THURSDAY, APRIL 13, 1916.

IRRADIATION: ITS PHYSIOLOGY, PATHOLOGY, AND THERAPEUTICS.

Radium, X-Rays, and the Living Cell. With Physical Introduction. By H. A. Colwell and Dr. S. Russ. Pp. x+324. (London: G. Bell and Sons, Ltd., 1915.) Price 12*s.* 6*d.* net.

THE authors' object is "to describe some of the main experimental facts which have been established as to the effects of the X-rays and the rays from radium upon living cells." The first part of the book is devoted to physics, and contains a trustworthy account of the properties of the X-rays, primary and secondary, and of the radio-active substances, with the characters of the various forms of radiation and the changes brought about by their action. The measurement of ionisation is described, the distinction between "hard" and "soft" rays—recognised clinically by all radiologists—is explained on physical lines, and the methods of measuring doses of X-rays are discussed. The empirical method of Sabouraud of judging the dose by the change of colour of a pastille is still in vogue, and those who use the method are aware that they must keep all the conditions constant (state of vacuum of the tube, length of the parallel spark gap, reading of the milliamperemetre, etc.); the authors are wise, however, to point out anew that the same change of colour, if produced by soft rays in one case and by hard rays in another, may give rise to results widely different in the two cases.

In describing the characters of radium emanation, the use of the "Emanatoria" is discussed. These institutions are founded on the fact that radium emanation, when breathed mixed with air, gradually makes its way into the circulation by solution and diffusion, and so reaches all the tissues of the body. The air of the Emanatorium is breathed for two or three hours at a time, and it is found that a state of equilibrium is reached in half an hour, while nearly all the emanation (90 per cent.) has disappeared from the system one hour after removal into fresh air. The emanation, while circulating in the body, is continually forming the active deposit, which is not lost by way of the lungs as is the case with the emanation. These Emanatoria have been extolled for the "scientific" treatment of gout, on the principle (capable of laboratory demonstration) that the insoluble monosodium urate can be broken up by radium D into several simpler bodies, which are eliminated as carbon dioxide and ammonia. The authors point out, however, that the concentration of the emanation in the blood in patients subjected to Emanatorium treatment never reaches more than one ten-millionth of that used in the laboratory experiments; hence it seems unlikely that any appreciable decomposition of monosodium urate can take place in the blood.

Globulin solutions are used in experiments to show that α radiation may produce results differing in degree and in kind from those due to β and γ rays.

The effects of the irradiation of bacteria is discussed with the aid of conclusive experiments, and it is shown that a bactericidal result can be attained, though the dose required is a very strong one from a clinical point of view. In local conditions a solution of radium emanation might be useful, but the choice of a solvent is important, and most of the fluids having high coefficients of absorption cannot be used for injection into the body. Liquid paraffin is the most suitable solvent; its coefficient of absorption is high, and its viscosity keeps it at the site of injection.

The changes produced in the skin by irradiation are only too well known to those who were pioneers in the clinical use of the X-rays. The histological changes are described in detail, and illustrated by photomicrographs. These changes are both atrophic and hypertrophic, and the latter tend to culminate in cancer.

The blood changes are of great interest, and in certain blood diseases a very favourable result is produced by irradiation. This is notably true of leukæmia, a disease in which the white cells are enormously increased in number, while many of them are abnormal in type. The red cells are decreased in number. The result of X-ray treatment is to restore the blood more and more nearly to a normal state, both qualitatively and quantitatively.

Of special interest to the medical profession, and also to the public, is the discussion of the effect of irradiation of cancerous cells. This subject receives full attention, an account of the results on experimental cancers (*e.g.* in mice) being followed by a description of those on spontaneous cancers in man and in the lower animals. It is found that young, actively-dividing cancer cells are most susceptible to irradiation, and that in some of these cases (especially in the grafted cancers of mice), while a large tumour may disappear rapidly, its destruction may cause the death of the animal by the toxins evolved during the disintegration of the mass.

Another aspect of the cancer question is the converse one, of the way cancerous change may be produced in healthy tissues by repeated small doses of soft X-rays. This topic has been touched upon already in the case of the hands of radiologists.

The question of idiosyncrasy is a difficult one, and radiologists of repute differ, even now, as to whether cases of real hypersensitiveness to X-rays exist. Every careful radiologist of experience will, we believe, agree with the authors that the same dose does not produce exactly the same effect in different persons, or even in the same person at different times. Another point is made by the authors when they show that a large dose acting for a short time is not equivalent to a small dose acting for a long time.

The book closes with a short but lucid chapter on the selective and differential action of the rays. In the case of the protozoa, it is shown that a

wide variation exists in their response to the same exposure. An absence of chlorophyll makes for increased sensitiveness, and the multi-nucleated forms suffer more than the mono-nucleated, and the large forms more than the small. In the testicle the rays show an essentially selective action, the seminiferous epithelium being destroyed by a dose to which the cells of Sertoli are indifferent. Certain tissues are highly sensitive to the X-rays—notably lymphoid tissue, cartilage, and the endothelium of blood-vessels. Within limits it is true to say that very rapidly growing cells are most affected by irradiation. But it is important to note that different rays give rise to different effects upon one and the same kind of cell, and "a careful distinction should be made between the differential action which different rays have upon the same variety of cell, and the selective action which the same kind of radiation has upon the many different varieties of cells." The X-ray spectrum covers a range of many octaves of wave-length.

If we consider a single cell, we find it exhibits a widely varying degree of reaction (to irradiation) according to the particular phase of its life cycle in which it happens to be at the time. Thus certain ova are nearly eight times as vulnerable to β-rays when they are in an active state of division as when they are in a resting stage. This fact indicates one of the difficulties of quantitative investigations upon living tissues. The chemical composition of a cell may determine the degree of change brought about by irradiation. In sections of malignant growths cut for the microscope before and after irradiation, the staining reactions point to marked changes in chemical composition, and these go hand in hand with the morphological changes.

The authors have given us a book which cannot fail to appeal to the clinical radiologist and to the laboratory worker. Each chapter has received careful study in the writing, and provides food for thought and suggests scope for further investigation on the part of the reader. The book is well printed in clear type on good paper, and contains many excellent illustrations. There is an index of authors, as well as a full general index.

THE MEDIUM UNDER THE MICROSCOPE. A Contribution to the Study of the Psychology of Mrs. Piper's Trance Phenomena. By Mrs. Henry Sidgwick. *Proceedings of the Society for Psychical Research.* Part lxxi., vol. xxviii, December, 1915. Pp. xix + 657. (Glasgow: R. Maclehose and Co., Ltd., 1915.) Price 12*s.* net.

WILLIAM JAMES once referred to Henry Sidgwick as "the most exasperatingly critical mind in England," and the whimsical compliment was well deserved. After the death of the famous professor of moral philosophy, the mantle of the arch-critic fell naturally on the shoulders of one of Sidgwick's most able pupils, Mr. A. J. Balfour, whose "Defence of Philosophic Doubt" was as destructive as we hope our Navy will be under his First Lordship; but now that he has reached a more constructive period, as evidenced by his recent "Theism and Humanism," the pallium passes to his sister, the professor's widow, and late principal of Newnham College. Anyone who is not willing to believe unquestioningly what has successfully passed the ordeal of her scrutiny must be constitutionally unable to believe anything. If she were censor the newspapers would have to cease publication, for she would never believe any but official reports, and probably not them.

In this bulky volume Mrs. Sidgwick discusses the phenomena of the famous Boston medium who has been for twenty-five years almost continuously under the supervision of various eminent scientific men, including Prof. James—who was an M.D. as well as the apostle of Pragmatism—and Sir Oliver Lodge. This lady began to experience sleep-like trances in 1884, but they were only sleep-like so far as concerned Mrs. Piper's normal consciousness, for her tongue talked—or, later, her hand wrote—in a very wideawake fashion. What was there, in place of Mrs. Piper's normal consciousness, which certainly was *not* there, furnishes the theme of Mrs. Sidgwick's discourse. First, ostensibly, came a Dr. Phinuit, a "spirit" who said he had been a doctor in Metz. Investigation failed to trace his earthly career, and his knowledge of French was scanty—seemed, in fact, about like Mrs. Piper's. But the queer thing was that this dubious entity could usually tell sitters quite a lot about their deceased relatives, and he professed to get the information from the relatives themselves, who were with him in the spiritual realms. This kind of thing happened freely, even when the investigators introduced sitters from a distance—people entirely unknown to Mrs. Piper—anonymously or pseudonymously. Then another spirit turned up—George Pelham, a lawyer formerly known to the Society's chief investigator, Dr. Richard Hodgson—who gave any amount of identification evidence about himself, recognising his friends and greeting them by name in astonishingly correct fashion. Later there appeared various characters in early history. Lastly came Hodgson, who had died in 1905; but his evidence is not very weighty, because he was known to Mrs. Piper, and consequently we must assume that any given would-be identification-fact may also have been known to her.

Now what about all these "controls" and "communicators"? What are they, anyhow? Spirits, as they allege, or dream-personalities, fragments of Mrs. Piper's subliminal or hypnotic consciousness? Mrs. Sidgwick thinks the latter; and most people will agree with her rather than weigh all her arguments, which are lengthy and complicated, though the historical part of the book is easy and interesting. She admits, however, that Mrs. Piper's trance utterances contain a great deal of matter which Mrs. Piper has not learnt through the known sensory channels. This dis-

poses of the fraud-theory. Some of this matter may be due to thought-transference ("telepathy") from living people; but in some cases it seems almost necessary to admit telepathy from the so-called dead. Particularly is this the case in regard to George Pelham, whose evidence is given in an earlier volume of "Proceedings"—No. 13.

All investigators admit that the evidence in that volume is impressive, and that the Piper case as a whole is remarkable. It is still more remarkable, perhaps, to find so cautious a mind as Mrs. Sidgwick's accepting communication from the dead as a reasonable hypothesis, even though she does dignify it with the sounding title of telepathy through a personation or subliminal fraction. Certainly the evidence does seem beginning to appear conclusive or almost so. It can no longer be "vanquished with a grin." Perhaps in due time it may become so strong that man's survival of death will be a scientific as well as a religious belief. Meanwhile, such volumes as that under notice are very welcome as showing a *via media* between extremes of credulity and incredulity, which are equally unscientific and regrettable.

J. A. H.

ANALYTICAL AIDS FOR FACTORY CHEMISTS.

Solvents, Oils, Gums, Waxes, and Allied Substances. By F. S. Hyde. Pp. vi+176. (London: Constable and Co., Ltd., 1915.) Price 8*s.* 6*d.* net.

