NATURE

A WEEKLY ILLUSTRATED JOURNAL OF SCIENCE.

*"To the solid ground
Of Nature trusts the mind which builds for aye."*—WORDSWORTH.

No. 2571, VOL. 102] THURSDAY, FEBRUARY 6, 1919 [PRICE NINEPENCE.

Registered as a Newspaper at the General Post Office.]

THURSDAY, FEBRUARY 6, 1919.

MIND-STUFF REDIVIVUS.

The Origin of Consciousness. An Attempt to Conceive the Mind as a Product of Evolution. By Prof. C. A. Strong. Pp. viii+330. (London: Macmillan and Co., Ltd., 1918.) Price 12s. net.

THIS is a very important book. Whether or not we are able to accept its thesis, the acute and exhaustive exploration of the problem of knowledge, and the thoughtful and sympathetic criticism it offers of the present-day theories of new realism and of post-Kantian idealism, must be reckoned with. It is some fifteen years since Prof. Strong gave us a book bearing the fascinating title, "Why the Mind has a Body," and the present work is a development of the theory therein expounded. Perhaps we should rather say that it is a continuation of the author's reflections on that theory, for he acknowledges important changes in his view. The influence of Bergson's theory of creative evolution is very evident in this development, although Prof. Strong is not to be classed as a Bergsonian. The title and subtitle of the present volume indicate that influence. Granting that the fact we name consciousness (meaning awareness) is a product of evolution, what sort of stuff must reality be in order that such evolution should be possible? This is the problem. The answer is that it cannot be any kind of body-stuff of which mind is an epiphenomenon, but it must be a kind of mind-stuff of which the body and the physical universe of which it is part and with which it is continuous are an epiphenomenon.

It will be seen, therefore, that Prof. Strong's theory is panpsychism; indeed, he uses the terms "panpsychism" and "mind-stuff" as synonymous. This marks a complete difference from the mind-stuff theory with which the late Prof. Clifford electrified an older generation. Clifford's theory was a form of psycho-physical parallelism. He supposed a mind-stuff or mind-dust dispersed in the universe as widely as physical matter and correlated point to point with it. Dualism in any form is insupportable to Prof. Strong, its rejection is for him axiomatic; indeed, knowledge itself implies the inconceivability of the independent real. While rejecting alike the "direct object" of the naive realist and the "block universe" of the post-Kantian idealist, his own view yet shows so strong an affinity to some forms of new realism (that, for example, which accepts Berkeley's *esse-percipi* principle, but interprets it realistically) that it is sometimes difficult to see wherein the difference lies. What comes perhaps nearest to it, and may very probably have suggested it, is the theory which James described as neutral monism, the theory that consciousness as a stuff or entity does not exist, and that there is one substance which can appear either as physical or as psychical. Prof. Strong, however, rejects the double aspect or two modes theory, and stands definitely for a mind-stuff pure and simple and ultimate.

When we watch a bumble-bee making frantic efforts to escape through a pane of glass, though an open casement may be only a few inches away, we are astonished at what appears to us the creature's stupidity. Is it a similar failure to pay attention to the obvious which dooms to failure our age-long efforts to solve the problem presented in the simple fact of knowledge? It may be, but so far everyone who has cried "Eureka!" has experienced the impossibility, even if he has satisfied himself, of bringing conviction to others. Prof. Strong is not under the illusion that he can solve by a simple formula what has baffled the ages. Our mistake, he tells us, is in supposing that truth must be simple and direct, whereas it is, in fact, complex and infinitely complicated. The main part of his book is a careful and elaborate discussion of difficulties, real and not imaginary, which can be urged against panpsychism.

The thesis itself is simple. What we know directly in sense-perception are essences, not existences. Consciousness is the "givenness" of essences. Existences have absolute spatial and temporal determinations and occupancy. The essence given to us in sense-perception is not representative of the existence; it is not a *tertium quid* which intervenes between the mind and the reality; it is the "vehicle" of knowledge, the object of which is the existence. Further, the consciousness itself is not an existence; it is "attention" to the "givenness" of the essence. But besides sense-perception there is another mode of knowing, another avenue to the real object; this is introspection. The essences given to introspection are feelings, and the existence to which these are the vehicle is the psyche. The argument is that the object of introspection, the psyche, is the same existence as the object of sense-perception, the spatio-temporal existence, and only the essences are different. A very happy illustration is afforded by the case of the brain. The brain is the unique condition of knowledge, yet it is itself a part of and continuous with the object of knowledge, the body and the physical universe of which the body is a part. It is not possible, of course, to appreciate the argument in a bare epitome. I can only say that it is lucidly expounded, and no difficulty is consciously shirked.

There is, however, to me a serious difficulty of which Prof. Strong, in common with most of the philosophers to whom his arguments are chiefly addressed, appears to be wholly unconscious. When philosophers talk about the independent existence of the objects of knowledge they almost invariably refer to the common-sense objects of daily life—to tables and chairs, mountains, horses, and men—and they discourse about the primary and secondary, and perhaps also the tertiary, qualities of these objects. They ignore completely the fact that physical science has transformed the reality of the common-sense world beyond recognition. They make the naive assumption that the common-sense view of reality is a necessary requirement of physical science. So here, when we ask what is the existence which is distinct from the essence given in sense-perception, space and time and stuff are offered us as the unquestionable framework, ground, and criterion of existence. In this Prof. Strong has, of course, the new realists in mind. But why do the new realists persist in ignoring the evolution of mathematical and physical theory, the principle of relativity, the new concepts of space, time, and velocity, the new scientific world-view of a universe consisting of events and history, in their touching anxiety to save at all costs the common-sense reality of the plain man's world?

This is not intended as depreciation, but as an indication of the real difficulty I feel in regard to Prof. Strong's theory, with which I am in general agreement.

I would advise anyone whom this review may induce to read Prof. Strong's book to begin at the second chapter, entitled "Introduction," and defer the first chapter, entitled "Preliminary," until he has read to the end of the book. The "Preliminary" chapter, probably on account of its brevity and attempt to epitomise, is very obscure in comparison with the main argument.

H. WILDON CARR.

BIOLOGY AND HUMAN WELFARE.

Civic Etiology: A Text-book of Problems, Local and National, that can be Solved only by Civic Co-operation. By Prof. Clifton F. Hodge and Dr. Jean Dawson. Pp. viii+381. (Boston and London: Ginn and Co., 1918.) Price 7s. net.

THIS timely book shows in a graphic way, thoroughly well documented, how much man might improve his place in Nature and his immediate environment if the available knowledge could be utilised in concerted civic action. The coloured frontispiece contrasts an earthly Paradise in Oregon with man-made desert conditions at Shingkung, China, and the idea of the book is: "Which?" "Discovery is pushing forward in every direction as never before in the history of the world, and still it would seem that enough is already known to make living well-nigh ideal and the world almost a paradise, if only *enough* people knew." Yet "probably not less than five hundred thousand valuable lives are sacrificed annually to the currents of preventable disease, along with the several billions of dollars' worth of foods and other property swept away by rats, insects, weeds, and fungi." Unco-ordinated individual effort can do little; co-operative scientific control backed by goodwill offers our only hope of success. "Our education needs to be so organised that every citizen shall know enough to stop a breach the instant he sees it."

The course of instruction mapped out in this book is thoroughly practical and on sound educational lines, as one would expect, of course, for Prof. Hodge is the author of perhaps the wisest of all books on "Nature-study." Rats cost the States some five hundred millions of dollars every year, besides losses inestimable in money, and injurious insects are three times as costly as the rats. This sort of fact occupies a prominent place in the book, and the practicable measures of control are made so clear that he who runs may read. Thus to make the most and the best of the bird life is an obvious communal duty. (We notice, by the way, that the authors refer to the survival of an old passenger pigeon in the Cincinnati Zoological Garden. The death of this bird was reported in England some considerable time ago, but this may have been an exaggeration.)

The inquiry broadens out to include discussion of the following and much more: the careless felling of trees and the disasters of forest-fires; the control of weeds (which do annual damage to the tune of five hundred millions of dollars); making a back door beautiful; the improvement of cultivated plants and domesticated animals; the campaign against flies, mosquitoes, and other serious pests; the control of fungoid and bacterial diseases of plants, animals, and man; the life-histories of parasitic worms; the cultivation of clams and Crustaceans; the improvement of fisheries; and the utilisation of genetics as a basis for eugenics. It is a wide ambit, but the authors are to be congratulated on the skill with which they have used common things to illustrate general principles, and have thrown the light of general principles on common things. So while the course is frankly utilitarian, it is at the same time a discipline in the methods of science.

The book ends with a lively chapter on "Knowing How to Know How," and another on the progress of scientific discovery. The authors are quite sound on the practical value of theory, but they naturally lay emphasis on even the simplest endeavours to face the facts (of any order of magnitude and intricacy) without blinking. They are at one with Goethe when he said: "The most pernicious thing in the world is active ignorance" (or words to that effect), and with Emerson when he wrote: "I am impressed with the fact that the greatest thing a human soul ever does in this world is to see something and tell what it saw in a plain way. . . . To see clearly is poetry, philosophy, and religion all in one." We are heartily at one with the authors in their exposition of what biology may do for human welfare; our only doubt is whether they have put in saving-clauses enough. For there are some readers of easy ambitions who may be tempted to think that all will be right with the world if we get rid of rats and hook-worms, if we control weeds and flies, if we take Pasteur and Mendel into our everyday confidence. Hopes so sanguine will meet, we fear, with bitter disappointment.

J. A. T.

VISIONARY SCIENCE.

Hindu Achievements in Exact Science: A Study in the History of Scientific Development. By Prof. B. K. Sarkar. Pp. xiii+82. (London: Longmans, Green, and Co., 1918.) Price 1 dollar.

SCARCELY would it be supposed from its artless title that this little book deals with what its author styles "the pre-scientific epoch of the history of science," and that its main object, as declared in the preface, is to place the scientific achievement of ancient and medieval India in proper perspective with that of certain other great nations of antiquity. Still less would it be supposed that its text would read sometimes like an awkward demonstration of the truism that Hindu civilisation is an indigenous growth little influenced from outside, and sometimes—indeed, more often—like an unhappy attempt to impugn the accepted opinion that the great flood of Western knowledge had its quickest and freshest rills in the sparkling soil of Hellas.

But, disregarding its misleading title and its ambiguity of profession, one evident purpose of the book is to vindicate the propositions that the "tendencies of the mind" have been pretty much alike in East and West, and that, prior to the present tercentenary, superstition had no more repressive effect in one part of the world than in the other. If "tendencies of the mind" be taken, in the common sense, to include merely the desires, passions, and motives of the wonderful piece of work Man, there needs no ghost to come from the grave of buried India to tell us that these have everywhere and at all times the generic constancy predicated by Shylock; but if it is to denote posture and attention of the mind towards Nature, then the argument that the history of science here reveals no inquisitive difference between East and West must be supported by something more than brave assertion and an ardent imagination.

The author protests that among the sages of Indian antiquity there were numbered "hosts of specialists," who freely explored all fields of Nature by observation and experiment, and systematised the results in "a vast amount of specialised scientific literature." He asserts of these set researches into natural phenomena that they were not less comprehensive, exact, and fruitful than those of the Greeks. Besides the ancient Hindu mathematicians, of whom we have heard, he tells us of physicists, chemists, mineralogists, botanists, zoologists, anatomists, and embryologists, whose discoveries are too vaguely summarised, chapter by chapter. In the chapter on physics little is to be found beyond a disparaging reference to Greece, and a catalogue of fragments of *nuda intellectualia,* to which an imaginative pen may give a local habitation and a name among the formal sciences. The chapter on chemistry tells us that the Hindu chemists of the sixth century were "masters of the chemical processes of calcination, distillation, sublimation, steaming, fixation, etc.," and that the Saracens learnt their chemistry from the Hindus. Under "Medicine" we learn that, in contrast to the impeding "pseudo-science of Galen," the great strength of the Hindus lay in observation of Nature. Under "Anatomy" we are informed, after deprecation of the ignorance of Hippocrates, that the "anatomical system" of the Hindus was "almost modern," although, not containing more than an idea of a circulation, it did not anticipate Harvey. Some of the "Hindu embryologists" approached quite respectfully near the level of present-day knowledge, and the following is quoted by the author as containing a kernel of their truth: "The menses, after conception, goes in part to form the placenta, and as the blood flows every month it coagulates to form the embryo, an upper layer being added every month to the embryo, and another portion to the breasts of the mother." As to "Natural History"—well, *non semper tendit arcum Apollo*; in India—as, it would appear, everywhere else before A.D. 1683—it was not very much to boast of, yet it is declared to have been minute and comprehensive in its scope, and to have been studied in a truly scientific spirit.

OUR BOOKSHELF.

The Science of Health and Home-making. By E. C. Abbott. Pp. xv+352. (London: G. Bell and Sons, Ltd., n.d.) Price 3s. 6d. net.

ON the whole, this book is a satisfactory introduction to the science of health and home-making, though there are some loose statements which need revision in a future edition. After a brief introduction on the importance of health, succeeding sections deal with the structure of the body and the functions of the various organs, food and digestion, the nervous system, germs and disease, the home, clothing, cookery and housekeeping, the care of babies, and school hygiene.

Under "Food" it is stated that mineral oils are chiefly obtained from petroleum and coal-tar, but no mention is made of the chemical differences between mineral oils and vegetable and animal fats, or that the former have no feeding value. The sections on disease germs, the formation of toxins and antitoxins, and vaccination are inaccurate in many respects. In dealing with the life-cycles of plants and animals it is stated that "plants take in as food CO_2 from the air, and water and salts from the soil, and with these build up starch and proteids." This is correct so far as it goes, but some mention should be made of the importance of nitrogenous compounds. The sections on the care and training of children are quite satisfactory. After every chapter subjects are given for working out practically, and also problems for solving, which should prove very useful to the teacher. The book is written in simple language and in an interesting style.

R. T. H.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

End-Products of Thorium.

