NATURE

SATURDAY, MARCH 29, 1924.

CONTENTS.

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

Advertisements and business letters should be addressed to the Publishers.
Editorial communications to the Editor.

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

NO. 2839, VOL. 113]

The Naples Zoological Station.

BIOLOGISTS all over the world will be interested in the news, of which we have just received official confirmation, that Dr. Reinhard Dohrn, the son of the founder of the Zoological Station at Naples, has once more taken up the post of director. As Dr. Dohrn is a German subject (although half-Russian by birth and Italian by upbringing), he was forced to leave Italy when it became clear that she was going to enter the War on the side of the Allies. During and since the War the Naples Station was under the Italian Government and the Municipality of Naples, with Prof. Monticelli, head of the Department of Zoology in the University of Naples, as director.

After the War a number of questions arose, and the legal status of the Station under the peace-treaty was gone into at the instance of Dr. Dohrn. He claimed that it was for many reasons not liable to sequestration, while the Naples Municipality asserted it to have been private property, and therefore to have passed legally to them as landlords. These points and many others were decided in the courts, the case eventually going to the highest court of appeal. On all the essential counts Dr. Dohrn gained his point. Finally, government decrees were issued establishing the status of the Station and defining its organisation. Briefly, we may say that, while Dr. Dohrn goes back as director, the control is vested in a board of seven members, all except the director Italians ; further, the heads of the separate departments of the Station (at present two—zoological and physiological) are to be Italians. The position is therefore not the *status quo ante*, but this modified by a measure of Italian control and Italian share in the internal administration.

From being private property, the Station has become a special form of public corporation known in Italy as an *ente morale*. The board is of seven members. The Mayor of Naples is *ipso facto* its president, while the other members are nominated quinquennially by the Minister of Public Instruction. The detailed direction and administration is reserved to Dr. Dohrn.

Plans for the future of the Station will, of course, be determined by financial considerations. Several foreign governments and institutions have rented or have promised to rent "tables." The income under this head, however, will for the present not be so great as before the War. The income from the public aquarium is considerable, and grants are also to be made from the Naples Municipality and the Italian Government. Finally, a certain amount of Dr. Dohrn's private property, which was sequestrated during the War, is to be applied to the use of the Station. With these funds the new director hopes to be able to make an

immediate start on a sound footing. He intends to appoint, besides the Italian *chefs de laboratoire*, several assistants of various nationalities on the staff.

As to his scientific aims, Dr. Dohrn writes :

"The Zoological Station was founded to enable naturalists to carry on their studies with the utmost economy of time, energy, and money. This is still, in my opinion, its fundamental *raison d'être*. The Station cannot be expected to lead towards new directions of research, but rather to follow them attentively ; and the staff will have to devote itself largely to the improvement of the methods and technique in the dominant fields of marine biological research, as well as to the efficient organisation of the laboratories. Since, in the new conditions, the Station cannot cover the whole field of marine work, it will concentrate on particular lines. The promotion of experimental biology will be made its first aim. Oceanography must be dropped, and fishery work much reduced, since facilities for research in these fields are provided by other institutions in Italy. Faunistic work, especially in its ecological aspect, will be continued, and every effort will be made to make the type-collection of faunistic and experimental material, which had already been started before the War, as complete as possible.

"No new volumes of the 'Fauna und Flora des Golfes von Neapel' will be undertaken, at least for the present (although several previously started will be published). The 'Zoologischer Jahresbericht,' which was discontinued in 1914, will not be taken up again ; but the old 'Mitteilungen' will be continued under the title of 'Pubblicazioni della Stazione Zoologica di Napoli.'"

We congratulate Dr. Dohrn on his return to the directorship of the Station, and all parties to a long and difficult dispute, on arriving at an arrangement which should ensure the smooth and efficient running of an institution with great scientific traditions.

It is only half a century ago that the Naples Station, the first permanent and properly equipped laboratory of marine biology, was founded by Dr. Dohrn's father. It is interesting to look back and try to estimate the importance of this event to biological science. At the start, the impetus given by thus systematically opening up a new field was enormous, not only to studies in pure morphology and descriptive embryology, not only to faunistic and fishery work, but also to experimental biology. It is not too much to say that the success of the Naples Station, and the consequent foundation of similar institutions in other countries, alone made it possible for men like Driesch, Boveri, Loeb, E. B. Wilson, and Morgan to carry out the fundamental pioneer work on which most of our knowledge of the physiology of fertilisation and development is based.

In the last twenty years, the marine station has not played quite such a predominant rôle in biology. Genetics has been the ruling passion—might one not sometimes say *fashion* ?—and this is as readily studied inland. The rise of ecology, and the greater adoption of current physiological methods by zoologists, are also factors which of recent years have kept inland workers at home rather than sending them to the seaside. A change, however, is now again noticeable. The physiologist, in response to the zoologist's theft of some of his less elaborate thunder, is invading the zoologist's domain. For one thing, it is found that various fundamental processes of life, such as fertilisation, ciliary action, amœboid movement, and a great many others, lend themselves more readily to study in life's original environment than in fresh water or in the tissues of higher terrestrial animals. For another, the physiologist, having pushed his analysis of vertebrate function almost to the limit at present possible, naturally tends to enlarge his knowledge by making it comparative ; and finally, the methods of ecology are coming to be applied more fully to marine biology, both pure and applied.

It will thus be seen that there is no reason to suppose that marine biological stations have their most important work behind them, or that there are too many of them (or at least of those with adequate equipment) in existence. The Naples Station, we may be sure, will have as important results to its credit in the future as it has had in the past. Once alone in its field, it has become the parent, or at least the prototype, of a whole crop of similar institutions elsewhere. Many of these are now flourishing and well organised ; and some, like Plymouth and Woods Hole, rival their original. Nevertheless, we sincerely hope that both financial support and a stream of biological workers will flow to the reorganised "Stazione" at Naples. In the past, as all who have worked within its precincts will testify, the full international spirit of scientific co-operation has always reigned. Under Dr. Dohrn we are sure that it will continue to do so in the future ; and that spirit, in these difficult days, is worthy of all encouragement.

Chinese and Little Tibet.

(1) *The Mystery Rivers of Tibet : a Description of the Little-known Land where Asia's Mightiest Rivers gallop in Harness through the Narrow Gateway of Tibet ; its Peoples, Fauna and Flora.* By Capt. F. Kingdon Ward. Pp. 316 + 16 plates + 4 maps. (London : Seeley, Service and Co., Ltd., 1923.) 21*s.* net.

(2) *Into Little Thibet.* By Helen Mary Boulnois. Pp. 256 + 20 plates. (London : Simpkin, Marshall and Co., Ltd., 1923.) 7*s.* 6*d.* net.

(1) YUNNAN, the south-western province of China, is now famous in horticulture for its many decorative contributions to western gardens. The collection of the seeds was begun by Mr. George Forrest

in 1905, and Mr. Kingdon Ward, a son of the late Prof. Marshall Ward of Cambridge, joined in the work in 1911. Mr. Ward had the advantage of some years' experience as a schoolmaster in Shanghai and of the knowledge thus gained of the Chinese language and characteristics. His first journey in Yunnan was described in his well-known work, "The Land of the Blue Poppy," named after one of the most beautiful plants discovered by Mr. Forrest.

In 1913–14 Mr. Ward paid a second visit to the country, again selecting as his headquarters the town of A-tun-tze, now the most remote of the Chinese garrison stations. He made numerous excursions during the summer to mark the position of attractive plants, and returned in the autumn to collect the seeds. After the close of the seeding period, Mr. Ward, who in addition to his botanical interests is a keen geographer, resolved to use the winter in a journey into Tsa-rong, one of the most jealously closed provinces of south-eastern Tibet. It has the great attraction to the botanist of being regarded as the possible original centre of distribution of the rhododendrons, in species of which Yunnan is so rich. Mr. Ward crossed from the Mekong valley to the Salween and tried to obtain permission to enter Tsa-rong. The Tibetan officials on the frontier told him that owing to frontier disputes and fights with the Chinese it was impossible to allow him to proceed; but they promised help if he would return when the political troubles were over. Mr. Ward therefore resolved to cross from the Salween into the next main valley to the west, one of the tributaries of the Irawadi in Upper Burma. He travelled down the Salween to one of the chief passes into Burma. The winter is often recommended as the best time for travel in this region as the summer is the rainy season, and the passes are said to be freer from snow in the early winter than in the spring. Successive snow-storms, however, temporarily closed the passes, and when the weather conditions improved the porters, generally at the last moment, refused to go.

The Chinese officials objected to Mr. Ward's photography and his suspected map-making, and may have influenced the porters. After repeated attempts, Mr. Ward was obliged to abandon the enterprise and to return from the Salween to A-tun-tze by his outward route. He has given, however, a very valuable account of the geography of a little-known part of the Salween valley, with notes on its plants and rocks; and one of the earlier excursions described in the book gave him the opportunity for the closest examination yet made of the glaciers of the most famous of the snow-capped ranges known as Ka-kar-po.

The book is attractively written, for the author has powers of graphic description; he makes his readers feel his intense joy in his experiences, his appreciation of the scenery, and the sublime majesty of night in the high camps amid the pine forests overlooking the profound gorges of Chinese Tibet. His safety was doubtless due to the sympathetic interest in the people, which is shown by the many observations on the tribes visited; the most important anthropological contributions in the volume are the author's remarks on the Nung, a people of north-eastern Burma and the upper Salween. The author is not partial to the Chinese, and says that their day is done; he predicts that they will never again stride to world power, and that the whole Chinese Empire is doomed to dissolution.

A short appendix on the three rivers points out the many gaps in existing knowledge of their upper reaches and sources. Mr. Ward explains the parallel valleys by which the three rivers escape from south-eastern Tibet as due to earth movements. He considers that the Himalaya formerly extended eastward across this country into south-central China and was continued as the watershed between the lower Hwang Ho and Yangtze Kiang. He claims that the evidence of plant distribution is conclusive as to the former continuation of such a mountain line, for only thus can the distribution of the Sino-Himalayan flora be explained. He gives no general statement of his conclusions, perhaps wisely, for it is difficult to make such complex issues popularly intelligible if the argument has to be continually broken to meet possible objections, and without distressing the expert by apparent dogmatism. The author's general conclusions have been stated in contributions to the *Geographical Journal*, and to the Journal of the Edinburgh Botanical Society.

(2) At the other end of the Himalaya is a part of Kashmir known as Little Tibet. Near it passes the well-known road from Srinagar, the capital of Kashmir, to Leh, the chief town of Ladakh. Miss Boulnois traversed this route as companion to a doctor and his wife, who were members of the Moravian Mission at Leh, and their two young children. She gives a pleasant, chatty account of the journey, made partly on yak over the high passes between the valley of Kashmir and the Indus valley, at Leh. The title of the book is of doubtful accuracy, for according to general usage (*e.g. Imp. Gaz. India*, 1908, vol. vi. p. 261) Little Tibet is Baltistan, which the author did not enter. The country around Leh is, however, Tibetan in many respects, and the features described include Lamist ceremonies and beliefs, and others that would especially strike a missionary lady traveller.

Both books are illustrated by excellent photographs, and "Little Thibet" is embellished by reproduction of four water-colour sketches by the author, which are pleasing in colour and atmospheric effect. J. W. G.

Social Behaviour among Insects.

(1) *Social Life among the Insects.* By Prof. W. M. Wheeler. Pp. vii + 375. (London, Bombay and Sydney: Constable and Co., Ltd., 1923.) 16*s.* net.

(2) *The Mystery of the Hive.* By Eugène Evrard. Translated by Bernard Miall. Pp. iv + 369. (London: Methuen and Co., Ltd., 1923.) 7*s.* 6*d.* net.

(3) *Adventures among Bees.* By Herbert Mace. Pp. 144 + 16 plates. (London: Hutchinson and Co., n.d.) 4*s.* 6*d.* net.

(1) PROF. WHEELER'S book represents half-a-dozen lectures delivered at the Lowell Institute in Boston during February and March 1922, and after appearing in the *Scientific Monthly*, they are reproduced with only slight changes. The prevalent conception of social insects is mainly derived from what is known concerning the hive bee and ants. It will, therefore, perhaps come as a revelation to many to learn how widely spread social organisation is among that class of animals. Such an organisation, at least incipiently analogous to our own, has arisen *de novo*, Prof. Wheeler tells us, in some twenty-four different groups of insects comprised in five very different orders.

The book is divided into six chapters, each representing a separate lecture. Chapter i. is devoted to generalities and to a discussion of the rudiments of social behaviour met with among beetles. In the latter connexion Prof. Wheeler's remarks embody recent research that he has carried out on some remarkable Silvanids of British Guiana, which live in the hollow petioles of a tree—*Tachigalia paniculata*. Associated with these Coleoptera are numbers of a small Coccid, the honey-dew of which is eagerly solicited by the beetles and their larvæ. When the young beetles emerge they remain with their parents and soon begin egg-laying, so that a colony consists of several dozen imagines, together with their larvæ and pupæ. In nearly all social beetles the male co-operates with the female parent in victualling or protecting the young. Such societies have their inception in the specialised feeding habits of the parents which resort to material vegetable origin. In some cases this pabulum is abundant but not very nutritious; in others it is highly nutritious but scarcer. In either event, the exploitation of such food-supplies is time-consuming and has evidently led to a lengthening of the lives of the adult beetles. This, in turn, has brought about an overlapping of the juvenile by the parent generation, thus enabling the parents to acquire acquaintance with their progeny, which they provide with the same food as themselves.

Chapter ii. treats of wasps—social and solitary. Among these insects we are able to observe to advantage a phenomenon termed by Prof. Wheeler "trophallaxis"—the mutual exchange of food between adults and young. Although the workers feed the larvæ, they themselves are repaid by the saliva which the larvæ exude for their nurses' consumption. Among bees, which form the subject of chapter iii., trophallaxis does not appear to have been observed. Bees, however, are only wasps which resort to nectar and pollen instead of the more precarious animal food. Nectar and pollen represent a very concentrated and energising diet that is readily obtainable. It is perhaps, therefore, possible that the greatly pronounced anthophilous habit of bees has rendered the exploitation of larval secretions unnecessary. The storage of abundant food by these insects may also help to explain the same fact.

Ants and the numerous other insects living in association with them are the subjects of chapters iv. and v. Returning to the theme of trophallaxis, it will be noted that it here attains a slighter degree of specialisation than among wasps. Prof. Wheeler has shown that the larvæ of certain species supply their nurses with saliva, but many or all exude a fatty secretion through their integument, and some produce secretions from special papillæ or processes of the body-wall. This explains much of the behaviour which has been attributed to genuine altruistic care for the larvæ. An egoistic appetite, it would seem, constitutes the link between parent and young. Chapter vi. is devoted chiefly to termites, concerning which knowledge has advanced by leaps and bounds the last few years. It is among these insects that Prof. Wheeler finds trophallaxis most highly evolved. Holmgren has laid stress upon the exudations produced by all the castes, particularly by the queen, which, for this reason, is constantly surrounded by a host of workers. Holmgren has even maintained that these exudations are of prime importance in caste production. The death-blow to such an idea has resulted from the discovery that caste differentiation in termites is already evident at the time of eclosion of the insect from the egg.

Enough perhaps has been said to direct attention to this remarkably interesting and stimulating book: its value, it may be added, is enhanced by the particularly realistic illustrations and the very full, annotated bibliography.

(2) No one species of insect has inspired so many members of the human race, in diverse ways, as the bee. For more than forty centuries man has domesticated the insect: during this lengthy period he has cherished and reiterated dreams and fancies respecting its economy. It was not until the middle of the seventeenth century that Swammerdam began to reveal the truth. It has been recently said that the U.S. Bureau of Entomology has a working catalogue of 20,000 titles on this single insect, and yet more is written to-day

about the bee than there ever was. In the realm of literature and belles lettres Maeterlinck's "Vie des abeilles" is unquestionably given first place, and Eugène Evrard's "Mystère des abeilles" is easily second. Evrard is less of the philosopher than Maeterlinck and more of the observer. The charm of his book lies in the author's simple but attractive style of recounting what he had noted and pondered over. We welcome the appearance of this translation, which should appeal to a wide circle of readers. Probably few people are better qualified for carrying out the task than Mr. Bernard Miall.

(3) Mr. Herbert Mace's little volume is one for the bee-keeper to take up for his recreation during a winter evening. It will recall to him some of his own past experiences and trials, while he will find many interesting topics discussed. Its author is evidently a close observer of Nature, with a gift of committing to writing what he has seen and experienced in a readable manner. He is little influenced by traditional knowledge, and records what he has observed first-hand. A. D. I.

Practical Mathematics.

(1) *Practical Mathematical Analysis.* By Prof. H. von Sanden. With Notes by the Translator, Prof. H. Levy. Pp. xv+195. (London: Methuen and Co., Ltd., 1923.) 10*s.* 6*d.* net.

(2) *Arithmetic for Engineers: including Simple Algebra, Mensuration, Logarithms, Graphs, Trigonometry, and the Slide Rule; with an Appendix on Verniers and Micrometers.* By Charles B. Clapham. (Directly-Useful Technical Series.) Pp. xiii+491. (London: Chapman and Hall, Ltd., 1922.) 7*s.* 6*d.* net.

(3) *Mathematics for Engineers.* By W. N. Rose. Part 2. Second edition. (Directly-Useful Technical Series.) Pp. xiv+423. (London: Chapman and Hall, Ltd., 1923.) 13*s.* 6*d.* net.

(4) *Line Charts for Engineers.* By W. N. Rose. (Directly-Useful Technical Series.) Pp. xii+95. (London: Chapman and Hall, Ltd., 1923.) 6*s.* net.

(5) *Fundamentals of Practical Mathematics.* By G. Wentworth, D. E. Smith, and H. D. Harper. Pp. vi+202. (London: Ginn and Co., 1922.) 5*s.* 6*d.* net.

(1) THE title of Prof. von Sanden's "Practical Mathematical Analysis" is perhaps misleading, for the book is by no means a guide to practical computation or graphics. On the contrary, it is essentially theoretical in outlook and treatment, and a more correct description would have been "Theory of Practical Mathematics." Certain features render the book difficult for students; the treatment is often hurried and very incomplete; practical details and difficulties are often slurred over completely—and only a very rash or unsophisticated reader would undertake to carry out the processes described without further direction.

The value of the book is, nevertheless, very considerable, as indicating the large number of practical methods that can be employed in the application of mathematical analysis to real problems. The author passes in rather rapid review such topics as numerical and graphical calculations (including three pages on nomography!), the slide rule, calculating machines, solution of equations graphically and by Horner's method, extrapolation and interpolation by means of differences, numerical differentiation and integration, mechanical quadrature, graphical calculus, curve fitting and smoothing, harmonic analysis, least squares, Graeffe's method, iteration, and numerical and graphical integration of differential equations. This is all done in 190 ordinary-sized pages! It is thus clear that Prof. von Sanden's book is not a treatise from which to learn actual processes, but rather a compendium of processes to be learnt elsewhere.

Several sections of the book are written in really masterly fashion; *e.g.*, chap. ii. dealing with the slide rule and calculating machines. It is an unfortunate fact that a large number of our mathematical graduates leave the universities with but very vague notions of the way to use actually the mathematical processes they have acquired schematically. There is often a feeling of helplessness that actually discourages the application of mathematics to science or industry. To such men and women Prof. von Sanden's book will be of great value as an introduction to more practical treatises on the subject.

Should this book have been translated into English? There is at present a boom in translations from the German, and one may be pardoned for remarking that some of the books recently translated into English might well have been replaced by better books written by English authors. The War and relativity are responsible for this boom; but we prefer that publishers should put their energy into getting books written for English students by English writers who know the needs and the psychology of English readers. This is not said in any spirit of exclusiveness; the present writer is very conscious of the great value of making the best writings of each nation accessible to other nations; and in the present instance one can say that Prof. von Sanden's book merited translating, and that Prof. Levy deserves our gratitude for having translated it so well. One must add, however, that the printing, especially of the mathematics, is somewhat careless, and that the exercises set by the author and the translator only tend to emphasise the fact that the book does not really teach how to *do* things.

(2) The sub-title of Mr. Clapham's book may sound archaic to modern ears, but the author may be pardoned for this reversion to ancient practice. The word "Arithmetic" is so much misused that if the present book had been announced simply as "Arithmetic for Engineers," the hasty reader of publishers' catalogues might pass it over as another addition to the vast array of volumes dealing with multiplication tables and money sums. Arithmetic is one of the most precious of intellectual tools, and the academically trained are often inclined to despise it through ignorance of its value.

This is the third edition of Mr. Clapham's book, originally published in 1916. We can easily understand this popularity, for the book is well written and informative. One or two minor faults should have disappeared in a third edition. With $\pi = 3{\cdot}1415926536$ why does Mr. Clapham say in two different places that $\pi = 3{\cdot}14159268$? The definition of parallel lines, straight or *curved*, is very unsatisfactory. Further, the author wisely warns the student to choose *convenient* scales in graphs; the student should also be warned that different scales give *different shapes* to the curve defined by any one equation. One of the great disadvantages of teaching graphs before calculus is that students get into the very bad habit of using scales so as to fill nicely the sheet of squared paper, without realising that the shape thus obtained is not necessarily the theoretical shape of the curve defined by the equation. Students should be taught that graphs have *geometrical* as well as algebraical significance.

(3) Mr. Rose's "Mathematics for Engineers," Part 2, is now issued in its second edition, the first part having passed through three editions. One need not, therefore, say much about the usefulness of his treatise. Something must be said, however, about a number of serious faults, in the hope that if a third edition of the second part is called for, the author may eliminate them—among others.