AT the moment the factory chemist is very much before the public. The university-trained man complains of the very inadequate reward which he can obtain for his labours. The manufacturer is reported to be dissatisfied with the chemist fresh from the university, and all parties criticise the present methods of training. It might be at least expected that the technical chemist should know chemistry, meaning thereby a full knowledge of the properties, preparation, and manipulation of the commoner substances, both inorganic and organic; that he should understand the spirit of research and how to set about a problem; that he should be versed in getting up the literature. The fact is, such chemists are rare; a real knowledge of chemistry, particularly organic chemistry, is largely neglected. As a consequence special text-books are provided for the use of factory chemists, such as the one before us. It contains in the minimum number of words a short statement as to the properties of a variety of organic substances, and will serve as a useful adjunct to the memory of the properly trained man. In the hands of others it is more likely to mislead, since as a result of the condensation necessary, the information is often scrappy and unequal, and the true spirit of organic chemistry is missing.

For example, the statement that dextrose is less sweet than cane sugar, though true, in no way conveys the proper idea to anyone imperfectly acquainted with the great difference between the two sugars in appearance and in crystalline character. Glucosides are defined as substances which "on fermentation" or by hydrolysis yield glucose. Ethyl alcohol is dismissed in nine lines! Ten pages suffice for the alkaloids and bitter principles.

As a whole, the book is well done; it is full of information, accurate and up-to-date, particularly as regards the sections devoted to oils, fats, and waxes, which occupy more than half the contents. This branch of chemical analysis involves the use of a number of special methods, largely empirical in character, and usually labelled with the names of their proposers, with which the would-be expert must be acquainted. For this purpose he will find Mr. Hyde's book most helpful.

It will be much more to the advantage of the individual worker as well as of the works laboratory, however, if information be sought from the larger manuals of chemistry and the critical faculty in analysis is cultivated, instead of striving more or less mechanically to carry out operations as quickly as possible, by following explicit instructions without any real understanding of the chemistry of the reactions concerned.

ASTRONOMY FOR JUVENILE READERS.

A Voyage in Space: ~~A Course of~~ Six Lectures "Adapted to a Juvenile Auditory" ~~delivered at the Royal Institution at Christmas~~, 1913. By ~~Prof.~~ H. H. Turner. Pp. xvi+304. (London: S.P.C.K., 1915.) Price 6*s.* net.

THE voyage in space which forms the subject of this book is not a romantic flight of the imagination, such as might have been written by Jules Verne, but an account of a journey by telescope. In other words, it is an elementary book on astronomy, and is founded on a course of lectures to young people at the Royal Institution. Following the example of Faraday on a similar occasion, the author has retained the language of the lecture room, and has thus been able to preserve the freshness of the original presentation. The reader is necessarily deprived of witnessing the actual experiments, and of seeing many of the pictures exhibited by the lantern, but the descriptions are so vivid and the illustrations so numerous that he will readily imagine himself to be a member of the audience.

The difficulty of leaving the earth in the flesh provides the occasion in the first lecture for an account of gravity in its historical, experimental, and astronomical aspects. Then, in the second lecture, the immense distances which have to be traversed before reaching the heavenly bodies are dealt with, and an interesting talk is devoted to our own atmosphere, which must necessarily be passed through during the first part of the voyage. Telescopes, as the only means of travelling to distant spheres, are the subject of the third lecture, and subsequent lectures deal respectively with visits to the moon and planets, to the sun, and to the stars.

Although an astonishingly wide range of subjects is covered by the lectures, the book is not to be regarded as a comprehensive introduction to astronomy. Thus, explanations of everyday phenomena, such as the phases of the moon, the apparent annual motion of the stars, or the appearance of Venus as a morning or evening star, do not come within its scope. On the other hand, the author has not hesitated to introduce such matters as the principles of spectrum analysis, the sun-spot swarm hypothesis, the selenium photometer, the systematic motions of the stars, and the spectroheliograph. But whatever the subject in hand, he is generally successful in making it interesting and easy of comprehension as regards general principles. The treatment is at times unconventional, but never dull or obscure, and the interest throughout is maintained by an abundance of appropriate stories and quaint allusions. The illustrations, of which there are more than 130, are well chosen, and include many which have not previously been seen in text-books, some of them being of marked originality. We cordially recommend the book as being likely to give an intelligent interest in the fascinating investigations of modern astronomy.

OUR BOOKSHELF.

East Lothian. By T. S. Muir. Pp. viii + 117. (Cambridge: At the University Press, 1915.) Price 1*s.* 6*d.* net.

EAST LOTHIAN includes representatives of the chief geographical types found in the Scottish lowlands. It has a varied coast, rich plains and high moorland, and its especial geographical feature is its series of volcanic necks, including Berwick Law. The county has played an important part in Scottish history, for in it were fought the battles of Dunbar and Preston Pans, and it was the birthplace of such representative Scots as John Knox, Baird of Corunna, and Moffat. Its coal mines are of historic interest as the oldest on record, and their mediæval labour conditions lasted till little more than a century ago, when the miners were still serfs who were restricted to their native places and whose children had to follow the occupation of their parent. The county is mainly famous for its agriculture, and owing to the exceptional quality of its soils and the scientific skill of its farmers, its crops are perhaps unsurpassed in value. Mr. Muir tells us (p. 58) that 4*l.* to 5*l.* per acre is a common rent, and that the county, though small, contains no fewer than seventeen farms with an annual rent of more than 1000*l.*

This volume of the Cambridge County Primers is fortunate in its author; for Mr. T. S. Muir, who is geographical master at the Edinburgh High School, knows the county well, and describes it in accordance with modern geographical ideas. The work includes summaries of the geology and natural history of the county, but they are treated from their geographical aspects. One of the most interesting sections is on the place names, which are illustrated by a map showing the distribution of those of Gaelic, Pictish, and Teutonic origin. The work is well illustrated by photographs and physical and geological maps. J. W. G.

Theosophy and Modern Thought. By C. Jinarājadāsa. Pp. 171. (Adyar, Madras: Theosophical Publishing House, 1915.) Price 2*s.*

THERE are here four lectures—on theosophy and the problem of heredity; history in the light of reincarnation; the basis of art expression; and the search for reality. Dealing with heredity, the author shows that he has been greatly influenced by Prof. Bateson's Australian address. "The growth from protoplasm to man, and from the savage to the genius, is by a process of *losing* inhibiting factors; and by loss of factors faculties are released." The release of the possibilities of life and growth is guided by intelligences, the Deva Builders, who bring about the evolution of the form side of things by producing changes from the life side in each group-soul.

The second lecture illustrates eloquently the idea that as nations pass away they reincarnate in other parts of the earth—the Phœnicians in the Germans, for instance, and those who said "Carthago est delenda" in those who say "Prussia must go." The third lecture is largely concerned with the doctrine of archetypes, which are striving to express themselves in organic evolution. Every beautiful organism is a window through which man may get a glimpse of an archetype, "a masterpiece of the artist of artists, the Demiourgos of our world." In the fourth lecture Mr. Jinarājadāsa speaks of the many pathways to reality and the spirit which must possess those who would be pilgrims.

Nutritional Physiology. By P. G. Stiles. Pp. 288. (Philadelphia and London: W. B. Saunders Company, 1915.) Price 6*s.* net.

THIS is the second edition of Prof. Stiles's useful manual, the first of which appeared about three years ago. Although its chief object (alimentation, digestion, metabolism) is expressed in the title, other related portions of physiological science, such as the circulation, the ductless glands, and even the nervous system are considered briefly. The main subject is treated from the point of view of energetics, and we can trace throughout the influence exercised by Prof. Graham Lusk, to whom the book is dedicated. Lusk is one of the leading lights across the Atlantic, who have successfully striven to render the subject of metabolism scientifically correct by such a method of treatment. W. D. H.

Our Cottage and a Motor. By Margaret Moncreiff. Pp. 163. (London: George Allen and Unwin, Ltd., 1916.) Price 3*s.* 6*d.* net.

THIS chatty description of a holiday spent in a Sussex cottage, when the days were often spent motoring among the lovely lanes, makes very pleasant reading. We hope the spelling Sir Charles Leyall, on pp. 127 and 128, for the name of the distinguished geologist will be changed in any future edition of the book.

LETTERS TO THE EDITOR.

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

Smithsonian Physical Tables.

THE Smithsonian Institution has just published a new edition of the Smithsonian Physical Tables, corrected and slightly modified from the sixth revised edition. Requests have come from certain educational institutions for separate copies of certain individual tables for the use of students in laboratories. If there is likely to be a considerable demand for such separates, the institution will have them printed on stiff paper and distributed at cost to those who desire them. With the view of ascertaining the probable demand for separate tables, it is requested that readers of NATURE inform the Institution which tables they would desire in separate form, and the number of copies of each they would probably require. All tables for which the probable demand of this kind reaches 100 copies will be reprinted separately.

The tables may be consulted in nearly all the larger libraries.

C. D. WALCOTT,
Secretary.

Smithsonian Institution,
Washington, U.S.A., March 23.

Effect of Tidal Water in an Estuary on the Level of Subterranean Water.

AN artesian well was bored at Portishead last August lined with 8 in. and 10 in. casing, the annular space between the casings being filled with cement, so that the possible ingress of surface waters is avoided.

The well has been in constant use since that date, the water-level standing in the summer about 10 ft. below the surface of the ground, which is only a foot or two above high-water mark. A few days ago pumping from the well was temporarily discontinued. It was noticed that the level fluctuated with the state of the tide. When the tide was out the level of the water was about 4 ft. below the surface; as the tide came in the level of the water gradually rose, until at high tide the well was overflowing.

This behaviour has continued regularly, the rise and fall of level closely corresponding with the rise and fall of the tide.

This affords an excellent example of the weight of the incoming tide water in the Severn estuary, subjecting the underlying strata to pressure and squeezing the water out as if out of a sponge. The water is drawn from strata underlying more than 100 ft. of clayey marl. JAS. KEWLEY.

Cambrian Lodge, Portishead, March 30.

Is Soap Necessary for Shaving?

AT the present time when economy is the watchword, it may be not altogether a waste of time to ask whether soap is necessary for shaving?

The old Romans and Greeks, as evidenced by the statues, were evidently gentlemen addicted to shaving, but, save for a small soap factory discovered at Pompeii, the means of producing soap in those days must have been very limited.

The only conclusion that one can arrive at is that they must have shaved without soap, a practice that is to the present day indulged in by our Oriental Allies, the Japanese, as well as by their neighbours, the Chinese.

Before deciding definitely to discard such a familiar adjunct of the toilet, it might be of interest to inquire why we have been in the habit of using soap for shaving.

