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Science and Industry.

LEMUEL GULLIVER, referring to the Brobdingnagians, remarked that "the learning of this people is very defective, consisting only in morality, history, poetry, and mathematics, wherein they must be allowed to excel. But the last of these is wholly applied to what may be useful in life, to the improvement of agriculture, and all mechanical arts ; so that among us it would be little esteemed." Hence it is not surprising to learn that the king of that country "gave it for his opinion, that whoever could make two ears of corn, or two blades of grass grow upon a spot of ground where only one grew before, would deserve better of mankind, and do more essential service to his country than the whole race of politicians put together".

The royal opinion was a little hard on the politicians, but it conveys an element of vital truth, for the power of science to exalt or destroy a nation is exceeded only by its power to sustain or wreck a generation. We have ourselves seen man employ it and compel its use in works of destruction, and we are realists enough to admit that only the complete suppression of war can justify neglect of the military potentialities of science. There is, however, now presented to us, and reiterated in convincing terms, an appeal for its more earnest application in the attainment of a greater measure of happiness, health, and wealth, and to that appeal we once again subscribe. The use of science in the service of industry (leading, incidentally, not to the last of these three aims only) and, conversely, the opportunity which industry enjoys of promoting the advance of pure science—an oscillatory motion of ever-increasing amplitude—formed the subject of a series of discussions at meetings of the British Association at Cape Town and Johannesburg, whereby an idea of the advantages already gained by such co-operation could be acquired.

Opening the discussion at Cape Town, Sir Thomas Holland said that science touches on problems of philosophy and often appears to trespass on the province of theology, whilst every branch has some influence on the progress of industry, but he admitted that one of the difficulties which is quickly encountered by those who attempt to present scientific results to the general public, and even to correlate scientific work in different directions, is that arising from rapidly developing specialisation, with its concomitant specialised terminology. Whilst this is perfectly true, we must remember that the difficulties of modern scientific

terminology do not, perhaps, appear so insuperable to the scientific worker as to the layman, for the former takes to a new, although possibly ungainly, word as naturally as a workman to a sharper tool, whilst the latter seldom troubles to understand terms not included in the vocabulary appropriate to his own interests. Once the interest is aroused, the difficulties tend to diminish, and the terminology, of radio communication for example, to become part of the common language. Nevertheless, the tool must not be brandished out of season, even though the alternative lacks convenience, whilst the layman should remember that the Balnibarbi method of abolishing words by substituting the things themselves merely laid greater physical burdens on the common people.

Sir Daniel Hall's subject, the development of agriculture and the anxiety which it is causing both to farmers and to statesmen, is fundamental in its importance. Food production all over the world is still being carried on by comparatively primitive methods and is mainly in the hands of small producing units, although it has been possible to give effect to some of the progress achieved by science whenever that is utilisable by the individual; the use of new varieties and the application of artificial fertilisers were quoted as examples. At the present day, comparatively little of the naturally rich and easily worked land is still unoccupied and, moreover, the peasant has observed that industry offers a livelihood in return for less continuous toil. Hence Sir Daniel Hall regards as inevitable some approach to the industrialisation of farming, citing as an example of such industrialisation and scientific control the development of sugar cane cultivation in Java, where in fifteen years the yield of sugar per hectare has been increased by one-half. The increased use of artificial nitrogenous fertilisers has had demonstrably favourable results and has demanded correspondingly increased employment of potash and phosphatic fertilisers; for these we must rely on natural deposits, and eventual recourse to means of conservation of these elements is envisaged.

Increased fertility of the soil is not, of course, the whole solution of the problem of feeding many more mouths than formerly. The plant breeder seeks to produce varieties of high utility, suitable for the enriched soil, resistant to disease, and economical of water, whilst the effective use of insecticides and fungicides, the preservation and transport of meat and fruits, and stock-raising offer wide fields for study.

Prof. A. C. Seward, who at Johannesburg illustrated his theme by reference to the Abbé Mendel's experiment in crossing peas, to the results of investigations on the storage of apples, the artificial ripening of oranges, and the refrigeration of meat, emphasised the importance of three factors: the specialist's investigations, the layman's intelligent and sympathetic interest, and the scientific popularisation of science; there is need for a wider recognition on the part of specialists of the importance of taking greater pains to make clear to the non-scientific worker and to the other specialist the nature of their researches. Yet another practical application of scientific study mentioned by Prof. Seward is the value of anthropological researches as a source of inspiration for administrators entrusted with the government and care of uncivilised peoples.

Sir Richard Gregory, speaking at Cape Town, showed in a metaphor which has attracted considerable attention that creative science, purposeful invention, and skilful labour are the three legs of the tripod upon which industrial development rests. There can be no stability unless each foot stands firmly upon the ground of common interest and each bears its share of the structure supported by the combination. Without this triple alliance of the scientific investigator, alert manufacturer, and skilled operative, no nation can expect to be in the van of modern progress. Sir Richard's examples of discoveries which revolutionised whole sections of industry included the foundation of electro-chemical processes by the work of Davy and Faraday at the Royal Institution; the evolution, from Sir Robert Hadfield's researches, of special alloys used in the construction of every motor car, aeroplane, projectile, tramway crossing, machine-tool, or other product of modern engineering; the life-belt which the late Auer von Welsbach threw to the gas industry in the form of his incandescent gas mantle; and, in recent years, the discovery of inert atmospheric gases and their application: argon for the manufacture of gas-filled electric lamps, neon for lamps adapted to the illumination of airways and to advertisement signs, and helium for the inflation of airships. The concluding words of this address will bear quotation and repetition: "The debt of industry and of modern civilisation to science is unmistakable; it can best be paid by creating and fostering facilities for further research, and from the argosies which will then in due course come into port, the human race may confidently expect to be provided with principles and powers even more potent for industry and social service than anything the world has yet seen."

The Hon. Henry Mond, after describing to a Johannesburg audience the origin of the Mond nickel carbonyl process, declared that patient research in those branches of science which are likely to be of assistance to industry will nearly always produce something. Yet although the general attitude of modern industry towards research is unexceptionable, industrial research is exposed to big dangers. There is a tremendous drift towards administration, which is always accentuated during a period in which an industry is expanding. The driving force behind any research department should be scientific enthusiasm, for it is only by enthusiastic, alert research workers that discoveries will be made. Again, success is often dependent on the development of a suitable technique, such, for example, as that which has been responsible for the growth of the great high-pressure industry of the manufacture of fertilisers by Imperial Chemical Industries, Ltd., at Billingham.

Dr. F. E. Smith devoted his address at Cape Town to one of the earliest industries in the world —the mercantile marine. Modern standards of safety and comfort have resulted from the labours of scientific men. Astronomers—Copernicus, Kepler, and Tycho Brahe—first taught the navigator to regard the starry universe as a great clock-dial, with the moon and planets as mighty hands moving through the heavens. The modern compass was developed by Lord Kelvin, who, in association with Sir George Airy, an astronomer, and Captain Flinders, a navigator, applied corrections for its use in iron ships, whilst the scientific work of Foucault led to the invention of the gyro-compass. Dr. Smith referred to the scientific worker's contributions in the form of echo-sounding, radio communication, the chronometer, and the sextant; he indicated advances in the science of ship construction, and the great progress that has been made in the use of motive power, mentioning, among others, the names Black, Carnot, Joule, Mayer, Regnault, James Watt, and Sir Charles Parsons. The day will come, he said, when the scientific worker has at his command excessively short wireless waves which can be transmitted from a ship and reflected from an iceberg, reception of the reflected waves rendering detection of the iceberg a certainty.

Prof. G. W. O. Howe told a Johannesburg audience that electrical engineering could be said just to have celebrated its golden jubilee, for although the science rests on Faraday's discoveries, in 1821 and 1831, respectively, that a wire carrying a current experiences a force tending to move it if it is situated in a magnetic field, and that an electric current is set up in a wire if it is moved in a magnetic field, it was in 1878 that Swan developed the first commercial incandescent lamp, and in 1879 that the electric locomotive was first demonstrated at an exhibition in Berlin. Now the electrical industry, a relatively new industry, born of scientific discovery and developed by patient scientific research in physical, chemical, metallurgical, and engineering laboratories, is an extremely large employer of labour.

Engineering science, said Prof. Howe, has contributed largely to the very rapid advance in the improvement of living conditions in the civilised world; it has even negatived Nature's ordination that man's movements should be limited to the surface of the earth. In no branch of human activity has scientific research worked greater wonders than in the transmission of intelligence; even the immense advances which have been achieved since about a hundred years ago, when messages were slowly transmitted over a few miles of wire, have been eclipsed in the popular imagination by the triumphs of the last few years in radio telegraphy and telephony. When the relation of science to industry is expressed as the relation of an ordered knowledge of the properties of the materials and processes employed in any manufacture to the successful and economic carrying out of the manufacture, little room is left either for doubt or discussion. The science pertaining to any industry is the very life blood of the industry, and every scientific discovery is an added asset to the human race.

It will be observed that the purpose of the discussions was not to reveal new or startling discoveries to a scientific coterie; its aim was to emphasise, and lend authority to, what has been said many times before, in the hope that individual citizens of our Commonwealth will take a serious and energetic view of their individual responsibility. The responsibilities are not merely national, or exclusively material; they do indeed closely concern our prosperity as an agricultural and an industrial Empire, but they also have a very intimate relation to the social conscience. The individual duty is that of contributing in due measure to the formation and expression of public opinion. Whether through the rise of popular government and the ubiquity of the printed and broadcast message, or through national stress and economic adversities, it is unquestionable that to-day well-educated and better-informed peoples have adopted a critical attitude, an attitude of intelligent examination of

the laws and circumstances at the helm of their lives. Their conclusions—public opinion—are not always resilient, not always quite accurate, but are in the main characterised by sound sense and humanity, and count for a great deal in places where they govern. Thus British public opinion to-day abhors drunkenness but preserves liberty, it condemns both sweated labour and selfish ease, it regards religious intolerance as a medieval anachronism ; it has so far progressed as generally to approve advance along scientific lines, to offer encouragement to a scientific development of agriculture and industry, and to implement its approval by subsidising such advance and development in certain ways.

What is now much to be desired is a public which will plainly show itself to be as intolerant of inefficiency in method as it is of inefficiency in effort ; which insists that its enterprises shall be conducted not only with faith and with courage, but also with open eyes, that its resources shall be conserved by the best methods known, and utilised to the best advantage attainable, that its man-power shall be employed as brain-power in preference to horse-power, and that ailments of the body politic shall be diagnosed and treated by specialists.

That the plea was made at Cape Town and Johannesburg by men of science themselves is significant, but in a sense fortuitous. They used no arguments, no illustrations, that have not been or could not be employed by captains of the ship of industry or of the ship of State, who have from time to time lent the weight of their experience and their authority to the same appeal, adding to it other and convincing examples of their profitable application of scientific work. Indeed science, like honesty, is indubitably the best policy.

The Bio-Psychology of the Cat.

The Modern Cat, her Mind and Manners : an Introduction to Comparative Psychology. By Prof. Georgina Stickland Gates. Pp. xii + 196 + 4 plates. (New York : The Macmillan Co., 1928.) 8*s*. 6*d*. net.

MANY books have been written about cats ; but this is the first to approach doing justice to the subject, for it tries to tell the truth about cats, so far as the truth is known at present. It is not fanciful or romantic ; it is a serious contribution to the bio-psychology of the domestic cat, and it is written critically and with humour. Yet Dr. Gates is far from being one of those philofelines who provoked Andrew Lang's wrath—" authors who speak concerning cats with a familiarity and a levity most distasteful ".

In a scientific appreciation of an animal's ways, it is useful to begin with the senses ; and in some respects the cat is well-endowed. Gautier tells a delightful story of Madame Théophile's encounter with a green parrot. " The cat, after spending some moments in silent contemplation of the bird, decided that what she saw was a green chicken, and reasoned further that even if green, the chicken should be good to eat. As she sprang at him, the parrot cried out suddenly, ' Have you had your breakfast ? ' The cat fell back ; her thoughts were apparent : This is not a bird ; it speaks ; it is a gentleman." Miss Gates appreciates Gautier's story, but scientifically she is bound to puncture it, since all the experimental evidence points to the conclusion that the cat is colour-blind. It can distinguish different degrees of brightness, but it lives in a grey world. Its very marked power of expanding and contracting the pupil may be correlated with the nocturnal hunting, when it is important to make the most of the scanty rays. The tactility of the vibrissæ is also an aid to walking effectively in darkness. Not much has been proved in regard to the cat's sense of smell, but it is probably acute. As to hearing, cats are able to discriminate between differences in sound, and can learn in forty-five or fifty lessons to associate a particular vocal signal with a particular reaction. Yet there is no convincing evidence that they can distinguish differences in pitch. Their auditory world is like that of a tone-deaf individual.

Awaiting further investigation is the ' homing ' exhibited by some cats, for experiments show that they can return from a place three miles off or so, to which they were carried under conditions excluding intimations from sight, hearing, and smell. They seem usually to take many hours to return, and this suggests that they have to make many tentatives. This probably holds for returns from long distances, for example, from Ayrshire to Fife, but no adequate experiments have been made with these ' orientations from a distance ', if such they are.

Another well-known capacity, that of falling on their feet, has been more adequately studied. For it is known that a cat dropped from a height on a soft bed, goes through a series of righting reflex-movements, activated partly from the eyes, but essentially from the semicircular canals of the ears.

There is a luminous chapter on the cat's instinctive behaviour, though more might have been made of the difference between a simple inborn

activity like purring and a concatenation like maternal routine. A good instance of instinctive behaviour is seen when the kitten chases a small moving object, and this is normally the prelude to the specialised mouse-killing instinct. In regard to the latter, it seems certain that it is likely to remain in abeyance if it is not activated before the third month. The trigger-pulling normally occurs when the kitten is about two months old, and it is a remarkable awakening. All of a sudden the playful and irresponsible kitten becomes transformed into a beast of prey very much in earnest. "The hair bristles, the tail is erected or switched, there occurs hissing, sometimes spitting, growling, unsheathing and sheathing of the claws. Even in the first kill the kitten seizes the mouse by the head, neck, or back, in such a way that it cannot bite." If the liberating stimulus is too long deferred, the relatively mis-educated kitten may grow up more or less indifferent to mice. Cat and mouse friendships have often been recorded, in newspapers at least.

Generous philofelines mix up sensory acuteness, inborn reflexes, and instinctive endowments with genuine intelligence; and the result is a very wonderful and equally unreal cat. Similarly, they put the results of training down to the credit of cleverness. When Stables held his cat opposite a big map of London with the chief buildings marked by dark splashes, it used to put its paw on the British Museum or the like when the name of the sight was shouted out. This was very disconcerting to the onlooker, but it turned out that the cat was accustomed to catch flies on the wall, and mistook the dark splashes on the map for its accustomed booty!

Cats can be trained to open boxes, to escape from latched cages, to use their paw in getting cream out of a narrow-necked jug, to press a button, to pull a loop, to ring a bell, and so on; and the usual method is to go through the process patiently and repeatedly, and to reward success generously. In other cases, the conditioned reflex method is used: a real stimulus induces a natural response, but along with the real stimulus there is simultaneously associated an arbitrary signal, such as a command; by and by the secondary stimulus works without the first. Thus the cat 'begs' when you tell it, and food may be dispensed with.

Having skilfully disposed of the non-intelligent modes of feline behaviour, Dr. Gates is able with a clear intellectual conscience to discuss the higher levels of the cat's mind. From the experimental data adduced "it seems extremely probable that the cat experiences the general bodily states of pleasure and pain, and those major emotions of fear, anger, general excitement, in a manner comparable though not identical with ours". On the ideational side, the cat does not seem to be highly evolved, for although it may sometimes show an intelligent appreciation of a critical situation, and put two and two together, controlling new action in the light of previous experience, it has probably a very poor repertory of ideas, very little memory, and still less anticipation. We should be inclined to be rather more generous than the author, but her critical parsimoniousness is most refreshing. We recommend the book with enthusiasm; it is a masterpiece of its kind and very good reading. It will in the end delight even those who are sure that their beloved puss "understands every word they say".

Sound, Speech, and Hearing.

(1) *Handbuch der Physik.* Herausgegeben von H. Geiger und Karl Scheel. Band 8: *Akustik.* Redigiert von F. Trendelenburg. Pp. x+712. (Berlin: Julius Springer, 1927.) 58·50 gold marks.

(2) *Speech and Hearing.* By Dr. Harvey Fletcher. Pp. xv+331. (New York: D. Van Nostrand Co., Inc.; London: Macmillan and Co., Ltd., 1929.) 21*s.* net.

WITHIN the last two or three years the whole of acoustics has been surveyed in several important books. Richardson's "Sound" has covered the experimental field, Crandall's "Vibrating Systems and Sound" may well be regarded as a third volume of Rayleigh's classical work, whilst the more specialised volume, Davis and Kaye's "Acoustics of Buildings", deals with a subject of great practical importance which has been neglected even in its applications to the lecture theatres of the physical departments of some of our universities.

(1) The first of the present two volumes, a collective work of 700 pages by eleven authors, is naturally very comprehensive and is, like the Auerbach volume in Winkelmann's "Handbuch der Physik", an indispensable work of reference. For this reason, at the outset, protest must be made against its publication without an author index. Whilst each of the sixteen sections is admirable in itself, there appears to have been little attempt at co-operation between the authors. The result is a good deal of needless repetition. In those subjects of which the reviewer has research knowledge the treatment is very complete but is

quite uncritical, references being given to work which other researches mentioned show to be unsound. The volume does not, therefore, itself always give directly the present state of knowledge in any particular subject. Such a critical treatment could easily be obtained by very considerably increasing the number of co-operating authors if some means of overcoming the difficulties involved in wide co-operation could be found. Then, through the medium of a 'Handbuch', a research worker could readily get the actual state of knowledge in any subject.

It is surely a mistake to have a separate section on the acoustics of musical instruments. The mechanism of these is too complex to be treated analytically, and to study their complex sounds experimentally by getting reliable records is a task of extraordinary difficulty. With the possible exception of the elaborate electrical outfit of the type used in the Bell Telephone Laboratories, New York, there is no sound-recording apparatus capable of giving quantitative data, and, moreover, there is no standard source of sound by which distorting sound-recorders can be calibrated. For these reasons little is known of the acoustics of actual musical instruments, and it is almost unavoidable that the 70-page section dealing with the subject considerably overlaps Prof. Kalähne's admirable section on mechanical sound generators.

The space saved by avoiding repetition could be well occupied by a comprehensive bibliography of books on acoustics to replace the meagre list (p. 4) of eight classical works.

(2) The telephone 'wrong number' problem is ever with us, either in reality or through the pen of the humorist. Dr. Fletcher's fascinating volume originated in researches upon the fundamental problems arising out of it. Fifteen years ago the Bell Telephone Laboratories of New York set out upon a systematic investigation of the whole telephone system, including both speaker and hearer. They wisely took advantage of the immense resources at their disposal and planned a research so comprehensive that it is still in progress, parts of it being little more than started. The aim was "to get an accurate physical description and a measure of the mechanical operation of human ears in such terms that we may relate them directly to our electrical and acoustical instruments; to test the keenness of the sound-discriminating sense and find what is the smallest distortion which the mind can perceive and how it reacts to somewhat larger distortions".

The solution here given of the extremely difficult problem of obtaining a reliable record of a complex sound, is by the use of an electrical apparatus (*Bell System Tech. Jour.*, **4**, pp. 586-626; 1925) consisting of condenser microphone, amplifier, and a special oscillograph, all of which have been carefully standardised and calibrated. The record obtained is a photographic oscillogram, and many examples are reproduced and discussed in the book.

The three main sections are devoted respectively to speech, to hearing, and to the perception of speech and music. Numerous interesting results, most of which have been obtained in the Bell Telephone Laboratories, are presented very attractively with ample illustration and quantitative data in the form of graphs. The text is almost free from mathematical argument, so that it can readily be followed by the general reader. This is important on account of the wide appeal of a subject which is fundamentally that of the most rapid means of communication of thought between human beings. The danger of placing too much reliance upon the evidence of our ears is clear from such results as are described in the chapters on minimum perceptible differences in sound and on the masking of one tone on another. There is a good deal of information on 'noise' in general. One curious result is that apparently the interference to a person carrying on a telephone conversation in a noisy room is due mainly to the room sounds getting into that ear which is pressed on to the receiver. The index is not quite so good as it might be, for data given in the chapter on physical properties of musical sounds, and not published elsewhere, are not to be found from the index under the names of the various musical instruments.

Throughout the volume there is abundant evidence of the immense importance in modern acoustics of the thermionic valve and electrical apparatus generally. The research worker will be delighted to note as he reads the many examples of elegant research technique, including the skilful use of physiological and psychological evidence when a purely physical treatment of a problem failed. It is very pleasant to realise that the actual result of the work of one of the largest industrial research organisations in the world is facilitation of the rapid interchange of thought between human beings no matter how widely they may be separated. This is a subtle and powerful factor in the removal of international misunderstandings. Our thanks are due to the workers of the Bell Telephone Laboratories for adding so much to knowledge, and to Dr. Fletcher for giving so excellent an account of the work.

W. H. GEORGE.

Elementary Physical Chemistry.

A Class Book of Physical Chemistry. By Prof. T. Martin Lowry and Dr. Samuel Sugden. Pp. vii + 436. (London: Macmillan and Co., Ltd., 1929.) 6*s.* 6*d.*

THIS book gives a clear and straightforward account of the principal parts of elementary physical chemistry. It contains instructions for carrying out illustrative experiments, and is provided with questions at the ends of the chapters.

In the preface the authors state that, since "the normal scope of an elementary course of physical chemistry is already well defined", they have "in the main been content to keep within it, without trying to exploit unduly the more novel or personal points of view". This is doubtless a prudent attitude, but it naturally limits the interest of the book as a contribution to the solution of that fascinating but difficult problem now confronting all teachers of physical chemistry, namely, how to present to their pupils the results of the last ten years of investigation. Modern work, both theoretical and experimental, has completely changed the aspect of many parts of physical chemistry, co-ordinating much that was fragmentary, and illuminating much that was obscure, but unfortunately a good deal of it is mathematically considerably more complex and difficult than that which it has superseded. An elementary treatise which is wholly modern in outlook will be something of a pioneering work. The nearest approach to it which we yet have in English is perhaps H. S. Taylor's shorter book, "Elementary Physical Chemistry".

In relation, however, to its stated object, the book under review is quite a good one. It deals first with the three states of matter and the phenomenon of liquefaction, then discusses in turn the phase rule, osmotic pressure and the determination of molecular weights, and proceeds to thermochemistry, chemical equilibrium, velocity of chemical change, and the mechanism of chemical change. Two chapters on electrochemistry follow, and finally one on colloids and one on adsorption. Thermodynamic proofs are given shortly in connexion with the matters to which they are relevant. One naturally looks for some account of the parachor, and is not disappointed, a few pages being devoted to a brief but clear summary of the principal results.

