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

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The Promotion of our Optical Industries.

THE Government has promised to introduce in the House of Commons early next session a Bill to safeguard and foster certain key industries in this country. Of these the optical glass and optical instrument industries deserve special consideration, for their importance is likely to be overlooked because they are relatively small industries, not employing large aggregations of capital or big numbers of firms and employees. It is dangerous for any nation to estimate the value and necessity of a particular industry by taking account merely of the capital sunk in it and of the number of people it employs. It is rather to the character of the industry and to the part it plays in the industrial life of the nation, both in peace and in war, that we must look if we are rightly to measure its intrinsic national value.

There are differences of opinion as to the best method of promoting the development of an incipient industry, whether by subsidies or by safeguards against unrestricted and unregulated foreign competition, but there is none as to the need for immediate action in the case of industries which are essential to the proper functioning of the nation's industrial system in peace and are vital to its safety in war. Adequate measures must be taken to foster these key industries, regardless of whether a general economic principle, sound in ideal circumstances or as a general proposition, is violated.

It is not difficult to show that the manufactures of optical glass and of optical instruments fall in this category. First, it must be realised that the manufacture of optical instruments in this country stands or falls with the manufacture of optical glass in this country. If the British optical instrument industry is to be maintained and to develop so as to turn out products equal, at least, to the best products of other nations, it must not be dependent on foreign sources for the supply of optical glass, but must have an adequate home supply, equal, again, at least to the best available anywhere. Owing mainly to our national neglect of scientific workers, supremacy in the optical glass industry, which was established in this country as early as 1837, passed over to Germany, the Government of which had the insight and the foresight to gauge its actual and potential value. Not only did the Prussian Government bear the expense of the prolonged series of scientific investigations commenced by Schott and Abbe in 1881, but also, in order to capture the world trade, large State subsidies were made continuously to the industry down to the declaration of war in 1914. In that year there was but one firm manufacturing optical glass in the British Empire, with the consequence that during the first year of the war our armies and our fleets could not be equipped with the optical glass required.

By the intensive research of our scientific workers; by lavish expenditure; by the energetic enterprise of manufacturers in building workshops, installing plant, and, under conditions of great difficulty, training labour to perform the highly skilled operations needed, these deficiencies were overcome; and by the end of the war British optical glass was as good as German, and it was being produced in quantities sufficient to meet every demand. The optical instrument industry developed correspondingly, and instruments for all the varied purposes of the Army, the Navy, and the Air Force were manufactured equal to, and in many cases surpassing, the best that Germany could make. The position now is that we have the buildings, the plant, the organisation, the technical knowledge and the technicians, and the skilled labour needed to maintain these industries at their present high level of efficiency. Moreover, as a guarantee of future progress, the industry has established the British Scientific Instrument Research Association, and the Imperial College of Science and Technology has formed a Department of Technical Optics, so that the study of this branch of science, hitherto neglected in this country, may be raised to the highest university status.

It is undeniable that the preservation of the optical glass and optical instrument industries is absolutely vital in war. The skilled labour needed for this industry cannot be hurriedly improvised, as it can and was, for example, in the engineering trades. There is no kindred industry from which, for example, the optical glass grinders and polishers can be drawn in time of emergency. The optical glass maker and the optical instrument maker require a long training, and if these industries are allowed to decline and another war occurs, we shall find ourselves in a position more dangerous even than was our situation in 1914.

A flourishing and efficient optical instrument industry is not less vitally important to the nation's peaceful pursuits than it is for purposes of warfare. The general use of optical instruments in industries is growing and must grow. The increasing use of the microscope in the textile and steel industries, and the application of the polarimeter for testing purposes in the sugar and essential oil industries, are but two of many examples that could be cited to show the growing dependence of our great national industries upon the optical instrument industry. The development and perfection of optical instruments and the invention of new types in this country will be brought to a standstill unless the instruments are manufactured here, where British inventors and designers can keep in close touch with the manufacturers. Moreover, this industry, springing directly from the loins of science, and progressing as scientific knowledge widens, is one of the most highly skilled industries we have. Its expansion means a definite increase in the numbers of technical scientific workers and of the most highly skilled artisans; and the national wealth, in any comprehensive conception of the term, must be increased by the increase of the numbers of such educated and skilled classes.

What is the position of these industries to-day? As the *Daily Telegraph* says in a leading article on January 6: "The industry is again exposed to the full blast of German competition, more formidable now than ever because of the state of the German exchange." Open competition, in these abnormal circumstances, is impossible.

There are two main objects which the Bill to be introduced should secure and reconcile. On one hand, if the industry is to be saved, the manufacturers must be protected from foreign competition aggravated by the state of the exchange; and, on the other, the users of scientific instruments must not be prejudiced or hampered, either by being unable to obtain the best instruments or by having to pay an extravagant price for them. These apparently conflicting interests are not merely reconcilable; they are interdependent. If the British optical instrument industry should dwindle and die, the scientific users of instruments will be at the mercy of foreign manufacturers, they will have to pay a heavy price for such dependence, and they will be handicapped as compared with scientific workers in foreign countries possessing a flourishing scientific instrument industry. Similarly, if the scientific users cannot obtain the best instruments for their work, or if they have to pay an exorbitant price for them, their work will be hampered, their demand for instruments will decrease, and the manufacturers will ultimately suffer.

The industries, through the British Optical Instrument Manufacturers' Association, ask shortly for the following measures of protection :—

(1) No optical glass or scientific instruments to be imported into this country for a period of, say, seven years, except under licence.

(2) Such licences only to be granted in respect of goods which are not being made in Great Britain in the required quantities or of the required quality.

(3) An expert licensing committee to be set up.

(4) The optical instrument manufacturers are prepared, in order to guarantee reasonable prices, to submit to a control of profits.

The manufacturers are satisfied and confident that, under such conditions for a limited period, they would be able to establish the optical glass and optical instrument industries on a sound and stable basis, and also be able at the end of the period to meet any foreign competition in the open market. On the other hand, unless they secure this limited protection, it is more than probable —indeed, it is almost certain—that the manufacture of optical glass in this country will cease, and that, in consequence, some of the largest British manufacturers of optical instruments will greatly curtail their production. The proposed measures seem to protect adequately the interests of the scientific users. Moreover, such a system of control of imports for a limited period seems preferable to anything in the nature of a permanent tariff. It is not likely to have on the industry the emasculating effect of a protective tariff; provided that the period be limited, and that the licensing committee adopt an enlightened policy, prohibition of imports, except under licence, is rather calculated to act as a stimulus on the development of the industry.

There is, finally, one point not dealt with in the proposals outlined above. In return for this shield from danger during a limited period, the country may well ask: What guarantee is there that the manufacturers are taking due measures to promote and prosecute the scientific research and scientific methods on which alone ultimately these, or any other, industries can be made efficient and able to stand against foreign competition? The leading manufacturers have combined to form a scientific instrument research association, and in addition many of them are engaged continuously in scientific research. But it is not clear that all the manufacturers who are demanding the legislative measures outlined above are contributing in either or both of these ways to the advancement of the industry. It is worth considering whether the proposed licensing committee should not take this factor into consideration in any specific case in which it is asked to grant or to refuse a licence.

British Mammals.

British Mammals. Written and illustrated by A. Thorburn. (In two volumes.) Vol. i. Pp. vii+84+25 plates. (London: Longmans, Green, and Co., 1920.) Price 10*l.* 10*s.* net two vols.

THE success of "British Birds" and "A Naturalist's Sketch-book" has induced Mr. Thorburn and his publishers to issue companion volumes on "British Mammals," the first of which is now before us. Although the subject of our native beasts has already been somewhat exhaustively dealt with by Millais, Barrett-Hamilton, Harting, Lydekker, Coward, Adams, etc., there is yet room for Mr. Thorburn's book, because he is an artist-naturalist of such unique quality and observation that anything he may give us is worthy of publication and permanent value. In his case the common truism that there is always room at the top applies definitely. Pictures of natural history are always in demand, and we cannot have too many of those of the highest quality, since the exponents who possess genius are so few. Wherefore, even if the author's text is short, it is quite sufficient and extremely accurate so far as it goes, whilst the illustrations of the various species and subspecies, especially the smaller ones, are of such remarkable accuracy and beauty that it is not too much to say they have not been, and never will be, surpassed. Where Mr. Thorburn excels all other artists of mammals or birds is in his supreme rendering of the colour and texture of fur and feather, as well as in his perfect association of natural background with the subject under treatment. He also introduces just the right botanical features found in association with the creatures he depicts, and skilfully inserts little and surprising notes of colour, such as a bluebell, an orange-tip butterfly, a golden kingcup, or a humble daisy, which often makes a charming picture out of what is really a dull and unattractive subject. This is pure skill, and the result of a severe artistic training combined with a knowledge of Nature.

Those of us who collect books of naturalist history find that there are few the text and illustrations of which stand the test of years. Processes of reproduction, as well as science and observation, are apt to become out-of-date and useless to the practical naturalist of to-day, since within the last few years this class of art and literature has reached a level never approached in past times. "The value of a book," once said Lord Rosebery, "is its price in the second-hand catalogues." Wherefore it behoves us, in these days of heavy expenditure and high taxation, to purchase our treasures with an eye to the future, and those of us who can afford a "Thorburn" book will be wise, for the work of this great artist must be limited, and will certainly rise in value.

The artist's pictures of dormouse, hedgehog, badger, fox, shrews, and various species of bats are quite little gems. His eye sees with Pre-Raphaelite exactness almost every hair on the lesser shrew, the smallest mammal in the world, and gives it that delicious softness which it possesses. If there is one picture that is a *tour de force,* it is the mole, a very difficult creature to paint. We have kept a mole alive and seen it gobbling a worm with the almost indecent haste so admirably depicted. There is the correct and strenuous position of the hind-legs, the holding of the powerful fore-paws, and the perfectly rounded line of the head as it gobbles its prey with a true gourmand's rapidity. Most artists would be content to paint just a dead mole, but Mr. Thorburn gives it life and character. Space does not permit us to criticise the numerous plates in which the artist has succeeded in giving us satisfactory renderings of our native beasts. He has a critical audience to satisfy, since he is apt to think that we now know our own mammals, few in number though they are; but special attention may be directed to the bats, which, although unlovely things, yet require an accuracy of delineation that calls for the highest care and exactitude. Mr. Thorburn has evidently taken the trouble to depict these somewhat elusive beasts from life, and is to be congratulated on his success. No artist-naturalist, however, is free from criticism, and if we find fault with a few inaccuracies, they are only such as occur in all works where fresh models are unavailable.

In the case of the bearded seal—a rare mammal that, Mr. Thorburn says, has occurred only once in British waters (twice would be more accurate, as a specimen was killed in the Beauly Firth a few years ago, and recorded in the *Field*)—the artist has evidently painted his picture from a cured skin in which the oil and tanning have spoiled the original colour, which in Nature (as we have seen) is a fine pearly grey. The eyes, too, are round and prominent, as in the common seal, and not sunk and overshadowed by the cranial sockets. The picture, too, of the otter is not a success, the neck being far too long. Also we are not enamoured with the little pen-and-ink tailpieces. Some are fairly good, but the majority are drawn too coarse to render fur accurately. This is doubtless due to the fact that the book is printed on a pure hand-made paper, which, whilst admirable for the text, does not permit the use of anything but blocks exhibiting coarse lines. It is to be regretted that, as yet, English firms of reproducers are still far behind those of the Continent in this class of reproduction.

These and a few other inaccuracies of detail are, however, but trifling detriment in a work which will always remain one of permanent value, and both Mr. Thorburn and his publishers are to be congratulated on having issued so valuable and magnificent a production. We look forward with pleasure to the second volume, which, if it is as good as the first, will satisfy the most exacting naturalists and connoisseurs of beautiful art-books.

Improvement of the Race.

Applied Eugenics. By Paul Popenoe and Prof. Roswell Hill Johnson. (Social Science Text-books.) Pp. xii+459. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1920.) Price 14*s*. net.

EVERYONE is agreed as to the desirability of improving the intrinsic qualities of the race, but the difficulty is to know what can wisely be done. The question, What is practicable? is much harder to answer than the question, What is desirable? But towards an answer to the more difficult question this very competent book by Mr. Paul Popenoe and Prof. Roswell Hill Johnson makes a definite contribution. "Emphasis has been laid on the practical means by which society may encourage the reproduction of superior persons and discourage that of inferiors."

The authors begin by estimating the relative importance of the two indispensable factors—hereditary nature and environing nurture. Their reasoned bias is evident in the sentence: "It is his nature, not his nurture, that is mainly responsible for his character." Perhaps it is not very profitable to discuss which of two necessary components is the more important in a resultant. So far as social efficiency in the wide sense is concerned—which includes character and working power—we hold that the man with five talents often goes further than the man with ten, simply because his nurture was better. But we have no statistics to prove this. The authors go on to a shrewd discussion of the transmissibility of exogenous modifications, giving as their verdict "Not proven." But here, again, they seem to us to draw their bow too tightly, not attaching sufficient importance to the *rôle* that nurtural peculiarities may have as the liberating stimuli of germinal variations. From emphasis on "nature" rather than on "nurture" and from rejection of the postulate of transmissible modifications, the authors pass logically to the conclusion that man is much more "born" than "made"; so what eugenics must look forward to is having more children well born. What this means biologically is clearly explained in the chapter on the laws of heredity. Civilised man has to some extent thrown off the yoke of natural selection—a fact that in itself suggests the desirability of some other mode of sifting to safeguard the interests of the race. This desirability is corroborated by the fact that where natural selection still operates on civilised mankind, especially in the way of a differential death-rate, it is not doing much to improve the race. In some ways it is rapidly hastening race degeneracy. It is here that practical eugenics comes in with suggestions towards "raising the level of the race by the production of fewer people with physical and mental defects, and more people with physical and mental excellences." What are these suggestions?

The first suggestion is the restriction of the marriage and reproduction of defectives. Good stock is spoiled by mingling with bad; many infants would better not be born; much misery is perpetuated; the cost to the State is enormous. The proposal is "to prevent the reproduction of those feeble-minded, insane, epileptic, grossly defective or hopelessly delinquent people, whose condition can be proved to be due to heredity, and is therefore probably transmissible to their offspring." But how is the restriction to be effected? The authors answer: By segregation, sterilisation in certain cases, and a good banns law. Besides these coercive methods, the first of which is regarded as urgently necessary, the authors look to an increasingly enlightened social conscience. The objections to coercive methods are considered in a fair-minded and temperate manner, but we confess to have less faith than the authors have in the wisdom of tribunals. We should not like our neighbours to decide whether we are to have permission to marry, and it is well known that such conditions as feeble-minded and epileptic are not very precise. It is interesting to speculate what human history would have been if eugenics boards had segregated—well, perhaps we had better not mention names.

On the positive side the authors write admirably. Sex-selection is a reality; if it were better educated and given wider opportunities, it might become a very potent factor in racial progress. To promote a higher marriage-rate among superiors, the authors make a plea for clean living, for simpler living, for a wider education of faculties, for a franker approbation of the married state as more normal than celibacy, and against the persistent prolongation of the training period beyond the early twenties. At the same time, the authors assure us that the people, as a whole, are not marrying less than they used to do; what is wrong is postponement or avoidance of marriage among the more individuated. Not only so, but when they marry they do not have enough children. They do not want to, and the reasons for this are not wholly selfish. A careful analysis is submitted, and attention is directed to the desirability of certain educational and economic changes which may counteract the tendency to race-suicide. There is a point here that seems to be often overlooked in regard to eugenic education. The authors say: "Perhaps the time is not so far distant when babies will be considered an integral part of a girl's curriculum." But while that may be very useful for the girls who marry, is it not apt to be a refined cruelty towards the many who find no mates?

The authors go on to discuss, in relation to eugenics, such subjects as the colour line, immigration, and war—all with the objectivity, scholarship, and fair-mindedness that are characteristic of the whole book. There is a useful chapter on the value of genealogical outlook, both ethically and scientifically. Preoccupation with it may lead to loss of perspective; but to call genealogy a fad is a betrayal of foolishness and vulgarity. The authors' studies end with an emphasis on good environment (euthenics), and this corrects what seems to us a slight partiality in the early chapters. We strongly recommend the book as an all-round, well-documented, level-headed answer to the question: What is practicable in the way of eugenics?

The First Great Alpine Traveller.

The Life of Horace Bénédict de Saussure. By D. W. Freshfield, with the collaboration of H. F. Montagnier. Pp. xii+479. (London: Edward Arnold, 1920.) Price 25*s.* net.

A LIFE of de Saussure, author of the "Voyages dans les Alpes," has long been desired, and that has now been supplied by an Englishman singularly fitted for the task, Dr. Douglas Freshfield, who was incited so long ago as 1875 by Ruskin, and has been ever since, directly or indirectly, gathering materials. The handsome volume before us is the result. No one has a better knowledge of mountains than Dr. Freshfield, for when a boy, in 1859 and 1860, he accompanied his father and mother on riding tours through several parts of the Alps, and has repeatedly returned thither. He has also explored many other mountain chains, and has published his experiences. In 1869 he described a journey through the Central Caucasus and Bashan, in the course of which he ascended Kasbek and one of the twin summits of Elbruz. In 1896 he published his splendid work on "The Exploration of the Caucasus," and his journey of 1899 "Round Kangchenjunga" was yet more adventurous, though rendered rather less successful by persistently bad weather; while since then, in "Hannibal Once More," he has discussed the route of the Carthaginian general across the Alps, suggesting one considerably south of those generally supported, for which there is undoubtedly much to be said.

Horace Bénédict de Saussure, born at Geneva in 1740, was a man of good family, strong intellect, and remarkably wide education. He could write with ease both Latin and Greek; in addition to French, he knew German, Dutch, and English well enough to converse easily with the educated men of each country, and had a wide knowledge for that day of mathematics, metaphysics, and natural science, especially geology, mineralogy, and chemical physics. In his youth, though the summit of Mont Blanc was visible from the quay of Geneva, very few travellers had penetrated so far as Chamonix until, in 1742, an English party proved that the glaciers of Savoy more than rivalled those of Grindelwald, already known through Scheuchzer's "Itinera Alpina."

De Saussure married early, and as his wife added to his means he was able to gratify his love for travel. Though at times suffering from dyspepsia, he had a strong constitution, and was for more than ten years after 1774 able to lead, with but one interruption, "a life of various activity as a hard-working professor, a man of science, a citizen, and a mountain traveller." In this time he made his principal Alpine explorations, which culminated in 1787–88 and 1789 in the ascent of Mont Blanc, the stay for thirteen days on the Col du Géant, and the tour of Monte Rosa. But evil times were approaching, for the Revolution in France soon found its imitators at Geneva. De Saussure's sense of duty drew him into politics in the vain hope of averting their evils, with the result that he was impoverished and his life more than once in peril. Dr. Freshfield gives us the pitiful story in all its details until in 1794 de Saussure had a stroke of paralysis which, though his brain remained clear and he was able to write two volumes of his "Voyages" and to seek alleviation by visiting baths, ultimately proved fatal on January 22, 1799.

Dr. Freshfield has spared no pains in accomplishing his task, which has evidently been to him a labour of love. De Saussure was the great forerunner of scientific Alpine exploration—a man better qualified than any successor until the days of Principal J. D. Forbes. The latter corrected some of the mistakes into which his illustrious predecessor had fallen, and put the question of glacier motion on a surer footing, about the year 1843, in his "Travels through the Alps of Savoy and other Parts of the Pennine Chain." This gave an increasing stimulus to Alpine travel, which culminated in the foundation of the Alpine Club in 1857, since which date scientific investigation of the Alps and the conquest of mountain difficulties have made wonderful progress. It is scarcely more than 120 years since de Saussure died, yet the pictures representing him on his greatest glacier excursion, and some of his geological speculations, seem to us strangely antiquated. Nevertheless they show him to have been a man of true courage and of a really scientific mind; and this reference to pictures reminds us that Dr. Freshfield has added to the value of his work by a number of well-selected illustrations, among which are not only excellent portraits of de Saussure and of some of his relations and friends, but also representations of places of interest in his history.

T. G. BONNEY.

X-Ray Analysis and Mineralogy.

Lehrbuch der Mineralogie. By Prof. P. Niggli. Pp. xii+694. (Berlin: Gebrüder Borntraeger, 1920.) Price 80 marks.

THIS book, written by the professor of mineralogy and petrography at the University and "Technischen Hochschule" of Zurich, but published in Berlin, is a comprehensive work of some originality. It is illustrated by a large number of figures, which are practically all reproductions of drawings made by the university artist from material supplied by the author. The result is doubtless effective from the author's point of view and for rapid production, but the illustrations are much coarser than would satisfy an average author or publisher in this country, especially in the case of so large and expensive a book.