The answers to the question received from scientific and unscientific persons are very interesting, culminating in the fascinating one of a barber who thought that the soap propped up the hairs and kept them in an upright position.

Lathering has the effect, when properly done, of reducing the bulk of the soap, and increasing the number of bubbles whereby water is kept in close apposition to the skin by the surface tension.

This is a roundabout way of using water as a lubricant for the efficient and easy passage of the razor across the skin, but once the lubricating qualities of water are recognised as of value in such circumstances it is but a short step to applying the water direct and shaving while the skin is well soused.

This is the method for long in use by the Orientals, and is one that can be thoroughly recommended for trial in this country.

Apart from its economy, the skin is not so liable to irritation, the edge of the razor is not so easily dulled, whilst the whole operation is completed in half the time. G. ARBOUR STEPHENS.

March 25.

MALARIA AND SANITATION.[1]

THE title of this work is somewhat inappropriate as the book deals scarcely at all with many aspects of rural sanitation, but is devoted in the main to what undoubtedly is a very important problem, viz., malaria prophylaxis. It is also not quite evident for what class of reader the book is intended. The book has none of the characters of a text-book or treatise on sanitation, but gives the impression of being written rather for the intelligent layman—we have, *e.g.*, two and a half pages of extract from Lafcadio Hearn's works—were it not that here and there discussions on technical points are recorded at some length, *e.g.*, the identity of certain species of Anophelines. What the book really consists of for the most part is a diary of various sanitary tours made by the author. The outstanding feature of the book is the author's enthusiasm for his subject, and the best portions, for they are the fullest, are those devoted to the sanitary problems that arose at every step in the making of the Panama Canal and the descriptions as to how these difficulties were overcome. Out of eighteen chapters, nine, and out of fifty-six illustrations, thirty-six, are devoted to the Canal.

To malaria in India, on the contrary, the author gives the inadequate amount of only a dozen pages, and these concern the importance of species in determining the prevalence of malaria, a fact fully recognised in India sixteen years ago, which the author confirms from his own experience in the Malay States. The author's work in reducing malaria in Klang and Port Swettenham is well known, but we do not get a clear idea from this book as to how it was done. We know these places were drained, but we should have liked sketch-maps of breeding-places showing the

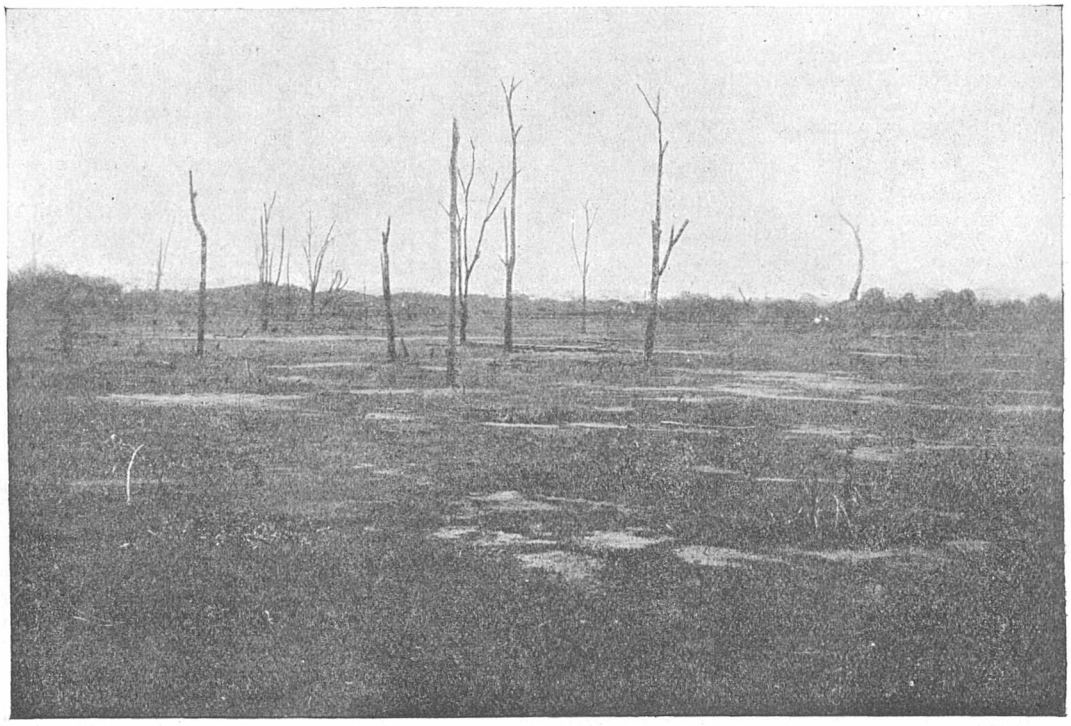
[1] "Rural Sanitation in the Tropics." By Dr. M. Watson. Pp. xvi+320 (London: John Murray, 1915.) Price 12*s.* net.

species of mosquito concerned, the result of the draining on the breeding-places, and generally a fuller account, but perhaps these will be found in another work to which the author refers, and here only the broad outline was intended.

The author in writing is inclined to use rather vague expressions, such as "a long series of blood examinations" (the number is not given), "proved up to the hilt" (sometimes a very dangerous expression, as one could easily show), "quinine in every shape and form" (dose not stated), "a high percentage" of the labourers harbours malaria parasites (figure not given), and his use of figures is not entirely satisfactory, *e.g.*, in the Panama chapters he quotes figures to show that there were eighty-three cases of hæmoglobinuric fever among Barbados natives, while there was only one author is the "flights of mosquitoes" noted in the Canal zone.

These began about 6 p.m. and ceased before 9 p.m. "Hundreds of Anopheles could be seen passing by," and the flights attracted insectivorous birds to activity. The range of flight was about 6000 feet, originating in a marsh and terminating in an inhabited area, the object of the flight being apparently blood.

A most important fact that the author draws especial attention to is that in certain estates in British Guiana malaria has disappeared. Agriculture has in some way, for all practical purposes, abolished it. Anopheles do not breed in the water in land which is cultivated in British Guiana, but Culex do so in abundance. Now a knowledge of what exactly is implied in the term "agriculture"



Land raised by "hydraulic filling" on the east bank of the French canal at Gatun. The remains of the swamp trees are still to be seen. From "Rural Sanitation in the Tropics."

among natives of Costa Rica; but as no data are supplied as to the relative number of these two classes of labourers, one can draw no valid conclusion. On page 249 the admission rate in 1906 for malaria among a labour force of 26,705 was 821; in 1913 the rate for a force of 56,654 was 76. Now in order that these figures should be comparable it should have been shown that the percentage composition of the force as regards races was the same in 1913 as it was in 1906, but this is not done. One has little doubt that there has been this fall, but the figures *per se* do not completely prove it; if, for instance, the white population had been partly replaced by the relatively immune negro in the interval, this would vitiate the figures.

A very interesting phenomenon recorded by the here is of the first importance. We should imagine no more valuable data could be given than would be in an account of the difference between a malarial area and a non-malarial area in British Guiana. This book should be read by all officials who obstruct, or turn a deaf ear to, the claims of sanitation, though there are other necessities of life, as the author points out in his epilogue. J. W. W. S.

THE POLLINATION OF FRUIT TREES.

INVESTIGATIONS carried out in this country, in America, and elsewhere have demonstrated the fact that many of our cultivated varieties of apple, pear, plum, &c., are self-sterile. They have shown, moreover, that whereas a variety

may be sterile when pollinated with its own pollen, it yields an abundant crop if pollinated with the pollen of certain other varieties. Hence it is of considerable economic importance to discover which varieties serve best for mutual cross-pollination.

Mr. Cecil H. Hooper has been engaged in the study of this subject for some years, and he published a short time ago a summary of the results of observations made by others and himself on the pollination of apples, pears, plums, and cherries.

The list of self-sterile apples is surprisingly large. It includes Lane's Prince Albert, Bismarck, Annie Elizabeth, Warner's King, Gladstone, Lady Sudeley, James Grieve, and Cox's Orange Pippin (rarely self-fertile).

It is to be observed, however, that, as indicated in the case of Cox's Orange Pippin, self-sterility is by no means absolute in all these varieties. This, although of no particular importance practically—for a poor setter no less than a completely self-sterile variety requires to be planted with a variety the pollen of which causes it to set fruit freely—is nevertheless significant from a scientific point of view. It means probably that some link in the chain of chemical changes pre-requisite for the germination of the pollen tube on the stigma and its growth in the style is missing, rather than an inability of the sexual nuclei to unite with one another. Thus it is known that the absence of a particular kind of sugar on the stigmatic surface may suffice for the suppression of the germination of a pollen tube. Hence it is most desirable that this problem of sterility of fruit trees should be studied more minutely than has been the case up to the present. The pioneer field work has been done fairly thoroughly; it is now time for the physiological botanist to intervene. He, unfortunately, is so sequestered in his laboratory that he rarely discovers even the existence of the stimulating problems which modern horticulture offers for elucidation.

The establishment of horticultural research stations at Merton, Wisby, and Long Ashton gives ground, however, for the hope that this attitude of aloofness is a thing of the past, and indeed it is these stations that are contributing most to our knowledge of the phenomena of self-sterility of fruit trees.

That the reproductive organs of fruit trees, like those of many other cultivated plants, are subject to grave disturbances is indicated by the fact that not a few apples are very shy of pollen bearing. Among varieties which exhibit this habit, Mr. Hooper mentions Newtown Wonder, King of the Pippins, Irish Peach, Baumann's Red Winter Reinette, Cox's Pomona and Broad-eyed Pippin.

Pears are apt even more than apples to be self-sterile, and such varieties as William's Bon Chrétien, Pitmaston Duchess, Doyenné du Comice, and others require to be planted in propinquity with good "pollenisers." Progressive fruit-growers are, of course, well aware of the stubborn fact of partial or complete self-sterility, and see to it that their orchards contain varieties which supplement each other's pollen requirements; but it is to be feared that many small growers are not so alive to these facts as they should be. However, so long as many of the small orchards of this country are so ill-cultivated as they are at present, self-sterility of varieties is of no great moment to the trees or owners, for the crops would inevitably be poor, in spite of the introduction of good pollenisers.

Of the insects visiting fruit trees and presumably engaged in transferring pollen to the stigmas of the flowers, Mr. Hooper gives an interesting list. In the case of apples observed during 1912 and 1913, the record was:—Hive bees, 72; bumble bees, 26; other wild bees, 2; other insects, 20. The insect visitors to the cherry were in somewhat similar proportions, but in the case of the plum the visits of bumble bees were to those of hive bees as 41 is to 29. How far the reduction in numbers of hive bees due to recent epidemics is likely to have an effect on the yield of apples is an open question.