On p. 306 the dictum that "chemical action is reversed electrolysis" is endorsed, but the reviewer is still unable after reading this particular section of the book to attribute any more meaning than before to this well-known phrase. The statement on the preceding page that "pure water formed from highly purified hydrogen and oxygen will not initiate an explosive combination of these gases", though quoted by nearly all books, is meaningless. If the pure water is formed, the gases have evidently combined, and whether or not the combination is explosive is purely and simply a question of the relative rates of the production of heat and of its removal by conduction.

The proof of Avogadro's law from the kinetic theory, given in Chapter i., is misleading. It is not obvious without elaborate and difficult proof that the average kinetic energy of the individual molecules is the same for each gas: therefore the impression should not be conveyed that it is self-evident. The ordinary elementary discussion involves something very like an argument in a circle.

It must not be supposed that the two points here dealt with are in any way characteristic of the book as a whole. Most of it is clearly and accurately written, and it is likely to be thoroughly useful to certain kinds of student.

Classical Electrodynamic Theory.

Lehrbuch der Elektrodynamik. Von Prof. Dr. J. Frenkel. Band 2: *Makroskopische Elektrodynamik der materiellen Körper.* Pp. xii + 505. (Berlin: Julius Springer, 1928.) 45 gold marks.

THE second volume of Frenkel's "Elektrodynamik" extends the microscopic theory—the individual electron theory—to the form of the theory, obtained by statistical averaging, which is concerned more with the behaviour of matter in bulk, that is, with electromagnetic phenomena as they are presented to our senses. The work is divided into two main sections, the first of which contains a derivation of the form of the equations of the theory applicable to fields containing distributions of matter of various types; here we find a detailed exposition of such subjects as dielectric and magnetic polarisation, of electrical conductivity, and of the energy and mechanical relations of the bodies in the field.

The second section of the work starts with a discussion of the propagation of electromagnetic waves in material media—of both limited and unlimited extent. This is followed by a treatment of the so-called quasi-stationary phenomena, including the usual problems of electromagnetic induction. Finally, there are brief chapters on electrostatics, magnetostatics, and electrokinetics, and an

appendix containing the detailed analysis of many of the formulæ quoted in the general text.

Although the treatment of the subject is essentially mathematical, the actual formal analytical work is not allowed to hide the predominant physical character of the theories discussed. In the later sections, for example, the individual problems are worked out quite generally, but only in sufficient detail to bring out the physical significance of the results derived from them. The result is that the work provides very stimulating reading, whilst in comprehensiveness it would be difficult to improve upon in such a limited number of pages.

To the present reviewer this work is specially interesting, in that it shows a definite break in the continental school of thought from the Helmholtz-Lorentz ideas on this subject, consummated in the various appropriate articles in the "Encyklopädie der mathematischen Wissenschaften" (Bd. 5). Thirty-five years ago Larmor pointed out certain errors and inconsistencies in this form of the theory and drafted the outlines of a modification, but his remarks remained unheeded, and the theory has held almost universal sway. At long last, however, it seems that someone else is realising that the usual conceptions of magnetic force and induction are really in the reverse order to what they ought to be, that the expressions given in all the usual treatises for the stresses in a polarised medium are not those derived in a really consistent theory, and that certain apparent discrepancies of sign which occur in discussions of magnetic energy are not discrepancies at all and do not need explaining away.

Dr. Frenkel's book is not completely satisfactory on these points, but at least it is sufficiently different from the older accounts to make the reader hesitate and wonder why; and if he does, he will have little difficulty in filling in the lacunæ himself. For this and many other reasons the work can be strongly commended to all those who are still interested in classical electrodynamic theory in its modern form. G. H. L.

Our Bookshelf.

Vergleichende Anatomie des Nervensystems der wirbellosen Tiere: unter Berücksichtigung seiner Funktion. Von Dr. Bertil Hanström. Pp. xi + 628. (Berlin: Julius Springer, 1928.) 76 gold marks.

THE introductory general part of the work contains accounts of the phylogeny of the nervous elements, of the inter-relations of the various types of cells—sensory, intermediary or associative, and motor—and of the cytology and histology of the nervous tissues of invertebrates, and a discussion of the neurone theory. The author states that his observations on the eyes and optic ganglia of arthropods afford no evidence of the continuity of neurones. In the special part each phylum is considered in turn, beginning with the Protozoa.

Although the nature of the neuromotor system of ciliates is as yet not definitely determined, the author is inclined to the view that it is a conducting system. Turning to cœlenterates, he gives a careful account of the nervous elements, our knowledge of which is admittedly not satisfactory. The observations of Bozler on the bipolar and multipolar cells of the ectodermal nerve plexus of *Rhizostoma* are cited as clear evidence that—in spite of the frequent reference by many authors to the existence of a nerve net in cœlenterates—the connexion between one neurone and another in this case is not by continuity but by contact (contiguity) of the fine terminal branches. For each of the other groups of invertebrates a summary is given, first of the general anatomy of the nervous system of selected examples, and then of the histology and, so far as it is known, of the topography of the neurones, concluding with a general survey of the structure, and a discussion of the function of the nervous system of the group with adequate references to the more important memoirs. Useful comparisons are made between different types of nervous system, for example, of Turbellaria and Annelida, of Arthropoda and other segmented invertebrates, and of the brain of insects, myriapods and Crustacea. An index of subjects and another of the genera and groups are appended.

The work is excellently produced and the author has spent great pains on the illustrations. Most of these have been carefully selected from published memoirs, but more than a hundred are new—chiefly photomicrographs of the author's preparations. Such a volume could have been written only by one who is familiar with the scattered literature of the subject and brings to its analysis the specialised knowledge of an investigator in the same domain. The author is to be congratulated on his adequate treatment of a difficult subject.

Oddities: a Book of Unexplained Facts. By Lieut.-Comdr. Rupert T. Gould. Pp. 336 + 8 plates. (London: Philip Allan and Co., Ltd., 1928.) 12*s.* 6*d.* net.

THE inexplicable is always fascinating, and here is both a humorous and a serious study of such oddities. The zoologist can speculate as to the 'Devil' who came out of the sea and impressed his 'Hoof-Marks' on the Devon coast. Crosse's Acari, produced by long-continued electrical action, go far beyond the bacteria and slimes produced by professional spontaneous generationists. The demons or ghosts which come from unknown realms to interfere with coffins and their contents, as at Barbados, certainly merit the attention of a 'learned' society and of some 'scientists'. The possibility of the reincarnation of such people as the Berbalangs of the Philippines is believed by all wild peoples. The Wizard of Mauritius of the eighteenth century, who could foretell the arrival

of ships several days beforehand, will be claimed by some ethnologists to have his prototypes in many a savage isle of the Pacific. The search for the Auroras and other lost islands still goes on, and this story of several southern isles is from an expert. All Britain was excited over the fate of Franklin in 1845–46, and were "The ships seen on the Ice" of a great berg near Newfoundland in 1851 the *Erebus* and *Terror* with which they so clearly corresponded? We suppose the astronomers will not allow us the planet Vulcan, but popular writers still regard it as a subject for speculation. Our editor and the president of the Royal Society are the two targets for the fiends of 'perpetual motion', but really it is rather difficult for the layman to understand that the hypothesis of the conservation of energy holds for space as we know it. Orffyreus was mad perchance, but we, like our author, would not accuse him of being a knave. Astrology in the person of Nostradamus comes in too—and we may refer our readers to the professor of this 'science' in Oxford, our sole specialist in this modern age. Buy and read this book; every page interests, and no page bores. J. S. G.

Proceedings of the Seventh International Congress of Photography, London, July 9–14, 1928. Editors: W. Clark, T. Slater Price, and B. V. Storr. Pp. xiii + 571 + 29 plates. (Cambridge: W. Heffer and Sons, Ltd., 1929.) 25*s.* net.

THE report of the proceedings of the Seventh International Congress of Photography, which was held last year, is now ready. It is noteworthy that the whole is in English, although some of the papers and speeches were originally in other languages. It contains an account of the opening and closing meetings, resolutions and recommendations, the introductory lecture by Mr. F. C. Tilney, "On the Relation of Technical Advance to further Artistic Achievement", the papers read at the various sections and the discussions on them, and as appendices, various lists of members, officers, and committees. The sections comprise the theory, practice, and scientific applications of photography, photo-engraving, colour photography, kinematography, bibliography, record photography, etc. It was unanimously agreed that the next Congress shall be held in 1931 in Dresden, an interval of three years instead of seven, which, however, is fully justified by the large number of chemists and physicists who are now at work on the subject. The volume is a very valuable addition to the literature of photography.

Institut International de Physique Solvay. *Électrons et photons: rapports et discussions du cinquième Conseil de Physique tenu à Bruxelles du 24 au 29 octobre 1927 sous les auspices de l'Institut International de Physique Solvay.* Pp. viii + 290. (Paris: Gauthier-Villars et Cie, 1928.) 60 francs.

FOUR of the six articles in this volume are concerned with the new quantum theory, L. de Broglie, M. Born and W. Heisenberg, E. Schrödinger, and N. Bohr contributing accounts of the special points of view with which they have become associated. The remaining papers are upon the intensity of reflection of X-rays (W. L. Bragg) and the discrepancies that exist between the electromagnetic theory of radiation and experiment (A. H. Compton). As in previous reports of the meetings of the Solvay Institute, each article is followed by an account of the ensuing discussion, the concluding one, on the general aspects of the new theories, being particularly interesting.

Lorentz's views on the new mechanics are stated fairly definitely in the last discussion. For him an electron was "un corpuscle qui, à un instant donné, se trouve en un point déterminé de l'espace"; he wished to "décrire tout ce qui se passe dans le monde par des images nettes"; and finally, "Faut-il nécessairement ériger l'indéterminisme en principe?"

This report is a useful record of the state of fundamental physical theory at the time when the conference was held, and as such is likely to become a valuable historical document.

Plant Life and its Romance. By Prof. F. E. Weiss. Pp. viii + 136. (London: Longmans, Green and Co., Ltd., 1928.) 5*s.* net.

IN "Plant Life and its Romance" Prof. Weiss reproduces twelve broadcast talks to school children. Of these, the first eight treat in succession of the various plant groups as presented by the life-histories of typical members. Beginning with *Euglena* and *Chlamydomonas*, the seaweeds, fungi, bacteria, liverworts and mosses, ferns, clubmosses and horse-tails, conifers, and flowering plants are each dealt with in turn. For the general reader the greatest interest will probably be found in the last three chapters, which respectively concern themselves with evolution, with the distribution of plants, and with the history of the British flora. It is interesting to note that in treating of distribution the author clearly favours Wegener's hypothesis, although it is perhaps from the biological point of view that this hypothesis is least acceptable.

The style, as befitted the occasions, is simple, but the author's hope that the reader's appetite may be whetted for further study would be more likely of fulfilment had a less academic point of view been adopted in the earlier chapters.

Alfalfa. By J. F. Cox and C. R. Magee. (Wiley Farm Series.) Pp. xi + 101. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1928.) 7*s.* 6*d.* net.

THIS handbook on the growing of lucerne in the United States of America is intended for the practical farmer. The authors discuss the merits of different varieties and strains and the need that exists for securing the right strain of seed to suit local climatic conditions. There follows a description of the methods of growing, harvesting, curing, and utilising the crop and of how to grow lucerne for seed. The place which lucerne takes in the rotation under different methods of farming is also dealt with and there is a short description of the major pests and diseases which affect the crop.

The book is thoroughly practical and is well illustrated.

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.*]

X-Ray Diffraction by Plane Gratings.

RECENTLY Bäcklin (*Inaug-Diss. Uppsala Universitets Årsskrift*, 1928) and Bearden (*Proc. U.S. Nat. Ac. Sci.*, **15**, 528; 1929) have made precision measurements on X-ray diffraction by plane gratings. Both investigators deduce from these experiments values for the wave-length which are slightly higher than those calculated from crystal reflection measurements. As the latter values depend on Avogadro's number, they conclude that the accepted value of this constant is slightly in error. Part of the discrepancy, however, may be due to another cause; Bearden and probably Bäcklin do not seem to have taken account of the fact that the usual diffraction formula needs a correction (Porter, *Phil. Mag.*, **5**, 106; 1928) when applied to X-rays under the usual experimental conditions. In the case of Bearden's results, I find that for the first order spectrum this correction amounts to about half the difference in question. As the exact data of Bäcklin are not now at my disposal, I cannot judge how far the same remark applies to these.

The correction arises from the fact that a *divergent* beam is broadened *asymmetrically* by diffraction at a *plane* grating. Different methods may be suggested to eliminate this effect. Probably the most simple device would be to put the first slit (as well as the plate) at a great distance from the grating. The alternative method of using very narrow slits seems less appropriate, as then the number of diffracting elements becomes too small. A third method, theoretically perhaps the best one, would be to use a cylindrical grating (radius of curvature about 20 m.). I have tried to bend a plane grating to this shape, but have not succeeded in getting a sufficiently regular surface in this manner.

I also wish to comment on the intensity of grating spectra. Recently I have made some experiments on this point, using an X-ray grating spectrograph designed by Prof. Coster and myself. In these experiments an X-ray beam (wave-length 1-40 A.) falls on a plane grating ruled on glass with a grating constant of 20 μ. The glancing angle of incidence is varied; when it is not too small, every spectral line gives rise to some spectra between the zero order and the direct ray ('negative orders') and several spectra at the other side of the zero order ('positive orders'). Now when the glancing angle is increased so as to approach the 'critical angle of total reflection' for a certain spectral line, then the positive orders (in the first place, the higher orders) of this line become very faint, as is to be expected. But at the same time the negative orders remain fairly strong, even when the glancing angle is increased so as to be appreciably greater than the critical angle. They disappear gradually when the angle is still further increased. The same effect is visible in the continuous spectrum.

To explain these facts, we must keep in mind the well-known property that the distribution of intensity over the different orders depends only on the scattering power of one grating element as a function of the scattering angle. Thus the observed facts show that this scattering power is considerable even when the glancing angle of the incident beam is greater than the critical angle, but that in this case the scattered beam is restricted to smaller reflection angles in such a manner that, roughly, the deviation is not greater than twice the critical angle. Evidently this scattering is not adequately described by the term 'total reflection at the surface of the element'. The term 'refraction' would be more appropriate, but, strictly speaking, neither of these terms can be used; the correct treatment would consist in the rigorous solution of the involved boundary problem of wave theory, including the influence of absorption.

It may be mentioned that sometimes the use of the negative spectra is to be preferred to that of the positive spectra, as the dispersion is much higher and even becomes infinite half-way between the zero order and the direct ray.

On the other hand, the fact that the different spectral orders do not disappear simultaneously throws a new light on an investigation of Thibaud (*Compt. rend.*, **187**, 219; 1928), who has tried to determine the critical angle of total reflection for soft X-rays by observing the angle of incidence at which the spectra disappear. He assumes that this 'critical angle of incidence' is the same as the ordinary 'critical angle of total reflection' for the wave-length in question, but finds values which are much smaller than the theoretical ones. Now this is just what we should expect: according to the present theory, the critical angle of total reflection would be nearer to half the angle between the direction of the incident beam and the spectrum that is disappearing.

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Habitats and Feeding Habits of *Ocinebra erinacea*.

IT is well known that the rough-tingle, *Ocinebra erinacea* (= *Murex*), preys on oysters by eating them through a hole bored in the shell, and that it is also found abundantly in localities where oysters do not occur (Jeffreys, "British Conchology", **4**, p. 308). The food of this tingle must therefore vary in different localities. In 1927 I began experiments with the object of finding out whether *Ocinebra*, taken from a locality where oysters do not occur, or occur extremely rarely, for example, the shores of Plymouth Sound, would recognise and eat oysters. In this preliminary experiment I found to my surprise that *Ocinebra* from Plymouth Sound did not eat oysters, but forms which are recognised as the same species from the Fal Estuary (where oysters do occur) ate both West Mersea oysters and Plymouth barnacles readily. In July and October 1928 I began a fresh experiment and added small West Mersea (River Blackwater) oysters to each of the following dishes containing:

A. Plymouth *Ocinebra*, which do not grow to a large size, but the largest obtainable were collected and used, namely, up to, but rarely, 3·6 cm. long.

B. Falmouth *Ocinebra*, which attain a large size, and large ones were used, up to 4·6 cm. long.

C. West Mersea *Ocinebra*, which also attain a large size, 4-4·5 cm. long, but in this dish only small (and young) individuals were used, up to 2·6 cm. long.

During the first few months of the experiment and the ensuing cold winter, the *Ocinebra* were lethargic and ate little, except for the Plymouth stock, which were observed—from the character of the fæces—to be feeding mainly on the debris in the dish. In April and May they became more active, and spawn was laid in all dishes except that occupied

by the small West Mersea stock. Larger individuals of the latter stock, however, spawned in a tank alongside. On July 26, 1929, the dishes were examined with the following result :

Dish.	*Ocinebra*.		Living Oysters.		Dead Oysters.		Total Oysters.	
	Living.	Dead.	Bored.	Not Bored.	Bored.	Not Bored.	Bored.	Not Bored.
Plymouth *A* .	193	71	4	18	6	54	10	72
Falmouth *B* .	57	93	16	39	18	30	34	69
West Mersea *C* .	21	9	1	3	45	10	46	13

The high mortality of non-bored oysters in the Plymouth dish, due no doubt to the deliberate overcrowding with *Ocinebra*, vitiates the experiment somewhat, but the general result is clear. The West Mersea *Ocinebra*, it is seen, fed largely on oysters ; those from the Fal ate some oysters, but appeared also to feed on the tubicolous worms growing on the shells of their fellows, and may also have taken detritus ; while those from Plymouth ate very few oysters, and obtained their food either from detritus or *Spirorbis*, which was growing plentifully on the shells of their neighbours. There were no barnacles in any of the dishes in this experiment. The Plymouth tingle were in better physiological condition than either of the other batches when first placed in the experimental dish, having been transferred in a few hours from the sea. On Jan. 16 three Fal *Ocinebra* were found to have crawled into the Plymouth dish and were removed, but it is unlikely that they had already eaten six oysters.

It is reasonable to infer from the experiment that a small percentage of the Plymouth *Ocinebra* discovered the value of the oysters and learned how to eat them. The fact, however, that 264 Plymouth *Ocinebra* attacked only 10 oysters, while 30 smaller West Mersea individuals actually ate 45 oysters, is a striking illustration of the difference in habit in the different localities, and shows, moreover, that the difference is not—as was first surmised—due to a different mode of feeding in the smaller and younger animals. There can be little doubt that *Ocinebra* from the three localities all belong to the facies generally recognised as the species *erinacea*, and that habit is a product of the habitat in this as in many other species, not excluding man. It is hoped in future to investigate to what extent the Plymouth and other stocks can develop a taste for oysters, and in so doing to acquire information regarding that correlation between physiological and morphological variation within the species which is so much desired.

J. H. ORTON.

Marine Biological Laboratory,
The Hoe, Plymouth,
Aug. 2.

Motion of an Electric Arc in a Magnetic Field under Low Gas Pressure.

IN the *Journal de Physique et le Radium* for April 1928, Prof. N. Minorsky describes observations he has made on the behaviour of a mercury arc in a magnetic field under low gas pressure. Under certain experimental conditions he found that the arc moved in a direction opposite to that which should be expected from the electrodynamical laws governing the movement of a conductor carrying current in a magnetic field, and proposes a space charge theory to explain this phenomenon. His theory is based upon the assumption that by the combined effects of collisions and the magnetic field, the electrons in the arc-stream are made to travel in the electrodynamic sense around the annular space in which his arc is drawn, and will thereby establish a negative space charge on the opposite side of the arc. The action of this space charge on the positive ions of the arc is assumed to cause the arc to move in the direction observed. It will be realised that this theory requires a circular or at least a closed path for the arc to move along.

Prof. Minorsky's article is the only reference to this phenomenon that I have been able to find in the literature. Without any knowledge of Prof. Minorsky's work in this field, I was greatly surprised to find, during some recent experiments with arcs under reduced air pressure, that the direction of travel of the arc was opposite to that which would ordinarily be expected from electrodynamic considerations. In my experiments the arc was drawn between straight metal contacts arranged as ' arcing horns '.

The contacts together with the necessary operating levers, etc., were located inside a glass desiccator, which during the experiments was evacuated to a pressure ranging between 30×10^{-3} mm. and 40×10^{-3} mm. of mercury. The arm supporting the movable contact was carried through the desiccator wall in a flexible bellows which permitted the separation of the contracts without interfering with the vacuum. The arc was formed by moving the contacts together, so that metallic contact was obtained, and then separating the contacts, drawing an arc between them. The arc was supplied with current from a 110 volt direct current source, the current being limited to about 10 amp. by an adjustable resistance. The only magnetic field present was that set up by the arc current itself when flowing through the contacts.

Under atmospheric pressure, it is well established that such a magnetic field would move the arc in a direction away from the points where the current is fed into the contacts. Under the pressures used during my experiments, the arc was found to move, however, in the opposite direction with velocities of several hundred centimetres per second. If electrodes of different metals were used, the anode was always found to be covered by a layer of the cathode metal, evidently transferred during the arcing. This was found to be the case even when the anode was made of a metal of much lower melting point than the cathode (for example, copper anode and tungsten cathode). After such experiments the cathode was evenly pitted to an extent easily noticeable with the naked eye, while the anode showed only faint traces of the arc even under a microscope, and then only when it had been carefully polished previously to the arcing.

The theory proposed by Prof. Minorsky is not able to explain the reversed direction of travel of an arc under the experimental conditions just described (where the arc does not move in a recurrent path). The experiments outlined above, the complete account of which will be published later, indicate that there is a considerable emission of metal vapour from the cathode. If this vapour is highly ionised, the positive ions moving with the vapour away from the cathode constitute a component of current opposite in direction to that of the resultant or total current in the arc. These positive ions moving with the vapour stream are thus deflected by the magnetic field in the opposite direction to that in which positive ions moving normally towards the cathode would be deflected.

After having travelled a short way from the cathode in the vapour jet, the positive ions are stopped and pulled back to the cathode by the impressed electric field. Although most of these positive ions probably disappear by recombinations, many of them will strike the cathode at a point shifted from the cathode spot from which they issued. The impingement on or at least the close approach of large numbers of positive ions to the cathode surface is very probably a necessary and sufficient condition for the formation of a cathode spot. We may therefore expect that these positive ions in the emitted vapour shifted in the magnetic field will cause a new cathode spot to develop, which ultimately will take over all the current from the previous cathode spot, causing the arc to move in a more or less discontinuous way in the direction opposite to that which would be expected from elementary electrodynamic considerations.