MR. J. R. COTTER's letter on this subject (NATURE, January 30), stating that he has been unable to detect the presence of thallium in thorianite, and is confident that it does not contain even 0·005 per cent., is in accord with other evidence of which I have been given private information. I may say, however, that the actual amount of thallium I separated from 20 kilograms of thorite was very small, certainly less than 0·005 per cent., though no particular precautions were taken to effect a quantitative separation, as its presence was only detected during the working up of the whole quantity for lead. Prof. Joly has pointed out (NATURE, June 7, 1917) that the hypothesis of the instability of the major end-product of thorium involves the explanation of the disappearance from the 20 kilograms of mineral of 150 grams of unstable lead, whereas the structure of the thorium halo gives no support to the view that unknown α-ray changes occur in the thorium series.

Not only against the particular suggestion as regards thallium, but also on the general one that one of the end-products of thorium is unstable, the evidence appears now to be against the view. I have no new observations to offer, but Mr. Lawson, writing to me recently from the Radium Institut, Vienna, refers to researches carried out there by Prof. Meyer and others, from which the conclusion has been drawn that both the isotopes of thorio-lead appear to be stable. Referring to elements which an unstable lead could conceivably produce, he mentions my observation of the presence of appreciable quantities of iodine in thorite and the possibility that this may be "eka-iodine" of atomic number 85. I may say that this point was thoroughly investigated four years ago by Mr. J. A. Cranston, who determined its atomic weight, and found it to be that of ordinary iodine.

FREDERICK SODDY.

The Neglect of Biological Subjects in Education.

PROF. BOYCOTT's letter on this subject in NATURE of January 23 deserves the serious attention of those who are striving to secure, as an element in our higher education, some sound knowledge of elementary science and of true scientific method of thought. Quite apart from the important and useful information which would be incidentally acquired from well-directed biological teaching, the student would thus receive an excellent schooling in how to think clearly. It is constantly forgotten that an immense proportion of the subject-matters which concern human beings in their everyday life are on the "biological" side of the border-line which conventionally divides them from the domain of "physics."

It has frequently been shown how ignorant many men in very high places are of the elements of chemistry and physics. To illustrate such lack of knowledge of simple biology would be a very easy task. But the value of some really sound instruction in biology, even only as a mental training, should be widely recognised.

H. BRYAN DONKIN.

London, January 30.

Scientific and Practical Metric Units.

IN the article entitled "Scientific and Practical Metric Units" which appeared in NATURE of October 24, 1918, reference is made to the convenient bridge to the metric system which exists in the ton, and the author asks for a convenient monosyllabic name for a weight of about 2·2 lb. I would commend for consideration the word "seer." The Imperial Indian seer, in common use all over India on the railways, weighs 2·05 lb., and would be as convenient a bridge to the metric system for India as the ton would be at home.

In many parts of Madras the local measuring seer for grain weighs a little more than 2 lb.

G. R. HILSON,
Deputy Director of Agriculture.

Bellary, Madras, S. India.
December 7, 1918.

THE ECLIPSE OF THE SUN ON MAY 29.

IT has been found impossible to organise any British solar eclipse expeditions since those sent to Sweden and Russia in the summer of 1914, just before the threat of war arose. Consequently, advantage is being taken of the cessation of hostilities to arrange for the occupation of two stations in the eclipse of next May by parties sent out by the Joint Permanent Eclipse Committee of the Royal and Royal Astronomical Societies. This eclipse is noteworthy for the long duration of totality, which is 6m. 50s. in mid-Atlantic, and 5m. 13s. at each of the selected stations. The duration of totality in the eclipses of the same series in the Saros cycle has been gradually increasing, and will reach a maximum of about 7m. 8s. in June, 1955, in the neighbourhood of Manila; this duration will exceed that of any eclipse in the preceding millennium.

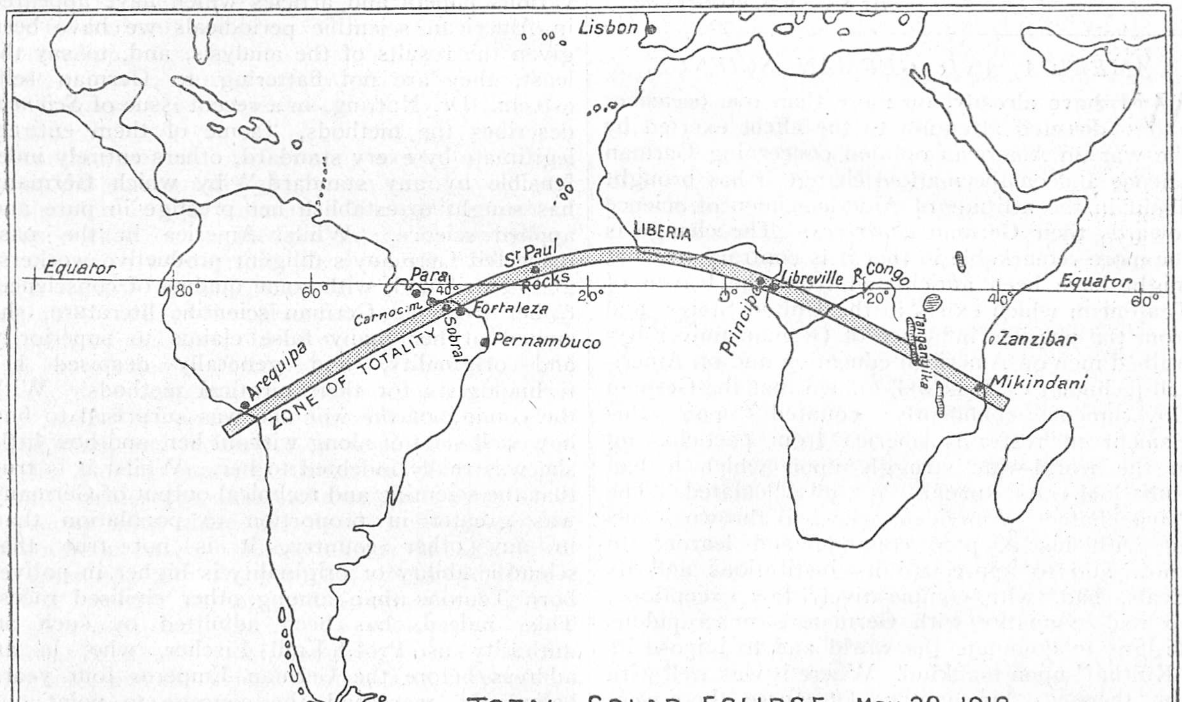
The track of totality next May crosses the entire breadth of South America and Africa. For stations of tolerable accessibility and sufficiently high sun, our choice is restricted to north-eastern Brazil and equatorial West Africa. There is a rather serious error in the maps of the eclipse printed in the ephemerides; they indicate the track of totality as lying to the south of the Liberian coast, but totality will, in fact, be observable on that coast, and the duration of totality and height of sun are greater than at any other land station. However, the weather prospects are not favourable, and it is not proposed to occupy a station there. The selected Brazilian station is Sobral, in Ceara, about 80 miles inland, connected by railway with Camocim, which is reached by steamer from Para. Messrs. Crommelin and Davidson, of the Royal Observatory, Greenwich, are going there, while Prof. Eddington and Mr. Cottingham will occupy the Portuguese island of Principe, 110 miles distant from the African coast, which is reached by fortnightly steamer from Lisbon.

Other possible stations are the African coast, near Libreville, or the high ground to the west of Lake Tanganyika. The weather prospects at the latter place are the best along the track of totality, but the sun's altitude is only about 15°, and the journey is difficult.

There is no information to hand at present as to expeditions from other countries. American astronomers have taken a prominent part in the observation of recent eclipses, but, apparently, they are satisfied with their successful observations in their own country last June, and do not contemplate making observations next May; it is hoped, however, that the South American observatories may take part.

Besides the long totality, this eclipse is also noteworthy for the rich field of stars round the sun; the Astronomer Royal gave a diagram of their configuration in the Monthly Notices for March, 1917, and directed attention to the very favourable opportunity that would be presented for testing Einstein's theory of relativity, according to which a ray tangential to the sun from a star would be deflected through 1·74″, the deflection for other stars being inversely proportional to their angular distance from the sun's centre. Prof. Eddington has directed attention to the deduction that, since a ray of light carries energy, even apart from Einstein's theory, we should expect the same shift as would be produced by the sun's gravitation on a particle passing close to its surface with the speed of light; it is easy to show that this shift would be exactly half that predicted by Einstein, or 0·87″ at the sun's limb. There are thus three possibilities: no shift, the half shift, or the full Einstein shift. The definite establishment of any one of the three as the truth would be an important addition to our knowledge of physics. Should the decision be in favour of the Einstein shift, it would, in combination with the success of the latter in explaining the motion of the perihelion of Mercury, suffice to lead to its acceptance as the actual system of the universe. Its definite disproof would also be of service, since it would avoid the dissipation of further energy in its elaboration, though it would still deserve our admiration as an ingenious system of ideal geometry.

Consequently, the British observers will leave questions of solar or coronal physics altogether alone on this occasion, and will concentrate on the effort to obtain accurate photographs of the star-field round the sun for comparison with photographs that have already been obtained of the same region in the night sky. There are thirteen stars in the region down to magnitude 7·0 within the field of an astrographic plate, which is a square slightly more than 2° in the side; nine of them are as bright as or brighter than 6·0 mag. It is not proposed to give exposures exceeding 10s., and it is hoped that, with restrained development, all the thirteen stars may be recorded without being overpowered by the diffused light of the corona. The object-glasses of the Greenwich and Oxford astrographic equatorials will both be employed, also some smaller lenses of longer focus. The driving clocks of the cœlostats have given some trouble in former eclipses, but they have been carefully overhauled by Mr. Cottingham, and a notable improvement is expected. In any case, exposures limited to 10s. do not require very accurate driving.



TOTAL SOLAR ECLIPSE, May 29, 1919.

The interval of time between totality at the two stations is 2h. 19m., during which the sun will move nearly 6′. Hence the shifts of the nearer stars should be sensibly altered in the interval, giving a further opportunity for verification.

Some photographs were taken for the same purpose in the United States last June, but the publication of results has been postponed until the same region has been photographed in the night sky. The region was much poorer in bright stars than that of next May.

The expeditions propose to leave Liverpool by the Booth line about the middle of March, travelling in company so far as Lisbon, where the Principe party will tranship. It is desired to reach the observing stations three or four weeks in advance of the eclipse.

A. C. D. CROMMELIN.

AMERICA AND GERMAN SCIENCE.

WE have already, on more than one occasion, directed attention to the effect exerted by the war on American opinion concerning German science and on the marked change it has brought about in the attitude of American men of science towards their German *confrères*. The change is the more remarkable in that it is contrary to what might have been anticipated from the leaven of Teutonism which exists in the United States, and from the possible influence of German university-trained men on American education and on American technology. It is well known that the German Government confidently counted upon this element to restrain America from participating in the world-wide struggle upon which it had embarked. As usual, it miscalculated. The "hyphenated" American, who had thrown in his lot with his adopted country, and learned to know and to appreciate its institutions and its ideals, had, with comparatively few exceptions, no real sympathy with Germany's unscrupulous designs to dominate the world and to impose its "Kultur" upon mankind. Where it was well with him, there was his country. Of course, there were traitors, for the most part controlled and instigated from Berlin, but, looking back upon the past, it is remarkable how small their influence was in modifying American opinion, or in thwarting American action.

Public opinion, indeed, thoroughly supported the American Government in its prompt and energetic dealing with covert attempts to undermine the loyalty of American citizens, or with overt acts to injure or terrorise them by outrage and crime. Such attempts, so far from achieving their object, had precisely the opposite effect. An act of outrage and terrorism like the destruction of the *Lusitania*, with its awful loss of life, did more to rouse and stiffen American feeling than any single measure that could have been conceived. As Fouché said, it was more than a crime; it was a political fault, and that of the most egregious kind. The extravagant jubilation with which the crime was everywhere hailed in Germany was the finishing touch to the episode, and greatly intensified the wrathful indignation and disgust of civilised humanity. It was significant that the American troops should go into action with the battle-cry of "*Lusitania!*" and that intellectual and cultured America should visit its resentment upon those of its own class in Germany, who, so far from protesting against this affront to our common humanity, shared the general joy of their countrymen that it had been committed.

Recent attempts to dissect the mentality of German men of science have accentuated this feeling. They and their works have been put through a scrupulous assay, with the result that they are no longer taken at their own valuation. The scales have fallen from people's eyes. In various papers and articles which have appeared in American scientific periodicals we have been given the results of the analysis, and, to say the least, they are not flattering to German self-esteem. Dr. Nutting, in a recent issue of *Science*, describes the methods, "some of them entirely legitimate by every standard, others entirely indefensible by any standard," by which Germany has sought to establish her prestige in pure and applied science. Whilst America in the past respected Germany's diligent productive workers, and contributed, with some qualms of conscience, rather freely to German scientific literature, she smiled at her many false claims to superiority and originality, and generally despised her technologists for their piratical methods. With the coming of the war she was surprised to find how well she got along without her, and how little she was really indebted to her. Whilst it is true that the scientific and technical output of Germany was greater in proportion to population than in any other country, it is not true that scientific ability or originality is higher in native-born Teutons than among other civilised races. This, indeed, has been admitted by such an authority as Prof. Emil Fischer, who, in an address before the German Emperor four years before the war, had the courage to point out to him the shortcomings of the Teutonic mind in originality and creative power. How, then, has Germany gained the prestige she has undoubtedly enjoyed? Dr. Nutting attributes it to what he styles "the intensive factor of publicity"—in other words, to intensive self-advertisement, conscious or unconscious. And he proceeds to indicate in what this has consisted.

It must be admitted that the Teuton mind has the faculty of application—more, perhaps, than that of any other nationality. "A specific problem occupies it to the exclusion of almost everything else. While we [Americans] are prone to work a few hours, then turn to something else, or run off to play, the Teuton eats and sleeps with his problem, takes little interest in anything else, talks shop with his colleagues, and does not completely relax even in his limited recreation."