The work possesses a particular value, however, as being that of a colleague of Prof. Laue, who was called from Munich, after his discovery of the diffraction of X-rays by the planes of atoms in crystals, to become professor of physics at Zurich University, and this fact is revealed by the constant references to the analysis of crystals by X-rays. Indeed, it must prove somewhat embarrassing and bewildering to a student who is not of some years' standing in scientific study to find in the first few pages statements which really embody the complex results of the most recent research—on the structure of the atom, or on the screw-structure of certain point-systems, for instance—alongside the most elementary treatment of the properties of crystals. It amounts more or less to the revelation of their innermost point-system and space-lattice structure before even the obvious characters and attributes of crystals have been touched upon.

The book is, indeed, in its general character, very like a collection of notes for lectures, illustrated by wall diagrams, only very rarely going into any detail with the subject in hand at the moment. Even the names of original authorities, when mentioned at all, are only given as an afterthought in brackets, or in an occasional note in small print, while references to published memoirs are entirely absent. However, a list of textbooks and works of reference is given at the end of the book. The lecture-room impression is still further emphasised by the large amount of tabular matter in the book. Thus the historic sequence of the acquirement of our knowledge of crystals is practically ignored, and information of all kinds—old and new, some easy of comprehension and some quite beyond the understanding of all but those well versed in the elements of the subject—is laid indiscriminately before the reader.

Having said this much, and being forewarned as to these limitations, it is indisputable that the book has many good points, chief of which is that it will be of considerable use to mineralogists, and especially to those of a petrological bent; for chemical crystallography is largely ignored, except as it concerns naturally occurring crystallised substances. Next must come the valuable fact that the book is not only written under the influence of the knowledge acquired during the last seven years by means of X-ray analysis, but also inspired by the presence in the same university of the discoverer of this remarkable method of probing crystal structure. It is also noticeable that certain sections of the book are specially good, chiefly from their novel mode of presentation and illustration. The four pages of drawings of crystals showing their optical properties are of a very original character, and if one were not reminded so forcibly of the wall diagram by their grouping in such closely compacted numbers, the effect would have been more pleasing and the result more striking.

Doubtless the main use for the book will be as an aid to the author's own students, in affording an authentic account of their professor's lectures. The book covers an immense amount of ground, but is, in the main, elementary and superficial, besides being crudely and cheaply illustrated. It is largely redeemed, however, by the many references to X-ray results and by its occasional bursts of originality. A. E. H. T.

Our Bookshelf.

Penrose's Annual. Vol. xxiii. of The Process Year Book and Review of the Graphic Arts, 1921. Edited by William Gamble. Pp. xii + 88 + plates. (London: Percy Lund, Humphries, and Co., Ltd.; Bradford: The Country Press, 1921.) Price 10*s*. 6*d*. net.

This is the second issue after the war, and there is evidence that the editor has now been able to resume the high level of quality that he had attained before the publication of these instructive annuals was interrupted by the exigencies of military service. The volume may not be quite so thick as, but it seems to us superior to, last year's in many ways, especially in the quality and variety of its specimens of reproduction. The editor, in his summing up of the year's progress, finds no striking new departure to record, though there is much evidence of progress in many directions. The activity during the year has been rather in laying foundations that may well be expected to lead to future advances than in the realisation of improvements. Rotary photogravure holds its own, and is doubtless firmly established, as in the *Times Weekly Edition Illustrated Supplement,* but it appears that the production of the cylinders cannot be ensured within the short time necessary to enable a daily newspaper to be produced entirely by this process. The shortage of skilled labour in the process trade is becoming acute.

Among the several interesting and useful articles is a contribution from Prof. Namias, who finds that bichromated papers (as carbon tissue) may be impregnated with the chromate, and yet remain stable for a very considerable time, if not indefinitely, by using a neutral chromate with a small quantity of an alkali, preferably caustic potash. Such paper does not spontaneously deteriorate. To prepare it for use, the sheets may be hung in a box in which is a small dish containing acetic acid for about half an hour. Obviously other methods of acidification may be adopted. Dr. Reginald S. Clay suggests a method of photography in colour by means of a series of interference units (Newton's rings).

The New Hazell Annual and Almanack for the Year 1921. By Dr. T. A. Ingram. Thirty-sixth year of issue. Pp. lvi + 823. (London: Henry Frowde, Hodder and Stoughton, 1921.) Price 7*s*. 6*d*. net.

We are always glad to see this useful annual, which is invaluable for reference in many matters. The volume gives the "most recent and authoritative information concerning the British Empire, the nations of the world, and all the important topics of the day." It contains among other details, including interesting astronomical and meteorological data, a useful list of all the scientific and other societies in the United Kingdom, and the names of the holders of the various Nobel prizes from the date of their foundation. There are also many valuable articles dealing with such diverse subjects as the statistics of education in the British Isles and the present state of aviation. A wide field is surveyed, and the positions of all the outstanding points are recorded.

Das Schmerzproblem. By Prof. A. Goldscheider. Pp. iv + 91. (Berlin: Julius Springer, 1920.) Price 10 marks.

In this little monograph Prof. Goldscheider, whose earlier researches into cutaneous sense physiology are well known, criticises the evidence relied upon by v. Frey to establish the specificity of the peripheral basis of cutaneous pain. The following sentence expresses sufficiently the author's point of view: "The sensation of pain, therefore, owes its existence to a heightening of irritability produced by the stimulus; unlike other sensations, it is not the simple expression of an excitation due to a peripheral stimulus, but presupposes an increased tonus of the sensory nerve-cell in comparison with the physiological condition" (p. 89).

Many of Prof. Goldscheider's criticisms are interesting, but the value of his book as a contribution to psycho-physiology is greatly diminished by his failure to take account of the recent researches of Dr. Henry Head and the latter's colleagues.

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.*]

Flint Implements from the Cromer Forest Bed.

THE discovery to which this letter relates was made towards the end of September of last year. For the past eighteen months I have spent a considerable amount of time investigating the deposits forming the cliffs of the north-east coast of Norfolk, and have already published a paper dealing with certain humanly fashioned flints found at, and in the neighbourhood of, Mundesley (Proc. Prehis. Soc. E. Anglia, vol. iii., part ii., pp. 219–43). I devoted my attention during last year to the district of Cromer, and have now to record the discovery of a flint-workshop site, which, in my opinion, is referable to the lowermost division of the Pliocene Forest Bed series. As is well known, the Cromer Forest Bed is generally regarded as of Newer Pliocene age, and was laid down after the deposition of the marine Weybourn Crag (latest beds of the Norwich Crag), and before the commencement of the great Pleistocene glaciations. In the Geological Survey memoir, "The Pliocene Deposits of Britain," Mr. Clement Reid states: "Where most complete, the 'Forest Bed' consists of three divisions—an Upper and a Lower Fresh-water Bed and an intermediate estuarine deposit." In many places along the coast the upper portion of the Cromer Forest Bed series can be seen in section towards the base of the cliff, but the lower part, being covered by beach material, can seldom be observed except when a succession of north-westerly gales has caused the sea to scour away the sand and shingle. It is now, however, possible at low water to examine the basal portion of the Cromer Forest Bed deposits when the receding tide has laid bare certain areas which only a comparatively short time ago were covered by great masses of Glacial and other strata in the then existing cliff. The site at Cromer where the humanly fashioned flints dealt with in this letter were found covers an area of foreshore about 150 yards long by 100 yards wide, and is almost opposite the north-western termination of the sea-wall at that place.

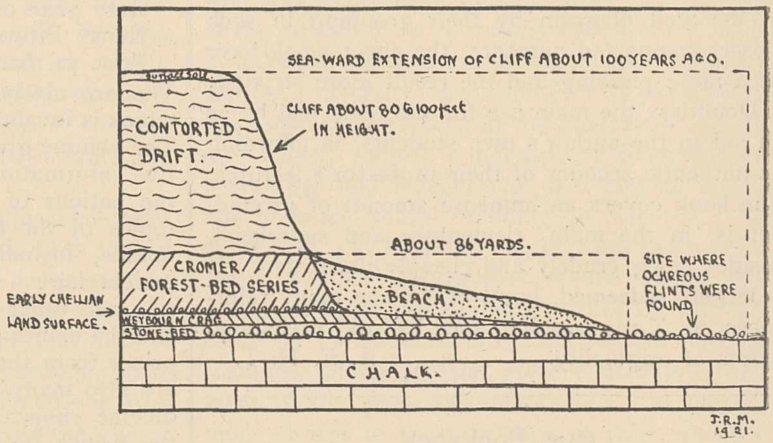

FIG. 1.—Diagrammatic cross-section of cliff, beach, and foreshore at Cromer showing probable relationship of implementiferous horizon to the cliff deposits. (Not drawn to scale.)

The implementiferous horizon is exposed at low water beyond the seaward extension of the shingle beach, and consists of a great number of flints of varying sizes which, for the most part, appear by their coloration and condition to be referable to the well-known Stone Bed occurring beneath the Crag deposits of Norfolk. Associated with these Stone Bed flints are (*a*) examples of paramoudras, (*b*) a few quartzite pebbles, (*c*) very numerous specimens of clay-ironstone pebbles and rolled pieces of chalk (the flint bed in several places rests upon solid stratified chalk which often shows *Pholas* borings in its surface), and (*d*) small pieces of mineralised bone (Mr. Savin, of Cromer, informs me that two molar teeth of *Elephas meridionalis* have been recovered from this site), belemnites, and other chalk fossils. Lastly, there are to be found scattered about amongst these relics numerous examples of humanly fashioned flint flakes and implements which generally exhibit upon their flaked surfaces a brilliant and arresting yellow-ochreous coloration. It is to be remarked also that many of the large blocks of Stone Bed flint show upon their surfaces flake-scars which are of the same ochreous shade, and the conclusion is drawn that these large flint masses represent the cores from which the ancient Cromerians obtained the raw material used in the manufacture of their artefacts. The position of the workshop site at Cromer is indicated in Fig. 1, which gives a diagrammatic cross-section of the cliff, beach, and foreshore.

The association upon the limited area of foreshore mentioned above of cores, flakes, and implements of varying sizes would appear to preclude the possibility of these specimens having drifted down the coast from some other site, as the sorting action of the tides would militate against such an association. Moreover, many of the Cromer flints collected do not exhibit marked signs of rolling by water. But the strongest evidence in support of the view that the specimens secured are referable to some period prior to that in which the Glacial deposits forming the Cromer cliffs were laid down is afforded by the fact that the ochreous artefacts have been made almost exclusively from pre-Crag Stone-Bed flints. These latter specimens, often very large and massive, are, to all intents and purposes, sedentary, and have remained so ever since the epoch when they were brought to their present position in pre-Crag times. Thus, when it is realised that many of these large sedentary specimens bear flake-scars exhibiting the same ochreous colour as is to be seen upon the implements and flakes lying near them, it becomes clear that the people who flaked the flints did so at a time when the Stone Bed was exposed, and prior to the deposition of the well-known "Lower Till" and Contorted Drift of Norfolk. And as the coloration of the pre-Crag flints is so markedly different from that of the ochreous specimens, it seems equally clear that the flaking of the latter is not referable to pre-Crag times, but to some later epoch.

I explain these facts in the following manner: After the laying down of the marine Weybourn Crag an emergence of the land took place, and in course of time the Crag suffered considerable erosion. This erosion in places laid bare the sub-Crag Stone Bed, and it would seem that the land surface then existing was inhabited by the makers of the ochreous specimens, who proceeded to use the large, sound pre-Crag flints in implement-making. In support of these conclusions it may be mentioned that in "The Pliocene Deposits of Britain" (p. 40) Mr. Clement Reid states: "There seem never to be more than a few feet of Crag beneath the Forest Bed." Again (p. 149) he states: "It is not improbable that there may also be another land surface beneath the *Lower* Fresh-water Bed, for in one place the Weybourn Crag below the Forest Bed has a rather weathered appearance; but of this one cannot be certain." Further (p. 151) it is stated: "The making of trial borings in 1886 and 1888 showed that the eroded surface beneath the deposit [the Forest Bed] was one of the most marked features, and that there was always a more or less gravelly base to the Forest Bed, beneath which the Crag was cut into by numerous channels or hollows."

As patches of Weybourn Crag are still to be seen near the workshop site at Cromer, and as a very careful search has failed to discover any flints of the same order and colour either in the Stone Bed, where it is exposed at West Runton and Sheringham, or in the upper strata of the Cromer Forest Bed series, it is concluded that the ochreous specimens now described are referable to the earliest member of this series, and are represented elsewhere, in all probability, by the "gravelly base" mentioned by Mr. Clement Reid. I have been able to ascertain that the Stone Bed extends for some distance underneath the shingle beach, and, if excavations could be made, would no doubt be found to occur under the cliff itself. The seaward termination of the shingle beach, where the Stone Bed outcrops, is about 86 yards from the foot of the cliff, and it can be regarded as in every way probable that the workshop site, at present exposed, was covered by the cliff one hundred years ago. In fact, the rate of recession of the cliffs to the south-east of Cromer is much in excess of that allowed for in this estimate. All the above conclusions regarding the geological age of the workshop site and the recession of the cliff at this part of the coast are shown diagrammatically in Fig. 1. It would appear that the sea is gradually uncovering and removing many of the ochreous implements and flakes, as to the south-east of Cromer a number of such specimens may be found upon the shore. These examples exhibit marked signs of rolling and the effects of what is known as "beach action."

The first discovery of flaked flints, claimed as being of human origin, in the Cromer Forest Bed was made by Mr. W. J. Lewis Abbott, who published his original paper in *Natural Science* in 1897 (vol. x., p. 89). I have seen Mr. Abbott's specimens, which are of quite a different order from those with which this letter deals. The number of flints recovered from the workshop site at Cromer now amounts to 249, and they comprise cores, half-finished and complete implements of Early Palæolithic Chellean forms, rostro-carinates, choppers, flake implements, râcloirs or side scrapers, points, scrapers of ordinary type, and simple flakes. The majority of the specimens are of massive size, and indicate that the people who shaped them were capable of delivering flake-removing blows of great accuracy and strength. One very large artefact, weighing 7 lb. 6 oz., is flaked into the form of a massive rostrate implement, and, if not used in both hands, could have been wielded only by an individual possessed of great strength and size of hand. The occurrence of several examples at the Cromer site of implements exhibiting flaking upon two opposite surfaces, which approximate in their form to the earliest Chellean artefacts, leads me to regard the whole assemblage of ochreous flints as referable to this cultural stage.

The presence of such an industry in a stratum of, apparently, Upper Pliocene age would seem to be of some interest and importance, and I hope to exhibit the Cromer flints, and to describe them in detail, in the near future.

J. REID MOIR.

Ipswich, January 20.

MR. REID MOIR has submitted sixty of the yellow-stained worked flints from beneath the Forest Bed of the Cromer shore to me, and has asked me to add a few words to his brief report. They are a most impressive collection on account of their abundance, frequently large size, and uniform lustrous surface and orange-brown colour. I have no doubt of their having been shaped by man. Very usually one surface of the flint is a flat orange-brown area produced by a single blow. Others show flaking on both upper and lower surface. Later marginal chipping—subsequent to the ochreous staining of the flint—appears as blue-grey or as black conchoidal scars. Whilst most of the specimens appear to be eminently fitted for use as rubbers in skin-dressing, some show more complete resemblance to coarsely worked ovate implements of Chellean character, and others are distinctly rostro-carinate. The most remarkable among them is the extraordinarily large and heavy rostrate implement weighing 7 lb. 6 oz. It is 10 in. in length and measures 5 in. in breadth and 4 in. in thickness at the butt-end. This huge implement is most definitely shaped by flaking of undoubted human origin. It is almost free from ochreous-yellow stain. Careful drawings of it of the natural size must be published for the use of archæologists. The whole "find" deserves really accurate illustration by figures giving both the actual size and the natural colour. The cost of such illustration is beyond the resources of our learned societies, but may possibly be met by the generosity of those who have enthusiasm for "prehistorics."

E. RAY LANKESTER.

January 29.

Modern Pass and Honours Degrees.

ALLOW me to express agreement with the article on "Scientific Education in the Metropolis" in NATURE of January 20, p. 653, where you deprecate the premature specialisation of a so-called honours degree under modern regulations, as contrasted with the old plan whereby a pass degree in a great variety of subjects had to be taken before specialisation in one subject was allowed. In the old days all the subjects were compulsory, and the range of knowledge required for Matriculation and for First and Second B.Sc. was quite considerable. A candidate who graduated with credit under those strenuous conditions might fairly be considered educated—to some extent even in the Humanities; and, at any rate, he had a severe training in working at subjects for which he had no special aptitude, but of which he ought not to be ignorant, as well as at those subjects which could be assimilated by him without effort.

I hold that the pass degree system in a modern university, if of a proper standard, as it was and I hope still is at the University of Birmingham, for instance, is generally of far more value to candidates and more helpful to their future development than a narrowly specialised course, which is so much easier. A man is engaged on his own specialty more or less all his life, but unless he gains access to the outlying districts of knowledge during his student stage, and under the stimulus of preparation for an examination test, he may never know anything about those other subjects at all.

Reference to an old London University Calendar will show the list of subjects that had individually and separately to be taken and passed in during my own student period—in addition to any attempt to carry some one or more to a higher grade so as to secure specific honours tested by a separate and supplementary additional paper:—

Matriculation.	First B.Sc.	Second B.Sc.
Latin	Mathematics (Trig. and Conics)	Organic Chemistry
Greek	Physics	Physiology
French or German	Inorganic Chemistry	Geology and Palæontology
Arithmetic and Algebra	Zoology	Logic and Moral Philosophy.
Geometry	Botany.	
English Language		
English History and Geography		
Mechanics		
Chemistry.		

Then, on this basis of general knowledge, the doctorate gave an opportunity of carrying some subdivision of one of these subjects to a very much higher stage. Options must be allowed sooner or later, of course, but the question is how soon an option should be allowed. A multitude of options at an early stage is liable to produce a crop of specialists. Such a crop may be necessary for the world's work, but the process of raising it can scarcely be called an education suited to the development of a human being.

While writing, and without presuming to comment on anything concerning London organisation, may I, as an outsider, venture to express a hope that Finsbury Technical College will not be closed? The admirable work done there in the past, and the great names associated with it, entitle it to be held in honour. Let us hope that its benefits will be continued to a generation seemingly more desirous of instruction than ever before. OLIVER LODGE.

January.

Heredity and Biological Terms.

WILL you allow me space for a short comment on the recent discussion in NATURE on Sir Archdall Reid's letters? The chief point raised by Sir Archdall Reid seems to me to be of great importance, and very far from being a side-issue. The usual custom of speaking of "characters" in living beings as either "innate" *or* "acquired": the product of either nature *or* nurture: or of describing them by other pairs of terms of similar import, does lead to much confusion in the minds of many when studying the production of "characters," and very especially that of human characters. Some seventeen years ago, when making a study of this kind, I was aided greatly by many communications I had with Sir Archdall Reid, and particularly by an article entitled "Biological Terms," published in the final number of *Bedrock* in 1914, which virtually sets forth the main position advocated by him in the present discussion. I do not intend to touch on any conflicting views on modes of hereditary transmission which may enter into this discussion, but are not strictly relevant to Sir Archdall Reid's main contention, except to say that the particular difficulty which he points out and strives to conquer can concern only those biologists who do not regard the modern Lamarckian hypothesis as established, or even as verisimilar. If that hypothesis were verified the whole contention would fail.

Sir Archdall Reid's chief point is that it would be a great benefit to science if all branches of it which deal with life adopted a like classification of "characters." At present biologists generally classify characters as "innate" *or* "acquired," while physiologists tend to classify characters from the point of view of the influences, or "nurture," which produce them. He takes, for instance, the case of a hand, a sixth digit on it, and a scar on it. The physiologist says all these characters are products of some kind of nurture, and tries to find out what kind it is. That is the physiologist's business. The biologist, concerned mainly with "nature," says the hand and the sixth digit are "innate" and the scar "acquired." In a certain sense both are right. But the physiologist's language implies that all "characters" are both inborn and acquired, while the biologist's implies that some are "inborn" and some "acquired." The language of the physiologists is always clear, while that of the biologists is very often obscure. Hence, probably, the absence among physiologists of the great divergences of opinion which exist among biologists.

Physiologists are mainly concerned with the development of the individual; biologists with heritage and evolution (or change in the heritage). Assuming that most biologists of the present day hold that heritage passes down the germ-tract, may it not be argued justly that if the child has a hand like the parent, there is no change in "nature" or "nurture"; that if the child has a sixth digit which the parent had not, there is a change in nature, or heritage, but none in "nurture"; and that if the child has a scar, there is no change in heritage, but only one in nurture? It therefore appears to me that Sir Archdall Reid's chief contention is very soundly based. If we think of a hand, scar, and sixth digit as "*characters*," as the physiologist does, they are all alike products of nature and nurture (innate and acquired); if we think of them as *likenesses and differences between individuals*, the hand indicates an innate likeness, the digit an innate difference, and the scar an acquired difference; and if we think of them in *terms of the germ-plasm*, the hand and the scar indicate no change, but the digit is a change (or, in biological language, a "variation").