The author differentiates x^n when n is a positive integer, using the binomial theorem, and then *without a single word of excuse or warning*, uses the result for n negative or fractional. The same applies to integration. Surely some engineering students are intelligent enough to deserve more honest treatment. The argument on pp. 35-6 is elaborate, and the effect is completely spoilt by the author's not noticing that the coefficient of the *first* power of h is zero. The statement that the slope curve of $y = \sin x$ has the same shape as $y = \cos x$, and vice versa, is only true for proper choice of x, y units. The author's notation for partial differentiation is a useless departure from accepted convention. The same applies to the use of j instead of i for $\sqrt{-1}$. Is it true that no definite meaning can be assigned to $\frac{1}{0}x^0$? The treatment is sometimes scamped and the proofs inadequate, as *e.g.* on pp. 282, 285. The author's use of the operator D is positively immoral; for example, pp. 288-9. The catenary is treated clumsily. The words horizontal and vertical on p. 331 are just what the good teacher should knock out of the student. The work on Fourier series is completely spoilt by the omission that in the zero integrals, m, n must both be integers and $m \neq n$, while the chapter on spherical trigonometry has little value.

The reader of Mr. Rose's book would have much to unlearn later on, which is a pity, because the book is on the whole not bad.

(4) The "Line Charts for Engineers" is better than the "Mathematics." The book is about nomography, and the title should have indicated the contents less ambiguously. Mr. Rose's object is to show how such charts can be constructed, and "the greatest possible attention is given to the details of the construction." This is all to the good, but after reading the book one has the feeling that in spite of the complexity of the mathematics, or perhaps because of this complexity, the student learns rather little about the essential principles. The introduction on functional scales is very good, but the application to even simple problems is discouraging to a reader who is anxious to learn how to use such scales himself. Mr. Rose does not do well in introducing the question of the scales in the involved manner beloved by Continental writers. To settle the best scales in a nomogram, an ounce of experiment is worth a pound of calculation. The scope of the book is limited, and the treatment rather lacks a connecting thread. The examples chosen are nevertheless very interesting and—what is important in such a book—the figures are excellent.

(5) Arithmetical processes, decimal and ordinary fractions, percentages, discount, ratio and proportion, easy mensuration in two and three dimensions, numerical trigonometry, and the slide rule, with applications to plans of houses, pulley and gear trains, electric wiring, boiler connexions, shaft-coupling and many other fascinating problems of practical interest make this book a very useful addition to the Wentworth-Smith mathematical series. Everything is well explained, and the diagrams in the form of blue prints add a reality often absent from so-called practical books.

The book is *vocational* in aim, but the authors hope that it might be useful also in some "high" schools, where many pupils would benefit from such a course more than from an academic course. We doubt whether this hope is justified. In any case logarithms should have been included. The diagrams on pp. 57 and 179 should be recommended to some of our housing authorities.

S. BRODETSKY.

Our Bookshelf.

Trattato di chimica fisica. Del Prof. Harry C. Jones. Seconda edizione italiana a cura di Prof. Michele Giua. Pp. xxiii+731. (Milano: Ulrico Hoepli, 1923.) 56 lire.

Elementi di chimica fisica. Del Prof. Arrigo Mazzucchelli. Pp. xv+504. (Roma, Torino, Napoli: Unione Tipografico-Editrice Torinese, 1923.) 50 lire nette.

Treatise on General and Industrial Organic Chemistry. By Prof. Ettore Molinari. Second English edition, translated from the third enlarged and revised Italian edition by Thomas H. Pope. Part 2. Pp. viii+457-897. (London: J. and A. Churchill, 1923.) 30*s.* net.

IT is unnecessary to do more than notice briefly the appearance of a second edition of the Italian translation of the "Physical Chemistry" of the late Prof. H. C. Jones, of a new work on physical chemistry in Italian by Prof. Mazzucchelli, and of a further instalment of the second edition of Mr. T. H. Pope's English translation of Dr. Molinari's "Treatise on General and Industrial Organic Chemistry."

Of these three issues, the first appearance of Prof. Mazzucchelli's book on physical chemistry is of most interest. This work follows a familiar course, dealing successively with such subjects as the kinetic theory of gases, the liquid and solid states, dilute solutions, equilibrium in binary liquid mixtures, in gases, and in electrolytes; it concludes with a series of chapters on thermochemistry, thermodynamics, and chemical kinetics. In general, the point of view is one that is familiar to English readers; but a suggestion made by Ciamician in 1890, which has not found its way into English text-books, is worthy of notice, namely, that the hydration of ions in aqueous solutions depends on the affinity of cations for oxygen and of anions for hydrogen. This is expressed by showing the "watery atmosphere" of the ions in symbols such as

$$\begin{matrix} & H_2 & \\ & O & \\ H_2O & K\cdot & OH_2 \\ & O & \\ & H_2 & \end{matrix} \qquad \begin{matrix} & O & \\ & H_2 & \\ OH_2 & Cl & H_2O \\ & H_2 & \\ & O & \end{matrix}$$

in which the molecules of water face in opposite directions in the cation and in the anion. This suggestion, although it was made over thirty years ago, is remarkably in accord with some modern views; and the formulæ set out above show definite points of resemblance to the symbols used by Werner in assigning formulæ to the complex hydrated ions of acids and bases, as, for example, when he writes caustic potash as $\left[\begin{matrix} K\cdot \\ H. \end{matrix} O.H\right] OH$, with potassium linked to oxygen, and hydrochloric acid as $(ClH\,.\,OH)+\overset{+}{H}$, with chlorine still linked to hydrogen in the hydrated ion.

The book is excellently printed on good paper and in large type, smaller print being used only for the bibliographies which are placed at the end of some of the chapters. It certainly does credit to Italian chemistry.

The Fauna of British India, including Ceylon and Burma. (Published under the authority of the Secretary of State for India in Council.) *Oligochæta.* By Dr. J. Stephenson. Pp. xxiv+518. (London: Taylor and Francis, 1923.) 30*s.*

UNTIL very recently, so little has been ascertained about the Oligochæta of India—and indeed about the Oligochæta generally—that Dr. Stephenson has been able to quote only 106 memoirs in his complete bibliography of this region of the East. The first of these appeared in the year 1844, but the greatly preponderant mass of the work has been completed in the last fifteen years, during which Dr. Stephenson's own contributions to the subject were published. We are now acquainted—and really very well acquainted—with no less than 338 species exclusive of certain "varieties" which some persons might raise to the rank of species; and of these, no less than 123 received their names and adequate description at the hands of Dr. Stephenson. It is thus clear that no better person than Dr. Stephenson could have been selected by Sir Arthur Shipley to carry out efficiently this valuable contribution to the "Fauna of British India."

The present volume, which is of about the average size of others of the series, contains 518 pp., of which by far the greater part is devoted to a full statement of the specific characters of the species found within the area, with such notes as are deemed necessary upon allied forms from other regions of the earth's surface. In addition to this, however, are to be found some by no means negligible observations upon the distribution of Indian earthworms and their aquatic allies, and upon various facts concerned with habitat and seasonal variation. With reference to habitat, it is interesting to note that a large number of obvious "earthworms," *i.e.* forms with no likeness to the slender and delicate aquatic Microdrili such as the Naids, are usually or constantly inhabitants of water or very wet soil. This state of affairs is also, we may remark, not unknown in other tropical regions. Thus, of the Oligochæta of equatorial Africa, which are in the same way definitely "earthworms" as opposed to "water worms," some reside, as it would appear, habitually in marshy places. It is further to be noted that in the latter (of the family Eudrilidæ), as well as in some members of the former, the dorsal pores are absent—a character which is one of the most marked of the purely aquatic worms such as Naids already referred to.

We congratulate the editor of the series as well as the author of this volume in having determined its very satisfactory scope and composition. F. E. B.

Race Problems in the New Africa: a Study of the Relation of Bantu and Britons in those parts of Bantu Africa which are under British Control. By the Rev. Prof. W. C. Willoughby. Pp. 296. (Oxford: Clarendon Press; London: Oxford University Press, 1923.) 15*s.* net.

THE Rev. W. C. Willoughby, a professor in the Kennedy School of Missions in Connecticut, was formerly principal of a mission institution in South Africa, where he had opportunities of studying some Bantu who had long been under European influence. His account of Bantu thought is written with the bias of the missionary,

and his point of view is indicated by his remark that the native women are better than the men. He widens his treatment by an account of work in other parts of Africa which is, however, largely an untrustworthy second-hand compilation. The author's views as to the future of the races in Africa are reminiscent of those of the early South African political missionaries, as shown by the stress he lays on the influence, which he regards as deplorable, of the "low whites," and his explanation of what are described as the poor effects of mission work as due to the Europeanisation of the natives. The colour difference he does not regard as a serious bar; he describes it as a "mere conceit," and according to him, it is an effect of sunlight and humidity and is easily varied. The physical differences between the African and the white races he says are no barrier to comradeship, and the importance attached to colour is only as a symbol of the differences in social standards. The most valuable contribution in the book is its brief account of the Ethiopian movement in South Africa.

Essai de philosophie chimique. Par Prof. Maurice Delacre. Pp. 170. (Paris: Libr. Payot, 1923.) 7.50 francs.

PROF. DELACRE of Ghent is in revolt against modern theories. In a "Profession of Faith" which forms the first section of his introduction, he asserts that "Every principle, every *a priori* conception, every theory, every system, however brilliant it may be, however fertile it may appear, is only an illusion." He questions even the *usefulness* of theories, on the ground that they have in the past often provided obstructions to the progress of new ideas, and quotes with approval the view that, if one makes use of theories, one should do so, in the words of St. Claire Deville, "without believing them." He appears to have reached this almost morbid point of view as a result of having devoted much time to the study of the pinacone-pinacoline transformation, one of the curious changes which (like the Walden inversion) have never yet found a clear interpretation on the basis of conventional views of atomic linking and molecular structure; but, whereas the average chemist (fortunately) is stimulated by such anomalies, and is always hopeful of finding some clue to the mystery which they conceal, Prof. Delacre prefers to "throw up the sponge" and to denounce all theories as useless frauds. Sir Joseph Thomson has recently stated that "A theory is a tool and not a creed"; this is at least a more cheerful and practical view than the exercise in which Prof. Delacre indulges of finding fault with tools in general, and especially with those of his own trade. They may not be perfect, but they are certainly not useless.

Wireless for the Amateur. By J. Roussel. Authorised Translation. Pp. xiii+270. (London, Bombay and Sydney: Constable and Co., Ltd., 1923.) 14*s.* net.

THIS book has been written specially for the scientific amateur. It combines a reasonable amount of theory with definite constructional details. Practically all the apparatus mentioned has been constructed by the author himself, and so the reader can have confidence that similar apparatus will function efficiently. The author deals only with "resistance-coupled" high frequency amplifiers. As this method of coupling valves is unsuitable for use on short waves, such as those used in Great Britain, the translator has added a chapter on amplifiers suitable for the reception of any wave-length down to about 150 metres. A further chapter is added describing methods of transmission for C.W. (continuous wave) systems on the wave-lengths allowed to English amateurs.

The author begins by describing a simple receiver. He then gradually increases the apparatus so as first to obtain better tuning, then to amplify the signals received, and finally to record them automatically. A chapter is added describing how to make the calculations required by the radio expert and how to make the rough measurements required in practice. The translation has been well done and the book will be useful.

General Chemistry: an Elementary Survey, emphasising Industrial Applications of Fundamental Principles. By Prof. H. G. Deming. Pp. xii+605. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1923.) 17*s.* 6*d.* net.

THIS is a modern American text-book of the best type. The treatment is fresh and attractive, and innumerable examples of practical applications are scattered through the text, in fact an apology for the inclusion of nearly every section is first given on utilitarian grounds. The author hopes that "the book may be appreciated for the things it has left unsaid." Omission of important matter has left space for things not found in similar text-books, but this has sometimes been carried to such lengths that many statements are so condensed as to be virtually useless. Tabular summaries are a useful feature, but the exercises are often trivial, as is usual in American text-books. The author exhibits a fervid patriotism which, although gratifying to American readers, naturally brings with it the penalty of diminishing the value of the book in wider circles. English readers will find the book stimulating and most useful in supplementing the usual text-books, but unless they take a wider view than the author's, they will receive a false impression of the importance of European chemistry. In many cases the descriptions of illustrations do not refer to those actually given.

Géométrie descriptive. Par Gaspard Monge. Augmentée d'une théorie des ombres et de la perspective, extraite des papiers de l'auteur par Barnabé Brisson. (Les Maîtres de la Pensée scientifique.) Vol. 1. Pp. xvi+144. Vol. 2. Pp. 138. (Paris: Gauthier-Villars et Cie, 1922.) 2 vols., 6 francs.

ALL mathematicians and others interested in the history of science will welcome this mathematical classic, both from the point of view of the personal interest in Monge himself, and also because of the occasion on which this book was originally written. The primary object of the book was purely utilitarian, namely, to make French industry independent of foreign enterprise, by "directing national education towards the knowledge of matters requiring exactness," and giving French artificers a greater command over materials and machines. Monge's object was to give a new aspect to French education, but he enriched mathematics with one of its classics.

Letters to the Editor.

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

The Bombardment of Elements by α-Particles.

In previous papers we have shown that hydrogen nuclei are ejected from the elements boron, nitrogen, fluorine, sodium, aluminium, and phosphorus by bombardment with α-particles. In these experiments the material subjected to the bombardment was placed immediately in front of the source of α-particles and observations of the ejected particles were made on a zinc sulphide screen placed in a direct line a few centimetres away. The ranges of the H particles were in all the above cases greater than the range (30 cm. in air) of free H nuclei set in motion by α-particles, so that, by inserting absorbing screens of 30 cm. air equivalent in front of the zinc sulphide screen, the results were made independent of the presence of hydrogen as an impurity in the bombarded material.

Some of the other light elements were examined at absorptions less than this, but in general the number of particles due to hydrogen contamination of the materials was so large that no confidence could be placed in the results. The difficulty of making trustworthy observations under these conditions is illustrated by the case of chlorine, where we were unable to observe the liberation of H particles although our present experiments show that such particles must have been present.

A further complication arises at absorptions less than 13 cm. of air. Bates and Rogers (NATURE, September 22, 1923, and Proc. Roy. Soc., A, 105, 1924) have recently shown that radium C emits, in addition to the α-particles of 7 cm. range, also particles of ranges 9·3, 11·2, and 13·3 cm., and the number of these particles is large compared with the disintegration effect we usually observe.

The difficulties of observation by the above direct method are also shown by the experiments of Kirsch and Pettersson (NATURE, September 15 and November 10, 1923, *Phil. Mag.*, March, 1924), who took special precautions to avoid hydrogen contamination both in the source and in the bombarded materials.

To overcome these difficulties we have devised a simple method by which we can observe with certainty the disintegration of an element when the ejected particles have a range of only 7 cm. in air. This method is based on the assumption that the particles of disintegration are emitted in all directions relative to the incident α-rays. A powerful beam of α-rays falls on the material to be examined and the liberated particles are observed at an average angle of 90° to the direction of the incident α-particles. By means of screens it is arranged that no α-particles can fall directly on the zinc sulphide screen.

This method has many advantages. We can now detect particles of range more than 7 cm. with the same certainty as particles of range above 30 cm. in our previous experiments, for the presence of hydrogen in the bombarded material has no effect. This can be shown at once by bombarding a screen of paraffin wax, when no particles are observed on the zinc sulphide screen. On account of the very great reduction in number of H nuclei or α-particles by scattering through 90°, the results are quite independent of H nuclei from the source or of the long-range particles found by Bates and Rogers. The latter are just detectable under our experimental conditions when a heavy element like gold is used as scattering material, but are inappreciable for the lighter elements.

A slight modification of the arrangement enables us to examine gases as well as solids.

Working in this way we have found that in addition to the elements boron, nitrogen, fluorine, sodium, aluminium, and phosphorus, which give H particles of maximum range in the forward direction between 40 and 90 cm., the following give particles of range above 7 cm.: neon, magnesium, silicon, sulphur, chlorine, argon, and potassium. The numbers of the particles emitted from these elements are small compared with the number from aluminium under the same conditions, varying between 1/3 and 1/20. The ranges of the particles have not been determined with accuracy. Neon appears to give the shortest range, about 16 cm. under our conditions, the ranges of the others lying between 18 cm. and 30 cm. By the kindness of Dr. Rosenhain we were able to make experiments with a sheet of metallic beryllium. This gave a small effect, about 1/30 of that of aluminium, but we are not yet certain that it may not be due to the presence of a small quantity of fluorine as impurity. The other light elements, hydrogen, helium, lithium, carbon, and oxygen, give no detectable effect beyond 7 cm. It is of interest to note that while carbon and oxygen give no effect, sulphur, also probably a "pure" element of mass $4n$, gives an effect of nearly 1/3 that of aluminium. This shows clearly that the sulphur nucleus is not built up solely of helium nuclei, a conclusion also suggested by its atomic weight of 32·07.

We have made a preliminary examination of the elements from calcium to iron, but with no definite results, owing to the difficulty of obtaining these elements free from any of the "active" elements, in particular nitrogen. For example, while a piece of electrolytic iron gave no particles beyond 7 cm., a piece of Swedish iron gave a distinct effect which was undoubtedly due to the presence of nitrogen, for after prolonged heating *in vacuo* the greater part disappeared. Similar results were experienced with the other elements in this region.

We have observed no effects from the following elements: nickel, copper, zinc, selenium, krypton, molybdenum, palladium, silver, tin, xenon, gold, and uranium. The krypton and xenon were kindly lent to us by Dr. Aston.

We hope later to make a systematic examination of the elements with an improved counting microscope in order to settle definitely whether any evidence of disintegration can be obtained. In the case of the lighter elements it should be possible to carry the examination for particles of disintegration down to an absorption of about 3 cm.

E. RUTHERFORD.
J. CHADWICK.

Cavendish Laboratory,
Cambridge.

The Gorilla's Foot.

In NATURE of January 5, I showed conclusively that the figure of the gorilla's foot published by the well-known taxidermist, Mr. Carl Akeley, in the *World's Work*, October 1922, is (as I had stated in my book, "Great and Small Things") entirely erroneous. The figure was a reproduction of a photograph of a cast deceptively illuminated and made to present a false resemblance to the foot of man. It was adduced by Mr. Akeley as evidence in support of his erroneous statements as to the existence of a closer resemblance between the gorilla and man than has been recognised, hitherto, by men of science.

At the same time I demonstrated by means of

new photographs (Figs. 4, 5, and 6, NATURE, January 5) that the statement proffered by Dr. W. K. Gregory, of the New York Museum, in NATURE of November 24, 1923, to the effect that Mr. Akeley's photograph gives "a very fair representation" of his cast of the gorilla's foot, is contrary to fact. Dr. Gregory's erroneous statement was due to singularly inaccurate observation, on his part, of the cast and of the photograph compared.

Mr. Akeley himself has wisely abstained from publishing any attempt to defend or excuse his fantastic photograph of the gorilla's foot.

Under these circumstances, Dr. W. K. Gregory might have retreated from a somewhat ignominious position with a frank admission of his error and an apology for his intrusion. It appears, however, from his letter in NATURE of March 22, that he is unabashed by his discomfiture, and seeks to divert attention from it by raising a discussion as to a number of subsidiary points concerning the foot of Primates. That discussion is irrelevant. The question here under consideration has been, "Is the figure published by Mr. Carl Akeley in the *World's Work* a trustworthy document?" That question is finally answered in the negative—by the evidence of other photographs of the cast, published by me in NATURE of January 5.

As I stated when I first wrote of Mr. Carl Akeley's misrepresentation of the gorilla's foot, I was anxious to direct the attention of the authorities of the American Museum of Natural History, New York, to the danger which threatened their proposed Roosevelt Hall of African zoology, were the imaginative efforts of their taxidermist accepted for exhibition without careful scientific control. The attention desired has now been secured. What the result may be remains to be seen. E. RAY LANKESTER.

44 Oakley Street, Chelsea, London, S.W.3.

SINCE Dr. W. K. Gregory now confesses that he was wrong in describing Mr. Akeley's photograph as "a very fair representation of the cast" of the gorilla's foot, and admits that the photograph is misleading, there is no need to discuss the matter further. He clearly fell into error through not detecting the failure of the photograph to show the hallucal crease. But when he chides me for not awaiting the arrival of the duplicate cast before writing to NATURE, I must reply that there was no reason for me to do so. The main defect of the photograph, which imparted its false likeness to the foot of man, was perfectly obvious from the first to any one acquainted with the appearance of the sole of the foot of the gorilla.

R. I. POCOCK.

The Transmission of Human Malaria.

I SHOULD be grateful if you could allow me space to make a brief rejoinder to Sir Ronald Ross's reply to my letter published in these columns on March 1.

Sir Ronald Ross says (NATURE, March 8) that he has given full references to all the pertinent literature in his "Memoirs"; but I may remark that from these references there are some omissions which are by no means trivial. For example, in No. 40 of his references he cites the note by Bastianelli, Bignami, and Grassi, published in the *Atti della R. Accademia dei Lincei*, 1898 (meeting of December 4). Although he quotes this note at length in his "Memoirs," both in the original Italian and in English translation, he unfortunately omits to quote the appendix to it, in which the *fundamental fact* was recorded that we had already at that time obtained a double tertian infection in a healthy person by subjecting him to the bites of *Anopheles claviger* alone (see my "Documenti," p. 51).