FREDERICK KEEBLE.

[1] "Notes on the Pollination of Orchards." By Cecil H. Hooper. *The Fruit, Flower and Vegetable Trades' Journal*, September, 1915.

PROF. OCTAVE LIGNIER.

PALÆOBOTANY recently suffered a serious loss in the death of Graf zu Solms-Laubach and Prof. Zeiller. Another gap has been made in the ranks of the small body of botanists whose work is mainly concerned with extinct plants by the death, on March 19, of Prof. Octave Lignier, who occupied the chair of botany at Caen since its foundation in 1889. Prof. Lignier was born on February 25, 1855, at Pougy (Aube, Champagne). His earlier botanical studies were chiefly concerned with investigations undertaken to test the value of anatomical characters as a guide to the affinities of the Calycanthaceæ and other Dicotyledons. These researches led him to adopt certain views with regard to the important part played by the foliar vascular system (the "meriphyte") in the evolution of the conducting system of the stem. For his original ideas on this subject Lignier did not always receive his full share of credit. He also wrote on the anatomy and floral morphology of many other recent genera; but it is for his numerous additions to our knowledge of Mesozoic and Palæozoic plants that he is best known.[1] One of his most important contributions is the masterly account of *Bennettites Morierei*, a Cycadean "flower," probably from the Gault.

Among other important contributions by Lignier reference may be made to his detailed description of several species of Jurassic and Cretaceous Coniferous and Cycadean stems and some Upper Cretaceous Angiospermous wood referred to the Hamamelidaceæ; his ingenious suggestions with regard to the relationships of

[1] For a list of Lignier's papers, see "Titres et Travaux scientifiques de M. Octave Lignier." Laval, 1914.

the Equisetales and Sphenophyllales; papers on Jurassic floras of France; and especially his recent work, in part in collaboration with M. Tison, on the flowers of the Gnetales and the systematic position of the group. Lignier's activities ranged over a wide field; he was a botanist of marked originality, a generous friend, and a man imbued with the true scientific spirit. It was through his persistence that a botanical laboratory was built at Caen, and under his able direction the University became an important centre of botanical research. A. C. S.

NOTES.

AT the ordinary scientific meeting of the Chemical Society, held at Burlington House on Thursday, April 6, Dr. Alexander Scott, president, announced that the council had decided that an extraordinary general meeting of the society should be summoned for Thursday, May 11, to consider the question of the removal of the names of the nine alien enemies from the list of honorary and foreign members of the society.

REPLYING to a question relating to the inventions branch of the Ministry of Munitions, Dr. Addison said, in the House of Commons on April 10:—The Director-General of Munitions Design is General Du Cane. His salary is 2000*l.* per annum. The Superintendent of Research is Colonel R. A. Craig. His salary is 850*l.* per annum. The present salaries of his staff range from 750*l.* per annum to 240*l.* per annum. It is not desirable to give their names. In addition to the staff of the Superintendent of Research, a number of most eminent chemists and other men of science in the country have for many months given their services to the Ministry of Munitions without payment, and have rendered invaluable assistance to the country.

SIR COLIN CAMPBELL SCOTT-MONCRIEFF, whose death occurred on April 6, in his eightieth year, was a man of distinguished parts, who achieved reputation in three several directions, as a soldier, as an engineer, and as an administrator. Born in 1836, his military career commenced at the age of twenty, when he entered the Bengal Engineers as a second lieutenant. He was engaged in the suppression of the Indian Mutiny, for which he received the medal. In 1883 he retired with the rank of Colonel. From that date he devoted himself to the inauguration and execution of engineering projects of a utilitarian character, connected in the first instance with the agricultural development of the North-West Provinces, by artificial irrigation. He also held office as chief engineer for Burma. In 1883 his services were transferred to Egypt, where he acted as Under-Secretary of State Public Works at Cairo. There, where perhaps his best and most notable work was performed, his efforts were concentrated upon the more effective regulation of the existing water supply for purposes of irrigation, and during his tenure of office he carried out the restoration of the Great Nile Barrage—a difficult and tedious operation, which extended over a period of six years. A comprehensive review of his labours and of the difficulties which he encountered and overcame is to be found in a paper entitled "Irrigation in Egypt," which was published in the Professional Papers of the Corps of Royal Engineers in 1893. This paper is the substance of three lectures delivered by Col. Scott-Moncrieff before the Royal Engineers' Institute, and it contains much interesting information on the Nile and its treatment, particularly as regards the restoration and adaptation of the barrage, which was effected in circumstances of great discouragement and no little opposition. In 1892 he left Egypt for home, and for the next decade he was in office as Under-Secretary for Scotland. Then, at the beginning of the century, he returned to India to take up duty as president of the Indian Irrigation Commission, for which service he was rewarded, in 1903, with the K.C.S.I. He had previously, in 1887, been made K.C.M.G.

WE regret to record the death of Sir Alexander R. Simpson, emeritus professor of midwifery in the University of Edinburgh. Although above eighty years of age, he was active both in mind and body, and it was on his way home from a meeting through the darkened streets that he was knocked down by a motor-car and received injuries from which he died shortly afterwards—on the night of Thursday, April 6. Born at Bathgate, West Lothian, in 1835, and receiving his early education at the local academy, Simpson went to the University of Edinburgh, and began the study of medicine in the apprenticeship days. He was apprenticed to John Goodsir, the anatomist, and amongst his other teachers was Syme. After his graduation he studied abroad at Montpelier and Berlin, acquiring, in addition to a widened knowledge of his profession, that facility in speaking French and German which made him such an admirable and acceptable representative of his University at many foreign congresses. On his return he for some years assisted his uncle, Sir J. Y. Simpson, then at the zenith of his fame, and after an interval of five years spent in practice in Glasgow, succeeded him in the chair of midwifery and the diseases of women and children in the University of Edinburgh. This chair he held for thirty-five years, 1870–1905. In 1906 he received the honour of knighthood. Simpson had a wide knowledge alike of the history, theory, and practice of his profession. He practically grew up with the modern science of gynæcology, and he was always awake to every new development of it, and familiar with everything of importance written upon it in all languages. His contributions to the literature of his department were numerous and valuable: many of them are collected in his "Contributions to Obstetrics and Gynecology." Sir Alex. Simpson took a wide and responsible view of his professorial functions, and interested himself in all that concerned the welfare of his students and the University. Lady Simpson predeceased him several years ago, and he is survived by four sons and a daughter.

THE death is announced, at sixty-five years of age, of Sir Stafford Howard, K.C.B., formerly Commissioner of Woods and Forests, a post to which he was appointed in 1893, and retained until 1912. He was also an active member of the Afforestation Committee.

THE *Nieuwe Courant* announces the death at the age of fifty-four, of Dr. H. P. Wijsman, formerly professor of pharmacy in the University of Leyden, and since 1908 extraordinary professor of the chemistry of foods and drugs at Utrecht. He was also secretary of the Colonial Institute of Amsterdam.

Science announces that the Avogadro medal has been awarded to Prof. H. N. Morse, of the Johns Hopkins University, for the most important contribution to molecular physics made since the meeting held in Turin in 1911, to celebrate the centennial of the announcement of the hypothesis of Avogadro.

DR. DAVID HOOPER, formerly curator of the Economic and Art Sections of the Indian Museum at Calcutta, has been elected president of the British

Pharmaceutical Conference for the remainder of the current session, in succession to Major Peck, who has been compelled to resign in consequence of the increasing pressure of his military duties.

A SERIES of popular lectures on "Our Tropical Industries," describing the production of rubber, tea, coffee, cocoa, sugar, etc., in the tropical colonies, and illustrated by the collections of the Imperial Institute, to be delivered by Miss Edith A. Browne, on Wednesdays in April, May and June, at the Imperial Institute, at three o'clock, commenced yesterday, April 12. Admission to the series of lectures will be free by ticket, for which application should be made to the director of the Imperial Institute, South Kensington.

THE sixty-ninth annual meeting of the Palæontographical Society was held on March 31, Dr. Henry Woodward, president, in the chair. The council's report referred to the temporary diminution of the annual volume of monographs in existing circumstances, but noted that palæontological work was still being actively carried on, and would shortly be offered to the society to the normal extent. Dr. Henry Woodward was re-elected president; Dr. G. J. Hinde was elected a new vice-president; Mr. R. S. Herries was re-elected treasurer; Dr. A. Smith Woodward was re-elected secretary; and Miss Mary S. Johnston, Mr. H. L. Hawkins, and Mr. G. W. Young were elected members of council.

WE regret to record the death of Mr. Henry Morgan, on April 3. A brief account of his career appears in *Engineering* for April 7. Mr. Morgan was born in 1834, and was trained in Sheerness Dockyard. After occupying responsible posts in the Royal Dockyards, he proceeded to the Admiralty in 1869, under Sir (then Mr.) Edward J. Reed. Mr. Morgan also served as chief constructor under Sir Nathaniel Barnaby and Sir William White. He retired in 1889, after twenty-five years' active service in the design of warships. He devoted much of his ability to the Institution of Naval Architects, and was a member of council from 1871.

DISCUSSING the question of centralisation in military aeronautics, *Engineering* for April 7 considers that the true function of a central board would seem to be the collection and collation of facts, their transmission to those interested, and the preparation of general specifications, which, so far as practicable, should specify ends, rather than means. Any attempt to centralise design and experiment, and to discourage independent work, will necessarily imply restrictions on the initiation of many able men. A central board, operating with salaried officials, may, no doubt, conduct routine researches accurately and ably; but, in the opinion of our contemporary, a central organisation must not be looked to for important new departures in either science or industry.

ACCORDING to the *Nieuwe Courant*, the Royal Academy of Sciences of Amsterdam has awarded the following grants from the Van't Hoff Research Fund: 640 francs to Prof. F. Ephraim, of Berne, for the continuation of his studies on the nature of subsidiary valencies; 600 guilders (£50) to Dr. P. E. Verkade, of Delft, for the purchase of apparatus for the determination of heats of combustion; 100 guilders to Dr. D. H. Wester, of The Hague, for a chemical examination of certain species of Loranthus; 200 guilders to Dr. C. H. Sluiter, of Vught, for the purchase of Beilstein's handbook and of materials for an investigation of formaldoxime; 400 marks to Prof. E. Jänecke, of Hannover, for the continuation of his work on melting and transition points under high pressures.