The burden of Sir Archdall Reid's complaint is that biologists have thought and expressed themselves in terms of "characters," not of the germ-plasm; and that this has largely caused the misleading question, widespread beyond all scientific borders, as to whether "nature" or "nurture" is the stronger influence. This is especially notable in relation to the production of "characters" in the higher animals, and most of all to that of the most distinctive characters of man. Sir Archdall Reid thus insists that a vague terminology has caused neglect of the evolution of the power of developing in response to functional activity; and that, with a more precise terminology, the simple statement, "*Variations are the sole cause of non-inheritance; apart from variations, like exactly begets like when parent and child develop under like conditions*," will cover almost the whole field and thus leave biology free to deal with the many problems of immense scientific and practical importance which concern it.

In my own inquiries I have found that the common assumption of human characters being rigidly divisible as to their origin into two groups, "innate" *or* "acquired," constitutional *or* environmental, is a cause of much confusion; and I think that the import of Sir Archdall Reid's exposition of this matter has not been accorded adequate attention or weight. Nor, after studying the discussion of it in NATURE, can I see any material difference between the views of Sir Ray Lankester and those of Sir Archdall Reid.

H. BRYAN DONKIN.

London, February 1.

The Scientific Glassware Industry.

I HAVE read with very great interest the article on the optical glass industry published in NATURE of January 20, and should like to direct attention to the condition of the scientific and illuminating branches of the glass industry, which are in the same position as the optical section and of equal importance to the nation. The manufacture of scientific glassware, practically non-existent in the country prior to 1914, was undertaken by several glass-makers at the urgent request of the Government, which, shortly after the outbreak of hostilities, discovered that the prosecution of the war was in danger of being impeded owing to the lack of supplies of these articles. The progress made in the manufacture of this apparatus has been very remarkable, especially when taking into consideration the comparatively short time it has been in existence in this country and the great difficulties with which the manufacturers had to contend. The latter have, however, succeeded in producing glass which is in many cases superior to German or Austrian pre-war glass, although it is freely admitted that in the early days the glass produced was in some cases of extremely bad quality. This has now been remedied, and one may fairly claim that, as regards both the quality of the glass and the technique and workmanship, British-made scientific apparatus now is among the best that can be produced anywhere.

The industry is, however, in grave danger of being again completely lost to this country. Owing to prevailing conditions Germany, Austria, and Czecho-Slovakia are trading under conditions which make it impossible for British manufacturers to compete, and the factories have no alternative but to cease work almost immediately unless the Government gives some very definite assurance that the promises it made when it asked the manufacturers to undertake this work will be very shortly redeemed. The industry has not been in existence sufficiently long to enable the manufacturers to create reserves to fight and meet this competition in the ordinary way. On the contrary, the present loss to those engaged in the industry is extremely large, and it is mainly for this reason that they cannot continue production without the assistance of the Government, the most suitable form of which would be legislation on the lines of the Dyes Bill. The large majority of users of industrial and scientific apparatus have considered this question, and have joined with the manufacturers in urging upon the Government the necessity for immediate action in order that they shall not again have to rely upon foreign countries—and possible future enemies—for supplies of glass which is so vital, not only to the scientific and industrial worlds, but also to the very defence of the nation.

T. LESTER SWAIN.

The British Chemical Ware Manufacturers' Association, Ltd., 51 Lincoln's Inn Fields, London, W.C.2, January 31.

Greenland in Europe.

WITH reference to the letter by "T. R. R. S." in NATURE of January 27, p. 694, I may be allowed to add some explanatory remarks which could not be included in the very condensed synopsis of my Cardiff paper. The map showing Spitsbergen as "Greenland" appears in "An Easy Introduction to the Arts and Sciences," by R. Turner, jun., LL.D., late of Magdalen Hall, Oxford, author of "An Easy Introduction to Geography," etc. The copy cited is the fifteenth edition of that work, and it was issued in 1812 by Longman and other London booksellers. The first edition may be assumed to have been printed about twenty years earlier, with or without that map.

It is difficult for us to determine how far the nomenclature of the 1812 edition was then regarded as old-fashioned. To this very day we call the ocean that stretches from the west coast of Spitsbergen southward to the Arctic Circle "the Greenland Sea." For what length of time that expanse of water has borne that name is an interesting question; at any rate, there is no room for doubting that our seventeenth-century whalers and mariners regarded the Spitsbergen region as specially "Greenland."

As for the passage from Goldsmith's Geography, quoted by "T. R. R. S." as indicating another point of view, he will find, I think, on fuller consideration, that it does not conflict with the map of 1812, because Goldsmith's statement that icebergs or ice-floes "are to be met with on the coasts of Spitzbergen, to the great danger of the shipping employed in the Greenland fishery," clearly implies that the scene of "the Greenland fishery" lay off the western seaboard of Spitsbergen. That the latter name was given in the first place to the mountain peaks is manifest; indeed, an Arctic voyager of 1653 illustrates the different application of the two terms. On his outward voyage towards Vaigatz his ship sighted the distant peaks of "Spitzbergen" to northward, but when a visit was afterwards paid to the great whaling station in that archipelago he speaks of the land as "Greenland." Probably the two names have been used interchangeably for many generations.

DAVID MACRITCHIE.

Edinburgh, January 29.

The Mild Weather.

IN continuation of the letter on the above subject in NATURE of January 20, it may be of interest to give a few facts for the calendar month of January, since high temperatures were so persistent throughout. From the beginning to the end of the month there was a neck-to-neck race for record temperature between the Januarys of 1916 and 1921. The temperature at Greenwich for the civil day as published by the Registrar-General's weekly returns shows the supremacy for warmth to be claimed by January of the present year, when the mean for all the maximum readings was 50·0° F., the minimum 40·8°, and the mean of the mean maximum and minimum 45·4°. For January, 1916, the corresponding means were 50·4°, 40·1°, and 45·3°. There is only a trifling difference between the results for the two Januarys, which are the warmest during the last eighty years. In January, 1916, the days were slightly warmer than in 1921, whilst in January, 1921, the nights were appreciably warmer than in 1916.

The two years 1916 and 1921 are the only instances with the January mean maximum temperature 50° or above, and they are also the only instances with the mean minimum temperature 40° or above. In January, 1916, there were nineteen days with the shade temperature 50° or above, and eighteen such warm days in January, 1921; whilst in 1916 there were three nights with the temperature 45° or above, and in 1921 nine correspondingly warm nights. In both years the mean temperature for January was 7° above the normal.

CHAS. HARDING.

65 Holmewood Gardens, S.W.2, February 4.

The Leader Cable System.

SO far back as 1893 the idea was conceived of using electric signals transmitted through a submarine cable to guide ships past dangerous places. But it was not until Prof. R. B. Owens, of McGill University, began investigating the subject that what is now known as the leader cable system took practical shape. Prof. Owens took out certain patents in 1901–3, and these were later presented to the Admiralty, which has decided to allow anyone who wishes to do so to use them without paying royalty.

When Prof. Owens first began his researches the thermionic-valve amplifier was not in existence, and from lack of this important adjunct to its efficiency the leader cable could not be put to practical use, as the signals originated by it were not strong enough for navigational purposes. The invention of the amplifier enabled this defect to be overcome, with the result that during the war leader cables were employed both by ourselves and by the Germans. Such cables have since been laid at Portsmouth, New York, and Brest.

In all these installations the underlying principle employed is that devised by Prof. Owens, but considerable improvements have been made in the details of the apparatus and in the manner of using it. These advances are mainly the result of work carried out at various Admiralty experimental stations, particularly at Portsmouth, where a cable 17 nautical miles in length has been laid along the eastern approach to the harbour. The working of this cable was demonstrated to the foreign naval attachés recently.

A leader cable system comprises a submarine cable laid in any waters where it is desired to facilitate navigation. The sea end of the cable is earthed, whilst the shore end is taken into a transmitting station and there connected to one terminal of an alternating dynamo, the other terminal of the alternator being connected to earth or the sea. In the cable at the shore station a power-operated signalling key is inserted by means of which the current in the cable can be made or broken so as to transmit through the cable any pre-arranged signals or Morse letter. In order that a ship may be able to locate the cable and follow along it a receiving apparatus is fitted in her, or a portable set may be taken on board by the pilot. This apparatus consists of two coils of wire, one on the port and one on the starboard side, which are connected to an amplifier and telephones on the vessel's bridge through a change-over switch. In the telephones the signals given out by the cable are heard as a sharply pitched musical note.

The electric current in a leader cable is an alternating one, and the actual field distribution arising therefrom is complicated by the fact that the return current appears to be mainly concentrated between the cable and the sea surface. Considering the case of a continuous current in the cable and a return path through sea water in the vicinity of the cable, the resultant magnetic field in the air above the cable will contain circular lines of force due to the constant current in the cable and horizontal lines of force due to the return current in the sea water. Assuming the return current to be distributed uniformly and thus to constitute a sheet of current the magnetic field of which is horizontal and at right angles to the cable, the resultant field will be horizontal directly over the cable, vertical some distance away, and again approximately horizontal, but in the reverse direction, at a considerable distance from the cable.

If instead of a current of constant intensity an alternating current is passed through the cable, electric currents in a direction opposed to those in the cable will be induced in the sea water, and the intensity of these induced currents will be greatest near the cable. Above the surface of the water the lines of force due to these induced currents will be slightly curved to the surface, but the general direction of the field will be opposed to that due to the current in the cable. In the final resultant field the points of inversion are moved towards the cable. With increase in the frequency of alternation the induced currents increase in intensity, and as a result the points of

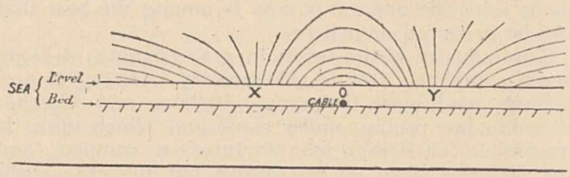

FIG. 1.—Approximate distribution of magnetic field caused by an alternating current in the cable.

inversion (X and Y, Fig. 1) move closer together as the frequency increases.

When the hull of a ship is brought into the vicinity of the cable that part of the ship—and the space adjacent to it—farthest removed from the cable will be screened to some extent. The ship being a good conductor, electric currents are induced in its outer surface when an alternating current flows through the cable. When the ship is broadside on to the cable these sheets of current flow fore and aft and give rise to a magnetic field parallel to the surface of the ship. If the intensity of the magnetic alternating field giving rise to these induced currents is greater on one side of the ship than on the other, then the resulting magnetic field will be greater on the former side.

When a steel or iron ship lies directly over the cable the intensity of the magnetic field is appreciably increased because of the presence of the ship, but the intensity is small over the deck because of the screening effect of the hull. If on each side of the ship a square frame is placed, and if on these frames a number of turns of wire are wound, thus forming a coil, some of the lines of force will pass through these coils. When the ship lies directly over the cable the number of lines of force passing through each coil will be equal, and the strength of the signals heard in each coil will be equal also. But when the ship is on one side of the cable the strength of the signals received in the coil nearest the cable will be the louder. By this variation in the strength of signals the navigator is able to tell which side of the cable his ship is on.

Experiments made at Portsmouth show that the best position for the coils to be placed is with their centre not farther than within 18 in. from the stripped back for a distance of 6 ft. so as to make good electrical connection with the sea. The inboard ends of the cables are connected to the receiving apparatus on the bridge through a twin wire led from the stern. The chief difference when using the electrodes instead of coils is that, as with the former there is no screening effect, the signals received do not indicate which side of the leader cable the ship is on. To ascertain this it is necessary to maintain a steady course for some few minutes and to observe whether the strength of the signals increases or decreases.

In the receiving apparatus aboard ship two leads

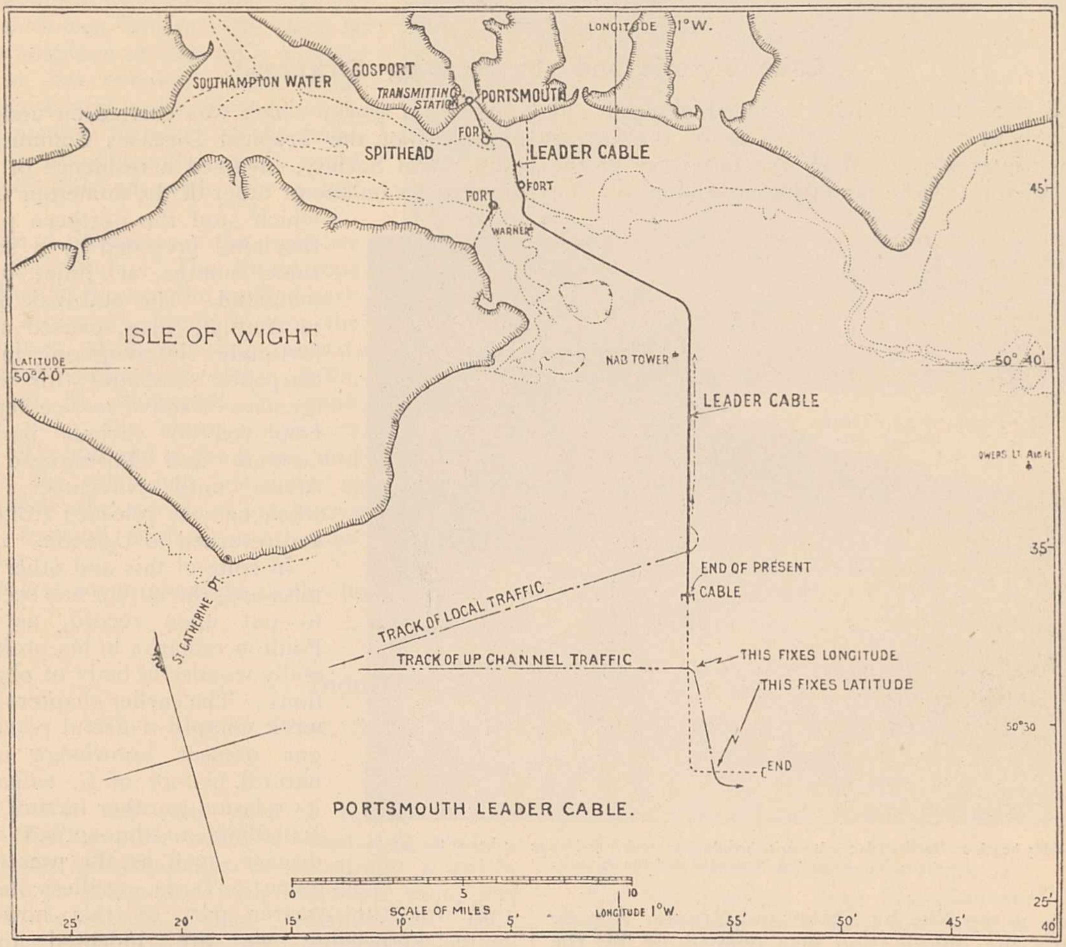

FIG. 2.—Position of Portsmouth leader cable. The broken line turning east from the end of the cable indicates the direction of a proposed extension of the cable which would enable ships proceeding up-Channel to fix their position in thick weather by crossing the cable twice at the points indicated.

ship's side and the bottom edges of the coils inclined outward at an angle of 15° to the vertical. When they are so placed screening is satisfactory up to 400 yards, the maximum range is approximately 600 yards, and fairly good signals are obtained even if the cable is approached at a steep angle.

The range at which signals from a leader cable can be received will be largely increased if in place of coils being used two electrodes are towed astern of the ship, these being insulated cables of approximately 50 and 150 yards in length, with the insulation at the outboard ends of the cables are taken from each coil to a change-over switch installed on the bridge in such a position that it is easy of access to the navigating officer. Two leads are taken from this switch to an amplifier of the three-valve low-frequency transformer type, using a 4-volt filament battery and a 60-volt anode potential. The telephones are connected directly with the amplifier, and can be fitted with a head-piece or a single receiver. By using a more powerful amplifier it is possible to install a loud-speaking telephone repeater which will enable the signals to be heard by all standing on the bridge. By working the change-over switch the navigating officer is able to detect, from the strength of the signals in the coils, which side of the cable his ship is on, as the signals will manifestly be loudest in the coil nearest to the cable.

The greatest length of leader cable in use is forty miles. For a longer distance than this it would be necessary to pay special attention to decreasing the continuity resistance of the cable and the capacity between the core and earth in order to reduce the current attentuation. This would probably lead to a very expensive cable being required. So far experiments have not been carried out in a greater depth than 30 fathoms, but there is evidence that as the depth of water increases, the strength of signals to one side (say 300 yards) from the cable does not decrease so rapidly as is the case directly over the cable, but the motion of a ship does not materially affect the reception of cable signals by her. It is also possible for a ship to receive visual signals, instead of audible ones, from a leader cable. In that case electric lamps are lighted by the current from the cable. But the visual system has not been developed to such a practically useful stage as the system described above.

Lake Victoria and the Sleeping Sickness.[1]

ONE need not yet have reached extreme old age to remember something of the extraordinary interest excited by the discovery of the great Victoria Lake and the unveiling of the sources of the Nile by Speke and Grant. A wide field for the imagination was opened up by the news of a vast expanse of water, second only to Lake Superior among fresh-water lakes, in the interior of the African continent. Dr. Carpenter's narrative enables us to substitute reality for romance, and to make the acquaintance of a country of great beauty and charm, marred, unfortunately, by the terrible plague of sleeping sickness.

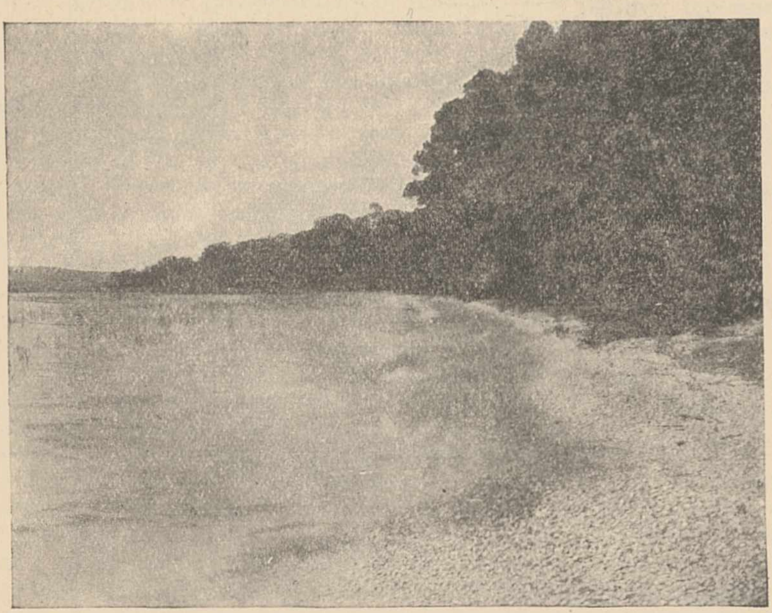

FIG. 1.—Fly beach on Damba Isle; a favourite breeding ground is under the bushes at the gap on the right. From "A Naturalist on Lake Victoria."

The main object of the author in his visit to the great lake was the investigation of the bionomics of *Glossina palpalis*, the tse-tse fly which carries the trypanosome of sleeping sickness. This important work, which was carried on under the auspices of the Tropical Diseases Committee of the Royal Society, involved a residence of about four years on one or other of the numerous islands which stud the northern part of the lake, preceded by a stay of some months at Jinja, on the mainland. The outbreak of war in August, 1914, caused an unfortunate interruption in Dr. Carpenter's labours; for the exigencies of active service kept him employed in various parts of German and Portuguese East Africa until November, 1918, when he was released from duty and returned to Uganda.

In spite of this and other intermissions, the author has been able to put upon record, as Prof. Poulton remarks in his preface, a really wonderful body of observations. The earlier chapters of his work contain a useful *résumé* of our present knowledge of the natural history of *G. palpalis* in its relation to other factors which contribute to the spread of the disease, such as the presence of game. It is needless to say that for the greater part of this now intimate knowledge we are indebted to the admirably devised and painstaking observations and experiments of Dr. Carpenter himself, as may be seen at greater length in the official reports of the Sleeping Sickness Commission. It is satisfactory to know that the author, as a result of his careful study of the habits of the pest, sees some hope, if not of exterminating the fly in certain regions, yet of diminishing its numbers to a point at which it may cease to be dangerous. This, it appears, can be done by constructing artificial shelters which are highly attractive to the fly, and systematically destroying the pupæ that are formed therein. An alternative plan, viz. the extermination of the Situtunga antelope (*Tragelaphus Spekei*), the

[1] "A Naturalist on Lake Victoria: with an Account of Sleeping Sickness and the Tse-Tse Fly." By Dr. G. D. H. Carpenter. Pp. xxiv+333+2 plates. (London: T. Fisher Unwin, Ltd., 1920.) Price 28s. net.

natural reservoir of the trypanosome, is pronounced by Dr. Carpenter to be impracticable.