Our author claims that his compatriots are as ready as any to attack difficult scientific problems, and they are not wanting in incentive. "What we do lack is the 'follow through' thoroughly to search out and master a problem in all its details, generalities, and side issues, before turning our attention to new problems. To minds teeming with ideas all clamouring for attention it is not easy to ignore the many that a few may receive fuller attention." How true this is may be seen by contrasting the methods pursued in German schools of chemistry, where a single conception is hunted to death, as it were, by the professor and his pack of collaborators, who follow it through innumerable ramifications, like a harried hare. It would constitute an interesting statistical exercise to determine the number of Ph.D.'s which have been created by chasing special ideas, with the professor as a whipper-in. Of course, the method is not without its advantages in the interests of knowledge, but its real *educative* value may be doubted, and it certainly does not conduce to develop any latent creative power in the student. It is more frequently directed to serve the interest of the professor than that of his pupils.

Another source of Germany's prestige arose from the comparative cheapness of printing and publication in that country. Struggling men of science eked out a meagre salary by compiling books which were readily accepted for publication on a narrow margin of profit. New serials and journals, and works of reference, were easily started, to find their way into university libraries and State-aided institutions throughout the world as more or less authoritative and indispensable. The output of scientific and technical literature, good, bad, and indifferent, was, in fact, prolific.

Dr. Nutting contends that alien students, university professors, and technical men working in Germany have aided greatly in building up her scientific prestige. These aliens, he calculates, represented fully 10 per cent. in each class—"clear 'velvet' to her, and a corresponding loss to their own countries." The students came, he states, in about equal numbers from Russia, England, and the United States, with a few from Scandinavia, Switzerland, and Japan, but scarcely any French or other Latins. The inducements were easy matriculation and graduation, while fees and living expenses were very moderate—barely half those at Oxford or Cambridge. "The instruction itself was hardly worth any special effort, but it was accessible, and it differed from the home product."

German universities have in the past drawn freely upon foreign countries for their instructors. It has been estimated that a third of the more noted German men of science were foreign-born—Russians, Dutch, and Swiss. These, for the most part, soon became Teutonised, and were thereafter regarded as Germans. The Jews, too, whom the typical Teuton regards as aliens, and secretly dislikes and despises, have contributed in no small measure to the fame of his universities.

German capitalists have always welcomed and been ready to exploit technical men of ability, no matter of what nationality, and a large proportion of the better-known German manufactures have originated in France, Italy, England, or America.

Such are the main factors which, in Dr. Nutting's opinion, have contributed to Germany's scientific and technical prestige. "Plagiarism and piracy," he asserts, "were common practices, and from personal knowledge I doubt whether a third of even the more eminent German scientists were free from this taint. Further, the work of foreigners was taught as the work of Germans in both literature and science. Neither fairy tale nor scientific discovery, if in an obscure publication, was safe from adoption as their own, while the misleading of the young student was easy and common."

Aliena optimum frui insania. American men of science have the wisdom to profit by the errors of the enemy. The war has taught them how to mobilise their man power and to organise their forces of productive achievement. They will, however, not take over that particular code of ethics or standard of literary and scientific morality and conduct by which modern Germany, in her too eager desire for wealth and power, has lowered herself in the estimation of the civilised world.

CLEAN MILK.

THE importance of clean milk, by which is meant a milk free from visible dirt and having a low bacterial content, has been recognised for many years, and various attempts have been made to improve the general milk supply. To a large extent these have failed owing to the conditions which have been supposed to be necessary to attain this end, involving considerable expenditure in reconstruction of buildings and extensive modifications in methods and plant—alterations which, setting aside cost, it is difficult to induce the average farmer and dairyman to adopt.

Recent work, however, has shown that by adopting comparatively simple methods, involving little monetary outlay and but slight modifications in manipulation, it is possible to produce a relatively clean milk vastly superior to that ordinarily supplied.

In a Bulletin (No. 642, 1918) published by the United States Department of Agriculture Messrs. Ayers, Cook, and Clemmer show that it is possible for the average dairyman on the average farm to produce milk practically free from visible dirt and, when fresh, with a low bacterial content by the adoption of three simple factors. These are (1) the use of sterilised vessels, (2) clean cows with clean udders and teats, and (3) the small-top milking-pail. If the milk is to retain its low bacterial content for any time a fourth factor is necessary, viz. the keeping of the milk at as near a temperature of 50° F. as possible. Each of the factors mentioned contributes something to the lowering of the dirt and bacterial content, as shown by the experimental results obtained, the experiments being conducted in many instances in barns which can only be described as filthy.

First, with regard to the small-top pail; this is a pail with a lid covering, say, two-thirds of the top of the pail. Using *unsterilised* pails without any other precaution, the open pail gave an average per cubic centimetre of 497,653 bacteria, while the small-top pail gave an average of 368,214 bacteria—a 25 per cent. reduction. With *sterilised* pails, under the same conditions, the numbers were 22,677 and 17,027 respectively, an enormous reduction by the additional precaution of using sterilised utensils. Washing of the udder and teats reduced the bacterial content of the milk by about 50 per cent. By a combination of these three factors it was possible to produce a milk containing only 2000–3000 bacteria per cubic centimetre even on farms which by any ordinary standard would be considered to be very unhygienic. The original cost of a small-top pail is little more than that of an ordinary open pail, and it is no more expensive or difficult to care for. Prof. Delépine, in a report (1918) to the Sub-Committee on Clean Milk of the Sanitary Committee of the Manchester City Council, arrives at much the same conclusions. He summarises the points requiring special attention as follows: (1) Cleanliness of the shippens, cows, milkers, utensils, and dairy-hands; (2) protection of milk against dirt during milking; (3) sterilisation of milk pails, churns, etc., and their protection against re-infection pending using; (4) protection of fresh milk against admixture with stale milk; (5) avoidance of straining through a common strainer; (6) avoidance of cooling by methods causing large surfaces of milk to be exposed to the air or to unsterilised surfaces; and (7) cooling of the milk by keeping churns in cold stores or places.

Prof. Delépine advocates the use of the small-top pail or some similar device. He finds that pails, coolers, and churns cleaned with very pure cold and hot water, and apparently scrupulously clean, are still capable of imparting a large number of bacteria to the milk, and urges the importance of steam sterilisation of the utensils. This last condition is not so difficult to accomplish, even on the small farm, as might at first sight appear, for simple and inexpensive steam generators can be devised. With a small boiler holding six quarts of water, heated with a paraffin stove and boiling in six minutes, it is possible to sterilise at one time six two-gallon pails or cans in fifteen to twenty minutes. By ensuring clean cows and milkers, and the use of sterilised utensils and of the small-top pail or similar device, really clean milk with a very low bacterial content, and therefore with enhanced keeping qualities, can be produced without of necessity the expensive remodelling of cowsheds and premises, and with very little disturbance of the time-honoured routine of the ordinary farmer or dairyman on the average farm.

R. T. HEWLETT.

NOTES.

SIR NAPIER SHAW has been elected a foreign member of the Reale Accademia dei Lincei of Rome.

WE notice with much regret the announcement in the *Times* that Prof. E. C. Pickering, director of the Astronomical Observatory of Harvard College, died on February 3 at seventy-two years of age.

A SPECIAL general meeting of the Geological Society will be held on Wednesday, March 26, to consider the resolution of the council of the society:—"That it is desirable to admit women as fellows of the society."

THE Institution of Civil Engineers has elected upon its roll of distinguished honorary members Marshal Foch, O.M., Field-Marshal Sir Douglas Haig, K.T., and Admiral Viscount Jellicoe of Scapa, G.C.B., O.M.

THE gold medal of the Royal Astronomical Society has been awarded by the council to M. Guillaume Bigourdan for his observations of nebulæ, carried on for about twenty-five years. It will be presented at the annual general meeting of the society on Friday, February 14.

AT the general monthly meeting of the members of the Royal Institution, held on February 3, a bequest of 300*l.* was reported from the late Dr. T. Lambert Mears, who was a member of the institution for fifty-three years, and a donation of 50*l.* from "an old member" in celebration of his fiftieth year of membership.

WE learn that M. G. Grandidier has been appointed general secretary of the Société de Géographie of Paris in succession to the late Baron Hulot. Baron Hulot, who had been secretary of the society for more than twenty years, was an occasional contributor to the pages of *La Géographie*. One of his most important papers was a life of d'Entrecasteaux, which appeared in 1894, and was the first complete biography of the explorer. M. Grandidier is well known for his researches in the exploration and geography of Madagascar.

THE Royal Horticultural Society in its report for 1918, which has just been issued, makes the important announcement that the revision of "Pritzel" is now in hand, and that the work of preparing it for the press is in progress at Kew under the personal supervision of Capt. A. W. Hill. It is estimated that the work will include about 250,000 references, and its cost of production will be at least 3500*l.*, towards which assistance is asked from the botanic stations, experimental stations, and libraries of the world as well as from private subscribers. All subscribers of 15 guineas will receive a free copy, and those of larger amounts a specially bound copy, according to their donation.

IT was announced by the president of the Royal College of Physicians on January 30 that the Swiney Prize, the award of which is adjudicated by a joint committee of the College and of the Royal Society of Arts, has been awarded to Dr. C. A. Mercier for his work on "Crime and Criminals." Dr. Raymond Crawfurd has been appointed to deliver the Harveian Oration of the College on St. Luke's Day, October 18, Dr. A. P. Beddard to be Bradshaw Lecturer, and Dr. Aldo Castellani to be Milroy Lecturer for 1920. Dr. J. McVail will deliver the Milroy lectures on "Smallpox and Vaccination since 1870," on March 13, 18, and 20; Dr. Topley the Goulstonian lectures on the "Spread of Bacterial Infection," on March 25 and 27 and April 1; and Sir H. D. Rolleston the Lumleian lectures on April 3, 8, and 10, taking as his subject "Cerebrospinal Fever."

AT the annual general meeting of the Royal Anthropological Institute, held on January 28, the following were elected as officers and council for 1919–20 (the names of new members are in italics):—*President*: *Sir Everard im Thurn*. *Vice-Presidents*: M. Longworth Dames, *S. H. Ray*, and Dr. W. H. R. Rivers. *Hon. Secretary*: Dr. H. S. Harrison. *Hon. Treasurer*: R. W. Williamson. *Council*: Capt. F. R. Barton, L. C. G. Clarke, *Miss M. E. Durham*, Dr. W. L. H. Duckworth, Sir J. G. Frazer, *Capt. A. W. F. Fuller*, Dr. R. J. Gladstone, Dr. W. L. Hildburgh, *Capt. T. A. Joyce*, *H. G. A. Leveson*, A. L. Lewis, Miss M. A. Murray, *E. A. Parkyn*, *Prof. F. G. Parsons*, *W. P. Pycraft*, *Capt. C. G. Seligman*, Dr. F. C. Shrubsall, *Lt.-Col. L. A. Waddell*, S. Hazzledine Warren, and *Prof. W. Wright*.

PROF. ICILIO GUARESCHI, who died recently after a very short illness, was professor of pharmaceutical chemistry and toxicology in the University of Turin and director of the Institute of Pharmaceutical Chemistry. He was one of the leading Italian chemists, devoting himself chiefly to researches on the alkaloids. The most important of his published investigations in this field were his chemical, physiological, and medico-legal researches on the ptomaines, but he also worked upon the derivatives of quinoline, on cocaine, on creatinine, etc. These investigations led ultimately to the publication by Prof. Guareschi of a volume summarising our knowledge of the alkaloids. This work was translated from the Italian into several other languages, and gained for the author a world-wide reputation. During the war he carried out investigations on the toxic gases used in chemical warfare, and much of his leisure was devoted to the study of the history of eminent chemists and physicists.

PARIS last week was greatly delighted with M. Guitry's five-act play *Pasteur*. M. Guitry *père* acted Pasteur, M. Guitry *fils* wrote the play; we are thus reminded of that filial affection which was one of the many inspirations of Pasteur's life. The play begins with the dispersal of Pasteur's students from the Ecole Normale at the call of the war of 1870–71; it ends with the celebration of his seventieth birthday, when the representatives of every country of the civilised world came to Paris to honour him and thank him. Lovers of the "Vie de Pasteur" and of Godlee's "Lister" do not need to be told about Pasteur. To those who saw Pasteur, sat at table with him, heard the slow, grave, quiet voice, watched the keen eyes and the tired, sad look of the face, it will be strange to think of him put on the stage. Besides, the life of a man of science is not a good theme for a five-act play. Galileo might stand through an act or two, or Vesalius—for the Holy Inquisition would make a "good curtain"—but Euclid, Aristotle, Newton, Galvani, Faraday, Darwin, are not figures for a theatre. What has Science to do with Drama? But Pasteur stands not for science alone; he stands for France. His father had served in the Grand Army; had received the Legion of Honour; had taught his children to believe in France, in her God, and in her glory. Pasteur was possessed, heart and soul, by the love of home and the love of France. The war of 1870–71 half-killed him. What could he do to help and console and glorify France in his life? "Henceforth," he said, "every one of my books shall have it written across them, *Revenge, Revenge*." That was his share of *la revanche*: to raise France out of the horror of defeat, exalt her over Germany, set her on her throne, by the work of his thought. That is what he did, what he lived for. "Science," he said, "has no country of her own; but the man of science ought to have a country of his own." Pasteur represents everlastingly the spirit of France, the genius of France. So it is a good thing, in this wonderful year, that some likeness of him should live and move before the scenes of a Paris theatre; that some of his words should be spoken by a living voice in the city where his body was buried. It would not be surprising if the Germans, a few years hence, should want to translate the play and produce it in Berlin as an educational instrument to teach the importance of bacteriology for the advancement of material prosperity.