Furthermore, Ross has omitted to include among his references the memoir entitled "Ciclo evolutivo delle semilune nell' *Anopheles claviger* ed altri studî sulla malaria dall' ottobre 1898 al maggio 1899," by Grassi, Bignami, and Bastianelli—published, with two plates (III and IV), in the *Atti della Società per gli Studî della Malaria* in June, 1899. Yet it is only by ignoring this memoir that Ross is able to assert that we supplied "no details and no proofs" in support of our statements ("Memoirs," p. 529).

Since Ross has thought fit to cite authoritative opinions in his favour, I may perhaps remark that I also, on my side, could quote some favourable opinions which are no less authoritative: Bizzozero, Cuboni, Foà, Pittaluga, Fabbri, Golgi (who proposed me for the Nobel Prize), the University of Leipzig (which conferred the honorary degree of Doctor upon me, proclaiming that I deserved *laudem æternam* for my work), etc. But I do not believe that this is the way to settle the controversy.

For anyone to reach a satisfactory conclusion in this matter it is, in my opinion, necessary that he should first master all the relevant facts—completely and exactly, to the last detail. This, it seems to me, has been done by Dr. Fritz Eckstein, in whose recent article,[1] which I consider decisive, I find little that requires modification. This is a work of 40 pages, by a specialist in the study of mosquitoes. After severely examining Ross's "Memoirs," he concludes with the following words (which are in German in the original): "To Grassi therefore—rather than to Ross, the discoverer of the life-cycle of Proteosoma—belongs the chief credit, in the investigation of human malaria, for determining the transmitter and for investigating, in conjunction with Bignami and Bastianelli, the development of Plasmodium in Anopheles, which Grassi was the first to designate as the sole transmitter." BATTISTA GRASSI,

Senatore del Regno.

Rome, March 12.

Cosmic Clouds of Calcium and Sodium.

THE most probable explanation I know of the existence of cosmic clouds of calcium and sodium, which reveal themselves in the stationary lines H and K in the spectrum of many helium stars, was proposed by Prof. Saha in NATURE of June 16, 1921, p. 488, on the ground of his theory of thermal ionisation. Ionised vapours of calcium, the resonance lines of which appear as H and K, are repelled by the radiation pressure of B-type stars, the radiation of which is particularly great in the region of those lines; in this way at a sufficient distance from the star there is an equilibrium between gravitation and selective radiation pressure, the conditions being specially favourable for Ca +, which forms extensive layers near the star.

This explanation, comparing the cosmic clouds of calcium with the abundant layers of this heavy material in the superior chromosphere, however, seemed less plausible after the discovery that in the spectra of helium stars there are not only the stationary lines H and K, but also the well-known D lines of sodium. The latter belong to neutral Na; they form its resonance lines and are found only in the spectrum of the inferior chromosphere and appear with increased intensity in the spectrum of sun-spots. The presence of the resonance lines of neutral Na, an element with a low ionisation potential, near the Ca + appears incomprehensible from the point of view of the quantum theory, and in contradiction to

[1] "Zur Entdeckungsgeschichte der Malaria: eine historisch-entomologische Studie," *Zoologischer Anzeiger*, vol. 58, 1924.

Saha's theory. An additional analysis is necessary for the explanation of this contradiction.

It is easy to show that the atoms of Ca + in the atmospheres of helium stars cannot be in equilibrium. In the neutral zone, where those atoms can be in equilibrium, from the mechanical point of view, there will be a continuous process of recombination of Ca + into Ca by the capture of free electrons. This process will be considerably facilitated by the presence of cosmic dust in the superior layers of the atmospheres, for it is well known that helium stars are the nuclei of nebulosities with continuous spectra. The neutral atoms of calcium thus formed will be no longer in equilibrium under the action of selective radiation pressure and of gravitation. The resonance line of neutral Ca ($1S - 2p_2$), excited by sufficiently low resonance potential (1·9 volts), has the wave-length $\lambda = 6574{\cdot}6$ Å.U., *i.e.* considerably farther from the maximum of intensity in the spectrum of helium stars than the lines H and K of Ca +. The resulting neutral atom must receive an impulse in the direction towards the star. We can suppose that the process is continuous, *i.e.* that the neutral atoms descending to the star will be replaced by atoms of Ca + directed from the star. Consequently, we should expect that the difference of observed velocities of the stationary lines H and K and γ (γ is the velocity of the centre of gravity of the system), according to the ascending character of the current, will be negative. The observations seem to confirm this supposition. Among 11 spectroscopic binaries with stationary or nearly stationary H and K, there was not found a single one having $(V_{H,K} - \gamma) > 0$; for all of them it was a negative quantity (between $-4{\cdot}1$ and -45 km./sec.). It would be interesting to investigate if there is also a stationary resonance line of neutral Ca in the spectra of stars with stationary H and K. Such a line would indicate a velocity greater than γ; nevertheless, having reached perhaps a comparatively high level and not having obtained yet a sufficient velocity, the atom may undergo anew an ionisation. A process analogous to that supposed, but far smaller, must exist also in the chromosphere.

All that is said above is, of course, valid for sodium vapours also. Undoubtedly in the atmospheres of helium stars there can exist only Na + (perhaps also Na + +). Supposing the temperature of stars of B2 type, according to Prof. Saha, to be 17,000° Abs., we find, by Wien's law, that $\lambda_{max.} = 0{\cdot}17\mu$. According to the researches of Nelthorpe and others (*Astrophys. Jour.* 41), we can affirm that a sufficiently sharp line of Na + (resonance line) lies in a remote part of the ultra-violet spectrum, scarcely accessible to the quartz-spectrographs; its precise wave-length seems to be unknown. Consequently the influence of the selective radiation pressure on the Na + atoms will be specially great and they will rush to a certain zone of equilibrium (different from that of Ca +, according to the difference in the atomic weights). The stationary lines of Na + will not be noticed by us, however, because of the extremely short wave-length. But after the recombination they will suddenly be noticed, because the resonance lines of neutral Na, D_1 and D_2, are excited by very low resonance potentials. Consequently we shall observe a stationary spectrum H, K and D, paradoxical from the point of view of the ionisation theory of stellar atmospheres. It would be very interesting to investigate the difference of radial velocities of those lines—it should be properly $(V_{Ca+} - V_{Na}) < 0$; but because of the possibility of rapid ionisation of falling atoms of sodium at a sufficiently high level, this difference of velocities may be hidden from us.

B. GERASIMOVIČ.
Astronomical Observatory,
Kharkow, Russia.

Isotopes of Mercury and Bismuth revealed in the Satellites of their Spectral Lines.

WITH the object of obtaining some insight into atomic structure, we have been occupied for several years with the accurate measurements of the position of the satellites of mercury and bismuth lines. Recent experiments on the ultra-violet lines show that the satellites are to be traced to the isotopes.

A highly evacuated mercury lamp, provided with quartz windows, was cooled in a freezing mixture, and the lines analysed by means of crossed Lummer-Gehrcke plates of quartz, which were singularly free from ghosts. The resolution of the component lines being tolerably high in the ultra-violet spectrum, the structure of many lines hitherto unexplored was minutely examined. The bismuth lines were excited by cathode ray bombardment. We give the following values of $\delta\lambda$ as types of measurement, starting from the principal line (P).

Hg 2536.		Bi 4722.	
$\delta\lambda$ (*mÅ*).	Intensity.	$\delta\lambda$ (*mÅ*).	Intensity.
k +173·7	1·5		
j 160·2	1		
i 150·7	0·5		
h 145·5	?		
g 137·6	0·5		
f 131·4	?	f +317	7
e 48·1	5	e 284	7
d 43·4	10	d 243	8
c 32·5	8	c 179	1
b 21·4	10	b 102	6
a + 10·8	8	a + 57	8
P 0	10	P 0	10
a′ − 4·9	6	a′ − 32	1
b′ 14·7	8	b′ 72	1
c′ 17·2	1	c′ 124	0·5
d′ 26·0	0·3	d′ 165	0·5
e′ 103·6	1	e′ 218	3
f′ 114·8	0·5	f′ 279	1
g′ 125·6	0·5	g′ −328	1
h′ 136·3	0·2		
i′ 146·9	3		
j′ 152·8	1		
k′ −159·9	?		

The structure of both lines is apparently complex, but the following consideration simplifies the analysis. Both mercury and bismuth are near the radioactive elements, so that the nuclei are probably approaching a meta-stable state. The K-radiation shows a small anomaly on passing from gold to mercury and from lead to bismuth; and the remarkable resemblance of non-series lines in gold and mercury indicates that, in spite of the unit difference in the atomic number, the nuclei may have something in common. The simple assumption is that a H-proton is slightly detached from the central nucleus, and quasi-elastically connected with it, so that when excited by electromagnetic waves they make coupled vibrations. The wave-length of such nuclear vibrations cannot be directly calculated, but the difference in wave-lengths arising from different isotopes can be easily calculated, as was done by Kratzer on the spectrum of hydrogen chloride. Denoting the masses of central nuclei by m_i and m_j,

$$\delta\lambda = \frac{\lambda}{2}\left(\frac{1}{m_i} - \frac{1}{m_j}\right),$$

when they are coupled with a H-proton, supposing that the quasi-elastic connexion remains the same, as it must be of electromagnetic nature. On the present assumption, $m = A - 1$, where A denotes the atomic weight. The only difference from hydrogen chloride is that the detached H-proton and the central nuclei are enclosed by an electron cloud. We consider the stimulus to coupled vibrations to be given by electrons according to Bohr's scheme, the period being given by quantum relation.

For mercury, we know from determinations by Aston that $A_i = 197, 198, 199, 200, 202, 204$; and for

bismuth, we assume that the isotopes are 207, 208, 209, 210, 212, 214, similar to mercury. The groups formed by combining them and the corresponding δλ's are given below for Hg 2536 and Bi 4722.

Hg 2536.

Group.	A_i, A_j.	δλ (calc.) mÅ.	δλ (obs.) mÅ.	Lines.	Mean.	Difference obs.-calc.
(1)	197, 198	32·86	32·7	e′—h′		−0·16
	198, 199	32·52	32·5	c —P	32·55	+0·03
	199, 200	32·20	32·6	d —a′		−0·1
			32·1	f′—i′		
(2)	197, 199	65·35	65·3	e —c′		−0·05
	198, 200	64·70				
	200, 202	63·50				
	202, 204	62·20	62·8	e —b′		+0·6
(3)	197, 200	97·60	97·6	c′—f′	97·5	−0·1
	199, 202	95·60	97·4	h —e		
(4)	198, 202	128·2	129·3	i —b	129·1	+0·9
			127·7	j —c		
			129·7	k —d		
			129·7	c′—i′		
			125·6	k —e	125·6	+0·1
			126·8	g —a		
			124·1	h —b		
	200, 204	125·5	126·8	d′—j′		
			125·6	a —f′		
			125·6	P —g′		
			125·0	b —e′		
(5)	197, 202	161·0	160·2	h —b′	161·4	+0·4
			162·7	h —c′		
			159·9	P —k′		
			162·9	e —f′		
	199, 204	157·8	157·7	b —h′	157·8	0
			158·1	c —g′		
			157·4	f —d′		
			158·2	d —f′		
			157·7	a —i′		
(6)	198, 204	190·3	190·3	d —i′	190·6	+0·3
			190·9	k —c′		
(7)	197, 204	223·2	..	Not found		

Bi 4722.

Group.	A_i, A_j.	δλ (calc.) mÅ.	δλ (obs.) mÅ.	Lines.	Mean.	Difference obs.-calc.
(1)	207, 208	55·4	57	a —P		+1·6
	208, 209	54·9				
	209, 210	54·3	53	d′—e′	52·5	−2·2
			52	b′—c′		
(2)	207, 209	110·0	110	e′—g′		0
	208, 210	109·1				
	210, 212	107·1				
	212, 214	105·0	105	e —c		0
(3)	207, 210	164·5	165	P —d′	164	−0·5
	209, 212	161·3	163	d′—g′		
(4)	208, 212	216·2	215	f —b	216·5	+0·3
	210, 214	212·1	218	P —e′		−1·1
			211	c —a′		
(5)	207, 212	271·5				
	209, 214	266·6	260	f —a	263·5	−3·1
			267	b —d′		
(6)	208, 214	321·5	320	b —e′	317	−4·5
			317	f —P		
			315	d— b′		
			316	e —a′		
(7)	207, 214	376·7	385	a —g′	385	+8·3
			381	b —f′		
			389	f —b′		

The foregoing table shows that (7) is absent from Hg 2536, but all the groups (1) to (7) are found in λλ 2753, 2893, 3341, and 4359. The following table gives the number of satellites observed, and the groups which can be obtained by their combinations.

Hg. λ.	Observed No. of Satellites.	Groups.	Bi. λ.	Observed No. of Satellites.	Groups.
2536	22	(1) to (6).	2781	4	(1), (2).
2652	7	(1), (2).	2809	4	(1), (2), (3).
2753	13	(1) to (7).	2898	5	(1), (2), (3).
2893	13	(1) to (7).	2938	6	(1), (2), (3).
2967	7	(1), (5), (6).	2989	4	(1), (2).
3126	14	(1) to (5).	2993	5	(1), (2).
3131·66	8	(1) to (2).	3068	6	(1) to (4).
3341	16	(1) to (7).	3077	3	(1), (2).
3650	9	(1), (2), (3).	3397	7	(3), (4), (5).
3655	10	(1), (2), (3).	3511	5	(1), (5) to (7).
4047	8	(1), (2), (3).	3596	5	(1) to (4).
4359	17	(1) to (7).	4122	3	(7).
5461	11	(1) to (4).	4308	5	(2), (5), (7).
4078	5	(1), (2), (3).	4722	13	(1) to (7).
5790	5	(1) to (5).			

These will be sufficient to show that the satellites in mercury and bismuth lines are due to different isotopes. The only exception to the above rule is found in three satellites of Hg 5769.

It may be objected that the energy quantum $h\nu$ given out by the principal line is insufficient to excite waves shorter than ν, but the experiment by Cario and Franck shows that the satellites, the wave-length of which is shorter than the principal, can be emitted by taking in the deficient energy from that of the moving atom.

Calculations were made on uranium isotopes, to see if we could not detect an α-particle detached from the central nucleus; the answer was not decisive on account of the multitude of lines. It is probable that there are many wandering α-particles, as judged from different values of δλ's among lines covering the whole spectrum, numbering more than 5000.

It should be pointed out that, if the above assumption as to the mercury nucleus is valid, we can perhaps realise the dream of alchemists, by striking out a H-proton from the nucleus by α-rays, or by some other powerful methods of disruption.

H. NAGAOKA.
Y. SUGIURA.
T. MISHIMA.
Institute of Physical and Chemical Research,
Komagome, Hongo, Tokyo,
January 29.

Problems of River Pollution.

THE letter of Dr. Orton and Prof. Lewis in NATURE of February 16, p. 236, on the necessary development of means for the study and recording of river pollution, opens anew a subject of great economic and biological interest. The letter dealt chiefly with this subject from the point of view of marine workers, but its authors would not be likely to lose sight of the great importance of the study of river pollution to the problems both of freshwater fisheries and of limnology in general. In a country such as Great Britain, which is very dependent upon ocean-borne food supplies, it might be anticipated that every effort would be made to develop the freshwater fisheries. It is well known that little has been done in this connexion in spite of the enormous areas of fresh water we possess. Indeed, little or no effort is made, even to preserve these fresh waters from pollution.

Dr. Orton and Prof. Lewis rightly point out that much might be learnt from observations on unpolluted waters. The problems of river pollution and lake pollution are closely allied, and much valuable information as to the biology of the less polluted British lake areas is in existence. This would give a general foundation on which to start, at least so far as north-west Britain is concerned. River pollution from manufacturing and other sources has been studied intermittently in the north of England, and is still under examination by the staff

of the West Riding Rivers Board. Various observations on the organisms of clean and polluted waters are being carried out by members of the Yorkshire Naturalists' Union, and an exhibit embodying some of the earlier results of these two lines of attack was shown during the British Association meeting at Hull in 1922. Something, therefore, has been done, largely by private enterprise, and further co-operation would doubtless result in much more being effected.

Emphasis is laid on the fact that pollution and recovery from pollution are likely to take place undetected in fresh water. This may be the case in estuaries or in rapid streams, but in lakes and even in slow streams, recovery from many types of pollution seems to be very slow. Particularly in lakes, the danger of the early stages of pollution appears to lie in the fact that they are relatively irreversible. In several of the English lakes, mining operations have been particularly harmful, even though nothing more has happened except the washing of ore detritus into the lakes. This produces no immediate effect, but the silts gradually blanket the shores and destroy the natural feeding grounds of trout. The deposited silt fosters a luxuriant vegetation, and the biological character of the lake is completely changed. The flora and fauna is actually more luxuriant, but the net result in terms of fish, is to replace trout (and char) by perch and pike. Once such a change has taken place, the experience of the Windermere conservators seems to suggest that, in large sheets of water, very great difficulty will be experienced in restoring the original preponderance of trout, and a permanent deterioration in the value of the fisheries thus results. Somewhat similar results are produced by the discharge of sewage effluents into lakes. These types of contamination tend to be overlooked because the harmful effects produced are very gradual and rarely catastrophic. The effects are, however, very persistent and of great importance.

The position of freshwater biology in Great Britain is curious and depressing. Much has, at different times, been accomplished through private generosity and enthusiasm. At present, we stand almost alone among the nations in possessing no laboratory facilities for carrying on the work. The studies carried on at the marine laboratories show what might be attempted if means were available, and it is to be hoped that the whole question will receive further ventilation.

W. H. PEARSALL.
The University, Leeds.

MAY I add my voice to those of Dr. Orton and Prof. Lewis as expressed in their letter on this subject in NATURE of February 16, and more especially as regards those rivers and streams which are utilised as water-supplies?

For the last eighteen months I have carried out systematic quantitative examinations of the plankton of a small stream and the two reservoirs which it supplies, and one of the outstanding facts shown by this investigation is the danger of basing any opinion, as is sometimes done, upon the examination of a single sample of a water.

It is found that there are enormous variations from week to week in the number and genera of organisms present, and furthermore there must always be considerable doubt as to whether the sample examined is representative. Two samples taken within a few feet of each other may show very material differences.

These two factors alone appear to me sufficient to justify the plea for *continuous* work, as it is only by the consideration of a continuous record that it can be determined whether the result of any given examination is representative of the usual conditions prevailing in the stream.

Apart from the more general question of pollution, such a record as regards their own waters is of considerable value to water undertakings, as it enables them to anticipate biological troubles, and these undertakings might, with very good reason, be appealed to for financial support. I would go even further and say that, in the case of undertakings dealing with surface waters, the compilation of such records, if undertaken as part of the routine of administration, would prove of very material advantage to themselves.

If the method of examination were standardised and the results recorded together as suggested by Messrs. Orton and Lewis, a very valuable body of evidence would be available for dealing with the question of general pollution, and the biological expert, when called in, would have some trustworthy data to go upon.

P. A. AUBIN.
10 Elizabeth Place,
Jersey.

The Geological and Cultural Age of the Harrisonian Eoliths.

MOST archæologists are familiar with the pieces of tabular flint—exhibiting rough flaking along one or other of their edges—which the late Benjamin Harrison found, many years ago, in and upon the highest portions of the plateau of Kent. With regard to the geological age of these specimens, though there is very good reason to suppose that the eoliths of the Kent plateau—as is the case with others found in similar situations in different parts of the country—are of a great antiquity, it is nevertheless clear that, having not yet been discovered, at these places, under any geologically datable deposit, the exact measure of that antiquity remains unknown. It is fortunate, therefore, that examples of eoliths of Harrisonian type occur in the detritus-bed beneath the Red Crag of Suffolk. These specimens exhibit, generally, much abrasion, thus differentiating them from the other, and later, sub-Crag implements with which they are associated, and indicating that they had had a long history before their arrival in the detritus-bed. It is possible, therefore, to decide that some of the implements of Harrisonian type are not younger than the Red Crag, but, at present, we do not know by how long they pre-date this deposit. It would, however, seem reasonable to suppose that these specimens must be referred to, *at least*, an early phase of the Pliocene period.

In considering the cultural age of the eoliths it is necessary to bear in mind the fact of their extremely primitive character, and that they are, without much question, the ancestral forms from which the normal sub-Crag implements were derived. When this is realised it becomes difficult to escape the conclusion that the Harrisonian specimens represent the earliest efforts of man to shape flints intentionally, and that they are separated by a great gulf of time from the earliest of the Chellean-palæolithic-hand-axes. This view is, however, contested by the Rev. H. G. O. Kendall (NATURE, March 8, 1924, p. 362), by reason of his discovery, at various places, of implements of eolithic form, exhibiting a similar "patination," and condition to, and associated with definite palæoliths of river-drift type.

Mr. Kendall argues, and I think rightly, that many of these eoliths are merely the rougher specimens made *pari passu* with the Chellean and Acheulean implements, but this only proves that such eolithic forms survived far into post-eolithic times, and cannot invalidate the conclusions based upon the presence of

definite eoliths in the sub-Crag detritus-bed—where no Chellean implements occur. In recent years—in two investigations carried out by me—I have found implements of eolithic form in Acheulean, and in Late Moustierian occupation levels, and such specimens may occur in even later cultures. But there is no doubt in my mind that the most ancient eoliths, by reason of (*a*) their presence in the sub-Crag detritus-bed, (*b*) their archaic forms and workmanship, and (*c*) the fact that they represent the ancestral types from which the normal sub-Crag implements were derived, must be regarded as the oldest implements in flint known to science, and as definitely pre-dating the earliest Chellean-palæolithic-hand-axes.

J. REID MOIR.

One House, Ipswich.

Formation of Mammato-Cloud.