IN the *Times* of April 4 Prof. W. C. McC. Lewis points out that the neglect of the science of chemistry in this country is due, not only to the public ignorance of the close connection existing between industry and the most abstruse forms of chemical research, but also to the miserably inadequate salaries paid to chemical assistants in university laboratories. In illustration of the former, he cites, amongst other cases, the work of the Corrosion Committee of the Institute of Metals, at Liverpool University, and the new process recently adopted by the War Office for the production of phenol. In mitigation of the latter, a plea is put forward for the establishment of a chemistry committee of the advisory committee on university grants, with an endowment of 30,000*l.* a year. Compared with the scheme proposed by Mr. C. A. Jacobson for the United States, and noticed in last week's NATURE (p. 130), for the creation of a chemical research institute at a cost of one million pounds annually, this is modesty indeed.

THE article on Zeppelins by M. Georges Prade, in the *Times* of March 25, has been followed by another on "The Newest Aeroplanes," by the same author, in the issue of April 7. There being no outstanding aeroplane in the sense that the Zeppelin is an outstanding airship, the treatment is totally different, and becomes a general review of the functions and general characteristics of aeroplanes. It is said that the idea of building one aeroplane which shall combine in itself all the good qualities has proved to be Utopian, and attention is now directed to four types:—(1) Scouting aeroplanes; (2) artillery observation aeroplanes; (3) bomb-droppers; and (4) battle planes. Discussing the question of size, Mr. Prade says that "an aeroplane is too small when it does not even permit a machine-gun to be carried; an aeroplane becomes too large when its increase in power and surface is not accompanied by a proportionate increase in weight-lift capacity." This statement does not carry very far, and limits aeroplanes to quite moderate sizes. Amongst the classes mentioned above, it appears that the lightest is that of battle planes, and the largest the bomb-dropper, the former having a total weight of less than a ton, and the latter an unspecified but not large weight if the horse-power of 200 may be taken as a criterion.

IN the last issue of the Journal of the Franklin Institute Dr. A. E. Kennelly suggests a scheme for the co-ordination of the work of American laboratories of applied science. There are now a considerable number of these laboratories, but in some cases the results of investigations are not published, and in others they are not sufficiently widely known. Moreover there is overlapping. "Each laboratory, as a rule, works for and in itself, as though it were the only one in the country. It is almost self-evident that the collective output would be improved, and the cause of engineering advanced, if these various laboratories could be co-ordinated, without imposing on them either hindering restrictions or burdensome expense." Dr. Kennelly therefore suggests that the Franklin Institute should take the initiative, in: (1) Giving publication, so far as it can, to the results reached in these laboratories. (2) Suggesting subjects for research to such laboratories as seem best suited for them. (3) Inviting subjects from the industries and grants for the expenses of research. (4) Encouraging mutual understanding between the laboratories. This matter also deserves consideration in the British Isles. Attempts are being made to promote unity of effort

on the part of the chief scientific and technical societies, and the time seems ripe for a similar movement towards co-operation between the research staffs of the chief colleges and technical institutions.

MISS MARGARET MURRAY contributes a very interesting paper to vol. xlv. of the Journal of the Royal Anthropological Institute, under the title of "Royal Marriages and Matrilineal Descent." She begins by quoting the well-known case of matrilineal descent in the kingdom of Travancore, and then proceeds to show that the same law prevailed under the Old and New Egyptian kingdoms, in the Ptolemaic period, and among the Hebrews in the time of David and of Solomon, the latter being reported by tradition to have gained possession of the kingdom of Sheba by marrying its Queen. She reaches more unfamiliar ground when she seeks to apply the same principle to the succession of the Roman Emperors. Not that indications of the same rule are wanting. Thus it is significant that Julius Cæsar, free to adopt whom he pleased, should have followed the same law of matrilineal descent by adopting Augustus, while something of the same kind may be gathered from the marriages of Octavia and Julia. So Caligula, son of Agrippina, succeeds Tiberius, who naturally wished his own son to succeed him, and there is some reason to believe that the circumstances surrounding the death of Messalina are only explicable by the custom of female inheritance and succession by right of marriage with the heiress. All this is very cleverly worked out, but the facts are not quite conclusive, and a further examination of the royal genealogies, so far as they can now be recovered, is needed before the theory can be fully established.

THE *Psychological Bulletin* (vol. xiii., No. 2) reports the papers given at the meeting of the American Psychological Association. The range of subjects treated is very wide, and the detailed investigations are of considerable interest. M. F. Meyer describes a rare case of colour-blindness. It is customary to recognise two groups of two antagonistic colours each, red-green and blue-yellow, and writers on the subject give details of the corresponding forms of colour-blindness, in addition to total colour-blindness. The author of the article before us describes a case of a somewhat unique kind, the subject regarding blue and green as one colour, and red and yellow as another. For him the division point in the spectrum occurs in the yellowish-green region: on one side everything is one colour, which he calls indiscriminately either green or blue; on the other side everything is another colour, which he calls indifferently red or yellow. He has no need for the four names. The author suggests that at a time when only two chromas existed, Nature vacillated between one type of animals having the dividing point in the spectrum in the (normally) bluish-green region, and a second type having the dividing point in the yellowish-green region; ordinarily the former type has prevailed, but there is still a trace of the latter.

WE have just received the report on Cetacea stranded on the British coasts during 1915. This is the third of its kind issued by the trustees of the British Museum, and prepared by Dr. S. F. Harmer, F.R.S., the keeper of the Zoological Department. Each of these reports not only adds to the value of its predecessor, but also emphasises the importance of this attempt to determine the precise character of the Cetacean fauna of our seas, and its seasonal migrations. Already it is clear that species hitherto supposed to be but rare and accidental visitors may prove to be, at any rate, annual visitors to our shores. This seems to be true, for example, of Cuvier's whale (*Ziphius cavirostris*), which, as Dr. Harmer has demonstrated, may easily be confused with the bottle-nosed whale (Hyperoodon), at any rate in the case of immature specimens. One of the two specimens recently acquired by the museum was at any rate thus mistaken. From the evidence in this report it would seem that Mesoplodon is represented in our seas by two, and perhaps three, species. Thus from a faunistic, as well as from an economic, point of view it is plain that the task which Dr. Harmer has set himself is one of extreme importance.

THE Journal of the East Africa and Uganda Natural History Society (vol. v., No. 9) contains a paper by Mr. C. W. Hobley on the alleged desiccation of East Africa, which will be read with interest by anthropologists, as well as by those for whom it is more especially written. The author remarks that between Kismayu and Port Durnford there are said to be sixty miles of coast full of ruins, and, again, north of Port Durnford, there are innumerable ruins of stone buildings. No record remains of the builders, but they are commonly supposed to have been early Persian settlers. But the settlements seem to have been formed since the establishment of the Mahommedan religion, for there are numerous remains of well-built stone mosques, and myriads of stone graves of the Moslem type. The author is inclined to believe that they may date back to as far as Himyaritic times. In the Somali hinterland, in Juba-land, there are large numbers of artificial mounds, many as much as 30 ft. high, which are believed to be the funeral mounds of an extinct race. At the earliest opportunity these mounds should be explored.

THE Journal of the Franklin Institute for February contains a useful survey of what is known in regard to the production of light by animals. This survey, which began with the January issue, and is not yet completed, is devoted to the coelenterates. Herein the phosphorescent discharge takes the form of granules mixed with mucin secreted by special cells of the epithelium. The discharged matter—luciferine—becomes luminous on coming into contact with the free oxygen contained in the sea-water. The author, Prof. U. Dahlgren, of Princeton University, cites a number of experiments made to determine the nature of the stimuli which produce luminescence, and these all show that light production is at its best at the optimum temperature at which the animals usually live. The eggs of ctenophores have often been said to emit light, but the author is unable to confirm this statement. The early segmentation stages, however, develop luminosity, and this increases in intensity from the gastrula stage onwards. Among the echinoderma, which, with the Mollusca, are reviewed in the March issue, luminescence has been demonstrated only in the "brittle-stars," or Ophiurids. It is exceedingly rare among the Mollusca. The author discusses at some length the well-known case of the pelagic Phyllirrhöe, and the remarkable instance of *Pholas dactylus*, which, though always buried, yet has large areas of the body provided with luminous glands. The light from these shines brightly when the animal is removed from its shell, but during life is manifested only by means of a mucous slime, discharged from the exhalant siphon, which alone is exposed to the outer world.

AN extensive ecological study of the fauna of prairie and forest regions near Charleston, Illinois, has

lately been published (Bull. Ill. State Lab. Nat. Hist., vol. xi., 2, 3), Dr. C. C. Adams describing the invertebrates and Mr. T. L. Hankinson the vertebrates. The regions dealt with seem to represent a remnant of the wild country of the State, now as a whole highly cultivated, and altered by human agency. The animals are divided into prairie and woodland dwellers, each with several groups of "associations," and the extensive series of photographs enables the reader to realise the nature of the localities described. Doubtless the invertebrates listed represent only a fraction of the fauna of the districts, but the authors may be congratulated on having collected so large an array of facts while wild areas are still at their disposal for study.

THE gram crop in India (*Cicer arietinum*) has occupied the attention of Mr. and Mrs. Howard and Mr. A. R. Khan at Pusa, and their results, which are of considerable scientific and economic value, are published in Memoirs of the Department of Agriculture in India, vol. vii., No. 6, for December, 1915. Gram is an important cold season food-grain in India, and some 18,000,000 acres are devoted to its cultivation every year. The best returns are obtained on light, high-lying, well-drained land, and in a wet season or on heavy land the yield is very considerably lessened. Another important factor is the time of sowing. Figures are given showing the root formation in relation to soil moisture, and the seed yield is found to be directly correlated with the root system, for when this is stunted, owing to too moist conditions, no seed is produced. Twenty-five types of gram have been bred at Pusa, and a careful classification of them is given in the paper. It is found that different types are suitable for different localities. The power to set seed, habit of growth, time of flowering, are all important features. The best type is a white gram, which in addition to this colour quality has given a yield of more than 20 maunds per acre.

IN no part of the world, not even in Japan, are the observations of earthquakes published on so lavish a scale as in Italy. As an instance of this, we have lately received the notices of earthquakes observed in that country during the year 1910. They form a volume of more than six hundred pages, which is issued as a supplement to the Bollettino for 1913 of the Italian Seismological Society. In it, Dr. G. Martinelli has collected the recorded observations of all local earthquakes, as well as those of external earthquakes which are registered instrumentally in Italy. Useful additions to the catalogue are lists of thirty-two Italian observatories with the constants of the different instruments which they contain, and of the epicentral regions of the stronger earthquakes. If we might offer two suggestions, it seems to us that the separation of the two classes of local and external earthquakes, and brief discussions of the materials collected for the more important local earthquakes, with maps, would add very greatly to the value of the catalogue.