R. TANBERG.
Research Laboratory,
Westinghouse Elec. & Mfg. Co.,
East Pittsburgh, Pa., Aug. 1.

Appearance of Noble Gases in Vacuum Tube Discharges.

THE views expressed in the article by A. C. E. in NATURE of June 8, p. 879, on the appearance of helium in apparatus employed in attempts at atomic synthesis and disintegration are in good accord with results obtained at the Physical Laboratories of the University of Chicago and of Hiram College. A repetition of the work of R. W. Riding and E. C. C. Baly, reported in *Proc. Roy. Soc.*, Series A, vol. 109, No. A 749, p. 186, has been undertaken by me under the direction of Prof. H. B. Lemon of the University of Chicago. The results have been inconclusive on the whole, but in all cases except one, helium has appeared in the observation tubes. The one exception occurred at the end of a very brief run in which insufficient time may have elapsed for diffusion to have provided enough helium to observe.

Our interest was aroused and has since been maintained, in spite of the appearance of much more complete tables of packing effects by Aston showing the unlikelihood of such results from energy considerations, by the statement of Riding and Baly to the effect that in the presence of a magnesium nitride film on their electrodes, helium was always obtained and neon generally, whereas these gases were never observed under conditions identical except for the absence of the film of nitride. No explanation of this particular phenomenon has been presented in the numerous criticisms which have appeared to date.

It seemed important, therefore, to attempt a repetition of the experiment. The procedure of Riding and Baly has been followed, introducing such alterations in the design of the apparatus as to make two identical bombarding and observation chambers differing only in the presence of a nitride film on the electrodes of one. Pyrex glass was used throughout, thus permitting a temperature of 450° C. during the out-gassing process. Mercury diffusion pumps were employed to evacuate the apparatus, and diffusion pumps were substituted for the Sprengel pump used by Riding and Baly to transfer the supposed products of disintegration from one point to another. A high-frequency electrodeless discharge was used to excite the residual gases in the observation tubes instead of the discharge between electrodes as was the case in the earlier experiments.

Each experiment was preceded by a thorough evacuation and simultaneous out-gassing at 450° C. extending from 24 to 48 hours, but the system was not washed out with hydrogen—which Paneth has found to be so essential. The apparatus was then allowed to stand for several days for minute leaks to be made evident. When no helium was found at the expiration of this period, the discharge was begun and continued for upwards of 100 hours at intermittent intervals. This part of the experiment extended usually for two weeks. In no case was any evidence found for the production of the noble gases from the nitride film, and it is our conviction that, as Paneth and others maintain, the appearance of such gases, helium particularly, is due to their diffusion in minute quantities from the atmosphere.

DONALD DOOLEY.
Colton Laboratory,
Hiram College, Ohio, July 15.

Raman Spectrum and Fluorescence of Benzol.

RECENT work on the Raman effect has indicated that the frequencies so determined may be attributed to vibrational frequencies, or combinations of such frequencies, of the normal electronic state of the molecule. It is therefore to be expected that these levels will appear as end states in the process of emission or fluorescence. This is neatly confirmed in the case of benzol.

Data on the fluorescence of benzol vapour is available from the work of Reimann (*Ann. d. Phys.*, **80**, 43; 1926) and Marsh (*J. Chem. Soc.*, **123**, 3319; 1923); although neither set of data can claim a high degree of accuracy, there is a satisfactory agreement between the two. It has now been found that all of the 51 bands given by Reimann can be arranged in series according to the general equation:

$$\nu = \nu_0 + n'a - n''_1 b_1 - n''_2 b_2 - n''_3 b_3 - n''_4 b_4,$$

where n' and the n'''s are the vibrational quantum numbers of the excited and normal states respectively, and a, b_1, b_2, b_3, and b_4 are the corresponding frequencies. The value of a is taken from the work of Henri on the absorption spectrum of benzol (see his "Structure des Molecules" (1925), p. 110) and is equal to 921 cm.$^{-1}$. The b levels, together with the corresponding Raman values in parentheses as averaged from recent literature, are:

$$b_1 = 998(991), \quad b_2 = 600(605), \quad b_3 = 855(853), \quad b_4 = 1180(1176).$$

Finally, $\nu_0 = 37494$ is given by Henri as the first member of an n' progression in absorption.

The following equations represent all of Reimann's data:

(1) $\nu = 37494 + n'(921) - n''_1(998)$
$n' = 0, 1, 2, 3$; $n''_1 = 0, 1, 2, 3, 4, 5, 6, 7.$

(2) $\nu = 37494 + n'(921) - n''_1(998) - n''_2(600)$
$n' = 0, 1, 2$; $n''_1 = 0, 1, 2, 3, 4$; $n''_2 = 1.$

(3) $\nu = 37494 + n'(921) - n''_1(998) - n''_3(855)$
$n' = 2$; $n''_1 = 0, 1, 2, 3$; $n''_3 = 1, 2.$

(4) $\nu = 37494 + n'(921) - n''_1(998) - n''_4(1180)$
$n' = 2, 3$; $n''_1 = 0, 1, 2, 3, 4, 5, 6$; $n''_4 = 1, 2.$

A fact which strongly corroborates the above arrangement is that more than half of the fluorescence bands originate on the $n' = 2$ level, the wave-length of which in absorption, 2540 A., is very close to the intense line at 2537 A. in the mercury arc, the source of illumination in the fluorescence experiments.

In view of the relatively low accuracy of the above data, it is not possible to calculate the quadratic terms which are to be expected for a non-harmonic vibrator, although experience indicates that this factor is relatively small for organic molecules. As it is, the agreement between observed and calculated values is quite satisfactory.

C. V. SHAPIRO
(National Research Fellow).
Physikalisch-Chemisches
Institut der Universität, Zürich, July 29.

Optical Investigations of the Passivity of Metals.

THERE have been published in NATURE communications by Evans (**118**, 51; 1926: **121**, 351; 1928) and Constable (**120**, 769; 1927: **123**, 569; 1929) showing that the passivity of metals is due to a film of oxide. It may therefore be of interest to record that I have been doing experiments similar to those of Freundlich, Patscheke, and Zocher (*Zeitschr. f. phys. Chem.*, **128**, 321; 1927: **130**, 289; 1927), investigating the state of polarisation of light reflected by mirrors of iron or nickel, which were made passive or activated by an electric current in aqueous solutions.

On passivation, the polarisation of the light changed in the same sense as in the experiments of Freundlich, Patscheke, and Zocher, when they brought an iron mirror out of a vacuum into air. If I made the metal passive and active alternately, the optical constants did not return to the same state as before passivation; there was always a small increase in the thickness of the oxide film itself. This cannot be explained on the assumption that passivation is only a change in the state of the metal or caused by an oxygen film on the surface, for in that event activation would simply be the reverse of passivation. These experiments show that the oxide film is not totally destroyed on activation; it only seems to get porous and spongy, whereas on passivation the holes in the film are refilled with oxide, the film itself growing thicker.

These experiments were performed in the Kaiser Wilhelm-Institut für physikalische Chemie und Elektrochemie, Berlin-Dahlem. The complete results are to be published in the *Zeitschrift für physikalische Chemie*.

L. TRONSTAD.

Royal Technical Institute of Norway,
Trondhjem, July 5.

The Number of Excited Atoms and the Absorption Spectrum of Nickel Vapour.

THE equation $N^1/N = e^{-E/RT}$, where N^1 is the number of excited atoms, N the total number of atoms, E the energy, R the gas constant, and T the absolute temperature, was applied by Dr. Loyarte and myself in the case of the absorption spectrum of tin vapour, with good agreement with experimental results (*Phys. Zeit.*, **30**, 68; 1929). In this case it is only necessary to consider the numerical values of spectral terms, because these are originated by the same electronic configuration.

In the arc spectrum of nickel the lowest terms are originated by two electronic configurations. The normal atom gives $^3F_{432}$ and the other lowest terms, $^3D_{321}$ and $^1D_2$, are originated by $(3d)^9\ (4s)$, but the levels $^3\overline{D}$ are entirely encompassed by those of ^3F. The absorption spectrum of nickel vapour at 2500° absolute shows as strong absorption lines only those originated in ^3F levels, with preference for the fundamental term $^3F_4$; the lines of $^3\overline{D}$ and $^1\overline{D}$ levels are of medium or faint intensities. The explanation of this fact is the following. The values of N^1/N calculated considering only the numerical values of terms are not true, because it is necessary to calculate also the energy consumed in passing from one normal configuration to the other: $(3d)^8(4s)^2 \longrightarrow (3d)^9(4s) = \Delta E$, and the corrected equation is therefore:

$$N^1/N = e^{-(E+\Delta E)/RT}.$$

ADOLFO T. WILLIAMS.

Instituto de Física, Universidad de La Plata,
R. Argentina, June 27.

Reflection of Polarised Light.

WHILE experimenting with a pair of silvered glasses, as in the Edser and Butler method of calibrating a spectroscope, I found that if the films are rotated about an axis either parallel or perpendicular to the slit of the spectroscope, a second line appears alongside each line seen and gradually moves to a point midway between each as the angle of incidence of the light is increased. The light forming these two lines is found to be polarised perpendicular and parallel respectively to the axis of rotation, and the relative sharpness appears to vary with the condition of the surfaces.

The explanation appears to be that on reflection at the first silver surface the light is resolved into two polarised components, one perpendicular and the other parallel to the plane of incidence. These two

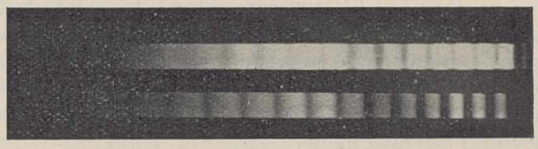

FIG. 1.

components are reflected at each surface with different phase changes and therefore the wave-length at which bright lines appear is different for each component. This effect does not appear to have been noticed before and therefore is undergoing further investigation. The accompanying photographs (Fig. 1) were taken with plane polarised light, in one case perpendicular and in the other parallel to the axis of rotation of the films.

A. CHRISTOPHER G. BEACH.

Chelsea Polytechnic,
London, S.W., July 15.

Geological Age of the Rostro-carinates.

IN reference to my friend Prof. Fairfield Osborn's remark in NATURE (Aug. 31, p. 345), I may say that Sir Ray Lankester's final opinion upon the age of the rostro-carinate flint implements, found beneath the Red Crag, was that they, and the Suffolk Bone Bed from which they were derived, are to be regarded, so far as East Anglia is concerned, as falling within the latest Pliocene, while he looked upon the Crag which surmounts the Bone Bed as being referable to the earliest Pleistocene. This, also, is my opinion.

The descriptive term 'rostro-carinate' was invented by Sir Ray Lankester, and first used by him in *Phil. Trans.*, B, vol. 202, pp. 283-336.

J. REID MOIR.

Occurrence of Sea-urchins on the Foreshore in Britain.

IN July of this year I noticed several specimens of *Echinus esculentus* on the foreshore at Robin Hood's Bay, Yorkshire, well above the low-water level of all tides. In every case they were on flat reefs without any shelter from overhanging ledges. While constantly searching under ledges for other organisms, I never saw an urchin in such a position. Specimens were seen on dark clay shales of the Lower Lias and on the more sandy Middle Lias of Peak Steel.

C. N. BROMEHEAD.

Geological Survey Office,
14A Parliament Street,
York, Aug. 12.

Geological Surveys and Development.[1]

By Sir ALBERT E. KITSON, C.M.G., C.B.E.

THE importance and value of a geological survey to a country has long been recognised by all progressive nations that desire to utilise the mineral resources with which Nature has endowed them. But though such value is fully appreciated and freely acknowledged by all thoughtful, observant people, the nation as a whole has no understanding of it, and no definite views on the matter. The rapid advance of science, and the application of the wonders of science to industry, in practically all divisions of the activities of mankind, are incontrovertible facts, and no nation or community under present-day conditions can afford to neglect to utilise all the assistance that science can give towards increase in production and reduction in cost of the fruits of the industries upon which that nation is mainly or largely dependent for its existence and advancement.

Where the question of cost is not an insuperable barrier to its establishment, a geological survey is formed. As regards our Empire, not only Great Britain, but also the British Dominions—India, Canada, Newfoundland, Australia, New Zealand, and South Africa—long since established such surveys and recognised their value. The Colonies and Protectorates that now have geological surveys in full operation and doing valuable work are Nigeria, the Gold Coast, and Sierra Leone in West Africa; in Central and East Africa—Uganda and Nyasaland, with the Anglo-Egyptian Sudan, and the Mandated Territory of Tanganyika; and the Federated Malay States. Among those which have had surveys for certain periods, but which have been varied, suspended, or concluded, are Jamaica, British Honduras, British Guiana, Gambia, Somaliland, Zanzibar, Ceylon, and the Falkland Islands. Geological advice is being given in Ceylon, Palestine, and Somaliland. In those now without surveys much useful work was done, and the discontinuance of operations was due to various causes.

There is a great deal of misconception regarding the functions of a geological survey, using the term geological in its broadest sense. By many it is thought to deal with the rocks of a country, to describe them, and to show on maps and in reports their divisions, disposition, and distribution; perhaps also to include the economic minerals, such as coal, brown coal, lignite, rock-salt, ores of iron, manganese, copper, nickel, zinc and lead; or valuable gem-stones, such as diamonds, rubies, sapphires, and opals. But there is very little, if any, recognition of the great part that geology plays in a most unobstrusive manner in connexion with mining, agriculture, stock-raising, water supply, forestry, public works, sanitation, geography, and education.

The importance of the remote possessions of a great Empire is dependent upon many factors—such as natural resources and their situation, physical character of the country, lines of communication and transport, nature of climate, soils and water supply, density and distribution of population, character of the peoples, conditions regarding agriculture and pasturage. To develop these fully there should be a government with wide vision and foresight, capable and energetic, with a broad outlook on possibilities of development, and ready to assist financially and sympathetically all proposals that show reasonable prospects of economic success.

The Colonies and Protectorates of the British Empire are almost without exception in the tropics. Many of them are wholly or partly in zones which are blessed with an abundant rainfall, and covered with dense forests or low vegetation. Some comprise areas of low rainfall, and, in consequence, have seasonally arid conditions, and little vegetation. A geological survey of the former is necessarily slow, for the dense vegetation and depth of soil effectually obscure the nature of the underlying rocks and what they contain. In such country much time, labour, and expense are necessary to examine carefully the watercourses, by cutting and clearing lines along them and through the dense bush between them. Nevertheless, it should be remembered that such country may have valuable mineral deposits lying hidden within a few yards of any line of traverse through the forest, and merely awaiting discovery. In areas of low rainfall and scanty vegetation, however, the examination of the country is rendered much easier and can be done much more quickly and thoroughly.

FUNCTIONS OF A SURVEY.

Opinions differ as to how the work is to be commenced. One geologist may consider it advisable to make first a series of rapid reconnaissances through the various districts, along natural boundaries such as the coast-line, large rivers, main paths or roads, railways, if any, or through promising belts of country; then later a series of rapid cross-traverses connecting with the first series, and, later still, numbers of others linking the two series in various directions. This method enables him to get, in the quickest manner, a general knowledge of the geology of the country as a whole. The mapping, in detail, of the geology, in conformance with a mathematical scheme of division of the country, can be done later as opportunity offers. Another geologist may prefer to survey in detail certain areas, such as a known mining field, a belt of country, or the main lines of communication, leaving outlying districts for later work.

Both methods have their advantages and disadvantages, but these cannot be discussed here. The particular features of the country and the wishes of the government will determine the system of work.

[1] From the presidential address, entitled "The Utility of Geological Surveys to Colonies and Protectorates of the British Empire", to Section C (Geology) of the British Association, delivered at Johannesburg on July 30.

The following remarks indicate some of the various activities of a survey of a young colony:

Reconnaissances and rapid surveys through the country, noting specially the physiography, nature of rocks with their structural features (anticlines, synclines, strike, dip, foliation, cleavage, jointing, faults, dykes, and reefs), nature, occurrence and testing of minerals in rocks and gravels of streams by crushing and panning. Kinds of soils, nature and volumes of streams regarding irrigation and water-power, underground water supplies, sites for dams and reservoirs, archæological notes, collection of rocks, minerals and concentrates, with general reports on all, and preliminary special reports on mineral deposits and other interesting features.

Detailed surveys and reports on particular areas, deposits and occurrences, such as mentioned in the preceding paragraph.

Special reports on the country along routes of proposed railways, water-power, sanitation, and other matters.

Assistance and advice to other departments on geological matters.

Surface and underground surveys of mines, with reports, maps, and sections.

Advice to mining companies and prospectors on the examination of their mines, areas, and specimens of rocks and minerals.

Assays, analyses and other determinations of samples of minerals collected by the survey, or received from the public, with reports on them.

Advice to Government regarding operations of prospectors and prevention of fraudulent flotation of companies.

Assistance to educational institutions by information supplied and descriptive museum collections.

Scientific (mainly geological and geographical) reports, with microscopical and chemical descriptions of rocks, maps, and photographs.

Special examination of minerals in concentrates and reports on them.

Publication of reports, maps, sections, assays, analyses, etc.

Formation of a geological museum, mainly of practical geology, with descriptions and uses of the materials therein.

There are numbers of other kinds of geological work that need enlargements of the staffs of the geological surveys before they can be undertaken, such as observations with regard to transport of sediment and chemical character of water in streams; inland denudation, and coastal erosion; underground flow of water through rocks; and decay of rocks under tropical conditions.

It may be advisable to describe very briefly the main features of the method adopted in the Gold Coast in the rapid examination of country possessing no reliable maps.

Traverses are made, by bicycle mainly, with (*a*) the prismatic or pocket compass, for direction; (*b*) cyclometer, or measuring wheel, for distance; (*c*) aneroid barometer, with thermometer attached, for altitude and temperature; and (*d*) watch, for time.

On leaving a camp all four observations are taken, but instead of the traverse being tabulated in columns as usual—which method gives no graphic idea of the orientation of the traverse—the graphic method is used. This shows at once the direction being taken, for the bearing of each line is roughly plotted in the field-book, as to direction and length, and a continuous traverse obtained, in which, in its relative position, each natural feature is placed. The observations embrace features, such as sites of camps, and prominent landmarks, edges of stream flats and banks, water-levels, gullies, tops of rises or ridges or plateaux, edges of plateaux or hills, huts, villages, outcrops of rocks, showing dips, strikes, characters, and any special features. All four observations (*a–d*) are taken at each of such places, except the occasional omission of that for time when stoppages are frequent. But at places where the stoppage is for ten minutes or more, the time observation also is taken on leaving, for the purpose of correction for altitude because of change in air-pressure.

So far as possible, samples of the gravels of all streams, as well as the loam beside outcrops of quartz reefs and dykes, and the material from road-gutters or paths, are panned, and concentrates of heavy minerals obtained. (In certain types of country panning is the most useful aid to prospecting, not only in the discovery of gems and stable metallic minerals, such as native gold, platinoid minerals, oxides of tin, thorium, titanium, iron, chromium, tungsten, and manganese, but also of many rock-forming minerals, which indicate the probable character of the rocks at the spot, or in the basin of the stream tested.) Specimens of rocks and samples of quartz are collected for reference, museum purposes, microscopic examination of thin sections, or testing by assay, analysis, or other methods. Coal, lignite, limestone, and other economic rocks, brick and pottery clays, and pigments are sought; also fossils, which, if found, are used to determine the age of the strata associated with them.

In addition to the general observations indicated, notes are made of the colour, kind, and thickness of soil, the nature of the vegetation, size and kind of stream and gravel, and measurement of volume of water—when there is opportunity, and if of possible economic value, with regard to domestic supplies and possible hydro-electric power and irrigation.

It will thus be seen that the geologist in a new country, by taking the opportunity to make the observations mentioned in the last section, is helping his colleagues in other departments by collecting evidence of probable future value.

It may be specially mentioned here that not only on the economic mineral side of geology is a geological survey of value to a colony. It is also of much assistance to such departments as agriculture, forestry, water supply, and public works, as indicated previously.

Agriculture and Forestry.—The growth of plants, whether grasses, herbs or trees, is dependent on the chemical and physical properties of the soil, on the configuration of the land, and on climatic and other conditions. Since plant foods consist largely of certain rock-forming minerals in a soluble condition, it is necessary to know what is the chemical character of the soil. This can be ascertained by

analyses of samples collected by geologists, for much of the value of the analyses depends upon a careful determination of the types of rock forming the base of the subsoil.

There is, however, another aspect to be considered. Many soils are not sedentary ones—derived directly from the underlying rocks—but are soils of transport. The character of the soil, or even the subsoil, often bears no genetic relation to the underlying rocks, and where such soil is of no great thickness, a geological knowledge of the rocks underlying it is necessary. In connexion with irrigation, the character of the soil of the supply channels needs the attention of the geologist. He should note if there is any crust of minerals on the soil, on the evaporation of water. If so, these minerals should be analysed to see if they are those injurious to plants, when in large proportion, such as certain sodium and magnesium salts. This is important in areas with soil derived directly from rocks of marine origin, particularly young clays, mudstones and sands deposited in brackish lagoons and estuaries. If these minerals be present, he may be able to devise means by which the proportion of these harmful salts when in solution can be steadily reduced by flowing away with the water, and not being alternately and continuously precipitated and dissolved.

Water Supply.—This question of water supply is one that concerns some colonies much more than others, but all are affected to some degree. In cases involving the conservation of the water of annual streams, the problem is dependent largely upon geological considerations. But where underground water is sought, whether of the character of an artesian supply, or due to seasonal rains, the problem is a much wider one, and may be difficult to settle satisfactorily. For artesian water, not only the configuration of the country, but also the disposition and nature of the rocks must be known before any conclusion can be formed as to the chances of success in obtaining such supplies. This is essentially a work for the geologist, and even for him it is quite likely that the evidence available in the district may be insufficient—owing to the absence of natural sections—and that he may be compelled to wait for the result of boring done at spots indicated by him. Therefore, it is advisable that a geological report should precede the efforts to obtain permanent water supplies, and not, as so frequently happens, be asked for after one or more costly attempts have failed.

Public Works.—To this department, perhaps, more so than to any other, the geological survey can be of assistance, specially with regard to—

(1) The discovery of rocks, suitable for constructional purposes (such as for houses, bridges, drains, macadam), and of limestone, for lime, mortar, concrete, cement, and house-washes.

(2) The character of the foundations for bridges, large buildings, dams, and breakwaters.

(3) The nature of the rocks in areas where new roads are to be made. This is mainly for possible variations of route with reduction of expense in construction and maintenance.

Hydro-Electric Power.—This question may be regarded as quite outside the duties of a geologist. A little consideration, however, will show that the geologist has a good deal to do with it, especially where the question of dam-building and reservoir formation is concerned. For the construction of a dam, and the formation of a reservoir for hydro-electric purposes, it is of great importance to know the geology of the area and the nature of the rocks, whether soluble (as limestones) or insoluble; porous and brittle, or impervious and firm, and all the variations between; their normal or faulted condition; their disposition, strike and dip, the latter against or with the direction of the current.

