927.) 150*s.* net.

THIS volume completes the monumental record by the late John Venn and his son, of the sons of Cambridge up to the year 1750 ; it contains 42 pages of additional information in supplement to the earlier volumes. The welcome announcement is made in the preface that the Syndics of the University Press have undertaken to see Part 2 also of "Alumni Cantabrigienses"—for the years since 1750—through the press.

There are not so many famous names in science in the present volume as in the earlier ones : we note John Wallys, one of the founders of the Royal Society ; Samuel Wegg, its treasurer for thirty-four years ; Edward Wright, of Mercator's projection ; Francis Willoughby, the distinguished naturalist, fellow traveller with John Ray ; William Turner, the scientific pioneer in botany ; Robert Smith, founder of the Smith's prizes ; Nicholas

Sanderson, who lost his eyesight in infancy from smallpox, yet became later Lucasian professor; and William Whiston, Newton's successor in the same chair, who was banished from the University for his Arian views. We note that T. Tudway, organist of King's and professor of music, was deprived of his chair for making puns on the queen, but he afterwards recanted and was readmitted.

Robert Taylor, who perfected the cure of ague by quinine and was physician to Charles II., is one of many distinguished medical men who figure in the volume, and it is noteworthy how frequently the letters F.R.C.P., F.R.S. are coupled together. Another prominent group are the divines, among whom may be mentioned William Tyndal, the translator of the Bible; Archbishop Whitgift; Samuel Wesley, father of John and Charles; and Thomas Sheppard of Emmanuel, in honour of whom Cambridge, Massachusets, was so called. The names of Edmund Spenser, John Suckling, and Edmund Waller remind the reader of the place of Cambridge as a nursery of English poetry, while Laurence Sterne and W. Stukeley recall other literary activities.

Echoes of bygone times are found in the record of Job Tookey, admitted at the age of thirteen years in 1658, removed after a fortnight, apprenticed to a grocer in Cheapside and later sent to sea, or of Henry Sumpter, sent from King's College to New College, Oxford, where he was thrown into a cave under the College where salt fish was kept—and died not long afterwards. A more modern touch is sadly supplied by F. Sterling, Fellow of Jesus, killed in the War in Flanders in 1692. The names of Sir Robert and Horace Walpole; of Thomas Wentworth, Earl of Stafford; and of George Villiers, Duke of Buckingham, recall the historical background; while Richard Whittington, Lord Mayor of London, figures in the volume as one of the early benefactors to the University. Cambridge owes a deep debt of gratitude to the authors of these volumes for their zeal, learning, and accuracy, and the services of the University Press in publishing them must not be forgotten.

The Origin of the Week.

The Week: an Essay on the Origin and Development of the Seven-day Cycle. By F. H. Colson. Pp. viii + 126. (Cambridge: At the University Press, 1926.) 5*s*. net.

THE seven-days week is a division of time which has long been in general use, and is commonly believed to have come down to us from at least the time of Moses, but why or how the days have become associated with the planets—the word planet is here used as understood by the ancients—is not so generally known. Mr. Colson's book supplies an immense deal of information on this point, and is obviously the result of a great deal of study and research.

The author's purpose is to show that our present week is a combination, which took place within the Roman Empire, of two distinct systems—the Jewish week and the 'planetary' week. The former had long been familiar to the Romans, but the latter, as he shows, cannot be traced back much earlier than the beginning of the Christian era, and was due to the development among the masses of astrological ideas as to the influences of the planets.

The accepted order of the planets according to their distances from the earth, starting with the outermost, was Saturn, Jupiter, Mars, Sun, Venus, Mercury, and Moon, but this order is not at first sight evident in the sequence of the names. There are successive jumps over two planets, but a suggestion of Dion Cassius is accepted as probably correct, namely, that the planets were supposed to rule successively for one hour at a time. Thus starting with the first hour of Saturn's day (Saturday) Saturn itself was regent, but Jupiter presided over the second hour, Mars over the third, and so forth, which brings the first hour of the second day under the regency of the sun (Sunday). Similarly, the opening hour of the third day will be ruled by the moon (Monday), and the order of the names throughout the week is thus readily explained. It is suggested that originally the point of contact between the Jewish and the planetary weeks was the Sabbath. It is shown that by the beginning of our era the idea had become widespread that that day was Saturn's day, and this may perhaps have given the planetary week its starting point.

Among other matters of interest in the book we find the discussion of such subjects as the week in the New Testament and the early Church, and the establishment of Sunday as the Lord's Day. With reference to the latter, while acknowledging that by the second century the first day of the week had acquired an undoubted sanctity as that on which the Resurrection took place, the author concludes that we owe our religious and civil Sunday to the combination of two factors, namely, "the immemorial familiarity of the Jewish Christian with the Sabbatical week, and the recent familiarity of the Gentile Christian with the

planetary week." There is also an instructive chapter on the week in northern Europe, and the names of the days in various European languages are collected together into five groups in the appendix.

The book is extremely well written and contains much information not readily accessible to the ordinary reader. Its usefulness would have been still further enhanced by the addition of an index or a synopsis of the chapters.

Our Bookshelf.

Treatise on Sedimentation. Prepared under the Auspices of the Committee on Sedimentation, Division of Geology and Geography, National Research Council of the National Academy of Sciences. By William H. Twenhofel and Collaborators. Pp. xxv + 661 + 38 plates. (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall, and Cox, 1926.) 34*s.* net.

THE treatise is a bold and ambitious attempt to present a comprehensive statement of our present knowledge of sediments and the processes which control their formation and development. From the point of view of work accomplished in America, it may be satisfactory as a preliminary basis for the discussion of future researches, but it is unfortunate that many British and European contributions to the subject matter should have been overlooked. The committee on sedimentation has apparently realised this source of weakness in their earlier work, for Prof. L. W. Collet has now been added as a European representative. In the treatise itself the lack of international proportion is shown by the fact that there is only one nominal reference to the far-reaching work of Prof. P. G. H. Boswell, and that to the statement that "sand is predominantly composed of quartz grains." On p. 629 one of Boswell's memoirs is wrongly attributed to Crook, but in compensation Crook's name does not appear in the index.

While it is in many parts admirable, the treatise is clearly far from being the authoritative work we might reasonably have expected. The necessity for further studies of environment of deposition and of diagenesis is revealed by the striking absence of precise knowledge in these fields of geological endeavour.

Melanesians of the South-east Solomon Islands. By Dr. W. G. Ivens. Pp. xix + 529 + 15 plates. (London: Kegan Paul and Co., Ltd., 1927.) 30*s.* net.

THIS book is very well written, in simple vivid language, and the author is at his best in the descriptions of particular customs, ceremonies, and beliefs. The chapters on sexual life, betrothal, and marriage; the accounts of fishing and gardening, of feasts and dancing, of warfare and magic, are one and all excellent. The description of bonito fishing, so characteristic of the Southern Solomons, is of outstanding literary merit and scientific interest.

The abstract subjects, such as kinship and legal or economic organisation, suffer from a weak grasp of sociological principles. The table of kinship nomenclature is well-nigh worthless, in that it gives the native words for English appellations instead of giving a sociological analysis of the native terms. The author is right in correcting the late Dr. Rivers (on p. 59) on the use of personal names between relatives in some parts of Melanesia, a custom which is by no means confined to Dr. Ivens's area. But when he adds that "relationship terms in these places (Sa'a and Ulawa) do not connote social duties," he contradicts his own evidence, and his mistake is due to an obvious misunderstanding of Dr. Rivers's words and ideas. Equally misleading are certain generalisations about native 'shell money.'

On the whole, however, the book is a valuable contribution to Melanesian anthropology; it provides very attractive reading, and is magnificently filled with illustrations in colour and black and white, with diagrams and maps.

Practical Psychology: Human Nature in Everyday Life. By Prof. Edward Stevens Robinson. Pp. xii + 479. (New York: The Macmillan Co., 1926.) 7*s.* 6*d.*

THIS is a simple presentation of the main features of psychological science aimed at bringing out the relations of its principles to the personal life of the student. As the study of human nature, psychology deals with human behaviour as well as with mental life in the abstract; and, for practical purposes, a knowledge of behaviour and its sources is the more important aspect of the two. Though most people know some psychology (since they carry human nature about with them and can scarcely fail to observe it), science is necessary to approve, correct, or reject popular notions as to the working of human nature, especially when such notions are employed in any attempt to alter or perfect its working. Chapters on the connexion between human nature and body are followed by a fairly complete discussion of all the topics dealt with in elementary psychological textbooks.

The matter is clearly presented, with simple problems suggested at the end of each chapter and references for further study appended. The book substantiates its claim to be practical throughout, and needs no educational background "greater than is likely to be possessed by a student in the latter part of the high school course." As an indication of the general method followed by the author, one of the problems set at the end of the chapter on personality may be quoted. "No personality is perfect. What steps might you take to make yourself a more effective individual?" Materials for its solution, as for that of the other problems set, are given in the text.

Faune de France. 13: *Diptères (Brachycères).* (*Stratiomyiidæ, Erinnidæ, Cœnomyiidæ, Rhagionidæ, Tabanidæ, Codidæ, Nemestrinidæ, Mydaidæ, Bombyliidæ, Therevidæ, Omphralidæ.*) Par E. Séguy. Pp. iii+308. 55 francs. 14: *Diptères pupipares.* Par Dr. L. Falcoz. Pp. 64. 12·50 francs. (Fédération française des sociétés de sciences naturelles: Office centrale de faunistique.) (Paris: Paul Lechevalier, 1926.)

WE welcome these two additions to that excellent series the "Faune de France." Part 13, by M. E. Séguy, deals with all the families of the so-called Platygenia group of the Brachycera with the exception of the Asilidæ. This family, along with the Orthogenia, will presumably form the substance of a future volume. Part 14, by M. L. Falcoz, is concerned with the group Pupipara, and we are glad to note that the Braulidæ are no longer included among the latter. These treatises are more especially intended as guides to the identification of the groups concerned, and for this purpose concise family, generic, and specific keys are provided. Further and more detailed characters will be found under each species together with a summary of its geographical range. Special mention needs to be made of the very large number of line figures illustrating important diagnostic features. The biology of these insects is also by no means neglected, and, wherever information exists, some account of larval and pupal structure and habits is given. These two parts are well up to the standard of their predecessors, already noticed in these columns, and they can be recommended to all dipterists as well as to the general entomologist.

A. D. I.

Aeronautical Meteorology. By Willis Ray Gregg. (Ronald Aeronautic Library.) Pp. xii+144+11 plates. (New York: The Ronald Press Co., n.d.) 2·50 dollars.

THE aeronaut's need of a knowledge of weather is vital, but the ordinary meteorologist when trying to provide for it finds it difficult to put on one side the conventional modes of treatment and to remember what is really wanted: thus when describing the upper winds at any place, he is tempted to give the mean wind direction at successive heights, instead of a table of the relative frequencies so that the pilot may know the likelihood of a favourable wind.

However, Mr. Gregg has admirably realised the situation. After an account of the general circulation and of the methods of observation, he naturally deals with American conditions, discussing the vertical structure of the air (but the constancy of e/P on p. 31 should be explained), the change of winds with height and gustiness, fogs and clouds (the photographs of these being excellent), visibility, thunderstorms, cyclones and anticyclones, forecasting, and flying over the North Atlantic and the north polar regions. His 'moving thunderstorm' corresponds with what is called in England a 'line squall,' but its width is given as 40 to 50 miles, the length being 150 to 200 miles. The chapter on cyclones is essentially practical, though interesting theoretical questions are raised by the predominance of rain to the N.W. of the centre, instead of to the S.W. and S.E., which the Bjerknes theory suggests. We wish that such a book were available for those under British conditions.

Field Astronomy: for Engineers and Surveyors. By Prof. D. Clark. Pp. viii+164. (London: Constable and Co., Ltd., 1926.) 10*s.* 6*d.* net.

THIS manual provides a concise summary of the astronomical principles and methods of observations employed by surveyors and engineers when requiring absolute positions on the earth's surface in the course of survey work. The contents are lucidly arranged in three chapters, dealing respectively with principles, instruments, and observations. Good type, explanatory diagrams, reproductions of the various instruments used, a number of worked examples, and a bibliography contribute materially to the value of the book. The description of the methods for determining longitude includes full details of the reception of radio signals used for this purpose. Consonant with its title, the book is of handy pocket size. It should be of great use both to engineers, who wish to have the working details of astronomical observations used in the field, and to university students of surveying and geodesy.

A Handbook of Renal Surgery. By F. McG. Loughnane. Pp. xiv+210. (London: Longmans, Green and Co., Ltd., 1926.) 10*s.* 6*d.* net.

IN his preface to this book, Mr. Loughnane tells us that it is intended for the use of general practitioners and students. The reader will therefore not expect detailed descriptions of kidney operations, which are largely in the hands of specialists. The author concerns himself almost entirely with the investigation of surgical diseases of the kidney, and his accounts of diagnostic methods are clear and complete. The number and quality of the radiographs with which the book is illustrated demonstrate the value of X-rays in this branch of surgery, and it is evident that there are few surgical conditions of the kidney which do not require preliminary radiological investigation. There is a useful chapter on the estimation of renal function.

Chambers's Encyclopædia: a Dictionary of Universal Knowledge. Edited by Dr. David Patrick and William Geddie. New edition. Vol. 9: *Sacrament to Teignmouth.* Pp. iv+904. (London and Edinburgh: W. and R. Chambers, Ltd.; Philadelphia: J. B. Lippincott Co., 1927). 20*s.* net.

THIS useful encyclopædia is now nearing completion. The present volume contains a number of new articles, while the others have been thoroughly revised. Several of the articles are of considerable length and give practically all the information about their respective subjects that the reader or student could desire. The free use of illustrations and diagrams adds to the value of the work. All the longer articles have numerous references to literature. There are eight coloured maps by Bartholomew with new boundaries clearly shown.

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.*]

An Effect of Sunlight on the Altitude of Aurora Rays.

ON Sept. 8, 1926, between 21h 30m and 22h, Greenwich mean time, I saw from Bygdö, near Oslo, a remarkable aurora in the west. It had the form of a portion of a feeble arc of grey violet colour, stretching upwards from the horizon about 40°. Later on this arc changed into a diffuse mass sharply limited on its south border.

Simultaneously, this aurora was very carefully observed from the Lerwick observatory as faint streamers on the northern, eastern, and western part of the sky up to zenith.

I was fortunate enough to have two of my aurora stations in action, Bygdö and Oscarsborg, mutual distance about 26 kilometres, and I obtained of this remarkable aurora a series of photograms of the greatest interest. The measurement and calculation of the photographic plates will appear shortly in *Gerlands Beiträge zur Geophysik*, and I will here only mention the principal results.

The arc appeared on the plates as a curtain of rays which were difficult to distinguish visually, and this curtain was situated over and to the north-west of the Shetland Islands at the quite unusual height of 300 to 500 kilometres. The diffuse form which ended the aurora display probably reached the immense height of more than 1000 kilometres. This high curtain was essentially different from all curtains measured in southern Norway from 1911–1922; in fact, these curtains generally had a yellow-green colour and were situated from 80 to 200 kilometres above the earth.

The situation of the curtain far in the west, some hours after sunset, led me to the supposition that it was perhaps illuminated by the rays of the sun. My assistant, Ragnvald Wesöe, made at my request the necessary calculations, and the hypothesis was verified: the *aurora was situated in that portion of the upper atmosphere directly illuminated by the sun.*

It was now an interesting question to know if the aurora rays, measured during the years 1911 to 1922 and of unusual altitude from 400 to 800 kilometres, were also exposed to the rays of the sun. Mr. Wesöe calculated the height of the dark portion of the atmosphere for each ray whose situation had been calculated from photograms[1] and the results are as follows:

The rays situated in the interval from 400 to 800 kilometres above the earth were all exposed to the sun's rays, and of those stretching from 100 to 400 kilometres, about 95 per cent were in darkness. This remarkable fact is most clearly seen in Fig. 1, which gives the situation of all the aurora rays from 20h 21m, Greenwich mean time, on Mar. 22, to 2h 53m on the following day. Each ray is marked by a vertical line, and an arrow indicates that the lowest or highest point of the rays were outside the photographic field. The boundary between the dark and sunlit atmosphere is marked by a short stroke the height of which is the mean between the heights corresponding to the highest and lowest measured point of the ray. In this first approximation no account has been taken of refraction.

From this diagram it is clearly seen that the height of the rays is great in the evening and in the morning, but low during the night. The high rays in the morning of Mar. 23 were of a beautiful blue colour, and through a small pocket spectroscope I saw a quantity of lines in the blue and violet, while the common green aurora line was rather faint. I am sorry that I had used all the plates on the other stations, so that only a very few photograms of these blue rays were taken. But judging from single photographs, the rays later reached heights probably exceeding 800 kilometres.

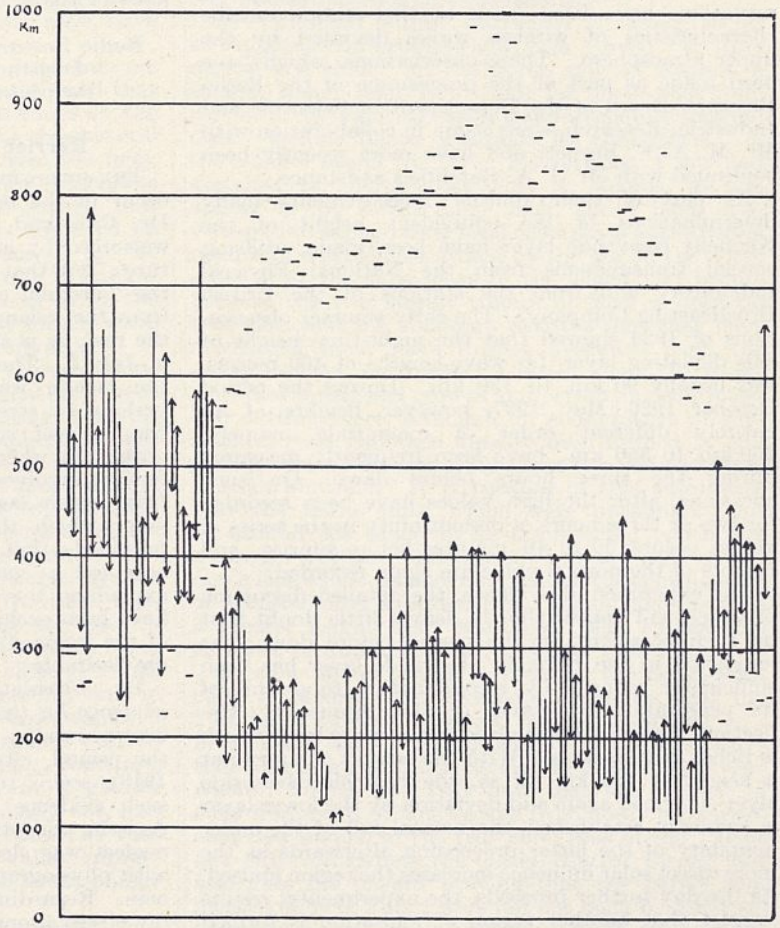


FIG. 1.