SIR ARTHUR NEWSHOLME has retired from the post of Principal Medical Officer to the Local Government Board a year or two before the time when his period of office would actually have expired under the Civil Service age limit—probably in anticipation of changes in the Department incidental to its incorporation in the proposed Ministry of Health. During his tenure of office Sir A. Newsholme has been responsible for special developments of public health work in various directions to which comparatively little attention had been directed in official quarters. Among these may, perhaps, be regarded as most important the introduction of the notification and treatment of tuberculosis, a general scheme for the treatment of venereal disease, and one for the advancement of maternity and child welfare work, in this latter respect continuing and expanding the pioneer work of his predecessor, Sir William Power. As addenda to his annual reports on the work of the medical department, Sir A. Newsholme published a series of reports dealing with the question of infant mortality and the various factors found, as the result of special inquiries by members of the inspectorial staff, to have a bearing on it, especially in a number of manufacturing areas, where, although, so far as was previously known, the conditions were somewhat similar, nevertheless the infantile death-rate varied within wide limits. Mention should also be made of the "General Review of Progress since 1871," published as an introduction to the report of the Medical Officer for the year 1917–18, in which the saving of life which has occurred in the forty years since the appointment of Mr. (afterwards Sir) John Simon as the first Medical Officer of the Local Government Board is illustrated by a comparison of the death-rate at different ages in 1911–15 and 1871–80 respectively. During the whole period of the war Sir A. Newsholme has acted on the Army Sanitary Committee, holding the rank of Lieut.-Colonel, R.A.M.C. (T.), and it has been largely due to his efforts that military and civilian public health authorities have worked together so harmoniously on the various special problems which developed as the outcome of war conditions. In acknowledgment of his services to the State, Sir Arthur Newsholme was created a C.B. in 1912 and a K.C.B. in 1917.

THE death is announced, in his fifty-first year, of Prof. Wallace Clement Sabine, who had been professor of mathematics and natural philosophy at Harvard since 1905, and was formerly dean of the Lawrence Scientific School. Two years ago Prof. Sabine was Harvard exchange professor at the University of Paris. He was the author of a treatise on "Architectural Acoustics."

Isis, an international quarterly devoted to the history and philosophy of science, commenced publication in Belgium in 1913. A complete volume had appeared, together with two or three fascicules of the second volume, when the publication was brutally interrupted by the German invasion. M. Sarton, its editor, was hospitably received in the United States, where during the last four and a half years he has conducted a number of very successful courses of lectures on the history of science at several universities. We are glad to hear that he is about to visit Europe again in connection with the restarting of his journal, of which the materials for vols. ii. and iii. are almost ready. We understand that M. Sarton may be joined by Dr. Charles Singer, who has worked in England on somewhat similar lines, in subsequent periodical publications in connection with the history of science.

THE death is announced, in his seventy-ninth year, of Dr. Rossiter W. Raymond, one of the leading American authorities on mining. Dr. Raymond graduated at the Brooklyn Polytechnic Institute in 1858, and, after pursuing further studies at Munich, Heidelberg, and Freiberg, served with distinction in the American Civil War. In 1866 he became editor of the *American Journal of Mining,* afterwards the *Engineering and Mining Journal,* to which he remained a contributor up to the time of his death. From 1868 to 1876 he was U.S. Commissioner of Mining Statistics, and in that capacity acquired a great reputation for his investigations and reports. Dr. Raymond was one of the founders of the American Institute of Mining Engineers, of which he was president from 1872 to 1874 and secretary from 1884 to 1911. He was the author of "Mineral Resources of the U.S. in and West of the Rocky Mountains," a glossary of mining and metallurgical terms, and various other technical works and papers.

NEWS has been received, by telegram from Cape Town, that Dr. G. S. Corstorphine, principal of the South African School of Mines and Technology, Johannesburg, died on January 25. Dr. Corstorphine was appointed to the principalship of the college in 1913, and was recognised as one of the leading South African geologists and mineralogists, and a very eminent authority on questions connected with the geology of the Rand goldfield. Born in Edinburgh in 1868, Dr. Corstorphine was first trained for the teaching profession, and passed through the Moray House Training College course. He soon, however, developed a marked interest in science, and studied at Edinburgh University, principally in biology and geology, obtaining the Baxter science scholarship in 1892 for the most distinguished graduate for the year in those subjects. Thereafter he was appointed university assistant to Prof. James Geikie, and was, fortunately, able to devote a considerable part of each year to study abroad. Munich was in those days a favourite resort of Scottish students for post-graduate work, and under Prof. Groth and Prof. Weinschenk Dr. Corstorphine's interest in mineralogy, petrography, and geology was greatly stimulated. He took the degree of Ph.D. in 1895 with a thesis on some igneous rocks from the south of Arran, which was his only contribution to British geology. In 1896 he went to Cape Town as professor of geology in the South African College. He was also keeper of geology in the museum, and received appointment as director of the newly instituted Geological Survey of Cape Colony. In 1902, however, the attractions of the Rand drew him away from Cape Town, and he went to Johannesburg as consulting geologist to the Consolidated Goldfields Co. Later he set up in practice as a consulting geologist in Johannesburg, and his advice was much in request by mining companies. His best known work is "The Geology of South Africa," which he wrote jointly with Dr. F. H. Hatch. First published in 1905, the volume is now in its second edition. Dr. Corstorphine wrote several papers on problems of Transvaal geology, in some of which he had Dr. Hatch as collaborator. He was president of the South African Geological Society in 1906 and honorary secretary from 1910 to 1915.

AT a meeting of the Society of Antiquaries held on January 30, Capt. R. Campbell Thompson read a paper on the excavations which he had conducted by War Office orders on behalf of the British Museum at Abu Shahrain, in Mesopotamia. This place, the Eridu of the cuneiform records, lies in the desert about twenty miles south-west from Nasiriyah. It was partially excavated by J. E. Taylor in the middle of the last century, but the value of his discoveries was not at the time appreciated. The results of the recent excavations are of high scientific importance. Numerous chipped and ground celts and flakes show that the early inhabitants lived in the Stone age. More important even is the pottery of buff, wheel-turned clay, painted with geometric designs in black, exactly similar to that found in the lowest stratum at Susa by M. De Morgan. Though the people of Eridu were ignorant of writing, their culture was decidedly advanced. They lived on cereals and on fresh-water mussels from the Euphrates, which must then have flowed near the city. The relics represent the pre-Sumerian population which occupied southern Mesopotamia before the arrival of the Sumerian race.

DR. W. E. COLLINGE, 3 Queen's Terrace, St. Andrews, has issued a circular announcing the proposed foundation of an organisation and publication that will bring together students of wild birds. The objects of the Wild Bird Investigation Society are:—(1) The more intensive study of the ways and habits of British birds; (2) the protection of all beneficial and non-injurious wild birds and the repression of really injurious species; (3) the influencing and educating of public opinion as to the destructiveness or usefulness of wild birds to agriculture, horticulture, forestry, etc., by means of publications, meetings, lectures, etc.; (4) the discouragement of egg- and bird-collecting, except under guidance or for scientific purposes; (5) the improvement and modification of the existing laws relating to wild birds; (6) the establishment of bird sanctuaries under efficient control; (7) the discussion and consideration of these matters from all points of view; and (8) the establishment of local branches throughout the United Kingdom. At a later date it is proposed to call a general meeting for the purpose of approving the draft rules and to elect officers. Further particulars may be obtained from Dr. Collinge at the above address.

THERE seems reason to hope that prosperity is returning to the Zoological Society of London, which has come singularly well through a very anxious time. At any rate, at the monthly meeting of the society held on January 15 it was announced that there had been an increase in the gate-money received during 1918 of 544*l.*, as compared with the total amount received during 1917. The most important additions to the menagerie during the month were a chimpanzee from Sierra Leone and thirty-two lizards, including eight starred lizards from Salonica, sent by Capt. W. D. Motton and Mr. G. H. Colt.

THE hawks of the Canadian prairie provinces in their relation to agriculture forms the subject of a valuable Bulletin (No. 28) by Mr. P. A. Taverner, issued by the Canadian Department of Mines. The author briefly, but lucidly, summarises the distinguishing features of the various species of hawks and falcons of these provinces, so that they may readily be identified by the farmer and sportsman, and,

CHEMICAL JOURNALS AND PERIODICALS

Both ENGLISH and FOREIGN.

Messrs. HENRY SOTHERAN & CO. are prepared to give liberal prices for COMPLETE or INCOMPLETE SETS, and will be glad to hear of any that may be for sale.

They are also open to buy LIBRARIES OF SCIENTIFIC WORKS, and to give for them their utmost value in cash.

They would also call attention to their exceptionally large and varied stock of Secondhand Works on Chemistry and other Scientific Subjects, catalogues of which have been issued.

140 STRAND, LONDON, W.C. 2.

Organic Chemists.

We are prepared to consider applications from well-trained organic chemists with a view to immediate or future employment in our laboratories. A sound training in theoretical and manipulative organic chemistry is essential. Experience in organic research work a great recommendation.

LEVINSTEIN Ltd. Blackley, Manchester.

SCIENTIFIC BOOKS & SERIALS.

JOHN WHELDON & CO. have the largest stock in the country of Books in all departments of Science and Natural History, also Transactions and Journals of Learned Societies, etc., in sets, runs, and single volumes or numbers

Libraries or small parcels purchased.

Special Catalogues: Botanical, Zoological, Ornithological, Entomological, Geological, Chemical, etc., 2d. each post free.

38 GREAT QUEEN STREET, KINGSWAY, LONDON, W.C. 2

Telephone: Gerrard 1412.

BOOKS!

Books on Scientific, Technical, Educational, Medical, all other subjects, and for all Exams.

SECOND-HAND AT HALF PRICES.

New books also supplied. Catalogues free. State Wants. Books sent on approval.

BOOKS BOUGHT Best Prices Given.

W. & G. FOYLE 121-123 Charing Cross Rd., London, W.C. 2

RARE BOOKS.—Lyell's Geology, last edit., 2 vols., 1875, 30*s.*; Barton & Castle's British Flora Medica, revised by Jackson, 1877, 30*s.*; Vine's Physiology of Plants, 1886, 10*s.* 6*d.*; Carpenter's The Microscope, edited by Dallinger, 1901, 28*s.*; Landolt's Handbook of the Polariscope, 1882, 25*s.*; Wallace's Island Life, 1880, 21*s.*; Holm's History of Greece, 4 vols., 1894, 30*s.*; A.B.C. Code, 5th Edit., 21*s.*; Prof. Curtius, History of Greece, 5 vols., 1873, £3 10*s.*; Life and Letters Sir Joseph Prestwich, 1899, 6*s.*; Bell's Manufacture Iron and Steel, 1884, £2 2*s.*; Martin's Dew Ponds, 3*s.*; Savage Man in Central Africa, 3*s.* 6*d.*; Newton's Dictionary of Birds, 10*s.* 6*d.*, pub. 30*s.*; Hewitson's Eggs of British Birds, 2 vols., 1846, £3 3*s.*; Galton's Record of Family Faculties, 1884, 35*s.*; Fox-Davies' Book of Public Arms, last edit., 35*s.*; Flower, History of the Trade in Tin, 1880, 25*s.*; Proc. Inst. Civil Engineers, 166 vols., cloth, rare set, £17 17*s.*; Proc. Inst. Mechanical Engineers, 1874 to 1914, rare set, £14 14*s.*; Keller's Lake Dwellings of Europe, 2 vols., 1878, 35*s.*; Sir Herbert Maxwell, "Trees," a Woodland Note-book, 1915, new pub., 42*s.* net, price 25*s.*; Kelson, The Salmon Fly, 1895, 21*s.*; Nicoll. Three Voyages of a Naturalist, 1908, 8*s.*; Hudson, Naturalist in La Plata, 1892, 30*s.*; Jones, Rock Climbing in Lake District, 1900, 30*s.*; Maddock, Florists' Directory, coloured plates, 1822, 25*s.*; Pike, Subtropical Rambles, 1873, 16*s.* Wanted, Encyclopædia Britannica, 29 vols., last edition, £25 offered.—BAKER'S GREAT BOOKSHOPS, 14 and 16 John Bright Street, Birmingham.

NOTICE.

New pattern Sets of Machine-made **DRAWING INSTRUMENTS,** which we have manufactured in large quantities for the Government during the war, will shortly be on sale.

Also **Slide Rules,** 10 and 20 inch.

W. H. HARLING

(Established 1851),

47 Finsbury Pavement, London, E.C. 2

Factory: Grosvenor Works, Clapton, E. 5

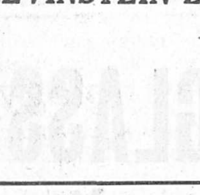
PRECISION WORK.

Firm specialising in first-class work desires inquiries for Optical and Scientific Instruments, Inventors' Models, Experimental Apparatus, Fine Details, &c., in brass or steel. War contracts just finishing.

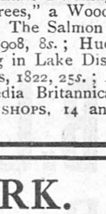
MALES and ANDREWS,
Iliffe Yard, Walworth Road,
London, S.E. 17.

SPECTROSCOPES (Second-hand) Special offers. Browning's Micro-Spectroscope, with wedge cells and tubes and extra prism tube with micrometer, fine mahogany case, 8 gns.; 4-inch Induction Coil, by Apps, in case, 20 gns.; Large Lantern for Spectrum Analysis, with box of slides, complete, cost 50 gns., 15 gns.; 3 Fine Bottle Prisms for 3 gns.; Brass Stand and cover for same, 2 gns.; Becquerel's Apparatus, on brass stand with rack motions, 3 gns.; Automatic Electric Regulator for use in spectrum analysis, 5 gns.; Pair of Electric Discharging Pillars, on mahogany base, 2 gns.; Brass Stand for Vacuum Tube Holder, 2 gns.; Mirror, mounted on nickel stand, 2 gns. Spectroscopes, Microscopes and Accessories. Binoculars, &c., Bought, Sold, or Exchanged. Send for complete lists post free.—JOHN BROWNING, 146 Strand, London, W.C. 2.

WANTED



MICROSCOPES, TELESCOPES, SURVEYING AND DRAWING INSTRUMENTS, AND OTHER SCIENTIFIC APPARATUS AND ACCESSORIES BY ALL THE BEST MAKERS.



338 HIGH HOLBORN, CLARKSON'S LONDON, W.C. 1.

(Opposite Gray's Inn Road.)