IN view of the recent letters in NATURE on the cause of mammato-clouds, some observations on the conditions accompanying them may be of interest. The only case I can find when an aeroplane observation was made in mammato-cloud was over Berck (N.E. France) on the evening of July 17, 1918, at the height of 11,000 feet, at the base of a large mass of "anvil" cloud which had been carried by a strong upper current in advance of a line of thunderstorms, and extended up to the cirrus level. In this case the air was very turbulent, there was strong evidence of a downward current, and the lapse-rate of temperature was intermediate between the dry and saturated adiabatic rates. The cloud had the true bulging spherical structure, but the outline was not sharp, so that it was not a very good example. This was probably due partly to evaporation, partly to snowflakes melting into rain-drops. As a general rule "anvil" clouds consist almost entirely of snowflakes.

Mammato-clouds also developed on the flank of a thunderstorm on May 22, and a very striking example occurred in rear of a storm on July 20, 1918. Upper air temperatures and humidities observed before and after these storms have been published by the Meteorological Office (Professional Notes, No. 8), but it is observations in and below the clouds themselves that are required.

The mammato-form normally develops under a lateral extension of cumulo-nimbus, at a greater height than their base. It is true that the cloud is occasionally quite low, but in these cases the base of the cumulo-nimbus may originally have been still lower. This may explain the great apparent density at the base of the best examples of mammato-cloud. In an ordinary cumulus or turbulent strato-cumulus cloud, the amount of water, ice, or rime (the two latter from supercooled drops) which is deposited on an aeroplane is usually greater in the middle of the cloud than it is near the base. The height of thunder-clouds, measured from the base to the top, is rarely less than 10,000 feet, and is usually much greater. When mammato-clouds develop from other forms, such as heavy strato-cumulus or alto-stratus, the thickness of the clouds does not appear less than four or five thousand feet.

There is a small-grained variety of mammato-cloud, illustrated by Fig. 21 of the recent French official publication "Les Systèmes nuageux," and a similar structure is occasionally seen on the upper surface of a cloud-sheet, though on occasions different from those of its appearance underneath. The chief characteristic is that the normal rippled appearance is replaced by a spherical structure. The best examples are seen with a lapse-rate of temperature close to the saturated adiabatic within and above the clouds. If this rate is exceeded the sheet grows up irregularly (the "castellatus" form), while if there is an inversion above the clouds the upper surface is comparatively level, unless disturbed by large cumulus clouds below.

C. K. M. DOUGLAS.

South Farnborough, Hants,
March 3.

Elizabeth Barrett Browning and Scientific Achievement.

PERHAPS few people now read the poetry of Elizabeth Barrett Browning, but some days ago, in an idle mood, I took down one of the volumes of her collected works and chanced to open upon "Lady Geraldine's Courtship."

I feel sure that readers of NATURE will be as interested as I was to find the following warning and protest against the intellectual vanity and material tendency of the thought of the time, and also to come upon what has proved a remarkable forecast of the later achievements of science. It must be remembered that these verses were written in the forties or fifties of the nineteenth century; their author died in 1861, and the first collected edition of her poems was dedicated to her father in 1844.

How little did the writer dream that what to her were but fantastic and illusive phantoms would, within a comparatively few years, have taken shape and become the commonplaces of the day. These are the extracts:

We are Gods by our own reck'ning and may well shut up the temples . . .

. . . . . .

For we throw out acclamations of self-thanking, self-admiring

. . . . . .

Little thinking if we work our Souls as nobly as our iron
Or if angels will commend us at the goal of pilgrimage.
Why, what is this patient entrance into nature's deep resources
But the child's most gradual learning to walk upright without bane?

. . . . . .

If we trod the deeps of ocean, if we struck the stars in rising,
If we wrapped the globe intensely with one hot electric breath,
'Twere but power within our tether, no new spirit-power comprising,
And in life we were not greater men, nor bolder men in death.

G. C. FRANKLAND.

Letterawe, Loch Awe,
February 28.

Prof. J. Symington.

IN the obituary of Prof. Symington that appeared in NATURE of March 22, p. 432, no mention is made of his most important contribution to science. I refer to his discovery, in 1892, that the so-called corpus callosum in the brains of monotremes and marsupials is really a hippocampal commissure. In 1835 Owen had directed attention to the fact that the corpus callosum was absent in these animals: but thirty years later Flower denied Owen's claims, and until Symington demonstrated the correctness of Owen's work and his interpretation of it, Flower's conclusions had been generally accepted, even by a series of distinguished anatomists who had themselves examined the structure of the marsupial brain.

In the early nineties of last century, three investigators had independently discovered that after all Owen was right; but the credit belongs to Symington of having been the first to record the fact that completely revolutionised our ideas of the morphology of the cerebral hemisphere.

G. ELLIOT SMITH.

The Acoustic Method of Depth Sounding for Navigation Purposes.[1]

OF the many novel scientific devices which appeared during the War the hydrophone is in some ways the most remarkable. This is neither because it is an instrument of great complexity nor because any discovery of radical importance was in question, but rather because of the hold it obtained over popular imagination, and the new fields of speculation which were displayed to the less sophisticated, in stories of its use. We have become so accustomed to using our powers of hearing in our natural element that the very idea of sounds travelling in water was to many the revelation of a strange thing.

In a similar way, it appears to occasion less surprise when one ventures to estimate the distance of a cliff or a hillside by the simple expedient of shouting at it and using a stop-watch to determine the time of the echo, than when one states that the depth of water beneath a ship can be measured, even when the vessel is proceeding on its course, by an almost equally simple device. The object of this article is to give some account of the development, both in Great Britain and abroad, of what is now commonly known as the echo method of depth sounding, and to refer particularly to the type of apparatus which has been developed under the Admiralty, and to results which have been obtained with such apparatus, when used at sea under practical conditions.

The method of sounding by lead is probably almost as old as the art of navigation, and so old that history can help little in discovering its origin. Herodotus (*circa* 450 B.C.) not only refers to sounding by the lead, but he also mentions arming the lead with grease for obtaining samples of the sea-bed; so that we may say with certainty that for more than two thousand years—that is, until the invention of the Kelvin wire sounding-machine—this ancient method remained an unimproved and unchallenged guide to navigation. During the last few years publications received from the United States, France and Germany have shown that the new method, in which an acoustic impulse replaces the lead and wire, is under active development. We may therefore thank the War for giving us the hydrophone, and perhaps for removing some of the psychological difficulties which appear previously to have stood in the way of utilising underwater echoes.

In April 1914 Prof. R. A. Fessenden experimented in America with a submarine signalling oscillator, which was made to emit a short note and then to receive the echo from the bottom. An observer provided with telephones and a stop-watch timed the interval between the original impulse and the echo as accurately as possible, but, since an error of 1/10 of a second in the time recorded corresponds to an error of about 250 feet in depth, the results obtained must have been far from accurate. In May 1919, Marti, a Frenchman, experimented in the Channel with an apparatus in which the initial sound was produced by the detonation under water of a small charge of explosive. The outgoing and returning impulses were received with a hydrophone, and were recorded on a chronograph reading correctly to 1/1500 of a second, corresponding to an error in depth of about 1 metre. Only 2 grams of explosive were necessary for depths up to 200 metres, and the system could be used with the vessel in motion up to speeds of 10 knots. This method was proposed some time previously by Berggraf, a Norwegian inventor, but no reports of its use by him have been seen. More recently, Marti has used the impulse provided by a bullet fired into the water as a source of sound, while in the Behm system, which has been brought into a practical form in Germany, a detonator is fired out of a specially designed holder attached to the hull of the vessel. This apparatus has been made automatic and self-indicating, but it has the disadvantage that a very large supply of detonators is required to obtain anything like a complete line of soundings over a considerable distance.

In the foregoing paragraph we have considered methods which are based on the calculation of depth by the measurement of the time interval alone. Clearly, however, this is not the only possible method. Proposals have, for example, been made to determine depth by emitting definite quantities of energy and measuring the intensity of the received echo. The deeper the water the smaller will be the intensity of the returning sound. In theory it should be possible to calibrate the receiver so as to read depth of water in terms of intensity, but the accuracy of such a method would probably suffer on account of the variation in reflecting power of various types of sea bottom. We should expect a smaller quantity of energy to be reflected by a muddy or sandy bottom than by a clean smooth rock formation, even if the depth of water were the same in all cases.

In America, Hayes has developed a method which is especially suitable for use in shallow water. In his arrangement a transmitter is placed below water at one end of the ship, say well forward, while aft there is fitted an acoustic receiver of special type, by which the direction of travel of the received sound may be ascertained. The course of the sound from the transmitter to the receiver is assumed to be along the two sides of an isosceles triangle, of which the vertex is a point on the sea bottom, while the base is the distance between the transmitter and receiver. The angle which the direction of travel of the received sound makes with the line joining the receiver and transmitter having been determined, it is a simple matter to calculate the vertical height of the triangle, that is, the depth of water. This system is understood to have given good results in shallow water, but corrections must be introduced when the bottom is not horizontal, and a method of obtaining this correction has been elaborated. It has also been proposed to eliminate the transmitter and use the propeller noises instead. In this case the receiver would be fitted forward in the vessel.

In Great Britain attention has been paid chiefly to the development of a system depending on the measurement of the time interval, since the indications of an instrument working on this principle appear likely to be more useful under all conditions than those of any other system; and because it lends itself more easily to the production of a simple, robust, and

[1] Communication made by permission of the Admiralty by the staff of the Director of Scientific Research, Admiralty.

trustworthy installation. An apparatus working on this principle has been designed by the Research Department of the Admiralty.

In this apparatus the source of sound is a steel diaphragm, about five inches in diameter, fixed to the hull of the ship. This diaphragm is set in vibration

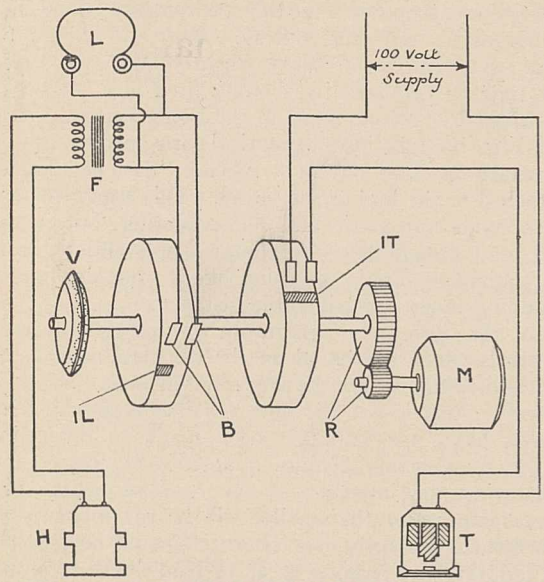

FIG. 1.—Diagram of connexions: T, transmitter; IT, insulating segment breaking transmitter supply; M, ½ h.p. electric motor; R, 10 to 1 reduction gear; H, hydrophone; F, transformer; L, telephone; IL, insulating segment breaking telephone circuit; B, movable brushes in telephone circuit; V, centrifugal governor.

at regular intervals by a small spring hammer which is withdrawn from the diaphragm by a solenoid, the circuit of the latter being broken automatically every half second. The note emitted by this transmitter has a frequency of 1250 per second, and when immersed in water the diaphragm is heavily damped, so that the energy communicated to it by the hammer is quickly transferred to the water. The receiving hydrophone is a simple microphone enclosed in a rubber body immersed in the water. This type of hydrophone is comparatively aperiodic, and has been found suitable for the work; since it is necessary when one is dealing with such small time intervals that both the transmitter and receiver should act quickly and not confuse the original sound and the echo by continuing to vibrate after an impulse.

Installed in the vessel, and placed in any convenient position, is a 1/8 h.p. electric motor running at 1200 r.p.m., which drives two switches through a 10 : 1 reduction gear. Constancy of speed within 1 per cent is obtained, in spite of large variations in the supply voltage, by the use of a specially designed centrifugal friction governor. One of the switches, which consists of a pair of brushes in contact with a rotating disc provided with an insulating segment, breaks the 100 volt D.C. supply to the transmitter every half-second. The other switch, running on the same shaft as this disc, short-circuits the telephones in the receiving circuit except as determined by the position, relative to the corresponding pair of brushes, of a second insulating segment.

When, therefore, the apparatus is running, no sound will be heard in the telephones unless the insulating segment in the telephone switch happens to open the telephone circuit at the instant when the transmitter is actuated, or at the instant when the echo returns from the bottom of the sea. By a simple mechanism, the position of the insulating segment in the telephone circuit can be displaced by hand relative to the corresponding pair of brushes, so that an interval of time, proportional to the angular displacement of the brushes, intervenes between the emission of an impulse by the transmitter and the opening of the telephone circuit. If, then, a sound is heard in the telephones, we know that the angular displacement of the brushes gives a measure, in terms of the known speed of rotation of the switch, of the time taken by the sound to travel from the transmitter to the receiver—a distance which is approximately double the depth of the water. To take a concrete example, the average velocity, over a depth of 30 fathoms, of sound in sea-water of 35 per mille salinity and at a temperature of 15° C. is 4935 ft. per second. Let us suppose that the angular displacement of the brushes relative to the insulating segment in the telephone circuit, when an echo is heard, is 18°. The time taken by the segment to rotate through 18° is $18/360 \times 1/2$ second or 1/40 second, since the segment goes round twice per second. In this time the sound will have travelled 123⅜ feet, and the depth of water is therefore a little over ten fathoms. The apparatus is shown diagrammatically in Fig. 1.

As soon as the apparatus was tried at sea, it was found that the system possessed a further important asset which one might describe as accidental, or at least

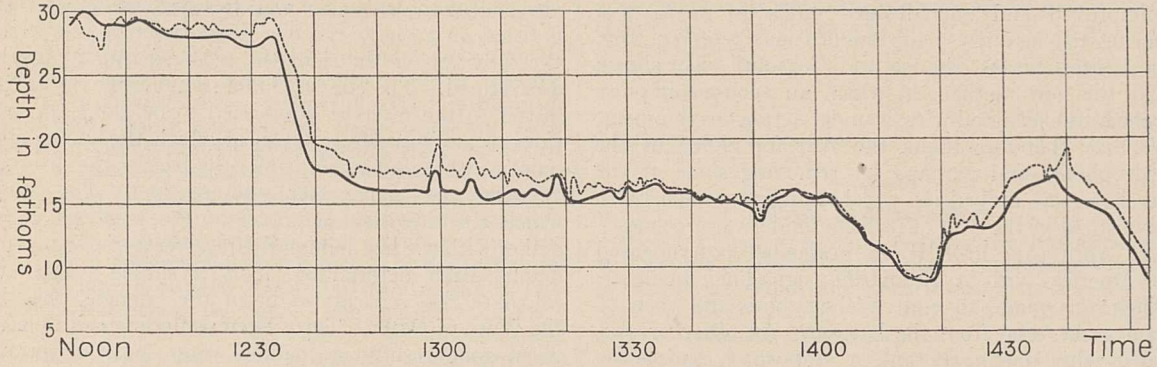

FIG. 2.—Diagram showing comparison of soundings obtained with
(1) ship's sounding gear .....
(2) echo sounding gear ———

unlooked for. One of the chief difficulties encountered in depth sounding with the vessel under way, using transmitters of moderate power, is due to the loud disturbances caused by movements of the water and sounds within the ship. If all these noises are listened to in the telephones without the short-circuiting device the echo may be difficult to distinguish, because it is not loud enough to be heard distinctly through the

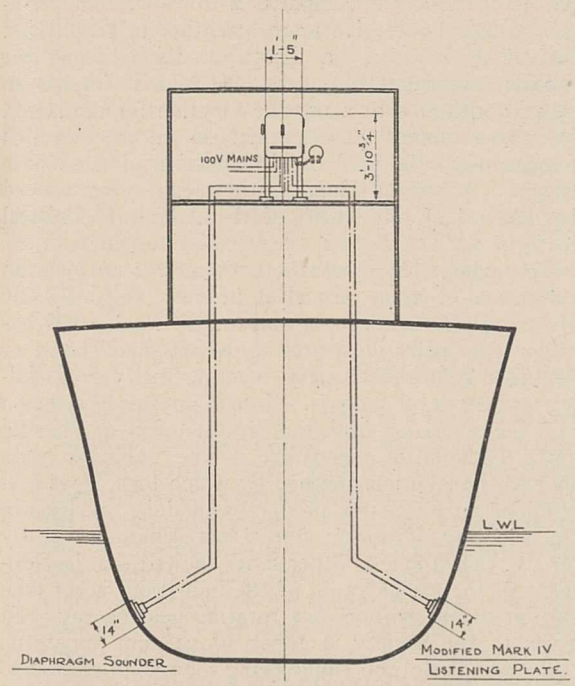

FIG. 3.—General arrangement of inboard apparatus.

other disturbances; but when the listening period is reduced to a small fraction of a second by the rotating switch, the echo is found to be clear and sharp.

In the specimen chart which is here reproduced (Fig. 2), Somerville wire and sonic soundings obtained on a trial run are compared. The apparatus was in this case handed over to the officers of an Admiralty survey vessel, who had had little or no prior experience of its use. The agreement is none the less good, and this may be taken as an indication of the simplicity and trustworthiness of the gear. In a report from the commanding officer of the vessel it is stated that the soundings were taken on a continuous run at a speed of six knots, under conditions which were by no means favourable — the send of the sea being sufficient to account for the four feet difference between the echo sounding and that obtained with the Somerville gear. From other trials the conclusion has been drawn that trustworthy indications can be obtained in all depths from almost the shallowest water in which a vessel will float, up to 35 fathoms. This does not, however, represent the greatest depth which the apparatus can be expected to measure.

In the trial run to which we have referred above the installation was exactly as described, except that the instrument was graduated to read fathoms directly, instead of time, while the transmitter, instead of being fixed in the hull, was hung overboard and submerged three feet. The receiver was placed in a ten-inch sluice valve, in order to shield it so far as possible from water currents and from the direct effect of the transmitter. In very shallow water a correction must be applied to allow for the distance apart of the transmitter and receiver, but this can be done very simply by an alteration in the scale of the fathom indicator. More powerful transmitters are being built so that the gear may be used in water of greater depth, and no difficulty is anticipated in obtaining indications over a range of 200 fathoms or more, with only minor modifications to the present apparatus. In equipment now in use both the transmitter and receiver are fitted directly on the hull on opposite sides of the vessel, as shown in Fig. 3, and the hull acts as a screen shielding the receiver from the transmitter. It is confidently anticipated that great depths may thus be sounded by a vessel proceeding at any ordinary speed. Special transmitters, which will be capable of dealing with oceanic depths, are under construction.

It is perhaps too soon to prophesy what will be the future of the sonic depth-sounding apparatus, and in what sphere it will find its most valuable application. There appears, however, to be good ground for anticipating that it may ultimately play an important part in the general practice of navigation.

The Physical Society of London.

JUBILEE CELEBRATIONS.

AN event of the first importance in the scientific world, the jubilee of the Physical Society, was marked by a series of celebration meetings held on March 20-21 at the Institution of Electrical Engineers, an exhibition of apparatus and demonstrations of great historical interest, and a banquet held at the Connaught Rooms on March 22. The labours of Prof. A. O. Rankine and those who helped him to organise the celebrations were rewarded by the spontaneous vigour which characterised the proceedings throughout their course. At the banquet Mr. F. E. Smith made the important suggestion that kindred societies which, like the Physical Society, do not possess a building of their own should unite in providing a common home in some central position.

On March 20, delegates were received from numerous learned societies of Great Britain and other countries (the foreign delegates including Profs. Fabry, Wien, S. J. M. Allen, Zeeman, and others whose names are well known), and addresses in a variety of languages were presented. The president of the Physical Society, in welcoming the delegates, commented on the contrast between the laboratory equipment which existed at the date of the Society's origin and that of the present day, and on the importance which the Society had always attached to demonstrations and apparatus. The number of fellows had grown from 99 to 600, and was rapidly increasing: amongst the younger fellows must be some of the intellectual giants of the future. Later in the afternoon the Guthrie lecture was

delivered by M. le Duc de Broglie, who discussed some effects of high-frequency radiation. After outlining the recent work on (1) the photo-electric effect and (2) the fluorescent excitation of K, L, M, N lines, the lecturer dealt with (3) the difference in wave-length which has been asserted to exist between scattered X-rays and the incident beam which excites them. By allowing X-rays from a tungsten target to be scattered by a re-radiator compounded of carbon and tungsten the lecturer has succeeded in obtaining on the same plate tungsten lines due to (*a*) scattering from the carbon and (*b*) fluorescent excitation in the tungsten re-radiator. He claims to have confirmed Compton's finding of an increment in wave-length in case (*a*). In the evening, under the auspices of the Institution of Electrical Engineers, a lecture on the nature of speech was given by Sir Richard Paget, assisted by Miss Sylvia Paget. In addition to demonstrations similar to those already described in NATURE, the lecturer showed the transmutation of certain vowels by alteration of the speed of a dictaphone record, and demonstrated Eccles' electrical vowel apparatus. The "cheirophone" added to its repertoire, in honour of the occasion, excellent reproductions of "Oliver Lodge" and "Vernon Boys."