AT the last meeting of the Illuminating Engineering Society the desirability of standardising the materials used in lighting glassware, and the sizes of chimneys, globes, reflectors, etc., was discussed. Letters from manufacturers were read pointing out that the multiplicity of shapes and sizes of glass was found to be a great drawback. A special problem is the production of "heat-resisting" glassware for globes used with high-pressure gas lamps, and other high-temperature illuminants. Other speakers remarked on the variations in quality met with in opal glass as regards absorption, uniformity of diffusion, and colour. Two special varieties of glass which particularly require standardisation are those used respectively for producing "artificial daylight" from various illuminants, and for neutral absorbing screens in photometry. Neutral-tinted glasses of guaranteed absorption cannot readily be obtained in this country, although they play an important part in many photometric and optical instruments. Several members of the Glass Research Committee of the Institute of Chemistry were present, and gave some particulars of the work of the Committee on laboratory and chemical glasses. In the course of the discussion it was suggested that the Illuminating Engineering Society should appoint a Committee on Lighting Glassware.

THE Netherlands Meteorological Institute has recently published the fourth and last part of the new edition of the oceanographical and meteorological observations in the Indian Ocean; the part comprises the months of March, April, and May from the observations for the years 1856–1912. Many of the observations are obtained from our English Meteorological Office and from other European weather offices. The results are published in a tabular form, in very great detail, and are grouped together in order of 10° ocean squares, and are subdivided into single-degree squares. Results are given for ocean currents, winds, barometer, air and sea temperatures, cloud, mist, rain, and hail. Charts are published in a separate volume, giving in a graphical form the general circulation of winds and currents, and the isobars, and isotherms, of air and sea, together with the general trade routes. The number of observations available for each element is given, so that the value of the results can be estimated, and for several of the elements more than a million observations have been used for the year. This work of the Dutch Meteorological Institute formed the subject for discussion on Monday, March 13, at the Meteorological Office, at South Kensington, the discussion being opened by Admiral Farquhar.

"THE Spread of Tuberculosis," by Dr. L. Cobbett, is in the press for publication in the "Cambridge Public Health" series (*Cambridge University Press*). The following works are in preparation for inclusion in the same series:—"Ticks as Carriers of Disease," Prof. G. H. F. Nuttall; "Serum Diagnoses," Dr. C. Browning; "The Purification of Water in Sedimentation, Filtration, and Precipitation," Dr. A. C. Houston; "The Purification of Water by Ozone and Chlorine; and Domestic Filters," Prof. G. Sims Woodhead; "The Principles and Practice of the Dilution Method of Sewage Disposal," Dr. W. E. Adeney; "Disinfection," Dr. C. W. Ponder; "Housing in Relation to Public Health," Dr. C. J. Coleman; "School Hygiene," Dr. E. T. Roberts; "Soils, Subsoils, and Climate in Relation to Health," G. Walker; "Meat Inspection," Dr. W. J. Howarth and T. D. Young; "Vital Statistics," R. Dudfield and G. U. Yule; and "Foods, Sound and Unsound," Dr. H. C. Haslam. For the "Cambridge Farm Institute" series the following are in preparation:—"Plant Life in Farm and Garden," Prof. R. H. Biffen; "The Feeding of Farm Animals," Prof. T. B. Wood, and "Common Fungus and Insect Foes," F. R. Petherbridge, and for the series of "Cambridge Agricultural Monographs":—"Poisonous Plants," H. C. Long: "The Strength of Wheat Flour," Prof. T. B. Wood; "The Constitution of the Soil," Dr. E. J. Russell; and "Disease Resistance," Prof. R. H. Biffen.

OUR ASTRONOMICAL COLUMN.

COMET 1916*a* (NEUJMIN).—Prof. E. Strömgren, in a post-card dated April 1, from the Copenhagen Observatory, gives the following observation of Neujmin's comet at Bamberg on March 23:—10h. 7m. 15s. M.T. Bamberg; α app. = 9h. 15m. 7·15s.; δ app. = +2° 18′ 31·9″. The corrections to the positions given in M. J. Fischer-Petersen's ephemeris are, for March 23: +7s., +1·0′.—Copenhagen Post-card No. 16 gives the following continuation of the ephemeris:—

1916		12*h.* G.M.T. R.A. h. m. s.		°Dec.′
April 20	...	10 2 41	...	− 7 34·0
22	...	6 47	...	8 6·5
24	...	10 56	...	8 38·0
26	...	15 9	...	9 8·6
28	...	19 25	...	9 38·3
30	...	23 44	...	10 7·1
May 2	...	28 5	...	10 35·1
4	...	32 28	...	11 2·2
6	...	36 53	...	11 28·6
8	...	41 20	...	11 54·3
10	...	10 45 50	...	−12 19·3

OCCULTATION OF MARS, OCTOBER 2, 1915.—Observations were made by W. Voss at Altona (*Astronomische Nachrichten*, No. 4831). Although the altitude was low (17°) and the air unsteady, all four contacts were recorded. The successive phases anticipated the calculated times by 10·0, 13·8, 27·1, and 31·8 seconds respectively. Corrections to the ephemeris of the moon have been calculated from the observations of second and third contacts. Taking into account the effect of the phase of the planet on the emersion, it appears that the moon is 10″ further on its path, and in the direction at right angles 3″ to the north of the position given by the Nautical Almanac.

THE RADIATION LAWS AND STELLAR PHOTOMETRY.—In *Meddelande* No. 67, Lund's Observatory, Dr. C. V. L. Charlier continues a statistical investigation of the consequences of various laws of radiation in regard to stellar light emission. Although Planck's law does not, yet both Stephan's and Wien's radiation laws indicate the existence of an inversion-temperature (visual >18,000°), at which for a given wave-length the radiation is a maximum recalling the results obtained by Kovesligethy. This important inference applied to the phenomena of new stars is considered to remove the objection to collision hypotheses, justifying the ingenious suggestion that the observed rapid diminution in brightness is due to the fact that the inversion-temperature has been passed. The investigation has a direct bearing on the question of colour-indices. A rigorous interpretation of the usual determinations is shown to require the numerical evaluation of several instrumental factors, which determine the difference between the measured and the actual energy.

DARK MARKINGS IN THE SKY.—Some striking photographs possibly showing dark objects are reproduced in a paper by Prof. E. E. Barnard in the January number of the *Astrophysical Journal* (in modified covers). A dark marking in Cepheus (1860·0, R.A. 20h. 48·0m. +59° 6′) would almost pass for a negative of the gaseous nebula N.G.C. 6995. Prof. Barnard advances the interesting suggestion that these dark bodies are rendered apparent by a faint general luminescence of the background. This bears a sort of reciprocal relation to Prof. H. H. Turner's suggested widespread absorbing areas, yet it is not impossible that both refer to coincident areas in space.

A CLUSTER OF NEBULÆ IN CETUS.—To the north of the 9·5 mag. star, B.D., 2° 128′, Prof. M. Wolf has found a rich cluster of small nebulous objects. In a region 30′ diameter around R.A. = 0h. 49·0m., $\delta = -20'$ (1855), no fewer than fifty nuclei were discerned with the 16 in. The nebulæ are nearly as abundant but much smaller than in the nebulous areas in Coma Berenices and Virgo, and all are to be regarded as either the remnants of, or the brightest parts of, very faint spiral nebulæ. Replicas on the tiniest scale of the Andromedæ nebulæ are very numerous. The cluster is not strongly condensed, but it is rather the arrangement in winding lines that attracts attention (*Astronomische Nachrichten*, No. 4833).

THE NEW CHEMICAL LABORATORIES AT UNIVERSITY COLLEGE, LONDON.

THE provision of properly equipped chemical laboratories with ample facilities, not only for teaching, but also research, is a matter of the utmost national importance. Fortunately, University College, London, has been engaged for the last five years in the endeavour to obtain a chemical laboratory worthy of its famous tradition, associated with the names of Graham, Williamson, and Ramsay, and equal to the strenuous demands of the present day and the years of keen scientific and industrial rivalry which await all civilised nations after the war.

As a result of strenuous effort and the generosity of many private benefactors and public bodies, a fine new building has been erected. The main façade has a frontage of more than a hundred yards, whilst the building itself occupies an area of about 18,000 square feet. The basement, which is, in reality, only a half-basement, and is amply illuminated owing to the use of prismatic glass in the windows and of white tiles and white glazed bricks on the walls, is devoted mainly to physical chemistry, electrochemistry, and technical chemistry, for all of which spacious laboratories are provided. A novel feature here is the provision of a very large room, about 50 ft. square, for the carrying out of chemical operations on an engineering scale (Fig. 1). This room will be provided with gas, water, steam, compressed air, electrical power, and special ventilation. The ceiling is very high, and strong steel girders run across from wall to wall at approximately half the height from floor to ceiling. These enable scaffolding to be rapidly erected, heavy machinery and apparatus to be moved about, tanks to be hoisted into position, etc. As every practical man knows, "technical" chemistry (a term very much misunderstood in this country) is simply, when effective, a combination of good chemistry, good engineering, and good business. The ample provision made at University College for adequate engineering tests of chemical processes marks the beginning of a new era in the development of university chemical laboratories. It is significant that this provision was designed and planned several years before the outbreak of the present war, and owes its inception to the insight and prescience of Sir William Ramsay. In September, 1915, the laboratory of technical chemistry was placed at the disposal of the Ministry of Munitions, and has been in constant use since then for the working out of the chemical engineering details of a new process, under the supervision of Prof. B. D. Steele, of the University of Queensland. As a result of this work a large new factory is in process of erection by the Government.

The basement also contains a large, well-equipped workshop (the equipment of which was made possible by the generosity of Dr. R. Messel, F.R.S.), and special rooms for storage batteries, electrical machinery, the liquefaction of gases, and spectroscopic and calorimetric work. In the rooms devoted to physical chemistry ample accommodation is provided

for carrying out every class of electrochemical work. Indeed, a marked characteristic of the building is the ample and adequate provision of space for physical chemistry and electrochemistry.

The ground floor contains the large chemical lecture theatre (with seating accommodation for 240 persons), the physical chemistry lecture theatre (100 persons), the library, and the analytical and inorganic laboratories. There is also a room for metallurgical work, and a store-room.

The first floor is devoted entirely to organic chemistry, and contains a spacious main laboratory, organic chemistry lecture theatre (100 persons), organic chemical store, combustion- and furnace-rooms, etc. On this floor is also a room for spectroscopic work.