PRINTED IN GREAT BRITAIN BY R. CLAY AND SONS, LTD., BRUNSWICK STREET, STAMFORD STREET, S.E. 1, AND BUNGAY, SUFFOLK.

further, indicates the prey of each. One or two species he condemns on account of their ravages on game or poultry. But for the most part he urges protection, pointing out the immense services of these birds in keeping down the gophers, which, apart from the great quantities of grain they consume, have become a serious menace on account of the diseases they spread, not only among cattle, but also among the population of the rural districts. Text-figures and four most excellent coloured plates add greatly to the usefulness of this work.

THE animal remains found in kitchen-midden deposits are relics of importance to both anthropologists and zoologists. Hence we are much indebted to Mr. Alexander Whetmore for his account of bird-bones found in kitchen-midden deposits in the islands of St. Thomas and St. Croix, published in the Proceedings of the United States National Museum (vol. liv.). Altogether thirteen species are represented in these deposits, of which one, a rail (*Nesotrochus debooyi*), is new to science. One or two species are now no longer found in a living state on St. Croix, and this is attributed to the fact that the early French settlers, somewhere about 1650, burned off the densely wooded covering of the whole island in order that they might render it more healthy, since up to that time fevers and other diseases had taken a heavy toll of the settlers. This conflagration, of course, entirely changed the character of the flora and fauna, and this fact has to be borne in mind by students of geographical distribution.

UNDER the title of "The Louse Danger," the British Museum (Natural History) has issued a third "poster" in the economic series. Attention is directed therein to the danger of the clothes (or body) louse as a carrier of relapsing fever, typhus, and trench fever. In order to avoid lice, regular washing of underclothing and bed-linen is advocated. It is further desirable to avoid contact with persons suspected of being verminous; hospital workers and others are advised to wear white linen overalls. For the purpose of getting rid of the lice, a hot bath, followed by a change of underclothing and immediate disinfestation of verminous garments, is an important measure. When eggs of the louse are present in the hair, close clipping or shaving is necessary; in the case of women, washing the hair with an insecticidal solution is advised, followed by thorough combing with a fine-toothed metal comb. Simple instructions for the disinfestation of clothing and bedding are appended, together with information concerning the most useful insecticides. The poster is written in a clear and easily understood style, and is well adapted for the purpose for which it is intended.

IN the Kew Bulletin (No. 10, December, 1918) W. G. Craib gives a further instalment of his "Contributions to the Flora of Siam." Fourteen new species are described, belonging to ten families of flowering plants. They are mainly jungle plants collected by Kerr. The most interesting is a new genus of Gesneraceæ, Damrongia, allied to Didymocarpus, and named in honour of H.H. Prince Damrong, "who, himself interested in scientific pursuits, has done so much for the advancement of education in his country."

IN the *Philippine Journal of Science* (vol. xiii., Section C, Botany, No. 5) E. D. Merrill continues his taxonomic work on the flora of the Philippines. Eighty-four new species, distributed among twenty-six families, are described, the principal additions being in the families Loranthaceæ, Myristicaceæ, Meliaceæ, Araliaceæ, Gesneraceæ (Cyrtandra), and Asclepiadaceæ. There is one new genus, Acanthophora (Araliaceæ), allied to Aralia, but recalling Acanthopanax in habit. It is a sparingly branched climber sprawling over thickets, with large compound leaves 3–5 ft. long, and an ample terminal inflorescence about 1 m. in length. Mr. Merrill has reason to believe that it occurs also in Celebes, and thus adds another to the already long list of forms common to the Philippines and Celebes. He adds:—"It is now thoroughly established that the Celebes and Moluccan floras are distinctly more closely allied to the flora of the Philippines than is that of any other region, indicating clearly that land connections undoubtedly existed in previous geologic times between the Philippines and the islands to the south and south-east." In addition to the new species, a few species previously known are for the first time credited to the archipelago, and a few changes in nomenclature are proposed.

IN order to facilitate the use of quartz mercury-vapour lamps in dye-fading tests, the U.S. Bureau of Standards has recently measured the radiation of different wave-lengths emitted by a number of these lamps, and has determined its variation with the age of the lamp. The measurements were made by means of a thermo-pile and galvanometer, the various portions of the spectrum being separated by transmitting the radiation through absorbing glasses. The results show that the total radiation of a mercury-vapour lamp decreases during 1000 hours' intermittent use to 30–50 per cent. of its initial value, the radiation of wave-length less than $1{\cdot}4\mu$ decreases during that time from 30 per cent. of the total to about 20 per cent., while that of wave-lengths less than $0{\cdot}45\mu$ decreases from 20 per cent. of the total to about 14 per cent. Messrs. Coblentz, Long, and Kahler, the authors of the paper (No. 330 of the Bureau), attribute this falling off to the blackening of the inside of the quartz tube and the devitrification of the quartz itself.

A RECENT issue of the *Board of Trade Journal* (December 5) records some notable developments of chemical industries in the United States. One instance is the production of nitric acid on a large scale from atmospheric nitrogen. A Government cyanamide-nitrate plant, No. 2, began operations in October at Mussel Shoals, Alabama. The product was utilised for making high explosives, of which the output from this plant is said to be at the rate of about a quarter of a million pounds per annum. Another example is that of potassium compounds. A new unit of a potash plant on Searle's Lake, Southern California, was brought into operation early in November; its employment brings the production of potash by a single company working on this lake up to 140 tons a day.

IN *Helvetica Chimica Acta*, No. 5, there is a short, but suggestive, paper by M. J. Lifschitz on chemical luminescence. Just as with the absorption of light, studies on the emission of light during chemical reactions may prove to be of notable significance in elucidating the connection between radiant and chemical energy and the nature of chemical action. The phenomenon of chemical luminescence is by no means confined to oxidation processes: a good display of light-emission is observed when hydrobenzamide is distilled in a current of hydrogen, although no oxygen is present. Similarly, other reactions indicate that the governing factor is not the total amount of transformed energy, nor the speed of the reaction. The author finds that the organo-magnesium compounds (*e.g.* Grignard's reagent) furnish very convenient material for the study of these and kindred phenomena.

FOR printing-out photographic processes, such as carbon printing, Mr. S. S. Richardson in the *British Journal of Photography* of January 24 recommends the new "Pointolite" lamp. This lamp needs so little current that special wiring is not necessary, and it will allow of, say, six negatives being printed from simultaneously, the exposure being about three-quarters of an hour with negatives of average density. Mr. Richardson also recommends the iron arc if a current of 5 or 6 amperes is available, using iron instead of the usual carbon poles. A lamp so arranged will run sometimes for hours without attention, as the iron burns away very slowly. At a distance of 50 centimetres the exposure required is about twenty minutes. With such "point" sources of light an ordinary glass negative may be printed "reversed" for the single transfer carbon process if ordinary care is taken to prevent troublesome reflections and movement of the negative during the exposure.

A PAPER on electric welding and three others on oxy-acetylene welding were read at the Institution of Mechanical Engineers on January 24. In his paper on electric welding Mr. Thomas T. Heaton says that in his opinion—based upon many years' experience—each known system of welding has its proper sphere, and that probably any given method may be the best in its respectively most suitable application. In the Benardos system of arc welding, direct current is employed at 90 volts and 250 to 500 amperes, according to the thickness of metal. The arc may be 1½ in. to 2 in. in length, and the heat may be spread over a fairly large surface, thus avoiding extreme local stresses. The work is positive to a carbon electrode. In the Kjellberg system a metallic electrode is used instead of carbon. The work is negative to the electrode, so that the natural tendency is to deposit the metal of the positive electrode on to the work. The electrode is coated with a fusible silica flux, which prevents oxidation and insulates the electrode. The arc dissipates this flux, leaving no slag. Generally, the electrodes are of 3/16 in. diameter soft iron wire. Mr. Heaton does not find this system to be satisfactory for plates thinner than 0·25 in. The quasi-arc process, invented by Mr. Arthur Strohmenger, of London, also employs metallic electrodes, and some excellent results are obtained by it. Various coatings may be applied to the electrodes, and may be of such a nature as to supply constituents that are burnt out of the metal in welding. Blue asbestos yarn is especially preferred as a coating in welding iron or mild steel, as it forms a reducing flux, and it may be smeared with a composition such as sodium silicate or aluminium silicate, etc., to vary the fusing temperature of the yarn. Descriptions of some useful testing machines for welds are included in Mr. Heaton's paper.

Messrs. H. K. Lewis and Co., Ltd., have in the press two books by Sir J. W. Barrett, viz. "A Vision of the Possible: What the R.A.M.C. Might Become" and "The War Work of the Y.M.C.A. in Egypt," illustrated. The latter work will contain a preface by Gen. Sir E. H. H. Allenby. *The Library Press, Ltd.*, is bringing out "Practical Shell Forging and the Plastic Deformation of Steel and its Heat Treatment," by C. O. Bower, of Messrs. Armstrong, Whitworth, and Co., Ltd. One object of the work is to show the ways in which hydraulic plant can be profitably employed in peace-time production. *Messrs. J. M. Dent and Sons, Ltd.*, give notice of "New Town: A Proposal in Agricultural, Industrial, Educational, Civic, and Social Reconstruction," edited by W. H. Hughes.

A NEW weekly periodical is about to be published (at 8 Bouverie Street, E.C.4) entitled *Ways and Means: A Weekly Review of Industry, Trade, Commerce, and Social Progress.* Among the editorial features promised in the prospectus issued are Colonial development, expert opinion, industry and money, Government finance, education in relation to industry, industrial administration, reconstruction, art in industry, science and industry, organisation and system, and welfare.

OUR ASTRONOMICAL COLUMN.

BORRELLY'S COMET.—This comet was under observation by Mr. R. L. Waterfield in Cheltenham during January. On January 9 it was a fairly easy object with 3-in., the magnitude being between 9·0 and 9·5; on January 26 it was still visible with 3-in., but much more difficult. The following is a short extension of the ephemeris (for Greenwich midnight):—

	R.A. h. m. s.	N. Decl. ° ′	Log *r*	Log Δ
February 6	6 31 57	66 14	0·2219	9·9607
10	6 36 17	66 6	0·2281	9·9815
14	6 41 48	65 52	0·2345	0·0014
18	6 48 20	65 34	0·2410	0·0203
22	6 55 39	65 11	0·2476	0·0381

REID'S COMET (1918*a*).—Circular No. 43 of the Union Observatory, Johannesburg, gives the following positions of this comet made by Mr. H. E. Wood, and the orbit which he deduced from them:—

G.M.T. 1918	R.A. 1918·0 h. m. s.	S. Decl. 1918·0 ° ′ ″
June 13, 1968	9 15 36·52	9 5 55·3
16, 1986	9 16 47·12	11 58 44·8
19, 1982	9 17 4·48	14 40 51·5

$$T = 1918 \text{ June } 5{\cdot}275 \text{ G.M.T.}$$

$$\left.\begin{array}{l}\omega = 194^\circ\ 7'\ 18''\\ \Omega = 17^\circ\ 49'\ 28''\\ i = 70^\circ\ 8'\ 41''\end{array}\right\} 1918{\cdot}0$$

$$\log q = 0{\cdot}04194$$

Middle place, obs.-comp. R.A. $-11''$, decl. $0''$. The orbit does not show a close resemblance to any in the catalogues. This was the only comet observed in 1918 that did not belong to the Jupiter family.

ASTRONOMY IN THE "TIMES."—We directed attention last week to the important new features in the meteorological reports in the *Times*, and have now pleasure in referring to another scientific innovation which appeared in the issue for February 1. A map is given, on the zenithal equidistant projection, of the stars and planets visible in London at 10 p.m. in mid-February, together with the path of the moon and our satellite's positions and phases at two-day intervals. There is accompanying letterpress by an astronomical correspondent, describing the leading points of interest in the constellations and directing attention to the approaching conjuncion (in 1921) of Jupiter and Saturn, which are now such conspicuous objects. If, as we understand, this is the first of a series of monthly maps and articles, they are likely to lead to a considerable awakening of interest in astronomy on the part of the general public.

THE ENERGY OF MAGNETIC STORMS.—Dr. S. Chapman contributes a paper on this subject to the Monthly Notices for November last. He considers that the sun is the source of energy, and that it is transmitted by streams of electric corpuscles. These ionise and charge the absorbing layer in the atmosphere. The accumulation of charge continues until the electrostatic repulsion overcomes gravity, when the electrified gas is impelled upwards, the atmosphere thus losing both its charge and part of its substance. It was formerly considered that to make the sun the source of energy would involve an inconceivable amount of output from the sun, but under the new theory this is not the case.

EDUCATION AND NATIONAL LIFE.[1]

ONE of the rare and valuable fruits of the sanguinary struggle in which the civilised nations of the world have been engaged since the summer of 1914 is to be found in the awakening of the public mind, at least in this country, to the consideration of the causes which provoked it, and in the disposition to search out the remedies which in the future will make such convulsions impossible of occurrence.

The grave events which still await a satisfactory solution have moved to serious reflection the leaders of the national Church, who two years ago, when the issue of the struggle hung perilously in the balance, felt called upon to ascertain the causes which lay at the root of the great upheaval of civilised humanity and to suggest the remedies. Five influential committees, under the direction of the Archbishops, were appointed to consider the subjects of the teaching office, the worship, the evangelistic work, and the administrative reform of the Church, and, finally, the question of Christianity and industrial problems, in which was included the place and functions of education, with which we are chiefly concerned.