Friday, March 21, the fiftieth anniversary day, was devoted to reminiscences by original fellows and other fellows of long standing, and numerous interesting particulars were given of Prof. Guthrie and the early days of the Society. Sir William Barrett exhibited the original lists, in his own and Prof. Guthrie's handwriting, of those who were first invited to form the Society, and Prof. Guthrie's draft of the circular by which they were invited. The Society grew originally out of the courses for science teachers held at South Kensington, and Guthrie chose for himself the minor post of demonstrator. Prof. J. A. Fleming, who had read the first paper to the Society fifty years earlier almost to an hour, said that the Society was founded in the belief that incomplete researches might give and receive stimulus if submitted to discussion. Some discountenance was met with, from Clerk Maxwell amongst others, and the attitude of the Royal Society was at first unsympathetic, but the above aim has been vindicated by the publication of progressive series of papers in the Proceedings. Guthrie himself showed in 1874 that red-hot iron loses negative more quickly than a positive charge, and was therefore the first to notice thermionic phenomena. Prof. C. V. Boys, who was unfortunately absent through illness, contributed a paper describing some early proceedings of the Society; and Sir Richard Glazebrook gave a discourse on the history of international electrical standards, in which British physicists (including the president of the Society) have played a leading part. Prof. Wien, in moving a vote of thanks, said that while the quantum theory had been "made in Germany," it required international co-operation to rescue it from the inconsistencies from which it at present suffers.

At the evening session Sir Arthur Schuster gave some amusing reminiscences of Joule (whose paper on the C^2R law the Royal Society refused to publish except in abstract), of Balfour Stewart, Stokes, and Boltzmann. Prof. H. E. Armstrong pleaded for closer co-operation between chemists and physicists, and indulged in some friendly gibes at the "clerical" tendencies of physics. He regretted the passing of the popular science of Tyndall, and mentioned that Guthrie was the inventor of what is now known as mustard gas. Dr. C. Chree emphasised the fact that skill in the use of apparatus is of even more importance than the construction of the apparatus itself. He suggested that the Society should publish a larger proportion of papers on *results* as compared with papers on *instruments*, and should give more attention to geophysics. Sir Oliver Lodge in a discourse claimed that the relativity postulate of an absolute velocity implies an ether, and hinted at a psychic function for the latter. He quoted some "queries" of Newton, one of which foreshadowed the modern identification of mass with energy. A vote of thanks to the speakers was moved by Prof. S. J. M. Allen, of the American Physical Society.

Throughout the celebrations there was on view an exhibition of great historical interest, organised by Messrs. J. H. Brinkworth and R. W. Paul. The exhibits principally illustrated apparatus first shown or described before the Society, together with corresponding modern developments. Special interest was shown in a series ranging from the earliest forms of Fleming valve to the latest commercial valves. Another series showed the laborious method by which Prof. Boys first obtained fuzed quartz products; and in his absence the shooting of quartz fibres was demonstrated by Mr. W. Colebrooke. Other series showed the development of the oscillograph, of the induction motor (the earliest demonstration of a rotating field having been given to the Society in 1879), of vacuum apparatus (the original McLeod gauge being shown), of resistance thermometry, the photo-electric cell, the moving coil galvanometer, etc.

Faraday's own lodestone, Wheatstone's original bridge, Hughes' induction balance and microphones, and Guthrie's diffusion apparatus were amongst the 183 exhibits. Some beautiful demonstrations were repeated, the most spectacular being those of Prof. C. R. Darling on drops and of Major C. E. S. Phillips on fluorescence with ultra-violet light.

A banquet, organised by Mr. R. S. Whipple and Major C. E. S. Phillips, brought the celebrations to a conclusion. H.R.H. the Duke of York, in replying to the loyal toast, expressed his interest in the international character of physics, and the social value of its application to industry. He noted that 25 per cent. of the Society's fellows have been elected since the War, a sign of vitality. The Prime Minister, whose late wife was a daughter of Dr. J. H. Gladstone, first president of the Society, referred to the latter's personality as illustrating the fact that reverence should be characteristic of every seeker after truth, whether he be theologian, explorer, or man of science. He regretted that physics had now become too complicated for the comprehension of the layman, who had felt the greatest enthusiasm for the popular science of Tyndall and Huxley, and he expressed the hope that the future might bring some broad simplification acceptable to the lay mind. He mentioned, with a slyness which was immensely enjoyed, that he had been present at the Bristol meeting of the British Association when De Rougemont was acclaimed by many of the members, but he did not

mention that it was at the same meeting that De Rougemont's travel-tales were exposed. Finally, he drew a parallel between the work of a government department in collecting and co-ordinating facts and applying them to policy, and the work of the scientific investigator and inventor, and suggested that a similar mentality was required for the due performance of each of these functions.

Mr. F. E. Smith, president, pointed out that the Faraday, Optical, Röntgen, and other Societies resemble the Physical Society in having no permanent accommodation of their own. He suggested a joint effort to obtain a central building with theatre, laboratory, refectory, and library. The suggestion was received with great enthusiasm. Lord Haldane referred to the unity of mind prevailing amongst scientific workers of different nationalities, and suggested that the introduction of scientific method into the study of national and international affairs might lead to a similar harmony there. Sir Richard Glazebrook, in the absence through illness of the president of the Royal Society, spoke of physics as the key science on which all the other sciences depend; Prof. Fabry directed attention to the necessity for international co-operation in science; and Sir Oliver Lodge expressed the belief that there are giant stars in the rising constellation of the Physical Society. Sir Joseph Thomson, proposing "The Visitors" in a witty speech, said that, although not a student of physics while at Cambridge, H.R.H. the Duke of York had excelled in the technique of that branch of applied physics which relates to the effect of rotation on the track of a sphere moving through an elastic fluid. He assured the Prime Minister that statesmen would never appeal in vain to the scientific world for help in the difficult tasks which confront them. The High Commissioner for Australia and Mr. J. H. Jeans replied, and the toast of the chairman (Mr. F. E. Smith) was proposed by Sir Ernest Rutherford.

Antidotes against Sleeping Sickness.

TOWARDS the latter part of 1920, German investigators announced the discovery of a new drug, "Bayer 205," which had a remarkable action on experimental trypanosomiasis in laboratory animals. It was far more efficacious than any other known remedy, and in addition possessed the great advantage of being therapeutically active in doses which were at least one-sixtieth of the maximum dose tolerated by these animals. It was later proved that horses suffering from dourine could be cured by injections of the drug. Such an active trypanosomicide naturally demanded attention from the point of view of human sleeping sickness. An opportunity offered itself in 1921. An Englishman who had contracted the disease in Africa was treated at the Liverpool School of Tropical Medicine with almost every known remedy without success. He was seriously ill and was rapidly failing. As a last resort he travelled to Hamburg, where he was given a few injections of the new remedy. The result was immediate improvement and restoration to normal health. This has been maintained to the present time, and there seems every reason to suppose that the cure is a permanent one. Since this first case was treated, numbers of others have received the drug, and in the majority of these it would seem that a permanent cure has probably been attained.

Whatever may be the final verdict, it seems clear that in "Bayer 205" we have the best-known antidote against sleeping sickness. The opportunity for testing the drug and treating cases of the disease has been afforded by the Bayer Dye Company, which has issued limited supplies to selected individuals under certain restrictions. The secret of its manufacture and composition has been carefully guarded, and though various suggestions have been made, no definite information as to its nature has been forthcoming.

Quite recently, however, the French chemist, Fourneau, and his assistants announced to the Paris Academy of Sciences that they believed they had discovered the secret. In a detailed account of their investigations which has just appeared in the *Annales de l'Institut Pasteur*, they trace the various steps which led them to the discovery. They were guided to some extent by the succession of patents taken out by the Bayer Company. Finally a lucky chance led them to produce a compound which, so far as their experiments go and the limited supply of "Bayer 205" at their disposal permits of a comparison, appears to be identical with it. The substance prepared by the French investigators is the urea of meta-aminobenzoyl-para-methyl meta-aminobenzoyl-1-aminonaphthalene-trisulphonate of sodium-4-6-8, and they designate it "309" as absolute proof of its identity with "Bayer 205" has not yet been obtained. In one respect "309" appears superior to "Bayer 205." The dose required to cure mice of experimental trypanosome infection is 1/160 of the maximum dose tolerated. Like "Bayer 205," it possesses the disadvantage of irritating the kidneys, with the consequent danger of producing nephritis.

A series of other ureas has been prepared, and some of them, though less active than "309," are not so costly to produce, and it is suggested that they may prove of service in the treatment of trypanosomiasis of domestic animals, which require much larger doses than those given to human beings. It is evident that the discovery of the nature of "Bayer 205" will lead to an increased supply of the drug and its extended use in the treatment of sleeping sickness and other allied diseases.

Whatever may have been the reason for secrecy, the action of the Bayer Company in issuing supplies only to carefully selected and competent physicians has had the advantage of preventing the flood of extravagant statements which would have resulted inevitably from an unrestricted distribution. The value of the drug is undoubted, the best method of its administration is known, its dangers are fully realised, and there is reasonable ground for hope, though this cannot be stated with absolute certainty even yet, that a large percentage of those who have been treated will be found to have been permanently cured.

Obituary.

W. H. MAW, LL.D.

DR. WILLIAM HENRY MAW was born at Scarborough on December 6, 1838, and died at his London residence in Addison Road on March 19, at eighty-five years of age.

Dr. Maw obtained his professional training on the Great Eastern Railway at Stratford, first as apprentice and then as chief draughtsman. During that time he made the acquaintance of Mr. Zerah Colburn, and wrote for him the part of a treatise on locomotives relating to valve gears. In 1865 Mr. Zerah Colburn founded the journal *Engineering*, and Dr. Maw joined the editorial staff. On the retirement of Mr. Colburn in 1870, Dr. Maw and Mr. James Dredge purchased the paper, and were soon joined by Mr. A. T. Hollingsworth, and under their joint editorship early difficulties were overcome and the success of the journal established. Dr. Maw's services in the management were continued until his death, a period of fifty-eight years. From the first he set a high standard for the quality of the illustrations, and the technical and scientific accuracy of the descriptive matter, and *Engineering* became probably the most influential technical journal in Great Britain.

Dr. Maw took a very active interest in many scientific and technical societies. He joined the Institution of Mechanical Engineers in 1873, was elected a member of Council in 1890, and president in 1901. He gave energetic service on Committees down to the time of his death, especially on the Marine Engine Trials, the Gas Engine, the Steam Jacket, and Friction of Gears Committees. He joined the Institution of Civil Engineers in 1896, was elected member of Council in 1911, and president in 1922. In addition to a valuable presidential address on engineering developments, he gave in 1908 the James Forrest lecture on "Unsolved Problems in Engineering." In 1923 the Iron and Steel Institute conferred on him the Bessemer medal.

In 1901 Dr. Maw played an important part in the foundation of the British Engineering Standards Association, which has rendered such invaluable economic services to the engineering industry. He was a member of the main committee until his death, and gave most useful expert assistance as chairman of the Committee on Publications and Calculations. During the War he was a member of various committees appointed by the Ministry of Munitions.

During the thirty years 1890 to 1920, Dr. Maw took a very prominent part in the work both of the Royal Astronomical Society and of the British Astronomical Association. He served almost continuously on the Councils of both bodies, and was treasurer of the Royal Astronomical Society from 1900 to 1905, and president from 1905 to 1907. His two presidential addresses, on presenting the gold medal of the Society to Profs. W. W. Campbell and E. W. Brown, were very useful documents, containing full and clear accounts of progress in stellar spectroscopy and lunar theory. He also held successively the offices of treasurer and president in the British Astronomical Association, and was always ready to place his intimate knowledge of the methods of reproduction of photographs and other astronomical illustrations at the service of the Association. He had an astronomical observatory at his town house and also at his country residence at Outwood, Surrey. His work consisted mainly in the measurement of double stars, but also included a study of the lunar and planetary surfaces. But his services to astronomy were by no means limited to his own observations; his enthusiasm and readiness to help the work both of corporate bodies and of individuals will long be remembered.

Dr. Maw's connexion with his great journal gave him knowledge of engineering affairs all over the world, and he had intercourse with most engineers in the Colonies and abroad. In spite of his incessant industry, he was always genial and accessible to those who asked for his assistance. All who knew him could testify to his kindness and his readiness to place his store of knowledge and experience at their service.

DR. W. DE GRAY BIRCH.

WE regret to record the death of Dr. W. de Gray Birch, which took place at Monte Carlo on March 8. Dr. Birch was in his eighty-third year, having been born on January 1, 1842. The son of Dr. Samuel Birch, Keeper of the Department of Oriental Antiquities in the British Museum, he entered the MSS. Department of the Museum at the age of twenty-two, after being educated at Charterhouse and Trinity College, Cambridge. He became senior assistant in the following year, and held that post for thirty-eight years until his retirement in 1902, when he became curator of the library of the late and the present Lord Bute.

Dr. Birch's special branches of study were charters, especially of the Anglo-Saxon period, and seals, but he was also an authority on Anglo-Saxon, medieval Latin, Portuguese, and Spanish. Of a large number of his published works, the most important are the "Cartularium Saxonicum" and the "Catalogue of Seals in the British Museum." He also wrote a history of Scottish seals and edited the Royal Charters of the Cities of London and Lincoln, a history of Domesday Book, as well as a number of other works dealing with medieval, ecclesiastical, and monastic records. These include a catalogue of Saxon abbots and histories of Margam and Neath Abbeys, "Memorials of the See and Cathedral of Llandaff," and an edition of the Register of Hyde Abbey, Winchester. In all matters relating to literary and record research, and especially on questions of handwriting, he was an acknowledged expert. For twenty-two years he edited the Journal of the British Archæological Association, of which he was successively honorary secretary, treasurer, and vice-president.

Dr. Birch was an honorary LL.D. of Glasgow, and an honorary corresponding member of the Royal Academies of Seville and Turin, an honorary member of the Hispanic Society of America, and a vice-president of St. Paul's Ecclesiological Association.

WE regret to announce the following deaths:

Dr. R. E. Froude, F.R.S., lately Superintendent of the Admiralty Experimental Works, Gosport, on March 19, aged seventy-seven.

Dr. William Jack, formerly professor of mathematics in the University of Glasgow, on March 20, aged eighty-nine.

Sir William MacEwen, professor of surgery in the University of Glasgow and president in 1922 of the British Medical Association, on March 22, aged seventy-five.

Current Topics and Events.

WE print in another part of this issue an article upon the position and prospects of the Zoological Station at Naples. The legal position of the Station has at last been defined by a statute, which according to the *Gazzetta Ufficiale* of Rome has been approved by decree. The Station is declared to be in *ente morale* (*i.e.* is legally constituted under government control, but accounts have to be kept according to government requirements, and certain privileges are enjoyed). The property known as Santo Pietro in Porto d' Ischia, comprising the land and house formerly owned by the heirs of Dr. A. Dohrn, and recently in chancery to the "Demanio dello Stato" by decree of April 10, 1921, is assigned with all rights to the *ente morale*. A capital fund of 250,000 lire is assigned to the *ente morale* for the service of the Station. This capital is raised by the sale of two properties, the farm of Settefondi in Forte dei Marmi in the province of Lucca, and the woods of Altofusco near Castello d' Ischia, formerly owned by the Dohrn heirs. The Demanio dello Stato is authorised to transfer these two properties to Prof. R. Dohrn for the said price of 250,000 lire. Following on the aforesaid arrangement, and with the agreement of the "Comune" of Naples and of Dr. Dohrn, the Dohrn heirs are to have restored to them their property situate in the Via Francesco Crispi, formerly known as No. 92 Rione Amedeo, with all furniture therein. The Prefect of Naples is authorised to transfer the same to Dr. Dohrn. The income of the Zoological Station will be derived from (1) annual contributions from the Minister of Public Instruction, from the Thalassographic Committee, and from the "Comune" of Naples; (2) contributions from public bodies and from Italian and foreign institutions; (3) fees for the letting of tables for research; (4) entrance fees to the aquarium, and from other sources. All the publications of the Zoological Station are to be issued in Italian form, but the contents may be in either Italian, French, English, or German, the four languages approved by the International Biological Congress. The internal administration of the Station will be under regulations approved by the Administrative Council and the Minister of Public Instruction. The research and administrative staff may be of any nationality, except the heads of departments, who must be Italian. A second and later statute refers to the composition of the Board which is to supervise the affairs of the Station, and defines the position of Dr. Dohrn as director.

AN interesting discussion on the choice of a grid for British maps took place at the Royal Geographical Society on March 17, when three papers upon this subject were presented by Col. H. S. L. Winterbotham, Col. E. M. Jack, and Mr. A. R. Hinks. The question is one which concerns military men a good deal and the public a little. A grid is a framework of lines of reference drawn across the surface of a map; it is usually, though not necessarily, rectangular. On the existing British one-inch sheets, for example, the grid is composed of fine lines drawn across the map at 2-inch intervals, parallel to the sides of the sheets. In this case each sheet has an independent grid, so that it is not easy to determine the relations of distance or bearing between two points on different sheets. But the best grid is one which covers the whole country continuously and on one system; if such a grid is rectangular, and, better still, if it is composed of square sides, a simple system of co-ordinates is available for the whole area mapped, and such a system is independent of the arrangement of sheet lines and can be made independent of the projection. For this purpose, the ideal is nearly reached when the projection is orthomorphic and the grid is composed of squares arranged decimally; the co-ordinate system is then very simple, and local angles and bearings can be computed with great simplicity. The easiest application of the method is found when the map is on a metric scale and metric units are employed; but the chief speakers in the discussion seemed to favour a grid of 10,000 yards, subdivided where necessary. The objections raised to the metric grid were, however, of a trivial kind, such as, for example, "It would be a mistake to introduce the metric grid at present, because people are not accustomed to it." How people are to become accustomed to anything before it has been introduced is difficult to understand. The present position seems to be that though metric units are acknowledged to have decided advantages over British in the construction of a grid for maps, yet they must not be adopted because a change from miles to some other unit might not be acceptable to the public.

WE are glad that progress is being made in the movement to present the Imperial University of Japan with the nucleus of a new library to replace that destroyed by the earthquake of September 1, 1923. The calamity involved the loss of about 700,000 volumes, of which 200,000 were English books. At the request of the Foreign Office, the British Academy has organised a representative British Committee for the purpose of co-ordinating the various efforts throughout the Empire to evince practical sympathy with Japan in this loss by presenting an adequate gift of books, to replace the English section of the Library, not only as a token of British sympathy, but also as a tribute to the intellectual life of Japan. We learn from a letter signed by the Earl of Balfour, Sir Charles Wakefield, and Sir Israel Gollancz that already the response to the appeal of the Committee has been most generous on the part of the learned societies and British publishers. Many works which are very costly, or are out of print, must, however, be purchased if important gaps are to be filled, and a carefully planned and co-ordinated collection of British books in the various categories of literature and knowledge is to be brought together. For this purpose an appeal is made for a few thousand pounds; and we trust it will meet with ready and generous response. Contributions should be sent to the Westminster Bank, Law Courts Branch,

263 Strand, London, W.C.2, for "the Tokyo Imperial University Library Fund." No portion of the contributions will be used for organising or secretarial expenses. Communications relating to books may be addressed to the honorary secretary, Sir I. Gollancz, Tokyo Library Committee, King's College, Strand, London, W.C. It is requested that, in respect of offers of books, a list (not the books) should be sent in the first instance.

H.M. OFFICE OF WORKS has circulated typewritten copies of a report of the Bird Sanctuaries Committee. This deals with the progress made since the previous report in November 1922, and one is glad to note that this useful movement continues to develop and that birds are being attracted by the increased opportunities for feeding, cover, and nesting in the Royal Parks. In an appendix, Mr. Rudge Harding records such items as the nesting of willow-warblers in the Hyde Park sanctuary and the interbreeding of a wild Gadwall drake and a female wild duck in Kensington Gardens. The artificial islets moored in the smaller Pen Pond in Richmond Park will be familiar to many Londoners, and Mr. Harding relates that last year one of them held the nests of a great crested grebe, a wild duck, a coot, and probably a moorhen, all within the space of a very few feet. The Superintendent of Greenwich Park supplies a list of thirty-two species seen in the sanctuaries there at different seasons.

THE Chaldean Society, which is devoted to the extension of interest in astronomy, held an extraordinary general meeting at the rooms of the Royal Astronomical Society, on March 6, to consider the carrying on of the work of the society. Mr. J. Hargreaves, the president, said it was admitted that the most important features of that work were the formation of local sections, to conduct astronomical meetings and popular lectures in provincial towns, and the publication of a quarterly magazine. Of the sections already formed, the most successful has been that established at Ipswich about three years ago (of which Miss A. Grace Cook is the correspondent). Regular meetings are held during the winter, supplemented by an annual public lecture or exhibition. This section has also done most useful work by bringing together a number of amateur observers. The editor (the Rev. D. R. Fotheringham) is also carrying on a most useful work in the publication of the *Chaldean*, which has been very well received in popular, and also in scientific, circles. It appears necessary, however, to broaden the scope of the Society, to form more sections, to increase the sales of publications in order to render expansion possible, and to facilitate co-operation with existing scientific societies. Other speakers directed attention to the favourable reception of astronomical lectures, especially in rural areas, and the need for a non-technical cheap subscription society. It was agreed that a committee be appointed to formulate a plan of reorganisation. The hope was expressed that the Society would be able to secure the support of some of the leading British men of science, and that steps would be taken to establish co-operation, especially with existing literary and scientific societies in provincial towns.