The second floor contains the "first year" laboratory (with accommodation for 100 students), the department of pathological chemistry, and numerous research rooms. Next to the provision made for instruction in engineering and physical chemistry, perhaps the most marked feature of the building is the accommodation provided for research work. There are no fewer than twenty-seven rooms devoted exclusively to post-graduate and research work, providing ample accommodation for at least sixty research workers. These rooms are suitably distributed throughout the building. In this respect it will compare favourably with the largest and most famous laboratories of the Continent. One may, perhaps, go so far as to state that when the internal equipment is complete the laboratory will surpass any chemical laboratory to be found in Germany.

Unfortunately, the outbreak of war occurred at a time when the internal equipment was incomplete. At present the laboratory is entirely devoid of electrical machinery, storage batteries, electrical power wiring and switchboards, and almost, if not entirely, wanting in instruments and apparatus for physical chemistry and electrochemistry. There is also a great want of many pieces of apparatus required for advanced study and research in inorganic and organic chemistry. A sum of about 20,000*l.* is urgently required in order to complete this internal equipment, without which the laboratory will be unable to fulfil its great purpose of training the research chemists of which we stand at present so badly in need. The country cannot afford to lose a moment. In the immediate future thousands of chemists will be required trained in the methods of research. Every well-equipped chemical laboratory is therefore an asset of the highest national importance. Not only power and wealth, and national well-being, are dependent thereon, but our very existence as an independent and civilised community. For if the events of the last two years have shown that war is dependent on chemical science, it is still more true that without it there can be no prosperity and security in time of peace. The thorough equipment of our chemical laboratories is therefore not only the best possible investment of national funds, but an indispensable condition of national security.

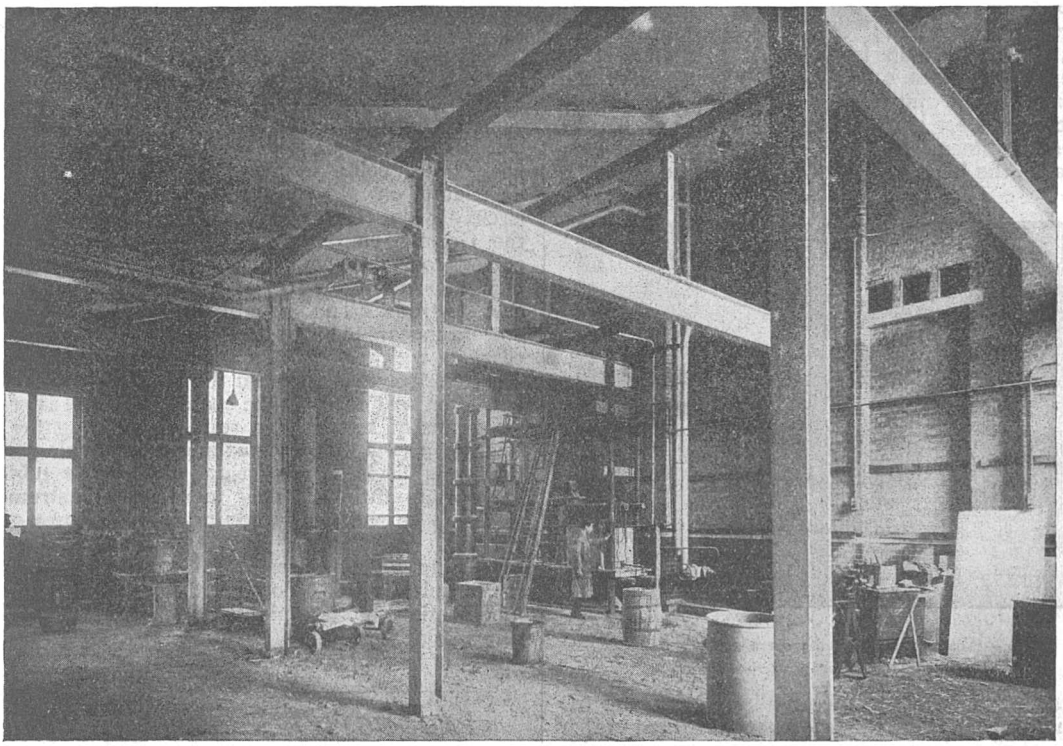


FIG. 1.—Laboratory of Technical Chemistry, University College, London.

We notice with very great pleasure that Sir Ralph Foster, Bart,, has promised 5000*l.* on condition that the remaining 15,000*l.* is obtained within a reasonable period of time. Sir Ralph Foster had already subscribed more than 34,000*l.* to the building fund, so that not only University College, but chemical science in general owe him a deep debt of gratitude. Sir William Ramsay has generously promised 500*l.* for the purchase of books and journals for the library of the new chemical laboratories. It is intended to call the library the "Sir William Ramsay Library," in commemoration of the great work he has done for chemical science. But in order to make the library worthy of its name another 500*l.* will be required for the purchase of books and journals, and about 500*l.* for library fittings.

INSTRUMENTAL HARMONIC SYNTHESIS.

THE Journal of the Franklin Institute for January contains a detailed description by Prof. Dayton C. Miller of a "32-element harmonic synthesizer" (would not synthetiser be more euphonious?), which appears to be admirably designed for many purposes. The main intention is to test the accuracy of any given harmonic analysis by recombining the harmonic terms and comparing the curve so obtained by synthesis with the original form analysed.

The principles of construction of the instrument are the same as those exemplified in Kelvin's tide predicter, but the investigations in photographic records of sounds for which the instrument was devised led to important differences in detail. For example, instead of a metallic ribbon threading the pulleys connected with the elements, a flexible chain of the chronometer fusee type is used. One end of this chain is attached to the pen-carriage above the drawing board on which the record is produced; the other end supports a weight, and the chain is clamped at a convenient intermediate point to a bar which passes under the chain as it crosses and recrosses from pulley to pulley. If the clamp is set at the far end of this rod, all the 32 elements influence the motion of the recording pen. If, however, the higher elements are not to be used, the

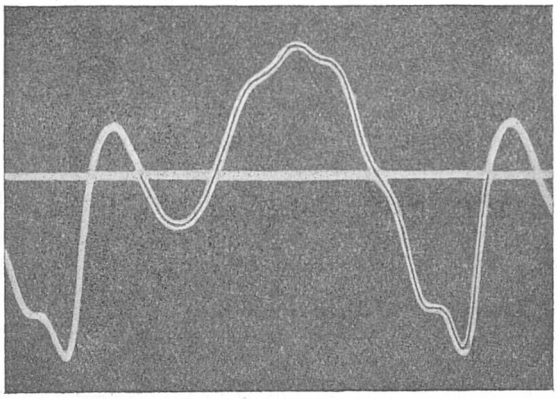


FIG. 1.—Proof of the analysis of a curve by synthesis.

clamp is shifted nearer to the drawing-board, and the pen is not influenced by the movements of these higher elements. The elements are arranged upon a table with their shafts vertical, and are geared together in such a way that when a handle is turned the rates of rotation of the successive elements are as the numbers 1, 2, 3, 4, etc., up to 32.

The satisfactory action of the instrument is well shown in a figure in which the synthetic reproduction of the analysis of the curve of an organ-pipe note is superposed upon an enlarged photograph of the original (Fig. 1). There is perfect coincidence. Another figure illustrates the sound wave from a clarinet and gives the harmonic components to the 29th term. Particularly interesting also are the representative curves built up of 15 or 30 terms of certain well-known Fourier series, which when summed to infinity give harmonic forms composed of straight lines. Beautiful examples are also given of beats obtained by the combination of two harmonic forms the frequencies of which are in the ratio of 10 : 29, 15 : 29, and 29 : 30. It should be mentioned that the instrument was originally designed to be used in connection with Henrici's analyser, which requires that all curves for analysis be drawn with a wave-length of 400 millimetres.

CEMENTS AND CLAYS.

THE Bureau of Standards (U.S. Department of Commerce) issues from time to time Technologic Papers bearing on various subjects of practical importance. Several of these papers dealing with cements and related subjects are before us.

No. 47 of the recent pamphlets deals with "The High-Pressure Steam Test of Portland Cements," and it is inferred from the results of the official investigation that the value of this rapid test varies greatly with the conditions (especially when abnormal) under which the material is to be employed. No. 48 describes a new "Air Analyser for Determining the Fineness of Cement." The chief distinguishing feature of this new elutriator is the principle of blowing an unretarded stream of air down into the cement from above, the sample being completely and continuously exposed in a conical bulb to the action of the air. It has been found to be well adapted for separations of various hard-grained materials, and might prove useful in other directions.

No. 51 refers to "The Use of Sodium Salts in the Purification of Clays and in the Casting Process." It is of special interest to those who are engaged in the ceramic industries, and in the working of clay deposits, but, being largely concerned with phenomena depending on viscosity, it may appeal to a wider circle. From results of experiments it is inferred that the German electrical osmosis process plays no important part in the actual purification of clays, but facilitates the deposition of the suspended particles on the electrode. The essential feature of the osmosis process appears to be the preliminary sedimentation process, in which a small proportion of caustic soda or other electrolyte is added to the clay mixed with water, and after well stirring, the coarser material is removed by means of screens and settling. During the investigation a new efflux viscosimeter of simple construction was devised, consisting of a brass tube with appropriate fittings. This inexpensive instrument is stated to be sufficiently accurate for purposes of comparison, the kinetic and temperature corrections applied in precise measurements not being necessary for technical work. Possibly the instrument (or some modification of it) might find useful application in connection with other technical processes where viscosity is an important factor. J. A. A.

PRODUCTIVE RESEARCH IN THE UNITED STATES.[1]

THAT the scientific method, which furnishes the instruments and the criteria for effective investigation, is now gaining esteem with unreflective as well as with reflective minds is in evidence in nearly every field of current activity. In the report for the year 1914 attention was directed to the rise of other research establishments and to the relations of reciprocity the institution should sustain to them. Several of these have effected organisation during the past year, and more such are in process of development.

Simultaneously with the rise of other research organisations, the scientific method is rapidly gaining control in the direction of commercial and industrial enterprises. Indeed, the phrases "scientific management," "industrial efficiency," and the like, are now so much over-applied and so often misapplied as to render them offensive to judicially conservative minds; for herein likewise, as in most other contemporary affairs, there is a popular tendency to anticipate the

[1] Abridged from the Report of the President of the Carnegie Institution of Washington contained in Year Book No. 14, 1915.

marvellous, and hence to obscure the realities of the forward movement now going on. Thus one might infer from current literature that the doctrine of efficiency is altogether new and that it has sprung suddenly from a few Americans and from the general staff of the German army. It is unnecessary to explain that this doctrine is not new, that it has undergone a long course of development, and that it did not originate as commonly supposed. What is new about it is a growing collective consciousness of its validity and a rapidly increasing apprehension of the advantages it may bring in many, if not most, fields of endeavour. But appreciation of this doctrine is neither more nor less than a recognition of the scientific method the beginning of which dates far back, prior to the period of unwritten history of primitive man.