The geologist has to help the engineer not only with regard to the suitability of the rocks at the site of the dam, but also in the whole of the area to be occupied by the proposed reservoir.

Sanitation.—Under the usual conditions for the disposal of nightsoil by burial in depots in the neighbourhood, where there is no proper sewerage or sterilisation system, the geological survey is able to help very considerably in the question of sanitation. The risk being run by using contaminated water is illustrated by a case brought under notice some years ago on the Continent. In this the cause of an outbreak of typhoid fever could not be determined until a geologist said it was probably due to a nightsoil depot on the side of a ridge, several hundred yards distant from a spring on the opposite side of that ridge. He was laughed to scorn. But, by pouring water, stained with a permanent dye, on the depot, he proved that the spring was taking the drainage from it. The geologist showed by scientific observation of the strata that the beds were dipping through the ridge from the depot towards the spring.

Some Practical Results from Survey Discoveries.

In order that a clear impression may be gained of the practical results following the activities of these surveys in Colonies, a few remarks may be made regarding the development of certain mineral deposits discovered solely and directly by the geological and mineral surveys of three colonies.

Nigeria.—The mineral survey of Southern Nigeria discovered the large, black coal field in 1909, surveyed it in detail over the greater portion of a length of some 24 miles and width of 10 miles, and prepared a geological-topographical map of the country, showing altitudes, outcrops of coal, and other information. Further work was done later and the coal-bearing area extended considerably. Mining operations by Government were commenced on the largest seam in 1916, and since then development has continued steadily. The total quantity of coal, in round numbers, produced from 1916 to Mar. 31, 1928, is 2,210,000 tons, valued at the mine at £1,282,000. The total net profit to Government to Mar. 31, 1928, is £452,559. The total cost of the geological survey of Nigeria since its inception in 1919 to Mar. 31, 1928, is approximately £68,700, and of the mineral survey of Southern

Nigeria for the period 1903–1913, about £20,000, or a total of approximately £88,700. Thus the total profit to the Government from this one discovery by a Government geologist is more than five times the total cost of the geological and mineral surveys.

Gold Coast.—The specially important discoveries made by the geological survey of the Gold Coast are huge deposits of manganese ore and bauxite (aluminium ore), and widespread alluvial deposits of diamonds. The manganese deposits were found in 1914 before the War, but not exploited until 1916, when the vital need for high-grade manganese ore caused the development of these deposits. Production of ore commenced in 1916, and the total production to Mar. 31, 1928, is 1,785,643 tons of high-grade ore, valued at £3,350,706, free on board ship at Sekondi.

Diamonds were first discovered in February 1919. These diamonds, though small, are of very good quality, and have a ready sale for industrial purposes and jewellery. Since mining operations were commenced in 1921 there has been a large progressive increase each year until, for the year ended Mar. 31, 1929, the figures are : production, 648,343 carats ; value, £538,860 ; export duty paid, nearly £27,000. The total weight of diamonds produced is 1,824,630 carats, valued at £1,758,348, on which the Government has received roundly £87,900 from the export duty of 5 per cent on the total value.

The Gold Coast has a great potential asset in its huge deposits of high grade bauxite—the total conservatively estimated quantity being upwards of 250 million tons. These deposits are not yet developed, owing mainly to the high cost of transport of bauxite to a port of shipment. Bauxite is an ore of low value and so cannot bear heavy charges for freight, but, with extension of railway communication and reduction of freight charges, the Colony should see a great development of this particular source of wealth, and a further mineral example be added to revenue from Geological Survey discoveries.

Sierra Leone.—The Geological Survey of this Colony is much younger than those of Nigeria and the Gold Coast. The Director has discovered large deposits of iron ore (hæmatite) of good quality, and considerable deposits of alluvial platinum and gold —all now being developed—besides occurrences of chromite, corundum, ilmenite, rutile, manganese, and graphite, all of them also minerals of economic value. If found on further examination to occur in promising quantities, these deposits should prove to be of commercial value.

The West African geological surveys have no offices and laboratories in the Colonies. During the dry and tornado seasons of the year, the geologists are engaged on geological surveys and examinations of various kinds in the Colonies, but during the rainy season field work is suspended and the staffs return to England. In these respects their organisation differs from that of the other Colonies. The specimens of rocks and concentrates collected are then examined and distributed for various modes of treatment, and reports not made or completed on the Coast, as well as microscopic examination of thin sections of rocks, are done in London. The greater portion of the chemical work, such as assays and analyses, devolves upon the Imperial College of Science and Technology and the Imperial Institute under special arrangements.

A country difficult to examine because of its natural features cannot be certainly expected to yield its mineral secrets, or confess its paucity of mineral deposits, in the course of a few months, or even years of effort. Let it be borne steadfastly in mind that spectacular discoveries of valuable mineral deposits are not the only benefits that a geological survey can bestow upon a country, however important they may be, and however valuable may be their contributions to the revenue and prosperity of the country.

In this address an attempt has been made to show the value of geological surveys to young countries, and the application of scientific knowledge and methods, both theoretical and practical, to the discovery of the valuable inorganic and organic resources of Nature, as opposed to the search for them in a more or less haphazard manner. To-day science plays the predominant rôle in these revelations, and is steadily forcing a recognition of this fact upon the peoples of the earth, for their common benefit.

The Public Regulation of Wages in Great Britain.[1]

By Prof. HENRY CLAY.

A GREAT change has taken place during the last twenty years in the methods of negotiating wage-changes. In 1910, when the Labour Department of the Board of Trade published the result of an inquiry into collective agreements, it was estimated that 2,400,000 workpeople worked under conditions specifically regulated by such agreements. It is not possible to compute a figure for a recent year to correspond with the 2,400,000 of 1910, because the status of collective bargaining in certain important industries is obscure ; but if we add together the numbers covered by trade boards, agricultural wages boards, joint industrial councils, and unions in certain industries, which, like coal and cotton, have adopted none of these forms of organisation, we get a total of eight millions out of a wage-earning population, which, excluding domestic service, numbers something less than fourteen millions. When we remember that the influence of an agreement or a determination, reached by a representative body, tends to go beyond the limits of the membership of the organisations, and even trades, directly represented,

[1] From the presidential address to Section F (Economic Science and Statistics) of the British Association, delivered at Johannesburg on Aug. 2.

we may safely conclude that there are few important gaps left in the provision for the settlement of wages by collective bargaining in Great Britain. Before the War, outside the organised industries, the adjustment was made by the individual action of the employers, who first felt the need; to-day the process of general wage-changes has, we may say, been constitutionalised.

It is the system resulting from this change that I refer to as 'the public regulation of wages'. It is only partially due to the direct intervention of the State, although the legalising of trade union activity was essential to the development of effective collective bargaining without the State's direct intervention. Whether, however, wage-changes are negotiated by voluntary industrial councils, spontaneous negotiations between trade unions and employers' associations, or statutory trade boards and agricultural wages boards, the result is the same. A change cannot be effected without public discussion between representatives; when effected, it applies generally to the trades and occupations represented; it is the outcome of an attempt to allow for all the economic factors in the situation, not of an attempt to impose *a priori* principles of social justice upon industry; it is a procedure for adjusting wages by agreement, rather than a policy aimed at overriding the commercial considerations that have determined wages in the past. It is 'public' in the sense that it involves formal discussion by representatives, and results in publicly formulated standards; it is 'regulation' only in the sense that it provides in this way for the formal consideration of the factors affecting wages by the representatives of employers and wage-earners, and the embodiment of the result in a formal agreement.

The extension of public regulation of wages in this sense from a part to the whole of the field of commercial wage-employment could scarcely be without some effects upon the general industrial situation. In their classic study of collective bargaining, Mr. and Mrs. Webb (now Lord and Lady Passfield) laid chief stress upon its influence in increasing the efficiency of industry. They drew a sharp distinction between restricting numbers in a trade and imposing common rules. Their survey showed that the former policy, anti-social and self-defeating, was adopted by a smaller and smaller proportion of trade unions, and was becoming more and more difficult of application; the discarding of any attempt to restrict numbers, and the concentration on the policy of imposing standard or minimum rates and conditions, was growing, and was the chief characteristic of trade unionism in the expanding industries.

This policy increased industrial efficiency in two ways, by its reaction on the workman and by its reaction on the employer. The workman, prevented from securing employment by accepting a lower rate of pay than his competitors, was compelled to improve his efficiency, and was enabled to do so by the increase in income and security that trade unionism usually brought. More important were the reactions on the employer. Stopped from taking the easy but dangerous path to lower costs of cutting wages, he had to find other means of increasing output in relation to wage-payments. Hence trade unionism encouraged an increase in the scale of production, a more extensive use of mechanical equipment, a more eager search for technical improvements, and, generally, the economy of labour. It did not extinguish competition, but diverted it from wages to other factors in costs.

The rapid expansion of the unionised coal, cotton, and engineering industries in the decade following the publication of this analysis seemed to confirm its soundness. The decline and stagnation of the same industries in the last eight years prompts the inquiry whether this influence has exhausted its potentialities.

Whether the influence on efficiency has continued and is general, the abnormal condition of British industry makes it difficult to decide. The large amount of short time, the increase in other costs, and the financial difficulties which prevent large numbers of firms from installing improvements, which they would like to install, all obscure the issue.

Contemporary experience of America shows that collective bargaining is not a necessary condition or the only means of stimulating an increase in efficiency. In so far as the extension of collective bargaining does stimulate or compel economy in labour—and, if it has not done so on any large scale at present, it may do so in the near future—it may maintain wages at the expense of increasing unemployment. In the great export industries of coal and cotton, for example, demand for British production appears to be inelastic, and considerable reductions in cost have not resulted in any substantial increase in employment. Moreover, much of the employment at present given is given at a loss.

A reorganisation that made it possible to maintain present wage-rates without loss would probably, therefore, involve a reduction in the numbers to whom employment could be given. Such an extrusion of unwanted labour, as a result of improvements in the technical processes or organisation of industry, is a normal incident of economic progress; and the hardship it may involve need be only temporary, provided that the expansion of industry as a whole is great enough and rapid enough to absorb the extruded labour. When all the industries of the country adopt collective bargaining, and all begin to adopt the policy of holding up wage-rates, leaving it to the employers to tune up industry to the pitch at which such rates can be paid, the numbers of extruded workers for whom the new and expanding industries have to find employment is likely to be increased, and the rate of expansion of industry as a whole becomes a factor of much wider and more pressing interest in wage-negotiations than before.

It is obvious that an advance in wages secured by any one class of workpeople, if it is not covered by a corresponding increase in the efficiency of the industry in which they are engaged, must be at

the expense of someone else. The increased efficiency may be due to the workpeople or to the employers; but, if neither of them create a fund from which increased wages can be paid, the increase will be paid either by consumers or by the co-operating industries that help them to supply the consumers. If the increase is merely sufficient to keep pace with an advance in the average level of wages, it may represent no more than the industry's proportionate share in the general increase of wealth; if, however, it is greater than the average, or in times of wage-reductions the reduction is less than the average, it must involve the diversion to the favoured industry of a larger share of society's income.

Such a diversion may be effected without overt restriction of numbers. If a union—or a trade board or arbitration authority—fix wage-rates in an industry at a level which makes it impossible for the industry to employ all the workpeople seeking work, and maintains rates at that level, it will immediately restrict employment, and ultimately may so discourage entry to the industry that the number of workpeople dependent on the industry is no greater than can be employed at the rates set. The demand for the products of industry, and therefore for labour, ebbs and flows with general fluctuations in trade; a strong union can maintain rates when demand ebbs and advance them when demand rises, thus preventing both a fall in *rates* proportionate to the general decline in money incomes in the depression, and an expansion in *numbers* proportionate to the general increase in production when trade improves. On the other hand, an unorganised industry may suffer a reduction of rates when trade declines and an expansion of numbers, on the low level of wages so established, when trade improves.

The mere regulation of wage-rates may, therefore, be restrictive in its effects. Such restriction may be legitimate and socially desirable; but it destroys any sharp distinction and opposition between a policy of restriction of numbers and a policy of imposing common rules of payment and conditions. It is not even clear that the reactions upon efficiency of the two policies are necessarily different. If the supply of a certain class of labour is restricted, employers will be stimulated to devise labour-saving appliances to substitute for it, or some reorganisation to dispense with it, just as certainly as if the supply is unrestricted but expensive.

Trade union control of wages, and the analogous control by public wage-fixing authorities, may be most simply regarded as an application of monopoly price policy to labour. The monopoly is seldom, if ever, complete; but what monopoly is? It gives the seller of labour no control over the demand for his services; it merely enables him, so far as it is effective, to select the point on the demand curve at which he will hold the price, until a general rise in demand absorbs at that price all the union members, instead of allowing competition for employment always to force wages down to the point at which the whole supply of labour is absorbed. It is a policy that can be pursued without causing more than temporary unemployment, under two conditions; first, that the wealth of society is steadily growing, so that continually higher wage-rates can be paid without causing unemployment: secondly, that it is practised only by a minority of the trades in the community. The latter condition no longer obtains.

So long as everybody was not organised to attempt it, it was always possible that favoured trades, by means of a monopolistic organisation, might secure for themselves a larger share of the final price received for industry's products. All now are organised, or provided by the Government with equivalent protection; all are able to set and hold rates of wages, as firmly as the minority of well-organised trades were able to hold them before the War.

Partial and sporadic monopolistic organisation has been displaced by universal control. Two consequences follow. First, it is no longer possible for well-organised trades, merely by virtue of their trade union organisation, to secure differential gains at the expense of unorganised or ill-organised groups with whom they co-operate; or, if it is still possible, at any rate it is more difficult. In the second place, influences upon wages that were formerly counteracted by trade union organisation have now free play.

From this point of view the intervention of the State, in establishing trade boards and agricultural wages boards and in other ways, and the contemporary extension of unionism to hitherto unorganised trades, takes on a rather different aspect from that which Mr. and Mrs. Webb put upon it. They represented it rather as an extension to the rest of industry of the principle of trade union control and of the benefits that they had shown to follow from trade union organisation. This, of course, it was; but it was at the same time a necessary corrective of trade union influence. So long as only a part of the field of wage-employment is covered by trade union organisation, the benefits secured by trade unionists may in part be at the expense of the workpeople in the unorganised part of the field; so far as those benefits are not the return of increased efficiency due to union pressure, they will almost certainly be in part at the expense of other wage-earners.

The second consequence of general control is the release of influences upon wages which were formerly prevented from exercising their full potential effect. In this release is, I think, to be found a partial explanation of the changed relations which wages in different industries bear to one another since the War. It might have been expected, for example, that wages would be high in an industry like railway transport, which enjoys a monopoly and has a relatively inelastic demand for labour. In fact, before the War they were low; since then the railwaymen have had the advantage of effective union organisation, and their wages have risen disproportionately to others, in spite of the invasion of the railways' monopoly by road transport and consequent depression of the industry.

Another influence is 'shelter' from foreign competition, possibly only a temporary influence, but one that has operated throughout the post-War depression.

The extension of trade union or Government control over the whole field of commercial wage-employment has cancelled an advantage, which the workpeople in the organised trades used to possess, and, by so doing, has increased the relative influence which other elements of monopoly or bargaining-advantage exercise upon wages. The extension would be an almost unqualified improvement if its effect was to confine wage-claims to amounts that could be justified by the increased efficiency of industry, to which the control of wages contributed. Since, however, there are other conditions, which enable or encourage one trade to profit at the expense of others, and since the different controlling authorities carry on the pre-War trade union tradition of considering only the needs and possibilities of their own trade, the general extension of control may result in a general attempt to secure more wages than can be paid.

The increased element of publicity and public control of wages will tend to harden wage-rates in a depression, provided that the representatives of the wage-earners really wish to resist reductions. Whether they will do so or not, however, will depend on the consequences of successful resistance. Before the War the consequence would have been unemployment; and unemployment would have involved, for the small minority of wage-earners covered by trade union unemployment insurance, a drain on the union funds; for the great mass of wage-earners, who had no such resource, early and extreme hardship. It was impossible for the representatives of the wage-earners in wage-negotiations to ignore unemployment.

To-day things are different. Successful resistance to a reduction may still involve unemployment, but unemployment does not involve the same certainty or degree of distress. Before the War the provision for unemployment relief was partial and inadequate. To-day there is a system of unemployment relief that covers all the industries that are liable to serious unemployment. Then the spokesmen of the wage-earners had to consider the employment situation, because their clients would be the chief sufferers, if their wage-policy restricted employment; now, in such a case, they may nevertheless persist in their policy, since they are conscious that their clients are not without resources, if all cannot be employed at the level of wages exacted.

This comparative disregard of unemployment in wage determinations is as distinctive a change from pre-War practice as the extension of collective bargaining, and much more significant for the problem we are now examining. It is the principal and direct explanation of the loss of plasticity in wage-rates. It should be noted, however, that the provision of unemployment relief is not the only cause of the change. The post-War depression in many industries is so much deeper and more widespread that any practicable reduction in wage-rates would scarcely affect it. The example of the coal industry, in which a substantial reduction in wage-rates has been followed by increase in unemployment—and in losses by the employing firms—is pointed to as evidence of the futility of wage-reductions; and no attempt is made to gauge the extent to which demand is as inelastic for the products of other industries as it has proved to be for coal.

There is an explanation for the wage-earner's attitude in yet another change; wage-rates of direct labour never were the sole determinant of costs, and to-day they are probably less important than before the War. Loan charges are still proportionately much heavier than before the War; rates and taxes and social insurance contributions are much heavier; indirect costs for transport, financial services, etc., are higher; distributing costs have increased disproportionately. Hence the wage-earner, asked for concessions, fears that he is being asked to make a sacrifice, not to revive trade, but to lessen the losses, or increase of profits, of retailers, banks, loanholders, railways, and co-operating industries, that may be more prosperous than his own.

The consideration of wages is purely sectional, industry by industry and trade by trade; the need of industry, so far as wage-adjustments can meet it, is for an all-round reduction, which will affect the indirect costs, simultaneously with the direct costs, of every industry. No machinery exists for such co-ordinated and synchronised adjustment; on the contrary, the extension of collective bargaining has probably intensified and extended the influence of this sectional outlook of industry, by enabling industries, that before the War could not have resisted the pressure imposed by general trade depression, to hold up wages.

It would appear that wage-fixing authorities, acting independently of one another and disregarding the general economic situation, are maintaining wage-rates at a level at which existing industries cannot provide full employment; the considerations that explain their policy will not serve to explain away the unemployment that has accompanied it. The outlet for labour thus excluded, which was provided before the War by industries in which wages were not controlled, no longer exists. There remains for examination the possibility that new industries may provide an outlet, industry as a whole expanding sufficiently to absorb the excluded labour.

It would seem that industry has, temporarily at any rate, lost its capacity of expansion. In certain directions there is expansion, but a closer examination compels us to discount any hopes derived from it. The largest single increase in employment has been offered by retail distribution, 360,000 or 31 per cent between 1923 and 1928. The Balfour Committee brought together material that suggests that retail distributing costs rose in greater proportion than prices generally between 1914 and 1925; since then we have had a further great increase in the number of insured persons employed in retail distribution. This expansion of the retail

margin has been sufficient to neutralise much of the writing down of capital, reduction of wages, and economies of re-organisation by which productive costs have been reduced. By keeping up the cost of living, while wholesale prices are falling, these costs also make it difficult to ask for any reduction in wages. So far, then, as retail distribution provides additional employment by its expansion, it probably does not succeed in compensating for reduction in industrial employment, which the cost it imposes on industry involves.

The second group of expanding industries is the building, building material, and furnishing industries. Together these account for 211,000 increase in the five years. The War-time arrears have now been made up, so that further expansion will be limited to the needs of the increase in population and of replacement with the aid of further subsidies. The case of the third group is similar. These are industries in which expansion has been stimulated by protection, but would have taken place without that stimulus, under the more economic stimulus of technical invention; motor manufacture and artificial silk are the chief members of the group. It is difficult to estimate how much of the growth was dependent on protection and merely a diversion from unprotected industries; but the aggregate expansion of the two together would not be sufficient to compensate for half the contraction in coal alone.

It remains in conclusion to point out that the loss of plasticity, and the adverse effects upon employment that may follow, are not necessary and inevitable consequences of the extension of collective settlements, but, in so far as they are attributable to it, due rather to an obvious defect in the machinery and current practice of collective bargaining than to anything inherent in collective bargaining as such.

The defect in the machinery for wage-negotiation to which the present unemployment points is the purely sectional character of its deliberations. It is no one's business to consider wages as a whole: there is no authority charged with the duty of reminding wages boards of their responsibility to industry in general. Collective bargaining must fail in securing an accurate adjustment of wages to industrial conditions so long as it is confined to negotiations over wages in individual trades and industries. If it is to continue, it must be supplemented by some device for ensuring that the negotiators in each trade and industry have regard to the effect of their determinations upon other trades and industries, and for compelling them to contemplate the needs of industry as a whole.

Moreover, by considering only its own needs and interests, an industry might pursue a policy that was restrictive in effect, though regulative in form. If all industries and all trades pursue such a policy—and all now have the requisite organisation—and maintain rates of wages that restrict employment, there will be excluded a mass of workers who must either be absorbed by new industries or remain unemployed. If there are new industries capable of absorbing them, well and good; but at the present time it would seem that there are not. The index or barometer, therefore, to which trade union and arbitration authorities' attention should be directed, is not solely, or even principally, unemployment in the industry immediately under consideration, but the rate of expansion of industry as a whole.

The task of co-ordinating wage-settlements in different industries, and of securing in each the consideration of such apparently remote factors as the productivity and rate of expansion of industry as a whole, may be too much for the spontaneous democratic machinery by which collective settlements are negotiated at present; but the alternative is almost certainly a breakdown of that machinery under the pressure of a growing problem of unemployment.

Obituary.

DR. E. S. BIELER.

A TELEGRAM from the Prime Minister of Australia, sent on July 26, announced the death of E. S. Bieler on the previous day from pneumonia. He died after thirty-two hours' illness at Geraldton, Western Australia, at the age of thirty-five. He was engaged with Dr. Boughton Edge and others in geophysical exploration under the joint auspices of the British Empire Marketing Board and the Commonwealth of Australia. He had received two years' leave of absence from McGill University for this important expedition.

Educated at Montreal High School, Bieler became a distinguished honour student in mathematics and physics at McGill University. Soon after the War began he joined the First McGill University Company and then served with the Princess Patricia's Light Infantry, receiving a commission in the Canadian Field Artillery. After being twice wounded he was transferred to the Anti-submarine Division and worked under Sir William Bragg at applied research methods at Scapa Flow and on the north coast of France. After the War he received an 1851 Exhibition Scholarship and went to Caius College, Cambridge, working as a research student at the Cavendish Laboratory at a time when Sir Ernest Rutherford and Dr. J. Chadwick were bombarding the nuclei of atoms with alpha particles.