It seems from these facts that the sunlight has a remarkable action on the upper atmosphere, so that the illumination caused by the electric rays forming the aurora borealis became visible to much greater altitudes than ordinarily.

[1] See "Résultats des mesures photogrammétriques des aurores boréales observées dans la Norvège méridionale de 1911 à 1922," Fig. 12, *Geofysiske publikationer*, vol. 4, No. 7, Oslo, 1926.

It is well known from wireless telegraphy that sunlight ionises very strongly the higher atmosphere, and it may be that the accumulated ionising effect of the sunlight and of the electric rays illuminates the atmosphere to a greater altitude than the electric rays alone. Perhaps also the ionisation lifts up the atmosphere by electric charge, as in Vegard's theory, or perhaps such a lifting up may be the effect of a raising of the temperature in those regions. A detailed study of photographs of the spectra of these high rays may solve the question as to the cause of this effect of sunlight on the altitude of the aurora.

CARL STRÖMER.

Oslo, Norway.

The Existence of more than one Ionised Layer in the Upper Atmosphere.

DURING the past year and a half systematic observations have been made at this station on the characteristics of wireless waves deviated by the upper atmosphere. These observations, which have been made as part of the programme of the Radio Research Board of the Department of Scientific and Industrial Research, were begun in collaboration with Mr. M. A. F. Barnett and have more recently been continued with Mr. J. A. Ratcliffe's assistance.

As part of such routine measurements many determinations of the equivalent height of the Kennelly-Heaviside layer have been made, utilising special transmissions from the National Physical Laboratory and from the stations of the British Broadcasting Company. The early summer observations of 1926 showed that the night-time height of this deviating layer, for wave-lengths of 400 metres, was usually 90 km. to 130 km. During the period October 1926–May 1927, however, heights of an entirely different order of magnitude, namely, 250 km. to 350 km., have been frequently measured during the three hours before dawn. On such occasions, after the high values have been recorded for two or three hours, a discontinuity in the series of values occurs 30 to 40 minutes before sunrise, and heights of the normal value are again recorded.

The experimental evidence, the detailed discussion of which will appear shortly, leaves little doubt that on such occasions, in the period before dawn, the ionisation in the Kennelly-Heaviside layer has been sufficiently reduced by recombination to permit of its penetration by waves of this frequency. Reflection, however, takes place at an upper layer which is richer in ionisation. With the advent of sunrise at a height of 100 km. or so, the Kennelly-Heaviside layer is formed again and deviation by the lower layer is suddenly established, the normal fall of the under boundary of the latter proceeding afterwards as the more direct solar influence increases the region ionised. As the day further proceeds, the experimental results suggest that another region of ionisation is formed below the Kennelly-Heaviside layer, which, while causing attenuation of the waves, does not very materially affect the height at which they are deviated.

The obvious bearing of these results on the nature of the solar radiation responsible for atmospheric ionisation and their correlation with the results of terrestrial magnetism must await a more detailed discussion. There is, however, one small point which may be mentioned here. It seems of interest in indicating the possibility that simultaneous observations between the same two stations on widely different wave-lengths might enable us to study the characteristics of both layers at the same time. Since ultra-short waves require a greater electron concentration to deflect them back than do the longer waves, there may not be enough electrons in the Kennelly-Heaviside layer to send back the former, so that for angles of incidence less than a certain amount (*e.g.* in short distance transmission), such wave-lengths would be deviated by the upper layer at all times of the day. The relatively large amplitude of the ray returned from the upper layer in the experiments mentioned above, in which 400 metre waves were used, demonstrates the low attenuation consequent on deviation at such great heights, so that with ultra-short waves the greater part of the absorption would probably take place in the penetration of the lower layer. Thus, even for transmission over long distances, we might expect a higher ray path, and deviation at the upper layer would result in less resultant absorption than a low ray path with deviation at the Kennelly-Heaviside layer. It may be mentioned in this connexion that the American determinations of the height at which these ultra-short waves are 'reflected' fit in with the above ideas of their deviation at the upper layer.

E. V. APPLETON.

Radio Research Station,
Dogsthorpe,
Peterborough.

Barrier Reefs of Tahiti and Moorea.

THE surprising fact that fragments of volcanic rock occur in the barrier reef of Tahiti, as reported by Dr. Crossland in NATURE for April 23, must be welcomed by all students of that remarkable structure; but that fact does not, it seems to me, prove the "original continuity of the present barrier reef from the [island] shore to the ocean slope" outside the reef, as is stated in his second letter in the issue of July 2. The fact only permits the inference that the lagoon was formerly filled in some manner, perhaps by stream deltas instead of by a broadened fringing reef, so that island detritus could be transported to where the barrier now stands. This inference involves so extraordinary a series of changes from former lagoon filling to later lagoon excavation —for which there is no other satisfying evidence provided—that even the inference should not be accepted as valid until all other possible means of explaining the occurrence of the volcanic fragments have been excluded. Further details as to the nature of the fragments and the manner of their occurrence are desirable.

Dr. Crossland's rejection of the physiographic evidence for the subsidence of Tahiti, as provided by drowned-valley bays and as given in my account of the island (*Annales de Géographie*, **27**, 241-284; 1918), seems to me of a piece with the neglect of such evidence on the part of Murray, Guppy, A. Agassiz, and other students of coral reefs; and that neglect was clearly the result of their unfamiliarity with physiographic evidence rather than of its weakness. Regarding the occurrence of embayed valleys, my observations in 1914 led me to be just as positive in asserting their presence near the isthmus which connects the two cones of the Tahiti doublet as Dr. Crossland is in asserting that "There are *no* bays in Tahiti." The bays to which I refer are "little bays which," as Dr. Crossland says, "open out of Port Phæton," and inasmuch as they enter well back of the general shore line of the island between eroded slopes of volcanic rock, I took them to be the partly drowned valleys of ordinary streams, and so still regard them, in spite of their being described as "peculiar" by Dr. Crossland and as "certainly not drowned valleys." But I fully agree that Port Phæton Bay is merely a re-entrant space between the two confluent volcanoes of which Tahiti is composed. This origin was by no means overlooked in my article, for I there said that Port Phæton Bay on the south-

west side of the inter-cone isthmus and the corresponding Taravao Bay on the north-east side of it "sont évidemment en rapport avec la forme initiale des deux cônes contigus" (p. 245).

When the small bays which open out of Port Phæton were produced by the entrance of sea water into their little valleys in consequence of a moderate subsidence of the island, all the many larger valleys of the island were presumably embayed also; but they have all been filled with alluvium, because the drainage areas tributary to them are larger and more mountainous. The small bays, which still remain but partly filled, appear to have escaped complete filling because they receive streams from small drainage areas. Of course the many bay-filling deltas have a seaward slope. Indeed, the associated facts that the delta flats are in no case level and that their streams have a rapid flow along them, both of which Dr. Crossland mentions as if to discredit the origin of the flats as the fillings of former bays, have no such bearing.

On the other hand, a number of the delta flats are a quarter or half mile wide at their mouths; and that so great a width should there be given them by the lateral erosion of their streams, while the streams still flow in sharp-cut V-valleys upstream from the flats, seems to me unreasonable. The more reasonable explanation of the flats is, as above stated, that they are the fillings of valleys that were embayed by island subsidence; and this explanation is all the more reasonable in view of the absence of a shallow rock platform in front of the great cliffs in which the inter-valley spurs have been cut back by former wave action around most of the island circumference.

I am glad that Dr. Crossland has recognised these "old marine cliffs," for they have generally been overlooked by earlier observers, excepting Agassiz; indeed, at least two observers have explicitly stated that there are no sea cliffs at the base of the island slopes. Surely, a rock platform must have slanted gently seaward just below sea-level when the cliffs were cut back by the ocean waves during a reefless period in the earlier history of the island; the absence of reefs at that time being presumably due to the abundant outwash of detritus from the non-submerged valley mouths, as is to-day the case in the reefless island of Reunion. But instead of being now fronted by such a platform, the cliffs of Tahiti are fronted by a lagoon twenty or more fathoms in depth, even though the lagoon floor has been aggraded by an unknown measure of detrital deposits derived from the island and the reef. Evidently, therefore, the cliff-base platform has subsided to a greater depth than that at which it was originally cut, and this subsidence must have been the same as that which produced the now delta-filled valley embayments. The cliffs as at present seen must plunge below sea-level.

As to my interpretation of the slopes of white sand inside of the Tahiti barrier reef as evidence of inwash from the reef, and as therefore contradicting the idea that the lagoon is now suffering excavation, I am by no means persuaded that it is erroneous. Agassiz' account of his dredgings in the lagoon lead to the same conclusion, for its floor contains much detritus from the island. If other parts of the inner slope of the barrier reef than those which I saw are devoid of inwashed sand, that may perhaps be because the reef is there broader, or because the sand has been shifted by lagoon waves down the slope from the reef to the middle depths of the lagoon floor. But regarding this point, as well as the blocks of coral rock on the sand slopes, I will wait for the appearance of Dr. Crossland's fuller report, which I will examine with the same interest that I hope he will give to my book on "The Coral Reef Problem," shortly to be published by the American Geographical Society of New York. He will there find many details concerning my observations on numerous Pacific reefs, the present lack of which he is good enough to regret. In the meantime I may refer him to a rather lengthy article on the coast and reefs of New Caledonia in the *Annales de Géographie* for 1925; and also to a small book on the Lesser Antilles, with particular regard to their imperfect barrier reefs, published by the American Geographical Society in 1925. But the details that I give are chiefly physiographical rather than biological. That side of the problem I am not prepared to deal with; and in any case it seems to me the less significant side, so far as reef origins are concerned; for it is to the forms and the changes of the island coasts, as determined by abrasion, erosion, and movements of upheaval or subsidence, that the reef-builders must adapt themselves.

Dr. Crossland is fully warranted in saying, so far as my published articles show, that I seem "to have missed the cliffs" on the north side of Moorea, a smaller island than Tahiti, not far north-west from it; for in my Tahiti article it is unfortunately asserted that "aucune falaise n'entaille les contreforts" of the smaller island (p. 277). Nevertheless I saw and sketched the north-coast cliffs of Moorea, as will appear in my forthcoming book, and I have even ventured to explain their local occurrence as the consequence of a prolonged attack by the sea on the north coast after the subsidence of the island had begun, because the two largest valleys of Moorea open on that side, and the abundant detritus that they have discharged must have drifted westward from the valley mouths and formed a beach along the shore, thus preventing reef growth and permitting continued cliff cutting there, although, in consequence of subsidence, reefs had then already been formed by upgrowth around the rest of the shore line and protected it from abrasion. It is because of this subsidence that the lower cliffs, which were presumably cut all around the island in its unprotected youth, are no longer visible. Cliffs are seen to-day only on the north side where, as above suggested, the continuation of abrasion after subsidence had begun gave the cliffs a greater height than elsewhere. This explanation is rather venturesome, but it is better than none.

In view of my failure to mention the north-coast cliffs of Moorea, Dr. Crossland concludes that my "criticism of Daly's theory of glacial control . . . fails in this case." By no means; but I must leave that long story for more deliberate presentation elsewhere. Suffice it to say now that the absence of cliffs from most of Moorea and from many other reef-encircled islands in the true coral seas of the Pacific not only contradicts the glacial-control theory, but also goes far toward proving that the partly submerged cliffs of Tahiti were not cut back by low-level abrasion in the glacial period. It is only in the marginal belts of the coral seas that cliffs due to low-level abrasion are to be found, as I have shown in the above-cited booklet on the Lesser Antilles and elsewhere.[1] In conclusion, let me add that I accept Dr. Crossland's dictum that "barrier reefs can no longer be taken as an index of subsidence without independent proof from the adjacent land;" and it is precisely because such independent proof is almost universally forthcoming that the upgrowth of barrier reefs as a consequence of island subsidence may be generally accepted, essentially as Darwin long ago inferred.

W. M. DAVIS.

Harvard University,
July 21.

[1] "The Marginal Belts of the Coral Seas," *Proc. Nat. Acad. Sci.*, **9**, 292-296; 1923; also *Amer. Jour. Sci.*, **6**, 181-195; 1923.

Surface Layers on Tungsten produced by Active Nitrogen.

WE have found that a fine tungsten filament at a very dull-red temperature placed in a stream of nitrogen undergoes a considerable (10-25 per cent.) lowering of its resistance (for constant current flowing through it) when active nitrogen produced up-stream by a condensed discharge passes over it. At the same time the colour changes to a much duller red, that is, the radiation is decreased. These changes persist until the filament is momentarily flashed at a white heat, whereupon the original condition is regained. Apparently a surface layer of some sort forms on the filament and produces a lowering of its temperature. The resistance of the filament at room temperature is the same either with or without the layer.

The same cooling effect can be produced by bombarding still nitrogen with electrons from another source filament accelerated by suitable electric fields. In a tube with large nickel electrodes which had been thoroughly degassed by the repeated use of an induction furnace, this effect was first detectable when the exciting electrons had an energy of 11 volts. The rate of formation of the layer increased rapidly with the voltage. In a second tube, in which the anode was a hot tungsten spiral, the effect was not detectable below 22 volts. The effect was independent of the potential of the testing filament, showing it to be produced by a neutral substance. It seems possible that in the first case the active substance was produced at the low voltage by bombardment of the metal surfaces. These effects were obtained both with commercial nitrogen which had been passed over hot copper and with nitrogen prepared by Waran's method which was so pure that it would not give the afterglow.

Peculiar current-voltage characteristics were obtained with the tube having the hot anode. With increasing voltage the current increased, as in other gases, up to 22 volts, at which voltage it began to fall off. At 25 volts an arc struck, the current took a sudden rise immediately, followed by a decrease in two or three seconds to a value considerably below that which it had had before the arc struck. Further increases in voltage produced slight increases in current. Upon decreasing the voltage, the current dropped off until the arc broke at about 20 volts. Here there was a sudden decrease in current followed by a slower rise to a much higher current, the same as that at the corresponding voltage before the arc had struck. The two currents were the same for lower voltages. That these effects are characteristic of nitrogen and not ascribable to charges on the walls of the tube seems probable, for no such effects were observed with argon in the tube. A decrease of the thermionic current in nitrogen at much lower pressures and higher voltages was observed by Langmuir (*Phys. Rev.*, 2, p. 450; 1913). We also observed a considerable temporary decrease in the thermionic emission from a tungsten filament as ordinary active nitrogen passed over it.

A tube was constructed having a pile of tungsten foil discs, spaced apart, and mounted so that they could be flashed with the induction furnace. Electrodes and filaments were provided, so that the nitrogen could be activated either by the disruptive discharge or by electron bombardment of known voltage. Gas pressures were measured with a hot wire guage of small volume. The total volume of the tube and gauge was small enough in relation to the area of tungsten that a gas layer one atom deep on the latter, if evaporated, would cause a pressure of the order of 0·1 mm. The tube was baked out under exhaust, as usual, at 450° C. and the discs well degassed by flashing. With a few tenths of a millimetre of nitrogen in the tube, and keeping the discs at a dull-red heat while the spark discharge was passed, a partial clean-up of the gas was obtained. After exhausting the remaining gas and closing off the pump, the discs were flashed, with the discovery of a considerable quantity of gas. Gas so recovered was not cleaned up by a hot tungsten filament, and on examination with a hand spectroscope gave all evidences of being nitrogen. The experiment was repeated a large number of times, varying the time of the spark discharge. In all cases except where the time of discharge had been very short, the amount of gas recovered on flashing was a constant quantity, approximately that to be expected from a layer one atom deep. Exactly the same results were obtained by activating the nitrogen with an arc at 25 volts. At 15 volts there was no indication of clean up, or of a gas layer on the tungsten which could be removed by flashing.

Our conclusions are that a clean tungsten surface at a dull-red heat, if placed in an atmosphere of nitrogen, activated either by a condensed discharge or by an electron bombardment at more than 22 volts, becomes covered with a nitrogen layer of the order of one atom deep. The effect of this layer, at this comparatively low temperature, is to cool the surface. It seems probable that it does this by allowing the surface to conduct more heat to the gas, *i.e.* by increasing the accommodation coefficient. At relatively high temperatures, the same layer is probably so unstable that only a small fraction of the surface can be covered at any one time, but it acts to increase the work function. The flashing of a filament covered with such a layer in the neighbourhood of a clean filament causes the production of a layer upon the latter. Apparently the layer evaporated by flashing comes off in an active form. These experiments suggest that active nitrogen can be produced by bombardment of nitrogen gas with 22 volt electrons, but further work is necessary to establish this conclusion. The experiments are being extended and completed, and will be described in detail later.

CARL KENTY.
LOUIS A. TURNER.

Palmer Physical Laboratory,
Princeton University,
Princeton, New Jersey, U.S.A.

The Temperature Variation of the Elasticity of Rochelle Salt.

VALASEK (*Phys. Rev.*, 478; 1922) has studied the temperature variation of the piezo-electric modulus of Rochelle salt. He found abrupt change in the values of this modulus at temperatures of −15° C. and 23° C., using crystal slabs with their length at 45° with the $\bar{b}$ and c crystallographic axes. In a later paper he describes experiments undertaken to investigate the temperature variation of other physical properties of the crystal, but these experiments do not indicate discontinuities such as occurred in the case of the piezo-modulus.

The object of this note is to point out that there is evidence for the existence of similar discontinuities in the values of the elastic constants of this crystal at these two temperatures.

Slabs of Rochelle salt have been cut and mounted so as to form piezo-resonators, similar to the quartz piezo-resonators used in modern wireless practice. As shown by Cady and by Dye, these piezo-resonators possess a well-defined resonant frequency, which depends on the dimensions, the density, and the Young's modulus of the crystal. Hence, by in-

vestigation of the resonant frequency at different temperatures, it is possible to deduce the temperature variation of Young's modulus for the crystal.

Such an investigation has recently been carried out in this laboratory, using a method due to Cady (*Proc. Inst. Radio Engrs.*, **10**, 83; 1922). By using a calibrated wavemeter of the resonant circuit type, resonant frequencies could be determined to within less than 1 part in 5000.

The following graph (Fig. 1) shows the variation of

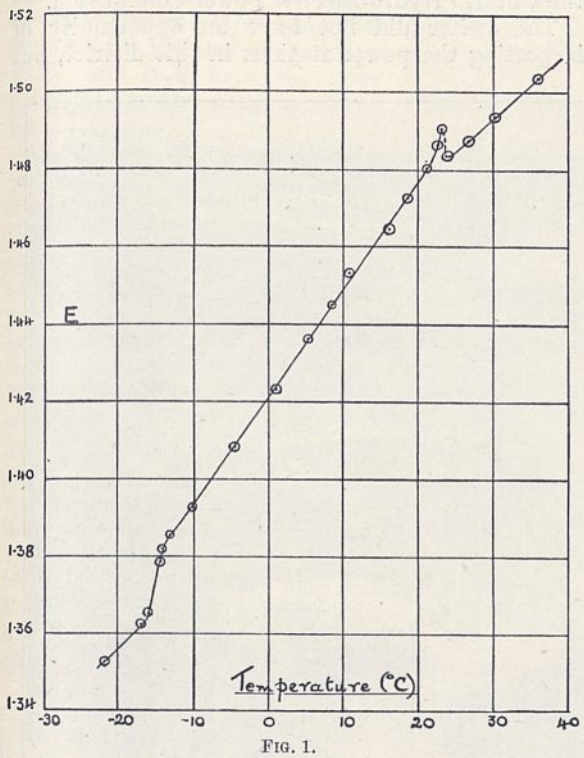


FIG. 1.

the extension modulus in a direction at 45° to the b and c crystallographic axes, between − 23° C. and 36° C. The ordinates represent a quantity, E, which is proportional to the extension modulus; the extension modulus is the reciprocal of Young's modulus. It will be seen that there are two distinct breaks in the curve, one in the neighbourhood of − 15° C. and the other in the neighbourhood of 23° C. Similar results have been obtained with crystals cut in other directions.