THE contract for Sydney Harbour bridge, New South Wales, has been placed with Messrs. Dorman, Long and Co., Ltd., of Middlesbrough, and some interesting particulars have been published by the firm in the *Engineer* for March 7, together with an illustration of the structure as it will appear when completed. The principal opening is a single arch of 1650 feet span with heavy decorative granite abutment towers. The total length of the steel arch and of the approach spans will be 3770 feet, and the head-room for vessels will be 170 feet at high water. The height to the top of the arch will be 450 feet. This will constitute by far the largest arch bridge in the world, the nearest to it having a span of about 1000 feet. The span is exceeded only by the Forth and Quebec cantilever bridges. The rail and roadway accommodation required necessitate a total width of bridge of 150 feet. The main span is therefore of exceptionally massive construction, and it is believed that the bridge will have the heaviest single span in the world. Dorman, Long and Co. have retained Mr. Ralph Freeman, of the firm of Sir Douglas Fox and Partners, and Mr. G. C. Imbault as consulting engineers, and the design and erection scheme have been prepared under their direction. The greater part of the heavy steel plates required will be manufactured at Middlesbrough and the whole of the material will be fabricated, or put together in special workshops on the site. The construction of the arch will proceed simultaneously from each shore of the harbour.

"MANURING for Profitable Production," by Mr. F. E. Corrie, is a most useful brochure presenting in a concise form much of the information necessary to aid the farmer in the most satisfactory use of fertilisers. Holding no brief for any particular type of manure, the author endeavours to summarise the principles which guide the use of fertilisers and the various factors which influence the manuring of the soil. The importance of farmyard manure, green manuring and lime is emphasised, though most attention is given to artificial fertilisers. In this connexion a table is given showing the amounts of nitrogen, potash and phosphoric acid removed from the soil by various farm crops, with the warning that the crop composition is by no means a guide to the requisite manuring for that crop. The chief sources of the various manurial constituents are detailed, and the costs and unit values of the more common fertilisers are compared, a table of conversion factors being given. Suggestions are made for mixtures of manures suitable for various crops on different types of soil, full recognition being given to the importance of local conditions and varying rotations in determining the amounts and times of application. Farmers are strongly recommended to carry out field trials for themselves to determine the manuring best suited for their own conditions, a sample experiment being outlined in detail. The conclusion deals with problems of manure mixing, graphic illustrations being given of those manures which may or may not

be mixed with safety and profit. The booklet may be obtained, free of charge, from Imperial House, Kingsway, or from the author at Star Cottage, Lingfield, Surrey.

THE problem of how to get the best out of women workers who are not "skilled" in the accepted sense of the word has received a good deal of consideration from engineers and others, and an extremely helpful article by Mary Macdonald will be found in the *Woman Engineer* for March. The writer of the article is the women's employment manager at the works of Messrs. Hans Renold, Ltd., Manchester, the well-known chain manufacturers, and explains that a carefully planned and systematic scheme of training is in force, so that the occupation of the girls cannot be described as a blind-alley one. Age, length of service, flexibility, and efficiency are the factors which determine the promotion of the girls from one grade to another. Each year a certain number of the more worthy girls are promoted into the office as clerical workers, or to be trained as tracers. Thus the girls in this factory have something to look forward to. The conditions under which the girls work have been carefully considered, and many experiments have been made with the view of rendering these conditions as little trying as possible. The women also take their share in the various advisory works' committees, and thus feel that they are taking a part in the responsibility of caring for the interests of their fellow-workers. Opportunities for self-improvement and recreation have always been encouraged by the firm since its foundation in 1879, and this policy is not looked upon as an act of grace, although they have wisely decided that the management of the recreative side should be in the hands of the workers. The success of the whole scheme may be estimated from the fact that the highest average percentage of avoidable labour turnover for the past three years is 5·7.

SIR WILLIAM M. BAYLISS, professor of general physiology in University College, London, has been elected a corresponding member of the Royal Academy of Medicine, Brussels.

THE Council of the British Association has resolved to nominate Dr. Horace Lamb, formerly professor of mathematics in the University of Manchester, as president of the Association for the Southampton meeting in 1925.

LIEUT.-COL. H. T. TIZARD will deliver the twelfth Wilbur Wright Memorial Lecture of the Royal Aeronautical Society, at 8.30 P.M., on Thursday, May 29, to the Royal Society of Arts, John Street, Adelphi. His subject will be "Fuel Economy in Flight."

A JUNIOR assistant is required at the National Physical Laboratory, Teddington. Candidates must be honours graduates in physics, preferably with experience in photometry. Written applications for the post must be sent not later than March 31 to the Director of the Laboratory.

ACCORDING to the *Chemiker Zeitung*, Prof. Nernst, after combining the work of the Technische Reichsanstalt, of which he was appointed Director, with that of the Reichsanstalt für Mass und Gewichte (Normaleichungskommission), will return to the University of Berlin in succession to Prof. Rubens as Director of the Physikalisches Institut.

THE seventh annual Silvanus Thompson Memorial Lecture of the Röntgen Society will be delivered by Prof. C. G. Barkla at the Institution of Electrical Engineers on Tuesday, April 1, at 8.15 o'clock. The subject will be "Some Recent Investigations in X-rays—The 'J' Phenomena." No tickets of admission will be necessary.

AT a meeting of the Royal Society of Edinburgh held on March 17, the president, Prof. F. O. Bower, announced that the Keith prize for the period 1921–1923 had been awarded to Prof. J. W. Gregory, professor of geology in the University of Glasgow, for his papers published in the Transactions of the Society, and in recognition of his numerous contributions to geology extending over a period of thirty-six years; and that the Neill prize for the period 1921–1923 had been awarded to Prof. J. McLean Thompson, professor of botany in the University of Liverpool, for his series of memoirs on staminal zygomorphy and on the anatomy of the Filicales.

THE following officers and members of Council of the Asiatic Society of Bengal have been elected for the year 1924: *President*, Sir Rajendranath Mookerjee; *Vice-Presidents*, Sir Asutosh Mukhopadhyaya, Mahamahopadhyaya Haraprasad Shastri, Prof. P. J. Brühl, and Major R. Knowles; *General Secretary*, Johan van Manen; *Treasurer*, Prof. C. V. Raman; *Philological Secretary*, Prof. D. R. Bhandarkar; *Joint Philological Secretary*, A. F. M. Abdul Ali; *Natural History Secretaries*, Dr. Baini Prashad (biology) and Dr. W. A. K. Christie (physical science); *Anthropological Secretary*, Dr. N. Annandale; *Medical Secretary*, Major R. Knowles; *Library Secretary*, Pramatha Nath Banerjee; *Other Members of Council*, Dr. Rai Upendra Nath Brahmachari Bahadur, S. A. Khuda Buksh, P. C. Mahalanobis, Dr. E. H. Pascoe, C. W. Gurner, and K. N. Dikshit.

A VERY interesting report on the research activities of the various institutions and private workers in New Zealand is published by Dr. J. Allan Thomson and the Hon. G. M. Thomson in the *New Zealand Journal of Science and Technology* for December. The object of the report is to make known the facilities for scientific investigation available in New Zealand with the view of stimulating interest in the matter among manufacturers and chambers of commerce, and ultimately, when the importance of research work is realised, of setting up an organisation for the co-ordination of scientific and industrial research in the Dominion. The report emphasises very forcibly the wide scope of the work now in progress and the large amount of valuable research which is being carried out there, and makes a plea for the more efficient and economical use of the research facilities of the country through the joint co-operation of all concerned.

We have received from the Pullman Publishing Company, New York, the first issue of a new monthly journal entitled *Testing*, which aims at becoming an international means of publishing papers on all aspects of the testing of materials. The January number, which is excellently printed and illustrated, contains some highly interesting articles, one by R. G. Batson on the fatigue of wires and wire-ropes; a German contribution to the theory of the hardening of duralumin; an account of the carbometer, a Swedish instrument for determining the carbon content of steels rapidly by a magnetic method; an attempt to arrive at a satisfactory method of comparing notched-bar impact tests by P. Fillunger of Vienna, and other papers on calibrating testing-machines, measuring Brinell hardness, investigating the quality of lubricating oils and bearing alloys, the testing of wood, and the detection of strain in glass by means of a simple polariscope. Although the multiplication of technical journals is to be deprecated, there is no doubt that this new publication will find an interested public.

We learn from Messrs. H. K. Lewis and Co., Ltd., 136 Gower Street, W.C.1, that they, as well as Mr. A. F. Bird, 22 Bedford Street, W.C.2, have been appointed agents for the sale of the publications of the Chemical Catalog Company in the British Isles. They inform us that they have all the principal books in stock.

We have received two further parts of the Dutch zoological periodical *Capita Zoologica*, which is issued under the editorship of Prof. E. D. van Oort, director of the State Museum of Natural History at Leyden. The journal is devoted to the publication of transactions on systematic zoological subjects, each forming a complete work and sold separately. A number of transactions form a volume of about 500 pages with illustrations. One of the parts before us is by Dr. K. Friedrichs, who writes on "Ökologische Beobachtungen über Embiidinen." The other is by Mr. Masamitsu Oshima, on "Fauna Simalurensis Termitidæ." Both memoirs are of a high standard and are well illustrated.

Many books of science figure in the spring announcement list of Messrs. Chapman and Hall, Ltd. Among them are the following: "Practical Microscopical Metallography," Dr. R. H. Greaves and H. Wrighton; "Testing of High Speed Internal Combustion Engines; with Special Reference to Automobile and Aircraft Types," A. W. Judge, dealing with the measurement of fuel consumption, density and calorific value, water for cooling, horse-power (brake and indicated), pressures and temperatures in the cylinder, and the commercial testing of automobile engines and chassis; "Merchant Ship Types: A Survey of the Various Units engaged in the Water Transport of People and Merchandise," A. C. Hardy, providing details of the principal characteristics of all types of steam vessels engaged in ocean and sea transportation of passengers and merchandise; "Gas Engine Operation, Testing and Maintenance," W. A. Tookey; "Electric Vehicles," C. W. Marshall; and "Coal and Oil-fired Boilers," Eng.-Comdr. F. J. Drover. We notice that Messrs. Chapman and Hall are now the English publishers of Sir J. J. Thomson's "The Electron in Chemistry," issued in America by the Franklin Institute, Philadelphia.

Our Astronomical Column.

Planetary Rotations.—Various attempts have been made to find some law connecting the periods of planetary rotation with each other. A fairly plausible one was given by Herbert Kaul in the *Physikalische Zeitschrift* for April 15, 1922 (also in *Astr. Nach.*), and further discussed by H. Troeger-Wohlau in the same publication, September 15, 1922. His formula involves diameter of planet, distance from sun, and a quantity K, which is a function of the inverse ratio of the orbital velocities of earth and planet. He is able to choose a value for K which gives correct rotation periods for Mars, Jupiter, and Saturn. But for Venus it gives 26½ hours, for Uranus 13¾ hours, for Neptune 11 hours.

The last three results have been rendered improbable by recent observations. Mt. Wilson spectroscopic observations make a much longer period probable for Venus, and for Uranus and Neptune values of 10¾ and 7¾ hours have been deduced by fluctuations of light, in conjunction in the case of Uranus with spectroscopic observations.

Kaul's formula indicates for Mercury a rotation of eighty-eight days, equal to the revolution.

Spectroscopic Parallaxes from the Dominion Observatory.—Messrs. R. K. Young and W. C. Harper have made a new determination of the parallaxes of 1080 stars (Journ. R.A.S. of Canada, Jan. Feb. 1924). The work was conducted so as to be quite independent of that at Mt. Wilson, the calibration of curves correlating line-intensities with absolute magnitude being done afresh, and many additional lines being selected for the purpose. The list of stars includes several of type A5, but the present paper deals mainly with those of types K and M. The spectral types have been redetermined, but accord very closely with those obtained at Mt. Wilson. There is a discussion as to the best method of combining the trigonometrical parallaxes so as to avoid systematic error in calibrating the curves; an important point is to have independent methods of dividing the stars into groups according to distance, and to use the mean of them.

The detailed results are given for 178 stars of "late" type. From Ko to K2, there is no systematic difference from Mt. Wilson; from this point the Dominion Observatory absolute magnitudes begin to be brighter than the Mt. Wilson ones, the difference being very decided in type M. The greatest individual discordance is in μ Cephei, the absolute magnitude of which was given as +0·3 at Mt. Wilson, −4·9 here; this implies a distance some seven times as great as the former.

The new absolute magnitudes for Aldebaran and Betelgeuse are respectively 0·6 mag. and 0·4 mag. brighter than the Mt. Wilson ones. The parallax of Betelgeuse is given as 0·010″, that of Arcturus 0·100″.

Research Items.

CLAY HEADS FROM THE GOLD COAST.—In *Man* for March, Mr. R. Kerr describes four small clay heads from Sekondi, Gold Coast, which have recently been presented to the Royal Scottish Museum by Mr. Gilbert M. Hunter. Similar heads are very rare in collections in Great Britain, and information as to their origin and meaning is scanty. The specimens in question are of soft grey clay, blackened and burnished. Two are hollow and one has the head prolonged upwards, terminating in a flat truncation. In one case the features are decidedly negroid in contrast with the smaller and more refined features of a second. The features of the remaining two are merely conventional. The eyes are represented as closed. The heads were obtained some twenty-four years ago by Mr. Hunter from a native graveyard, which was a small clearing in the bush, much neglected. In it were a number of low burial mounds on most of which were placed clay heads. The native carriers said the heads were very old and that they represented dead chiefs and their wives, and that as such they were sacred.

MODERN STONE IMPLEMENTS IN CORNWALL.—Some interesting instances of survivals of the use of stone in Cornwall are described by Mr. R. Morton Nance in the ninetieth annual report of the Royal Cornwall Polytechnic Society. It is noteworthy that these mostly occur among the fishermen, practically a self-contained group in the population which seldom marries beyond its own circle. This exclusiveness no doubt has perpetuated the Cornish "fisherman" physical type recognised by anthropologists. Flat stones with "jaws" knocked out one on each side are used for ballasting crab-pots, and for mooring lines and fishtraps. Sometimes they are oval with a groove right round the centre to take the rope fastening. Circular stones but of a larger size are used as killicks or anchors, sometimes in combination with a bar of iron twisted to form a ring and flukes, but more commonly the simple rope or twisted withy fastening alone is used. The Cornish killicks illustrate some of the stages of the development of the anchor from the stone killick, which by the addition first of one or more wooden crooks, then of timbers to form a four-armed grapnel, finally became the half-killick with two arms and a stone "stock," actually a stone and wood anchor, to which type the Cornish boat anchors belong.

ALGÆ AND FUNGI OF THE CANADIAN ARCTIC REGIONS.—The Algæ and Fungi collected on the Canadian Arctic Expedition of 1913–18 have recently been reported upon (Report of the Canadian Arctic Expedition, 1913–18. Vol. 4: Botany. Part A: Freshwater Algæ and Freshwater Diatoms. By Charles W. Lowe. Southern Party, 1913–16. Part C: Fungi. By John Dearness. Ottawa: F. A. Acland). Most of these plants were collected by Mr. Frits Johansen, the marine biologist who accompanied the Southern party, and are from Alaska and the Arctic regions of the North-West Territories. One interesting result is the observation that the Algæ from brackish ponds are mainly freshwater in character. It appears that these Algæ flourish in the influx of freshly melted water in May and June, formed from melted snow, the deeper and more saline layers of the ponds, last to freeze at the end of summer, being still unmelted. In the spring season, therefore, a freshwater flora of green Algæ and diatoms is to be found in the ponds, being replaced later in the season, as the lower brackish layers melt, by a marine diatomaceous flora. Besides examining some thirty species of fungi collected by Mr. Frits Johansen, Mr. Dearness examined the collections of Phanerogams for parasitic fungi. He directs attention to two features of the parasitic flora as thus revealed, namely, (1) the relatively small number of summer stages of parasitic types, most of the fungi being found in the ascigerous or mature condition; and (2) the wide range of host plants inhabited by the same fungus species.

INTERESTING FLOWERING PLANTS.—Volume 149, part ii. of *Curtis's Botanical Magazine* figures eleven new or rare flowering plants, several from the Royal Botanic Gardens, Edinburgh; in such cases the editor, Dr. Otto Stapf, has frequently been able to avail himself of drawings made for the late Sir I. Bayley Balfour. *Thryptomene thymifolia* Stapf is an interesting heath-like Australian shrub belonging to a genus of Myrtaceæ; a key is given illustrating the more conspicuous floral characters by which the species may be grouped into sections within the genus. China is, as usual, well represented with a rhododendron, *R. Searsiæ* Rehder and Wilson, *Schizophragma integrifolium* Oliv., a curious plant allied to hydrangea, with semaphore-like sepals developed from single sepals of single flowers of the uppermost cymes of some of the branches of the inflorescence; and by a lanceolate leaved cotoneaster, *C. salicifolia* Franch. An interesting European plant, very rare and localised in its native habitat in the Pyrenees, is *Lithospermum oleifolium* Lapeyr., a very rare plant in gardens also. The plant is illustrated from a beautiful specimen which has been in cultivation in Miss Willmott's garden for twenty-five years. The editor has an interesting note on the distribution of this and certain allied species, also strictly localised. In spite of the present vogue of the views as to "Age and Area," which may be briefly paraphrased as "Increased Area with Age," he concludes that in this case these species belong to a group "which is in its last stage of evolution and doomed to disappearance." Among other species illustrated is a curious Siamese *Amorphophallus cirrifer* Stapf, with well-marked, thread-like staminodes between the pistillate and staminate regions of the spike. The plant was only received at Kew in 1922, sent from Bangkok by Dr. Kerr, of Chiengmay, Siam.

THE JAPANESE EARTHQUAKE.—The issue for March of the *Geographical Journal* (p. 242) contains an interesting map showing the great changes in and around Sagami Bay (Japan) in connexion with the great earthquake of September 1. While the coast of Sagami Bay has experienced in one part an elevation of 8 ft. 5 in. and in another a depression of 1 ft. 6 in., the floor of the bay has been subjected to remarkable changes. A preliminary survey has revealed the existence of three small areas of elevation, within which the uplifts are 96, 113, and 135 fathoms, and three areas of depression, the maximum amounts in them being 63, 166, and 259 fathoms. An interesting feature of these great changes is the closeness of the areas of depression and elevation. One end of a line $1\frac{1}{2}$ miles long has risen 810 feet while the other is lowered 1224 feet. Some further details with regard to the earthquake were given in a lecture last month by Mr. I. Tokugawa, first secretary to the Japanese Embassy, before the Royal Society of Arts (Journal, vol. 72, 1924, pp. 224-232). The after-shocks seem to have been

unusually numerous. During the first twelve hours about 114 shocks were felt, and during successive intervals of the same length the numbers were 88, 60, and 47. In the first three days more than 1700 shocks were recorded by seismographs in Tokyo. After the Mino-Owari earthquake of 1891 the number of after-shocks recorded at Gifu during the first three days was 639, and nearly a month elapsed before the number rose to 1700.

THE PROBLEM OF LIGHT QUANTA.—In the February issue of the *Philosophical Magazine*, M. le Duc de Broglie puts forward a tentative theory of light quanta and shows how it furnishes an explanation of some of Bohr's results while at the same time it gives the diffraction and interference effects of the wave theory. According to the author, the light quantum has a mass of the order of 10^{-50} grams, a variable velocity nearly that of light and an internal symmetry corresponding to that of an electro-magnetic wave. These light quanta considered as a gas give the pressure of light on a surface exposed to them. If at any time the internal variations in the quantum are in phase with the oscillations in an Einstein energy-less wave with which it for the instant coincides in space, they will remain in phase and therefore all quanta on the same wave will be in phase with the wave and with each other. It is this "coherence" amongst the quanta distributed over the same wave which allows the wave theory explanations of diffraction and interference to be retained in the new theory.

EMISSION OF α-PARTICLES BY RADIUM.—Messrs. H. Geiger and A. Werner describe in the *Zeitschrift für Physik*, February 8, 1924, an investigation made in the Physikalische Reichsanstalt to redetermine the number of α-particles emitted by radium. A special instrument was devised, in which the zinc sulphide screen was placed at an angle of 45° to the direction of the α-rays, so that it was possible for two observers to watch the front and back simultaneously, by means of separate microscopes. Special attention was given to the preparation of the screen, to ensure that the result should be influenced as little as possible by failures of the α-particles to produce scintillations. A small funnel, the opening of which was closed by a sheet of mica, was filled with radium emanation, and compared with a standard radium preparation by means of the γ-rays. The emanation, with its products of degeneration, was used to produce scintillation on the screen, and these were recorded independently by the two observers on a revolving drum. It was thus possible to determine which scintillations were missed by each observer, and thus eliminate the subjective, personal error. It was found in the preliminary experiments that the error due to inactive grains in the screen was only about 0·4 per cent. The effects of scattering of the rays and of statistical variations were considered, and the corrected value for the number of α-particles emitted by one gram of radium was found to be $3{\cdot}40 \times 10^{10}$. Rutherford and Geiger, in their first counts, when the standards were not fixed as at present, found $3{\cdot}57 \times 10^{10}$. Assuming the velocity of the α-particles of radium to be $1{\cdot}5 \times 10^{9}$ cm./sec., the heat emitted per gram of radium in equilibrium with emanation, radium A and radium C′ is 22·25 calories per hour. Hess found experimentally 25·2, and Rutherford 25·1 calories per hour per gram; so that it seems as though, besides the kinetic energy of the α-particle and the recoil atom, further energy is liberated on disintegration, in consequence of the rearrangement of the atomic nucleus of radium.