His descriptions of the sights and sounds of the lake and its islands give a lively idea of the interest of the naturalist's surroundings. "The colouration," he says, "in the bright sunlight during one of the clear days characteristic of the heavy rains is really wonderful in its brilliancy. From high ground one looks over the top of vividly green forest towards distant purple islands set in a sparkling deep blue lake, which is stirred into white-capped waves by the prevailing south-east breeze. So clear is the atmosphere at this time, especially in the evenings, that from Bugalla Island some of the individual houses at Entebbe, on the mainland, twenty-five miles away, could be distinguished with the naked eye."

Some of the voices of the night are thus described: "The thunderous snortings of hippos, the muffled bark of the Situtunga, break in upon the continuous shrill tinkling sound, curiously suggesting sleigh bells, produced by thousands of small frogs along the shore. Crickets chirp all round and in the house, and during the rains one enormous species, sitting just inside the mouth of its burrow, makes the earth resound with a continuous high-pitched buzzing."

The last seven chapters of the book contain a mass of valuable observations on the fauna, especially of the group of islands south of Entebbe, and of the Sesse archipelago in the north-west portion of the lake. The chapters on the insect life are of especial interest, more particularly the minute account of the wonderful mimic, *Pseudacraea eurytus*, in relation to which Dr. Carpenter's criticism of the mutation theory will be read with interest. The book is well illustrated by photographic views and other plates, which are excellently reproduced.

F. A. D.

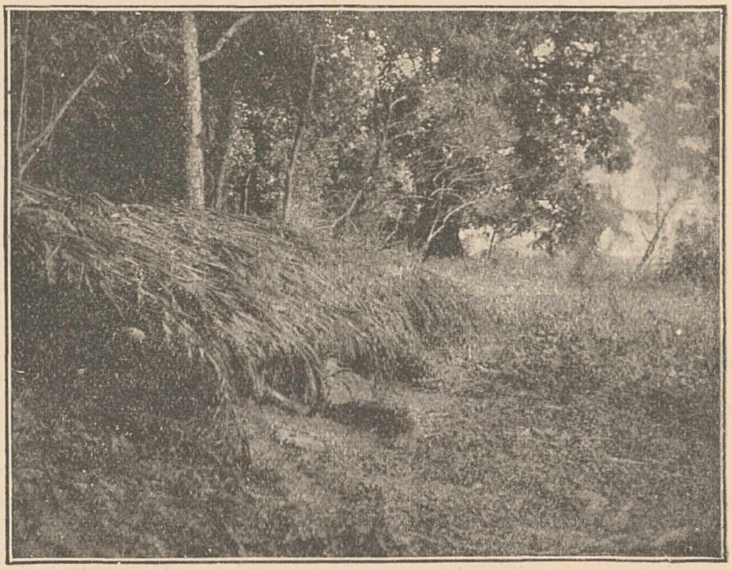

FIG. 2.—The raised beach of Ngamba cleared of vegetation up to the edge of the forest behind. From "A Naturalist on Lake Victoria."

Industrial Research Associations.

IX.—British Boot, Shoe, and Allied Trades Research Association.

By John Blakeman.

DURING the year 1918 a few prominent Northampton business men felt that it would be advantageous to encourage scientific research in connection with the boot, shoe, and leather industries. The Northampton Boot Manufacturers' Association was approached and promised support, as also did the more prominent leather manufacturers; but at first it was intended that only a local research scheme should be set on foot, conducted jointly by the Northampton boot, shoe, and leather manufacturers. The Research Department was asked for advice, and the secretary, Sir Frank Heath, having attended a conference at Northampton on September 24, 1918, urged strongly that a British Research Association for the boot and shoe industry should be established which should be national in its scope, and should work in co-operation with the Government Department. It was also decided that a separate association should be formed for leather manufacture, but that the Boot and Shoe Research Association should invite leather manufacturers to membership, as they would have many problems in common.

The Northampton Boot Manufacturers' Association promised an annual subscription of 375*l.* for five years, which has been raised by a levy of 7*d.* each on the average number of employees, while the minimum subscription for any firm is three guineas per annum. The council of the Research Association has undertaken that the total contributions from members shall be not less than 500*l.* per annum for five years, and the Research Department will then contribute a sum equal to that contributed by members up to a limit of 1500*l.* per annum.

The association began in Northampton as a local effort, and its organisation has consequently centred round the Northampton Technical School. The work that has been accomplished so far has been made possible only by having the equipment and staff of the technical school available. The organisation, however, is such that if at any time the association develops to such an extent that it would be an advantage to separate from the technical school, this could be done without difficulty. In any case, the work that the association has set before itself can be done efficiently only by national effort, and as interest in the work spreads, the question of the relation of the association to other centres of industry and to educational institutions will have to be reconsidered.

The main objects of the association are:

(1) To establish a reference index for the trade by the systematic collecting, filing, and circularising of information, and the building up of a technological museum.
(2) To establish a scientific laboratory for analysing, testing, and standardising materials used in boot and shoe manufacture.
(3) To investigate the applications of science and scientific methods to the industry.
(4) To investigate suggestions for new materials and processes.
(5) To improve scientific and technological teaching in connection with the industry.

The boot and shoe industry is somewhat peculiar in its character. It does not effect any chemical or physical change in the structure of materials, but simply collects the highly finished products of other industries, assembles them, and converts them into boots. There are a large variety of materials used, the chief one being leather, and little attempt has been made in the past to apply scientific tests to these materials or to standardise them. The materials have to fulfil certain technical conditions, both in manufacture and in wear, and the Research Association will study these materials with the object of expressing their properties in terms of physical and chemical constants, and of seeking the correlation between them and the practical properties required in manufacture and wear.

In the manufacture of boots there are also a very large number of small processes of a highly specialised character, for which a large variety of extremely complex machines are required. The development of these machines comes to-day almost entirely from the engineering side, although they are subject to the criticism of the practical boot and shoe man who operates them. So far there has been little effort to reduce these processes to written descriptions with the object of arriving at an agreement as to the best methods of performing them.

A materials chart and a processes chart have been printed and issued to members (copies of which may be obtained from the secretary, Technical School, Northampton). The objects of these charts are as follows:—

(*a*) To present in a concise form a survey of the problems which may arise in the working of the association, and of the questions on which information may be desired.
(*b*) To form a basis for the systematic filing of information.
(*c*) To secure the co-operation of members of the association in collecting the most useful information.

Specimen entries from these charts are given below:

MATERIALS CHART

Departments			Standardising *a.*	Chemical analysis *b.*	Testing *c.*	Kinds *d.*	Comparison *e.*	Suitability *f.*	Substitutes *g.*	Cost *h.*	Sources *i.*	Terminology *k.*	Literature *l.*
3	Lasts	Measurements											
12	Patterns	Geometrical tools											
24	Clicking	Calf (full chrome)											
37	Clicking	Linen linings											
55	Closing	Linen threads											
58	Closing	Rubber adhesives											
86	Bottom stock	Insoles											
111	Lasting	Toe hardeners											
126	Attaching	Welting needles											
153	Finishing	Edge trimmer cutters											
187	Cleaning	Patent abrasives											

PROCESSES CHART

Departments			Methods *a.*	Machines *b.*	Combinations *c.*	Speed *d.*	Quality *e.*	Organisations *f.*	Costing *g.*	Comparisons *h.*	Physical effects *i.*	Terminology *k.*	Literature *l.*
3	Patterns	Standard cutting											
26	Clicking	Cutting outsides											
42	Closing	Skiving											
92	Bottom stock	Channelling											
120	Lasting	Pulling over											
131	Attaching	Welt sewing											
170	Finishing	Edge setting											
194	Cleaning	Sizing											

Each square in the charts is intended to suggest a field of investigation—*e.g.* M. 111 *b* would deal with the chemical analysis of toe hardeners, P. 120 *b* with the various machines used for pulling over. The materials chart contains 192, and the processes chart 200, entries.

In the preliminary period to date, the association has investigated problems proposed by members, some minor and some important, and has separated out the problems for immediate investigation. Among those which have been attacked are:—

(1) Analyses of tanning liquors.
(2) Detection of adulterants in linings.
(3) Detection of free acid in insole leathers.
(4) Tensile strength of threads, waxed and unwaxed.
(5) Tensile strength of linings, loops, etc.

The most important of the questions demanding prompt investigation are:—

(1) The suitability of various leathers for welted insoles, the properties required, and the methods of manufacture most likely to yield those results. A special committee is conducting this investigation. A general investigation of sole leathers is to come later.
(2) The cracking of patent leather.
(3) Complete analyses of gums and adhesives used in the industry.
(4) The testing of all threads used in the industry, and the effects of gums and waxes on them.
(5) Finishing of chrome leather soles.
(6) The effects of perspiration on leather.

A large amount of experimental work has been done on the mechanical behaviour of leather under tension, repeated bending to test fatigue effects, and abrasion. Some of these results have been given in a printed paper entitled "Experiments on the Wearing of Bottom Stock Leather under Abrasion," copies of which may be obtained from the secretary at the address given above.

The nature of the problems which are considered likely to be of immediate importance may be illustrated by the questions which have arisen in the work of the special committee on welted insole leather. This committee was set up to consider the properties required in leather to render it satisfactory for welted insoles, to seek the relation between different tannages and the extent to which the desired properties are produced, and to set up a standard for an adulterant-free welted insole.

During the process of manufacture the leather must be such as admits of a satisfactory and durable seam in the process of welt sewing and in wear. It should behave in an ideal manner in its relation to the perspiration from the feet. Most of the English tanners who produce this kind of leather have submitted samples of their products, and these samples are being submitted to the following kinds of tests:—

(1) Wearing tests on hot and dry feet.
(2) Chemical analyses giving percentage of ash, fat, moisture, hide substance, tannin, and water solubles.
(3) Microscopic examination of fibres.
(4) Physical and chemical tests, including tension, abrasion, fatigue on repeated bending, water penetration, drying after wetting, and the tearing strength given by the channel cut in a standard manner.

In conclusion, it must be stated that the Boot and Shoe Research Association has been set up on a very modest scale, with some uncertainty as to the extent to which scientific methods can be applied to the industry. Experience to date has shown that definite and important lines of investigation do exist, and it is hoped that the work of the association will extend.

Obituary.

Dr. J. C. Cain.

DR. JOHN CANNELL CAIN, whose death occurred suddenly at his residence in Brondesbury Park on Monday morning, January 31, at the early age of forty-nine, was the eldest son of the Rev. Thomas Cain, of Stubbins, Lancashire, and was born on September 28, 1871, at Edenfield, near Manchester. He received his education at the Victoria University (Owens College) and at the Universities of Tübingen and Heidelberg, obtaining the B.Sc. in the Honours school at Owens in 1892, and the D.Sc. at Tübingen in 1893. It was after he had migrated from Tübingen to Heidelberg in the autumn of 1893 that the writer of this notice first met him. He returned to Owens College for a short time in 1894, where he worked with W. A. Bone, but it is evident that at this period he was already feeling drawn towards that field of organic chemistry to which he ultimately devoted his life, for in 1895 he resisted the lure of research in the rapidly developing organic school at Manchester and entered the works of Messrs. Levinstein, Ltd., of Crumpsal Vale, where he remained until 1901. It was during this period of his career that the writer became intimately acquainted with him, for they lived in the same house at Cheetham Hill, the writer working at research at Owens College, and Cain at Crumpsal. Many were the discussions on colour chemistry which were held during the evenings, and it was here that it was decided to write the book which ultimately appeared under the title of "The Synthetic Dyestuffs" in 1905.

Cain did not, however, remain long at Levinstein's, and in 1901 he became head of the chemistry and physics departments of the Municipal Technical School at Bury, in Lancashire, where he started, with Frank Nicoll, the important series of researches on the rate of decomposition of diazo-compounds, three parts of which were published during 1902 and 1903. At this stage he also commenced his study of the diphenyl compounds, an investigation which, as will be seen, he continued at a later date elsewhere. As an outcome of his research work, Cain obtained the degree of D.Sc. in the University of Manchester in 1904, being one of the first three to receive the highest degree of the newly created University. Nevertheless, his love for the practical side of his science prompted him in 1904 to leave the Bury Technical School and to take up the post of manager and head chemist to Messrs. Brook, Simpson, and Spiller, of London, a position in which he remained until 1906, when he was appointed editor of the Chemical Society's publications, an office he held at his death.

During the period of his editorship Cain spent much of his spare time at research, and in 1907 published his theory of the constitution of the diazo-compounds, an ingenious attempt to harmonise much conflicting evidence, which, although it has not found general acceptance, yet still affords the simplest means of explaining many of the reactions of these very reactive substances. In 1908 Cain published the first edition of his "Chemistry of the Diazo-Compounds," a book which contains a complete account of these valuable substances. Although during this period he was handicapped by the strenuous work required by his office, and to a certain extent by the lack of laboratory accommodation, he was able to continue his research work on the diphenyl compounds, and in conjunction with Miss Micklethwait, Dr. Brady, and others he published three parts of the series. Perhaps one of the most interesting features arising out of this work was the final demonstration that there are two distinct *o*-dinitrobenzidines yielding distinct acetyl derivatives and distinct dinitrodiphenyls, phenomena which, it is suggested, are due to a form of isomerism which depends on the limitation of the free rotation of the singly linked carbon atoms.

During the war Cain placed his services where they were most needed, and as chief chemist to the Dalton Works of British Dyes, Ltd., at Huddersfield, he was responsible for much of the work which has led to the reorganisation of our dye industry. He also, for a short time, acted as superintendent to H.M. factory at Hackney Wick. The services he rendered to the Chemical Warfare Committee were especially valuable, because to him was allotted the task of searching the literature for substances likely to be of a noxious character. This, to the writer's knowledge, he did in no uncertain manner.

During recent years Cain produced a new edition of the "Chemistry of the Diazo-Compounds," a valuable and interesting book on the "Intermediate Products," and a revision of vol. i. of "Roscoe and Schorlemmer." It will be seen, therefore, that Cain was an organic chemist of no mean order, especially in connection with the theory and practice of his favourite subject. That he was an editor who carried out the duties of his editorship with the thoroughness which characterised all his actions the publications of the Chemical Society for fifteen years bear witness; but it will be neither as an organic chemist nor as an editor that he will be remembered best, because he occupied a position alone, in that he possessed a knowledge of chemistry and of chemical data which can only be described as encyclopædic. He was, in fact, a living "Beilstein," and no question seemed to come to him amiss. Woe betide the man who ventured to ignore the previously published work of others, Cain soon pointed out his error to him. The writer can recall an instance in which he had happened to forget a previous paper published by himself on the same subject and to which Cain at once directed his attention.

Cain had an exceedingly lovable disposition. His loss to his friends will be grievous, and to science one which it will be hard to repair.

J. F. T.

CHARLES EDWARD FAGAN, C.B.E., I.S.O.

MR. C. E. FAGAN, secretary of the Natural History Departments of the British Museum, died at his residence in West Kensington on January 30, after an illness which commenced about a month earlier. A short account of the value of his services to the museum was published in NATURE of January 13, p. 638, in a notice of his impending retirement, which was to have taken place on March 31 next.

Mr. Fagan's immediate ancestors were in the Diplomatic Service, and he himself possessed to a remarkable degree qualities which might well have led to high distinction in the same career if he had adopted it. He was born at Naples on Christmas Day, 1855, when his father was Secretary of the Legation in that city. At the age of nine he came to England and was placed under the charge of Sir Anthony Panizzi, being sent to school at Leytonstone. After Sir Anthony's retirement from the post of principal librarian of the British Museum, Mr. Fagan was frequently at his house, where Mr. W. E. Gladstone sometimes joined them in a game of whist. In 1873 he entered the British Museum, and he afterwards followed the natural history collections to the South Kensington branch, where the remainder of his work was done. He became assistant secretary in 1889, and he was appointed secretary of the Natural History Departments in 1919, in special recognition of his services, as a part of the reorganisation consequent on the retirement from the directorship of his contemporary, Sir Lazarus Fletcher, who died on January 6 last.

Mr. Fagan was a man of wide and varied tastes. He had a strong love for natural history; but he was also interested in art, on which he was well informed, and in European history. He could speak with authority of the Napoleonic campaigns, on which he had a good library, and he had also a wide knowledge of the history of the Victorian era. He was joint-author with Mr. Andrew W. Ture of a book on this subject, entitled "The First Year of a Silken Reign." He was interested in every form of sport, and he never missed a University boat race from the year in which he came to London to the last year of his life. His knowledge of the history of English racing was of good service to the museum in the formation of a collection of distinguished racehorses. During the recent war he organised propaganda work, which was important in informing our Allies of the efforts made by this country in the great struggle. In view of his ancestry, which was partly Italian, and of his artistic tastes, it is not surprising that he had a special affection for Italy, which he often visited.

It is impossible to speak too highly of the services Mr. Fagan rendered to the Natural History Museum. Events beginning with Sir William Flower's illness while still director placed important responsibilities in his hands, and the administrative experience thus gained was of the greatest use to Flower's successors in that post, while he worthily upheld the interests of the museum during periods of interregnum. He possessed conspicuous tact and remarkable insight, and he had an extraordinary capacity for forming a correct judgment on a difficult question. These qualities gave him an exceptional position in the museum, and his colleagues who sought his assistance rarely left him without feeling that they had gained by hearing his opinion. The view which he took of the functions of the National Museum was a broad one. Its obvious purposes were to serve as a treasure-house for the accumulation of specimens and to educate students and the general public in all that pertains to natural history. But he thoroughly realised the importance of making it a centre of research, and there can be no question that his initiative was responsible for many new departures which have materially assisted in the advancement of knowledge. In his opinion, an institution supported out of public funds had the responsibility of giving practical service to the nation, and he welcomed opportunities of showing that this could be done. The consultative functions of the museum have been increasingly appreciated in recent years, and particularly during the war, a result largely due to his influence. Its advice has been repeatedly sought by other Government Departments in such matters as the protection of birds and other animals in our Colonial possessions, the part played by insects and arachnids in the spread of disease, and the extraordinary development of the whaling industry during the last fifteen years, in questions relating to fishery problems, and in many other practical applications of zoology, botany, geology, and mineralogy.

On many occasions Mr. Fagan was specially concerned in promoting scientific expeditions, among which may be mentioned those to Ruwenzori, 1907, and to Dutch New Guinea, 1909–11 and 1912–13, the collections in the museum being largely augmented in these ways. By his personal influence he was responsible for inducing private benefactors to present numerous collections and important specimens. He was hon. treasurer to the International Ornithological Congress in 1905 and to the Society for the Promotion of Nature Reserves, British representative on the International Committee for the Protection of Nature in 1913, and a member of the Council of the Royal Geographical Society and of other scientific bodies. He organised the exhibits of the British section of the International Shooting and Field Sports Exhibition, Vienna, 1910, of the Festival of Empire and Imperial Exhibition (game fauna section), Crystal Palace, 1911, and of the British section, Ghent Exhibition, 1913, illustrating the relation of entomology to tropical diseases.

At the age of twenty-one Mr. Fagan married Miss Stronach, who died in 1905, and he leaves one son. His career was one long record of single-minded service, strenuously and successfully performed. His influence on the Natural History Museum, from the commencement of its existence as an independent branch of the British Museum, has left a permanent mark on its character. His disposition was essentially sympathetic, and he never permitted himself to express uncharitable opinions of others. He is deeply mourned by his many friends, and particularly by his colleagues, who recognised his lovable qualities and the great value of his services to the museum and to science.

SIDNEY F. HARMER.

C. SIMMONDS.

WE regret to announce the death, on January 15, of Mr. Charles Simmonds, one of the Superintending Analysts in the Government Laboratory. Born at Stourbridge in 1861, Mr. Simmonds was educated privately, and, selecting the Civil Service as a career, secured one of the chemical studentships at South Kensington established by the Commissioners of Inland Revenue for training the staff of their laboratory, then at Somerset House. This was afterwards raised to the status of a separate Government Department under Sir Edward Thorpe as the first "Government Chemist." Mr. Simmonds was entrusted (*inter alia*) with the investigation into the composition of "Pottery Glazes and Fritts" for the information of the Royal Commission appointed to report on that subject, and contributed an article under this title to Thorpe's Dictionary of Applied Chemistry, as well as several papers of a kindred nature to the Journal of the Chemical Society, viz. "Lead Silicates in relation to Pottery" (1901); "Constitution of certain Silicates" (1903); "Reduced Silicates" (1904); and (in conjunction with Sir Edward Thorpe) "Influence of Grinding upon the Solubility of Lead in Lead Fritts" (Manchester Memoirs, 1901). Mr. Simmonds was also the author of a treatise on "Alcohol," published by Messrs. Macmillan and Co., which is admittedly the most up-to-date and comprehensive work in English on the subject, and he was up to the last a frequent contributor to the pages of NATURE.