A full account of these experiments is in course of preparation and will be published elsewhere shortly.

R. MORGAN DAVIES.

Physics Department,
University College of Wales,
Aberystwyth, July 29.

Newtonian Time Essential to Astromony: A Correction.

IN the supplement to NATURE of April 9, I was permitted to discourse on the necessity, after Newton, of a universal time for astronomical science, and had identified it objectively and everywhere with the intrinsic vibrational times of the material atoms. In the last section it was imagined that this course had eliminated what had been considered to be a formidable discrepancy in the verification of the relativity scheme for gravitation.

It is now to be confessed without further delay that this is not so. The reason is, briefly, that it is only the changes of time-epoch *in the observer's own frame* that can be neglected: which makes dT/dt equal to $e^{-\frac{1}{2}}$ instead of $e^{\frac{1}{2}}$. This change conforms with the discussions, when duly amended, of variable electric inertia, and of the influences of gravitation on the paths of rays and on the spectrum. But it seems to make hay of any gravitational Action function of the type naturally assumed, namely, $\Sigma\int m_p c ds_p$ with adoption of the usual form for ds^2, and also equally of the Einstein postulate that each orbit is separately a geodesic on its own account.

It appears that one has to conclude that another invariant form must be found for the Action function, or else if that be not feasible, that this type of relativity scheme stands in essential contradiction with the spectroscopic postulate of absolute time for the atoms, as measured in their own frames, and unaffected by accelerations of their motions.

JOSEPH LARMOR.

Portrush, Aug. 18.

On the Structure of the Spectra of Krypton and Xenon.

As absorption measurements proved to be the key to a complete analysis of the arc spectra of neon and argon, we recently extended the use of the method to include an investigation of the spectra of krypton and xenon.

As in the case of neon and argon, we found that some lines in the spectrum of krypton were powerfully absorbed by this same gas when a weak electrical discharge was passed through it. With xenon similarly stimulated, selective absorption of spectral lines was also observed. Even a casual glance at photographic spectrum plates obtained with both gases showed this weakening of selected lines. As was to be expected, lines in the visible spectral region were scarcely, if at all, absorbed.

Examples of spectral lines, showing strong absorption by the method indicated, are, in the case of krypton, λλ7601, 7854, 8104, 8112, and in the case of xenon, λλ8231, 8819. The degree of absorption that took place in the case of other spectral lines is being determined from microphotometric observations.

In our analysis of the spectrum of xenon, the wave-number difference 9140 was observed between pairs of wave-lengths with the following frequencies:

$$\left\{\begin{matrix}11167,\\20307,\end{matrix}\right. \left\{\begin{matrix}11977,\\21117,\end{matrix}\right. \left\{\begin{matrix}12675,\\21815,\end{matrix}\right. \left\{\begin{matrix}13655,\\22795,\end{matrix}\right. \left\{\begin{matrix}13664,\\22804,\end{matrix}\right. \left\{\begin{matrix}15371,\\24511,\end{matrix}\right.$$

$$\left\{\begin{matrix}16177,\\25317,\end{matrix}\right. \left\{\begin{matrix}16181,\\25321,\end{matrix}\right. \left\{\begin{matrix}17552.\\26692.\end{matrix}\right.$$

The wave-number difference 9140 is the same as that between the wave numbers of the resonance lines λλ1469·9 and 1295·8 found by Hertz. The pairs of lines are therefore S_2p_i and S_4p_i ($i = 1$ to 10) lines expressed in the old notation originally used with neon. The infra-red wave-lengths S_3p_i and S_5p_i involve a metastable state, but wave-lengths showing strong absorption are found among them.

The results given above go to show that the structure of the spectra of the heavier rare gases krypton and xenon corresponds to that of the spectra of the lighter ones neon and argon, namely, a $'S_0$ normal state, a $^3P_{012}$ state comprising 2 metastable sub-levels, a $'P_1$ state, etc. There is, of course, a much larger separation between the $^3P_{012}$ and $'P_1$ levels with krypton and with xenon than with either argon or neon.

J. C. MCLENNAN.
RICHARD RUEDY.

The Physical Laboratory,
University of Toronto,
Aug. 11.

Canadian Hydro-Electric Power Development.[1]

By Dr. BRYSSON CUNNINGHAM.

II.

IN a review of last year's activities in water-power development by provinces, Quebec took a pronounced lead with 168,000 h.p., followed by British Columbia with 48,000 h.p.; Manitoba with 43,200 h.p.; Ontario with 5700 h.p.; New Brunswick with 2600 h.p., and Nova Scotia with a small amount. Dealing first with Quebec, it is to be noted that though the plant actually placed in operation during 1926 fell short of the record year of 1925, projects now in course of construction represent a future addition of more than 1,400,000 h.p., which indicates a continuance of substantial progress. The outstanding event of the year was undoubtedly the virtual completion by the Gatineau Power Company of two installations on the Gatineau River at Chelsea and Farmers' Rapids and the initiation of constructional operations at Paugan Falls, the three sites having a total estimated capacity of 530,000 h.p. The Gatineau Power Company, which operates in the valley of the river of that name, flowing into the Ottawa River, is associated with the Canadian International Paper Company, which has pulp and paper mills in the district, while a large quantity of power will be diverted to the Niagara system of the Ontario Hydro-Electric Power Commission.

The writer did not have an opportunity of inspecting the power stations in this district, but he had the privilege of going through the two power stations of the Shawinigan Water and Power Co. at Shawinigan Falls in the St. Maurice River Valley, a group of the most important hydro-electric installations in the province, and he can testify with appreciation to the very complete and efficient service of generating and distributing plant which he found in operation. Since its incorporation in 1898, the Shawinigan Water and Power Co. has grown to be the fourth largest distributor of electricity in the world: it controls in the form of electricity or hydraulic supply nearly 600,000 h.p. The St. Maurice River is one of the largest rivers in the whole of Canada. It has its

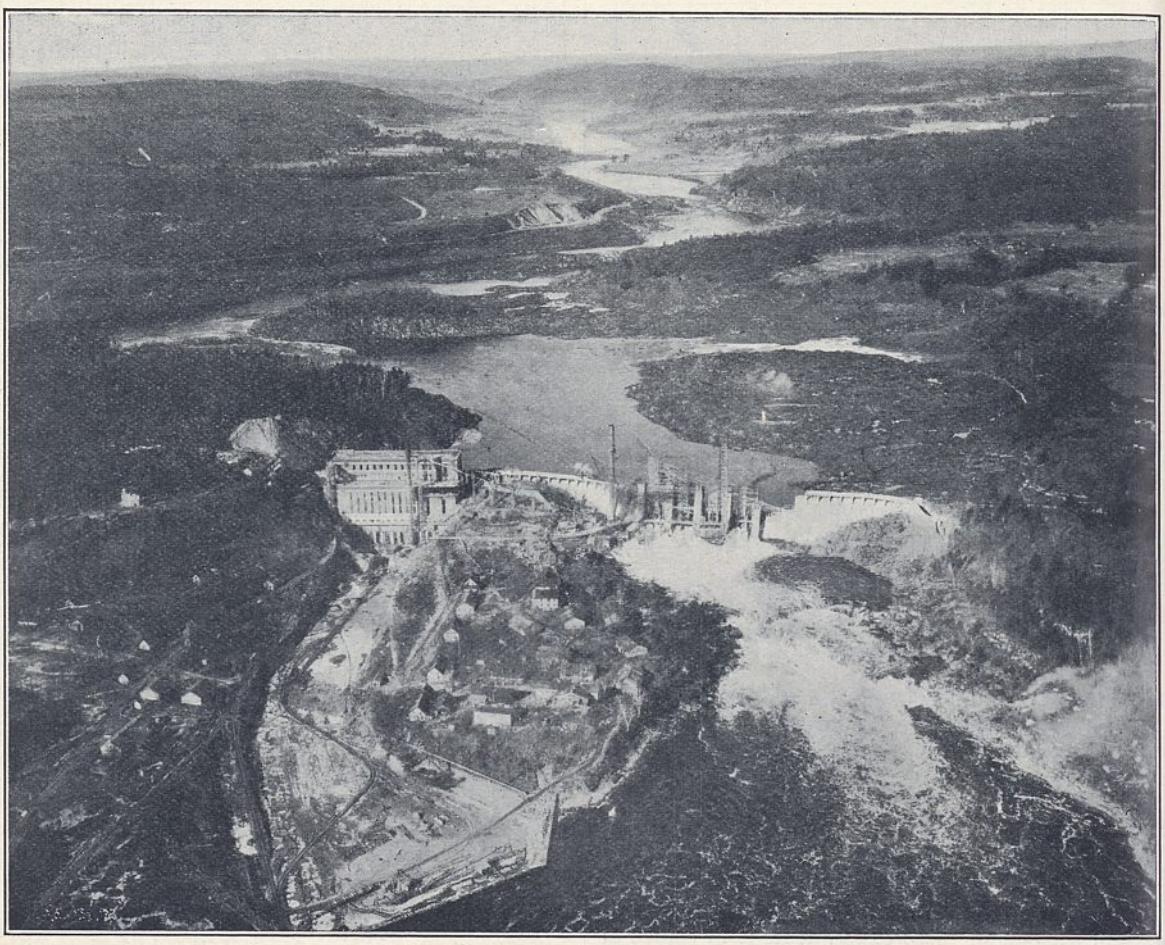


FIG. 2.—Chelsea Falls development of the Gatineau Power Company, Gatineau River, Quebec. Capacity, 170,000 H.P. Under construction, 1926. This plant has recently been completed.
Reproduced by permission of the High Commissioner for Canada in London.

[1] Continued from p. 301.

source at the divide between the valley of the St. Lawrence and the watershed of Hudson Bay at a point about 300 miles north of the former river, and it drains a region of nearly 20,000 square miles. Practically the whole drainage region is forest or woodland, a circumstance which is most favourable for maintaining constancy of river flow. In a part of its course, the waters of the river descend more than 250 ft. within a distance of a dozen miles, and it is here that the principal power stations have been developed.

Shawinigan Falls was the site of the first development, and it is now the centre of the Company's generating and transmission system. Located about twenty miles from the junction with the St. Lawrence, the curvature of the St. Maurice at this point, where the fall is 150 ft., lends itself admirably to economical exploitation. The first installation, completed in 1902, consisted of two 5000 h.p. water wheels and generators, now incorporated in Power House No. 1, the capacity of which was raised in 1910 to 58,500 h.p. by the addition of four units of 11,500 h.p. Power House No. 2, begun in 1911, with two 20,000 h.p. units, received a third unit in 1912; two additional units in 1914; and a sixth unit of 45,000 h.p. in 1923; thus bringing the total capacity up to 145,000 h.p. at the present time. There is contemplated the installation of two more units of 45,000 h.p. each; so that, when completed, the total electrical capacity of Power Houses Nos. 1 and 2 will be 293,500 h.p. In addition, 50,000 h.p. is supplied to the Aluminium Company of Canada, Ltd., and 15,000 h.p. to the Belgo-Canadian Paper Company in the form of hydraulic power.

At Grandmère, which is six miles above Shawinigan, the power development of the Laurentide Power Company, Ltd., an allied concern, comprises six 20,000 h.p. units and two 22,000 h.p. units, with provision for a final unit of 22,000 h.p. to be installed in the future. The total capacity at present is 164,000 h.p.

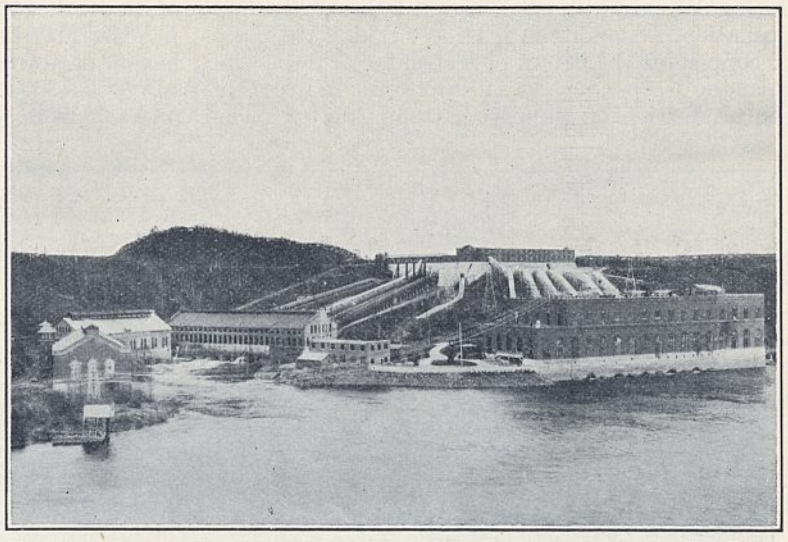


Photo. [*S. J. Hayward.*

FIG. 3.—Shawinigan Power Station. Capacity, 145,000 H.P.
Reproduced by permission of the Shawinigan Water and Power Company.

The latest addition to the Company's generating system is an installation of 120,000 h.p. at La Gabelle, seven miles below Shawinigan. This was completed and put into operation in 1924. Provision has been made for the addition of another unit of 30,000 h.p.

In the short stretch of about a dozen miles of river between La Gabelle and Grandmère, there are, therefore, three hydro-electric generating stations having a total capacity of 507,500 h.p. The local storage ponds of the three stations are under unified control and a balance is maintained of the electrical loads so that the water is utilised to its full extent in passing down the river.

Through a subsidiary company (the North Shore Power Company) the Shawinigan Water and Power Company completed and put into operation last year another installation of 22,000 h.p. at St. Narcisse on the Batiscan River (about 20 miles below the St. Maurice River), replacing an installation of 1600 h.p., reputed to be the first in the British Empire to supply energy over long-distance transmission.

The question of transmission is, of course, an

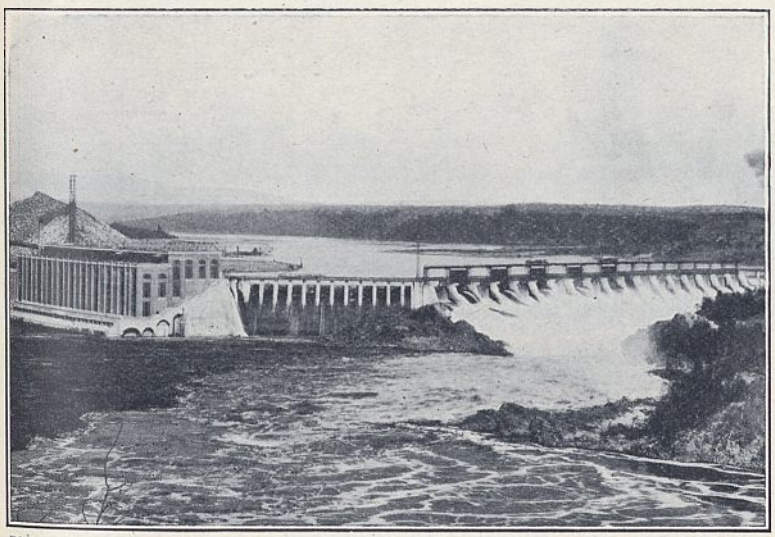
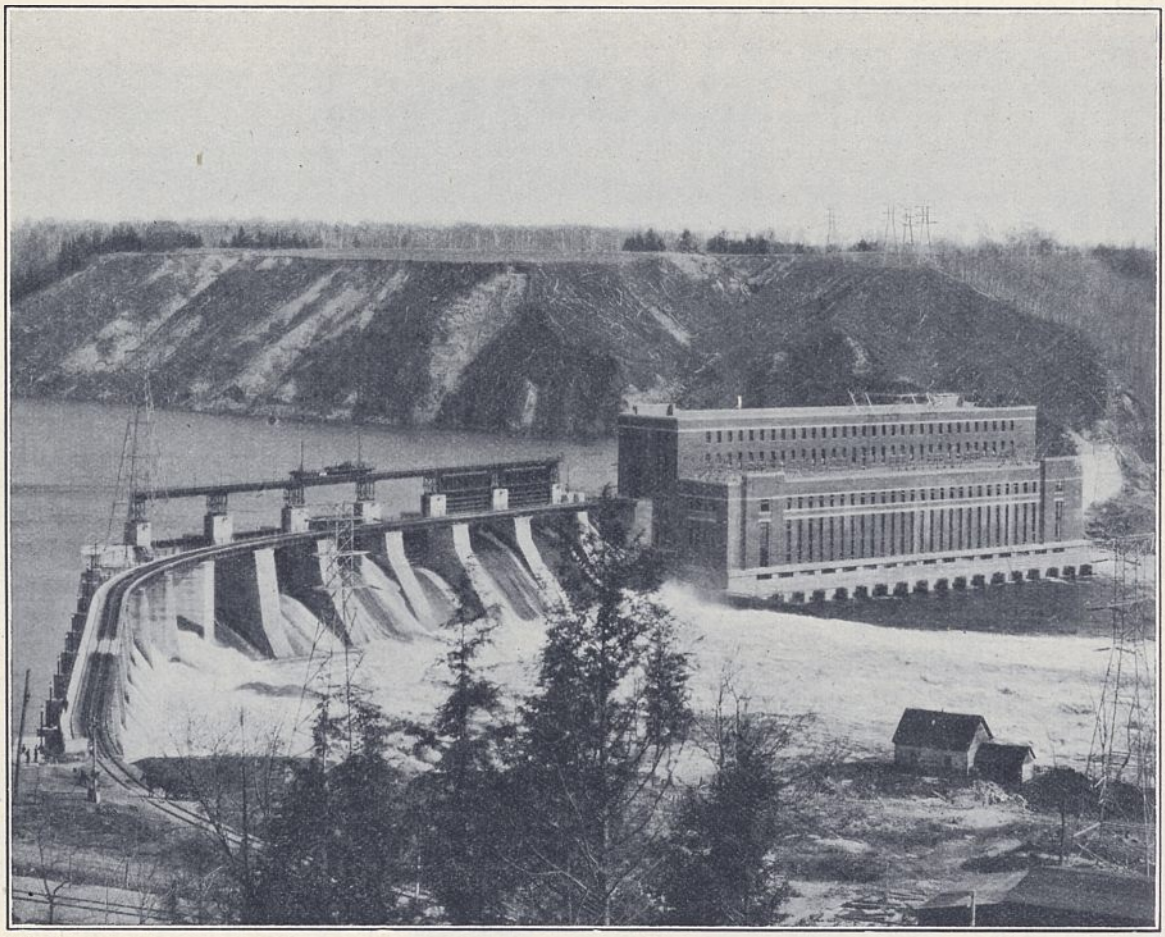


Photo. *S. J. Hayward.*

FIG. 4.—Grandmère Power Station. Capacity, 164,000 H.P.
Reproduced by permission of the Shawinigan Water and Power Company.

important problem in dealing with the supply of energy from the generating centres to the various localities of consumption. The Shawinigan Company transmits 3-phase alternating current at 114,000 volts over four lines to Montreal, and the high tension used, together with the large amount of current passed, necessitate very careful insulation. Aluminium is largely taking the place of copper for the cables of transmission lines, and this step is opening out an important industry in the production of aluminium from bauxite. The 300 miles of steel tower and steel pole voltage lines and about 400 miles of high voltage wood pole lines, with more than a thousand miles of wood pole lines of low voltage. The lines on the southern route to Victoriaville cross the St. Lawrence River one mile above the city of Three Rivers, by means of an overhead crossing which is one of the largest in existence, both as regards length of span and height of tower. The distance between the two towers is 4800 ft., which, with the anchorage spans on each bank, gives a total length of 6324 ft. of



[*Photo.*] [*S. J. Hayward.*

FIG. 5.—La Gabelle Power Station. Capacity, 120,000 H.P.
Reproduced by permission of the Shawinigan Water and Power Company.

process is being developed among other places on the Saguenay River, where the bauxite is imported from districts in Central and South America, to be treated with the aid of the local hydraulic power.