Having regard to the history of educational enterprise in this country, the results of the labours of the twenty-seven able and influential men and women who constituted the last-named committee, with the Bishop of Winchester (Dr. Talbot) as chairman, assisted by the Bishops of Oxford, Peterborough, and Lichfield, together with the Master of Balliol, can only be characterised as revolutionary, so striking is the breadth of view they exhibit, and so complete the admission that education is meant for all the children of the nation without exception of class or condition. Education is "to assist human beings to become themselves . . . is the witness of equality . . . the foundation of democracy . . . and is, in short, the organised aid to the development of human beings in a society." This is the keynote of the admirable report issued by the committee on December 19, 1918, with its well-grounded and clearly stated argument and the fruitful suggestions it offers for the radical reform of our educational methods, incidences, and aims. "There must be," it states, "diversity of educational methods, because there are diversities of gifts. The basis of differentiation should be differences of taste or of capacity, not differences of class or of income. The manual worker needs a liberal education for the same reason as the barrister or the doctor: that he may develop his faculties and play a reasonable part in the affairs of the community." The basis of such an education, it strongly pleads, must be laid in the elementary school, from which all attempts at specialisation should be rigorously excluded, and it further contends that the only sound foundation for technical training is to be found in "the cultivation of mental alertness, judgment, and a sense of responsibility by means of an education of a general and non-utilitarian character."

The report laments the causes which have done so much to hinder the development and diffusion of education during the great industrial epoch, with its materialistic aims and subordination of human faculties to the exigencies, or alleged exigencies, of industry, and among them does not fail to cite the strife and lack of accord of the various religious bodies. It looks to an education, wisely conceived and universally applied, for the effective solution of domestic and international problems by peaceful means. The committee cordially welcomes the provisions of the Education Act of 1918, especially those which are concerned with the physical welfare of children and young persons, and would make mandatory the supply of nursery schools by the local education authorities. It looks forward to the time when the compulsory school-age will be raised to fifteen, and even to sixteen, but recognises that this cannot be expected until the rewards of industry are more equitably distributed and the great working class placed in a position of less anxiety and with the means to enable it to realise a healthy and vigorous life. Fuller opportunities, it is urged, should be provided for the higher education of specially capable children, and the educational system so organised as to raise to a higher level the moral and intellectual standard of the whole people.

Much stress is laid upon the necessity for the better payment of teachers and for more consideration for their status, having regard to their important services to the State. The report strongly approves the proposals contained in the Act for the establishment of compulsory continued education of young persons up to eighteen engaged in employment, but would extend it from eight hours per week to twenty-four out of a working week of forty-eight, or for a corresponding proportion of the month or year according to the special necessities of the case. The main aim of such education should be to develop the physical and mental capacities of the children and to strengthen their character. Even in the continuation schools it is thought desirable that a vocational bias should be given only in the later years of school attendance. It is noted that there is a wide and increasing demand for education of a non-vocational character among adult men and women which should, it is considered, be encouraged in every way possible, and that such opportunities of education should form part of the normal provision of the community.

The report, which is signed by all the members of the committee, quotes with approval Milton's definition of education as "that which fits a man to perform, justly, skilfully, and magnanimously, all the offices, both private and public, of peace and war," but contemplates a much wider application of it, in that all men and women must be included within its scope according to their capacities and powers. A useful bibliography accompanies the report.

[1] "Christianity and Industrial Problems." (London: S.P.C.K., 1918. Price 1s. net.

SEA-STUDIES.[1]

OF the four papers contained in the part of the Bergen Museum Year-book before us, the one of greatest scientific and practical importance is perhaps that by Mr. Torbjørn Gaarder entitled "Die Hydroxylzahl des Meerswassers." The extent of the concentration of hydroxyl ions in sea-water has a great influence on the physiological processes of marine organisms; as Loeb and Herbst have shown, a certain concentration is necessary for the development of echinoderm ova, whether fertilised or not. In a word, the productivity of a sea region depends largely on the concentration of the hydroxyl ions. It becomes, therefore, of importance to study the variations of sea-water in this respect, and to discover the factors on which they depend.

Mr. Gaarder discusses the various methods used for estimating this concentration, which he calls the hydroxyl-number, and enumerates the radicals normally present in sea-water which may affect it. Of these the most important is carbonic acid, which serves as a buffer against the factors that change the hydroxyl-

[1] "Bergens Museums Aarbok, 1916-17." Naturvidenskabelig Raekk 1 Hefte. (Kristiania, 1917.)

number. Thus marine plants (by assimilation) and all marine organisms (by respiration) respectively lessen and increase the concentration of carbonic acid, and so exert considerable influence on the inversely related changes of the hydroxyl-number in any body of water. The carbonic acid is also affected by the carbonates and bicarbonates brought into sea-water from the land or dispersed over the sea-floor. As a result of the successive chemical processes, the hydroxyl-number becomes greater when the sea-water dissolves carbonates from the bottom deposits. Consequently the bottom water should have a larger hydroxyl-number than that of the superjacent layers. Organic life acts on the hydroxyl-number, not merely through the carbonic acid, but also through the carbonates. By removing the calcium and magnesium carbonates from the sea-water it lowers the hydroxyl-number, but gradually, as the organisms die, the organic material and the carbonates are carried down through the deeper layers to the sea-floor. The effect of the atmosphere seems to be confined to readjusting in the upper layers the balance of carbonic acid disturbed by plant assimilation. The chemical changes consequent on an influx of fresh water have as their final expression a reduction of the hydroxyl-number; in other words, the salter the sea, the greater the hydroxyl-number, and the more alkaline the water. The concentration of oxygen in sea-water is, by reason of the vital processes mentioned above, inversely proportional to that of carbonic acid, and therefore stands in direct relation to the hydroxyl-number.

The principles thus worked out by Mr. Gaarder from theoretical interpretation of previous observations have been applied by him to the fjord-waters of western Norway, and have there found both confirmation and extension.

Of the other papers, Mr. J. A. Grieg's inquiry into the age of starfish individuals collected from various localities in the North Sea and North Atlantic is not without its practical bearing. It is found that in any given spot the starfish, like the brittle-stars, are represented only, or in great majority, by the product of a single year. The length of life of a starfish is usually about four years. The species as yet investigated, however, do not appear to include the forms of chief economic importance.

Dr. J. D. Landmark contributes a well-illustrated discussion of the valley system at Dale, in Bruvik; and Prof. G. O. Sars describes, under the name *Urocopia singularis*, a new member of the Copepod family Lichomolgidæ, which, unlike its confamiliars, lives, not near the shore, but in the open sea at some distance from the bottom, and, presumably for this reason, has its caudal rami broadened into oar-blades.

RESEARCH ORGANISATION IN INDUSTRIAL WORKS.[1]

Introduction.

NO plans for the future development of industry are now considered complete unless they provide for scientific research, and although this is necessary to a greater or less degree in all industries, in no industry is there such scope for research as in the highly technical electrical industry.

During the past few years there has been a great deal of research directly controlled by or associated with industry. For instance, while universities and technical colleges have in the past conducted research, only a fraction of which has been directed to industrial requirements, the tendency is for an increasing proportion of the research carried out in such institutions to be of an industrial character. Various other laboratories and organisations, together with scientific and engineering societies, have either conducted or financially supported research in connection with their interests.

In a national sense, the Department of Scientific and Industrial Research with its large Treasury grant is endeavouring by the establishment of research associations to develop means whereby co-operative research can be established in various industries, with the initial assistance of Government funds.

Many of these laboratories will provide new industrial knowledge for the common use of those able to make use of it, and, while there is need for them, the individual manufacturer invariably has his own immediate problems, for which he requires special provision directly under his control. In such cases he has to consider whether he should establish his own research organisation or whether he can be efficiently and suitably served by research associations, university or other laboratories. Whatever facilities are available, it is clear that in many instances it is advisable for firms—particularly large ones—to establish research organisations in connection with their own factories.

I.—*Functions of the Organisation.*

The function of an industrial research organisation in its broadest sense is to acquire and to apply all the knowledge and experience which can assist the advancement of the industry, since it is only by the application of new knowledge and experience that progress is made.

It is necessary to draw a clear distinction between research work in pure science and industrial research. Both are essential to industrial progress, the former being directed towards widening the boundaries of knowledge, formulating principles, and revealing relationships that are the raw material of the latter, which is generally directed towards the solution of some specific industrial problem or towards meeting some industrial need.

The justification for undertaking research in pure science in a research laboratory associated with an industrial concern lies in the almost inevitable industrial applications which follow rapidly in the wake of a new scientific discovery, and it should be noted that the functions of the man of science, industrial worker, and manufacturer are equally necessary in rendering the ultimate product of a new discovery available to the public. It is questionable from the economic point of view, however, whether the majority of works laboratories should undertake such research, since only a fraction of the new knowledge produced is likely to be of value to one particular works. Much of this work, therefore, must be carried on, as hitherto, by men of science working in private, university, co-operative, or national laboratories. On the other hand, in very large laboratories in complex industries, particularly where special products resulting from discoveries can be manufactured, the undertaking of research in pure science may be of very great value.

Research laboratories partly or wholly supported by industrial firms may be broadly classified according to the particular interests they are intended to serve, as, for example:—

(1) Industrial research laboratories self-contained and serving one particular works.

(2) Central industrial laboratories each forming the scientific focus of an industrial organisation comprising several works, often in different industries, and linked up by control laboratories at the individual works.

[1] From a paper on "Planning a Works Research Organisation" read before the Institution of Electrical Engineers on January 23 by A. P. M. Fleming.

The function of the central laboratory is to conduct research bearing on the manufactures of all the works, and that of each control laboratory is to serve the immediate requirements of the works to which it is attached.

(3) Laboratories planned to serve a wide range of interests in various industries in connection with isolated problems, such as the Mellon Institute of Industrial Research, Pittsburgh, or ordinary commercial laboratories such as that of A. D. Little and Co., Boston.

(4) Laboratories designed to serve the needs of one particular industry working on a co-operative basis, such as the laboratory of the National Canners' Association, U.S.A. The laboratories of the proposed research associations in Great Britain would fall into this class.

(5) State laboratories carrying out researches occasionally of an industrial character, but not necessarily for any particular firm, such as the National Physical Laboratory, the Bureau of Standards, U.S.A., and various university laboratories.

The majority of firms, particularly when commencing research work, find it expedient to combine necessary routine testing with research work, at any rate in the initial stages of development. There are many reasons in favour of this course. Both routine testing and research have much in common, and can make use of the same building and much of the same equipment. The routine testing department serves as a training ground and nursery for some members of the research staff. Further, through the work involved in routine testing the research department is kept in close contact with other works departments.

In the later stages of development, however, and especially in large and complex organisations comprising several works each requiring routine testing, it becomes desirable to establish a separate and, if possible, central laboratory for research work alone.

The laboratories referred to in this paper are considered to comprise both routine and research work, as their combination is the policy most likely to be adopted by manufacturers initiating research organisations.

The functions of such a works research organisation, which involve the arrangement of the department in a number of sections, may be classified thus:—

(1) Testing of raw material supplies and the establishment of a suitable technical basis for purchasing.

(2) Production of new materials or substitutes for those already in use, as, for instance, high-speed tool-steels, improved magnetic sheet-steel, etc.

(3) Investigation of difficulties arising in the manufacturing organisation.

(4) Investigations necessary for controlling and maintaining at their proper level technical processes in manufacture.

(5) Development of new and improved processes and their establishment on a manufacturing scale on most economical lines.

(6) Development of methods for the treatment of factory waste and scrap for by-products.

(7) Investigation of phenomena required in the compilation of fundamental data for designing new apparatus.

(8) Development of new tools, appliances, and methods of testing; improvement and standardisation of those existing.

(9) Investigations of operating troubles and service for customers.

(10) Investigations for the information of financiers of the possibilities of new projects of a scientific character.

(11) Physiological and psychological investigations relating to vocational selection and for determining the most efficient means of employing human services.

(12) Research in pure science.

II.—*Divisions of the Organisation.*

The character of the industry determines mainly the scope and nature of the work to be done and, consequently, the number of sections of the laboratory. In rolling mills, for example, sections devoted to chemical, metallurgical, microscopic, and physical testing are sufficient to meet the main requirements. In the electrical and allied industries the number of sections is perhaps as great as will be found in any industry. These are given below, together with a brief statement of their functions for the general kinds of electrical and mechanical engineering works. In the case of a small works, some sections, such as the workshop, may be provided in the manufacturing departments. It will be noted that some of these sections deal wholly or largely with routine testing, and that they are subsidiary to other sections.

Chemical (Organic and Inorganic).—Co-operating with all other sections and undertaking routine analysis of incoming materials, ferrous, non-ferrous, and organic, for works use, and of materials in process of manufacture, and investigating and standardising speedy methods of routine testing.

Mechanical Testing.—Dealing with all routine tensile, transverse, compression, hardness, and torsion tests on metals and alloys in sheet, rod, or wire form; tests on textile fabrics, papers, fibre and other insulating materials, cements, etc.; destruction tests on assembled parts, and the testing of scale models.

Metallurgical (Ferrous and Non-ferrous).—Responsible for advising on the suitability of metals and their appropriate treatment for use in apparatus and in works equipment and tools; for supervising annealing and other heat treatment processes; for the conduct of investigations for the production of improved metals and alloys; for investigating failures in metals.

Photomicrographic.—Co-operating with the metallurgical and other sections in preparing specimens for microscopic examination and in photographing them.

Electrical.—Responsible for special tests on insulators, conductors, and resistances, both when received and as required during manufacture; for special tests on finished machines, oscillograph investigations, etc.

Magnetic.—Responsible for tests on steel forgings and electrical sheet-steel for permeability, hysteresis, and eddy losses, and on permanent magnets for remanence and coercivity.

Optical.—Dealing with investigations and tests of an optical character, such as the examination of large forgings by optical and X-ray methods; the application of colour testing to routine work, optical examination of screw threads and gauges.

Illuminating.—Undertaking investigations in connection with lamp manufacture.

Physical.—Undertaking all investigations of a physical character not optical or electrical, such as investigations connected with standards of measurement, heat transmission, acoustics, etc.

Pyrometric.—Responsible for the standardisation, repair, regular checking, and supervision of works pyrometers; selection and installation of appropriate instruments where required, and manufacture of spare parts for works use; advising on thermostatic control, methods of high-temperature measurement, refractory materials.

Materials.—Responsible for the standards of size and quality of materials used in the works, and for the acceptance of materials purchased after appropriate chemical, mechanical, electrical, microscopic, and inspection tests. This section draws up specifications to define the limits of variation of sizes and properties of standard materials where required, and secures uniformity of practice throughout the works. It undertakes investigations into defective materials for which special provision is not made.