MR. EDWARD C. BOUSFIELD, whose death is announced, received his professional training at St. Bartholomew's Hospital, and after qualifying spent a number of years in general practice, at the same time carrying out a good deal of research work in microscopy and bacteriology. He was one of the first to take up photomicrography, and published a useful manual on the subject. He afterwards established a clinical research laboratory, and became bacteriologist to the metropolitan boroughs of Camberwell and Hackney.

IT was reported from Copenhagen on February 1 that the official Soviet Press Agency had denied the report of the death of Prince Kropotkin, whose obituary notice we published last week. We have been hoping that later messages would confirm this news; but a wireless Press report from Moscow states that Prince Kropotkin died there on Tuesday, February 8.

Notes.

NEXT week's issue of NATURE, February 17, will be a special number devoted to articles upon the principle of relativity. We have been fortunate in securing contributions from leading authorities upon this subject, including Prof. Einstein himself, and the whole number will form the most important presentation of its various scientific aspects yet published. The principle is of such wide significance, and so many books and papers have been written upon it, that a synoptic statement of its structure and consequences will be of permanent value.

THE Actonian prize of the Royal Institution has been awarded to Prof. G. E. Hale, director of the Mount Wilson Solar Observatory, California, for his contributions to solar physics. On Saturday next, February 12, at 3 o'clock, Prof. A. Fowler will begin a course of three lectures at the institution on spectroscopy. The Friday evening discourse on February 11 will be delivered by Dr. F. W. Aston on isotopes and atomic weights, and on February 18 by Mr. Solomon J. Solomon on strategic camouflage.

THE newly incorporated Institute of Physics has issued a pamphlet describing its objects and giving the regulations for the admission of members. The institute proposes to grant diplomas to members indicating a high standard of professional competency, and hopes in this way to secure proper recognition of the professional status of the physicist. It will serve also to co-ordinate the work of existing societies connected with physics and its applications. Any member of a "participating society" is eligible as an ordinary member of the institute, but to become an associate or a fellow he must satisfy certain other conditions which relate generally to his training as a physicist and to the importance of the work in physics in which he has been engaged. The annual subscriptions are: for fellows and associates, two guineas and one guinea respectively, while ordinary members pay no subscription. A member of two or more participating societies pays a reduced subscription to those societies, and under certain conditions the charges for the publications of the societies are reduced. The office of the institute is at 10 Essex Street, W.C.2.

SIR JAMES J. DOBBIE, whose recent retirement from the position of Government Chemist and Principal of the Government Laboratory, held by him since 1909, was referred to last week, has to his credit a considerable amount of research work, particularly relating to the constitution of the alkaloids. He has also devoted much attention, in conjunction with the late Prof. Hartley, to the study of absorption spectra, with special reference to the relation between absorption and chemical constitution, and a large number of papers on these subjects were published in the Transactions of the Chemical Society between 1898 and 1912. Quite recently he contributed papers to the Royal Society (conjointly with Dr. Fox, of the Government Laboratory) on the absorption of light by elements in a state of vapour in relation to their molecular constitution. As Government Chemist Sir James Dobbie has been responsible for numerous important investigations for various Government Departments, such as the nature of the pigments used for postage and other stamps, the properties of celluloid, the preservation of the timber in the roof of Westminster Hall, etc. During the war a large amount of difficult and responsible work was thrown upon the Government Laboratory in connection with the War Trade Department, the analysis of metals and alloys for the Air Board and Admiralty, and the examination of food-supplies for the Expeditionary Forces. Chemical stations were established at the principal supply depôts, and it is acknowledged that the almost total absence of complaints from the Front as to the quality of the food was largely due to the work of the Government Laboratory. Sir James Dobbie is a past-president of the Institute of Chemistry, and is just about to complete his term of office as president of the Chemical Society. We trust that his right to complete enjoyment of his well-earned *otium cum dignitate* may not be long delayed.

A NUMBER of conferences on questions of national interest are announced for the *Daily Mail* Efficiency Exhibition to be held at Olympia on February 10–26. The meetings of the first four days will be devoted to personal efficiency and public health; on February 10 Dr. C. W. Saleeby will speak on child welfare and maternity, and Mr. E. B. Turner, Dr. Latham, and Mr. E. Farmer on industrial fatigue. Sir H. Baldwin, Prof. E. L. Collis, and Mr. F. Watts will discuss preventable diseases on February 11. Both conferences arranged for February 14 will deal with fatigue elimination; the speakers will be Major F. Gilbreth, Mr. Eric Farmer, Dr. H. M. Vernon, and Prof. A. F. Stanley Kent. Fuel efficiency will be discussed on February 17 and 18, when Mr. F. W. Goodenough will deal with coal gas and Capt. R. H. Montgomery with motor fuel. A number of evening medical conferences have also been arranged by the Middlesex Hospital. On February 14, 16, and 23 Dr. W. B. Tuck will speak on the relations between chemical research and medicine, health and pharmacology; and Dr. W. S. Lazarus-Barlow will discuss fluorescence, X-rays, and radium on February 15, 18, and 25. All conferences will be open to visitors to the exhibition, but societies and individuals desirous of taking part in them should apply for special tickets to the Higher Production Council, 66 Victoria Street, London, S.W.1.

MR. L. BOLTON, a senior examiner in the Patent Office, London, has been awarded the prize, amounting to about 1300*l*., offered by the *Scientific American* for the clearest explanation for general readers of Prof. Einstein's theory of relativity.

AT the annual meeting of the Yorkshire Numismatic Society, held at Leeds University on February 5, the society's first annual medal was presented to Mr. T. Sheppard, curator of the Hull Museums, in recognition of his contributions to the study of numismatics.

A DESTRUCTIVE earthquake occurred on February 4 on the Isthmus of Tehuantepec separating the Gulf of Mexico from the Pacific. According to messages received in the United States from Mexico City, considerable loss of life was caused and much damage to property.

A JOINT meeting of the Faraday Society and the Manchester Literary and Philosophical Society will be held at 36 George Street, Manchester, to-morrow, February 11, at 6.30 p.m. The meeting will be presided over by Sir Henry Miers, president of the Manchester Literary and Philosophical Society, and Prof. A. W. Porter, president of the Faraday Society. The subject to be discussed will be "Measurements of Surface Tension," and it will be opened by Dr. Allan Ferguson.

DR. W. CROOKE discusses certain curious rites at the accession of Rajas in India in the January issue of *Man*. In Vedic times the Raja used to start in his chariot and shoot an arrow at an animal from the herd of one of his relations. Even so recently as 1886, when Madhava Rao Sindhia was invested, the farm was given over to plunder, the sufferers being afterwards compensated at the cost of the State. When a Rajput Raja came to the throne his first duty was to perform the "inaugural foray" by marching against and sacking a town belonging to a neighbouring chief. These are what French anthropologists call *rites de passage*, ceremonies at periods of crisis performed with a magical intent. They represent the period of anarchy occurring between the death of a Raja and the accession of his successor. The new Raja performs an act of bravery or redresses an admitted grievance, such acts being of happy augury for the future reign.

DRS. R. W. HEGNER and G. C. Payne in the *Scientific Monthly* for January (vol. xii., No. 1, p. 47) give a summary of the intestinal protozoa of man in health and disease. They express the hope that the discussion of the subjects presented in this paper will stimulate investigation, and they plead for a carefully organised survey of the intestinal protozoa among civil communities.

WE have received the report of the Research Defence Society for the last quarter of 1920. The society has now been in existence since January, 1908, and its propaganda work has been very valuable in the cause of biological science. The president and treasurers of the International Medical Congress of 1913 have handed over to the society the surplus of the funds of the congress, amounting to some 35*l*. Mr. Stephen Paget is no longer hon. secretary, having been elected vice-chairman of committee, but he will continue writing and advising for the society. Miss Dorothy Burgiss-Brown remains as secretary.

IN connection with the attempt to scale Mount Everest, which is to be made by the Royal Geographical Society and Alpine Club's expedition, it is of interest to learn the views of Col. H. H. Godwin-Austen, whose surveying experiences in Kashmir date back to 1857 and in Bhutan to 1863. Col. Godwin-Austen, in an article in the *Surrey Advertiser* for January 22, expresses the opinion that the best men for the task will be found in the Survey Department of India, and he believes that the number of climbers even in the reconnaissance party projected for the coming summer should be small. He recalls some of his experiences in the first surveys made in Sikkim and the views of Mount Everest which he had from Senchal, near Darjeeling, in 1863. Incidentally, he thinks that the discovery of a route to Mount Everest may not prove a very difficult task.

WE have received from Messrs. W. and A. K. Johnston several sheets of the survey on a scale of 1 : 125,000 of the Gold Coast, prepared under the direction of Major F. G. Guggisberg and engraved and printed in Edinburgh. Each sheet is ½° square, with full reference in the margin to conventional signs and orthography. Hill features are shown by brown shading, but there are no contours; water features and names are in blue, and boundaries in red and brown. The maps are clear and finely engraved, and contain a great deal of information without any crowding or illegibility. The sheets published cover the whole of the Gold Coast, and join in the north the War Office 1 : 250,000 sheets of Ashanti.

Two useful articles on Spitsbergen appear in *Naturen* for September–October, 1920, the publication of the Bergen Museum. Prof. B. J. Birkeland, in writing on the climate, has been at pains to collect most of the meteorological data, some of them previously unpublished, which have been taken at various times. In addition to means of seven years from the Norwegian wireless telegraph station at Green Harbour and Swedish records from Cape Thordsen and Mossel and Treurenberg Bays, Prof. Birkeland gives five years' records from Axel Island, in Bell Sound, three years' from South Cape, and several years' from different stations in Edge and Barents Islands. The South Cape, Edge Island, and Barents Island records, having been made by winter hunters, are in most cases incomplete for the summer months. No data are given from the former Russian station in Horn Sound or from the German station in Cross Bay. The second paper, by Mr. O. Holtedahl, deals with the geology of Spitsbergen and Bear Island, and includes two revised geological sketch-maps, besides several illustrations.

IN 1902 Miss Rathbun, of Washington, described three specimens of a tiny prawn found in the Galapagos and belonging to the crustacean group Caridea. On them she established a new genus Discias, the representative of a new family combining highly specialised characters with others that appear to be primitive. In the Records of the Indian Museum (vol. xix., part 4) Dr. S. Kemp describes a new, but closely related, species from five specimens (male and female) found on a sponge in the Andaman Islands, which are "separated from the Galapagos Islands by almost exactly half the circumference of the globe." A full-page shaded drawing of an "ovigerous female" is reproduced by photogravure—a luxury indicating the importance attached to the discovery; but if Dr.

Kemp was the artist he should have included a scale. Among the many figures in this part of the Records the magnification is given in only four cases.

IN the Proceedings of the United States National Museum (vol. lviii., No. 2344) Messrs. C. P. Alexander and W. L. McAtie deal with the crane-flies and their allies (Tipuloidea) found in the District of Columbia. These insects are prevalent in almost all parts of the world, and they are restricted only by intense cold and dryness. Water or moisture is a necessary condition for the development of most species, and, consequently, deserts form efficient barriers to their dispersal. Among the more interesting features in this paper is a note on the occurrence of the rare and primitive insect *Protoplasa Fitchii*; several larvæ which are referred to this species were found in a decayed drift log, but the adults were not bred out. The winter-gnats (Trichocera) are represented by three species, and the authors follow other recent writers in referring this genus to the Rhyphidæ. The greater part of the paper is devoted to the rich fauna belonging to the family Tipulidæ, which is represented by 40 genera and more than 190 species. The authors include notes on the larval habits of all species wherever known, and they append useful synoptic keys to the various groups along with their genera and species.

PROFS. A. C. SEWARD and B. Sahni have contributed to the Palæontologia Indica (vol. vii., Mem. 1, in Memoirs of the Geological Survey of India, 1920) a memoir entitled "Indian Gondwana Plants: A Revision." The specimens were mostly among those described by Feistmantel, but a revision of the species in the light of modern knowledge had become necessary. The memoir is illustrated by seven fine folio plates, partly photographic, partly from drawings by Mr. T. A. Brock, as well as by a few figures in the text. The senior author was helped in the early stages of his work by Miss Ruth Holden, a young American botanist, whose premature death while on medical service in Russia is a grave loss to science. Prof. Sahni came in at a later period, and hopes to continue work on the same lines in his own country. Two quite distinct floras are dealt with: the Lower Gondwana, of Permo-Carboniferous age, and the Upper Gondwana, which is Jurassic. As regards the former, the authors point out that their results suggest a closer resemblance between the Indian plants and their contemporaries in Europe and North America than had hitherto been realised. For example, the Gondwana genus Nœggerathiopsis is now merged in the familiar Cordaites. The specimens from the Upper Gondwana include several good examples of Williamsonia fructifications, very similar to the well-known European fossils, and to those from Mexico recently described by Dr. Wieland. This illustrates the author's conclusion that the examination of the Indian Jurassic species has revealed additional evidence of the remarkable uniformity of Jurassic floras of widely separated regions. The specimens described in the memoir are impressions, not petrifactions showing the structure, but use has frequently been made of modern methods to bring out such microscopic details, *i.e.* of the epidermis, as can be recognised.

THE Archives of the Cambridge University Forestry Association (No. 4, October, 1920) contains an illustrated article by Mr. H. Stone on the origin of the so-called medullary rays in wood. This paper, which advocates a new theory, contains some information about bird's-eye maple and the cause and nature of the pith-flecks which are so characteristic of birch and certain other woods. The author also discusses the capricious occurrence in the natural orders and in allied genera of the broad compound rays which give rise to "figure" in oak, beech, and plane.

THE Queensland Geological Survey Publication No. 267 (1920) is a description of petrified plant remains from the Queensland Mesozoic and Tertiary formations, by Prof. Birbal Sahni. The series includes two ferns belonging to the genus Osmundites which were previously known only from Jurassic rocks in New Zealand; seven species of gymnospermous woods, six of which are described as new; and three species of angiospermous woods, two of which are new.

THE Norwegian Meteorological Institute has published its Jahrbuch for 1919, containing records of the observations of more than seventy stations. Hourly records are given for Kristiania and Aas, daily means for twelve stations between Mandal in the south and Vardö in the north, and monthly means for the other stations. An appendix gives the observations at Green Harbour, Spitsbergen, for the year 1918–19. The institute has also published "Nedböriagttagelser i Norge," giving the precipitation records for 1919 for 491 stations and a large-scale coloured map showing the distribution of the year's precipitation.

DR. MURRAY STUART's final report on the Srimangal earthquake of July 8, 1918, is published in the last part of the Memoirs of the Geological Survey of India (vol. xlvi., 1920, pp. 1–70), the principal results having been already given in a preliminary report (see NATURE for April 3, 1919, p. 91). The new memoir contains full details of the nature of the shock and the damage to property, a discussion of the seismograms at distant observatories, and an account of the changes of level in the central district. The epicentre is situated in the Balisera Valley, 3½ miles south of Srimangal railway station, and the epicentral area (the longer axis of which is directed about west-north-west) is crossed centrally at right angles by the line of levels made in 1911–12 from Silchar to Comilla. During the winter of 1919–20 the levelling along this line was repeated by the trigonometrical survey, and this shows that in the interval no settlement had taken place on the north-east side of the epicentral axis. Nor is there any evidence of disturbance on the other side of the axis until the low range of hills six miles west of Srimangal is crossed, but from this range to a distance of thirty miles from the town a subsidence of from 1½ in. to 9 in. has occurred. It would thus seem that "the earthquake was due to subsidence along the southern side of a normal fault cutting the rocks below the alluvium of the Sylhet district, and situated approximately under the major axis of the epicentral area."

La Nature for January 22 contains an illustrated article by M. Léon Laffitte on the methods which are being used by the French naval authorities to refloat those vessels which were torpedoed during the war and sank in situations which render them dangerous to navigation. Maps are given on which the position and name of each submerged wreck are marked. No numbers are mentioned by the author, but the maps show that at least 200 vessels, many of them near the entrances to the larger ports, were lost. The operations are directed by three captains of the fleet, and in most cases are carried out by the compressed-air method, temporary wooden patches being fixed by divers over the holes made in the sides of the vessel by the torpedoes. It is found possible to carry out this work down to a depth of 180 ft.

IN a paper read recently before the Institution of Petroleum Technologists Mr. F. H. Garner, of the Mellon Institute, Pittsburgh, discussed the importance of the carbonisation constant of lubricating oils. This constant is determined by exposing the oil to a definite temperature in an oxidising atmosphere, and then measuring the quantity of asphaltene produced. The carbonisation constant is closely connected with the content of resinous matter in the oil, which may be extracted by utilising the selective adsorption of charcoal for these resins. The Conradson coke test was brought forward as an important means of discriminating between different lubricating oils, and it was shown that this criterion was particularly valuable in connection with internal-combustion engines.

DR. H. E. ARMSTRONG has a charming address on "Detective Work in the Potbank" in the current issue of the Transactions of the Ceramic Society. He shows that, if rightly interpreted, the story of the "crime" committed when, say, iron rusts, so that a valuable strong metal is changed to a worthless powder, is as exciting in its way as the shilling-shocker detective story. He utilises the discovery of the composition of limestone to give his views on the general principles which obtain in the application of science to the manufacture of pottery in particular and to the industries in general. The title of Dr. Armstrong's address is singularly appropriate, because much of the so-called application of science to the industries is an application of the detective instinct in locating sources of loss.

IT appears from the *Procès-Verbaux* of the last meeting of the International Committee of Weights and Measures that it will be proposed at the general conference in September next that the functions of the International Bureau shall no longer be confined to the construction and verification of standards of length and mass, but extended to include other units and standards, as well as the determination of physical constants. In the event of this being agreed to by the countries participating in the metric convention, a commencement will probably be made with electrical units and standards. The conference will also consider a proposition to increase the fixed annual budget of the Bureau from the present figure of 100,000 francs to 250,000 or 300,000 francs. The periodical recomparisons of the iridio-platinum national prototypes of the metre and the kilogram are now in progress at the Bureau, and preliminary observations on four of the metres seem to indicate that all of them have undergone a small diminution of length, of the order of half a micron, since their original verification more than thirty years ago. The investigation of the properties of nickel-steel alloys, which led to the discovery of invar, has been resumed, and it has been found that by the addition of 12 per cent. of chromium to alloys of the invar type a metal ("elinvar") is obtained which exhibits a constant modulus of elasticity throughout a wide range of temperature.

A REPORT has now been issued by the Department of Scientific and Industrial Research giving particulars of the work accomplished by the lubricants and lubrication committee. The report fills 126 pages, and contains a large amount of interesting information. A bibliography has been compiled, to be published separately, containing classified references to every published work or paper on lubricants or lubrication of definite importance; abstracts of a large number of important papers are also given in the bibliography, and a complete translation of Prof. Otto Faust's researches on the increase in the viscosity of certain liquids with pressure appears in the report. Research work has also been carried out on behalf of the committee; complete reports and the results of each individual research are given in appendices to the report. There are also a summary of the existing knowledge of lubrication and recommendations for future research on lubricants and lubrication. The tests on the viscosity of liquids at high pressure are of particular interest; in Mr. Hyde's experiments, carried out at the National Physical Laboratory, it was found that all the oils tested showed a rapid increase in viscosity with pressure, and the increase was much greater for the mineral than for the animal and vegetable oils. Castor (vegetable) and Trotter (animal) gave almost identical results up to about 4 tons per sq. in., but at 8 tons per sq. in. the Castor had increased to 5·5 times and the Trotter to 5 times their atmospheric values. The report can be obtained from His Majesty's Stationery Office, price 2*s.* 6*d.* net, and those interested in this subject are recommended to procure a copy.

WE have received from the British Scientific Apparatus Manufacturers, Ltd., 198 rue Saint-Jacques, Paris (5e), a general catalogue (in French) of the instruments and apparatus manufactured by its members. This company was formed in February last with the object of making British scientific products more widely known in foreign countries; it serves generally as an advertising medium and a connecting link between manufacturers at home and consumers abroad. The first action of the company was to establish a showroom in Paris, which is now well stocked with samples. Not only can visitors to the showroom obtain full information regarding the apparatus, but also in most cases facilities are available for the demonstration of the exhibits. Although the showroom has been open for a few months only, the results are most encouraging, and a considerable number of inquiries are being dealt with daily. Paris is found to be essentially suitable for a centre of this sort, as is shown by the fact that the visitors' book already contains names of visitors from thirteen different countries. The general catalogue is divided into nine sections under the following headings;—(1) Chimie, Industries chimiques. (2) Electricité, Industrie électrique. (3) Marine. (4) Aviation, Aérodynamique. (5) Métallurgie, Mécanique de précision, etc. (6) Médecine, Bactériologie, Physiologie, Ophtalmologie, etc. (7) Topographie, Géodésie, Astronomie, Météorologie, Dessin. (8) Physique expérimentale. (9) Photographie, Cinématographie. It will be seen that the range of apparatus covered is very extensive. In connection with their Paris showroom the "B.S.A.M." have formed a reference library of English scientific and technical books which are at the disposal of visitors. The showroom is under the management of Mr. F. C. Dannatt.