The high voltage transmission lines forming the trunk lines of the Shawinigan system radiate from Shawinigan Falls westward to Montreal (85 miles), eastward to Quebec (55 miles), and southward across the St. Lawrence River to Sherbrooke and the Thetford Mines Asbestos district. Three general types of support are in vogue: steel towers, steel poles, and wood poles. Of these, the steel structures are the more permanent. There are crossing. The towers stand 375 ft. above the foundation level. The minimum clearance above the water is 165 ft., so as to admit of the passage of ocean liners between Montreal and Quebec.

It would be possible to dwell at considerable length on the development of water power in the Province of Quebec alone. In addition to the Gatineau River, the St. Maurice River, and the Saguenay River installations, to which reference has been made, there are a number of minor installations of cumulative importance, some of which in time will form the nuclei of future groups of power centres. Projects which are in hand, or under active consideration, include a 65,000 h.p.

development on the Prairie River, near Montreal, by The Montreal Island Power Co.; a 50,000 h.p. development at Spicer Fall, on the St. François River, by the Southern Canada Power Co.; a 40,000 h.p. plant at Mountain Fall, on the Rouge River, by the Canadian International Paper Co.; a 50,000 h.p. addition to the Ottawa River Power Company's installation at Bryson, and a number of lesser calibre.

The Quebec Streams Commission continues a very useful and beneficial work in fostering water-power development in the Province. The Commission has extensive storage reservoirs established on the St. Maurice and St. François Rivers, Kenogami Lake, Ste. Anne de Beaupré and Mitis Rivers, all of which are at present reported as filled to capacity, the various plants in connexion therewith being thus assured of an ample supply of water during the winter season. The Commission now has under its supervision the construction of the Baskatong reservoir on the Gatineau River, which is at the point of completion. This reservoir is formed in part by Baskatong Lake, and has a capacity of 94 billion cubic feet; it serves to regulate the flow to 8000 cubic feet per second. Other work of the Commission includes surveys and investigations of likely projects, some of which will materialise in due course.

The Province of Ontario includes, of course, the world-renowned Falls of Niagara, or, at any rate, the Canadian portion of them. The Ontario Hydro-Electric Power Commission recently completed two large stations, the Queenston on the Niagara River with 550,000 h.p. development, and the Cameron Falls on the Nipigon River with 75,000 h.p. development. The Queenston Station is now fully loaded, and for the further supply of the Niagara system the Commission has entered into a contract with the Gatineau Power Company for the delivery of from 230,000 to 260,000 h.p. over a 220,000 volt line, commencing next year.

In Northern Ontario, the Abitibi Power and Paper Co. has completed the transmission line from its 48,000 h.p. plant at Island Falls to the mills at Iroquois Falls. The town of Cochrane is also served from this line. A short distance to the west, the Spruce Falls Co. has in hand the construction of works at Smoky Falls on the Mattagami River, which will result in the obtainment of 70,000 h.p., which will be utilised to supply energy to the Company's pulp and paper mills in the district.

In the extreme west of the Province, a 17,000 h.p. development at the western outlet of the Lake of the Woods has been achieved by the Keewatra Power Co. In the same district, the Bachus Brooks Co. has undertaken the construction of three power sites on the Seine River, which will have an aggregate capacity of 37,620 h.p. It is expected that all three will be completed and in use by the end of the current year.

Important developments are in progress in British Columbia and Manitoba, but as these are much farther afield than the writer's ambit, only very brief allusion will be made to them. In the former Province there are works in hand on the Kootenay and Powell Rivers, while the British Columbia Electric Railway Company's dam at the Alouette lakes, eight miles north of the Fraser River and about 25 miles due east of Vancouver, has proved a valuable addition to the supply at Stave Falls. A project promoted by the same Company at Bridge River is designed for an initial capacity of 54,000 h.p., which may ultimately reach a total of from 550,000 to 700,000 h.p. In Manitoba, the City of Winnipeg and the Manitoba Power Company have made notable additions to their respective installations.

There is not, however, quite the same inducement in the Western Provinces of Canada to exploit water-power as in the Provinces of Quebec and Ontario. Coal is procurable, and although not of high quality, yet the power situation is not so compulsory or so drastic as if no alternative source were available. It is therefore in the Eastern Provinces, with their conspicuous lack of coal-mines, that the greatest and most sustained effort is being made to develop water-power, and the foregoing notice of the steps which are being taken to remedy a striking deficiency in the natural fuel resources of the country, so obviously prejudicial to the development of its industry and commerce, can scarcely fail to interest those whose duty it is to survey the field of Nature and exploit it in the interest and service of mankind.

The British Association at Leeds.

IN the phraseology of our trans-Atlantic cousins, the Handbook for the Leeds meeting may have 'said a mouthful' when it describes the area visited this year by the British Association as a 'conurbation,' but behind the word a very important feature of this year's meeting is struggling, if clumsily, for recognition. Proximity of population, and the interlacing of road and rail communication, make the area of the West Riding of Yorkshire one urban unit with a population between one and a quarter and one and a half millions. At the same time, local civic spirit proclaims its divisibility into independent units every whit as strenuously as the physicist splits up the chemist's atom. The uninitated visitor must not confound Dewsbury with Batley, or (as the provisional issue of the time-table did !) Halifax with Huddersfield; his crime is as great as that of the visitor to the Western States who assumes that Los Angeles and San Francisco are much the same thing.

The Englishman may pay about the same high price for grape fruits from California and Florida, but this is a mistake condemned on entirely different grounds, and equally emphatically, by both these States; similarly, local championship individualises the products of the local looms, and in its own

way has nothing to learn from the Florida story of the turtle masquerading in the Californian visitor's blankets as a bed bug, to demonstrate the scale of things in Florida. These civic rivalries key up the pace of life in the West Riding, both in industry and in sport. Local league cricket is in a different world from the country cricket of the west of England, and the Whitsuntide rival counties of the White and the Red Rose are credibly reported on that occasion to say "How do" on their first morning, afterwards nothing but "How's that!"

In such an area, visits to works and to educational and civic institutions by interested Sections, can be almost indefinitely continued, each city or borough having its own lesson to teach. Similarly, the Association's meeting is characterised by a very large extension of the list of citizens and childrens lectures, an experiment which will be watched with interest. These lectures are still somewhat a new development, and there is sometimes a difficulty in utilising the favourable opportunity to attract a general audience to listen to science which is created by the general publicity associated with the meeting.

The Handbook has a very interesting chapter by the editor, Dr. C. B. Fawcett, upon the location of Leeds, which began as a foothill town on the eastern edge of the Pennines. Its central position, halfway between the south coast and the Highlands, between London and Glasgow, and between North and Irish Seas is naturally emphasised. Leeds citizens at present consider themselves centrally placed also for the dissolution of the series of depressions which follow in melancholy succession from the Atlantic and apparently disperse in rain down the flanks of the Pennines. At the same time, from the north of Scotland, from Ireland and the Isle of Man, and from the Riviera, holiday makers return with tales of days spent in sunshine.

August has had an exceptionally heavy rainfall record, and the visitors when in the gardens of their hosts are asked to remember that for most days of the last month it has been quite impossible to work upon the sodden land. Certain excursions have of necessity been altered. Section K (Botany) which always enjoys splashing about a swamp, as it did with success both at Southampton and in Canada, had arranged to visit the interesting marsh at Askham, near York, referred to by Mr. Sledge in his botanical notes in the Handbook. This marsh was quite inaccessible a few days before the meeting, and the Yorkshire papers still record flood conditions in various parts of the three Ridings that are quite remarkable for the season. This year the adventurous visitor to Gaping Ghyll should certainly find the 340-foot waterfall descending this pothole an impressive if damp experience.

The inaugural meeting was held in the Majestic Cinema, which possesses a very large auditorium. The overhead lighting was strengthened specially for the occasion, so that the audience should both be able to see and be seen.

On Tuesday, Sept. 6, the R. W. Provincial Grand Master of West Yorkshire, the Viscount Lascelles, K.G., will attend a meeting at the Masonic Hall, Great George Street, to welcome visiting members who are Freemasons. H.R.H. Princess Mary will also attend the Civic Reception to be held at the City Art Galleries on Thursday night, Sept. 1.

The Stone Age in Kenya.

THE brief reports which have reached England from time to time of the discoveries relating to the stone age in Kenya by Mr. L. S. B. Leakey (see NATURE, July 16, p. 85) have pointed to the possibility that evidence of great importance for the early history of man in this part of Africa might be brought to light at any moment. The announcement, therefore, that a preliminary report on the excavations recently carried out by Mr. Leakey and Mr. B. H. Newsam, with the advice and co-operation on geological points of Dr. Nilsson and Mr. E. J. Wayland of Uganda, would be presented to Section H (Anthropology) at the meeting of the British Association at Leeds had been received with considerable interest. In the absence of the authors, who will return to England later in September, the report was communicated to the Section by Dr. A. C. Haddon.

The work covered by the report is in the nature of a preliminary survey and deals with the results of excavations in two areas, one in the neighbourhood of Lake Nakuru on the floor of the Rift Valley, the second at Upper Elmenteita.

Before dealing with the present discoveries, it may be recalled that ever since 1893, implements and obsidian flakes, some accompanied by pottery, have been found in Kenya. Some of these were surface finds, others were situated at a depth of two to three feet. Some, again, were obtained from the high level beaches of the Rift Valley. Among them also were implements comparable to the palæolithic implements of Europe, and in some cases they were associated with the remains of extinct animals. Similar finds have been made in Uganda, and Mr. Wayland has classified these implements into three divisions. Reference may also be made to the skeleton found in the Oldeway Gorge in 1914 which was associated with fauna now extinct.

Turning now to the results of Mr. Leakey's first year's work on the Nakuru site, evidence was found for at least two periods of high lake-level reaching to 6604 ft. above sea-level as against the present 5768 ft. In relation with these high levels there was evidence for falls to a point below the 200-ft. level. It is suggested that these high levels represent pluvial periods to be correlated with the glacial epochs of Europe. This suggestion awaits further examination in the light of evidence to be furnished by fossil bones and shells collected from the various horizons in the lake deposits.

The archæological site at Nakuru is situated

365 ft. above present lake-level and consists of a deposit along the edge of a cliff. The two upper strata show no sign of a submergence and therefore must be later than the high lake-level. In these upper strata, ten burials were found distributed through a depth of 13 ft. With them were large numbers of implements and pottery fragments as well as stone bowls, the latter being more numerous in the upper levels. One skeleton was found in perfect condition and alone afforded material for detailed measurement. The notable characteristics were the length and width of the face and the great depth of the mandible at the symphysis, the height of the palate and the prominent nose with a low index of 50. The skull is markedly dolichocephalic. The associated industry is essentially microlithic. Beneath these two strata, and obviously earlier in date, was a small deposit of sand and pebbles which had been subject to the action of water. This contained a few obsidian flakes, the tools being for the most part backed blades.

At Upper Elmenteita two sites were investigated. The first is at a height of 393 ft. above present lake-level, and is situated on the edge of a cliff which consists of lava overlying an alluvial deposit. The cliff is one side of a valley which was cut by a prehistoric river during an interpluvial period, and afterwards filled by a rise of the lake, most of the later alluvium being washed away in a subsequent fall. In this later alluvium, which lay in pockets in recesses and crevices, were found the remains of twenty-six individuals scattered about at various depths with obsidian tools, pottery, stone mortars, and eggshell beads. It is suggested that these individuals belong to a period previous to that at which they were deposited where they were found. All the bones are more or less fossilised and well preserved. There are at least two skull types. Elmenteita *A* is a primitive type. Remarkable features in the mandible are the depth at the symphysis—41 mm.—the thickness of the horizontal ramus and the relative height of the ascending ramus. The angle is also remarkably obtuse. Other notable features of this type are the low forehead, the length and breadth of the face, and the exceptionally long and narrow nose, of which the index is 47·4. The skull is dolichocephalic, its index being 68·2. The second type, Elmenteita *B*, is not so primitive as Skull *A*, differing from it in its greater breadth, the index being 75. It has a remarkably high cranial capacity—1660·96—and an exceptionally narrow nose with an index of 40. Neither of these types resembles the modern negro of the country.

A cave or rock-shelter at Elmenteita, situated at a height of 594 ft. above present lake-level, produced important stratigraphical evidence. Eleven horizons were exposed, of which the first three were modern and showed no tools, the fourth was alluvial, and the fifth composed of debris from the roof. The sixth produced implements and pottery, the eighth was alluvial, and the ninth rock rubble, while the tenth was an occupation hearth layer with obsidian tools and bones. The eleventh contained burials. If, as is argued, the alluvial deposits at four and eight are to be identified with the high lake-levels, the first or later prehistoric period belongs to the second interpluvial and the lower or earlier culture to the first interpluvial. Of the two cultural horizons, the first or later belongs to the neolithic in culture if not in date, and is to be compared to the Elmenteita site (Monro's Farm), while the earlier contains a much cruder industry without pottery, the implements being rough flakes showing just a very small trace of secondary chipping. In the lowest level, 14 ft. below the surface, have been found traces of burials; but at the time the report was written no human remains had been taken out.

The most conclusive evidence as to the age of the industry with lunate and backed blades was found in a drift across the Enteril River, giving a clear section across the alluvial plain at a level of 330 ft. above present lake-level and showing very clearly the deposits during the high-level periods. In the deposits of the last pluvial period are a number of obidian tools, chiefly lunates and backed points, definitely associated with fossil bones which would seem to belong to some form of hippopotamus.

Taking the results of the investigation as a whole, they would go to show the occurrence of two high lake-levels indicating two pluvial periods, the existence of stone age cultures earlier than both the high lake-level deposits, and in the case of the earliest deposits antedating the earlier rise of the lake, human remains are associated with crude tools.

Obituary.

SIR HARRY JOHNSTON, G.C.M.G., K.C.B.

THE death of Sir Harry Johnston removes one to whom the British Empire and science owe great debts. Henry Hamilton Johnston was born at Kennington on June 12, 1858, and he died near Worksop on July 31 last at sixty-nine years of age. He was educated at the Stockwell Grammar School, King's College, London, and later at the Royal Academy Schools. Endowed with great natural ability and with a vigorous and fearless mind, he soon displayed an amazing versatility which led him to success along many different paths. Distinguished as an artist in water colours, an intrepid explorer, a naturalist, an anthropologist, a linguist, and a writer, he won for himself a permanent place in history as one of the builders of Great Britain's African Empire and as a wise colonial administrator. Political activities, alone or in conjunction with Cecil Rhodes, Sir Alfred Sharpe and others, constituted the most important part of Sir Harry Johnston's life-work. An excellent account of these activities was published in the *Times* for Aug. 1.

Although he had visited Tunisia previously, Sir Harry Johnston's connexion with Africa may be said to date really from 1882, when he accom-

panied Lord Mayo on a journey through southern Angola. Thence he marched away northwards by himself to meet Stanley on the Congo. This journey and his book ("The River Congo") describing it displayed the power and resource of the young explorer. As a result he was chosen to lead the scientific expedition to Kilimanjaro organised by the British Association and the Royal Society. Politics, science, and art marched with Johnston on this, as on all later occasions; the fruits of the expedition were important biological collections, a valuable book ("The Kilimanjaro Expedition"), and a crop of satisfactory treaties with the native chiefs. In 1885, as vice-consul in Cameroon and the Niger Delta, Johnston showed his capacity for courageous administration. Later came special missions to, or long spells of administration in Nyasaland, what is now called Northern Rhodesia, British East Africa, Uganda, and Liberia, where his labours in Africa terminated in 1906.

In spite of all difficulty and danger, and of the pressure of onerous duties, Sir Harry Johnston never lost his early enthusiasm for Nature and art. No administrator in Africa or elsewhere has ever done so much as he did to advance science in the countries under his control. His own contributions to science were many; his explorations of Kilimanjaro, Ruwenzori, and the Semliki Forest, the discovery of the okapi, anthropological investigations among the pygmies and other African people, and studies of the native languages being among the most important. Firm in the belief that white rule in Africa depends ultimately upon a complete knowledge of the country, its natural history, its people and their institutions, Johnston lost no opportunity to collect information and material himself; and what was still more important, he urged all his subordinates to the performance of a similar duty. He was too wise to fritter away his time in a vain attempt to work out everything for himself. On one occasion one of his lieutenants was heard to grumble. "I collect endless mammals and birds," he said, "but Sir Harry won't look at them. All he says is, 'Put them in the box.'" But in due course the boxes came home to South Kensington to play their part in building up our knowledge of African zoology.

Sir Harry Johnston wrote many books dealing with natural history and exploration; of these the most important are "The Kilimanjaro Expedition" (1885), "The Uganda Protectorate" (1902), and "Liberia" (1906). Lucidly written and charmingly illustrated by reproductions from the water-colour paintings of the author as well as by good photographs, these books are of permanent scientific value as sources of original information. Despite its weight and its date, the best guide that the traveller interested in natural history can carry in West Africa is the second volume of "Liberia." In addition, Sir Harry Johnston also wrote various political works, novels, and a play.

The present writer first saw Johnston at a meeting of the Zoological Society of London in 1905. He knew that appearances were often deceptive; yet he found it hard to believe that the dapper little man reading out a long list of native names for animals in a curiously high-pitched voice could be in the sterner places of the world the strong leader of men. A broad view of this remarkable man and of his life and work seems to suggest comparison with another great pioneer of Empire—Raleigh. There are differences of course. To-day the way of the universal genius is both harder and easier than it once was; thanks to science and the press, so many have now become vocal that genius, unless it be of the narrow specialist kind, has difficulty in making itself heard above the general din and very little chance of being remembered in the restless seas of modern distraction. Had he lived three centuries ago, Johnston would have become a popular hero and he would have gone to the block; to-day, except on those rare occasions when he chanced to share headlines with the doubtful figures of a *cause célèbre*, Raleigh would attract little attention and would die quietly in bed. M. A. C. H.