The idea of a barrier round the nucleus resulted from this work and Rutherford has spoken to me with enthusiasm of Bieler's research. After taking his Ph.D. degree at Cambridge he became assistant professor of physics at McGill, and he directed his attention to the susceptibilities of the alkali metals and the Hall effect in them, believing that the greatest progress could be made in that manner. He communicated some admirable summaries on magnetism and on the Fermi-Dirac theory to the *Journal of the Franklin Institute*; and published papers also on electrical measurements.

Bieler had, in 1917, done research work in

acoustics at Father Point with Dr. L. V. King, to whom he was indebted for much of his training in mathematics and physics. He also became interested in geophysical prospecting in northern Quebec, and with Mr. H. G. I. Watson invented and patented a method for searching for ore bodies by measuring the ratio of the axis minor to the axis major of the ellipse of polarisation. He was thus by experience well equipped to become deputy director of the geophysical expedition, and his life in camp and in the Canadian bush seemed a guarantee of physical fitness also. He was a man of eagerness and enthusiasm with well-balanced judgment and sound scientific acumen. His family and his friends and colleagues have lost a man of sterling character and McGill University has lost a physicist hard indeed to replace. A. S. EVE.

WE regret to announce the following deaths:

Sir Alfred Bateman, K.C.M.G., formerly Comptroller-General of Commerce, Trade and Statistics of the Board of Trade and president in 1897 of the Royal Statistical Society, on Aug. 7, aged eighty-four years.

Prof. L. H. Cooke, professor of mine surveying at the Imperial College of Science and author of many improvements and inventions relating to surveying instruments, on Aug. 23.

Prof. Thomas Eagleson Gordon, president of the Royal College of Surgeons in Ireland and professor of surgery at Trinity College, Dublin, on July 24, aged sixty-two years.

Dr. Paul A. Lewis, of the Department of Animal Pathology of the Rockefeller Institute for Medical Research, known for work on immunisation and related subjects, who died of yellow fever while studying that disease in Brazil, on June 30, aged fifty years.

Prof. John A. Mandel, professor of chemistry and physiological chemistry in the University and Bellevue Hospital Medical College, New York, who worked mainly at the chemistry of the nucleic acids, on May 5, aged sixty-three years.

Rear-Admiral Albert P. Niblack, K.C.M.G., C.V.O., United States Navy (retired), president since 1927 of the Directing Committee of the International Hydrographic Bureau, on Aug. 20, aged seventy years.

Karl Auer, Ritter von Welsbach, inventor of the incandescent gas light and of the osmium filament electric lamp, on Aug. 4, aged seventy years.

News and Views.

ON Sept. 7 occur the centenaries of the births of the American geologist Hayden and the German chemist Kekulé. Ferdinand Vandeveer Hayden, who was born at Westfield, Mass., graduated from Oberlin College, and in 1853 took his M.D. at Albany College, and by James Hall was induced to join an exploring party to Nebraska. During the Civil War he served as a surgeon, in 1865 became professor of geology in the University of Pennsylvania, and for twelve years, 1867–79, was geologist in charge of the United States Geological Survey of the Territories. His labours resulted in a most valuable series of reports in all branches of national history and economic science. He first made known the basalt plateau in Oregon and Washington through which the Columbia River had channelled its course; he described in 1871 the wonderful lava plateau in north-western Wyoming on the banks of the Yellowstone River, with geysers, hot springs, mud volcanoes, and extinct volcanic hills, and the idea of the great National Yellowstone Park was his. Hayden died at Philadelphia on Dec. 22, 1887, and the following year his widow endowed the Hayden Medal of the Academy of Natural Sciences of Philadelphia for work in geology or palæontology, among the recipients of which have been Suess, Huxley, Daubreé, and Geikie.

FRIEDRICH AUGUST KEKULÉ, also born on Sept. 7, 1829, was sent from the Darmstadt Gymnasium to Giessen to study architecture. He had already displayed remarkable ability and at Giessen was attracted to chemistry by the lectures of Liebig. At twenty-one years of age he published his first piece of research. A year spent in Paris led to an acquaintance with Dumas, Wurtz, Cahours, Regnault, and with Gerhardt, whose treatise on organic chemistry he read in manuscript. A year or two later Kekulé became assistant to Stenhouse at St. Bartholomew's Hospital, London, and it was in London, as is known from his addresses, that his ideas with regard to structural chemistry began to take shape. In 1856 he became a privat docent at Heidelberg; in 1859 professor of chemistry in the University of Ghent, and in 1867 he was called to Bonn, where he found himself head of the palatial laboratory just erected to Hofmann's design. Kekulé had already in 1858 published his views on the linking of atoms, and in 1865 his memoir on the theory of the structure of benzene, containing what Japp in 1898 called the most brilliant piece of scientific prediction in the whole range of chemistry. Distinguished as a thinker, teacher, and investigator, Kekulé's merits never lacked recognition; he was feted three times by his students, and in 1895 the German Emperor ennobled him with the title Kekule von Stradonitz. It was then he dropped the accent on the final e. He died of heart failure on July 13, 1896, and seven years later his statue was erected in front of the laboratory at Bonn. Among his students were Baeyer, Ladenburg, Dewar, Thorpe, Van 't Hoff, and Japp, the last of whom in 1898 delivered the Kekulé Memorial Lecture to the Chemical Society.

THE estate of the late Mr. Oldfield Thomas, who died on June 16 last, has been sworn for probate at £42,613, with net personalty £37,374. By his will and four codicils he made numerous bequests for scientific and charitable purposes. Among these the most interesting are legacies of £500 each to the Society for the Promotion of Nature Reserves and the London Playing Fields Society, £300 to the National Lending Library for the Blind, £200 each to the Decimal Association and the Nature Cure Association, and £100 to the Simplified Spelling Society. To the

Trustees of the British Museum (Natural History) he has bequeathed his portrait by J. E. Breun in 1904, "to hang, if permitted, in the Mammal Room; . . . any zoological specimens I may be possessed of together with the cabinets or boxes containing them; . . . my collection of zoological tracts and scientific books for the special use of the Assistant in charge of the Mammalia in the Museum"; and £1000 "for the express purpose of constructing a light passenger lift for the use of the staff from the hall or basement of the Museum to the second floor, in case it shall not have been constructed in my lifetime". The testator says: "Such a lift would greatly facilitate the work of the Museum and at the same time lengthen the period of life during which assistants and helpers as they become older would be able to carry on their work at the Museum. The loss of assistance, especially unpaid assistance, that I have known occasioned by the want of such a lift has been by no means inconsiderable." The residue, expected to amount to about £12,000, is left in trust for the trustees of the Godman Exploration Fund, who are directed to use the income "in their absolute discretion for the benefit and increase of any of the Museum collections".

ATTENTION is directed in the annual report of H.M. Chief Inspector of Factories for 1928 (London: H.M. Stationery Office) to the fact that the engineering industry in the south of England, particularly in the neighbourhood of London, is expanding very rapidly. This is the main reason why the population between Acton and Slough has increased two and a half times during the last five years. Of the accidents reported due to electrical shock, 37 (3 fatal) arose from the careless handling of portable apparatus. There can be no doubt that these accidents are due to the ease with which a portable electric lamp can be improvised by anyone having only a rudimentary knowledge of electricity. Electrical engineers now consider damp plaster or concrete which is in contact with 'live' metal as itself alive and take precautions accordingly. They now insist that all exposed metal in bathrooms which is liable to become alive in the event of defective insulation of a neighbouring pipe must not only be earthed but must also be placed out of reach of a person standing in the bath. At very high pressures there were 34 accidents (7 fatal). In most of these cases the men responsible were competent and experienced. They suffered apparently from momentary forgetfulness or lack of care. At pressures below 250 volts, that is, the pressures used in domestic supply, there were 17 fatal accidents, every one of which was due to alternating current. Taking this in conjunction with previous reports, it appears quite certain that alternating current shocks are much more dangerous than direct current ones. It is becoming customary for builders who use electricity for their cranes and lighting during constructional work to convert the alternating current obtained from the public mains to direct current at 110 volts, before it is connected with their temporary wiring arrangements.

MR. WILLIAM COLLARD gives an interesting account in *World Power* for August of the London and Paris Railway scheme. Briefly stated, the proposal is to construct a high speed electric railway connecting Paris and London. Under the Channel there would be two tube tunnels. In order that the scheme should be commercially profitable, it is necessary that the twin tubes should be utilised to the utmost and that the traffic load should be approximately constant. A Government committee is at present examining the economic aspects of the scheme. As the trains are to run at a speed of 120 miles an hour, it is proposed to have a seven-foot gauge so as to ensure safety. The scheme seems to be quite feasible from the electrical point of view. In the modern type of locomotive used on the St. Gothard Railway, there are four motors each of 770 horse-power and each driving an axle. The same locomotive is used for driving an express or a goods train. Owing to the broader gauge, locomotives of at least twice this power could be used through the Channel tube. The journey between London and Boulogne could be performed in 85 minutes, and between London and Paris in 2 hours 45 minutes. The locomotives would be rated at 6000 horse-power. Arrangements would have to be made for hauling only fully loaded goods waggons between London and Paris. Otherwise it would be cheaper to tranship the goods. The proposed railway would run a service between London and Paris at intervals of 45 minutes throughout the day. If this railway were constructed, it would be possible to reach the great majority of Swiss holiday resorts by a daylight service from London. Doubtless also there would be one-day return tickets to Paris.

IN the early days of electric supply, the sudden demand for energy at certain periods of the day and its equally sudden cessation made it necessary for the engineers to provide plant far in excess of that required if the load were constant and equal to the average load. As a result of the great increase of the demand for electric heating and power purposes, the ratio of the maximum demand at any one time to the average demand has considerably diminished; the usual load curve of a station may show several peaks which occur at various times of the day and often on Sunday morning. In a paper by A. G. Christie, read recently before the American Society of Mechanical Engineers, methods are suggested for diminishing the capital expenditure on plant by providing storage plant for the system which would absorb energy at certain times of the day and give up energy at other times, so as to help the generators. The plant intended for peak load service should be as cheap as possible, as the total cost of this plant consists mainly of capital charges. High level water storage, storage batteries, steam accumulators, and Diesel engines have been suggested. The first and last of these, however, would seldom be applicable. Prof. Christie makes out a strong case for the steam accumulator. In Great Britain the considerable space occupied by steam accumulators would be a drawback. To operate well, also, it is necessary to use special turbines owing to the variation in the steam pressure which occurs in these thermal storage boilers. Anything which makes the plant more

complicated and prevents standardisation is objectionable. The paper, however, is well worth study by supply engineers.

THE Carnegie Institution of Washington was founded by Andrew Carnegie in 1902, the total endowment amounting to 12 million dollars, with an additional income from a reserve fund of 3 million dollars. Its purpose was "to encourage in the broadest and most liberal manner investigation, research, and discovery, and the application of knowledge to the improvement of mankind". At first the activities of the Institution were directed towards the support of a relatively wide range of subjects and grants were made for specific projects covering limited periods, but eventually the tendency veered towards certain major projects the solution of which required longer periods and greater opportunity for the concentration of funds. Now it may be said that the Institution aims at advancing fundamental research in fields not covered by the activities of other agencies. In so doing it concentrates its attention upon specific problems, with the idea of shifting attack from time to time to meet the more pressing needs of research as they develop with increase of knowledge. A special feature has been the publication and prompt dispersal of the Year Books and other works, which now number 600 volumes, to most of the greater libraries of the world. The extent and great variety of main lines along which the Institution is advancing knowledge may be gathered from the summaries of the investigations carried out by a dozen departments, each concerned with its own branch of science and yet working in full co-operation with the others. These summaries appear in the fourteenth issue of "Carnegie Institution of Washington", published in May last.

ANOTHER work, published by the Carnegie Institution of Washington last May, should be at hand for reference by every scientific worker. It is a volume of 202 pages containing a "Classified List of Publications of the Institution". The works are catalogued in three sections: a serial list of publications; lists arranged according to the appropriate branch of science, with a short description of each work following the title; and an alphabetical list of authors with their works. Copies of each publication are sent gratuitously to a carefully selected list of libraries throughout the world, and a list of these libraries will be sent post-paid upon application. The index shows that many of the works are now out of print, but most of these will be found in the libraries in question. Books not otherwise disposed of are for sale at prices approximating to the cost of publication. Scientific workers may obtain price-lists or classified lists, as issued, by furnishing requisite addresses, and special lists of additional papers in reprinted form, relating to the work of the Geophysical Laboratory, Department of Terrestrial Magnetism, and of the Mount Wilson Observatory, are also available.

ON the morning of Aug. 29 the German airship, *Graf Zeppelin*, reached Lakehurst, New Jersey, having completed a 'round-the-world' flight of about 21,000 miles in a little more than twenty-one days. About nine days were spent in resting and refuelling at Friedrichshafen, Tokyo, and Los Angeles, and the actual flying time is given as 27 minutes short of 12 days. The voyage was made in four stages, the first, the eastward journey across the Atlantic, taking just over fifty-five hours. The next stage, from Friedrichshafen to Tokyo, an unbroken flight of about seven thousand miles, constituting a record long-distance flight, took the airship over Berlin and Danzig, between Leningrad and Moscow, north of Tobolsk and across Siberia, and occupied about a hundred hours. Full advantage was taken of favourable winds. From Tokyo across the Pacific took a little more than sixty-eight hours. The speed throughout seems to have been about 70-90 knots an hour, and the passengers speak highly of the comfort of the journey. Dr. Eckener, the commander, is to be congratulated upon the skilful manner in which he handled his ship and upon the successful conclusion of his feat of circumnavigation.

THE Annual Report of the Auckland Institute and Museum for 1928–29 records a most important stage in the development of that institution. During the year, the magnificent new Auckland War Memorial Museum has been completed and furnished with up-to-date cases and fittings, and good progress has been made with the arrangement of the collections. It is believed that by November preparations will be so far advanced that the building may then be formally opened to the public with appropriate ceremony. It is a fitting occasion for rejoicing, for not only are the collections, brought together in the course of sixty years by the members of the Auckland Institute, to be finely housed, but, a matter of as great significance, the responsibility of their upkeep has been enormously widened through the voluntary accession of twenty-five local bodies. These, with the Auckland City Council, form a unified body created by the Auckland War Memorial Museum Maintenance Act, and the new arrangement should not only add to the financial security of the Museum, but should also guarantee a wider interest in, and greater educational use of, the collections.

WE have received the first two numbers of a new journal for theoretical and applied genetics entitled *Die Züchter*. It is edited by Erwin Baur, and the first number contains on the title-page a figure of his new institute for breeding-research at Müncheberg. The journal appears monthly, each part containing at least 32 pages. The publishers, Messrs. J. Springer of Berlin, announce the price as 30 marks per year or 3 marks for each part. Printed on smooth paper, the journal is well illustrated, and its aim is apparently to keep practical plant and animal breeders in touch with the progress of genetics. That this aim is interpreted in a broad sense and that new results in genetics are also included, is shown by the contents of the first two numbers. An article by Bělař on breeding and cytology points out the importance of chromosome investigations, particularly to plant breeders. Another, by H. Stubbe, summarises the recent work of Muller, Goodspeed, and others in producing mutations in animals and plants by the action

of X-rays. Other short articles are concerned respectively with crosses between Roumanian Mangalitza and German breeds of pigs, with xenia in cereals, and with the production of potato varieties immune to wart disease. A short account is given of the Russian Genetical Congress held at Leningrad in January. The second and larger number begins with a paper by C. F. Rudloff giving some new results on the relation between chromosome linkage and heredity in *Œnothera*. Another article, on sugar-beet varieties, describes crosses between the wild *Beta maritima* and sugar-beets. Biographical sketches of breeders are included, as well as accounts of meetings and of institutes devoted to breeding work. The journal will no doubt serve a useful purpose in this field.

IN the Annual Report of the Department of Coal Gas and Fuel Industries of the University of Leeds, the Livesey professor, J. W. Cobb, gives an account of the activities of this Department both in teaching and research. Considerable extension of accommodation and equipment is being undertaken to meet growing needs. Of more general interest are the observations on education for the fuel industries. The National Fuel and Power Committee in 1928 reported that "the advance in the economical use of Fuel is largely dependent on a highly trained personnel". Any considerable extension of the manufacture of smokeless fuel, as popularly anticipated, will necessitate a greatly increased body of workers, not only for the preliminaries of research and experiment but also for the construction and operation of the plant. The recognition of this is, if anything, more evident in universities abroad. Even now, Prof. Cobb reports a demand for graduates which he cannot supply, and it invites comment that more young men with an aptitude for practical affairs do not fit themselves for careers awaiting them. Schoolmasters have a great influence on the decision of their pupils, but are not fully aware of the opportunities which exist, while for many the securing of 'open scholarships' exerts an irresistible attraction which has the result of diverting suitable boys from industrial careers.

"A LIST of the Original Scientific Communications by J. Reid Moir" has been published by Messrs. Harrison of Ipswich in response to requests from various quarters for a complete list of the original communications by this distinguished archæologist which have appeared in various scientific periodicals. Mr. Reid Moir, though still, as his friends and admirers will hope, far from attaining 'retiring age', has had a long and distinguished career as an archæologist; but perhaps even those who follow his work with close attention will be surprised at the length of this list, which contains no less than one hundred and forty-three items, ranging in date from 1910 to the current year. These are communications appearing in British periodicals, and do not include Mr. Reid Moir's contributions to the *Scientific American* and other publications in the United States. At the moment one entry makes a special appeal to our sympathies. It is that relating to rostro-carinate implements. It will be remembered how whole-heartedly the late Sir E. Ray Lankester threw the weight of his support into the controversy on the subject of these implements, on the side of Mr. Reid Moir, when they were first brought to the notice of the archæological world. Mr. Reid Moir himself refers to this subject in a letter on p. 373 of this issue.

A BRIEF report in the *Times* for Sept. 2 shows that the great earthquake that occurred in New Zealand on June 17 was accompanied by one feature of unusual interest. The survey of the central district made by the Public Works Department reveals great changes in the level of the land. An area about 50 miles long and 18 miles wide has been raised above its former level, the maximum uplift being 16 feet, while in 1855 the greatest elevation was not more than 9 feet. At Murchison, where most of the houses were ruined, the uplift amounted to 4 feet.

THE Medical Research Council announces that it has received from Mrs. Odo Cross a sum of £40,000 as the endowment of a trust for the establishment of research fellowships in the study of tuberculosis, to be known as the "Dorothy Temple Cross Research Fellowship Fund". The amount in question is the total sum received by Mrs. Odo Cross in respect of her daughter's estate, no part of which does Mrs. Odo Cross desire to retain for her own benefit.

THE summer issue of the *Fight against Disease*, the quarterly journal of the Research Defence Society, contains the third Stephen Paget memorial lecture, by Prof. A. V. Hill, on "Enemies of Knowledge", and the annual report of the Committee. An appeal is made for more funds which are now urgently needed to meet the demands for increased activities, as for 1928 there was a deficit of £113.

WITH the view of reducing maternal mortality in childbirth, the Ministry of Health has issued a pamphlet (Memorandum 145/M.C.W. London: H.M. Stationery Office, 1*d*. net) on "Ante-Natal Clinics: Their Conduct and Scope". The principles emphasised are that every pregnant woman should receive sufficient ante-natal care to ensure (1) that a difficult labour will be foreseen so far as can be by previous examination, (2) the early detection and treatment of toxæmia, and (3) the institution of measures against an existing infection, including venereal disease.

AN address by Prof. M. T. Bogert delivered in Philadelphia in memory of Edgar Fahs Smith, who died on May 3, 1928, appears in the issue of *Science* for May 31. It contains a full account of Smith's many contributions to knowledge in the fields of organic chemistry, inorganic, analytical and electrochemistry, and historical chemistry. Under Smith's direction, determinations of the atomic weights of eighteen elements were carried out by a variety of different methods. He was the author of a number of works on theoretical and applied chemistry, in addition to being the translator of certain well-known text-books.

WE have received the first number of a new periodical, the *Journal of the Cancer Research Committee of the*

University of Sydney (Sydney: The Australasian Medical Publishing Co., price 5*s*. per annum), which contains several papers of interest. The Commonwealth Director-General of Health, Dr. Cumpston, shows that cancer mortality in the Commonwealth is steadily rising—from about 34 per 1000 deaths in 1885 to about 94 in 1928. The cancer research fund of the University of Sydney now amounts to £134,000, of which more than £100,000 has been contributed by private subscribers.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—A full-time lecturer in physics at the Leicester College of Technology—The Registrar, College of Technology, Leicester (Sept. 10). An assistant lecturer and demonstrator in the Zoology Department of the East London College—The Registrar, East London College, E.1 (Sept. 14). A woman assistant lecturer in botany in the Department of Education (Women's Division) of the University of Birmingham—The Secretary, The University, Birmingham (Sept. 18). A head of the Mining Department of the Chesterfield Technical College—The Principal, Technical College, Chesterfield (Sept. 21). An assistant lecturer in agriculture at the Seale-Hayne Agricultural College—The Bursar, Seale-Hayne Agricultural College, Newton Abbot, Devon (Sept. 21). A lecturer in botany at the University College, Rangoon—The Secretary to the High Commissioner for India, General Department, 42 Grosvenor Gardens, S.W.1 (Sept. 28). A professor of biochemistry at the Indian Institute of Science, Bangalore—Sir F. G. Hopkins, F.R.S., 71 Grange Road, Cambridge (Sept. 30). A lecturer in commerce in the University of Hong Kong—C.A. (N.), The Secretary, Board of Education, Whitehall, S.W.1; Scottish applications to (C.A.), The Secretary, Scottish Education Department, Whitehall, S.W.1 (Sept. 30). A senior lecturer in economics in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, South Africa House, Trafalgar Square, W.C.2 (Oct. 1). Male junior assistants at the Chemical Warfare Research Department, London, and at the Experimental Station, Porton, Wilts—The Chief Superintendent, Chemical Warfare Research Department, 14 Grosvenor Gardens, S.W.1. A sanitary inspector in the Sudan Medical Service—The Controller, Sudan Government, London Office, Buckingham Gate, S.W.1. A science master at the Day Continuation School of the Rugby College of Technology and Arts—The Organiser of Further Education in Rugby, 61 Clifton Road, Rugby. Civilian education officers in the R.A.F. Education Service—The Secretary, Air Ministry, Gwydyr House, Whitehall, S.W.1.

Our Astronomical Column.