DR. NORMAN R. CAMPBELL is bringing out, through Messrs. Methuen and Co., Ltd., a work entitled "What is Science?" the aim of which is to explain what science really is and the kind of satisfaction which may be derived from its study. Two other books in Messrs. Methuen's spring list make an especial appeal to readers of NATURE, viz. "Atomic Theories," by F. H. Loring, and "Biological Chemistry: The Application of Chemistry to Biological Problems," by Prof. H. E. Roaf. The first-named volume is written to give in a concise and simple form an account of all the important theoretical and experimental researches on the atom, its structure, and the arrangement of electrons in atoms, in molecules, and in ions. The second may be regarded as an introduction to the more specialised branches of its subject. It will consist of three sections, dealing respectively with a brief description of the parts of organic and physical chemistry which relate to biological chemistry; the accumulation of energy by plants and the interconversion of carbohydrates, fats, and proteins; and the liberation of energy from the food substances.

Our Astronomical Column.

INTERESTING BINARY STARS.—Mr. J. S. Plaskett investigates, in vol. i., No. 2, of the Publications of the Dominion Astrophysics Observatory, Victoria, B.C., the orbit of the spectroscopic binary U Coronæ. Both spectra are visible, each being of type B3. The following are the elements of the two stars in terms of the sun, the brighter star being placed first:—Radii, 2·90, 4·74; masses, 4·27, 1·63; and densities, 0·175, 0·015. Taking the surface intensity of the bright star to be −2·7 magnitudes, as compared with the sun, of which the absolute magnitude is 4·86, the distance is deduced as 400 parsecs. It is, however, noted that the fainter star, though of the same spectral type, has only one-eighth of the surface brightness; this indicates that the correlation of surface brightness with type is less close than some physicists have assumed.

Two other eclipsing binaries of type B, μ^1 Scorpii and V Puppis, are discussed by Miss A. C. Maury in *Popular Astronomy* for January. The masses come out fairly large in these cases, $(m+m_1)\sin^3 i$ being 16·5 and 33 respectively. These would not be very different from the real masses, for, owing to the occurrence of partial eclipses, i cannot differ very much from 90°. μ^1 Scorpii is stated to be of the β Lyræ type, showing double eclipse and continual variation. Stellar tides are suggested in explanation of part of the change of light, and also of changes in the character of the spectrum.

A famous visual binary, 70 Ophiuchi, is discussed by F. Pavel, of Neubabelsberg, in *Ast. Nach.*, No. 5082. It is shown that the irregularities are explicable on the assumption that the principal star is describing the following small orbit owing to an unseen companion:—T=1809·0, a=0·033″, e=0·1, λ=150°, i=0°, period=6·5 y. The author then obtains for the orbit of the visual pair:—T=1895·965, a=4·495″, e=0·4988, ϕ=29·916°, ω=166·648°, Ω=122·184°, i=58·743°, period=87·710 y. He obtains 0·36 for the ratio of masses, and 1·06 times the sun for the joint mass of the system on the assumption that the parallax is 0·225″.

THE GREEN RAY OR FLASH.—It has often been noticed when the sun is setting behind a well-defined horizon that the last appearance of the disc is a bright green flash. Various explanations have been put forward, some asserting that it was a case of complementary colour, due to fatigue of the retina. This was negatived by the flash being seen at sunrise. Another view was that the sea-water had something to do with it, but it was found that the effect could also be seen at a distant land horizon. There remained the explanation of atmospheric dispersion; but here again there were diversities of view, some holding that the normal colour dispersion would suffice, others invoking abnormal phenomena of the nature of the mirage.

L'Astronomie for December contains an interesting research by MM. A. Danjon and C. Rougier, of the Strasbourg Observatory. They installed a spectroscope on the roof of Strasbourg Cathedral, and were able to demonstrate that the phenomenon arises from normal dispersion. There is an image of the sun produced in light of each wave-length, and as the sun gets low these images are more and more widely separated. When the sun was a few degrees above the horizon the observers were able to obtain a spectrum showing red only when the slit was at the lower limb, and a spectrum with the red absent when it was at the upper limb. When the altitude is less the blue and violet are altogether absorbed, and the green image of the sun's upper limb is the last visible at sunset. Their horizon was formed by distant low hills, but they point out that a sea horizon may be better in that the presence of the bands of water-vapour helps to separate the red light from the green. The spectra obtained are reproduced in the article, and seem to settle the nature of the phenomenon beyond a doubt.

Applied Entomology.

BULLETIN 805 of the United States Department of Agriculture deals with "Two Leafhoppers Injurious to Apple and Nursery Stock," and gives an account of the apple leafhopper and the rose leafhopper. Of the two species, the apple leafhopper causes the greater damage, and is most prevalent in the eastern States, attacking a large variety of plants, on which it chiefly injures the tender terminal leaves, causing them to turn brown. The rose leafhopper also attacks a large variety of plants, and is especially prevalent in the north-western States. Full accounts of the life-histories and descriptions of the insects in all stages are given, and sprays for controlling them recommended.

Farmers' Bulletin 650 of the United States Department of Agriculture deals with the San José scale, which attacks many species of trees, causing considerable damage to, and sometimes killing, fruit trees. During the summer the scale reproduces exceedingly rapidly, the life-cycle taking thirty-three to forty days, and, although it has a large number of parasites, they are insufficient to act as an effective check. The scale is distributed on nursery stock, etc., and the young are also probably spread by wind, other insects, and birds. The scale can be kept in check by thorough annual spraying when the plants are dormant, lime-sulphur wash being recommended for this purpose.

In Farmers' Bulletin 1061 an account is given of the Harlequin cabbage bug, which occurs in all but the northern States, and is a very bad pest of cabbages and allied plants. Removal of wild crucifers and remains of crops, trap-crops, and hand-picking are effective, and also contact insecticides, but co-operation between neighbouring growers is necessary to control this pest.

Farmers' Bulletin 1086 gives an account of "How Insects Affect the Rice Crop in the United States." The most important pest is the rice water-weevil, the larva of which feeds amongst the roots of the rice plant at the base of the stalk, causing considerable damage to the crop. The stink bug attacks the soft grains of the rice while they are forming. The fall Army worm or Southern grass worm occasionally becomes abundant and damages rice fields in the spring, but is easily destroyed by flooding the fields. The caterpillar of the rice-stalk borer feeds in the stalk and causes the head to die. These pests are controlled by thorough cultivation, by suitable flooding and draining of the fields, and by keeping the fields and banks clear of weeds.

In Farmers' Bulletin 1101 an account is given of "The Argentine Ant as a Household Pest." This ant occurs in scattered localities throughout the South. Owing to its encouraging aphids and scale insects, it causes considerable trouble to fruit-growers and others, while it causes much annoyance by swarming in houses. The ant has been distributed in foodstuffs, and is also carried by floods. Formulæ are given for tree-banding mixtures and for poisons for use in houses and in the open.

Farmers' Bulletin 1104 deals with the book lice or Psocids which frequently occur in houses and other buildings, and may occasionally increase in numbers to such an extent that it is necessary to take steps to destroy them, for which purpose fumigation with sulphur or hydrocyanic acid is recommended.

In the *Journal of Agricultural Research* (vol. xviii., No. 9, 1920) an account is given by J. M. Aldrich of "The European Frit Fly in North America." This pest occurs principally in the regions in which winter wheat is grown, from the Great Lakes to the Ohio River and westward to the Missouri, but it is generally distributed over most of the country. A full description, with figures, is given of the life-history, and also a plate of the adult and puparium. As many as four broods were obtained in the summer, the first, from larvæ which had lived through the winter, in April. Eggs and larvæ are usually found on the young and tender shoots and also sometimes upon or within the glumes, wheat, barley, and various grasses being attacked. It is recommended that wheat should be sown late in the fall or early in the spring in order to escape the attack of this insect.

In the same journal (vol. xix., No. 1, 1920) an account of "The Banana Root Borer," which is a widely distributed pest of the banana, is given by G. F. Moznette. The larvæ of this weevil, *Cosmopolites sordidus*, feed in the roots of the plant, and the damage done to young plants causes them soon to wither and die. Full descriptions of all stages and of the life-history are given in the paper, which is illustrated by four plates. Destruction of infested plants and trapping of adults by means of strips of banana-trunks placed on the ground are advised.

The European corn-borer has recently been introduced into the United States, being first discovered there in 1917, and has already spread over considerable areas in the North-east, and it seems likely to do more damage than any native species (State of Illinois, Department of Registration and Education, Division of Natural History Survey, Bulletin, vol. xiii., art. 10, "The European Corn Borer and some Similar Insects," by W. P. Flint and J. R. Malloch). The larva of this moth, *Pyrausta nubilalis*, Hubner, feeds on all parts of the plant above the ground, many species of plants being attacked, but corn appears to be preferred. An account is given of the life-history of this insect, which may have two broods in the year, the winter being spent as full-grown larvæ which hibernate in the stems of the food plant. This pest is probably chiefly spread in the stems of its plant-host, although, as the moth is a fairly strong flyer, it might also be disseminated in the latter stage. A number of native borers closely resemble the European corn-borer, and descriptions are given to enable it to be distinguished therefrom.

Bulletin, vol. xiii., No. 11, 1920, of the same series is concerned with "A Study of the Malarial Mosquitoes of Southern Illinois. 1. Operations of 1918 and 1919," by S. C. Chandler. An account is given of a survey of the mosquitoes of two districts of Southern Illinois in which malaria occurred frequently, in addition to less thorough work at other points. The breeding areas were examined, and larvæ were most plentiful in fairly clean, still water in which there was vegetation. Two of the species found are capable of transmitting malaria. To get rid of the mosquitoes drainage is the most effective measure. Clearing the edges of the ponds, etc., of vegetation is also suggested, as well as oiling the surface of the water, and the use of larvicides. Houses should be screened or fumigated.

The Department of Agriculture, Ceylon, Bulletin No. 46, by N. K. Jardine, gives an account of "Field Experiments with Anti-Tortrix Fluids." The experiments showed a greater yield from the treated plots than from the control, and the quality of the tea was not lowered. In treating a substance intended for human consumption, such as tea, the use of poisons is not possible, and as contact poisons are useless against the tea tortrix, owing to its rolling itself up in a leaf, it was necessary to find some other substance which would serve the purpose, and lead chromate was found to be very suitable. The formulæ used are given and also the cost of each and of the spraying. Samples from the cortrol and sprayed plots were tested by tea-brokers, and their reports are given, the tea treated with the sprays, especially that containing resin and sodium carbonate, in addition to lead chromate, being generally preferred. Rain was found to have little effect, provided the spray had dried.

Food and its Preservation.[1]

THE work done under the direction of the Food Investigation Board of the Department of Scientific and Industrial Research during the year 1919, although its primary object may be said to have been of a practical nature and mainly devoted to the various means of preserving animal and vegetable food, serves well to show how such an object requires previous investigation of many fundamental and purely scientific problems. On account of the strictures that have been made as to the support of pure science by the Department in question, we may take note that it is pointed out in the report before us that "the application to industry of many of the researches is not immediate, and often not obvious." Such results will be especially referred to in the course of this article, but it is not intended thereby to minimise the value of the practical work of the Board.

With regard to the freezing of meat and fish, a valuable series of researches was undertaken on the phenomena occurring in the freezing and thawing of systems containing colloids and electrolytes, with especial reference to the separation of the constituents of such systems and to the diffusion of salts through their solid phases. Our knowledge of the properties of these systems has been greatly enlarged by this work, and a general report on it is now being prepared. Attention may be particularly directed to the fact that by sufficiently rapid cooling to a temperature which corresponds to the eutectic of a saline solution the separation of frozen water as a visible phase is avoided. Thus, on thawing, the system returns to its original state and the irreversible separation of the colloidal material does not take place, as happens on slow freezing at a temperature only a few degrees below the freezing point of the system.

The conditions of growth of bacteria and moulds were naturally subjects of immediate interest. It is well known that bacteria growing in a particular medium, after a period of multiplication, gradually die off. This is shown by Dr. Graham-Smith, in the report, to be due, not to accumulation of toxic products of their own activity, but to the exhaustion of some specific food material. Bacteria of another species are able to grow in a medium which has previously been exhausted by a different species so far as its own growth is concerned. An interesting fact brought out by researches on the "black-spot" mould (shown to be a species of Cladesporium) is that it will grow at a temperature of -5° C. It is clear that the protoplasm in the cells does not freeze, although the expressed juices of plants usually freeze between -2° and -3° C. No doubt capillary forces are responsible for the lowering of the freezing point in the narrow cells.

The question of the discoloration of fruit led to an investigation on the nature of the enzymes responsible for oxidation in plants. An important fact in relation to the general theory of the mechanism of oxidation was brought out in an examination of linseed oil. It was found that the oil oxidises slowly in air without the presence of any kind of catalyst, although in the oxidation system of the cell there is evidence of the presence of a catalyst accelerating autoxidation. In connection with enzymes the work on pectin production may be mentioned.

Of more strictly chemical interest is the discovery that glycerol can be replaced in fats by mannitol, such fats being similar to the corresponding glycerol esters and behaving in the same way as foods. Other work giving an insight into the chemistry of the production of glycerol itself was also undertaken. Of practical importance for workers with the products of degradation of proteins is the method devised by Mr. Foreman for estimating the simpler products of bacterial decomposition. A curious fact is that the equilibrium position reached in the autolysis of beef is not the same as that in the case of mutton, suggesting that the presence of more than one phase in the heterogeneous system of the cell must be taken into consideration.

The work of the Engineering Committee of the Board, as would be expected, has been mainly industrial, but the systematic investigation of the heat-flow through various materials and the loss of heat by convection from plane surfaces may be referred to here as of general scientific interest.

We may note, finally, that the Board has obtained a grant to build and equip a research station at Cambridge for biochemical and biophysical investigations at low temperatures.

W. M. B.

[1] Department of Scientific and Industrial Research. Report of the Food Investigation Board for the Year 1919. Pp. 36. (London: H.M. Stationery Office.) Price 6*d*. net.

The Older Palæolithic Age in Egypt.

PROF. C. G. SELIGMAN, at a meeting of the Royal Anthropological Institute on January 11, read an important paper on "The Older Palæolithic Age in Egypt," embodying the results of an attempt made in 1914 to secure definite stratigraphical evidence of the antiquity of implements which, if found in Europe, would be classed as Chellean, Acheulean, or Mousterian. The sites visited were Abydos, Thebes, Tel-el-Amarna, Meir, and Wady Sheikh, and a short trip was made to the Fayum. Some areas, however, may be described as flintless; flints of Palæolithic type were very common in the neighbourhood of Thebes and Abydos, but were scarce near Meir and Tel-el-Amarna, and did not include either Chellean or Acheulean types. Wady Sheikh showed no definite Palæolithic types, but specimens of early historic date were valuable for the light they threw on the patination of high desert specimens.

The implements found included hand-axes (Chellean type), hand-axes with borer point (not found in Europe), and finely worked ovates (Acheulean type). The points, side scrapers, borers, hollow scrapers, and tanged points (spear- or arrow-heads) Prof. Seligman grouped together as Mousterian, not because they were specially typical of the Mousterian culture, but for reasons connected with the localities of the finds, stratigraphy, and patination. Also included in the group were two forms not occurring in Europe, namely, "crescents" and a heavy drawing-tool, for which the name "tortoise point" was proposed. Forms transitional to Capsian, or Capsian, were notched flakes, end-scrapers, hollow end-scrapers, nose end-scrapers, end-borers, and asymmetric end-borers. From the morphological point of view the river-drift types were unmistakable, while the Mousterian types, so far as the borers, scrapers, and points were concerned, could be paralleled precisely from European forms, while the non-European forms could either be derived from well-known types or were produced by an identical process. A certain number of implements could not readily be referred to Chellean, Acheulean, or Mousterian technique, and, although they might be classed in Europe as Aurignacian of a coarse type, Prof. Seligman was inclined to regard them as highly developed Mousterian modified by Capsian influence from the north.

The great majority of the implements from the Thebaïd present a more or less lustrous surface of various shades of reddish-brown. Specimens of different shades of dull white occur, but only in wadies and "wash-outs." This marked difference in coloration was undoubtedly due to the fact that the white specimens had only comparatively recently been weathered out of the gravels forming the banks of the wadies.

In reference to the stratigraphical evidence for the age of these implements, Prof. Seligman gave a detailed account of the geological character of the area in which they were found. Implements of a highly developed Mousterian type, without the characteristic brown patina of the palæoliths which have been exposed to weathering, have been found *in situ* in undisturbed gravels of Pleistocene age.

An interesting discussion followed the reading of the paper, in which several points of importance were touched upon. Mr. Reginald Smith argued that while patination was an indication of great age, absence of patination did not indicate the reverse; the oldest types of French cave implements showed no patination. He also asked if Prof. Seligman had been able to correlate relative antiquity of type and shade of patination. In reference to the geological data, he was of the opinion that further evidence was required to establish the Mousterian character of some of the implements, especially in the case of those not collected by Prof. Seligman himself. Mr. M. Burkett briefly reviewed recent French work on this subject, and cited the results of a correlation of type and patina which had recently been made by the Abbé Breuil in a series from Tebessa (Southern Algeria). Mr. H. Peake pointed out that the Mousterian industry appeared to have developed further in Africa than in Europe, where its development had been interrupted by the Aurignacian type, and he suggested that this might be due to more favourable climatic conditions on the former continent. It had been stated that no Solutrian culture was found in Africa, but in this case it was difficult to account for the resemblance between certain Saharian and the Solutrian implements. Prof. Fleure said that Prof. Seligman's evidence pointed to a continuous development from Mousterian to Capsian; geographical conditions suggested that at this period there was a great difference between the climates of Africa and Europe.

Tides in Small Seas.

TWO important papers on the tides in small seas have recently been published by the Vienna Akademie der Wissenschaften. The first, in Bd. 96 of the *Denkschriften,* is the latest of a series of researches by R. Sterneck, jun., on the tides of the Adriatic; the second, in Bd. 129 of the *Sitzungsberichte*, is the sixth part of A. Defant's researches on tides in "Mittel- und Randmeeren, in Buchten und Kanalen," and concerns the tides of the Irish Sea. Both investigations are applications of hydrodynamical principles, assuming from observation just sufficient to give or replace the "boundary conditions" where the sea communicates with the larger body of water. Both treatments depend on the elongated nature of the sea in question and utilise charts of soundings after the manner initiated by Chrystal for the longitudinal seiches of lakes. Defant makes separate applications to the Bristol Channel, Liverpool Bay, and Solway Firth. In each case the assumed type of motion may be regarded as a longitudinal oscillation sustained by the tides outside, together with a transverse gradient maintained by the longitudinal current in virtue of the earth's rotation.

Sterneck considers separately the four chief semi-diurnal and the three chief diurnal harmonic constituents; Defant considers mainly the semi-diurnal spring tides. In each case the agreement with observation is remarkable. That for the Irish Sea is not so close as that for the Adriatic, but this is to be expected when the deviations from a canal of slowly varying section and the ratio of tidal range to water-depth are taken into account. Friction is neglected altogether by Sterneck for the Adriatic, but is an important element in Defant's explanation of the Irish Sea tides, in which the amount is of the same order as that used by G. I. Taylor. The negligible importance of friction in the Adriatic may be ascribed to its greater depth and much smaller currents as compared with the Irish Sea. Sterneck calculates the longest free period of the Adriatic to be about 23 hours as against the 16 hours of previous calculations by the "Merian" formula. The larger number agrees well with the observed seiches, and shows the possible error of rough methods. Defant estimates the longest free period of the Irish Sea to be about 18 hours.

J. P.

Paris Academy of Sciences: Loutreuil Foundation.

REQUESTS for grants to the amount of 219,600 francs were received by the Academy. Six of these were refused on the ground that they were presented by persons belonging to universities already in receipt of funds from M. Loutreuil. A total sum of 131,200 francs is allocated by the council of the foundation to the following:

I. *Grants to Establishments named by the Founder.*

(1) National Veterinary School of Alfort: 8000 francs for the construction of a special room for researches relating to the therapeutics of cutaneous and respiratory diseases.

(2) National Veterinary School of Lyons: 3200 francs to François Maignon, for the purchase of

instruments and apparatus for his researches on nutrition.

(3) National Veterinary School of Toulouse: 3000 francs to Jean Lafon, for his researches on the comparative physiology of the secretions in different animal species.