NOTICES on the life of Dr. Carl H. Eigenmann, by David Starr Jordan and Fernandus Payne, in *Science*, vol. 65, No. 1691, give good accounts of the work of this eminent ichthyologist, able teacher, and indefatigable explorer, who died on April 24 last. A student under Prof. Starr Jordan, he succeeded him in 1891 as professor of zoology in Indiana University, and in 1908 was made dean. For some years he was curator of fishes in the Carnegie Museum, Pittsburg, and in 1895 he established a fresh-water biological station in Northern Indiana, of which he was director up to a few years before his death. One of his most important works is on the blind cave fishes of North America, and for the purpose of collecting material for this study he made expeditions to the cave regions of Indiana, Kentucky, Missouri, Texas, and Cuba, and for the detailed exploration of the fish fauna of the Amazon and other Brazilian rivers he made four trips to South America, besides sending students on other expeditions. In all, 195 new genera, containing about 600 species, were defined by Eigenmann and his colleagues, and his technical papers number upwards of 170. It is an interesting fact that Dr. Eigenmann entered the university as a student in Latin, but most fortunately it was not too late to change when in his second year he discovered that his tastes were zoological rather than classical.

WE regret to announce the following deaths:

Mr. G. C. Champion, who collected entomological material for Godman and Salvin for their "Biologia Centrali-Americana" and contributed largely to the published work, on Aug. 8, aged seventy-six years.

Mr. Alban H. G. Doran, who collaborated with Sir James Paget and Sir James Goodhart in the compilation of the second edition of the Catalogues of the Pathological Series in the Museum of the Royal College of Surgeons, and also prepared a descriptive Catalogue of Surgical Instruments in the Museum, on Aug. 23, aged seventy-seven years.

News and Views.

AT the inaugural meeting of the British Association at Leeds on Aug. 31 a message was received from H.R.H. the Prince of Wales expressing regret at his inability to attend in person to welcome his successor to the office of president, of whom he says: "I have reason to believe that when any one in this country digs up a bone his first instinct (subject to the intervention of the police) is to send it to Sir Arthur Keith." Referring to his own presidential address at Oxford last year, His Royal Highness suggested that his choice of subject, "Science and the State," has been justified by the emphasis which was afterwards laid upon the value of scientific research to imperial development at the proceedings of the Imperial and Colonial Office Conferences. This recognition, he considered, places it beyond doubt that "more general attention for the objects of science" is in process of achievement. He expressed the opinion that an increasing measure of public support should be accorded to the British Association for the furtherance of this object. Fortunately, its powers have been very materially strengthened during the past year, through the splendid generosity of Sir Alfred Yarrow, in making it a gift of £10,000 for general purposes.

UNDOUBTEDLY, the address of the royal president of the Association at Oxford last year did much to focus public attention upon the function of the scientific worker in the social organism. It informed the non-scientific members of the community, in language perfectly intelligible to them, what science has achieved, what the nation can achieve if it applies the scientific knowledge it already possesses, and the nature of those further problems confronting the world, for the solution of which the scientific worker is indispensable. The Leeds address of Sir Arthur Keith may be said to stress the spiritual aspect of science as contrasted with the material aspect dealt with by his predecessor. It is equally remarkable for its breadth of outlook and its freedom from irritating and unnecessary technicalities and obscurities of language which mar so many addresses on scientific topics. It would be well, perhaps, if the Council of the "so-called parliament of science" would consider the possibility of insisting that at least every sectional president should also deal broadly with his particular branch of science in order that the general public and members of others sections might be in a position to appreciate its implications. Papers dealing with a highly specialised piece of research are, as a general rule, best delivered before members of a learned society. Judging from some of the sectional presidents' addresses and papers read or to be read at Leeds, it would appear that the essential difference in function between a section of the British Association and the corresponding learned society, or between the British Association as a body and the Royal Society, is not sufficiently appreciated. It happens that this year only four of the presidents of the thirteen Sections are fellows of the Royal Society, whereas usually the number is six or more.

THE instructive survey of man's physical nature and history displayed by Sir Arthur Keith in his address is sure to attract close attention. The address is printed in full in a Supplement to this week's issue, and the statement it contains as to the present position of Darwin's theory of man's descent will be welcomed by a wide circle of readers. We need not follow the survey here, but there are certain aspects of the search for the elusive line of man's direct ancestry which force themselves to notice. Many discoveries of remains of fossil men have been made since Darwin's day. It is remarkable how little they have helped to unravel the direct stages of the ascent of modern man, and how many have been side-tracks off the main line, so that, in the terms of the genealogical tree, the branch of modern humanity has become beset by a thicket of collateral branches. We do not yet know the place of origin of the human branch, for although the weight of evidence points to close relationship in some sort with the anthropoid group, other possibilities have been advocated, each founded on legitimate arguments. Indeed, it seems as if association with one or another existing type of monkey depends upon the choice of the particular structure upon which the stress of comparison is laid. Even as regards existing man, we cannot yet trace each living race indubitably to its place of origin on the ancestral tree.

MAY it not be that in searching for each minute intermediate stage in a series, we search for something which may not have existed; that we are still too much dominated by the idea of the rise of species by way of the continuous minimal variations which Darwin so effectively advocated? Did we but understand in full the possibilities of the correlated development of parts, the difference between basal variation and correlated sequence, we might cease to expect in the development of each and every structure a complete series of minimal gradations, and be freed from the bogey of the 'missing link.' Such difficulties do not affect the main story of the ascent of man. Every discovery bearing on the problem made since Darwin's day, whether it be morphological, embryological, physiological, psychological, or biochemical, has confirmed the general thesis of Darwin that man is an offspring of the animal world and that his nearest existing relatives are the higher apes; as Sir Arthur Keith puts it, "the fundamentals of Darwin's outline of man's history remain unshaken. Nay, so strong has his position become that I am convinced that it never can be shaken."

SOME six hundred delegates, of whom more than four hundred are from the British Isles, arrived in Montreal for the official opening on Aug. 22 of the second triennial Empire Mining and Metallurgical Congress. The Congress has been organised by ten separate mining and metallurgical institutes from Great Britain, South Africa, Australia, India, and Canada. At the first morning's session, the chair was taken

by Sir Robert Horne, the honorary president, who with the Honourable Charles Stewart, Canadian Minister of the Interior and president of the Congress, delivered inaugural addresses. The Congress will be divided into two sections for a comprehensive tour of all the Dominion's mining centres. One tour goes right through Canada by special train to the Pacific coast, while the other confines its attentions to central and eastern Canada. On Aug. 23, the delegates left Montreal by special train for Ottawa and the Niagara Falls. Technical sessions were held in Toronto on Aug. 25 and 26.

THE Empire Mining and Metallurgical Congress has endorsed unanimously a resolution proposed by Mr. R. E. Palmer, president of the Institution of Mining and Metallurgy of London, embodying the suggestions, contained in the paper read before the Congress by Sir Thomas Holland, for the survey of the mineral resources of the Empire. Sir Thomas urged the necessity of reviewing for each unit of the British Empire the mining resources for smelting capabilities with the view of accumulating in addition to the ordinary official statistics the essential data necessary for the formulation of an Empire economic policy. The British Empire produces about a quarter of the total mineral production of the world of nearly two billion tons; but it is not independent and completely self-contained in respect of mineral requirements, and it might be desirable to carry surplus stocks of vital mineral necessities which could be drawn upon in any temporary emergency, such as, for example, in the case of nickel in the time of the War. The Congress adopted the resolution as a move towards achieving a comprehensive tabulation of the Empire's mineral and industrial resources.

A NEW forestry society, termed the Society of Foresters of Great Britain, has been founded during the past year. The idea originated amongst some of the younger forest officers under the Forestry Commission; and though it is laudable enough, doubts have been expressed as to the wisdom of taking the step so soon after the inauguration of the Commission and whilst the number of trained foresters in Great Britain is so small. There exist already in Britain the Scottish Arboricultural and the English Arboricultural Societies and the Empire Forestry Association, whilst at least three other societies can lay claim to an interest in forestry or arboriculture. Neither of the three societies mentioned above can be considered to be in an overwhelmingly strong financial position. It was perhaps natural to ask whether there was room for yet another, even though its aim and object was to restrict membership to fully-trained and qualified foresters. This qualification had to be waived and associate members admitted in order to enable the society to be started. Those interested in forestry in Great Britain will watch the new-born plant with interest, but not without anxiety. For societies of this kind cannot be maintained without funds, and the man of science and the technical officer have many calls of this nature made upon them now-a-days; and to expect a junior or even senior officer to belong to three societies all, according to their articles of membership, aiming at the same end, is rather a severe trial.

IT is fully recognised that a technical society of the type referred to above loses half its utility and interest unless it is represented by a journal recording both its own progress and that of the science which it represents. The new society was not unmindful of this necessity. The first number of its journal, entitled *Forestry*, has recently appeared. It is an ambitious publication issued in beautiful style by the Oxford University Press and contains articles of considerable interest. But the question at once arises in the minds of those acquainted with present costs and the habits and requirements of professional men, especially forest officers—Can the money be found to maintain this high quality, and can the interest be maintained in a publication issued only once a year: for this is the present announced intention? If issued more frequently, can the high interest of the present number be maintained? We hope that, in parliamentary phrase, the answers to these questions are in the affirmative; for old hands know that they are vital to success.

IT is expected that some two hundred organisations will be represented at the fourth conference of the Association of Special Libraries and Information Bureaux which meets at Trinity College, Cambridge, during the week-end Sept. 23-26. Following a reception by Sir J. J. Thomson, Master of Trinity, Sir Geoffrey Butler, senior M.P. for the University of Cambridge, will deliver the presidential address, whilst among the many well-known experts giving papers are Sir Henry Lyons (Director, The Science Museum), Mr. A. E. Overton (Principal, Board of Trade), and Sir Richard Gregory. The subjects to be discussed at the Conference include such topics as the recent Report of the Public Libraries Committee, co-operation between libraries, and book selection in science and technology. Sectional meetings will be held on information and statistics in commerce and industry, on patent classification and on information bureaux questions. The Conference is open to all interested, whether members of the Association or not; a copy of the detailed programme and other particulars can be obtained from the Secretary, Aslib, 38 Bloomsbury Square, London, W.C.1. With the assistance of the Carnegie United Kingdom Trustees, the Association is publishing in the autumn a directory of sources of specialised information, edited by Mr. G. F. Barwick, late Keeper of Printed Books at the British Museum. The book is unique in character inasmuch as it records under thousands of subject headings the various centres in Great Britain and Ireland to which those in search of specialised information should turn.

THE importance of the issues involved in prehistoric chronology and archæology must be our excuse for a

further reference to *l'affaire Glozel*. The scepticism of l'Abbé Breuil and Mr. O. G. S. Crawford has received further support from M. A. Vayson de Pradenne in the *Bull. de la Société Préhistorique Française*, No. 6, 1927. M. de Pradenne, a personal friend of Dr. Morlet, has visited Glozel, himself excavated on the site, and carefully examined the collection of engraved bone objects, pottery, clay tablets, and stone implements in the collection of the peasant Fradin through whom the site was brought to light and of Dr. Morlet himself, by whom it was made known to the scientific world. So far from concurring in the Magdalenian or derived Magdalenian origin of this remarkable association of alleged prehistoric objects, M. de Pradenne in convinced that they are not ancient. Two points in his investigation are particularly striking. The material of the bone objects exhibits none of the marks of a high antiquity. Its character is either that of fresh bone which has been boiled, or old but not ancient bone which has been exposed to the weather, and the marks on it have evidently been made by a metal implement; and he formed the conclusion, which he verified in the case of an implement that he himself unearthed, that the soil immediately surrounding the objects found was not in the same state as that of the rest of the stratum. This latter opinion was formed after investigating the harder as well as the looser strata. M. de Pradenne's relations with Dr. Morlet add weight to his views. It seems unlikely that we shall hear anything more of this site worthy of serious consideration in contradiction of the conclusions which have now been formed after a fair and, we think it may be affirmed, impartial examination of the facts. It is scarcely necessary to emphasise the harm done to archæological science by the hasty and ill-considered world-wide dissemination in the daily press of sensational alleged discoveries which prove on investigation to have no foundation.

TRINITY HOUSE is now constructing radio beacons for assisting navigation at various points round the English coast. These beacons send out distinctive radio signals at regular intervals and thus are intended to enable vessels fitted with direction finders to determine their position. During darkness and in foggy weather, these installations will be a great aid to marine navigation when ships are approaching land and will add appreciably to the safety of life at sea. The first beacon station to be put into commission by Trinity House is situated at Round Island in the Scilly Isles. It is operated on a wave-length of 1000 metres (a frequency of 300 kilocycles), which will be the standard for radio beacons. It has been designed by the Marconi Company to the specifications of Trinity House. It is automatically controlled by a master clock and transmits groups of continuous wave-signals—in the case of Round Island the letters GGG in Morse code—at predetermined intervals. Every precaution has been taken to diminish the risk of a breakdown. All running machinery, including the master clock, is duplicated. If a valve burn out it is immediately replaced automatically and a warning signal notifies the attendant. The radio mast consists of a steel lattice tower 60 feet high, and the aerial is supported at a height of 50 feet. The signal for 'Fair' weather consists of the call sign repeated for 47 seconds, followed by a prolonged dash of 10 seconds' duration, and terminated by one repetition of the call sign, the whole transmission taking 60 seconds exactly. A silent period of three minutes then follows. In fair weather this cycle is repeated three times every half-hour. In foggy weather the one-minute transmission and three minutes silence are repeated continuously. In a normal ship's receiver, the bearings can be received accurately up to a distance of about 100 miles.

PROF. EDWARD WESTERMARCK has accepted an invitation to deliver the Frazer Lecture at Glasgow in 1928. It will be remembered that the lectureship is vested in four universities in Great Britain in rotation and this time the election falls to Glasgow. In view of the fact that the British Association will be meeting in Glasgow in 1928, the University has decided that the date of the lecture shall coincide with the date of the meeting, in order that those may have an opportunity of attending the lecture who otherwise might not be able to travel so far as Glasgow at another time.

LORD MORTON'S chestnut mare, which is supposed to have produced a quagga-horse hybrid about 1814, and afterwards to have produced, by a black Arabian stallion, three bay foals resembling the quagga in some of their markings and in having more or less erect manes, has long been cited as evidence of telegony. The inheritance of coat colour in horses is now known. Chestnut is recessive to all other colours, and the series runs grey, dun, bay, black, chestnut, grey being dominant to all others. Prof. Cossar Ewart has shown that in zebra-horse hybrids, the horse colours are dominant to those of the zebra. It is also well known that horse-donkey hybrids take the colour of the horse. In the light of these facts, Mr. James Wilson (*Sci. Proc. Roy. Dublin Soc.*, vol. 18, No. 41) concludes that the quagga was not the father of the supposed quagga-horse hybrid, since the latter was bay while the mother was chestnut, and could only produce a bay foal by a bay, dun, or grey father. Hence any evidence of telegony falls to the ground.

THE International Hydrographic Bureau, of which the principal maritime nations are members, is chiefly concerned with the co-ordination of surveys and chart production. The latest issue of the *Hydrographic Review* (vol. 4, No. 1, May 1927), which is published by the Board at intervals of about a year, contains articles on the organisation, equipment, and methods of the Norwegian, Swedish, and Danish Hydrographic Services, and on various subjects germane to navigation and cartography. Amongst these, Rear Admiral A. P. Niblack, U.S.N., presents a plea for the extension of oceanographic research, particularly the study of ocean currents, which are of international interest, and the study of which is intimately linked with marine biology, meteorology, and fishery research.

The review contains a bibliography of contemporary publications and articles concerning oceanography in the widest sense of the term; this should be of value to all who are interested in the science of the sea.

APPLICATIONS are invited by the Zoological Society of London for the Anatomical Research Fellowship, tenable for three years with a possible extension for two further years, of the annual value of £400, and for an Aquarium Research Fellowship, tenable for three years, of the annual value of £350. Applications must be sent to reach Dr. P. Chalmers Mitchell, Zoological Society, Regent's Park, N.W.8, before Nov. 1.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An Inspector of Agriculture in the Sudan Department of Agriculture and Forests—J. Nield Cameron, Old Vicarage, Wetherby, Yorks. (Sept. 15). An assistant lecturer in mechanical engineering at King's College, London—The Secretary, King's College, Strand, W.C.2 (Sept. 16). A graduate assistant in the Information Bureau of the British Cotton Industry Research Association—The Secretary, British Cotton Industry Research Association, Shirley Institute, Didsbury, Manchester (Sept. 17). A lecturer in mining at the Denbighshire Technical Institute, Wrexham—The Secretary and Director of Education, Education Offices, Ruthin (Sept. 17). A reader in pathology at Westminster Hospital Medical School—The Academic Registrar, University of London, South Kensington, S.W.7 (Sept. 23). A junior technical officer at the Royal Aircraft Establishment for work in the specification section of the Wireless and Photographic Department—The Chief Superintendent, R.A.E., South Farnborough, Hants (Sept. 24, quoting No. A.210). A professor of chemistry and a professor of English language and literature in the University of Melbourne—The Agent-General for Victoria, Victoria House, Melbourne Place, Strand, W.C.2 (Oct. 1). Two assistants, one male and one female, in the Plant Pathological Laboratory of the Ministry of Agriculture and Fisheries, Harpenden—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall Place, S.W.1 (Oct. 1). A lecturer in biology and a lecturer in chemistry in the University of Western Australia—The Agent-General for Western Australia, 115 Strand, W.C.2 (Oct. 1). A research fellow in bacteriology at the Lister Institute of Preventive Medicine—The Secretary, Lister Institute of Preventive Medicine, Chelsea Bridge Road, S.W.1 (Oct. 8). A professor of mathematics and a professor of education at Raffles College, Singapore—C.A. (N), The Secretary, Board of Education, Whitehall, S.W.1. Scottish candidates (N), The Scottish Education Department, Whitehall, S.W.1 (Nov. 1). An assistant in the Research Department, Woolwich, under the directorate of metallurgical research—The Chief Superintendent, Research Department, Woolwich. An assistant lecturer in economics in Auckland University College—The High Commissioner for New Zealand, 415 Strand, W.C.2. A chief assistant in the Domestic Science department of Battersea Polytechnic—The Principal, Battersea Polytechnic, S.W.11.

Our Astronomical Column.