Technical Processes.—Dealing with the development of new or the improvement of existing processes, particularly those giving trouble in the shops, and requiring the services of expert engineers in a suitable laboratory. Technical supervision may also be exercised over works processes, such as electro-plating, galvanising, sherardising, electric arc, resistance, and spot welding, insulating processes of various kinds, casting, painting and varnishing, and the modes of procedure crystallised in specifications. The development of new processes requires the employment of plant of a semi-manufacturing scale after preliminary small-scale laboratory experiment before the process can be placed in the shops. A most important function of this section is to remove, so far as is practicable, all experimental work from departments the true purpose of which is manufacturing.

By-products.—Responsible for recovering usable products from factory waste and scrap such as oils, metals, and insulating materials. In addition, this section may conveniently be equipped for the preparation of oils, solders, cements, fluxes, special insulating compounds, paints and varnishes where these are special to the works or where they can be prepared more cheaply than they can be purchased outside.

Psychological and Physiological.—Modern methods of engaging employées, particularly juveniles, and of determining a basis for promotion involve the development of psychological tests of intelligence. The evolution of tests of proved validity involves continuous investigation in a laboratory of applied psychology.

Workshop.—For the manufacture of small parts, instruments, etc., and for the preparation of specimens for physical testing, a small workshop is required, fitted with the commoner types of machines, lathes, drilling, milling, and shaping machines, and handtools.

Intelligence and Information Section.—It is important in a research organisation to prevent the expenditure of time and money on investigations which have been carried out previously, either inside or outside the organisation, the results of which can be made available for reference. Information of this character may be collected much more economically and thoroughly by a small trained staff than through the promiscuous efforts of the research workers themselves. The information thus collected would form the research library, also under the control of this section. Such a section would serve as a focus and a coordinating centre for the research department, and would also facilitate relations between the works and the department and between the department and outside institutions. The section further becomes a repository for the reports of work done in the research department. Too much stress cannot be laid on the importance of keeping adequate records, setting forth not only the causes bringing about the need for research, but also full details of the investigations, the methods employed, the apparatus used, the deductions drawn from results, and a special note of any further researches arising out of the particular investigation reported. It may not be possible to carry out subsidiary investigations at the time, but they may be of sufficient importance to be considered later. In preparing a report, a standard plan is desirable.

Administrative.—Accommodation must be provided in the laboratory building for the staff dealing with the administration of the research organisation. It will be the duty of part of this staff to maintain a proper record of costs of investigations. In some laboratories it is usual for a sum to be set aside for each major investigation; in others, an overall sum is voted each year for the maintenance of the laboratory. Where routine work is done the cost of this may be charged against the works department on behalf of which the expense is incurred. In any case, a systematic record of all costs, stores, breakages, and wages, subdivided according to the various investigations, is of great importance.

III.—*Administration.*

The internal organisation of an industrial research laboratory depends largely upon the nature of the work undertaken. Where it comprises routine testing for works departments the nature and number of the tests carried out form a series of sections each having a departmental chief responsible to the director, and a staff of senior and junior assistants to carry on the work and to provide for continuity in case of transfer or promotion. Where research work of a kind not immediately related to works practice is concerned, each major investigation should be placed in the hands of a competent research man, working with or without assistance, but directly responsible to the director. Where work is combined, as will generally be the case, both methods may be combined.

In either case, the work of the staff is greatly facilitated by regular conferences of the departmental chiefs and research workers, as in this way the progress of work of interest to more than one section can be discussed and the cumulative experience of the whole staff brought to bear on new problems. Overlapping and duplication of work can also be avoided, a possibility which may frequently arise when every part of a problem has to be analysed and different aspects minutely studied by different workers.

IV.—*Staff.*

The most important feature of a research organisation is that of the staff. This country has for centuries produced a succession of distinguished men of science, especially physicists, and at the present time there is no lack of gifted men who are able to extend the boundaries of knowledge. It has, on the other hand, been repeatedly emphasised that there has been a lack of technically trained young men who are able to apply the results of scientific research in industry. The demand was not sufficient to stimulate a suitable supply. The experience of the war period has changed the attitude of industry considerably in this respect, and the inducement offered to university men to enter research work is much greater than hitherto. So far as the limited supply of students permits, the universities have endeavoured to respond, and the scholarships now being awarded, together with the assistance offered by the Department of Scientific and Industrial Research, should do much to encourage students still further. For a considerable time to come, however, the supply of men will be totally insufficient for the needs of industry.

It is an error to suppose that industrial research cannot be carried on without men of genius of the type which has been responsible for many brilliant advances in the past, frequently under considerable personal difficulties and without adequate experimental equipment. Such a type, indeed, is generally not at ease in an industrial works, where research can be reduced to the character of a business, where procedure can be organised on systematic lines towards a clearly defined objective, and where progress can be made by co-operative effort of resourceful, energetic, well-trained, but otherwise ordinary men.

With the exception of those actually engaged in directing research, the staff should comprise comparatively young men and women capable of distinguishing cause from effect, able to observe keenly, and possessing sound technical training, preferably of university standard in the faculty pertaining to the industry they propose to enter, followed by some practical experience. Graduates who have shown during their university career that reasoning capacity, knowledge, resource, and skill in manipulation which comprise aptitude for research might proceed to a works for a period of practical training and then return to the university for a post-graduate course in research before entering the works organisation. Alternatively, students may enter the works for practical experience on concluding a post-graduate course, afterwards being placed in the research department.

In addition to serving as a nursery for research workers, the laboratories should undertake part of the training of all those young men who in a large organisation are being trained for higher industrial positions, as, for instance, many of those on the designing, commercial, and works management sides. In this way the industry becomes permeated with men having a keen appreciation of the value of scientific method. In connection with the section dealing with works processes, some of these men, promoted possibly from the trade apprentice course, may ultimately be permanently employed. Others would be transferred to the works, where they could utilise their experience in the direction of such processes.

In view of the limited supply of research workers, it is essential that the research department should work in close contact with the educational portion of the organisation now becoming an essential feature in industrial concerns, since the latter would control the selection, training, and promotion of all grades of apprentices. Every possible step should be taken to reveal latent talent, and to provide opportunities for the acquisition of the necessary education and experience.

The universities can only partially complete the training of the staff required for industrial research. This may be illustrated by the procedure adopted at the Mellon Institute of Industrial Research, Pittsburgh, which was founded for the express purpose of conducting researches for manufacturers, the work being undertaken by research fellows selected principally from the universities. These men co-operate closely with the works concerned, and frequently become absorbed into its staff at the conclusion of the research.

The staff of an industrial research organisation, comprising sections as indicated above, will generally include a director, sectional heads, senior and junior assistants, with possibly a number of individual research men responsible to the director. The function of the director calls for special consideration. He must appreciate the possibilities of applying new knowledge to industry to commercial advantage, and be able efficiently to direct specialised research workers, avoiding aimless research having no utilitarian objective. While he requires a wide scientific knowledge to be able to follow intelligently and appreciate the trend of scientific development, he must have, in addition, considerable organising capacity, commercial instinct, and a thorough knowledge of the manufacturing processes of this industry. He must have sufficient breadth of view to be willing to employ expert assistance whenever occasion for this arises.

The sectional heads will, in general, be men of high scientific standing, especially in their particular branch of science. These and the senior staff should be men of university education and training. It is essential that every position in the department should be filled by the best available man for the post, and the research staff should be considered to offer the most highly prized positions, unsuitable men being transferred to other parts of the works organisation.

Conclusions.

No hard-and-fast rule can be laid down as to the amount of money that should be expended on research. Every undertaking must be considered on its own merits, and research expenditure based on the economic needs of the moment and the probable requirements of the future. In many cases it is the impoverished industry which stands in the greatest need of research. Similarly, the small concern, though it may not be able to afford expensive research facilities, can make considerable use of those afforded by universities, national institutions, and private or commercial laboratories. Then, again, the wealthy firm or prosperous industry can maintain an unassailable position through improving by research its methods of production, this being ultimately the only effective method of securing monopoly.

It is an economic error to assume that the best method of increasing profits is, through trade combinations or other means of protection, to increase the selling price. A much more logical method is to bring about the difference between manufacturing cost and selling price by reducing the cost of manufacture, and it is in this connection that the possibilities of research are unlimited.

Apart from its value in assisting economic manufacture, the advertising value of research should not be overlooked. The knowledge that a manufacturing firm employs scientific methods establishes in the public mind a feeling of confidence in the firm's products. Similarly, this may be a by no means negligible factor in favourably influencing investors.

It is to be hoped that firms undertaking research on a large scale will adopt a broad-minded policy in regard to the publication of a great deal of the results of their work. The tendency towards secrecy on the part of most British firms has been weakened to a considerable extent during war-time, when many otherwise rival firms have been engaged upon similar kinds of new work, in which each firm could benefit by exchanging its experience with other firms engaged in the same production. This exchange of experience and information is of the greatest importance in keeping all sections of an industry up to date, and in this way an industry becomes much more potent in international competition, and at the same time individual firms through differences in organisation are no less able to compete among themselves. Moreover, the preparation of work for publication and discussion is of great educational value to a research worker.

In staffing a research organisation, the highest economy is secured by obtaining the very best brains in the various positions, and posts in the research department should be looked upon as those most highly prized in an industrial organisation.

It is to be hoped that the great industrial organisations having well-established research facilities will extend their hospitality freely to those workers in universities and elsewhere to conduct important investigations which they have leisure, but not equipment, to undertake, and that considerable freedom of interchange of ideas and experience with other research organisations will be practised.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. A. Harker, fellow of St. John's College, who held the office of University lecturer in petrology, has been appointed reader in petrology.

Mr. C. R. A. Thacker, fellow of Sidney Sussex College, has been appointed junior demonstrator of physiology until September 30, 1919.

Grants have been made from the Balfour fund of 150*l.* to Mr. C. F. Cooper, of Trinity College, 100*l.* to Mr. J. F. Saunders, of Christ's College, and 100*l.* to Mr. J. Gray, fellow of King's College, in aid of zoological investigations.

The Senate has approved the proposal to establish a Geographical Tripos, and the examination for part i. of this Tripos will be first held in 1920, and for part ii. in 1921. It is recognised that the subject of geography is so extensive and borders upon so many other sciences that to fit a student for geographical research or higher teaching a training is necessary which is of the standard of that required for a Tripos. It is also suggested that such a training would be valuable for the future statesman, administrator, merchant, or missionary. The two parts of this Tripos together will qualify for an honours degree, and part i. will qualify for the diploma in geography, which has proved so useful that it is regarded as important that it should be retained.

LONDON.—Dr. Reginald R. Gates has been appointed for three years, as from January 1, 1919, to the newly established University readership in botany tenable at King's College. Dr. Gates has been demonstrator in botany at McGill University, senior fellow and assistant in botany at the University of Chicago, lecturer in biology at St. Thomas's Hospital Medical School, and acting associate professor of zoology in the University of California. He is the author of "The Mutation Factor in Evolution" and numerous articles in English, German, Canadian, and American scientific journals on various aspects of botanical research.

It has been resolved by the Senate that for the duration of the war, and for a period of twelve months from its termination, the Army education certificate shall be accepted as exempting candidates from the matriculation examination.

The degree of D.Sc. in chemistry has been conferred by the Senate on Dr. A. M. Kellas, an external student, for a thesis entitled "The Determination of the Molecular Complexity of Liquid Sulphur."

SCHOLARSHIPS of the value of 50*l.* per annum, and tenable for two years, are being offered by the Institute of Marine Engineers to young engineers desirous of gaining additional technical knowledge.

A TRAVELLING scholarship of the value of 150*l.* a year, for past or present students of Somerville College, Oxford, is offered by the Mary Ewart Trust. Applications must be received by Mrs. T. H. Green, 56 Woodstock Road, Oxford, by, at latest, March 15.

A CONFERENCE on "Industry and Educational Reconstruction" will be held under the auspices of the Industrial Reconstruction Council on Tuesday, February 11, at 6 p.m., in the hall of the Institute of Journalists, 2 and 4 Tudor Street, E.C.4. The opening address will be given by Mr. F. W. Sanderson, headmaster of Oundle School. No tickets are necessary.

A RESIDENT fellowship is offered by Somerville College, Oxford, for research in classics, mathematics, philosophy, history, economics, or natural science. Its annual value is 120*l.*, and the normal tenure is five years—renewable. Particulars are obtainable from Miss Darbishire, Somerville College, Oxford. The latest date for receiving applications and evidence of fitness is March 15.

Two lectures arranged by the London County Council Education Officer will be given next week. One on "Agriculture and Rural Life" will be delivered by Mr. Christopher Turnor at King's College, Strand, W.C.2, on Friday, February 14, at 5.30 p.m., and the other on "Pure Science in Relation to the National Life," by Dr. Arthur Schuster, will be given at the Regent Street Polytechnic, W.1, on Saturday, February 15, at 11 a.m.

IT will be recalled that the Engineering Training Organisation was founded at a meeting held at the Institution of Civil Engineers on October 25, 1917, when a resolution was adopted to appoint a committee, representative of all the chief engineering and educational bodies, to consider the improvement and better co-ordination of engineering training. The committee thus formed has since been making a general survey of the ground to be covered and establishing the broad principles of future work. It has so far been dependent on voluntary assistance, in which the honorary organisers, Mr. A. E. Berriman, of the Daimler Works, Coventry, and Mr. A. P. M. Fleming, of the British Westinghouse Electric and Manufacturing Co., Ltd., have taken a leading part. A stage has now been reached when a paid secretary has become necessary for the future work of the Organisation, and in our advertisement columns in this issue an announcement is made of the offer of this appointment at a salary of 1000*l.* a year. For this important post a fully trained engineer with adequate educational experience seems essential, and we are glad to observe that the Organisation is offering a salary commensurate with the duties of the position. In doing so the Organisation relies on the generous support of leading firms in the engineering industry. There can be no doubt as to the vital importance to the future of the industry of well-organised and efficient engineering training, and we hope that the appeal will meet with an adequate response.