II. *Grants to Establishments Called to the Consultative Committee of the Foundation by the President of the Academy.*

(1) Conservatoire national des Arts et Métiers: 6000 francs to Henri Chaumat, for his studies on the electrical and magnetic properties of electrolytic iron.

(2) Central Electrical Laboratory: 10,000 francs for the researches, under the direction of Paul Janet, on the absolute standards of the international ohm.

III. *Grants Given on Personal Application.*

(1) 10,000 francs to Charles Alluaud and to R. Jeannel, for the study of the zoological and botanical material collected by them in the high mountains of eastern Africa and for the publication of the results.

(2) 5000 francs to Jules Baillaud, for the establishment of a recording microphotometer of the type suggested in 1912 by P. Koch.

(3) 3000 francs to Henry Bourget, director of the Marseilles Observatory, for the *Journal des Observateurs.*

(4) 2000 francs to Clément Codron, for his researches on the sawing of metals.

(5) 5000 francs to the School of Anthropology, for the publication of the *Revue d'Anthropologie.*

(6) 4000 francs to Justin Jolly, for the publication of a work on blood and hæmatoporesis.

(7) 7000 francs to Louis Joubin, for the publication of the results of the French Antarctic Expedition.

(8) 3000 francs to the late Jules Laurent, for the publication (under the direction of Gaston Bonnier) of a work on the flora and geography of the neighbourhood of Rheims.

(9) 3000 francs to Henri Brocard and Léon Lemoyne, for the publication of the second and third volumes of their work entitled "Courbes géométriques remarquables planes et gauches."

(10) 2000 francs to A. Menegaux, for the *Revue française d'Ornithologie.*

(11) 5000 francs to Charles Nordmann, for his researches on stellar photometry.

(12) 8000 francs to the Zi-Ka-Wei Observatory, in China (director, R. P. Gauthier), for recording time-signals from distant centres.

(13) 2000 francs to O. Parent, for his studies on a group of Diptera.

(14) 10,000 francs to G. Pruvot and G. Racovitza, directors of the *Archives de Zoologie expérimentale et générale*, for this publication.

(15) 6000 francs to Alcide Railliet, for the publication of researches on the parasites of the domestic animals of Indo-China.

(16) 4000 francs to J. J. Rey, for the publication of a botanical geography of the Central Pyrenees.

(17) 10,000 francs to Maximilien Ringelmann, for researches relating to the physical and mechanical constants of metals intended to be used in the construction of agricultural machines.

(18) 12,000 francs to the Academy of Sciences, for the establishment of a catalogue of scientific and technical periodicals in the libraries of Paris.

It was pointed out by the council in 1917 that, although the special object of this foundation was the promotion of original research, up to that time requests for assisting work to be carried out according to a well-defined scheme had been exceedingly few in number. For the three years 1914–17 the majority of the requests had for their object the establishment or improvement of equipment more suitable for teaching than for personal work. These remarks still apply, and a possible modification in the method of dealing with the revenue of this foundation is foreshadowed.

University and Educational Intelligence.

BIRMINGHAM.—At a special degree congregation held in the Great Hall of the University on Saturday, February 5, the honorary degree of Doctor of Laws was conferred on the Prime Minister, the Right Hon. David Lloyd George, who had a most enthusiastic welcome. After receiving the degree the Prime Minister made a short speech in which he expressed his admiration of the way in which the universities of the country had come to her aid in the great war, and his own surprise at the discovery of the vital importance of the universities, not only as centres of culture and learning, but also as essential factors in the strength of the nation. He paid a generous tribute to the energy and foresight of the founder of the University of Birmingham (Mr. Joseph Chamberlain), and hoped that the Midland area generally, realising its obligation, would come to the assistance of the University in this its time of serious financial need.

On behalf of the subscribers to the Poynting Memorial Fund, the portrait of the late Prof. J. H. Poynting (by Mr. Bernard Munns) has been presented to the University, and Mr. W. Waters Butler has presented the portrait of the late Prof. Adrian Brown by the same artist. The council has expressed its warm appreciation of these gifts, both of which now hang in the Great Hall of the University.

In response to the appeal for 500,000*l.*, the sum of 280,444*l.* has been received or promised.

CAMBRIDGE.—Dr. C. S. Myers, Gonville and Caius College, has been appointed reader in experimental psychology, and Mr. F. A. Potts, Trinity Hall, demonstrator of comparative anatomy.

A grant of 150*l.* from the Craven Fund has been made to the managing committee of the British School at Athens in aid of further excavations at Mycenæ.

A LECTURE on "The Innervation of Striped Muscle Fibres and Langley's Receptive Substance" will be given at the rooms of the Royal Society of Medicine, 1 Wimpole Street, W.1, by Dr. J. Boeke, professor of embryology and histology in the University of Utrecht, at 5 p.m. on Wednesday, February 16. This lecture has been arranged under a scheme for the exchange of lecturers in medicine between England and Holland. Four other Dutch lecturers will also give one lecture each, particulars of which will be announced later. The chair at the lecture of February 16 will be taken by Prof. W. M. Bayliss. Admission is free, without ticket.

THE University of Bristol will shortly possess as fine a block of university buildings as can be found in the United Kingdom outside Oxford and Cambridge. The entire expense of erecting these buildings was, from the outset, undertaken jointly by Mr. George A. Wills and Mr. Henry H. Wills. The cost of completing the work will vastly exceed even the liberal sum contemplated when the gift was originally made. Additional contributions were made by the two brothers during the course of the war, and since the present year commenced they have placed in the hands of the University an additional benefaction of as much as 200,000*l.*, hoping to enable the buildings and design to be fully carried out. It is reassuring to note that these two public-spirited citizens are not allowing their munificent gift of 1913 to fail of fulfilment even in the difficult circumstances of the present time.

THE universities in Australia are apparently suffering, like our own institutions, from an inability to make their incomes meet their expenditures under post-war conditions. At Sydney the University authorities have decided to raise the fees in all the various schools, in some cases by as much as 50 per cent., in order to meet the increased cost of materials. Melbourne University has issued an appeal for 100,000*l.*, towards which it has obtained only the sum of 30,000*l.*, subscribed in small amounts; it hopes to raise a further sum of 20,000*l.* in a similar way, but no large gifts have yet been made. Sir W. H. Irvine, Lieutenant-Governor of Victoria, discussed the situation at Melbourne on January 31, according to a *Times* correspondent, and suggested that wealthy Victorians might well follow the example set by Sir J. Langdon Bonython in South Australia, who has presented the sum of 40,000*l.* to Adelaide University.

WE learn from an article in the *Times Educational Supplement* that the Vice-Chancellor of the University of Madras, Mr. K. Srinivasa Iyengar, who is now a member of the Madras Executive Council, laid great stress on the neglect of science and technology in India in his recent convocation address. The careers of 18,500 graduates of the University had been traced, and of this number about 3700 were engaged in teaching, 765 had taken up medicine, while only 56 had devoted themselves to science; the remaining 14,000 were divided between law and Government administrative service, with a big majority for the former. The Vice-Chancellor concluded his account of the statistics he had accumulated with the words: "You will search in vain for any solid contribution to the sum of human knowledge among the magnificent number." These facts have been appreciated by many leaders of Indian thought, and several of the more wealthy men have endeavoured by their munificence and influence to create a stronger feeling for science. The Indian Institute of Science at Bangalore owes its existence to the late Jamsetji Tata, and some eight years ago the late Sir Taraknath Palit made over money and land of the aggregate value of 15 lakhs of rupees (100,000*l.*) to the University of Calcutta for the promotion of scientific and technical education in Bengal. University chairs of chemistry and physics which can be filled only by persons of Indian birth were created from this fund. In 1913 Sir Rash Behary Ghose gave 10 lakhs of rupees (66,666*l.*) to the University for the establishment of chairs of applied mathematics, physics, chemistry, and botany, all in relation to agriculture; these again can be held only by Indians. A year or so ago this gift was supplemented by a further sum of 11 lakhs of rupees (73,332*l.*), given by Sir Rash Ghose for the proposed technological branch of the College of Science. This gift enabled the University to send Sir Prafulla Chandra Rây, the dean of the faculty of science, on a three months' tour of the universities of Great Britain. Sir P. C. Rây is a distinguished chemist who has been closely associated with numerous industrial concerns in Bengal, and he has been appointed to supervise the equipment of the technological department, while four young research workers are being trained in London under the terms of Sir Rash Ghose's gift.

Calendar of Scientific Pioneers.

February 10, 1868. Sir David Brewster died.—A founder of the British Association and the biographer of Newton, Brewster made important discoveries in optics, for which he was awarded the Rumford, Royal, and Copley medals of the Royal Society.

February 10, 1878. Claude Bernard died.—A great physiologist, Bernard for many years held the chair of experimental physiology at the Collège de France.

February 10, 1891. Sonia Kovalevsky died.—One of the best known of women mathematicians, Sonia or Sophie Kovalevsky studied under Weierstrass, and after her husband's death in 1883 became professor of higher mathematics at Stockholm.

February 11, 1650. René Descartes died.—Born in 1596, and educated by the Jesuits, Descartes served for a while in the Army, and in 1629 settled in Holland, where his principal works were written. He has been called "the father of modern philosophy." He made many improvements in mathematics, and is regarded as the founder of analytical geometry. His theory of vortices, devised to explain the motion of the heavenly bodies, held the field until it was superseded by the Newtonian philosophy. He died at Stockholm, but his remains now rest in Paris. On the pedestal of his statue at Tours is inscribed, "Je pens, donc je suis."

February 11, 1868. Jean Bernard Léon Foucault died.—To Foucault we owe the demonstration, by means of the pendulum and the gyroscope, of the rotation of the earth. In 1850 he showed that light travelled more slowly through water than through air. He was physicist to the Paris Observatory.

February 12, 1787. Ruggiero Giuseppe Boscovich died.—The Society of Jesus has produced many notable workers in science, but none with a wider reputation than Boscovich. He was a mathematician, physicist, and astronomer, and is remembered for the famous theory of matter which he propounded. For some years he resided in Paris. His last days were passed in neglect and misery, and he died insane at Milan.

February 12, 1799. Lazaro Spallanzani died.—Holding various chairs at Modena and Padua, Spallanzani was interested in all branches of science, but his main discoveries related to physiology. He especially studied digestion and fertilisation.

February 13, 1839. Edward Turner died.—The first professor of chemistry in the University of London, Turner made many accurate determinations of atomic weights.

February 13, 1909. Hans Peter Jürgen Julius Thomsen died.—An educationist, administrator, and technologist, Thomsen held the chair of chemistry at Copenhagen. He made long and important investigations in thermo-chemistry, comparable with those of Berthelot.

February 14, 1744. John Hadley died.—A mathematician and scientific mechanist, Hadley produced the first serviceable reflecting telescope and invented the reflecting quadrant.

February 15, 1680. Jan Swammerdam died.—While practising as a doctor at Amsterdam and Leyden, Swammerdam became one of the earliest and most successful entomologists. He especially studied the anatomy of the bee.

February 15, 1736. Stephen Gray died.—The first recipient of the Copley prize of the Royal Society, Gray was a pensioner in the Charterhouse, London, where he made many successful electrical experiments.

E. C. S.

Societies and Academies.

LONDON.

Royal Society, January 27.—Prof. C. S. Sherrington, president, in the chair.—K. **Sassa** and Prof. C. S. **Sherrington**: The myogram of the flexor-reflex evoked by a single break-shock. In the spinal preparation excess of the reflex contraction over maximal twitch indicates that summation of successive contraction-waves is present in the former. Repetitive discharge from the reflex centre occurs, therefore, in response to a stimulus consisting of a single induction shock. —Sir Almroth **Wright**: "Intertraction" between albuminous substances and saline solutions. It is demonstrated by means of experiments in which serum is directly superimposed upon heavier salt solutions, and of corresponding experiments in which lighter salt solutions are superimposed upon heavier serum, that the fluids thus brought into conjunction interpenetrate with extreme rapidity. The phenomena are due to an interaction between the salts and the albuminous substances. The designation "intertraction" is applied to this form of interaction; and it is suggested that these forces supplement diffusion. In supplementary experiments it is shown that by intertraction microbes lodged in serum are rapidly carried down into heavier, or caught up into lighter, salt solutions.—Dr. S. **Russ**, Dr. Helen **Chambers**, and Gladwys M. **Scott**: The local and generalised action of radium and X-rays upon tumour growth. The local effects of the β- and γ-rays from radium and X-rays upon rat tumours, under varying conditions, were obtained by exposing the tumour only to measured quantities of radiation. When large doses are employed destructive action upon the tumour-cells is observed; as the dose is reduced the action tends to become stimulative in character, so that the tumour-cells grow more rapidly. The generalised effects of the rays used were obtained by submitting the whole animal to the radiation, the tumour being screened. Large generalised doses could not be borne by the animals; with repeated small doses an increase in body-weight and in resistance towards tumour growth was observed. The bearing of the observations on radiation treatment in man is discussed.

PARIS.

Academy of Sciences, January 10.—M. Georges Lemoine in the chair.—P. **Marchal**: The utilisation of ladybirds against insects harmful to cultivation in the South of France. Specimens of *Cryptoloemus Montrouzieri* obtained from America have been cultivated at Mentone, and colonies were liberated in that town and the neighbourhood. It was proved that the insects could pass the winter in the open air in spite of an unusually low temperature.—M. **Lugeon** and J. **Villemagne**: An old glacial bed of the Rhone between Léaz and Pont-Rouge des Usses (Haute-Savoie).—A. **Schaumasse**: Observations of the Skjellerup comet (1920*b*) made with the bent equatorial at Nice Observatory. Positions are given for December 16, 20, and 23. The comet was of 10·5 magnitude, about 1·5′ diameter, with an ill-defined nucleus.—G. **Fayet** and A. **Schaumasse**: Provisional elements of the new comet 1920*b* (Skjellerup).—H. **Godard**: Observations of the Skjellerup comet made at the Bordeaux Observatory with the 38-cm. equatorial.—S. **Posternak**: The tetrabasic polymolybdates.—E. **Chaput**: Observations on the old alluvia of the Seine.—L. **Cayeux**: The mineralogical evolution of the oolitic iron minerals of France, independent of the time factor.—A. **Guilliermond**: The morphological constitution of the cytoplasm.—E. **De Wildeman**: The theories of myrmecophily.—G. **Mangenot**: The "fucosane grains" of the Pheophyceæ.—H. **Lagatu**: The respective *rôles* of the three bases, potash, lime, and magnesia, in cultivated plants. The K : Ca : Mg ratios for a large number of plants are plotted on a rectangular isosceles triangle. The results explain experimental figures recently obtained by the use of calcined dolomite as a manure.—E. **Lombard**: A collection of phenomena, clinical and experimental, permitting the study of the functional state of the vestibular apparatus in its relations with organic equilibrium.—M. **Doyon**: The anti-coagulating action of the nucleic acid of the pancreas. The stability and characters of the nucleated plasma.—A. **Mayer**, H. **Magne**, and L. **Plantefol**: The toxicity of the chlorinated methyl carbonates and chlorocarbonates. Thirteen chlorine derivatives of methyl carbonate were studied; the results are expressed graphically with substituted chlorine atoms as abscissæ and minimum focal concentrations as ordinates.—P. **Chabanaud**: A new Batrachian in intertropical Africa. The larva found appears to be that of *Triton Poireti*, although there are some differences.

January 17.—M. Georges Lemoine in the chair.—C. **Guichard**: Couples of two O_1 congruences, reciprocal polars, with respect to a linear complex.—T. **Varopoulos**: Functions having a finite or infinite number of branches.—C. **Trémont**: The testing of thin metal sheets by stamping. Two methods are described, one for metal sheets utilised for their rigidity, the other for resistance to shock. Some data obtained with sheets of steel, copper, brass, and aluminium are given.—H. **Villat**: The initial flow of a liquid through an orifice opened suddenly.—R. **de Mallemann**: The variation of the rotatory power of tartaric acid. The marked increase in the rotatory power of solutions of tartaric acid caused by the addition of certain weak acids (boric, molybdic, tungstic, etc.) has been attributed to the formation of new chemical compounds of high rotatory power. The author describes modifications of rotatory power produced by the chlorides and nitrates of the alkalis and alkaline earths which appear to be due to another cause. The rotatory power diminishes and then changes its sign; the dispersion changes follow a definite law.—G. **Chaudron**: Reversible reactions of carbon monoxide with the oxides of iron. The composition of the gaseous phase in this equilibrium has been determined by an interference method. Below 580° C. there is a single system corresponding to the equation

$$Fe_3O_4+4CO \rightleftharpoons 4CO_2+3Fe.$$

Below 580° C. there are two equilibria corresponding to

$$Fe_3O_4+CO \rightleftharpoons 3FeO+CO_2.$$
$$FeO+CO \rightleftharpoons Fe+CO_2.$$

A diagram is given, plotted from the experimental figures showing the three branches of curves corresponding to these systems.—J. B. **Senderens**: The catalytic decomposition of the chloroacetic acids. Whilst acetone is readily formed by the catalytic decomposition of acetic acid, the chloroacetic acids are split up in quite a different manner. Monochloroacetic acid gives carbon monoxide and dioxide, aqueous hydrochloric acid, and a little ethylene chloride; trichloroacetic acid gives the same gases with a little phosgene, with a condensed liquid containing chloroform, tetrachloroethylene, and a little hexachloroethane. Thoria and kaolin have practically identical catalytic actions in these decompositions; but animal charcoal gives different products with trichloroacetic acid, 85 per cent. of the distillate consisting of chloroform.—M. **Delépine** and P. **Jaffeux**: The two homologues of ethylene sulphide, 1:2-thiopropane and 1:2-thiobutane. These two sulphides have been prepared in a pure state, and their principal physical constants are given and compared with the isomers described by Grichkévitch-Trokhimovsky.—R. **Fosse**: The synthesis of cyanic acid by the oxidation of formamide and of oxamic acid. Formamide was oxidised by potassium permanganate in strongly ammoniacal solution and the resulting solution heated with ammonium chloride; urea was proved to be present by the xanthydrol reaction.—C. **Dufraisse**: The auto-oxidation of α-bromostyrolene.—O. **Mengel**: The inter-Glacial and post-Glacial tectonic movements of the eastern end of the Pyrenees.—C. **Dufour**: The values of the magnetic elements at the Val-Joyeux Observatory on January 1, 1921.—Ad. Dawy **de Virville**: Modification of the form and structure of a moss (*Hypnum commutatum*) kept under water. After six months marked changes in the mode of growth were observed.—E. **Miège**: The action of chloropicrin on the germinative faculty of seeds. The destruction of parasitic insects on seeds with chloropicrin vapour is readily carried out, but in some cases the seeds are injuriously affected. Leguminous seeds are not injured by this treatment.—P. **Mazé**: The chemical mechanism of the assimilation of carbon dioxide by green plants.—A. **Pézard**: The latent period in experiments of testicular transplantation and the law of "all or nothing."—M. **Marage**: The limits of audition.—C. **Porcher** and L. **Panisset**: Experimental researches on colostrum. Colostrum is not a special fluid secreted by the mammary gland, but the product of phagocytosis of ordinary milk; it is a product of retention. The lactose is absorbed, and the phagocytes attack the colloids and fat globules.—E. **Kayser**: The influence of light radiations on the azotobacter.—H. **Vallée** and H. **Carré**: The adsorption of the aphthous virus.

Books Received.

The Development of Institutions under Irrigation. By Prof. G. Thomas. Pp. xi+293. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 16*s.* net.

Laboratory Projects in Physics: A Manual of Practical Experiments for Beginners. By F. F. Good. Pp. xiii+267. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd.) 9*s.* net.

The Origin and Development of the Nervous System from a Physiological Viewpoint. By Prof. C. M. Child. Pp. xvii+296. (Chicago: University of Chicago Press; London: Cambridge University Press.) 1.75 dollars net.

An Introduction to Zoology for Medical Students: By Prof. C. H. O'Donoghue. Pp. x+501. (London: G. Bell and Sons, Ltd.) 16*s.* net.

Mechanism, Life, and Personality: An Examination of the Mechanistic Theory of Life and Mind. By Dr. J. S. Haldane. Second edition. Pp. vii+152. (London: J. Murray.) 6*s.* net.

New Studies of a Great Inheritance: Being Lectures on the Modern Worth of some Ancient Writers. By Prof. R. S. Conway. Pp. viii+241. (London: J. Murray.) 7*s.* 6*d.* net.

First Course in General Science. By Prof. F. D. Barber and others. Pp. vii+607. (New York: H. Holt and Co.; London: G. Bell and Sons, Ltd.) 9*s.* net.

Elementary Vector Analysis: With Application to Geometry and Physics. By Dr. C. E. Weatherburn. Pp. xxvii+184. (London: G. Bell and Sons, Ltd.) 12*s.* net.

Anuario del Observatorio de Madrid para 1921. Pp. 591. (Madrid.)