COMET GALE.—Mr. Walter F. Gale, the discoverer of comets 1894 II. and 1912 II., has sent particulars of the discovery of comet 1927 *f*. He was sweeping the neighbourhood of Theta Piscis Australis with a Zeiss binocular just after midnight on June 7, and picked up a small faint nebulosity, the cometary character of which was quickly verified with his telescope. He obtained approximate positions on the next three nights (incidentally these positions suggest that Prof. Gonnessiat's observation of June 10 was inadvertently telegraphed half a degree too far north); these, together with a rough position on June 25 by Mr. Townsend at Hawera, New Zealand, afford material for an approximate orbit, which Dr. A. C. D. Crommelin has deduced as follows: T: 1927 June 14·30 U.T.; ω: 212° 35′; Ω: 66° 38′; i: 12° 40′, log q 0·1030. The small value of i suggests the possibility that the orbit may be periodic. The distance from the earth at discovery was 0·43 astr. units. The comet still remains too far south for convenient observation in England. Some observations were made at the Cape, which have been sent to the I.A.U. Bureau at Copenhagen. It is noteworthy that three of the four unexpected comets discovered this year are due to British observers, as is also the detection of Comet Grigg-Skjellerup on its return.

Later.—The Cape observations, now to hand, suggest that Gonnessiat's declination is right and Gale's wrong.

VENUS.—Mr. H. McEwen, director of the Venus Section of the British Astronomical Association, contributes an interesting paper to the July issue of the *Jour. B.A.A.* He quotes the radiometric measures of Coblentz and Lampland from which Menzel deduced a surface temperature of 122° F., which bears to that of the earth the proportion of the inverse squares of distances from the sun. He also uses the temperature measures to advance an argument in favour of the period of rotation and position of axis announced by Prof. W. H. Pickering; the period was about 3 days, and the inclination so high that the tropics would be within 5° of the poles. Under these conditions the poles would be for most of the time the hottest regions of the planet, for they would have a very high sun continuously for a large fraction of the planet's year. The measures indicated that one cusp was much hotter than the other, this being the one where the sun was setting, whereas the other had cooled during the night. The spring equinox of the northern hemisphere is stated to occur when the planet's heliocentric longitude is 316°·6, the other seasonal points being found by successive additions of 90°.

Pickering's view is that the planet is practically covered with oceans, so that there would be no surface markings of a permanent character. Those that are seen are presumably atmospheric. Mr. McEwen shows that their changes are in good accord with the atmospheric circulation that would result from such an axial pose. When the pole is nearly central on the disc, there would be little rotational velocity in the line of sight; but this should be appreciable when the pole was near the limb.

The writer has made out a good case for the view he advocates, and it may at least be adopted as a working hypothesis. The rotation has long been a puzzling enigma, and any further light is welcome.

Research Items.

DREAMS IN AFRICA.—In *Man* for August, Mr. J. P. Driberg records a number of dreams of different types and their interpretation which he has collected, at the suggestion of Prof. C. G. Seligman, among the Lango and Didinga of the south-eastern Sudan. The Lotuko-speaking Lango provide eleven varieties of dream, the Didinga fourteen. Among the Lango no greater significance attaches to the dream of a magician than of a layman, but among the Didinga, although the magician does not have a different class of dream from that of the layman, all his dreams have a greater significance, and if the significance is ill-omened a sacrifice must be made of a bull or a goat to avert the threatened evil. Among both peoples the significance of many of the dreams is a simple prognostication. For example, among the Lango a dream that some one kills the dreamer is considered a true forecast; to dream of killing an elephant means that one will do so; among the Didinga, to dream of hunting means that success on the next expedition will correspond, and so forth. Certain dreams, however, have a special significance. Among the Lango, to dream of being carried away in a flood causes the dreamer fear, though whether this is because of an ill omen is not clear. To dream of being bitten by a snake is a very bad omen. A piece of charcoal must be bitten and spat out and the dreamer must prick himself with a thorn. Among the Didinga, a similar use of charcoal and thorns follows on a dream that *A* kills *B* by witchcraft. The dreamer must the next day call on *B*, bite a piece of charcoal and spit it on *B*, rub soot on his forehead and scratch him with thorns. The same procedure follows a dream that *A* accidentally spears himself; but it must be done immediately on waking even if this involves a journey in the night. To dream of falling in the fire must be followed by the sacrifice of a white goat and the tying of a goatskin bracelet on the person of whom one dreams.

BETH-SHAN IN 1926.—In the *Museum Journal* (Philadelphia) for March, Mr. Alan Rowe surveys the work carried out by the Palestine Expedition of the University of Pennsylvania at Beisan in the season of 1926. In addition to the actual work of excavation on the Tel and in the vast cemetery to the north, a comprehensive survey of the area was made, which showed that the original top of the mound was 346 ft. below the level of the Mediterranean, and the height 213 ft. at the north and 134 ft. at the south ends. Eight successive periods are represented by superimposed layers, but the occupation of some of the principal buildings extended from one period to another, they being used over and over again. For example, the two temples of Rameses II, which are identified as the House of Astaroth and the Temple of Dagon of the Bible, and belong to the fifth level dated 1295–1225 B.C., were used until at least Israelitish times, say 1000 B.C. The period covered by the eight levels extends from some date before 1412 B.C. not yet determined down to modern times. In 1926 all the strata from the second to the eighth were worked. Up to the present that of Amenophis III, the seventh, is regarded as the most important. The material recovered from this level admits of certain inferences of great historical importance. Among the finds are a number of inscribed Syro-Hittite cylinder seals, a bronze Syrian dagger, and a Hittite axe-head of which one end is in the shape of a hand with outstretched fingers, unique but similar to an axe held by a Hittite king on a sculpture at Boghaz-Keui. This affords supporting evidence of the extent of the advance of the Hittites known to be taking place at about this time into North Syria. Further, the model of a chair or throne of Cretan (Minoan) type with Egyptian emblems and a model of a table, also of Cretan type, doubtless parts of a group of cult objects, with other finds, point to an infiltration during the Bronze Age of Ægean influence via Cyprus, of which the final phase was represented by the domination of the iron-using Philistines. This Ægean-Cypriote influence in the old religion of Palestine was not recognised fully before these discoveries at Beth-Shan.

THE INSECTS OF SAMOA.—Reference has recently been made in these columns to a monograph dealing with the insects and other land arthropods of Samoa that is being issued by the British Museum (Natural History). This work is based upon collections made by Dr. P. A. Ruxton and Mr. G. H. E. Hopkins, who visited the islands under the auspices of the London School of Hygiene and Tropical Medicine in 1924–25. Within the last few weeks three new fascicles of this monograph have come to hand. Micro-lepidoptera are dealt with by Mr. E. Meyrick and his contribution forms Fasc. II. of Part 3. It appears that scarcely half-a-dozen named species of these insects were recorded from Samoa before the receipt of the present collection, which raises the total number to 137. Of these, two-thirds of the species are endemic, and the remainder also occur elsewhere, being probably introduced through shipping. Mr. Meyrick concludes that Samoa constitutes, by the test of specific endemicity, a perfectly distinct and isolated faunal region. Another noteworthy feature is the total absence of representatives of the families Pterophoridæ and Œcophoridæ from the indigenous fauna. Part 2, Fasc. I. is devoted to certain families of Hemiptera. The Fulgoroidea are dealt with by Mr. F. Muir, who finds that eight families, twenty-seven genera, and fifty-one species are now known from the islands. He describes a new genus, Buxtoniella, the systematic position of which appears to be an enigma but it is relegated to the Lophopidæ. The Psyllidæ are reported on by Prof. D. L. Crawford, and Mr. F. Laing has dealt with the Coccidæ, Aphididæ, and Aleyrodidæ. Part 7, Fasc. I. contains Mr. G. F. Hill's account of the Termitidæ and Lieut.-Col. Fraser's description of the Odonata.

ACCELERATION OF PLANT GROWTH.—At the Boyce-Thompson Institute for Plant Research in New York, experiments are being carried on for the purpose of investigating the conditions necessary to accelerate plant growth. In a *News Bulletin* recently issued by Science Service of Washington, Dr. John M. Arthur gives a review of the work being carried on. The results include spring wheat harvested 35 days after sowing, red clover in flower 38 days after seeding, and a large head of lettuce grown in three weeks. These remarkable results have been obtained by the use of artificial light, heat, and atmosphere. The process of photosynthesis in a plant is somewhat inefficient, only about one per cent. of the radiant energy falling on its leaves being utilised. More than a century ago de Saussure showed that green plants could utilise more carbon dioxide than is actually available in the atmosphere, but no application was made of that fact until the War. Then, under pressure of food shortage in Germany, processes were perfected by Riedel and others for scrubbing gases from combustion of coal, coke, and charcoal to produce carbon dioxide, which was piped into greenhouses among growing plants. With high temperature and

high light intensity, a concentration of less than 0·5 per cent. of carbon dioxide (the normal amount present in the air is 0·03 per cent.) just about doubled the dry weight of plant tissue produced. Similarly, many plants can use more light than they get in Nature. If such plants are kept continually under an arc lamp, or if artificial light is used to supplement daylight, their growth is hastened. Wheat and clover can stand 24 hours of light a day. The tomato, however, grows fastest with 12 hours of daylight supplemented by 6 hours of artificial light. Unfortunately, commercial application of these facts is not yet in sight, and will not be until electrical power can be produced at a much cheaper rate than at present.

WEED SPRAYS.—Mr. A. Åslander, in the *Journal of Agricultural Science*, vol. 34, p. 1065, describes some interesting experiments with weed sprays. Cornellian oats and field mustard (*Brassica arvensis*) were grown together in pots and sprayed when the mustard had developed four leaves. Concentrations of 5-15 per cent. of iron sulphate and 1-2 per cent. of sulphuric acid were used, and after the treatment the pots were kept under various conditions of humidity. In all cases the oat plants were uninjured by the sprays, but the effect on the mustard varied. Iron sulphate was only effective when the relative humidity was high (100 per cent.), a 5 per cent. solution completely killing the plants in twenty-four hours under such conditions, whereas in dry air (relative humidity 30-60 per cent.) concentrations up to 15 per cent. were used without injury. The effectiveness of sulphuric acid, however, was much less dependent on the humidity, though the best results were obtained in dry air. The plants were completely killed by 1·5 or 2 per cent. solutions, the higher concentration being necessary if the soil in the pots had been kept dry. Temperature had a marked influence on the effect of the spray. Whereas at 30° C., a 2 per cent. solution proved fatal after one hour, at 6° C., the same result was only obtained after five hours. Artificial rain, produced by sprinkling the plants with water, failed to decrease the action of the acid. Experiments with *Elodea canadensis* bore out the spraying results with mustard, since protoplasmic streaming continued for two hours in a 10 per cent. solution of iron sulphate, but ceased in 30 seconds in 1 per cent. sulphuric acid.

NEMATODA OF THE LEIDY COLLECTIONS.—A. C. Walton has examined the extensive collection of Nematoda made by the late Dr. Joseph Leidy and presents the first of a series of reports on this material (*Proc. Acad. Nat. Sci. Philadelphia*, vol. 79, pp. 49-163; 1927). The worms were obtained chiefly from American hosts, but a few were from imported animals in captivity in America. Many of the original Leidy species are present in the collection, and in some cases it has been possible to designate type specimens. The main interest of this account is that it contains descriptions with drawings of species which, since Leidy's time, have been either unrecognised or but doubtfully identified by later workers. More than a hundred definitely recognised species are recorded, twenty-four of which are described as new. Appended is a list of hosts and their respective Nematoda.

OIL IN MUD FROM SEA-FLOOR.—Some interesting research on the oil-content of sea-bottom muds and sands accumulating at the present time is being conducted by Dr. P. D. Trask, of the American Petroleum Institute. Samples of muds were taken from shoal-waters off the coasts of Southern California and North Carolina; such samples are then subjected to destructive distillation and other chemical and physical tests. According to Science Service, No. 326 F, Washington, D.C., of June 25, 1927, oil was produced from all these types of sediment; "the yield was low, and in general varied in amount with the degree of fineness of the sediments, ranging from a maximum of 2·7 gallons per ton in a clay-silt to almost nothing in a sand. This maximum yield of 2·7 gallons per ton is but 5 or 10 per cent. of the amount obtained from the better grades of oil shale, which run from 30 to 50 or even more gallons per ton." This work has obvious bearings on modern theories of the origin of petroleum, particularly those which invoke marine mother-substance and primary environment; so far it is only in the preliminary experimental stage, but it is backed by a grant from the John D. Rockefeller fund of the Institute, and exhaustive investigations along these lines are contemplated.

IONISATION POTENTIALS OF MERCURY.—Dr. E. O. Lawrence, who recently obtained very strong evidence that the ionisation potential of mercury was multiple, with at least four distinct types of inelastic electron impacts between 10·6 volts and 12·1 volts, has described experiments in the July number of the *Journal of the Franklin Institute*, in which he has confirmed this with different apparatus. In the earlier form, he obtained a homogeneous pencil by magnetic sorting: with the present arrangement he has worked with electrons from an oxide-coated filament, with a thermal distribution of velocities. He used very small electron currents, of the order of 10^{-9} amp., and measured the positive ion currents by a null electrometer method, employing a slightly modified Lenard system of fields. There is little doubt that the effect is real, and not due to some action of magnetic fields, or to diffusion of positive ions, but it would be interesting to repeat the work with other monatomic gases, and with a continuous variation of the accelerating potential.

OPTICAL ISOMERISM.—In a recent paper in the *Zeitschrift für Physik* on the quantum theory of polyatomic molecules (vol. 43, p. 805), Dr. F. Hund arrived at an interesting paradox. According to his analysis, molecules possessing the mirror symmetry associated with optical activity should not have stationary states which correspond to small displacements from the two main positions of equilibrium, but should undergo transitions between the right and left handed forms. This is evidently not in agreement with the permanence of the properties of many optically active substances. The solution follows when the expression for the average time of life in either state is evaluated numerically. This contains an exponential term involving the internal energy, and seven-fold increase of the latter could change the time of relaxation from 10^{-9} second to 10^{9} years. It seems as if apparently stable bodies of this class are actually undergoing slow spontaneous transformation into an inactive mixture which contains equal quantities of the lævo and dextro forms.

LOW-TEMPERATURE PROCESS.—The *Chemiker-Zeitung* of July 16 contains an account, given by Dr. F. Simon of Berlin at the recent meeting of the Deutscher Kälteverein, of a new laboratory method of producing low temperatures by pumping adsorbed gases from charcoal, silica-gels, or from zeolites. Thus helium, adsorbed by charcoal and cooled by immersion in liquid hydrogen, could be further cooled to − 269° C. The process is not continuous, and is at present only available for the production of small quantities of liquid helium, hydrogen, and other gases.

A CRYSTALLINE POTASSIUM HYDROGEN DIOLEATE.—No acid soaps of definite composition analogous to

the two acid sodium acetates have been shown to exist. In the *Journal of the Chemical Society* for June, McBain and Stewart describe the preparation of the first definite crystalline compound of this type observed with soaps. Potassium hydrogen dioleate is prepared from oleic acid and potassium oleate in alcoholic solution. Well-defined crystalline plates separate on cooling in ice. The substance shows a transition point at 43°, at which it breaks up into potassium oleate and a solution of oleate and oleic acid. On account of the ease with which it crystallises from alcoholic solution, it offers a means of purifying oleic acid.

SULPHUR DIOXIDE IN FOOD.—The determination of sulphur dioxide in foods forms the subject of the Ministry of Health Report on Public Health, No. 43, recently published by H.M. Stationery Office (1*s.* 3*d.* net). The only preservatives now permitted to be used in foods and drinks are benzoic acid and sulphur dioxide. The determination of benzoic acid has already been dealt with in Report No. 39 of this series, and the present Report deals on similar lines with sulphur dioxide. Although the Public Health Regulations specify the total amount of sulphur dioxide permitted in various foods, no distinction between free and combined sulphurous acid is made. It is, however, important to know the nature and extent of the combination between sulphur dioxide and certain constituents of food, since the presence of comparatively stable compounds with sulphur dioxide will affect the determinations unless due precautions are taken. The sulphur dioxide is separated from combination on the addition of alkali or on distillation with acid. Gravimetric determination as barium sulphate gives accurate results in nearly all cases.

IGNITION TEMPERATURES AND 'ANTI-KNOCK' INVESTIGATIONS.—The effect of small amounts of lead tetraethyl and other substances in allaying the 'knock' which occurs with some fuels under certain conditions in an internal combustion engine has evoked considerable interest. Much work has been done on the effect of various compounds on the knocking characteristics of fuels by Egerton and Gates, and we have received a series of four papers reprinted from the *Journal of the Institution of Petroleum Technologists*, vol. 13, No. 61, April 1927, which summarises their work. The first three papers deal with the effect of metallic vapours on the ignition of substances, the significance of ignition temperatures, and the effect of certain organic compounds on the igniting and 'knocking' character of petrol. The fourth paper reviews the above work and discusses the reasons for the effects observed. It suggests processes of combustion and ignition and supplies a theory of 'anti-knock' action. A full report of this work was sent to the Aeronautical Research Committee, and is also summarised in the Air Ministry's Reports and Memoranda, No. 1079, which has recently been published. The experiments show that the use of 'anti-knocks' retards the initial processes of combustion and the 'anti-knock' may be regarded as a negative catalyst which reacts with and removes those substances which autocatalyse combustion. Ten theories which have been advanced in explanation of the action of anti-knocks are briefly described, including Callendar's nuclear drop theory (see NATURE, April 9, p. 542). With regard to the latter, it is remarked that no account is taken of the chemical behaviour of 'anti-knock' compounds, and experiments show that more is required of an 'anti-knock' than protection or dilution of the droplet. There is reason to expect that Callendar's suggestions may come in as a secondary effect, and by concentrating the dope in the droplets the tendency would be to enhance its effect where most required.

ELECTRICAL APPARATUS FOR MINES.—A further report on flame-proof electrical apparatus for use in coal-mines, by H. Rainford and R. V. Wheeler, has just been published (Safety in Mines Research Board Paper, No. 35. London: H.M. Stationery Office). The research was made principally to discover the means of preventing the flames due to fire-damp explosions which sometimes occur within the casing of electrical apparatus from passing to the outside atmosphere. Experiments were also made on the ring-relief device, which is intended to provide additional means of pressure-release when the volume contained by the casings is large. In this case neither flange nor perforated plate protection, as shown in previous reports, is adequate. The ring-relief device consists roughly of a number of metallic rings separated from one another by narrow radial distance pieces. These are assembled in the form of a cage and held securely in position by a circular brass end plate which is connected to the end plate by bolts. The interior of the casing is thus in communication with the outer air by the series of gaps formed by the separation of the rings. The general conclusion drawn from the experiments described in the report is that the use of the ring-relief device forms both a satisfactory method of releasing the pressure due to the fire-damp explosion in the interior of the electrical apparatus and also prevents the passage of the flame to the outside. The British Electrical and Allied Industries Research Association assisted in carrying out the work.