TITANIUM AND SILICON IN STEEL.—No. 241 of the Technologic Papers of the U.S. Bureau of Standards is by G. K. Burgess and G. W. Quick, the subject being "A comparison of the deoxidising effects of Titanium and Silicon on Rail Steel." The experiments cover a large number of tests of American rail steel, which is a high-carbon product containing 0·65 to 0·75 per cent. carbon. Ingots deoxidised by silicon and by titanium have been used in the manufacture of rails, which have then been compared by mechanical tests and by sulphur prints. The result of the investigation is to show that titanium has a greater effect than silicon in reducing segregation both of carbon and of sulphur, and that the resulting rails are more uniform in hardness. The results of tensile, impact, and endurance tests do not show so much improvement. A small quantity of titanium remains in the steel and is sometimes to be seen in the form of coloured inclusions. The amount of piping is greater in rails treated with titanium than in those which have been deoxidised by silicon. The amount of nitrogen in combination with iron and manganese is reduced by the addition of titanium, but when the proportion of added titanium is large, the nitrogen is probably held in combination with that element.

MAINTENANCE OF TELEPHONE SYSTEMS.—P. E. Erikson and R. A. Mack read an interesting paper on telephone maintenance to the Institution of Electrical Engineers on March 6. It is well known that owing to the development of faults on a telephone line its efficiency gradually falls off unless special precautions are taken to detect and remove them at the earliest opportunity. In recent years the construction of high tension power lines for supplying electrical energy to factories and railways has made necessary special precautions to safeguard the communication circuits against external disturbances. The various systems of transposing telephone wires have been developed not only to reduce this interference but also to prevent "cross-talk" between the individual circuits. The successful operation of a "phantom" circuit is only possible when a very accurate balance between the various circuits it utilises is maintained. Paper insulated telephone cables had been in use for years before the Pupin coil was invented. The introduction of this coil made the maintenance of an accurate balance a necessity. The thermionic valve repeater sometimes develops "echo" effects, especially when used with long loaded cables. With the new four-wire repeater the echo effects can be practically avoided, but at the ends of the circuit balancing is still necessary. As the outside line plant of a large telephone system represents the great bulk of the capital expenditure, every effort should be made to utilise it to the utmost of its capacity. The authors describe various types of apparatus developed by the Western Electric Co. of America by means of which the various losses in a telephone system can be accurately measured and in some cases the causes readily located. From the discussion which followed, it appears that the Post Office engineers in Great Britain have developed accurate methods of their own for testing insulation and for locating minute faults to a high degree of precision.

ERRATUM.—In the Research Item in NATURE of March 22, p. 441, referring to the crystal structure of hydrogen chloride, it should have been stated that the capillary tube on which the crystal deposit is formed is cooled by passing through it a current of hydrogen cooled in liquid air, or for the lowest temperatures a current of liquid oxygen; the hydrogen chloride is introduced into the vacuum through another tube.

Antarctic Sea-Ice.[1]

By R. W. JAMES.

THE study of the Antarctic ice-pack may be approached from two distinct points of view. In the first place, we may consider its movements on a large scale, its distribution and direction of drift, its formation and its ultimate disappearance, and the geographical bearing of these matters. For it is the presence of the ice-pack which has limited the exploration of Antarctica, and no future attempts to reach the still unknown coasts are likely to succeed unless the known facts concerning the distribution of ice are taken into account.

In the second place, we may consider the physical aspects of the pack-ice, its growth, the changes of structure it undergoes after its formation, and the causes producing the breaking and motion of the ice fields. The two lines of inquiry, although broadly distinct, of course overlap considerably.

One important point which has been learned from the drifts of ships such as the *Belgica*, the *Gauss*, the *Endurance*, and the *Aurora*, which have been beset and carried with the ice, is that there is a considerable westerly component in its motion. The chief motive power of the drift is undoubtedly the wind flowing down from the continental ice-sheet, which is generally south-easterly in direction, and so accounts for some of the westerly component. In addition there is a well-marked tendency for the ice to move to the left of the wind direction, owing to the rotation of the earth. The actual direction of the ice-drift at any place is to a large extent governed by local circumstances, such as the presence of promontories or ice-tongues. But for the navigator it is very important to keep in mind the general westerly tendency. For example, attempts to get south in the Weddell Sea are much more likely to succeed along the east coast than along the west.

In considering the structure of the pack, it should be remembered that the growth of the winter's ice usually starts in a sea already covered with loosely-packed fragments of old ice which the new ice cements together. The large winter floes are heterogeneous in character and are liable to break up owing to a variety of causes. The ice sheet grows by breaking, opening, and thus forming pools, over which a new ice surface soon forms. The new ice may, however, be crumpled up again to form a pressure-ridge. Some very interesting physical problems are associated with the cracking and relative movements of large ice floes and the subsequent formation of pressure ridges. Another little understood point is the mechanism whereby, after exposure to summer temperatures, the hummocked ice loses its salt completely, while even ice *in situ* loses it to some extent. The salt is imprisoned between the flakes of ice during freezing, and newly frozen ice has a platy structure, giving a section of it a fibrous appearance, while ice which has lost its salt has an entirely different structure, and appears granular and bubbly. Undoubtedly high temperatures are necessary for loss of salt to take place, but it cannot be a mere draining out of a saline solution under gravity, since the ice is not porous and an ice sheet in place is subjected to a hydrostatic pressure which should tend to force salt water into it. It is probable that an alternate freezing and thawing of the saline inclusions in the ice will cause them to pass slowly downwards through it.

[1] Substance of a paper, "Some Problems relating to Antarctic Sea-Ice," read before the Manchester Literary and Philosophical Society on March 18.

The Nature of the Wool Fibre.

MR. H. J. W. BLISS, director of the Woollen and Worsted Research Association, in a lecture delivered at the Technical College, Bradford, on March 13, made a contribution to our knowledge of the wool fibre, which, while not entirely new, is certainly suggestive from a commercial point of view. That wool is specially elastic and extensible when wet has been common knowledge for the past decade, but the idea of taking a comparatively thick wool thread and stretching it out to a comparatively thin wool thread, to the best of our knowledge has not previously been suggested nor attempted. That this is possible at least in the case of the majority of wool yarns, Mr. Bliss has fully demonstrated: the effects of such stretching upon the yarns and on the cloths (woven or knitted) made from the yarns is yet an open question.

If "quality" be defined in terms of fibre diameter, the quality of yarns treated as suggested is certainly higher, but one questions at once whether something, which perhaps may be termed the "nature" of the wool and of the yarns into which it is spun, is not at the same time sacrificed. It is quite conceivable, however, that for some purposes the stretched yarn may be better than the normal yarn: this the industry itself should decide, and we sincerely hope that it will seriously put the idea to the test by means of large-scale experiments. Note is made of the lack of twist following the extension of the thread to a greater length and of the tendency to "draw out" in the case of a "twitty" yarn. But these difficulties would be overcome by putting twist into the yarn in accordance with the ultimate fineness to which the yarn is drawn out rather than in accordance with the temporary thickness to which the yarn is first spun. This same method was employed during the War for cotton yarns for balloon fabrics which were singed down at least ten counts: twist was inserted on the singed yarn basis.

As to whether the stretched yarn will make a good handling piece which will take a satisfactory "finish," and finally result in a good wearing cloth fulfilling all normal requirements, can only be decided in the light of the large-scale experiments already referred to. If it should prove that, by this method, light weight tropical fabrics may be made from comparatively thick yarns, Mr. Bliss, through the Research Association, will have conferred a lasting benefit upon the industry. But should this prove to be the case, the question will then arise as to whether the same end may not be achieved by dealing with heavily conditioned wool and effecting the desirable fibre extension gradually throughout the worsted spinning processes. This would probably be quite possible during combing and in the "English" drawing processes, but not in the "French" drawing processes, the twist control exercised in the former giving just that control required for the extension of the fibres. On the other hand, the stretching of an ordinary cloth 20 per cent. in length and width, while not unthinkable, introduces difficulties and problems which, for the time being, possibly rule out this method from the field of practical attainment. A. F. B.

Photoelectric Conductivity.

DR. B. GUDDEN and Prof. R. Pohl, in the *Zeitschrift für Physik*, January 24, 1924, give the results of further experiments made by them on the phosphores, with their views as to the theory of the subject. Lenard and his school are of the opinion that the conductivity produced by the action of light in phosphores is not connected with the production of phosphorescence, and that their emission of light has nothing to do with their conductivity. Gudden and Pohl, however, in 1920 showed that there is a close connexion in both cases, and came to the conclusion that, both in excitation and emission, there is really a spatial rearrangement of electrons, which implies a flow of current while the change is taking place.

The view of the latter authors is that when an elementary $h\nu$ process takes place, an excited molecule remains behind as a positive ion, the electron travelling more or less rapidly to the anode, giving a primary current A. The positive ion may also travel slowly to the cathode; in general, however, it is only the position of the positive elementary *charge* which will shift, the excited molecule taking an electron from its neighbour on the cathode side, and so on until the electrode is reached; this gives a supplementary current B. If this happens in every case the galvanometer measures all the N electrons of the quantum equivalent. With a perfectly insulating crystal this second action does not take place, and the galvanometer only measures N/2; but the second portion of the primary photoelectric current, B, can be obtained, either by heating or letting the excited molecules absorb light of the frequency of the absorption spectrum of the crystal, and the ammeter then reads a further N/2.

In their previous experiments Gudden and Pohl used the secondary current to investigate the spectral distribution of the excitation; but in view of present knowledge it is considered better to employ the primary current; large single crystals should be employed if possible. Unfortunately the typical phosphores cannot be obtained in this form, and only more or less qualitative observations on a number of small crystals touching one another in a confused manner are possible. The current A remains constant, so long as the available supply of unexcited centres remains practically unaltered; a current B, which may grow with the time, is added to this in some cases. On the other hand, a diminution more frequently takes place, owing to the exhaustion of the available centres, the copper sulphide molecules in the zinc sulphide lattice, for example, all becoming excited, and only the selective absorption of the zinc sulphide remaining.

In Gudden and Pohl's most recent experiments the phosphores ZnSCuα, ZnSMn, and ZnSCuγ were investigated, using the primary current method, *i.e.* measuring the initial current when excitation with light of wave-length $\lambda = 436$ mμ began, by means of a single thread electrometer. The primary current sets in with a finite value within the period of vibration of the electrometer. With all three phosphores the current was roughly doubled when red light was used at the same time, although in the case of the first no lighting up took place. The increase in conductivity was due, in the authors' opinion, to the return of electrons to the excited molecules in all three cases, independently of whether an emission of light took place or not; in the latter case there is a "Tilgung" or extirpation of the excitation of the molecule.

The results obtained are confirmed by the experiments of Rupp, who accelerated the emission of the phosphores by heat, and showed that the amount of electricity moved reaches a saturation value with increased voltage. This appears to Gudden and Pohl to support their view that the movement of the electrons in a phosphore, which is caused by an electric field, is identical with the mechanism of the photoelectric primary current in such crystals as diamond and zinc sulphide, for which saturation also takes place. They doubt the correctness of Rupp's estimate of the number of electrons connected with each quantum $h\nu$ of the emitted light, surmising that, if the experiments could be made with single crystals, this number would be found to be unity.

Protection of Ancient Monuments and Sites in Great Britain.

THE conference of representatives of learned societies and other bodies summoned by the British Association to consider the question of "further protection of sites of historic or scientific interest or of natural beauty against disfigurement or obstruction" was held at the rooms of the Society of Antiquaries on March 21. Among the bodies represented were the British Association, the Society of Antiquaries, the National Trust, the Society for the Protection of Ancient Buildings, the Royal Geographical Society, the Royal Anthropological Institute, the Zoological Society, the Congress of Archæological Societies, the Archæological Institute, the Society of Roman Studies, and the Folklore Society. The chair was taken by Lord Crawford and Balcarres.

The discussion was opened by Prof. J. L. Myres (British Association), who gave a brief account of the circumstances in relation to Avebury, Lulworth Common, and Holmbury Hill, by which the shortcomings of the existing Ancient Monuments Act had been brought into prominence, and at the same time had given cause for alarm to archæologists and others. Lord Sligo (Zoological Society), while expressing sympathy with endeavours of archæologists, emphasised the desirability of establishing sanctuaries for the preservation of animal and bird life. Mr. E. Hamer (National Trust), while advocating the employment of the machinery available through the Trust, welcomed the invitation to co-operate with the British Association. Mr. Peers, Chief Inspector of Ancient Monuments, explained the difficulties of efficient preservation of ancient monuments through the Act owing to lack of funds. The first requisite was the formation of a strong body of public opinion. A liberal interpretation of the term "monument" had made it possible to give some measure of protection to, and to prevent unauthorised or imperfectly equipped excavation on, early sites on which there might be no buildings or erection, but which might, as in the case of burial mounds, on investigation at some future time, provide invaluable evidence to archæologists. About 1000 sites had been scheduled, this number including all sites known or supposed to be prehistoric. Mr. Peers suggested the establishment of subsidiary Ancient Monument Boards. Mr. Hill (Society of Roman Studies) advocated the formation of a committee to draft an antiquities law, and Mr. Martin (Congress of Archæological Societies) urged the revision of treasure trove. The chairman agreed that the law of treasure trove was a scandal, but expressed a doubt as to whether it was wise to entrust the case of important sites and monuments to local archæological societies.

The meeting closed without any formal resolution, but Prof. J. L. Myres intimated that the views expressed and the suggestions made at the conference would be submitted to the Council of the British Association for consideration at its next meeting.

Early Science at the Royal Society.

March 30, 1671. Mr. Hooke produced his glass-bell with flour in it, to shew to the eye, that according to the several strokes or pulses made upon the glass, the air thence receives as many several impressions; it being manifest by this experiment, that, as every different stroke made a different sound, so the making a different impression upon the flour gave it as many several motions. It appeared also, that the powder goes from the place, whence the pulse comes; and that in a perpendicular pulse the powder has a kind of vibration: as also, that as long as the sound of the bell lasts, the powder seems to be fluid, but as soon as that ceases, the powder also lies still. It being conceived, that this experiment might much contribute to the explication of the nature of the internal motion in bodies, Mr. Hooke was to prosecute it.

March 31, 1681. Several matters were discoursed concerning perfumes. Mr. Evelyn affirmed that the present duke of Norfolk had a very large collection of receits. With regard to the offence, which perfumes give to some women, Mr. Henshaw was of opinion that there was something peculiar in the air of England in that respect; that ladies in Spain and Italy use the highest perfumes without the least offence; whereas the contrary is very remarkable here. And, he added, that he knew a lady, who, when she first came to England, used the highest perfumes with great delight, and wondered with some disdain at the nature of English women, who suffered much prejudice by them: But, having lived here some time she began to hate them as much as she had valued them before, as well for the smell itself as for the effects.

1686. It was ordered that a pole for erecting a telescope in Gresham college be set up, and that the treasurer pay thirty shillings for the charges of it.

April 1, 1680. Mr. Hunt produced the brass and iron nails, which were covered with tin, that had lain all the preceding week in brine, and seemed to be little altered thereby.

April 2, 1668. Mr. Hooke produced a glass receiver for the improvement of hearing. Being tried by holding the neck of it to the ear, it was found that a stronger sound was conveyed by it than would have been without it. It was ordered that at the next meeting there should be brought a better and larger receiver for hearing.

1684. Dr. Lister remarked that fairy-circles were made by the moles running round after one another under-ground in a circle, at the time of their coupling.

April 3, 1679. Mr. Aubrey was desired to write to Mr. Anthony Wood, to understand from him what account he designed to publish of Roger Bacon in his history of the antiquities of Oxford.

April 4, 1666. It was order'd that Mr. Balle should be written to by Mr. Oldenburg, to know what he had done in magnetical experiments, and that he should be desired withal to send up the magnetic apparatus, that was with him.

1672. Mr. Oldenburg communicated a letter to him from Mr. Newton, dated at Cambridge, 30th March 1672, containing his answer to the difficulties objected by Mons. Auzout against his reflecting telescope: together with Mr. Newton's proposal of a way of using, instead of the little oval metal in that telescope, a crystal figured like a triangular prism.

1678. Notice was taken that Mons. Huygens was the first, that found out, that the motion of the weight of a pendulum in a cycloid would make all its excursions isochrone; but that he was not the first, who applied the pendulum to a clock.

University and Educational Intelligence.

CAMBRIDGE.—Mr. R. B. Braithwaite has been elected to a fellowship at King's College.

The annual report of the General Board of Studies for the year 1922–23 on the progress of the scientific departments has just been issued. A further falling off is noted from the conditions of extreme congestion and overcrowding which marked the years immediately following the War, the chief drop in numbers being reported in the Chemical and Engineering Departments. The completion of the Laboratory of Biochemistry, the equipment and occupation of the Laboratory of Physical Chemistry, the preliminary arrangements for a Research Institute for the study of Animal Diseases, and the purchase by the University of the University Farms are typical examples of the rapid growth of Cambridge on the scientific side. The latest development foreshadowed is the establishment of a Horticultural Research Station in connexion with the School of Agriculture. This is made possible by the offer of a grant (up to 2500*l.* for initial outlay and up to 2000*l.* a year for maintenance and salaries) from the Development Commissioners, together with gifts of 950*l.* and further promises for capital expenditure subscribed by societies and individuals interested in the Research Institute. It is proposed to carry out research in fruit and vegetable growing, pomology, plant breeding, chemical and plant physiology, and plant pathology.

Amongst many points of interest in the reports of the heads of the several departments, it is pleasing to note that Prof. Liveing is still working in the chemical laboratory. The Department of Aeronautical Engineering has had the use of a small flight of aeroplanes at the Duxford Aerodrome to assist in research into methods of aerial surveying. The Department of Experimental Psychology reports a marked increase in the number of research students and workers. A visit of a party of advanced students to Brazil during the Long Vacation under Mr. Balfour Browne is reported by the professor of zoology. Each student undertook some special branch of zoology. An exchange of teachers with the University of Basel was arranged; Prof. Zschokke came to Cambridge and Mr. J. T. Saunders went to Basel.

DURHAM.—Dr. Irvine Masson, reader in inorganic chemistry, University College, London, has been appointed professor of chemistry and director of the Science Department in the Durham Colleges of the University.

LONDON.—The following have been awarded the degree of Ph.D. in the Faculty of Science: Mr. F. R. Goss (Imperial College—Royal College of Science) for a thesis entitled "Three-carbon Tautomerism," Mr. W. S. Martin (Imperial College—Royal College of Science) for a thesis entitled "The Chemistry of the Soil Solution."

MANCHESTER.—The following honorary degrees are to be conferred at the Founder's Day ceremony on May 21: *D.Sc.*, Prof. Niels Bohr and Prof. Max Weber; *M.Sc.*, Mr. Charles Heape, who has made and presented to the Museum a valuable collection of ethnological specimens.

The degree of M.Sc. under the provisions of the Charter II. (3) has been conferred upon Prof. L. J. Mordell, Fielden professor of pure mathematics.

AT a meeting of the governing body of the Imperial College of Tropical Agriculture held on March 12, the appointment of Mr. Overton Fuqua Boyd to be sugar technologist was confirmed. Mr. Boyd graduated at Louisiana State University, and has since acted as chemist to several sugar companies in the United States and West Indies.

Societies and Academies.

LONDON.

Royal Society, March 20.—R. Campbell **Thompson**: The plants of the Assyrian medical tablets. Some fifty new identifications of plants have been made. The chief sources of information in cuneiform are (1) the medical tablets; (2) the botanical lists. The following gives the number of species and their occurrences:

Drugs.	Approx. Species.	Approx. Occurrences.
Vegetable . . .	250	4600
Mineral . . .	120	650
Other, and unidentified	180	630
	550	5880
Alcohols, various . . .	490	
Fats, oils, honey, wax, milk .	660	

Five channels lead to their identification: (1) Tabulation of the relative frequency of each plant in Assyrian medicine; (2) the different medical value of each; (3) philological comparison with other Semitic languages; (4) comparison with and limitation to the drugs of the ancient world; (5) the synonyms and comments in the botanical lists. Among the new plants believed to be identified are fir-turpentine, rose, lolium, mustard, asafœtida, daisy, pomegranate, sumach, hemp, chamomile, anemone, medlar, apricot, cherry, *Euphorbia helioscopia*, mulberry.