Botany with Agricultural Applications. By Prof. J. N. Martin. Second edition, revised. Pp. xii+604. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 21*s.* net.

A Laboratory Manual of Organic Chemistry for Medical Students. By Prof. M. Steel. Second edition, revised. Pp. xi+284. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 9*s.* 6*d.* net.

Geography for Junior Classes. By E. Marsden and T. Alford Smith. Pp. viii+278. (London: Macmillan and Co., Ltd.) 5*s.*

Purpose and Transcendentalism. An Exposition of Swedenborg's Philosophical Doctrines in Relation to Modern Thought. By H. S. Redgrove. Pp. xvi+170. (London: Kegan Paul and Co., Ltd.; New York: E. P. Dutton and Co.) 5*s.* net.

The Carnegie Trust for the Universities of Scotland. Nineteenth Annual Report (for the Year 1919–20) Submitted by the Executive Committee to the Trustees on February 9, 1921. Pp. iv+102. (Edinburgh: T. and A. Constable and Co., Ltd.)

Orographical, Regional, and Economic Atlas. Edited by T. Franklin. Part 3: Asia. Pp. 32. (Edinburgh: W. and A. K. Johnston, Ltd.; London: Macmillan and Co., Ltd.) 1*s.* 6*d.* net.

Memoirs of the Geological Survey. Special Reports on the Mineral Resources of Great Britain. Vol. xii.: Iron Ores (continued). Bedded Ores of the Lias, Oolites, and Later Formations in England. By G. W. Lamplugh and others. Pp. iv+240+viii plates. 12*s.* 6*d.* net. Vol. xiv.: Refractory Materials: Fireclays. Resources and Geology. Pp. iv+243+iv plates. 8*s.* net. (Southampton: Ordnance Survey Office; London: E. Stanford, Ltd.)

Diary of Societies.

THURSDAY, FEBRUARY 10.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. W. A. Herdman: Oceanography (Problems of the Plankton).

ROYAL SOCIETY, at 4.30.—Rev. John Roscoe: Certain Ethnological Features of Uganda.

LONDON MATHEMATICAL SOCIETY (at Royal Astronomical Society), at 5.—Prof. A. S. Eddington: World Geometry (with particular reference to Weyl's Electromagnetic Theory).—J. Brill: Note on the Electromagnetic Equations.—J. E. Littlewood: Researches in the Theory of the Riemann Zeta-function.—S. Pollard: A New Condition for Cauchy's Theorem.—I. J. Schwatt: (1) An Independent Form of the Numbers of Bernoulli; (2) Euler's Numbers of Higher Order; (3) Certain Numbers which are related to Euler's Numbers of Higher Order.—S. Tunoschenko: (1) The Tension of a Prism one of the Cross-sections of which remains Plane; (2) The Analogy with Membranes in the Case of the Bending of a Prism.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Dr. G. H. Miles: Vocational Tests.

INSTITUTION OF ELECTRICAL ENGINEERS (at Institution of Civil Engineers), at 6.—Discussion on Electric Appliances for Domestic Purposes, to be introduced by Dr. E. Griffiths and F. H. Schofield in a Paper on Some Thermal Characteristics of Electric Ovens and Hot Plates.

LONDON DERMATOLOGICAL SOCIETY, at 6.—Dr. Sibley: Alopecia (Chesterfield Lecture).

OPTICAL SOCIETY, at 7.30.

ROYAL SOCIETY OF MEDICINE (Neurology Section) (at National Hospital for Paralysis and Epilepsy), at 8.

FRIDAY, FEBRUARY 11.

ROYAL ASTRONOMICAL SOCIETY (Anniversary Meeting), at 5.

ROYAL SOCIETY OF MEDICINE (Clinical Medicine, Surgery), Joint Meeting, at 5.—Dr. H. Mackenzie, J. Berry, and Others: Discussion: The Medical and Surgical Treatment of Graves' Disease.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Prof. A. G. T. Fisher: Loose Bodies in Joints.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.—Discussion on Absolute Measurements of Electrical Resistance, and Instruments Based on the Temperature-variation of Resistance.—Sir Richard Glazebrook and F. E. Smith: Absolute Measurements of Electrical Resistance.—Resistance Thermometry: Prof. H. L. Callendar: The Compensated Resistance Bridge, and Instrument for the Measurement of Radiation.—C. R. Darling: The Early Work of Siemens on the Resistance-Pyrometer.—

C. Jakeman: The Measurement of Steam Temperatures.—The Hot-Wire Microphone: Major W. S. Tucker: The Function of the Convection Current in the Hot-Wire Microphone.—Capt. E. J. Paris: Theory of the Tucker Microphone.—Anemometry and Heat Convection: Prof. J. T. McGregor Morris: A Hot-Wire Anemometer.—Dr. J. S. G. Thomas: A Directional Hot-Wire Anemometer.—A. H. Davis: An Instrument for Measuring Convected Heat.—Miscellaneous Applications: Dr. G. A. Shakspear: A Gas Permeameter.—Prof. Leonard Hill: The Caleometer.—E. A. Griffiths: Liquid Depth Gauge (Distant Reading Type).—Dr. Daynes: A CO_2 Recorder.—Dr. E. Griffiths: Electrical Hygrometers.

MONTESSORI SOCIETY (at University College), at 5.45.—Miss M. Drummond: The Psychological Basis of the Montessori Method.

JUNIOR INSTITUTION OF ENGINEERS (at Caxton Hall), at 8.—F. A. Simpson: Some Limit Gauges.

INSTITUTE OF INDUSTRIAL ADMINISTRATION (at Central Hall, Westminster), at 8.—Sir Lynden Macassey: Present-Day Industrial Psychology.

ROYAL SOCIETY OF MEDICINE (Ophthalmology Section), at 8.30.—B. T. Lang: Scotometry.—Dr. T. H. Butler: Late Infections after Sclerectomy.—M. L. Hepburn: Some Notes on Trephining.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Dr. F. W. Aston: Isotopes and Atomic Weights.

SATURDAY, FEBRUARY 12.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. Fowler: Spectroscopy (Experimental Spectroscopy).

PHYSIOLOGICAL SOCIETY (at National Institute for Medical Research, Mount Vernon, Hampstead), at 4.

MONDAY, FEBRUARY 14.

BIOCHEMICAL SOCIETY (at University College).

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 4.—Sir Charters J. Symonds: Hunterian Oration.

INSTITUTE OF ACTUARIES, at 5.—F. A. A. Menzler: The Census of 1921: Some Remarks on Tabulation.

ROYAL GEOGRAPHICAL SOCIETY (at Lowther Lodge), at 5.—Lt.-Col. E. A. Tandy: The Circulation in the Earth's Crust.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting) (at Chartered Institute of Patent Agents), at 7.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Special Lecture), at 7.—Sir John Dewrance: Generation of Steam.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—W. E. Willink: The Cunard Building.

ROYAL SOCIETY OF ARTS, at 8.—Dr. E. K. Rideal: Applications of Catalysis to Industrial Chemistry (Cantor Lecture).

MEDICAL SOCIETY OF LONDON (at 11 Chandos Street, W.1), at 8.30.—Sir James Galloway and Others: Discussion on Skin Disease: Its Relation to Internal Disorder.

ROYAL SOCIETY OF MEDICINE (War Section), at 9.

TUESDAY, FEBRUARY 15.

ROYAL SOCIETY OF MEDICINE (Therapeutics and Pharmacology Section), at 4.30.—Dr. J. H. Burn: A Comparison of Digitalis Tinctures by Different Physiological Methods.—Dr. P. Hamill: Pituitary Extracts given by the Mouth (Experimental).—Dr. Donaldson: Pituitary Extracts given by the Mouth (Clinical).

ROYAL SOCIETY OF MEDICINE, at 5.—General Meeting.

ROYAL STATISTICAL SOCIETY, at 5.15.—Dr. J. Bonar: The Mint and the Precious Metals in Canada.

INSTITUTION OF PETROLEUM TECHNOLOGISTS (at Royal Society of Arts), at 5.30.—P. de Chambrier: Working Petroleum by means of "Pits" and "Galleries."

WEDNESDAY, FEBRUARY 16.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Dr. F. W. Edridge-Green: The Cause and Prevention of Myopia (Arris and Gale Lecture).

ROYAL SOCIETY OF ARTS, at 8.—Dr. W. Cramp: Pneumatic Elevators in Theory and Practice.

ROYAL METEOROLOGICAL SOCIETY, at 8.—M. de Carle S. Salter: A New Method of Constructing Average Monthly Rainfall Maps.—G. A. Clarke: An Unusual Pilot-balloon Trajectory.

ROYAL MICROSCOPICAL SOCIETY, at 8.

HUNTERIAN SOCIETY (at Sion College), at 9.—Dr. H. H. Bashford: The Ideal Element in Medicine.

THURSDAY, FEBRUARY 17.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. W. A. Herdman: Oceanography (The Sea-Fisheries).

ROYAL SOCIETY, at 4.30.—*Probable Papers*.—Dr. C. Chree: A Comparison of Magnetic Declination Changes at British Observatories.—Prof. H. M. Macdonald: The Transmission of Electric Waves Around the Earth's Surface.—Prof. T. H. Havelock: The Stability of Fluid Motion.—Prof. W. H. Young: The Transformation of Integrals.—J. L. Haughton and Kathleen E. Bingham: The Constitution of the Alloys of Aluminium, Copper, and Zinc containing High Percentages of Zinc.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. Martin Flack: Respiratory Efficiency in Relation to Health and Disease (Milroy Lecture).

LINNEAN SOCIETY, at 5.—Prof. G. B. De Toni: A Contribution to the Teratology of the Genus Datura.—Capt. J. Ramsbottom and A. J. Wilmott: A Plant Collection from Macedonia.—Dr. G. C. Druce: Shetland *Plantago* and Other Plants from the Northern Isles.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—F. Handley Page: The Handley Page Wing.

INSTITUTION OF MINING AND METALLURGY (at Geological Society), at 5.30.—E. H. Clifford: A Scheme for Working the City Deep Mine at a Depth of 7000 ft.

INSTITUTION OF ELECTRICAL ENGINEERS (at Institution of Civil Engineers), at 6.—Prof. E. Wilson: Magnetic Susceptibility of Low Order: I. Instrumentation.

INSTITUTION OF AUTOMOBILE ENGINEERS (London Graduates' Meeting) (at 28 Victoria Street), at 7.30.—E. L. Bass: Engine Lubrication.

CHEMICAL SOCIETY, at 8.—L. J. Hudleston and H. Bassett: Equilibria of Hydrofluosilicic Acid. Part I. Mixtures of Hydrofluosilicic and Hydrofluoric Acids.—R. G. Fargher and H. King: Additive Compounds of Antipyrylaminodiacetic Acid and its Salts with Neutral Salts.—H. Bassett and T. A. Simmons: The System, Picric Acid—Phenyl Acridine.—F. S. Kipping: Organic Derivatives of Silicon. Part XXIV. *dl*-Derivatives of Silicoethane.—F. W. Atack: The Structural Isomerism of Oximes. Part I. Criticism of the Hantzsch-Werner Hypothesis of the Geometrical Isomerism of Carbon-Nitrogen Compounds.—F. W. Atack: The Structural Isomerism of Oximes. Part II. Constitution of Oximes.—F. S. Kipping: Organic Derivatives of Silicon. Part XXV. Saturated and Unsaturated Silicohydrocarbons Si_4Ph_8.

RÖNTGEN SOCIETY (at University College), at 8.15.—N. E. Luboshez: Intensifying Screens and Secondary Radiation.

FRIDAY, FEBRUARY 18.

ASSOCIATION OF ECONOMIC BIOLOGISTS, Annual General Meeting (in Botanical Lecture Theatre, Imperial College of Science), at 2.30.—Sir David Prain: Some Relationships of Economic Biology.

GEOLOGICAL SOCIETY OF LONDON, at 3.—Anniversary Meeting.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—J. F. Dobson: The Function of the Kidneys in Enlargement of the Prostate Gland (Arris and Gale Lecture).

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Annual General Meeting.—F. M. Farmer: The Desirability of Standardisation in the Testing of Welds.

INSTITUTION OF ELECTRICAL ENGINEERS (Students' Section) (at King's College, Strand), at 6.30.—L. B. Atkinson: Presidential Address.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—S. J. Solomon: Strategic Camouflage.

SATURDAY, FEBRUARY 19.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. A. Fowler: Spectroscopy (Regularity in Spectra).

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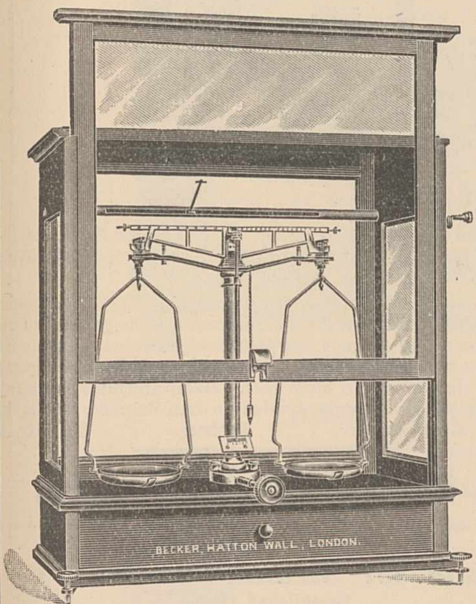

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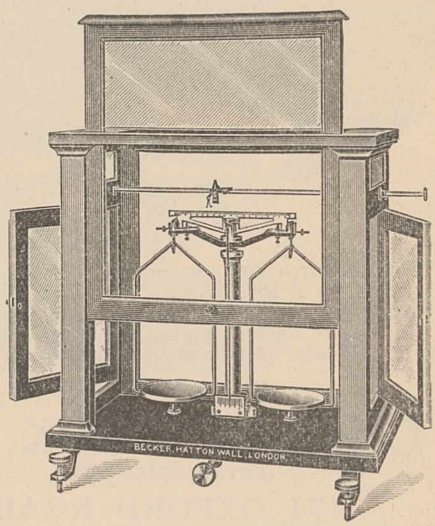

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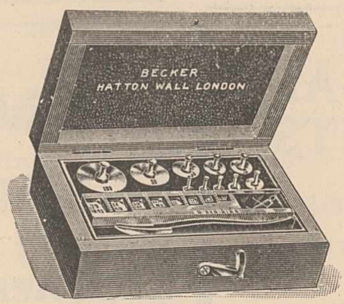

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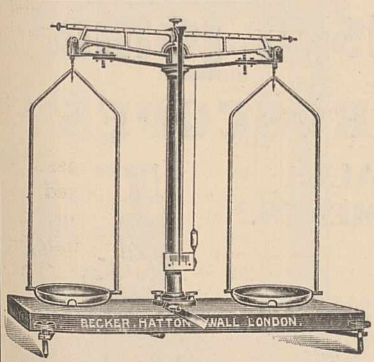

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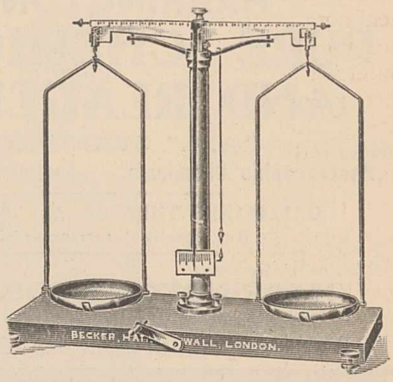

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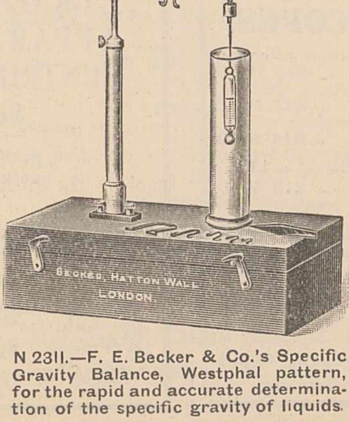

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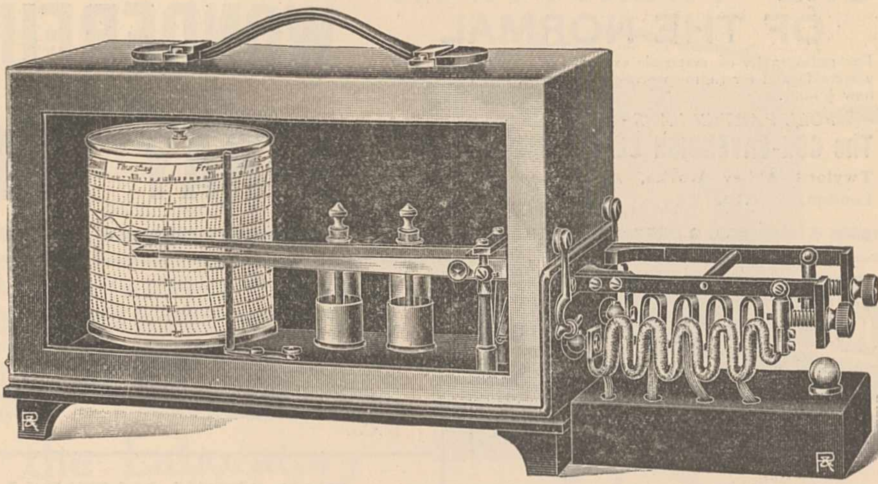

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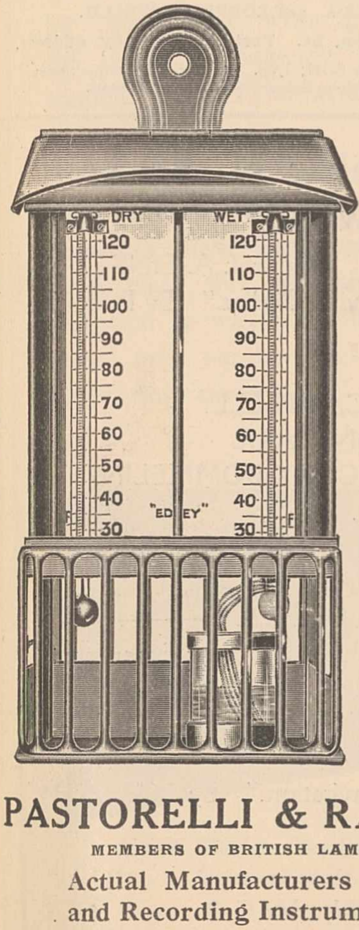

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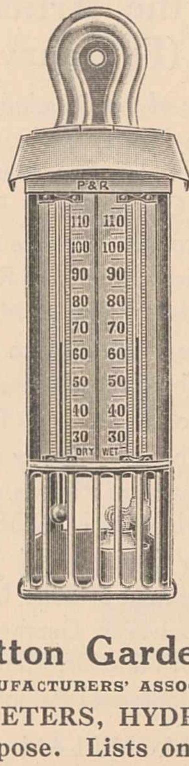

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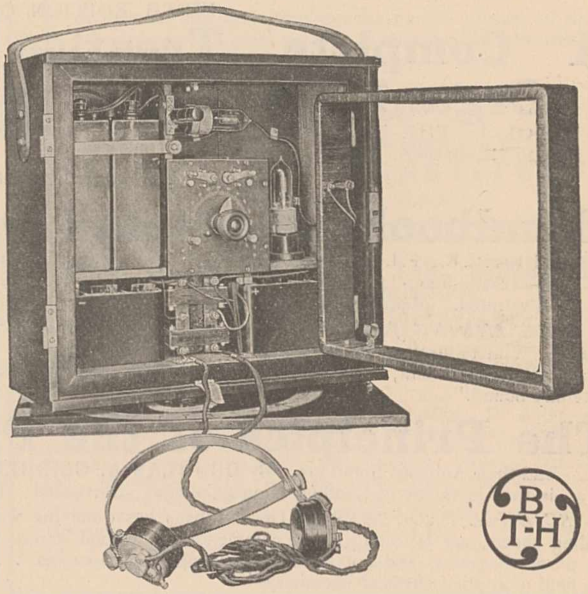

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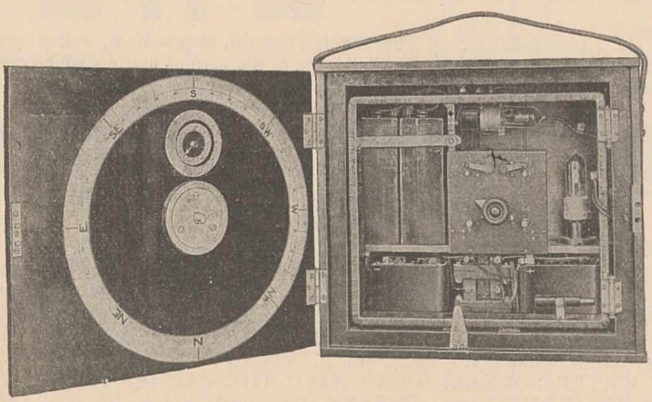

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