Lembang Observatory, Java.—This observatory is of special interest from its proximity to the equator. In the list of active observatories in the *Nautical Almanac* there are only four within 10° of the equator; they are Bogota +4° 36′, Colombo +6° 54′, Lembang −6° 50′, Trivandrum +8° 31′. These observatories command a much greater extent of the heavens than those in the temperate zones. *La Nature* for Aug. 1 contains a description by Dr. A. Gradenwitz of the new equatorial which has recently been erected at Lembang. It has two objectives, each constructed by Zeiss, of 60 cm. aperture, one being designed for visual work, the other for photographic. The weight of each lens is 300 kgm., that of the whole revolving portion of the equatorial being 14,000 kgm. The focal length is 10·5 metres. The two lenses are mounted in a single cylindrical tube 1·70 metres in diameter. The diameter of the dome is 14·4 metres. Both telescope and dome are electrically driven. The article has three illustrations; two show the telescope and its mounting, the third shows a stage in the manufacture of the objectives at the Zeiss works. Two statements in the article need correction. The construction of the first reflecting telescope is ascribed to Herschel instead of to Newton, and it is stated that no double stars have been discovered by reflectors. Herschel discovered a considerable number.

Starlight.—Prof. H. N. Russell contributes a further article on this subject to the *Scientific American* for September. He quotes Prof. van Rhijn's conclusion that five-sixths of the background illumination of the sky arises from permanent auroral glow and sunlight reflected from meteoric dust. The remaining sixth is starlight; the amount received from a hemisphere is 1/600 of the light of the full moon; a certain fraction of the starlight (probably between 1/10000 and 1/1000 of the whole) comes from objects external to the galaxy. The article proceeds to speculate on the ultimate fate of the starlight in space. A considerable fraction of it is intercepted by the dark nebulæ which abound in some regions of the galaxy. These must get warmed to some degree and give out feeble radiations in their turn. The question is then raised whether matter, the annihilation or rather conversion into radiant energy of which is now generally supposed to be the maintaining power of the light and heat of the stars, is in process of being rebuilt in space. Prof. Millikan's theory is quoted that the cosmic rays which he has studied arise from the process of atom building. Prof. Russell leaves the matter open, but indicates that his own opinion is rather against such rebuilding.

Variation of the Calcium *K* Line with Distance in Early Type Stars.—Dr. O. Struve lately concluded that the strength of the *K* line in early type stars, presumed to arise from absorption in interstellar space, afforded a fairly reliable measure of the distance of the stars. In view of the importance of this conclusion, Dr. J. H. Oort has made an independent investigation which is published in *Bull. Astron. Inst. Netherlands*, vol. 5, No. 177. The distances were estimated from the proper motions. Boss's P.G.C. was used for these, but they were corrected for (1) systematic errors of proper motions in declination, (2) alteration in precession constants, (3) effect of galactic rotation. They were resolved into components towards the ant-apex and at right angles to this; the former was taken as a measure of the star's distance. The absorption coefficient is found to be about 0·00045 magnitude per parsec, a little higher than the value of Gerasimovič and Struve. A further investigation divides the stars according to galactic latitude. There is a slight tendency to greater absorption as the galactic plane is approached.

Research Items.

Culture in Polynesia.—In a monograph entitled "An Enquiry into the Question of Cultural Stability in Polynesia", which is published as Vol. 9 of the *Columbia University Contributions to Anthropology* (issued in England by the Oxford University Press, 10*s.* 6*d.* net), Miss Margaret Mead has reviewed the evidence afforded by the culture of Polynesia in its bearing on certain general questions — such as the problem of the relation of different elements in a culture, that is, the relative stability of ritual and technique, of terms of relationship and of the moiety, of the field of decoration and elements of the design, and so forth. Canoe building, house building, and tattooing were considered in five insular cultures: in Hawaii, the Marquesas, Tahiti, Samoa, and among the Maori. In the case of canoe building, it was found that variations in technique and mechanical principles were rare, but the relative importance of priest and craftsman varied enormously between the extremes in Hawaii, where the priest performed the skilled parts of the work and the builders were held in low esteem, and in Samoa, where the priest had no function and the builders were all-powerful, while in New Zealand some parts of the work was left to the chief only. The taboos also varied in extent and in degree. The extent to which the canoe entered into the religious complex was different in the different areas. In house building there was little deviation. The most definite individualisation occurred in the shape and appearance of the house, and where they were closely allied with decoration the most highly developed individualisation also was found. In tattooing the technique was even more constant, but the style was unique and specially developed in each area. The closest association appeared between Hawaii and southern New Zealand. The status of the craftsman also varied; only in New Zealand did the priest play an important part. The content of the associated taboos and rites was different in each group. So far as the evidence carries, it would appear that technique is the more stable element, and form and decorative elements the most variable. Such data as these, therefore, would not appear valid evidence for possible culture contact between, for example, Oceania and America or Africa and Melanesia.

Line Fishing in the Moray Firth.—In continuation of his survey of the Moray Firth fisheries, Dr. A. Bowman deals with line fishing in *Fisheries, Scotland, Sci. Invest.*, 1927, II. This paper forms a review of the fishery during the period 1904–16, for which especially detailed statistics are available. Of the three methods of line fishing, small-line, great-line, and hand-line, the first mentioned is by far the most important, contributing more than 83 per cent of the total weight of all fish landed during the period. Small-line fishing is mainly a fishery for haddock, and it is most intense during the fourth and first quarters of the year when the larger categories of haddock are relatively most abundant. There is a summer-autumn feeding migration of adult haddock into the Firth from regions beyond, and a winter-spring emigration of mature fish to the offshore spawning grounds; these movements are repeated with the greatest regularity each year. Thus, during the summer months, the small-line fishermen are dependent on the stationary population composed largely of fishes of the younger year-classes, whereas in the winter their success depends upon the magnitude of the invasion of adult fish. The annual renewal of stock by the arrival of young fish from outside is very unequal. The broods of 1904, 1909, and 1913 were exceptionally good, and dominated the catches of the larger market categories in 1907, 1912, and 1916. Accession to the stock by the progenies of the other years of the period appear to have been only moderate or poor. The effects of these alternate good and bad brood years are so marked, that over so short a period of observation they mask any progressive changes in the stock which might be due to other causes, such as fishing.

Giant Earthworms of South Gippsland.—Charles Barrett has recorded his experiences in search of these giant earthworms, *Megascolides australis* (*Victorian Naturalist*, July). They were not rare in the locality investigated, and fifty could easily have been collected from the flats near the farm, but the length of the worms and the irregular curves of the burrows make it difficult to extract a worm without damage. The burrows are generally in rich clayey flats, and in these the worms live deep down in summer, coming often to within a foot of the surface in autumn and winter. The burrows, vertical or horizontal, are always damp and slimy, and the approach of an investigator is heralded by a loud gurgling noise made by the worms as they contract in their burrows, where they can travel quickly. The eggs may lie free in loose soil, may be fixed amongst grass rootlets, and are often picked up amongst the clods in a freshly ploughed paddock. They are tough and horny, greenish in colour and translucent, oval in shape, and from two to three inches in length. The average size of the worms themselves is perhaps four feet, but six-feet examples are fairly common; the largest Mr. Cook actually saw measured was nine feet in length, and the largest reported measured eleven feet.

Northern Hydrozoa.—Dr. Hjalmar Broch gives a good account of the Hydrozoa of the North Sea and Baltic in a recent part of "Die Tierwelt der Nord- und Ostsee" (G. Grimpe und E. Wagler. Lieferung 13, Teil III. b.c. Hydrozoa I. (Hydroida, Trachylina), Hydrozoa II. (Siphonophora). Leipzig: Akademische Verlagsgesellschaft, 1928). After a full general survey of the anatomy of the group, the author proceeds to the biology and general distribution. The bio-geographical portion of the work is interesting, certain hydroids (for example, *Eudendrium rameum* and *Hydrallmania falcata*) having a range from the laminarian zone to 2000 metres or more. Temperature is a very important factor in their distribution. In describing the feeding of polyps, the observations by Luther and Schneider are quoted, showing that *Protohydra* feeds principally on certain nematodes. It is, however, known to feed largely on copepods and oligochæts in other localities. Very little is said about the feeding of medusæ, although a good deal is known. They are exceedingly voracious and carnivorous, and their importance as devourers of larval fishes is great. A useful key is given for the identification of genera and species, the method used being excellent for quick identification. The medusa names (when known) are placed in brackets after the hydroid genus, and similarly the hydroid names after the medusæ. The order Trachylina has a chapter to itself. In it the author includes the very peculiar and aberrant genus *Halammohydra* (so far only found in the Kieler Bucht and in Heligoland), which is truly benthonic. The few Siphonophora occurring in this region belong to both cold and warm water, often appearing regularly but rarely staying for long periods.

Asiatic Species of *Corbicula*.—The Zoological Survey of India continues its invaluable series of monographs

on groups of the non-marine mollusca, the latest to appear being on the Asiatic species of the genus *Corbicula* by Dr. B. Prashad (*Mem. Indian Mus.*, vol. 9, Nos. 1-2, pp. 68, 8 pls.). On this difficult group, which, as Dr. Blanford remarked, "appears to have been designed by a beneficent Providence for the amusement of species-makers", the author has expended the same care that characterised a former paper on the Viviparidæ (see NATURE, Nov. 3, 1928, p. 712). The work of previous writers is fully discussed and criticised in the light of later knowledge and fresh material, and the list of species considerably reduced, thirty-two in all (including seven new species) being recorded and described from the region in question, which it should be noted takes in Formosa and the Philippine Islands. The half-tone plates from photographs deserve special mention since the natural coloration of the shells renders them exceptionally difficult subjects for the camera, an obstacle here most successfully overcome.

Relapse in Bird Malaria.—R. D. Manwell (*Amer. Jour. Hygiene*, vol. 9, No. 2, March 1929) records observations on relapse in bird malaria, based on the study of about 180 birds. Relapse was studied most thoroughly in the case of chronic infections with *Plasmodium cathemerium*, which is the most convenient strain for experimental work, but three other series of birds infected with *P. præcox*, *P. inconstans*, and the Whitmore strain of the latter have also been used. Both short-term and long-term relapses occur in bird malaria as in human malaria; the short-term relapses appear to be more common and usually more dangerous to the bird. A seasonal variation in the relapse rate occurs, the greatest number of relapses being noted in the autumn and winter and the smallest number in summer. The four strains differed in their liability to relapse; the Whitmore strain relapsed in 61 per cent of the cases, *P. præcox* in 36·5 per cent, *P. inconstans* in 25·8 per cent, and *P. cathemerium* in 5·5 per cent. The susceptibility of individual birds to relapse varied; for example, 60 per cent of the birds infected with *P. cathemerium* did not relapse, and most of the relapses recorded for this species of malaria occurred in 20 per cent of the birds. Some birds relapsed eight or ten times. There is no evidence that the severity of the original infection has anything to do with the liability to relapse. If complete recovery, in the sense of absence of parasites, ever occurs naturally, it is very rare; prolonged absence of the parasites from the peripheral blood, as judged by ordinary methods of examination, cannot be regarded as any indication of such recovery. The part played by environmental factors in bringing about relapse is problematical. A useful summary of the investigations on bird malaria which have been carried out at the Johns Hopkins School of Hygiene during the last ten years is given by Prof. Robert Hegner in the *Quarterly Review of Biology* (March 1929).

Preserved Potatoes.—Potatoes are an important crop in Holland, being cultivated for two distinct objects, namely, human consumption and industrial purposes. Different varieties are grown according to the use for which they are intended. Unlike grain crops, potatoes cannot be stored for use in the following year, so that the farmer who is situated at a distance from a co-operative meal factory is apt to lose a good deal through wastage. This is particularly the case in seasons of exceptionally high yield, or if, owing to disease, the natural keeping qualities of the crop are impaired. A method of preserving surplus eating potatoes for feeding to stock, employed by the Dutch farmer, is described by J. Dunlop in *Scottish Journal of Agriculture*, **12**, p. 318. The potatoes are first washed and then steamed in as little water as possible. After pouring off the liquid the tubers are packed closely and firmly into a pit about 3 ft. deep in the ground. Old jute bags are laid over the potatoes, which are then covered with a foot of soil. In wet climates the pit is thatched over with straw. With proper packing all air is excluded and the potatoes keep in good condition for years. Salt is needed before feeding the tubers if it was not added during the process of steaming. The total cost of labour and fuel is calculated at about 2*s.* per ton, and as the feeding value and flavour of the potatoes undergo but little depreciation during either steaming or storage, the saving effected is considerable.

Preservation of Fossils.—The *Naturalist* for April, May, and June 1929 contains a valuable paper by E. G. Radley on "The Preservation of Pyritised and other Fossils". The cause of the disintegration and destruction of pyritised and phosphatised fossils is the action of oxygen in the presence of water, whereby sulphates of calcium and iron are formed. A series of experiments suggests that either pyrites or marcasite (or both) are disseminated throughout the specimens in an extremely fine state of division. If the particles within the mass are already in course of conversion to sulphate, it is not possible to save the fossils from complete destruction. If, however, the damage be slight, preservation can be successfully achieved by removal of the superficial white decomposition products, through washing and drying, followed by a coating of the specimen with celluloid varnish or preferably 'dope'. The latter is a nitrocellulose with amyl acetate and alcohol. It may be sprayed over the specimen, or poured over and worked in with a brush. Dilute solutions of 'dope' are sold under the name of 'invisible lacquer', but if this be used it is advisable to give two or three coats. Of all the media used as protective coverings for pyritised fossils, 'dope' has been found to be not only the most resistant to noxious gases, but also sufficiently elastic to withstand the contraction and expansion due to changes of temperature.

Frost Heaving.—A series of experiments have been carried out by Stephen Taber to determine the factors involved in the uplift of surface soil that takes place when the soil water freezes. The results are recorded and discussed in the *Journal of Geology*, July–August 1929. Freezing of soils often results in heaving to a greater degree than can be attributed to the change in volume of the water present. This excessive heaving is due to the upward segregation of water as it freezes near the surface, the additional water being drawn in by molecular cohesion. Pressure effects result from the growth of ice crystals, the direction of growth being determined chiefly by the direction of heat conduction and the availability of further supplies of water. In the experiments, pressures of more than 14 kgm. per sq. cm. were obtained through the growth of ice crystals to form segregated layers. Segregation occurs readily if the grade size of the particles is less than a micron. It is also favoured by a high water content, and very thick ice layers may develop where water can be drawn up from the water-table. Where the soil is very impermeable because of a high colloid content, shrinkage cracks appear and are gradually filled and enlarged by ice. The principles revealed by the investigation help to explain such geological phenomena as buried sheets and lenses of ice and soil-polygons with convex surface; they also suggest applications to engineering, as in the construction of hard-surfaced roads.

Atmospheric Electricity.—We learn from *World Power* for August that progress has been made in the experiments with atmospheric electricity now being carried out by the Physical Institute of the University of Berlin at Monte Generoso, near Lugano. Unfortunately, one of the three physicists engaged in the tests—Mr. Urban—was accidentally killed by falling from an antenna. The other two, Messrs. Brasch and Lange, are continuing the research. The early experiments were made with a network of wires suspended by strings of high tension insulators from two mountain peaks, the minimum height above the ground being eighty metres. The voltage obtained between the network and the earth when sufficiently high was measured in the ordinary way by an air-gap between spherical electrodes. The width of the air-gap was adjusted by an operator from an adjacent metal-sheathed hut. During the first year, the network once remained highly charged with electricity for about thirty minutes. Unluckily, sparks kept occurring across the air-gap when it was extended to its maximum width of four and a half metres. The voltage was obviously greater than that required to bridge this gap. It was estimated as being about four million volts. The following year (1928) the insulation resistance of the net of overhead wires was greatly improved. It was suspended by double chains, each consisting of 175 insulators in series and each weighing more than two tons. These, however, were finally replaced by seventy metre lengths of impregnated hemp ropes in series with insulators. These gave a long leakage path, high resistance to puncture, and ample mechanical strength. The spark gap was also replaced by the gap between an arrangement of two parallel wires. Discharges eighteen metres long were obtained, but the maximum pressure could not be measured as a wide enough air-gap could not be obtained. It was computed to be more than ten million volts. Simultaneously with the research work, useful commercial work at high voltages is being carried out.

Capture of Electrons by α-Particles.—Some very interesting results for the neutralisation of α-particles are reported by Prof. Bergen Davis and Mr. A. H. Barnes in a preliminary paper in the first July number of the *Physical Review*, which is now being issued twice monthly. Parallel beams of electrons and α-particles were passed through an exhausted vessel, and the final composition of the beam examined by analysis in a magnetic field. The number of α-particles which were partly neutralised was found to vary in a remarkable way with the relative velocities of the α-particles and electrons, and it appears that capture of an electron by an α-particle does not occur unless the electron, as seen from the α-particle, has almost the exact speed which it would possess in one of the circular quantised orbits of singly ionised helium. The curve showing the percentage of captures against the energy of the electrons is composed entirely of sharp peaks, one of which corresponds to zero relative velocity of the particles, and the others to capture in orbits with quantum numbers between one and eleven. This work raises important theoretical questions, and both the experimental methods and the interpretation put upon the results will no doubt be subjected to a searching scrutiny when they are published in detail.

Chlorides of Sulphur.—The *Journal of the Chemical Society* for July contains an interesting communication from Prof. T. M. Lowry and G. Jessop on the optical properties of liquids containing sulphur monochloride (S_2Cl_2) and chlorine. A previous investigation by the freezing-point method, published in 1927, showed that sulphur dichloride, SCl_2, has a definite range of stability and can be frozen out as a crystalline solid from a liquid of suitable composition. A new chloride, S_3Cl_4, in addition to the previously known SCl_4, was also indicated on the freezing-point diagrams. There is no maximum at the composition of SCl_2, as the compound dissociates as it melts. The present experiments, based on a study of molecular extinction coefficients, show that whilst SCl_4 is the stable solid phase from 65 to 100 atoms per cent of chlorine, it is almost non-existent in the liquid state. The garnet-red liquid produced by chlorinating sulphur monochloride consists almost entirely of the monochloride and dichloride. The usual opinion that the liquid dichloride is a mixture of tetrachloride and monochloride is shown to be incorrect. The liquid dichloride is dissociated to the extent of about 16 per cent at atmospheric temperature: $2SCl_2 \rightleftharpoons S_2Cl_2 + Cl_2$.

A Qualitative Reagent for Sodium.—The difficulty of obtaining positive evidence for the presence of sodium in qualitative analysis is well known, and the description, by E. R. Caley in the July number of the *Journal of the American Chemical Society*, of a new reagent which precipitates sodium is therefore of interest. The reagent is made as follows: One solution is prepared from 40 gm. crystallised uranyl acetate, 30 gm. glacial acetic acid and water to 500 c.c., and a second solution from 200 gm. crystallised cobalt acetate, 30 gm. glacial acetic acid and water to 500 c.c. Each solution is separately warmed to 75° until all is in solution; then they are mixed at this temperature and allowed to cool to 20°, being kept at this temperature for an hour. The reagent is then filtered through a dry filter into a dry bottle. It keeps indefinitely. The sodium solution should be as concentrated as possible, and to 2 c.c. of it are added 10-20 c.c. of the reagent. The test-tube is stoppered, shaken vigorously for two or three minutes, and allowed to stand at least five minutes. A yellow precipitate indicates sodium. In qualitative analysis the filtrate from Group IV. (alkaline earths) is acidified with dilute sulphuric acid, evaporated, the ammonium salts fumed off and the residue dissolved in 2 c.c. of water. One portion is tested for potassium with cobaltinitrite and the other for sodium as described. Two milligrams of sodium give an immediate precipitate, one milligram after standing an hour or two.

Steam Turbine Progress.—In a paper read at Johannesburg on July 31 before Section G (Engineering) of the British Association, and published in *Engineering*, Aug. 16, Sir Charles Parsons referred to the growth in size of turbo-alternators and to modern developments in steam turbines. The first turbo-alternators in South Africa were three 135-k.w. sets supplied to a company at Cape Town in 1901; the largest sets to-day are the four 20,000 k.w. machines at the Witbank Power Station. A 30,000 k.w. unit is under consideration for Vereeniging. Recent developments leading to increased fuel economy and output per unit include higher steam pressures and temperatures, regenerative heating of the feed water, the use of air preheaters and economisers, reheating of the steam after partial expansion, improvements in surface-condenser design, and new methods of winding stator conductors. New methods have also been introduced for producing sound ingots for the turbine shafts and alternator rotors. Development in marine work is indicated by the fact that there are now built or building mercantile installations of about 500,000 total horse-power, with boiler pressures ranging from 350 lb. to 550 lb. and steam temperatures of 700° F., and more than 650,000 h.p. for war vessels, with steam pressures ranging from 325 lb. to 500 lb. and steam temperatures of 600°-750° F.

The Zimbabwe Ruins.

FURTHER details of Miss Caton-Thompson's excavations in Rhodesia on behalf of the British Association have now reached England by mail. They confirm the brief outline of her results conveyed by cable. The detailed evidence contained in the report presented to Section H (Anthropology) when the Association met at Johannesburg may be taken to place the question of the origin and dating of the Zimbabwe ruins beyond dispute. Miss Caton-Thompson's report was presented to a crowded audience, among whom was the president of the Association, Sir Thomas Holland, and not only was it necessary that it should be relayed, but also the lecture had to be repeated afterwards at an evening meeting.

Miss Caton-Thompson's conclusion as to the relatively modern date and native origin of these ruins in no way detracts from the wonder with which we cannot but regard this remarkable assemblage of structures. Indeed it must heighten it, for although she finds the technical skill displayed and the structural perfection somewhat less than has sometimes been asserted, the extent and character of the ruins still point to an ability and a capacity for organisation on a large scale which are justly considered remarkable in an indigenous people.

Miss Caton-Thompson came to the investigation of the Zimbabwe ruins with great advantages. Apart from her experience as an excavator, she had the results of many previous investigators, including Bent and Randall-MacIver, before her. The excavations of Randall-MacIver, made twenty-four years ago, were peculiarly important, as they were the only investigations made by a competent trained archæologist. Miss Caton-Thompson, therefore, felt herself justified in accepting his facts, while ignoring his conclusions, in carrying out her own investigations. It may, however, be borne in mind that Randall-MacIver had found medieval objects, especially Chinese porcelain, and pottery, iron, and other objects of native origin in strata which were contemporary with the buildings. In particular, he found that such objects were contemporary with and an integral part in time of the cement floor upon which R. N. Hall, by whom he was most strenuously attacked, had relied for his evidence of an earlier date. Randall-MacIver's conclusion, therefore, was that the ruins were medieval. Conclusive as was the argument to anyone trained in archæological methods, it did not obtain general acceptance in South Africa. It was maintained that the investigation was hurried and not sufficiently wide in scope, that evidence had been misinterpreted, and that Randall-MacIver's knowledge of indigenous culture was not adequate to enable him to pronounce a judgment. It is to be noted that he is completely vindicated by Miss Caton-Thompson's results.