THE ACTION OF LIGHTNING ARRESTERS.—Devices called 'lightning arresters,' or electrical safety valves, have been in use for many years to protect electrical machines, more particularly those which are connected with overhead systems of distribution. The phenomena that take place on electric lines during thunderstorms are well known. Sparks take place from conductors to neighbouring conductors connected with the earth. If the electric pressure of supply be high, an arc may be established, causing a short circuit, which may overstress the dynamos or burn out the device, leaving the system unprotected. At the recent international conference on high tension supply in Paris, Mr. McEachron, of the General Electric Co., U.S.A., gave a theory of the action of the safety-valve which explains well what happens in practice. During a thunderstorm, owing to the electrically charged clouds, quite appreciable charges of electricity are induced on the conductors. A lightning flash sets these charges free by suddenly altering the potentials of the clouds. The charges now travel in both directions along the conductors, half of the initial electrostatic energy being converted into electromagnetic energy. The potential gradient of the wave-front causes the safety-valve to act, and if a sufficient charge passes to earth in a very brief interval, the pressure drops to its working value, the valve ceases to operate, and the system again works normally. In California, a working voltage of 220 kilovolts is employed. It was thought that the necessary high insulation would completely protect the line. This it fails to do. Even when fourteen disc insulators in series are used to support the conductors, 'flash overs' occur repeatedly. This proves that the impulse voltage causing them must exceed 2000 kilovolts. The insulation only breaks down when the time of application of the applied voltage is excessive.

Research and Industry in South Africa.

THE Union of South Africa, although possessing so small a population (1,672,000 whites), employs the scientific worker and the engineer to an exceptional extent; and progress in the Union is correspondingly remarkable. Forty years ago the country was sparsely populated and scarcely possessed a factory. In 1925 the gross value of the output of its industries was estimated at £79,789,000, and that of its mines at a further £50,000,000.

Much of this progress is directly due to the intelligent employment of scientific and engineering skill. In gold-mining, the discovery of the cyanide process made possible the present output of more than £40,000,000 a year. The handsome profits obtained, in spite of the low grade of most of the mines, have been made possible by the application of years of research and experiment to the development of metallurgical processes, the cheap production of electricity, explosives, and compressed air, and to the design and handling of rock drills and jack-hammers.

Fortunately, this is now fully realised by the financial heads of the mining industry. Apart from the central research laboratories of the groups, some of the larger mines have their own 'study departments,' the staffs of which devote their full time to research, experiment, and instruction in methods likely to reduce costs. In the best mines only men with technical training as well as practical experience are employed on this work; and they are well paid.

In some countries agriculture is popularly regarded as one of the most empirical industries. In South Africa the local peculiarities of soils, the varieties and virulence of pests and diseases, and the irregularity of the rainfall, early led to a special call on the services of the research worker and of the civil engineer. In spite of the disadvantages mentioned, South Africa now exports more than ten million pounds worth of farm products a year.

So long ago as 1911, four highly paid posts were created for research on the fertility of seeds, whilst the large veterinary research institute near Pretoria was founded in 1908. There are now, in addition, five schools of agriculture with experimental farms, and also a national herbarium. There is a department for the study of bacterial diseases of plants at Pretoria, and a government laboratory at Durban for the study of the sub-tropical diseases of the sugar-cane and allied plants. Durban also possesses a private institution for research on problems met with in the sugar-cane industry. At Cape Town there is a government laboratory for the study of the diseases of deciduous fruit trees.

The Department of Agriculture maintains a special experimental farm for the study of the resistance of plants to drought and frost, and also two chemical laboratories (Cape Town and Johannesburg), equipped for both analytical work and research.

Students who wish to take up the scientific study of agriculture complete a preliminary three years in South Africa and then proceed for a further two years, usually aided by a government scholarship, either to Guelph, Ontario, or to Denmark or Sweden. Those taking up veterinary sciences for the degree of B.V.Sc. take a two-years' preliminary course at an approved college or university in South Africa, and then a three-years' course at the Institute at Onderstapoort near Pretoria.

That the application of the results of such study and research may be made to yield good profits or, alternatively, to prevent heavy losses, is now widely appreciated by the majority of the farmers in South Africa, but not by all. A story is told of one old cattle farmer, the local oracle of his district, who did not believe in blood tests for disease. Such tests are carried out free of charge if the suspected animal is found to be infected, whilst a small fee is charged if a negative is obtained. This farmer sent a sample of his own blood to the government laboratory and widely proclaimed his cleverness in devising this pitfall for the ——! (gentlemen) who spend the poor farmers' taxes in such foolery. In due course the report was received by him. It stated that a mistake had been made; the blood sample was not from any farm animal but appeared to have been taken from an old gorilla which was suffering from the list of diseases attached and was apparently in such a bad condition that it should be killed at once. The report also stated that, in accordance with the regulations, no fee would be charged for the examination of the sample submitted. The farmer was not heard proclaiming his views on this subject any more.

In connexion with forestry, as apart from farming, a small sylvicultural research station has been established near Knysna in Cape Colony and the establishment of similar stations is contemplated in other districts. Timber investigations are carried out at Pretoria by the Department of Agriculture in co-operation with the Railway Administration. Relevant inquiries from the public are dealt with by the officer of this section.

Medical research has received particular attention in South Africa, and expenditure has been on a lavish scale. Apart from the outstanding investigations on the prevention of silicosis and pneumonia on the mines, much work has been done on epidemic influenza by the South African Institute for Medical Research. Eighteen memoirs have been published on these and other subjects. The chief medical school of the Union is at Johannesburg.

In mining, apart from the central laboratories of the mining groups and the efficiency and study departments of the larger mines, the Department of Mines and Industries carries out much research work. Health, safety, and particularly the prevention of miner's phthisis, are the subjects dealt with by the latter. Recently, in conjunction with the Geological Survey, special attention has been given to exploring the commercial possibilities of mineral deposits, particularly those of the base metals and the non-metallic minerals. The subject of uses and markets overseas receives special attention.

In chemical industry, still in its infancy in South Africa, private enterprises have carried out a large amount of work on local problems such as the manufacture of wattle bark extract, refractories, phosphates, caustic soda, acetates, paper, starch, wood and coal distillation products, and rubber from the raw materials occurring in the Union. Promising local research is now being carried out on yet another process for the 'liquefication' of coal, and on the distillation of oil from the local shales and torbanite. Practical experience and systematic experiment have been successful in establishing the local manufacture of leather, soap, candles, calcium carbide, cement, glass, tiles, and earthenware.

The production of iron, steel, and alloy steels from local ores is only just commencing, although the utilisation of the immense supplies of scrap metal from the mines was more or less perfected during the period of the War.

With so much interest in research, and so much development in industry, it is not surprising that South Africa has many scientific societies, most of which publish their own proceedings and maintain a high

standard in the contributions of their members. In Johannesburg an interesting venture is the Technical Club, an attempt at a social club for the members of the scientific societies which contribute to its upkeep. The club successfully houses the offices of the secretaries of the contributing societies; but as in London, scientific workers do not seem to be anxious to see each other in the evenings except at the meetings of their respective societies. At the universities, on the other hand, there is a considerable amount of social intercourse, a good esprit de corps, and keen competition in games; but in both the scientific societies and the universities the importance of research to industry and of industry to the country is keenly appreciated.

Industry already employs many thousands of whites and blacks in addition to the thousands employed by the mines. With its firmly established agriculture, its fine geographical position with regard to the growing markets of the East, its vast national resources of coal and iron, its fine railways and good harbours, and its wide appreciation of the value of research, the future of the South African industries should be bright indeed.

The Food of Young Herring.

IN the investigation of the food contents of large batches of small herring (Fishery Board for Scotland, Scientific Investigations, 1927, No. 1, "Observations on the Food of Post-Larval Herring from the Scottish Coast"), Miss Helen S. Ogilvie, of the Fishery Board for Scotland, has an exceptional opportunity. The fishes examined measured about 30 mm. to 45 mm., and were metamorphosing, having a more or less transparent body with, in the larger specimens, scales in the process of formation. Hitherto it has been far more difficult to find such stages than to find the fully scaled forms which are slightly older and larger and constitute the 'white-bait'. These post-larval stages have now been found in abundance in the coastal waters and up the estuaries in the neighbourhood of Aberdeen. Lot No. I was taken outside Aberdeen Breakwater, Lot No. II off North Pier, and Lot No. III, examined for comparison with the other two, from Kincardine-on-Forth.

Observations have been made on the food of very young herring and of those of whitebait size, but not so far to any extent on post-larval herring between these stages. The present work is therefore extremely valuable. As was to be expected, the food found consisted almost entirely of copepods, the commonest species being *Pseudocalanus elongatus* and *Oithona similis*, and, in those from Kincardine, *Eurytemora hirundoides* in great abundance, which last is a brackish water copepod, the station where the third sample was caught being an estuarine one. One fish belonging to this group measuring 45.5 mm. contained 369 copepods. Another from Lot II measuring 40 mm. contained 479.

Miss Ogilvie finds, contrary to those workers on the younger stages who found many empty, that nearly all the herring examined were feeding. Out of 345 individuals, 95·4 per cent. contained food. In fishes of the same size examined by Hardy from the North Sea, only 46 per cent. contained food. Moreover, more food was found in the Scottish herring than in those from England. One particular copepod was the chief food in each lot. Thus in Lot I Pseudocalanus was predominant, in Lot II Oithona, and in Lot III Eurytemora. All three copepods are some of the commonest present where the fishes were respectively taken, and it seems more a matter of size than anything else which determines the species eaten.

University and Educational Intelligence.

LONDON.—Applications are invited for the William Julius Mickle fellowship, value not less than £200 and open to men and women graduates of the University, resident in London. The fellowship is for the student who, in the opinion of the senate, has done most for the advancement of medical art or science during the preceding five years. Applications should reach the Academic Registrar, South Kensington, S.W.7, not later than Sept. 30.

DR. R. M. WENLEY, who has been acting as director of the British division of the American University Union, is about to return to the headship of the Department of Philosophy and Psychology in the University of Michigan.

APPLICATIONS are invited by the Wigan and District Mining and Technical College for the A. M. Lamb scholarship in mining, value £30 annually and tenable for three years at the full-time courses of the college. Particulars can be obtained until Sept. 7 from the principal.

NOTICE has been received of the Prof. Aurelio Bianchi International Prize of 10,000 lira (about 100 guineas) for "works in phonendoscopy, phonendography, phonendometry" of an experimental character. The prize is open to persons of all nationalities and to individual workers or several persons working in collaboration. Memoirs must not have been published before, and may be in Italian, English, French, German, Spanish, or Portuguese. The competition closes on May 24, 1928. Further particulars can be obtained from the Rector, Royal University of Perugia.

TITLES of theses for doctorates conferred in the sciences by American universities in 1925–26 are given in a list published by the National Research Council as *Reprint and Circular* No. 75 (N.R.C. Washington, D.C., 50 cents). The list is classified under twenty-one subject headings, and statistics of doctorates conferred under each of these headings are given for the past ten years. During this period the number of doctorates conferred annually has increased from 373 to 740, the increase being greatest under chemistry (from 108 to 256). The Council expresses the hope that those who find the data of interest will write, so that the Council may judge whether the publication should be continued.

BRADFORD Technical College opens this year a new department of pharmacy, particulars of which are given in the college prospectus for 1927–28. The courses are recognised by the University of London and the Pharmaceutical Society of Great Britain for the purpose of training for the degree of bachelor of pharmacy and for the Society's professional examinations respectively. A special feature of the College is the provision made in its department of commerce and banking, established in 1925, for meeting the needs of students who will enter the commercial side of industrial undertakings or such professions as accountancy, and for equipping students in all branches of technology with a useful knowledge of economics. Three research scholarships of £100 each are offered to students proposing to stay on at the College after completing diploma courses.

Calendar of Discovery and Invention.

September 5, 1862.—James Glaisher, who was the first superintendent of the magnetical and meteorological department of the Royal Observatory on its foundation in 1840, and was also the founder of the Royal Meteorological Society, made many balloon ascents for scientific purposes, the most notable of which was that made from Wolverhampton on Sept. 5, 1862, when a height of nearly seven miles was attained.

September 6, 1863.—It was on Sept. 6, 1863, that Philipp Reis (1834–1874), a professor of Frankfort-on-Maine, explained to the Emperor of Austria his 'telephon' for transmitting musical sounds to a distance. Reis probably designed ten distinct forms of transmitter and four forms of receiver. Some of his apparatus is to be seen at the Science Museum, South Kensington. A Reis 'telephon' was also experimented with by Hughes, who exhibited the instrument to the Emperor Alexander II. of Russia at Tsarskoye Selo in 1865.

September 6, 1870.—The need for the application of scientific methods in designing and building ships has often been brought home by disasters at sea, of which the loss of H.M.S. *Captain* is perhaps the most notable. Built on the Mersey to the plans of Captain Cowper Coles, the *Captain* was a fully-rigged low-freeboard turret vessel 320 feet long and 6950 tons displacement. She was completed in 1870, and after preliminary trials she joined the Channel Fleet off Finisterre, but on the night of Sept. 6-7 capsized, 475 officers and men being lost. An outcome of the tragedy was the appointment of a Committee of Design, on which Armstrong, Rankine, Kelvin, Woolley, and Froude served, while much more extensive investigations into the question of stability of ships was undertaken than had hitherto been the case.

September 7, 1807.—Winsor's success in lighting Pall Mall with gas in January 1807 had far-reaching effects and also led to extravagant speculation. Winsor himself lectured and gave demonstrations, and on Sept. 7, 1807, Lady Bessborough, writing to the Earl of Granville, said: "Winsor promised a return of 6000 guineas a year for every guinea subscribed. No fewer than 17,000 shares were sold in ten days, and Pall Mall was blocked with people in carriages, on horseback, and on foot rushing to invest."

September 8, 1859.—After many delays, the famous *Great Eastern* proceeded down the Thames on trial on Sept. 8, 1859. She had then been five years under construction. About as large as our present *Mauritania*, her machinery was only about a seventh of the power. She had both screw and paddles, but her combined horse-power was only some 9000 H.P. Moreover, she had but 25 lb. steam pressure in her boilers, and her coal consumption was very high. It was the backwardness of marine engineering that, as much as anything, made it impossible to make her pay.

September 9, 1892.—"On Sept. 9, 1892, Mr. [Prof. E. E.] Barnard was studying Jupiter with the large telescope at the Lick Observatory, which has an aperture of three feet, and as the light of the planet produced too great an illumination of the field of vision, he carefully intercepted it, whereupon he noticed a feeble luminous point nearer than the first satellites. At first he thought it was a small star, but as the days passed all such doubts were removed, and it became clear that here was indeed a fifth moon, situated at no greater distance than 113,475 miles from Jupiter's enormous globe. . . . Few observers are powerfully enough equipped to perceive this tiny world, whose diameter is only some 90 miles" (Moreau).

E. C. S.

Societies and Academies.

PARIS.

Academy of Sciences, July 25.—André **Blondel**: Abacus for the resolution of the general equation of the third degree and the discussion of the differential equation of the third order with constant coefficients.—Paul **Sabatier** and Antonio **Fernandez**: Dehydrogenations and hydrogenations catalysed by metallic oxides. In previous communications the catalytic behaviour of various metallic oxides has been mainly studied by the reactions with alcohols. Piperidine has now been submitted to similar experiments. The reduction of nitrobenzene and alkyl nitrites by hydrogen in the presence of manganous oxide or zinc oxide has also been studied.—D. **Wolkowitsch**: A geometrical interpretation of Castigliano's theorem in a particular case.—G. **Pfeiffer**: The construction from a system of partial differential equations of the first order with an unknown function, of an equation, linear in Jacobians, satisfying Hamburger's conditions, and also of a system of equations, linear in Jacobians, for which the generalised conditions of Hamburger are fulfilled.—Serge **Bernstein**: The multiply monotone polynomials which deviate the least from zero.—A. **Veronnet**: The most general movement of an isolated heterogeneous fluid mass, which keeps an invariable form. The trajectories are circular and the level surfaces of revolution.—**Swyngedauw**: The unfolding of belts.—D. S. de **Lavaud**: The stability of the vibrations of the front axle and wheels of a motor-car.—**Rebillet**: Carburation in internal combustion motors. A general formula is given for the weight of air drawn into the motor in a given time and a mechanism described and illustrated by means of which the petrol injected can be made to follow the same law.—Léon **Kirste**: The practical limit to increase of size of commercial aeroplanes.—E. M. **Antoniadi**: Recent observations of the planet Mercury with the Meudon 83 cm. telescope.—Carl **Störmer**: Remarkable action of sunlight on the height of the aurora borealis. On Sept. 8, 1926, the height of an aurora measured on a 26 kilometre base at Oslo was found to be 300 km.–500 km. above the earth, instead of the average 80 km.–200 km. This aurora was directly exposed to sunlight, and examination of earlier data showed that a high aurora was usual when exposed to the rays of the sun. The spectrum of the high aurora gives lines in the blue and violet which are not shown by the low altitude aurora.—H. **Deslandres**: Remarks on the preceding communication.—Mlle. J. **Clavier**: Study of the reflecting power of some unoxidisable steels. Four non-rusting steels were examined and their reflective powers measured for eight different wave-lengths. One group of mirrors was exposed to the air for two months; the other group was kept away from air and moisture. The measurements were practically identical and show that these steels possess the qualities of a good material for reflectors.—G. W. **Ritchey** and Henri **Chrétien**: Presentation of the first model of an aplanatic telescope.—Edmond **Bayle** and Lucien **Amy**: The application of spectrum analysis to the detection of metallic impurities. A modification of the method of Jolibois and Bonnet, in which the metal is first deposited electrolytically. A list is given of the minimum amounts of various metals capable of detection by this method, varying from 1×10^{-6} gm. of silver to 1×10^{-10} gm. of manganese.—L. **Dunoyer**: The measurement of the gases dissolved in water. The method is based on the evaporation in a high vacuum of a small quantity of water (1 c.c. to 2 c.c.), absorption of the water

vapour by phosphorus pentoxide, and measurement of the pressure produced by the evolved gas. The results are higher than the figures usually accepted.—A. Colani: Study of the systems uranyl sulphate, alkaline sulphate, water, at 25° C.—Félix Taboury: The basic carbonate of beryllium. The decomposition of the ammonium beryllium carbonate does not give the substance indicated by Debray, but a more basic carbonate still containing ammonia. Even after prolonged washing with water charged with carbon dioxide, it is extremely difficult to remove the whole of the ammonia.—Max and Michel Polonovski: A scopinium derivative: reduction to ψ-scopine and degradation to *m*-oxybenzaldehyde.—Emile André and Mlle. M. Th. François: Contribution to the study of the marine animal oils. Researches on the unsaturated fatty alcohols of spermaceti oil.—Mme. Ramart, Mlle. Laclôtre, and M. Anagnostopoulos: The action of the organo-magnesium compounds on the α-trisubstituted primary amides. Whilst mono- and di-substituted acetamides give ketones when condensed with organo-magnesium compounds, the trisubstituted acetamides yield nitriles.—Raymond Charonnat: The solubility of 1-phenyl-2 . 3-dimethyl-4-dimethylamino-5-pyrazolone in water.—Branco Dimitrievitch: The conditions of deposit of the axinite of Mont Avala (Serbia).—Ch. Mauguin: The study of muscovite mica by means of the X-rays.—P. Corbin and N. Oulianoff: The difference and the resemblance of the crystalline schists of the two slopes of the Chamonix valley (massifs of Mont Blanc and Aiguilles Rouges).—Jean G. Popesco: A variation of terrestrial magnetism.—A. Lebediantzef: The modifications of the nitrogenous substances in earth dried in the open air and left fallow.—A. Mordvilko: Anolocyclia in the Pemphigus of Pistachia.—F. Henrijean: New researches on the heart and the electrocardiogram.—Philippe Fabre: Relation between the linear constant and the chronaxy.—Ch. Champy and Th. Keller: Uterine and mammary development by injection of ovarian hormone.—J. Houget, André Mayer, and L. Plantefol: A particular form of biological oxidation.—L. Margaillan: Remarks on the oil of grape pips.—R. Fosse and Mlle. V. Bossuyt: The estimation of allantoic acid as xanthylurea. Application to the analyses of the leaves of *Acer pseudoplatanus*.