A PETITION is being presented to the governors of the Imperial College of Science and Technology by past and present students of the college urging that immediate steps should be taken to raise the status of the college to that of a university of technology, distinct from the University of London, and empowered to confer its own degrees in science and technology, as is done by the Technical Universities of Germany. At a meeting of past and present students held on January 29 at the Imperial College Union, it was decided, with one dissentient only, to sign and present such a petition. The recognition of the Imperial College as an institution of university rank should, says the petition, be one of the earliest items in the programme of legislative reconstruction. The creation of an Imperial University of Technology appears to be justified, the memorial continues, if it can assist in meeting the ever-increasing demand of industry for men efficiently trained in scientific and technological work. The apathy evinced by many firms in London and elsewhere towards technological research is, the petitioners urge, largely attributable to the absence of an institution devoted to technology bearing the authority and dignity of an imperial university; and they go on to plead that students who have passed through the prescribed courses should be able to start their careers with university degrees equivalent to those granted elsewhere. There will be widespread sympathy with the desire expressed in the petition for the further development in London of research in technology, and for greater facilities for students desiring to pursue courses of work in applied science; but there are likely to be differences of opinion as to the wisdom of inaugurating a separate university devoted only to study and research in pure and applied science. At Manchester, Glasgow, Edinburgh, Sheffield, Bristol, and other places the colleges of technology have in recent years become technical faculties of the universities of their respective areas; and it would seem that similar co-ordination might be possible in a reconstituted University of London with the Imperial College and other London colleges which provide special facilities in applied science, forming a faculty of technology. Also, it may be doubted whether the associateship of the Royal School of Mines—a constituent college of the Imperial College—could be given a higher value than it has at present by being merged in a mining degree of the proposed new university. No doubt these matters have been considered by the promoters of the movement, and will be carefully weighed by the governors of the Imperial College before taking the steps suggested.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 23.—Sir J. J. Thomson, president, in the chair.—Admiral Sir Henry **Jackson** and Prof. G. B. **Bryan**: Experiments demonstrating an electrical effect in vibrating metals. Experiments are described which demonstrate the electrical effect produced by vibration in wires and other metallic bodies, and a method of detecting and recording them by means of searching coils connected to delicate recording apparatus. The diminution of the effect when the surface of a steel wire is rusted is dealt with, in continuation of a paper by one of the authors on the subject of vibrating wires. The inductive effect of a vibrating wire on a neighbouring circuit is mentioned; and this led up to the fact that all metallic bodies experimented with, whatever their shape or material, generate eddy currents, which can be detected in them by using suitable searching coils. That this effect is primarily due to the vibrating conductor cutting the lines of the earth's magnetic field is proved by the experiments, but that there seems to be a residual effect, not at present fully accounted for, which is greater than can be attributed to experimental errors. Details of the tests are described. These have been carried out with wire bridges, tubes, utensils of various forms and materials, and also with Chladni plates.—Prof. T. H. **Havelock**: Wave resistance: some cases of three-dimensional fluid motion. It is shown how to calculate the wave resistance when the surface pressure is two-dimensional and the wave-pattern like that of ship-waves. Certain cases are examined in detail, and the method can be extended to more complex systems. Interpreting some of the results in terms of the related problem of a submerged body, expressions are obtained for the wave resistance of a prolate spheroid and of other bodies.—W. S. **Abell**: Chances of loss of merchant ships. This communication discusses the effect of damage to vessels in respect of chances of loss of bulkheads and the consequent chances of loss of vessels. If the extent of damage be fairly constant, as in torpedo explosions, it would appear that there is an inferior limit to the spacing of bulkheads. Further, as the carriage of cargo is impeded by subdivision, there is an economic reason for calculating the number of bulkheads sufficient for reasonable safety. Such calculation involves the discussion of chances of loss of one or more bulkheads, and of the relation of size of vessel to bulkhead spacing. Assuming that water-tightness is destroyed within radius R from centre of damage, it is shown that where (1) bulkhead spacing $=2R+a$, the "odds on" for loss of *one* bulkhead are $2R/a$; (2) spacing $=2R-a$, "odds on" for loss of *two* bulkheads are $a/(2R-2a)$; and (3) spacing $=R-a$, "odds on" for loss of *three* bulkheads are $2a/(R-3a)$. These results are applied to the case of ordinary cargo-carrying vessels of fixed type, but of varying lengths, with $R=20$ ft. representing longitudinal extent of torpedo damage. Diagrams accompanying indicate that (1) for a given standard of subdivision, decrease of size of large vessels only slightly increases chances of loss; (2) for small vessels, risk of loss is relatively high, and it is doubtful whether any subdivision whatever is effective for vessels below 320-ft. length; (3) safety increases markedly with length of vessel; and (4) intermediate bulkheads are more useful in larger vessels, but may also, in certain cases, increase risk of loss. By suitable assumptions the method may be used to discuss subdivision of passenger vessels exposed to ordinary marine risks.—Prof. W. M. **Hicks**: A critical study of spectral series. Part v.: The spectra of the monatomic gases. This part deals with the series relationships in the second or blue spectra of the rare gases. Not only are the S, D, and F series allotted, but the discussion serves to amplify and sustain the laws developed in preceding parts, and illustrates their value for the purpose of the analysis of spectra in general. Amongst new methods may be mentioned the use of the links, discovered in part iv. of these communications, for the purpose of dealing with lines expected from formulæ or other considerations which lie outside the observed region. Thus, in the case of a wave-number n of a line in the ultra-violet $n-e$, or $n-u$, or *vice versa* if in the ultra-red $n+e$, $n+u$, where e, u are definite and calculable quantities, may be wave-numbers in the observed region and correspond with lines actually seen. In this way it is possible to obtain evidence of the existence and wave-length of lines belonging to the spectrum, although not actually measured. Of importance also in the general theory of spectra is the discovery of summation series. Thus in the case of the ordinary well-known series the wave-numbers are represented as the difference of two quantities $A-\phi(m)$, where m is the order in the series. It is shown that in the case of the F series at least there are, in addition to these difference frequencies, also a corresponding series of summation frequencies given by $n=A+\phi(m)$. For S, D series, such series, if existing, would occur far down in the ultra-violet.

PARIS.

Academy of Sciences, January 20.—M. Léon Guignard in the chair.—H. **Deslandres**: The reform of the calendar. A discussion of a recent proposal of M. Bigourdan, with a summary of previous proposals with the same object. A sketch of an alternative calendar is given.—J. **Andrade**: The minimum number of associated spirals.—R. **Garnier**: The irregular singularities of linear differential equations.—M. **Riquier**: The analytical prolongation of the integrals of certain systems of linear partial differential equations.—G. **Julia**: Some problems relating to the iteration of rational fractions.—P. **Lévy**: Functions of implicit lines.—A. **Guldberg**: The errors of situation of a point.—M. **Mesnager**: A case of simplification of the formulæ of M. Boussinesq.—E. **Belot**: A hypothesis bringing into agreement the vortex cosmogony and the explanation of the peculiarities of novæ and the sun.—G. **Déjardin**: Calculation of the ratio of the principal specific heats of benzene and of cyclohexane by the cyclic method of M. Leduc.—E. **Esclangon**: A new determination of the velocity of sound in the open air. The determination of positions by sound requires a knowledge of the velocity of sound in free air with a very high precision. The numerous experimental difficulties are summarised, and particulars given of determinations made during 1917 and 1918, under varying weather conditions, and at temperatures between 0° and 20° C. The mean value found was 339·9 metres per second in dry air at 15° C.—M. **Horsch**: A method of rapid reduction of potassium chloroplatinate. The salt is dissolved in boiling water, some alcohol added, and evaporated in a platinum crucible on the water-bath. The platinum is deposited as a coherent film on the crucible. Test analyses are given.—Ph. **Dautzenberg** and G. **Dollfus**: A raised beach in the neighbourhood of Saint Malo.—A. **Guébhard**: The cooling of the planetary globes.—P. **Bertrand**: The flora of the coal basin of Lyons.—L. **Joleaud**: Relations between the migrations of the genus Hipparion and the continental connections of Europe, of Africa, and of America during the Upper Miocene period. The author gives evidence which, taken together with the data collected by American geologists, leads to the probable conclusion that during the Upper Miocene period there was land connection between the Old and New World, by means of which Hipparion and other species of mammals could pass from America into Europe and Africa.—C. E. **Brazier**: The influence of the velocity of the wind on the vertical distribution and the variations of the meteorological elements in the lower layers of the atmosphere. The barometric pressure at the ground-level, calculated from observations made on the Eiffel Tower, is lower than the observed pressure. The difference between the observed and calculated pressures increases with the average velocity of the wind.—P. **Guérin**: The development of the anther and pollen of the Labiates.—L. **Moreau**: The architecture of the calcaneum in stereoradiography.—H. **Vincent** and G. **Stodel**: Results of the treatment of gas gangrene by multivalent serum. The serum was obtained from the horse after increasing injections of sixteen races of micro-organisms. Sixty-nine cures out of eighty-one cases were obtained, and of the deaths only eight were the result of gas gangrene.

BOOKS RECEIVED.

The Australian Army Medical Corps in Egypt: An Illustrated and Detailed Account of the Early Organisation and Work of the Australian Medical Units in Egypt in 1914–15. By Lt.-Col. J. W. Barrett and Lieut. P. E. Deane. Pp. xiv+259. (London: H. K. Lewis and Co., Ltd., 1918.) 12*s*. 6*d*. net.

Pre-History in Essex, as Recorded in the Journal of the Essex Field Club. By S. H. Warren. (Essex Field Club Special Memoirs, vol. v.) Pp. 44. (Stratford, Essex: The Essex Field Club; London: Simpkin, Marshall, and Co., Ltd., 1918.) 2*s*. 6*d*. net.

Traité Clinique de Neurologie de Guerre. Par Paul Sollier, Chartier, and Félix Rose, Villandre. Pp. viii+830. (Paris: Félix Alcan, 1918.) 32 francs.

DIARY OF SOCIETIES.

THURSDAY, FEBRUARY 6.

ROYAL INSTITUTION, at 3.—Dr. W. Wilson: The Movements of the Sun, Earth, and Moon.

ROYAL SOCIETY, at 4.30.—A. Mallock: The Elasticity of Metals as Affected by Temperature.—W. L. Cowley and H. Levy: Vibration and Strength of Struts and Continuous Beams under End Thrusts.—A. Dey: A New Method for the Absolute Determination of Frequency (with a prefatory note by C. V. Raman).

LINNEAN SOCIETY, at 5.—N. E. Brown: (1) Old and New Species of Mesembryanthemum, with Critical Remarks. (2) A New Species of Lobostemon in the Linnean Herbarium.—Dr. J. R. Leeson: Exhibition of Mycetozoa from Epping Forest.

CHEMICAL SOCIETY, at 8.—G. N. White: A Note on the Action of Chloroform on certain Aryl Mercaptans in Presence of Caustic Soda.—J. T. Hewitt and W. J. Jones: (1) The Estimation of the Methoxyl Group. (2) The Estimation of Methyl Alcohol in Wood Distillates and their Concentrates.—P. F. Frankland, F. Challenger, and N. A. Nicholls: The Preparation of Monomethylamine from Chloropicrin.—W. C. McC. Lewis: Studies in Catalysis, Part x. Preliminary Note upon the Applicability of the Radiation Hypothesis to Heterogeneous Reactions.

FRIDAY, FEBRUARY 7.

ROYAL INSTITUTION, at 5.30.—Prof. J. G. Adami: Medical Research in its Relationship to the War.

MONDAY, FEBRUARY 10.

ROYAL SOCIETY OF ARTS, at 4.30.—Prof. J. A. Fleming: Scientific Problems of Electric Wave Telegraphy.

ROYAL GEOGRAPHICAL SOCIETY, at 8.—Commander Roncagli, Italian Navy: The Adriatic.

TUESDAY, FEBRUARY 11.

ROYAL INSTITUTION at 3.—Prof. J. T. MacGregor-Morris: Study of Electric Arcs and their Applications.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—*Further Discussion*: Hon. R. C. Parsons: Centrifugal Pumps for Dealing with Liquids containing Solid, Fibrous, and Erosive Matters.—*Probable Papers*: F. J. Mallett: The Flow of Water in Pipes and Pressure Tunnels.—A. A. Barnes: Discharge of Large Cast-Iron Pipe-Lines in Relation to their Age.

WEDNESDAY, FEBRUARY 12.

ROYAL SOCIETY OF ARTS, at 4.30.—Sir Frank Heath: The Government and the Organisation of Scientific Research.

THURSDAY, FEBRUARY 13.

ROYAL INSTITUTION, at 3.—Dr. W. Wilson: The Movements of the Sun, Earth, and Moon.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—Bt.-Lt.-Col. W. A. J. O'Meara: The Functions of the Engineer: his Education and Training.

CHILD-STUDY SOCIETY, at 6.—Dr. C. W. Kimmins: The Significance of Children's Dreams.

OPTICAL SOCIETY, at 7.—Annual General Meeting.—At 7.30.—Lord Rayleigh: A Possible Disturbance of a Range-finder by Atmospheric Refraction due to the Motion of the Ship which carries it.—L. C. Martin and Mrs. Griffiths: Deposit on Glass Surfaces in Instruments.

FRIDAY, FEBRUARY 14.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Anniversary Meeting.

ROYAL INSTITUTION, at 5.30.—Prof. C. G. Knott: Earthquake Waves and the Interior of the Earth.

MALACOLOGICAL SOCIETY, at 7.—Annual General Meeting.

CONTENTS.

Editorial and Publishing Offices:
MACMILLAN AND CO., LTD.,
ST. MARTIN'S STREET, LONDON, W.C.2.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.
Telephone Number: GERRARD 8830.

Printed in Great Britain by R. Clay and Sons, Limited, at Brunswick Street, Stamford Street, S.E.1, and published by Macmillan and Co., Limited. at St. Martin's Street, London, W.C. 2, and The Macmillan Co., 66 Fifth Avenue, New York.—Thursday, February 6 1919.