Institute of Metals, March 12.—W. E. **Alkins**: The relation between the tensile strength and the electrical resistivity of commercially pure copper. The relation between the tensile strength and the percentage increase of the resistivity as compared with the annealed wire is reasonably rectilinear when the tensile strength exceeds 20 tons per square inch. The resistance (Rt) of wire of tensile strength T tons per square inch is given by

$$Rt = Ra\left(\frac{100 + T/10}{100}\right),$$

where Ra = the resistance of a similar annealed wire corresponding to the international standard.—D. **Bunting**: The brittle ranges in brass as shown by the Izod impact test. A series of alloys varying in composition from 99 per cent. copper to 52 per cent. copper were tested at temperatures between 15° C. and 700° C. Brittleness occurs in all brasses containing less than 90 per cent. of copper, being first encountered in 90 : 10 brass, in which the brittle range exists from 470° C. to 540° C. With increase of zinc the range expands, and in the case of a 70 : 30 brass occurs between 325° C. and 800° C. At a composition of 65 per cent. copper the range extends from 325° C. until the solidus is entered. The $\alpha+\beta$ alloys possess a recovery of toughness at high temperatures. The brittle range of the 58 : 42 alloy extends from 325° C. to 450° C., above which the recovery of toughness occurs; any further increase of temperature causes the plasticity of the metal to become more pronounced. The brittle ranges are believed to be due to the thermal inversion occurring in β at a temperature in the neighbourhood of 470° C.: it is probable that a similar thermal change occurs in α brasses.—J. Newton **Friend** and R. H. **Vallance**: Determination of the thermal coefficients of expansion of some commercial metals and alloys.—W. E. W. **Millington** and F. C. **Thompson**: The investigation of a fatigue failure of brass tubes in a feed water heater—with a consideration of the nature of fatigue. In the course of this investigation, involving a study of the close-packed cubic material, it is shown that a movement on octahedral planes, which has been termed "easy glide" in distinction from "slip," is responsible for: (1) Plastic deformation in hot and cold working; (2) changes of packing from cubic to hexagonal; (3) mechanical twinning; (4) fatigue. In certain circumstances under cycles of stress, twin bars (Neumann lamellæ) are cumulatively formed in the material, which not only stiffen the crystals but also cause them to become internally stressed, until eventually failure results.—T. **Martin**: The tensile properties of aluminium at high temperatures. Tensile tests on two qualities of aluminium at temperatures up to the neighbourhood of the melting-point show a continuous diminution in the strength of the metal, with corresponding increase of ductility, up to about 325° C. At this temperature a marked change in the mechanical properties takes place, which is attributed to a sudden increase in the rate of recrystallisation of the metal. Tests on cold-worked material indicate that up to 200° C. the added strength conferred by cold work is well maintained. The tests on the less pure metal show that the effect of the impurities present is to make the metal stronger but less ductile at all temperatures. Tests at two different rates of extension show that, at all temperatures above the atmospheric, the maximum stresses observed for the faster rate are greater than those for the slower rate, the effect increasing with the temperature. At 300° C., a temperature at which aluminium vessels are frequently used in practice, the maximum stress observed may be increased by more than 10 per cent. by trebling the rate of extension.—S. H. J. **Wilson**: Note on the effect of cold-drawing and annealing on some electro-chemical properties of a low-tin bronze. The thermo-electric power of a series of cold-drawn bronze wires at first rises, and then ceases to do so as the amount of cold work is increased. With still more work the power again increases. The effect of the drawing operation at different depths in the wire is also investigated, and it is shown that the wire is very far from homogeneous. On annealing a cold-drawn wire the thermo-electric power at first undergoes little alteration, but at a temperature of 400°-500° C. shows a rapid and important increase, thereafter falling to a value lower than that in the cold-drawn condition. Measurements of the electro-chemical potential show at first a marked rise to a maximum as the wire becomes more and more worked. They then fall to a minimum and finally again rise.

March 13.—M. **Cook**: The cadmium-lead-zinc system. Data concerning the three binary systems involved have been collected; the ternary system has been investigated thermally and microscopically. Near to the cadmium-lead binary eutectic is a ternary eutectic containing 81·7 per cent. lead, 17·3 per cent. cadmium, and 1 per cent. zinc which freezes at 245° C. There is a large zone in which the metals are not completely miscible in the liquid state. The concentrations of cadmium in the two liquid layers are not identical. It is not until more than 65 per cent. of cadmium has been added that a mixture of equal weights of lead and zinc yields a homogeneous liquid phase.—J. Newton **Friend** and J. S. **Tidmus**: The relative corrosion of zinc and lead in solutions of inorganic salts. The results resemble closely those obtained with iron under similar conditions, and the explanation appears to be substantially the same.—K. **Iokibe**: Copper-zinc alloys which expand on solidification. Extensometer tests show that the expansion is observed only with alloys containing from 5 per cent. to 30 per cent. of copper. There is a sharp maximum peak with 15 per cent. of copper. There is a contraction on alloying. The amount of expansion varies with the rate of cooling; with very slow cooling the density may fall from 7·3

to 6·2 corresponding with an expansion of about 18 per cent. due to the formation of minute voids, which are not gas holes. Slowly cooled alloys are of uniform composition throughout: but chill cast bars, though of uniform average composition when examined in horizontal sections, are inversely segregated vertically. The more rapid the cooling, the greater is the difference in copper content between successive vertical layers on proceeding from the outside to the inside of the bar; it may amount to as much as 25 per cent. of the total copper content. The maximum inverse segregation in rapidly cooled alloys coincides with the maximum expansion of slowly cooled alloys. The expansion appears to be connected with the change, on slow cooling or annealing, from the unstable state of inverse segregation to the stable state of uniform composition.—M. **Isihara**: The equilibrium diagram of the copper-tin system. The electric resistance of the alloys at different temperatures was measured, the rate of heating and cooling being slow enough to enable the equilibrium state to be obtained. Some points are as follows: The α constituent shows a progressive transformation beginning at 480° to 580° C., according to the concentration of tin; the maximum solubility of tin in α is 11 per cent.; the constituent δ is a compound Cu_4Sn, and has no capacity for dissolving copper below 510° C.; the constituent η is a solid solution of tin in a compound Cu_3Sn; the constituent ϵ is a compound CuSn, and has no capacity for dissolving η or tin below 400° C.—C. H. M. **Jenkins** and D. **Hanson**: The constitution of the alloys of copper and cadmium. The alloys of copper and cadmium have been previously investigated by Sahmen, revealing the presence of the two compounds Cu_2Cd and Cu_2Cd_3. Six primary constituents, α, β, γ, δ, ϵ, and η, capable of separating from the liquid condition, are found. Two eutectics occur, one between γ and δ at 544° C. with a copper content of 39 per cent. by weight, the other between ϵ and η at 314° C. with a copper content of 1·2 weight per cent. of copper. The solid solubility of cadmium in copper (α) is approximately 2·7 per cent., while the solubility of copper in cadmium is approximately 0·07 per cent. The concentrations representing the homogeneous phase fields appear to correspond closely to those of the compounds Cu_2Cd, Cu_4Cd_3, Cu_2Cd_3, and $CuCd_3$. At temperatures below that of their formation Cu_4Cd_3, Cu_2Cd_3, and possibly $CuCd_3$ possess a solubility in the solid state for either copper or cadmium.—E. R. **Jette**, G. **Phragmén**, and A. F. **Westgren**: X-ray studies on the copper-aluminium alloys. Four different phases appear in these alloys. The $CuAl_2$ phase has tetragonal structure, with an axial ratio of 0·805. The elementary prism is body-centred, and contains four molecules of $CuAl_2$. The phase present in the range 16 to 25 per cent. aluminium has a cubic lattice. In the 16 per cent. alloy the elementary cube contains about 52 atoms, and in the 25 per cent. alloy the corresponding number is only 49. The solutions within the range are thus formed by a *complex substitution*. The curve of the change of density is in close agreement with that obtained by supposing that three copper atoms in the lattice are replaced by two aluminium atoms. A photogram of a quenched specimen containing 12·5 per cent. aluminium shows lines corresponding to a phase stable only at higher temperatures.—F. W. **Rowe**: The effect of casting temperature on the physical properties of a sand-cast zinc-bronze. A bronze of the composition: Copper, 87·96; tin, 6·08; lead, 0·52; zinc, 5·31; phosphorus, 0·021; iron, 0·02, was used. The tensile strength, the elongation and impact figures showed a marked optimum with a casting temperature of 1130° C. The Brinell hardness figure rose steadily as the casting temperature fell, a common feature of all gun-metals and bronzes. The microscopic appearance showed that bars cast at higher temperature have the eutectoid more finely divided than those cast at the lower temperatures. The macroscopic appearance showed the grain size to fall progressively with the casting temperature.—D. **Stockdale**: The aluminium-copper alloys: alloys of intermediate composition. Alloys containing between 16 per cent. and 76 per cent. of aluminium were used. The methods used were thermal and microscopic. The compound, Cu_2Al, exists in two polymorphic modifications. A second series of solid solutions, which is stable at high temperatures, is remarkable in that the structure cannot be maintained even by the most sudden quenching. This series, too, may exhibit polymorphism. The compound $CuAl_2$, once formed, is extremely stable, and neither copper nor aluminium can dissolve in it. Silicon, even in small quantities, exerts a very disturbing influence on the diagram, probably through the formation of the compound Cu_3Si. The intermediate alloys are all white, and exceedingly brittle. Saturated solutions show strange twinning effects and are very difficult to polish. It is unlikely that these alloys can be put to any common industrial use, even though they are most resistant to the action of acids.

Royal Statistical Society, March 18.—Lord Emmott, president, in the chair.—A. W. **Flux**: The census of production. In the United States the census of industrial production in 1919 showed that the value added to materials in the process of manufacture per head of those engaged was 91 per cent. above the 1914 figure, the rise in money value of everything concerned in manufacturing processes being the principal explanation of this large increase. In 1921 a slight fall was registered, while the numbers concerned, which had increased between 1914 and 1919 by 31 per cent., fell back to practically the 1914 total. Comparing the figures from the three United States censuses of 1909, 1914, and 1919 with the corresponding data for the United Kingdom in 1907, the productiveness of industry per person employed appears to have been about two and a half times as great in the United States as in Great Britain, while the variations in the United States at successive censuses appear to reflect rather changes in price levels than variations in effectiveness of productive processes. The Canadian results show production values equal to or greater than those of the United States relative to the aggregate numbers employed. In Australia the returns show that about 1907 the net output per head was greater (in money value) by 50 per cent. than in Great Britain. It has increased with the rise of prices to the latest date covered by the issued reports, 1921–22. The money value of the net output was higher in New Zealand than in Australia, so far as the published figures can be taken as covering precisely the same categories. The mechanical power used per person employed in New Zealand has more than trebled in the last sixteen years.

Official Publications Received.

Memoirs of the Geological Survey of India. Vol. 47, Part 2: The Alkaline Lakes and the Soda Industry of Sind. By Dr. G. de P. Cotter. Pp. vii+202-297+xiv+9 plates. (Calcutta: Geological Survey of India.) 4 rupees.

U.S. Department of Agriculture. Farmers' Bulletin No. 1362: Insects injurious to Ornamental Greenhouse Plants. By C. A. Weigel. Pp. ii+81. (Washington: Government Printing Office.) 15 cents.

Southern Rhodesia. Geological Survey Bulletin No. 9: The Geology of the Country west of Sinoia, Lomagundi District. By H. B. Maufe, B. Lightfoot, and the late A. J. C. Molyneux. Pp. 74+14 plates. (Salisbury.)

Department of the Interior: United States Geological Survey. Bulletin 749: Geology of the Tullock Creek Coal Field, Rosebud and Big Horn Countries, Montana. By G. Sherburne Rogers and Wallace Lee. Pp. vi+181+16 plates. 50 cents. Bulletin 760-A: Pedestal Rocks in the Arid Southwest. By Kirk Bryan. Pp. ii+11+5 plates. (Washington: Government Printing Office.)

Smithsonian Institution: United States National Museum. Bulletin 100, Vol. 1, Part 10: Contributions to the Biology of the Philippine Archipelago and Adjacent Regions. The Polyclad Turbellarians from the Philippine Islands. By Tokio Kaburaki. Pp. 635-649+2 plates. (Washington: Government Printing Office.) 5 cents.

Department of the Interior: United States Geological Survey. Forty-fourth Annual Report of the Director of the United States Geological Survey to the Secretary of the Interior for the Fiscal Year ended June 30, 1923. Pp. ii+89+1 plate. (Washington: Government Printing Office.)

Department of the Interior: Bureau of Education. Bulletin, 1923, No. 43: Games and other Devices for improving Pupils' English. Compiled by Prof. W. W. Charters and Prof. Harry G. Paul. Pp. ix+88. (Washington: Government Printing Office.) 10 cents.

Annual Report of the Director, United States Coast and Geodetic Survey, to the Secretary of Commerce for the Fiscal Year ended June 30, 1923. Pp. v+149+39 plates. (Washington: Government Printing Office.)

Department of the Interior: United States Geological Survey. Water-Supply Paper 502: Surface Water Supply of the United States, 1919 and 1920. Part 2: South Atlantic Slope and Eastern Gulf of Mexico Basins. Pp. iv+80+2 plates. 10 cents. Water-Supply Paper 505: Surface Water Supply of the United States, 1919 and 1920. Part 5: Hudson Bay and Upper Mississippi River Basins. Pp. v+287+2 plates. 30 cents. Water-Supply Paper 524: Surface Water Supply of the United States, 1921. Part 4: St. Lawrence River Basin. Pp. iv+112+2 plates. 10 cents. Water-Supply Paper 528: Surface Water Supply of the United States, 1921. Part 8: Western Gulf of Mexico Basins. Pp. iv+96+2 plates. 10 cents. Water-Supply Paper 520-A: Variation in Annual Run-off in the Rocky Mountain Region. By Robert Follansbee. Pp. ii+14+2 plates. (Washington: Government Printing Office.)

State of Connecticut. Public Document No. 24: Forty-sixth Annual Report of the Connecticut Agricultural Experiment Station; being the Annual Report for the Year ending October 31, 1922. Pp. xi+497+3+53. (New Haven.)

U.S. Department of Agriculture: Weather Bureau. Monthly Weather Review, Supplement No. 23: The Temperature of Mexico. By Jesus Hernandez. Pp. iii+24+75 charts. (Washington: Government Printing Office.) 10 cents.

Proceedings of the Rochester Academy of Science. Vol. 6, No. 5: The Pinnacle Hills, or the Rochester Kame-Moraine. By Herman L. Fairchild. Pp. 141-194+plates 24-77. (Rochester, N.Y.) 1.50 dollars.

University of London. Information as to Appointments and Careers for Graduates and Students. Prepared by Henry J. Crawford. Pp. 87. (London: University Appointments Board, 46 Russell Square.) 1s.; to Members of the University, 6d.

London School of Tropical Medicine: Research Memoir Series. Vol. 5: Helminthological Researches in the Caribbean Sea. Memoir 7: Filariasis in British Guiana: Clinical, Pathological and Therapeutic Investigations. By Dr. John Anderson. Including a Chapter on Statistics based on a Filarial Survey, by J. Anderson, M. Khalil, C. U. Lee, and R. T. Leiper; With an Addendum on Filaria Carriers and a List of Mosquitoes, by G. M. Vevers. Pp. vi+122+23 plates. (London: London School of Tropical Medicine, 23 Endsleigh Gardens.)

Woods, Forests, and Land Revenues. Abstract Accounts, Year 1922-23. Abstract Accounts of the Commissioners of His Majesty's Woods, Forests, and Land Revenues, for the Year ended 31 March 1923; together with the Report of the Comptroller and Auditor General thereon. Pp. 13. (London: H.M. Stationery Office.) 6d. net.

Proceedings of the Cambridge Philosophical Society. Vol. 22, Part 1, February 28. Pp. 81. (Cambridge: At the University Press.) 2s. 6d. net.

The Carnegie Foundation for the Advancement of Teaching. Eighteenth Annual Report of the President and of the Treasurer. Pp. vi+166. (New York City.)

Diary of Societies.

SATURDAY, MARCH 29.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Sir Ernest Rutherford: Properties of Gases in High and Low Vacua (4).

MONDAY, MARCH 31.

INSTITUTE OF ACTUARIES.—W. A. Osborne and others: Discussion on The Inclusion of Disability and Fatal Accident Benefits in Life Assurance Contracts.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—C. E. Shattock: Lymphatic Glands (Demonstration).

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—F. Gill and others: Discussion on Economics in Engineering.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.—H. S. Goodhart-Rendel: English Gothic Architecture of the 19th Century.

ROYAL SOCIETY OF ARTS, at 8.—Dr. T. Slater Price: Certain Fundamental Problems in Photography (Cobb Lectures) (2).

SOCIETY OF CHEMICAL INDUSTRY (London Section) and THE INSTITUTE OF CHEMISTRY (London and South-Eastern Counties Section) (at Institution of Mechanical Engineers), at 8.—Cinematograph Films of Coal and its Products: Heavy Chemicals.

ROYAL SOCIETY OF MEDICINE, at 9.—Sir John Goodwin: Reminiscences.

TUESDAY, APRIL 1.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. L. G. Parsons: Some Wasting Disorders of Early Infancy (Goulstonian Lectures) (3).

ZOOLOGICAL SOCIETY OF LONDON, at 5.30.—O. Thomas and other European Mammalogists: *Nomina Conservanda* in Mammalia.—Dr. W. N. F. Woodland: A new Species of Cestode of the Genus Caryophyllæus from an Egyptian Siluroid.—Dr. C. H. Joh. Petersen: The Necessity for Quantitative Methods in the Investigation of Animal Life on the Sea Bottom.—Prof. R. T. Leiper: An Account of the Parasitological Work at the Society's Gardens.

INSTITUTION OF CIVIL ENGINEERS, at 6.—D. H. Remfry: The Interaction in Bridgework of the Deck System on the Main Girders, and the Consequent Modification of Stresses therein.—Prof. C. E. Inglis: Theory of Transverse Oscillations in Girders and its Relation to Live-load and Impact Allowances.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—H. A. Saunders: The Making of a Topical Film.

RÖNTGEN SOCIETY (at Institution of Electrical Engineers), at 8.15.—Prof. C. G. Barkla: Some Recent Investigations in X-rays—The "J" Phenomena (Silvanus Thompson Memorial Lecture).

WEDNESDAY, APRIL 2.

ROYAL SOCIETY OF MEDICINE (Surgery Section), at 5.30.—Clinical and Pathological Meeting.

INSTITUTION OF CIVIL ENGINEERS (Students' Meeting), at 6.—Eng.-Capt. J. A. Richards: The Manufacture of Solid-drawn Steel Tubes. (Cinematograph Lecture.)

INSTITUTION OF ELECTRICAL ENGINEERS (Wireless Section), at 6.—Research Staff of the G.E. Co., Ltd. (work conducted by M. Thompson and A. C. Bartlett): Thermionic Valves with Dull-emitting Filaments.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (at Engineers' Club, Coventry Street), at 7.—S. J. Benham: Lay-out of Kitchens in this Country and America.

ROYAL MICROSCOPICAL SOCIETY (Biological Section), at 7.30.—Annie Dixon: Some Aspects of Soil Protozoology.

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at Chemical Society), at 8.—J. Golding: Report on The World's Dairy Congress held at Washington, D.C., U.S.A.—Dr. L. H. Lampitt, E. B. Hughes, and M. Bogod: The Routine Examination of Dairy Products with special reference to the Mojonnier Tester.—Dr. J. C. Drummond, Miss M. G. Palmer, and Miss D. E. Wright: Experiments on the Absorption of Copper following the Consumption of Vegetables containing Copper Sulphate.—J. H. Lane and L. Eynon: Determination of Sugar in Urine by means of Fehling's Solution with Methylene Blue as Internal Indicator.—Miss P. H. Price: Attempt to extend Mitchell's Colorimetric Method to the Catechol Tannins.

ROYAL SOCIETY OF ARTS, at 8.—Sir Lynden Macassey: London Traffic.

ENTOMOLOGICAL SOCIETY OF LONDON, at 8.

THURSDAY, APRIL 3.

ROYAL SOCIETY, at 4.30.—Sir Charles Sherrington and E. G. T. Liddell: Reflexes in Response to Stretch (Myotatic Reflexes).—H. M. Carleton and G. C. Robson: The Histology and Function of certain Sex-limited Characters in the Cuttle Fish *Doratosepion confusa*.—*Paper to be read in title only*:—Dr. J. G. Dusser de Barenne: Experimental Researches on Sensory Localisation in the Cerebral Cortex of the Monkey (Macacus).

LINNEAN SOCIETY, at 5.—C. Turner: Further Notes on the Development of *Staurastrum Dickiei* var. *parallelum* Nordst.—Dr. H. S. Holden: Tyloses and Cavity Parenchyma in Ferns.—Dr. H. S. Holden and A. Evelyn Chesters: The Seedling Anatomy of Certain Species of Lupinus.—W. O. Howarth: Occurrence and Distribution of *Festuca ovina* in Britain.

ROYAL COLLEGE OF PHYSICIANS OF LONDON, at 5.—Dr. T. McCrae: The Clinical Features of Foreign Bodies in the Bronchi (Lumleian Lectures) (1).

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Dr. E. J. Allen: Scientific Research on Sea Fisheries.

ROYAL AERONAUTICAL SOCIETY (at Royal Society of Arts), at 5.30.—Col. the Master of Sempill: The British Aviation Mission to the Imperial Japanese Navy.

CHILD-STUDY SOCIETY (at Royal Sanitary Institute), at 6.—Dr. J. E. Borland: Music in the Schools.

CHEMICAL SOCIETY, at 8.—E. H. Ingold: The Tautomerism of Dyads. Part II. Acetylene and its Halogen Derivatives.—H. Bassett and D. J. T. Bagnall: The Potassium Salts of Phenolphthalein.—H. Bassett and A. S. Corbet: (*a*) A Phase Rule Study of the Cupro-, Argento-, Auro-, and Thallo-Cyanides of Potassium; (*b*) The Hydrolysis of Potassium Ferricyanide and Potassium Colbaticyanide by Sulphuric Acid.

FRIDAY, APRIL 4.

ROYAL COLLEGE OF SURGEONS OF ENGLAND, at 5.—Sir Arthur Keith: Development and Surgical Anatomy of the Nasal Air Sinuses (Demonstration).

PHILOLOGICAL SOCIETY (at University College), at 5.30.—Prof. W. A. Craigie: Dictionary Evening.

INSTITUTION OF MECHANICAL ENGINEERS (Informal Meeting), at 7.—Resumed Discussion on Mechanical Methods of Boiler Firing.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—A. C. Banfield and B. Cox: The Oil Processes (Demonstration).

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—A. J. Sear: Mineral Oils, with Special Reference to Lubricating and Insulating Oils.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Sir Ernest Rutherford: The Nucleus of the Atom.

SATURDAY, APRIL 5.

GILBERT WHITE FELLOWSHIP (Annual General Meeting) (at 6 Queen Square, W.C.1), at 2.15; at 3.—G. J. B. Fox: The Angel Choir of Lincoln Cathedral.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Dr. C. Singer: Aristotle as a Biologist.

PUBLIC LECTURE.

SATURDAY, MARCH 29.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—S. H. Warren: Prehistoric Man and the "Land of Lyonesse."