In one respect the present investigation was hampered by previous work. Enthusiastic amateurs had attacked most of the best sites, and Miss Caton-Thompson was for a time at a loss as to which site would serve her purpose. Her main object, as defined by herself, was to check the exact relationship of the lowest occupation layers beneath the original cement floors to the main walls of the Elliptical Temple at Great Zimbabwe. It was therefore necessary to choose a site unquestionably as old as the Elliptical Temple of Great Zimbabwe, and also a site which showed an intact cement floor. On such a site it should have been possible to demonstrate whether the walls were contemporary with a pre-medieval level. As neither the well-known ruins at Dhlo-Dhlo nor Great Zimbabwe itself complied with both these conditions, the Maund buildings in the Valley of Great Zimbabwe were selected. Though in ruins, the walls showed all the characteristics of Great Zimbabwe, and were held to belong to the oldest group.

A trench was dug from wall to wall to test the stratification. It was found that beneath a thin skin of humus was ten inches to a foot of hard cement formed of pulverised granite, which in turn overlay 2 ft. 6 in.–3 ft. of a brown-red soil of natural origin—hill wash—containing charcoal, sherds, iron slag, etc. Upon this the walls were actually built, and this was found to be the case, except in one instance, with every one of the 29 segments of wall in the ruins. This occupation layer rested upon virgin soil, and as the walls were built upon it, it afforded exactly the evidence which was sought.

Of the material found *in situ*—as much *in situ*, as Miss Caton-Thompson put it, as "any ever will be this side of heaven"—there were 448 potsherds in small fragments, of which 40 were rims. Four hundred and eighteen were in coarse red-brown ware, gritty, with quartz particles, from which the slip, or other surface, had disappeared owing to damp. There was also a small class of plain black polished ware, indistinguishable from that found through the higher levels. Ware similar to the coarse red-brown ware was found by Dr. Randall-MacIver at Niekerk, near Umtali—ruins which he judged to be rather older than Zimbabwe.

A certain amount of iron was found and lumps of iron slag were distributed throughout; no smelting furnace was found. There were also a small number of iron weapons and an axe head from this pre-wall stratum. A few fragments of bangles of flat bronze wire coiled over grass fibre were also discovered of a type familiar at all levels in the Rhodesian ruins. It was pointed out by Miss Caton-Thompson that at this stage none of these objects is dateable, but they are typically Bantu in character.

A series of pavements of granite slabs about 4 inches thick and forming causeways about 2 feet wide, were found resting on the virgin soil, and in one place running under the foundations of the entrance. Pottery and slag were found actually in contact with this pavement, but, it was concluded, it afforded no evidence of occupation prior to the building, but was a pavement laid down for convenience, exactly similar to the device employed by natives to-day preparatory to building.

Up to this point, no article not of native manufacture had been found. Attention was now turned to Great Zimbabwe and in the first place to the middens. It was found that at a depth of about 12 ft. 6 in., clay passed into black midden with quantities of split animal bones, especially ox, of no very ancient aspect; between 13 ft. 6 in. and 15 ft. came two pots of undecorated native ware, six pottery phalli, and fragments of bronze wire bangles, and at 18 ft. on rock bottom were two more pots of ordinary Bantu type, to be paralleled from any Rhodesian ruins. In another similar investigation a curious stone structure was encountered, and beneath it, from under a pavement of granite slabs at from 15 ft. to 17 ft. beneath the surface, were found three fragments of iron tools, iron slag, a white porcelain bead on copper wire, and 80 other beads in coloured opaque glass, this at a level five times as deep as the finds at Maund. They therefore represent the earliest period of debris of the Zimbabwe "Acropolis".

Extensive work in the neighbourhood of the

Elliptical Temple produced strictly comparable results. The Conical Tower of Zimbabwe was also attacked with the consent of the Rhodesian Government; a tunnel was driven through from side to side, exposing a width of 3 ft. to 4 ft. to bed rock. It was found to rest without any preparation whatsoever on 6 ft. 6 in. of sandy yellow subsoil similar to that under the Maund ruins. The first find was a beautiful early stone implement. The soil was sieved, but all that it produced was a small iron band, a minute gold bead, traces of wire bangle, and a small sherd of the usual black polished pottery. The workmanship is haphazard, the foundations have not been levelled, and hence to counteract a fall of 1·9 ft. in a diameter of 18 ft. 4 in., the upper courses have had to be thickened.

As regards dating, a larger number of beads has been obtained than ever before, possibly owing to the use of the sieve. Although a full report on them has not yet been received, they include types from southern India, definitely considered to be not later than A.D. 900. Others are found in ruins of villages in Malaya and Borneo, and are assigned to a period between A.D. 600 and A.D. 1100. Dr. Randall-MacIver's evidence from objects of foreign origin gave comparable dates ranging to the sixteenth century. The evidence of the two investigations may be regarded as complementary; one fully substantiates the other. As to the Semitic origin of the ruins, there can be no question, in Miss Caton-Thompson's view, that they are typically Bantu. This, however, does not eliminate their interest. As the author said in the remarks with which she concluded her report: "Instead of a degenerate offshoot of a higher Oriental civilisation best studied in its homeland, you have, I believe, a vigorous native civilisation, unsuspected by all but a few students, showing national organisation of a high kind, originality, and amazing industry. It is a subject worthy of all the research South Africa can give to it; South African students must be bred to pursue it."

The Chilean Earthquake of 1922.

IN studying the great Chilean earthquake of Nov. 10, 1922, Prof. Bailey Willis has been led to some interesting conclusions with regard to the origin of the great earthquakes of Chile and Peru. Invited by the Carnegie Institution to study the earthquake, he spent seven months in Chile, five of them in the province of Atacama, in which the earthquake attained its greatest strength. The results of his work are described in a volume of unusual interest and value.[1]

The northern part of Chile consists of the desert region of Atacama. In climate and topography it closely resembles southern California. It is a region of interior basins, of salt plains and sterile mountains, one of the most arid districts of the world. Both countries are similarly situated with regard to the deep ocean basin of the Pacific and the high cordilleras to the east. In Chile, however, there is no great longitudinal river system as there is in California. The rivers flow from the Andes direct to the sea in channels that are in places divided by mountain ranges of considerable altitude.

In the last four centuries, from 1543 until 1922, the province of Atacama has been visited by 22 destructive earthquakes, the last but one, on Dec. 4, 1918, especially strong at Copiapó. During the month preceding the earthquake of 1922, from Oct. 4 until Nov. 8, there was general activity throughout the entire length (1500 miles) of the earthquake zone of Chile and south Peru, no fewer than eight earthquakes of unusual strength, though of limited incidence, having occurred within it. Then came the great earthquake at about 11.45 P.M. on Nov. 10 (4h. 32m. 33s., A.M., Nov. 11. G.M.T.).

The earthquake was remarkable more for the extent of its area of disturbance than for its intensity at any point within it. From some rough estimates made by Prof. Willis, it would seem that the maximum acceleration was about 3000 mm. per sec. per sec., and it nowhere attained so high a value as 4800 mm. per sec. per sec. In other words, the shock was about as strong as that of the Japanese earthquake of Sept. 1, 1923. But while the disturbed area of that earthquake does not appear to have exceeded 166,000 square miles, the Chilean earthquake was violent over a zone not less than 300 miles in length, from La Serena to Potrerillo; it was fairly strong within an area reaching from Iquique to Concepcion (1250 miles); it was readily perceptible over an area of about two million square miles, including Buenos Aires to the east and the island of San Felix to the west. A disturbed area so extensive points, of course, to an unusual depth of origin.

Within the central area there were wide and rapid variations of intensity, the destruction, as usual, being greatest on marshy ground and least on rocky spurs. But part of the irregularity was also due to the occurrence of fault-lines, along which the shock was most violent, possibly from the occurrence of secondary shocks. It was found impossible to draw isoseismal lines, not only because records of intensity were scanty, but also because there was no central region surrounded by zones of decreasing strength. Copiapó and Vallenar, for example, are 87 miles apart and they are built on similar subsoils. At both places the intensity was very great and approximately the same, while between them are villages, built of essentially the same materials, that suffered little or no damage.

In California, the earthquake-faults are vertical planes. The movements that have given rise to earthquakes are partly upwards and partly horizontal, but while the total uplifts are to be measured in hundreds of feet, the horizontal shifts are to be reckoned in miles. In Chile, Prof. Willis could find no proof of the existence of such faults. He therefore supposed, as Mr. R. D. Oldham had supposed thirty years before,[2] that the earthquake might be connected with a compound structure consisting of a great major thrust at a depth of some miles with minor thrust-planes running up to the surface. In his search for such a structure, he found that the whole district from La Serena to Potrerillo is a zone of minor thrust-faults, fourteen of which were found to run nearly parallel to one another at distances of from 2½ to 12 miles apart. The total width of the faulted zone in the latitude of Copiapó is about 100 miles, but the zone may extend westwards beneath the ocean and eastwards among the mountains. The outcrop of the great major thrust was not seen by Prof. Willis, but its existence has been recognised by other geologists along the eastern base of the Andes.

Prof. Willis thus concludes that the earthquakes of Chile are of tectonic origin and are independent of

[1] "Studies in Comparative Seismology: Earthquake Conditions in Chile." By Bailey Willis. With Contributions by J. B. Macelwane, Perry Byerly, Johannes Felsch, and H. S. Washington. (Publication No. 382.) Pp. xi+178+75 plates. (Washington, D.C.: Carnegie Institution, 1929.) 5.50 dollars.

[2] India, *Geol. Surv. Mem.*, vol. 29, 1899, pp. 164-179.

volcanoes. They are due, he thinks, to extensive movements along a major thrust or thrusts, which originate beneath the Pacific Ocean basin and rise gently to their outcrop. These surfaces of rupture are of vast extent; it is possible that their area may amount to hundreds of thousands of square miles. There may also have been movements along the minor thrust-faults, for the shock was strongly felt at many places along their outcrops, but, so far as Prof. Willis was able to observe, there do not seem to have been any displacements left visible at the surface.

C. DAVISON.

Dibranchiate Cephalopods of Japanese Waters.[1]

A STUDY of the late Dr. Sasaki's monograph is a sufficient reminder that the death of this accomplished specialist was a serious loss to systematic zoology. The writer of this review wishes to take the opportunity of expressing his feeling of personal loss and his appreciation of Dr. Sasaki's courtesy and kindness.

This monograph is devoted to the cephalopods of Japan and the area between Bering Straits and the Bonin Islands and Formosa. It embodies the results of a study of no less than 10,000 specimens, which must be the largest collection of cephalopods ever handled by a single investigator. The cephalopods of Japan have been studied in the past by able systematists such as Appellöf, Wülker, and Stillman Berry. We have, however, for a long time required a critical study of this fauna.

The chief importance of Dr. Sasaki's work lies in the fact that it provides this intensive and critical study. The author deals with 125 species referable to 52 genera. Each species is very exhaustively described, and the author does not confine his attentions to the external parts, 'gladii', etc., which have been usually the principal objects of taxonomic study. In many instances he describes internal structures (radula and reproductive organs) which have been too often neglected. He supplies valuable tables of measurements by which the variation of the species may be assessed, and the copious and admirably clear text-figures are a noteworthy feature of the volume. This is work of a kind that is always needed and is perhaps too little forthcoming in the study of a group like the cephalopods. Concurrently with the output of descriptions of new species, etc., we require a constant critical taxonomic revision, a deeper exploration of anatomical features and a fuller analysis of variation, in order that our genera and species may as nearly as possible reflect the divergences in the natural populations from which our material is abstracted.

In his treatment of the broad outlines of classification, Dr. Sasaki does not depart from the lines laid down by earlier workers, and one could have wished that he had discussed decapod phylogeny and classification to some extent. He does not accept Naef's threefold division of the Decapoda, but retains the older and unsatisfactory Myopsida and Egopsida. He divides the Octopoda into Pinnata and Apinna, which are exactly equivalent to Grimpe's earlier Cirrata and Incirrata. Sasaki's names, however, may eventually prove more appropriate, as Berry's *Lœtmoteuthis* (in most respects a 'cirrate' form) seems to be devoid of cirrhi.

Sasaki's amplified account of the rare octopod *Watasella* is a very welcome addition to our knowledge of an interesting group intermediate between the Decapoda and Octopoda. He does not, however, discuss the highly important question as to whether the 'filaments' of *Watasella* are homologous with the arms. Finally, he makes valuable additions to our knowledge of the structure and classification of the Pacific octopods, though it is a pity that by an inadvertence which, had he been able to correct the proofs, he would doubtless have remedied, he includes in his definition of *Polypus* (=*Octopus*) "Nor (*sic*) cartilaginous stylets present internally". The "cartilaginous" (chitinous) stylets of *Octopus*, last vestige of the shell, have been figured in several species.

G. C. R.

[1] *Journal of the Faculty of Agriculture*, Hokkaido Imperial University, Sapporo, Japan. Vol. 20, Supplementary No.: "A Monograph of the Dibranchiate Cephalopods of the Japanese and adjacent Waters". By Madoka Sasaki. Pp. v+357+30 plates. Tokyo: Maruzen Co., Ltd., 1929.

Copals and Damars.

AT a recent meeting of the Royal Society of Arts an interesting paper on East Indian copals and damars was presented by Mr. A. F. Suter, which has appeared in *Jour. Roy. Soc. Arts*, vol. 77, April 19. The distribution of resiniferous plants is world-wide. Of the resins known to commerce the two chief groups are the copals and the damars. This division of the major resins is somewhat arbitrary, being based upon the difference of their physical characteristics, but is, however, quite a useful one.

There are eight commercial copals, their names indicating the country of origin, namely: Macassar or Manilla, Kauri, Congo, Zanzibar or Lindi, Mozambique or Inhambane, Sierra Leone, Angola (Benguela), and Demerara. The first two are obtained from species of *Coniferæ* (*Agathis*), whilst all the others come from leguminous species of trees. The damar-producing trees all belong, so far as present known, to the order *Dipterocarpaceæ*. They are largely collected in the Federated Malay States, Sumatra, and Borneo.

Considerable confusion has existed in the past on the subject of copals and damars. Mr. Suter states that the name copal, which is the Mexican for resin, is unknown in the East, where both copals and damars are known as damar, the Malay name for resin or a torch made of resin. In Europe, in the trade, both groups have been erroneously called gums, on account of their physical similarity to true gums. The author's paper mainly concerns copals, and deals chiefly with Macassar or Manilla copal which is obtained from *Agathis alba*, where it occurs most commonly in the Dutch East Indies; the tree is also found in the Celebes, the Moluccas, Borneo, Sumatra, and New Guinea. It is also present in the Philippines, where it is exploited, and in the Federated Malay States, where the resin is not as yet collected. The *Agathis* has characteristics in common with the Araucaria, and Mr. Suter deals at length with the tree and its habitat, the nature of the resin, and the methods of tapping the trees.

The various types of Macassar copal known in the trade are (*a*) hard or fossil copal, of unknown but often very great age, and very hard, (*b*) half-hard copal, less hard and much younger, (*c*) soft or spirit-soluble copal. The first is found either in the crotches of branches in old trees or else dug from the ground under old trees or where trees at one time existed; the other two are of recent origin, and are obtained by tapping the trees. Mr. Suter directed attention to the very efficient Dutch Forestry Department, which has studied the copal business and industry with great thoroughness.

University and Educational Intelligence.

THE thirteenth series of "Methods and Problems of Medical Education" has been issued by the Rockefeller Foundation of New York. It is in the same form as previous issues and is entirely devoted to a description of the various medical departments of the Vanderbilt University School of Medicine, Nashville, Tennessee.

A SERIES of lectures during the Michaelmas and Lent terms on general science—or better, perhaps, on aspects of modern scientific thought—has been arranged by University College, Cardiff. The lectures, by various members of the staff of the College, are delivered on Saturday mornings at noon, beginning on Oct. 5. The lectures are not free, but are open to members of the public.

OF sixty-eight doctorates the conferment of which was notified in the *London University Gazette* of July 31, thirty-seven were in the faculty of science, as follows: ten in chemistry, five in botany, three in bacteriology, two each in anthropology, biochemistry, geology, psychology, and zoology, and one each in agricultural chemistry, chemical technology, economics, education, physics, physiology, and statistics. Of the recipients of these degrees thirteen were students of the Imperial College of Science and Technology, nine of University College, and four of King's College. Of fifty-nine Ph.D. degrees, thirty were in the faculty of science, sixteen in arts, eight in economics, and five in engineering. This distribution of doctorates among the various branches of science may be compared with the following distribution of American university doctorates in 1927–28: chemistry 269, zoology 89, physics 78, psychology 66, botany 61, mathematics 44, geology 35, agriculture 31, pathology 31, bacteriology 29, engineering 28, physiology 28, other subjects 44.

AT the world conference on 'New Education' held at Elsinore, Denmark, during August under the auspices of the New Education Fellowship, reports on examinations were submitted to the Examinations Enquiry Committee from 22 different countries. Dissatisfaction with the examination systems as conducted in their respective countries was generally expressed by the delegates. Among the principles adopted by the Committee were the following: Scientific inquiry into the examination system is necessary, possibly on the lines of that started in England by the New Education Fellowship in co-operation with teachers' organisations. A rigid mechanistic type of external examining and supervision interferes seriously with good teaching. Teachers should take an active part, both as individuals and in their corporate capacity, in examination procedure and reform. In any inquiry undertaken there must be consideration of (1) a newer philosophy and method in education; (2) the expanding programme of publicly supported education; (3) the changing curriculum; (4) the more recent developments in psychology, particularly available evidence on the emotional effects of the present examination system; (5) the practical experience in pioneer schools in different countries; (6) the scientific measurement movement with its efforts on behalf of new-type examinations. As to examinations for entrance to universities and higher technical institutions, it will undoubtedly be necessary to devise more adequate methods of selection. The authorities should give careful consideration to the desirability of taking into account various measures of the candidate's ability to profit by university study, such as the judgment of the teachers and the record of school work. Experiments that have been made in practically unrestricted admission to university study in several countries should also be examined.

Calendar of Patent Records.

September 8, 1832.—The patent granted on Sept. 8, 1832, to Richard Badnall for his new system of railway in which great economy of working was to be obtained by running the trains on an undulating track having long descents and comparatively short ascents, aroused a lengthy discussion, sponsors and opponents of the scheme having a battle royal in the pages of the *Mechanics' Magazine* and other journals throughout the years 1833 and 1834. Experiments were actually carried out on a section of the Liverpool and Manchester Railway with Stephenson's *Rocket* and other locomotives, but proposals for further trials of the system were abandoned.

September 9, 1829.—T. S. Brandreth's patent, dated Sept. 9, 1829, for "a new method or methods of applying animal motion to machinery" covers the invention of his 'cyclopede' locomotive which ran during the celebrated Rainhill locomotive trials, the centenary of which occurs next month. The 'cyclopede' was worked by two horses moving an endless platform with their feet, and at the trials, with a gross weight of about 5 tons, travelled with its load at 5 miles per hour. The horses themselves actually walked at the rate of 1¼ miles an hour.

On the same day, Sept. 9, 1829, there was granted to James Soames a patent for the separation of coconut oil into its solid and liquid constituents, which laid the foundation of the present-day firm of Price's Patent Candle Co., Ltd. The patent was purchased in 1830 by Edward Price and Co. for the purpose of using the coconut stearin as a substitute for tallow in the production of a cheap candle. The use of the material itself did not prove satisfactory, but a half-and-half mixture with tallow was more successful, and the 'composite candle' put on the market for the first time in 1840 was immediately popular. The patent was extended for three years from 1843, and the business was acquired by the present company four years later.

September 10, 1856.—Sir William Siemens' application for a patent on Sept. 10, 1856, included a provisional specification in which was described for the first time a 'drum-wound' armature of the kind afterwards used in the Siemens' dynamo, as suggested to him by his brother Werner. The application was not proceeded with, and the patent was not granted.

September 11, 1828.—One of the most important improvements in metallurgy was the introduction of the hot-blast in iron-smelting, which was patented by James Beaumont Neilson on Sept. 11, 1828, and was first demonstrated at the Clyde Ironworks in Glasgow the following year. The actual invention of the use of the hot-blast has been with some reason attributed to Robert Stirling, who describes its use for the purpose of economising fuel in glass furnaces in his patent of 1816, but prior to Neilson's patent there was no commercial application to the making of iron. In fact, the iron-masters had been convinced of the superiority of the cold-blast because the furnaces were known to have a greater production in winter than in summer. Neilson's rights were hotly contested, but the litigation, which came to an end only in 1843, resulted in Neilson's favour.

September 11, 1876.—The Jablochkoff 'electric candle', one of the earliest successful arc lamps, was the subject of a patent application made on Sept. 11, 1876. The application was not completed, but a patent was sealed on a second one made a few months later. The lamp, which for a time was extensively used, comprised two parallel carbons cemented together and insulated one from the other by a mass of kaolin, and required a 'bridge' to start it.

Societies and Academies.

CAPE TOWN.

Royal Society of South Africa, June 19.—Sir Thomas Muir: The literature of Cayleyan matrices.—A. Ogg: The space group and symmetry of potassium, ammonium, and rubidium sulphates. Taylor and Boyer have confirmed the space group for ammonium and cæsium sulphates, and have given an atomic structure which is substantially the same as that given by the author. The space group V_h13 given by F. P. Goeder for potassium, rubidium, and cæsium sulphates is untenable; the space group is V_h16, as originally determined by the author and confirmed by Taylor and Boyer.—W. Pugh: Germanium dioxide in aqueous solution; germanic acid. Germanium hydroxide is truly amphoteric. As an acid, it forms the more characteristic series of salts, the germanates; as a base, it forms the less stable series of salts with the halogen acids. Electrometric titrations of sodium germanate solutions show that germanic acid is a dibasic acid; the existence of sodium bi-germanate in solution has been established. The degree of hydrolysis of sodium germanate has also been measured at various dilutions.

GENEVA.