SYDNEY.

Linnean Society of New South Wales, June 29.—G. H. Cunningham: The Gasteromycetes of Australasia (Part vii.). The genera Disciseda and Abstoma. Under Disciseda eight species are placed, one being described as new. Under Abstoma are placed two species, one being confined to New Zealand, the other, hitherto undescribed, being confined to Australia. (Part viii.) The genus Mycenastrum. The single species *M. corium* is fully described and its great variability indicated.—E. C. Chisholm: Additional flora of the Comboyne Plateau, 1926.—G. H. Hardy: (1) Further notes on a new classification of Australian robberflies (Diptera, Asilidæ). The whole family Asilidæ is dealt with. Three subfamilies and seven tribes are recognised. The old subfamily Laphrinæ is divided, two of the genera being incorporated in the Saropogonini, the remainder forming a new tribe. (2) The phylogeny of some Diptera Brachycera. Tabanoidea, Asiloidea, and Empidoidea are dealt with and special attention is given to the first two. The families Therevidæ, Apioceridæ, and Mydaidæ are closely related to the Saropogonini tribe of the Asilidæ; also the genus Clesthenia, previously regarded as a Therevid, may be an off-shoot from a stock of the Asilidæ much more primitive than the Saropogonini.

Official Publications Received.

BRITISH.

Publications of the British Astronomical Association. No. 58: Tables giving $\tan\frac{v}{2}$ and $\tan^2\frac{v}{2}$ in Parabolic Motion, with Argument $M=(t-T)q-\frac{3}{2}$, to facilitate the Computation of Ephemerides from Parabolic Elements. By Bengt Strömgren. Pp. 41-57. (London: British Astronomical Association.)

The Indian Forest Records. Botany Series, Vol. 13, Part 1: Illustrations of Indian Forest Plants. By R. N. Parker. Part i: Five Species of Dipterocarpus. Pp. ii+30+5 plates. (Calcutta: Government of India Central Publication Branch.) 1 rupee; 1*s*. 9*d*.

Records of the Indian Museum. Vol. 29, Part 1: Notes on Lizards in the Indian Museum, III., On the Unnamed Collection of Lizards of the Family Scincidæ, by Dr. Sunder Lal Hora; The Flatfishes (Heterosomata) of India, with a List of the Specimens in the Indian Museum, by J. R. Norman. Pp. 47+7 plates. 2 rupees. Vol. 28: Appendix (List of Literature referring to Indian Zoology (excluding Insecta) received in Calcutta during the Year 1926.) Pp. 25. 1 rupee. (Calcutta: Zoological Survey of India.)

Rugby Engineering Society. Proceedings, Session 1925-6. Vol. 20. Pp. xxii+160. (Rugby.) 10*s*. 6*d*.

Transactions of the Institution of Chemical Engineers. Vol. 4, 1926. Pp. 209. (London: Institution of Chemical Engineers.)

Aeronautics. Report of the Aeronautical Research Committee for the Year 1926-27. Pp. 55. (London: H.M. Stationery Office.) 2*s*. net.

Proceedings of the Croydon Natural History and Scientific Society. Vol. 10, February 1925 to January 1927. Pp. 52+5 plates. (Croydon.)

Catalogue of Cases of Birds in the Dyke Road Museum, Brighton: giving a few Descriptive Notes, and the Localities in which the specimens were found. By E. T. Booth; with further Notes by A. F. Griffith. Fifth edition. Pp. 290+31 plates+viii. (Brighton: Brighton Library, Museums and Fine Arts Committee.) 2*s*. 6*d*.

FOREIGN.

Department of Commerce: Bureau of Standards. Scientific Papers of the Bureau of Standards, No. 551: Absorption Spectra of Iron, Cobalt and Nickel. By W. F. Meggers and F. M. Walters, Jr. Pp. 204-226+2 plates. (Washington, D.C.: Government Printing Office.) 10 cents.

Proceedings of the United States National Museum. Vol. 71, Art. 14: A new Type of Caddis Case from the Lower Eocene of Tennessee. By Edward W. Berry. (No. 2686.) Pp. 4+1 plate. Vol. 71, Art. 16: Some Peculiar Fossil Forms from Maryland. By Wendell C. Mansfield. (No. 2688.) Pp. 9+5 plates. Vol. 71, Art. 22: A new Nematode, Nematodirus antilocapræ from the Prong-Horn Antelope, with a Key to the Species of Nematodirus. By Emmett W. Price. (No. 2694). Pp. 4+1 plate. Vol. 71, Art. 23: A Fossil Insect from the Lower Permian of the Grand Canyon. By Frank M. Carpenter. (No. 2695). Pp. 4+1 plate. (Washington, D.C.: Government Printing Office.)

United States Department of Agriculture. Farmers' Bulletin No. 1531: The Tobacco Budworm and its Control in the Georgia and Florida Tobacco-growing Region. By A. C. Morgan and F. S. Chamberlain. Pp. 10. 5 cents. Farmers' Bulletin No. 1533: Rat Control. By James Silver. Pp. 21. 5 cents. (Washington, D.C.: Government Printing Office.)

Journal of the College of Agriculture, Hokkaido Imperial University, Sapporo, Japan. Vol. 16, Part 5: Studies on Myxosporidia of Japan. By Tsunenobu Fujita. Pp. 229-247+1 plate. Vol. 17, Part 4: Chemische und physiko-chemische Untersuchung des Mannans von *Amorphophallus Konjac*. Von Suguru Miyake. Pp. 163-184. (Sapporo.)

Conseil Permanent International pour l'Exploration de la Mer. Rapports et Procès-verbaux des Réunions. Vol. 44: Rapport Atlantique 1926. Par Dr. Ed. Le Danois et Rafael De Buen. Pp. 136. (Copenhague: Andr. Fred. Høst et fils.)

CATALOGUES.

A Catalogue of Books on British and Foreign Birds. (No. 499.) Pp. 16. (London: Francis Edwards.)

Constable Books: Autumn 1927. Pp. 20. (London: Constable and Co., Ltd.)

Diary of Societies.

CONGRESSES.

AUGUST 29–SEPTEMBER 3.

INTERNATIONAL COMMISSION FOR THE EXPLORATION OF THE UPPER AIR (at Leipzig).

AUGUST 31–SEPTEMBER 3.

WORLD POPULATION CONFERENCE (at Geneva).

AUGUST 31–SEPTEMBER 7.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (at Leeds).

Friday, September 2, at 10 A.M.—Addresses by Sectional Presidents: H (Anthropology).—Prof. F. G. Parsons: The Englishman of the Future.—I (Physiology).—Dr. C. G. Douglas: The Development of Human Physiology.—Discussion (Sections A, B): The Nature and Formation of Colloidal Particles.—Discussion (Section G): Coal.—Discussion (Sections K, M): The Control of Plant Diseases.—Discussion (Section L): Education in Tropical Africa.

At 11 A.M.—Discussion (Section I): Circulation Rate.

At 11.30 A.M.—Address by the President of Section L (Education), Her Grace The Duchess of Atholl: The Broadening of the Outlook in Education.

At 8.30 P.M.—Evening Discourse by Prof. R. A. Millikan: Cosmic Rays.

Monday, September 5, at 10 A.M.—Addresses by Sectional Presidents: A (Mathematical and Physical Sciences).—Prof. E. T. Whittaker: The Outstanding Problems of Relativity.—C (Geology).—Dr. H. H. Thomas: Centres of Tertiary Volcanic Activity in Britain.—J (Psychology).—Dr. W. Brown: Mental Unity and Mental Dissociation.—Discussion (Section B): The Chemistry of Hormones.—Discussion (Section K): The Carpel.—Discussion (Section L): Education and Industry.—Discussion (Section M): The Production and Distribution of Milk.

At 8.30 P.M.—Evening Discourse by Dr. F. A. E. Crew: The Germplasm and its Architecture.

Tuesday, September 6, at 10 A.M.—Discussion (Sections C, K, and Cosmical Physics Department of Section A): Climates of the Past.—Discussion (Sections F, J): Innate Differences and Social Status.—Discussion (Section L): School Examinations.—Discussion (Section M): Soil Surveys.

At 2 P.M.—Conference of Delegates of Corresponding Societies.

Wednesday, September 7, at 12 NOON.—Concluding General Meeting.

SEPTEMBER 1–4.

SCHWEIZERISCHE NATURFORSCHENDE GESELLSCHAFT (at Basel) (in 14 Sections), as follow:—Medical Biology (Prof. R. Stachelin, President); Chemistry (Prof. H. Rivier, President); Physics (Prof. P. Debye, President); Geophysics, Meteorology, and Astronomy (Prof. S. Mauderli, President); Mathematics (Prof. F. Gonseth, President); Pharmacy (J. Lang, President); Geology (Prof. A. Jeannet, President); Mineralogy and Petrography (Prof. M. Rheinhard, President); Palæontology (Dr. A. Tobler, President); Zoology and Entomology (Prof. A. Reichensperger, President); General Botany (Prof. E. Wilczek, President); Systematic Botany and Plant Geography; Anthropology and Ethnology (Prof. R. Zeller, President); History of Science and Medicine (Prof. G. Senn, President).—Presidential Address by Dr. F. Sarasin.—Lectures on, respectively, The Causes and Factors of Morphogenesis, by Prof. A. Brachet; Recent Work and Views in Astronomy, by Prof. L. Courvoisier; The Urals from the Point of View of Geophysics, Geology, and Mining, by Prof. L. Duparc; Paracelsus in Relation to Modern Thought, by Prof. H. E. Sigerist.

SEPTEMBER 3–10.

INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS (at Prague).

EMPIRE MINING AND METALLURGICAL CONGRESS.

Winnipeg Meeting, September 3.—G. E. Cole: The Development of Gold Mining in Canada.—W. A. Quince: Methods of Eliminating Barren Rock from Ore at the Sub-Nigel Mine.—C. R. Davis, J. L. Willey, and S. E. T. Ewing: Notes on the Operation of the Reduction Plant at West Springs, Ltd.—E. J. Laschinger: A New Form of Air Meter and the Measurement of Compressed Air.

Vancouver Meeting, September 14.—C. P. Browning: Canadian Copper and its Production.—F. J. Alcock and T. W. Bingay: Lead and Zinc in Canada.—C. J. N. Jourdan: A Brief Review of the Principal Base Metal and Base Mineral Resources of the Union of South Africa.—R. Craib: Dewatering the Lower Levels of the Simmer and Jack Mines, Ltd.—W. S. Robinson: Manufacture of Sulphuric Acid by the Contact Process. From Zinc Blende Roaster Gases.

Edmonton Meeting, September 20.—R. Strachan, W. J. Dick, and R. J. Lee: The Coal Industry in Western Canada.—J. Ness: Petroleum in Canada.—A. Docquier, L. Bataille, and R. Beetlestone: A Combination of the Baum, the Draper, and the Froth Flotation Systems as applied to the Washing of Coal at the Linsi Mine of the Kailan Mining Administration, North China.—A. E. Cameron: Impact Resistance of Steel at Low Temperatures.

Quebec Meetings, September 5 and 26.—J. G. Ross: Asbestos Mining and Milling.—A. W. Nash: Possible Auxiliary Sources of Liquid Fuel.—A. Job: The Sinking and Equipment of the Ventilation Shaft of the Government Gold-Mining Areas.—G. W. Sharp: The Tipping and Guiding of Vertical Skips.—P. M. Newhall and L. Pryce: Improvements in Drilling Efficiency with Jack-Hammers.

Sydney Meetings, September 9 and 10.—F. W. Gray: Mining Coal Under the Sea in Nova Scotia.—Sir Robert Hadfield: The Metal Manganese and its Properties: also, the Production of Ferro-Manganese and its History.—Raw Materials for the Iron and Steel Industry in India.—B. Yaneske: The Manufacture of Steel in India, by the Duplex Process.

SEPTEMBER 4–9.

INTERNATIONAL CONGRESS OF ZOOLOGY (at Budapest).

SEPTEMBER 6–9.

INSTITUTE OF METALS (Autumn Meeting) (at Derby).

Tuesday, September 6, at 8 P.M.—Dr. L. Aitchison: Non-Ferrous Metals in Modern Transport (Lecture).

Wednesday, September 7, at 10 A.M.—Reading of Papers selected from *

Thursday, September 8, at 10 A.M.—Reading of Papers selected from *

Friday, September 9.—All-day Excursion.

* W. T. Cook and W. R. D. Jones: The Copper-Magnesium Alloys. Part II.—W. Hume-Rothery: Researches on Intermetallic Compounds. VI. The Reaction between Solid Magnesium and Liquid Tin.—K. L. Meissner: Age-Hardening Tests with Elektron Alloys.—A. R. Raper: The Equilibrium Diagram of Copper-Tin Alloys containing from 10 to 25 per cent. of Tin.—C. S. Smith: Note on Cathodic Disintegration as a Method of etching Specimens for Metallography.—H. Sutton and A. J. Sidery: The Protection of Aluminium and its Alloys against Corrosion.—H. Sutton and J. W. W. Willstrop: The Nature of the Film produced by Anodic Oxidation of Aluminium.—Dr. C. J. Smithells, W. R. Pitkin, and J. W. Avery: Grain Growth in Compressed Metal Powder.—Marie L. V. Gayler: The Undercooling of Some Aluminium Alloys.—A. G. C. Gwyer and H. W. L. Phillips: The Constitution of Alloys of Aluminium with Silicon and Iron.—F. Hargreaves: Effect of Work and Annealing on the Lead-Tin Eutectic.—W. Hume-Rothery and S. W. Rowell: The System Magnesium-Cadmium.—C. H. M. Jenkins: The Constitution and Physical Properties of Some of the Alloys of Copper, Zinc, and Cadmium.

SEPTEMBER 11–17.

INTERNATIONAL CONGRESS OF PHYSICS IN COMMEMORATION OF THE CENTENARY OF VOLTA (at Como).

SEPTEMBER 11–18.

INTERNATIONAL CONGRESS OF GENETICS (at Berlin). In three sections: General Genetics and Cytology, Heredity in Man and Eugenics, Animal and Plant Breeding.

SEPTEMBER 12–14.

INTERNATIONAL SOCIETY OF LEATHER TRADES' CHEMISTS (Bi-Annual Conference) (at Leathersellers' Hall, St. Helen's Place, E.C.3.

SEPTEMBER 12–17.

BRITISH MYCOLOGICAL SOCIETY (Annual Meeting) (at Aviemore).

Monday, September 12.—Excursion.

At 8.45 P.M.—Council Meeting: Exhibits.

Tuesday, September 13.—Excursion.

At 8.45 P.M.—Dr. E. J. Butler: Presidential Address.

Wednesday, September 14.—Excursion.

At 8.45 P.M.—Annual General Meeting.

Thursday, September 15.—Excursion.

At 8.45 P.M.—Dr. M. Wilson: Life-History of Milesina Kriegeriana and its Occurrence in Britain.—Dr. G. G. Hahn: Species of Phomopsis occurring on Conifers and their Distinction in Culture.

Friday, September 16.—Excursion.

At 8.45 P.M.—Miss M. Wilson: The Dutch Elm Disease.—C. Rea: Remarks on Fungi found during the Foray.

SEPTEMBER 15–17.

ANNUAL CONFERENCE OF WOMEN ENGINEERS (at Shipping, Engineering and Machinery Exhibition).

Thursday, September 15, at 8 P.M.—Presidential Address at Olympia.

Friday, September 16, at 2.45.—Discussion on the Relative Importance of Commercial and Technical Engineering under Present-day Conditions. Commercial Side: Miss E. M. Kennedy; Technical Side: Miss Norah M. Jeans.

Saturday, September 17, at 2.15 (at Crosby Hall).—Miss Iris Cummins: Water Power and the Electrification of the Irish Free State.

SEPTEMBER 18–OCTOBER 3.

INTERNATIONAL CONGRESS OF THEORETICAL AND APPLIED LIMNOLOGY (at Rome). In four sections: Physics and Chemistry, Geology and Hydrography, Biology, and Applied Limnology.

SEPTEMBER 20–22.

IRON AND STEEL INSTITUTE (Autumn Meeting) (at Royal Technical College, Glasgow), at 10 A.M.—*Papers to be submitted:*—D. F. Campbell: High-Frequency Induction Melting.—H. A. Dickie: Magnetic and other Changes concerned in the Temper-Brittleness of Nickel-Chromium Steels.—Prof. C. A. Edwards and K. Kuwada: The Influence of Cold-Rolling and Subsequent Annealing on the Hardness of Mild Steel.—A. B. Everest, T. H. Turner, and D. Hanson: The Influence of Nickel and Silicon on an Iron-Carbon Alloy.—C. S. Gill: The Effect of Varying Ash in the Coke on Blast-Furnace Working.—D. Hanson: The Constitution of Silicon-Carbon-Iron Alloys, and a New Theory of the Cast Irons.—E. G. Herbert: The Work-Hardening of Steel by Abrasion.—K. Honda and K. Takahasi: On the Quantitative Measurement of the Cutting Power of Cutlery.—E. H. Lewis: The Use of Silica Gel as a Medium for Drying Blast.—T. Matsushita and K. Nagasawa: The Mechanism of Tempering of Steels.—T. W. Robinson: The Economic and Social Development of the American Iron and Steel Industry.—Dr. W. Rosenhain and D. Hanson: The Behaviour of Mild Steel under Prolonged Stress at 300° C.—J. H. Smith and F. V. Warnock: A Testing Machine for Repeated Impact, and a Preliminary Investigation on the Effects of Repeated Impact on Lowmoor Iron.—J. H. Whiteley: The Solution of Carbon in α-Iron and its Precipitation.—F. Wüst: A Contribution to the Theory of the Blast-Furnace Process.

SEPTEMBER 23–26.

ASSOCIATION OF SPECIAL LIBRARIES AND INFORMATION BUREAUX (at Trinity College, Cambridge).—Subjects for discussion: Report of the Public Libraries Committee of the Board of Education (A. E. Twentyman and Lieut.-Col. L. Newcombe); Recent Developments in connexion with the Science Library, South Kensington (Sir Henry Lyons); Information, Organisation, and Statistics in Industry (Major L. Urwick, S. J. Nightingale, H. Quigley, W. Wallace, A. E. Overton, F. W. Tattersall); Patent Classification (A. R. Wright, A. Gomme); Problems of the Information Bureau (A. F. Ridley, P. K. Turner, Dr. J. C. Withers); Photographic Reproduction of Printed and MS. Material (N. Parley, Sir William Schooling, R. H. New); Standards of Book Selection in Science and Technology (Sir Richard Gregory).