Society of Physics and Natural History, June 20.—H. Lagotala: The geology of the region comprised between the Combabet and the eastern Luvisi. The author has recognised in this region, between the sandstone grit plateaux of Tchicoumba and Cataractes, a system of folds and fractures presenting two orientations. The limestone-schist series underlying the grit is strongly folded on the edge of the grit plateaux; in the interval between the two plateaux it is undulated. Under the grits this series is much more even.—M. Gysin: The geological profile of Mount Passa at the Cataractes plateau. The author has made a petrographical study of different varieties of conglomerate grits, of siliceous limestones, and of foliated limestones. He distinguishes two conglomerates, one in the grits and near their base, the other between the limestones and the grits. His observations confirm, on broad lines, the observations of Delhaye and Sluys.—R. Berner: The magnitude of a force which tends to displace the continents towards the west. The author sets out to control by calculation the hypothesis of Wettstein on the retarding action exercised by the lunar-solar attraction on the terrestrial crust relatively to its viscous substratum. The ratio of this force acting on an element of continent to the terrestrial attraction exercised on this same element is $\frac{1}{33 \times 10^9}$, a negligible quantity. Hence this force cannot be a cause of displacement of the continents to the west.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 11).—V. Mitkevič: Anomalous magnetic flux of a toroidal coil (2). The case of an unclosed screen. The author has succeeded in separating the anomalous magnetic flux and in establishing its existence; he has also found some conditions in which the anomalous magnetic flux arises in the form of free magnetic rings.—N. I. Vavilov: Geographical localisation of genera of wheat. The principal world centre of forms of cultivated wheats proved to be in Abyssinia, where as many as two hundred varieties of *Triticum durum* and *T. turgidum* and more than sixty varieties of *T. polonicum*, *T. dicoccum* and *T. vulgare* have been found. The second centre of wheat varieties is in the restricted area at the southern foothills of the eastern Hindu Kush and of the western Himalayas.—M. K. Serebrennikov: Review of the beavers of the Palearctic region. Five subspecies of *Castor fiber* L. are recognised by the author, namely, *C. fiber fiber* L., in Sweden; *C. f. elbicus* Matschie, in Central Europe; *C. f. vistlans* Matschie, in the basin of the Vistula and the Dnieper; *C. f. pohlei*, sbsp., in the Ural mountains; and *C. f. birulai*, sbsp., in the Mongolian Altai.—A. M. Djakonov: New starfishes from the Okhotsk Sea. (2). *Leptasterias orientalis*, sp. n.

Comptes rendus, No. 12.—N. M. Kryloff and N. N. Bogoliubov. The approximate solution of the problem of Dirichlet.—V. Mitkevič: Total electromotive force of mutual induction.—A. G. Frank-Kameneckij and N. M. Vaksberg. The mineral spring of Gonzha in the Amur region. Analysis of water of the spring.—A. N. Labunčov: Fersmanite, a new mineral from the Khibin tundras. The formula of the mineral is $4RTiO_3 . 2R_2Si(O, F_2)_3 . SiO_2$. Crystals are monoclinous, pseudoquadratic.—W. A. Lindholm: Some new molluscs (Pelecypoda and Gastropoda) from the waters of south-eastern Siberia.

Comptes rendus, No. 13.—P. Lazarev: A phenomenon of adaptation in peripheral vision. The sensibility of visual centres is an adaptation which changes in accordance with the conditions of life.—P. Lazarev and L. Kuper: On the action of ions of bromium on the adaptation of the eye in peripheral vision. Sodium bromide depresses the sensibility of the nervous visual centres.—W. A. Lindholm: Three interesting water-snails (Gastropoda) from western Turkestan. *Lymnæa* (*Cerasina*) *luteola* Lam. sbsp. *oxiana* O. Boettgar is the only Indian species of the genus in Turkestan. *Physa acuta* Draparnaud is a purely Mediterranean species which has been recently found in Turkestan. *Caspia issykkulensis* Clessin is a *Hydrobia* and closely related to the European *H. ventrosa* Montagu. First snails (Gastropoda) from Lake Kosogol in north-western Mongolia. Descriptions of *Limnæa* (*Radix*) *auricularia*, *L. morpha kosogolensis* nov. and *kobeltocochlea michnoi*, sp. n.—E. Miram: Contribution to the knowledge of the genus *Bergiola* Stschelk. (Orthoptera, Tettigonioidea). Redescription of the female of *B. balchaschica* Stschelk. and the description of its hitherto unknown male.—N. Kusnezov: Absence from the Crimea of some elements of the Lepidopterous fauna. The autochthonous fauna of the Crimean peninsula appears impoverished as a consequence of (1) the reduction in the area of the peninsula after the sinking of the Pontian continent, which event made Crimea an island; (2) the cooling of its climate during the glaciation; (3) particularly as a result of a reduction in the post-Pliocene immigration from the east because of the isolation. This absence of certain otherwise widely distributed species and the presence of southern species like *Acronycta pontica* Staud., *Triphœna haywardi* Tams, *Eutelia adoratrix* Staud. makes the Crimean fauna approximate to that of the most southern areas of the Mediterranean region, namely, Crete, Cyprus, and north-west Africa.

Comptes rendus, No. 14.—D. N. Prianishnikov and V. N. Ivanova: The absorption and excretion of ammonia by the roots of plants. Normal plants, with sufficient reserve of carbohydrates absorb ammonia from ammonia nitrate more energetically than they do the nitric acid. When the carbohydrate reserves are exhausted ammonia is excreted by the roots.—D. N. Prianishnikov and S. I. Inozemcev: A contribution to the physiological characteristics of potassium chloride. Potassium chloride is less acid physiologically than ammonium chloride.—M. F.

Neuburg: The stratigraphy and age of coal-bearing deposits of the Kuznetzk basin in Siberia. The fossil flora of the basin is more ancient than the Lower Jurassic. — B. Kupletskij: A mineral of the astrophyllite group from the mountain Urma-Varaka in the central area of the Kola Peninsula. The new mineral differs from astrophyllite mainly in the greater content in silica, lesser content in manganese, and a somewhat lesser content in alkalis. In true optical characters it is near lavenit and lamprophyllite.— K. A. Rassadina: A new species of *Umbilicaria* from Siberia, *Umbilicaria pertusa*, sp. n. A species from the shores of Lake Baikal is described.

SYDNEY.

Linnean Society of New South Wales, June 26.— H. G. Raggatt: Calcareous concretions in the Upper Marine Series, Singleton District, N.S.W. Attention is directed to the occurrence of calcareous concretions having an average size of 10 ft. by 8 ft. in plan, by 55 ft. vertically, on a horizon 250 ft. above the Muree beds. They have been noted over an area of 220 square miles. The concretions are considered to have been formed contemporaneously with the enclosing rock in an isolated shallow sea subject to the influx of cold water, the main factor operating to produce continuous deposition being the inverse relation between temperature and the solubility of calcite.—F. W. Edwards: Notes on the Ceroplatinæ, with descriptions of new Australian species. One genus, twelve subgenera of *Platyura*, and one subgenus of *Heteropterna*, and four species are described as new. Keys are given to the subgenera of *Platyura* and of *Ceroplatus*.—Ida A. Brown: A garnet-bearing dyke near Moruya, N.S.W. A record is given of a basaltic dyke outcropping on the coast of New South Wales, ten miles south-east of Moruya, which contains fragments of basic and ultrabasic plutonic rocks, including particularly pleonaste-bearing pyroxenites and large xenocrysts of red garnet, brown hornblende, augite and basic plagioclase, which probably constituted a coarsely crystalline garnet-bearing eucrite. The inclusions are most probably truly xenolithic in origin, and not comagmatic with the basalt; their inclusion in Cainozoic hypabyssal rocks may be due to special tectonic conditions which prevailed over the tablelands and coastal area of eastern Australia during late Tertiary time.

Royal Society of New South Wales, July 3.—I. W. Wark: An extension of the conception of the distribution coefficients. A general thermodynamic treatment of physico-chemical equilibria based upon an extended conception of the distribution process. Initially, relations are demonstrated for the change of the distribution coefficient with temperature and pressure. From these, quantitative expressions are deduced showing how temperature and pressure changes influence different types of equilibria. One and two component systems, with solid, liquid, and gaseous phases are considered, the treatment being identical for physical and chemical processes. A generalised form of the Clapeyron equation is deduced. It is shown in an appendix that the experimental data for the distribution of bromine between air and water confirm some of the deductions.

WASHINGTON, D.C.

National Academy of Sciences (*Proc.*, Vol. 15, No. 5, May 15).—Jenny E. Rosenthal and F. A. Jenkins: Perturbations in band spectra (1). A theoretical examination of certain bands of the CN system.—E. L. Hill and E. C. Kemble: On the Raman effect in gases. Analysis of experimental results recently obtained for diatomic gases.—A. Sommerfeld: About the production of the continuous X-ray spectrum. Wave-mechanics applied to the continuous spectrum from a thin target.—A. Frumkin and John Warren Williams: The relation between the electric moment and the potential difference at an interface. A discussion of experimental results suggesting that any comparison between these two sets of data can be qualitative only.—Paul S. Epstein and Morris Muskat: On the continuous spectrum of the hydrogen atom. By a new integral representation for the wave function in this special case, expressions suitable for numerical calculations are obtained for the intensities in the continuous spectrum.—F. Rasetti: On a fluorescence spectrum of oxygen. A series of very faint doublets extending from the ultra-violet to the visible and excited by the resonance line λ1849 of mercury which is strongly absorbed in oxygen.—R. J. Lang: On the spectra of Zn II., Cd II., In III., and Sn IV.—Paul Kirkpatrick and Iwao Miyake: Polarisation of the tungsten L radiations. No polarisation of any line was found; one per cent polarisation would have been detected.—John Warren Williams and Alexander Hollaender: A study of the Raman effect in acetone. —M. H. Stone: Linear transformations in Hilbert space: (2) Analytical aspects.—Raymond Pearl, Florence Barclay White and John Rice Miner: Age changes in alcohol tolerance in *Drosophila melanogaster*. For adult flies, the time to reach a definite stage of anæsthesia under a constant dosage of alcohol vapour decreases with age, rapidly at first and then more slowly; the time for complete anæsthesia is generally shorter for females than males. The time-age curve is similar to that of Gompertz for the progress of senescence and also to that for the change with time of surface tension of colloids.—Paul R. Rider: Moments of moments.— Elery R. Becker: Methods of rendering the rumen and recticulum of ruminants free from their normal infusorian fauna. Goats were used. A successful method was to starve the animal for three days, and then give two large doses at 24-hours interval of about 0·4 per cent copper sulphate solution delivered into the rumen by a horse catheter, The animals remain free from infusoria on a diet of alfalfa hay and a grain mixture.—Wilder D. Bancroft and David S. Morton: Monatomic iodine and molecular hydrogen. At temperatures up to 300° C. in the dark, there is very little reaction in glass vessels between iodine and hydrogen; between 300° and 350° there is an enormous increase of reaction velocity. No appreciable photochemical effect was observed. On the other hand, in quartz containers, reaction occurs at ordinary temperatures. Apparently, light in the visible spectrum does not activate hydrogen at the temperatures used, whereas ultra-violet light does. The reaction in the dark at 350° is between thermally produced monatomic hydrogen and molecular (or monatomic) iodine.—Gregory Paul Baxter and Howard Warner Starkweather: The density, compressibility, and atomic weight of argon (2). The argon used in earlier work was found to contain a trace of hydrogen. The new value for the normal density is 1·78394; the limiting density is little affected, so the atomic weight remains 39·944. $(PV)_0/(PV)_1$ is increased from 1·00090 to 1·00107.— Wilder D. Bancroft and Raymond P. Allen: Photochemical temperature coefficients. The curve of photochemical reaction velocity against temperature seems to consist of three parts, one ascending rapidly at low temperatures, the next being nearly horizontal, and the last ascending rapidly with the approach of thermal instability.—Maynard M. Metcalf: The Opalinidæ and their significance. Suggestions for further study of structure and behaviour; their significance in host-parasite distribution studies.

Official Publications Received.

BRITISH.

Records of the Indian Museum. Vol. 30, Part 3: A Revision of the Indian Ixodidae with Special Reference to the collection in the Indian Museum. By M. Sharif. Pp. 217-344+2 plates. (Calcutta.)

Committee of Civil Research. Locust Sub-Committee: First and Second Interim Reports. (Cmd. 3367.) Pp. 14. (London: H.M. Stationery Office.) 3*d*. net.

The North of Scotland College of Agriculture. Calendar, Session 1929-1930. Pp. viii+123. (Aberdeen.)

(University of London): County Councils of Kent and Surrey. The Journal of the South-Eastern Agricultural College, Wye, Kent. No. 26. Pp. 223. (Wye.) 8*s*. 6*d*.; to Residents in Kent and Surrey, 4*s*. 6*d*.

County of Northumberland: Education Committee. County Agricultural Experiment Station, Cockle Park: Guide to Experiments for 1929. Report by Prof. Clement Heigham. (Bulletin No. 42.) Pp. 66. (Newcastle-upon-Tyne.)

Bishop's Stortford College. Report of the Proceedings of the Natural History Society, 1928. Pp. 24. (Bishop's Stortford.)

Administration Report of the Travancore Government Museum and Public Gardens for the Year 1103 M.E./1927-28 A.D. Pp. iii+19. (Trivandrum: Government Press.)

Norman Lockyer Observatory. Director's Annual Report, April 1, 1928–March 31, 1929. Pp. 8. (Sidmouth.)

Ceylon Journal of Science. Section E: Mathematics, Physics and Meteorology; including Bulletins of the Colombo Observatory. New Series, Vol. 1, Part 3, July 5th. Edited by A. J. Bamford. Pp. 173-240 +33 plates. (Colombo: Observatory; London: Dulau and Co., Ltd.) 3 rupees.

Union of South Africa. Department of Mines and Industries: Geological Survey. The Geology of the Postmasburg Manganese Deposits and the Surrounding Country: an Explanation of the Geological Map. By Dr. Louis T. Nel. Pp. 109+12 plates. 10*s*. 6*d*. (including Map). The Geology of the Major Portion of East Griqualand: an Explanation of Cape Sheet No. 35 (Matatiele.) By Dr. Alex L. Du Toit. Pp. 36. 5*s*. (including Map). (Pretoria: Government Printer.)

Proceedings of the Edinburgh Mathematical Society. Edited by Prof. H. W. Turnbull and Dr. W. Saddler. Series 2, Vol. 1, Part 4, July. Pp. 189-257. (London: G. Bell and Sons, Ltd.)

Proceedings of the Cambridge Philosophical Society. Vol. 25, Part 3, July. Pp. 255-367. (Cambridge: At the University Press.) 7*s*. 6*d*. net.

Union of South Africa: Department of Agriculture. Science Bulletin No. 69: A Study of some *Alternarias* affecting *Citrus* in South Africa. By E. M. Doidge. Pp. 29. (Pretoria: Government Printer.) 3*d*.

Report of the Director of the Royal Observatory, Hong Kong, for the Year 1928. Pp. 17. (Hong Kong.)

Aeronautical Research Committee. Report for the Year 1928-29. Pp. 63. (London: H.M. Stationery Office.) 2*s*.

The Journal of the Institution of Electrical Engineers. Edited by P. F. Rowell. Vol. 67, No. 392, August. Pp. 937-1064+xxxiv. (London: E. and F. N. Spon, Ltd.) 10*s*. 6*d*.

FOREIGN.

United States Department of Agriculture. Farmers' Bulletin No. 1586: The Southern Pine Beetle; a Serious Enemy of Pines in the South. By R. A. St. George and J. A. Beal. Pp. ii+18. 5 cents. Farmers' Bulletin No. 1595: The Bollworm or Corn Ear Worm as a Cotton Pest. By F. C. Bishopp. Pp. ii+14. 5 cents. (Washington, D.C.: Government Printing Office.)

Bulletin of the Earthquake Research Institute, Tokyo Imperial University. Vol. 7, Part 1, June. Pp. 191+9 plates. (Tokyo.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. 81. The Orthoptera of Colorado. By Morgan Hebard. Pp. 303-425+ plate 11. Notes on the Statoblasts and Polypids of *Pectinatella magnifica*. By Chandler M. Brooks. Pp. 427-441. New Cuban Urocoptidæ, by Carlos de la Torre; The Locomotion of Urocoptidae and Descriptions of New Forms, by Henry A. Pilsbry. Pp. 443-467+plates 12-16. (Philadelphia.)

Smithsonian Institution: Bureau of American Ethnology. Bulletin 86: Chippewa Customs. By Frances Densmore. Pp. xii + 204 + 90 plates. (Washington, D.C.: Government Printing Office.) 1.60 dollars.

Smithsonian Miscellaneous Collections. Vol. 81, No. 12: Archeological Investigations in the Taos Valley, New Mexico, during 1920. By J. A. Jeançon. (Publication 3015.) Pp. 29+15 plates. (Washington, D.C.: Smithsonian Institution.)

Proceedings of the United States National Museum. Vol. 75, Art. 5: A Generic Revision of the Fossorial Wasps of the Tribes *Stizini* and *Bembicini*, with Notes and Descriptions of New Species. By Prof. John Bernard Parker. (No. 2776.) Pp. 203+15 plates. (Washington, D.C.: Government Printing Office.)

Department of Commerce: U.S. Coast and Geodetic Survey. Special Publication No. 145: Manual of Second and Third Order Triangulation and Traverse. Pp. v+226+23 plates. (Washington, D.C.: Government Printing Office.) 60 cents.

U.S. Department of Commerce: Bureau of Standards. Bureau of Standards Journal of Research. Vol. 2. No. 6, June. Pp. 1001-1211+25 plates. (Washington, D.C.: Government Printing Office.)

Department of Commerce: Bureau of Mines. Coal in 1927. By F. G. Tryon, O. E. Kiessling and L. Mann. (Mineral Resources of the United States, 1927, Part 2.) Pp. x+327-509. (Washington, D.C.: Government Printing Office.) 30 cents.

Department of the Interior: U.S. Geological Survey. Bulletin No. 794: 'Red Beds' and Associated Formations in New Mexico, with an Outline of the Geology of the State. By N. H. Darton. Pp. xvi+356+ 62 plates. 1.30 dollars. Bulletin 801: Geology and Water Resources of the Edgeley and La Moure Quadrangles, North Dakota. By Herbert A. Hard. Pp. v+90+5 plates. 50 cents. Bulletin 803: Geography, Geology and Mineral Resources of the Portneuf Quadrangle, Idaho. By George Rogers Mansfield. Pp. vi+110+8 plates. 40 cents. Bulletin 807: Geology of Hyder and Vicinity, South-eastern Alaska, with a Reconnaissance of Chickamin River. By A. F. Buddington. Pp. viii+124 +14 plates. 35 cents. (Washington, D.C.: Government Printing Office.)

Field Museum of Natural History. Zoology Leaflet No. 10: The Truth about Snake Stories. By Karl P. Schmidt. Pp. 19. 20 cents. Zoology Leaflet. No. 11: The Frogs and Toads of the Chicago Area. By Karl P. Schmidt. Pp. 15+5 plates. 25 cents. Geology Leaflet No. 10: Famous Diamonds. By Oliver C. Farrington. Pp. 27+5 plates. 25 cents. (Chicago.)

Diary of Societies.

FRIDAY, SEPTEMBER 6.

PHILOLOGICAL SOCIETY (at University College), at 5.30.—Sir W. A. Craigie: Lexicography.

CONFERENCES.

SEPTEMBER 8 TO 14.

INTERNATIONAL CONGRESS OF THE WORLD LEAGUE FOR SEXUAL REFORM ON A SCIENTIFIC BASIS (at Wigmore Hall, Wigmore Street).

SEPTEMBER 9 TO 14.

LIBRARY ASSOCIATION (at Brighton).

Lord Balniel: Presidential Address.

Col. J. M. Mitchell: The Small Town in Relation to the County Library System.

A. Esdaile: The Student Reader and his Books.

Discussion on Cataloguing.

L. S. Jast, W. C. B. Sayers, Mrs. A. H. Radice, Miss Belle Rennie, J. W. H. Brown, and F. A. Hughes: Symposium on Children's Reading.

E. Davis and others: Discussion on Books in Elementary Schools.

SEPTEMBER 9 TO 12.

INSTITUTE OF METALS (at Düsseldorf).

Monday, September 9, at 5.—Dr. A. G. C. Gwyer: Aluminium and its Alloys (Autumn Lecture—in German).

Tuesday, September 10, at 9.30 A.M.

Dr. W. Rosenhain: Some Methods of Research in Physical Metallurgy.

G. Masing: Methods of Research in Metallography.

P. Chevenard, A. M. Portevin, and X. F. Waché: A Dilatometric Study of Some Univariant Two-Phase Reactions.

M. Haas and D. Uno: An Improved Differential Dilatometer.

W. H. J. Vernon and L. Whitby: The Open-Air Corrosion and Surface Patina of Copper.

C. O. Bannister: Studies on the Crystallisation of Gold from the Liquid State.

A. G. Lobley: The Creep of 80:20 Nickel-Chromium Alloy at High Temperatures.

Wednesday, September 11, at 9.30 A.M.

W. J. P. Rohn: Reduction of Shrinkage Cavities and Vacuum Melting.

M. Tama: New Methods for Melting Non-Ferrous Metals in the Electric Furnace.

N. F. Budgen: Pinholes in Aluminium Alloy Castings.

O. F. Hudson, T. M. Herbert, F. E. Ball, and E. H. Bucknall: Properties of Locomotive Firebox Stays and Plates.

A. von Zeerleder and P. Bourgeois: Effect of Temperature Attained in Overhead Electric Transmission Cables.

Dr. J. Newton Friend: The Relative Corrodibilities of Ferrous and Non-Ferrous Metals and Alloys. Part II. The Results of Seven Years' Exposure to Air at Birmingham.

C. Blazey: Idiomorphic Crystals of Cuprous Oxide in Copper.

Thursday, September 12, at 8.15 A.M.—Excursion to Krupp Works, Essen.

SEPTEMBER 10 TO 12.

IRON AND STEEL INSTITUTE (at Newcastle-upon-Tyne).

Tuesday, September 10, at 10.15 A.M.

C. S. Gill: Notes on the Damping-Down and Re-Starting of Blast-Furnaces.

A. T. Adam: Notes on Wire for Mining Ropes.

A. Hultgren: Crystallisation and Segregation Phenomena in 1·10 per cent Carbon Steel Ingots of Smaller Sizes.

J. A. Jones: High Elastic Limit Structural Steels.

Wednesday, September 11, at 10 A.M.

J. H. Whiteley: The Coalescence of Pearlite.

H. A. Dickie: The Solubility of Carbide in Ferrite.

T. D. Yensen: Iron-Silicon-Carbon Alloys. Constitutional Diagrams and Magnetic Properties.

T. A. Rickard: Iron in Antiquity.

Thursday, September 12, at 10 A.M.

E. G. Herbert: The Hardening of Superhardened Steel by Magnetism. The Lattice Resonance Hypothesis.

E. Diepschlag and F. Wulfestieg: Electrical Conductivity of Magnesite and some other Refractory Materials in Relation to the Temperature and their other Properties.

H. O'Neill: The Hardness of Vacuum-Annealed Crystals of Iron.

J. H. Smith, C. A. Connor, and F. H. Armstrong: The Correlation of Fatigue and Overstress.

SEPTEMBER 16 AND 17.

BIBLIOGRAPHIQUE INTERNATIONALE (at Imperial College of Science).

Monday, September 16.—Council Meetings.

Tuesday, September 17, at 10 A.M.—Prof. A. F. C. Pollard: Presidential Address.

The agenda will include Further Proposals for the Reorganisation of the Institute, Reports of the Commissions on Cataloguing Rules and on Documentary Technique, and a Discussion on the Possible Unification of the Aims and Objects of International Bibliographical Organisations.