A far-reaching effect of the determinate introduction of the principles of science in commercial and industrial affairs is seen in the resulting diffusion of sound learning among the masses of men. Increase in efficiency in such affairs requires, in general, application of a wide range of demonstrable principles, all of which must stand the tests of economic practicability. The so-called labouring man, therefore, as well as the manager, must become familiar with a correspondingly wide range of facts, methods, and appliances affording typical illustrations of those principles. Thus many manufacturing plants are now great laboratories supplying instruction to operatives, although nominally conducted with quite other objects in view; while some individual machines, like the internal-combustion engine, embody in their construction and operation striking and easily acquired lessons in certain fundamentals of physical science.

But what is more important in this connection is the general recognition of research as an essential preliminary to progress. Accordingly, numerous national organisations are now forming research committees for the investigation of problems common to their several interests, while not a few individual establishments are conducting special research laboratories the contributions of which to knowledge must be justly measured by a much higher standard than that of commercial profit alone. In this process of evolution the conventional divisions of pure and applied science are coming into closer contact and the invidious distinctions between them, often set up disadvantageously to both, seem to be slowly disappearing.

Fundamentally related to the application of the scientific method in increasing measure in nearly all fields of inquiry is the question of the costs involved, although it has been little considered and is often contemptuously disregarded both by enthusiastic investigators and by optimistic financiers. It is, in fact, in its entirety, often a question of great complexity, involving as a rule many difficulties with "personal equations," and all the entanglements due to the uncertainties which successful research seeks to remove. A statement of certain of its more obvious aspects may help to remove common misapprehension. Briefly, these aspects may be stated as follows:—

(1) Sound research, like any trustworthy work, is expensive in proportion to its comprehensiveness and thoroughness.

(2) The number of projects worthy of investigation is now far greater than can be adequately financed, and hence advantageously pursued, either by any single agency or by all such combined; and the prevalent lack of financial support for this kind of work appears destined to continue indefinitely, certainly so long as there is no general recognition of existing conditions or of practicable ways of improving them.

(3) Each research organisation must therefore choose for itself at any epoch the field, or the fields, it will cultivate, and must restrict itself to them. No such privately endowed organisation may seek to delegate its duties to others, to play the *rôle* of paternalism, to undertake the functions of a scientific clearing-house, to secure monopolistic privileges, or to engage in propagandism, without danger of defeating its primary purposes.

That large sums are now spent annually by Governments, by municipalities, and by industrial organisations in defraying the costs of investigations, sums vastly greater in the aggregate than the combined incomes of all existing endowed research organisations, is a fact which needs to be visualised as a preliminary to an understanding of the relatively narrow limitations of the resources and capacities of the institution.

Thus, to illustrate, in the conduct of work which may be fittingly called research, the United States Government spends annually not less than twenty times the income of the institution. It matters not that this work is often designated by the ambiguous word "practical," or by the misleading phrase "applied science." In so far as it deals with facts and principles, and substitutes knowledge for ignorance, it is worthy of prompt recognition and unstinted support.

If, for example, the United States Department of Agriculture can succeed in supplanting "lunar methods" in husbandry by methods founded on physical fact and verifiable induction, it will be entitled to conspicuous distinction in the annals of American science. But while antithetical words and phrases continue to befog contemporary thought it may be easily ascertained, and should be better known, that the United States Government, through its numerous departments and bureaus, is now carrying on, and has in recent decades accomplished, a large amount of high-class research, the annual costs of which quite overshadow the income from any existing research endowment. It may be as easily ascertained, and should be as well known, that no such endowment can be reasonably expected to supplant governmental functions or to supplement governmental resources. The legislator who sees no reason why the institution may not undertake electrification of postal routes, the publicist who entertains fears lest a few endowed organisations should secure a monopoly of research, and the educator who imagines the income of the institution sufficient to meet academic needs and emergencies, are all alike deceived by fallacies which become manifest as soon as one is asked to assume responsibility for their consequences.

In connection with these matters of public concern, it is fitting to remark that while the world at large has entertained all manner of fictitious expectations from the institution, its actual development has proceeded in conformity with the limitations of its income and the conditions of its environment. As a matter of fact, it is now essential to curtail research in order to live within income, since the purchasing capacity of monetary standards, which has fallen by more than 30 per cent. during the last two decades, appears to be still diminishing.

Characteristics of the Carnegie Institution.

It appears advantageous now, in the interests of all concerned, after a decade of patient observation of actual developments and of considerate attention to an unsurpassed wealth of private and public opinion, to state briefly the ideas and the ideals which have animated the present administration and seem fitted to endure in the conduct of any similar organisation.

The institution is an establishment for the conduct and for the promotion of original research, the results of which are given freely to the world.

It is important in this connection to offer an answer to the underlying question perennially put directly, and

indirectly, to the institution, namely, "What is research?" The answer to this question is contained in the answer to the larger question, "What is science?"; for the methods of research are the methods of science. The meaning of this much used and much misused term is now well defined. It was established during the last half of the nineteenth century, although in common parlance it may still mean anything from "skill in boxing" to the prediction of solar and lunar eclipses.

In a summary way science presents itself under three distinct stages, to wit:—(1) The elementary stage of observation and experiment, or the fact-gathering stage; (2) the secondary stage of comparison, measurement, and calculation, or the statistical stage; (3) the stage of correlation under theory with capacity for prediction. But within the limits of these distinct stages there is endless diversity of detail, and hence the widest latitude for amateurism, dilettantism, and even pseudo-science. Thus it happens not infrequently that inquiry is made whether the institution undertakes any other than "scientific investigations," whether its work is limited to science, or whether it seeks to enter the domains of philosophy, metaphysics, etc. Concerning these matters, the attitude of the institution is at once liberal and critical, liberal in recognising all branches of demonstrable knowledge, and critical in respect to all unverified and unverifiable representations. No attempt has been made to limit recognition to the domain of mathematico-physical science or to the quite unhappily designated domain of "natural science."

It would be rash to assert that the methods and the inductions of science, which have cost more than twenty centuries of laborious effort in their evolution, are not still susceptible of many or even endless improvements. But these methods are now so well defined and so well known by all acquainted with the history of human progress that it is no longer essential to use the adjective "scientific" in qualification of the words investigation and research. One may safely assume, for administrative purposes at any rate, that investigations which purport to be unscientific or superscientific do not fall within the scope of a research organisation. And in conformity with this view the term science may be no longer limited advantageously to designation of the mathematico-physical sciences (including the biological and the so-called natural sciences), which for certain obvious reasons have thus far helped most to fix its meaning.

But while the term science should be interpreted in the most comprehensive and liberal manner, experience teaches that its criteria should be strictly observed and impartially applied. Liberality of inclusion and consideration may not be construed as implying leniency of judgment in matters scientific. Science furnishes no royal road to learning. It will undertake to blaze trails, to set up constructions conformable to the laws of the universe, and to test ideas, hypotheses, and theories; but it is unable to work in regions from which its methods and criteria are excluded.

The most striking characteristic of the institution is found in its departments of research. These are absorbing the bulk of the institution's income. They are devoted to fields of inquiry in which continuity of effort over long periods of time is a prime requisite. Their problems, like many of the phenomena under investigation, are of a secular nature and their progress may not be measured adequately in terms of an interval shorter than a decade. They are centres of activity which, if properly sustained, should continue to contribute additions to knowledge the fuller fruition of which can be appreciated only by our successors.

The questions most frequently raised with respect to these departments are:—(1) "What practical results are expected from them?" (2) "Assuming them attainable, will the expected results justify the costs entailed?"; (3) "When will the work of any department be completed?"

(1) An essential preliminary in answering the first question is removal of the obscurity which commonly attaches to the word "practical." Those who use this word freely are rarely competent judges of research or of the accessions to learning secured thereby. What is practical to them is usually confined within the limits of personal experience instead of being permitted to fall within the far wider limits of the experience of our race. He who would venture an off-hand opinion concerning the practical, or directly realisable utilitarian, value of any proposed investigation must needs be uncommonly wise or possess a temerity not derived from an acquaintance with the history of science. This history demonstrates in the clearest manner that every established fact, every newly-discovered principle, and every generalisation from fact and principle are sooner or later turned to advantageous account. Moreover, this induction from history is now so well established that a research organisation as such should never concern itself seriously with the question whether a proposed investigation will turn out to be of immediate utility. The question it should ask is: "Whether it is now practicable to undertake the proposed work and do it thoroughly well?" If this is decided in the affirmative, the organisation may proceed with equanimity, confident of the final, even if doubtful of the contemporary, verdict.

On the other hand, while holding to the views just indicated, it is not necessary to ignore equally important items of mundane wisdom. It needs to be kept in mind that not all worthy subjects of research are at any epoch co-ordinately practicable of pursuit. In fact, there may be enterprises quite unready for investigation by a given organisation at a given time, and other enterprises which under existing conditions would result only in a waste of energy and resources.

(2) In answer to the second question it may be said that while there is inherently an element of uncertainty in respect to the comparability of returns with outlay in the conduct of research, this uncertainty is in general much less than in most unexplored fields for investment of effort and capital. Systematic research is quite certain to secure some advances; even negative results are often of great value; and the elimination of error is almost as important as the discovery of truth. Here, again, appreciation of the time element is essential. A just verdict cannot be rendered by our contemporaries; it must be left to posterity. Progress is not so much for the individual as for the race. It should be observed, also, that the costs of progress attributable to deliberate investigation have been, and are still, vanishingly small in comparison with the costs of the less contemplative forms of human endeavour. But who shall say that the permanent returns from these two contrasted realms of social effort are not more nearly inversely than directly proportional to the respective outlays?

The appalling events now absorbing the world's attention are painfully instructive in seeming to prove that in some of his efforts to understand the cosmos wherein he appears to play a unique *rôle* man has met with little or no success during the past twenty centuries; on the other hand, during the same interval, his efforts along scientific lines to interpret that cosmos have been rewarded by extraordinary advances, the aggregate of which constitutes the bulk of the learning we may pass on unreservedly to our successors. The superiority of the learning of to-day over that of the first centuries of our era is indicated, for example, in the difference be-

tween the navigation of the Greeks and Romans by aid of knowledge and appliances available to them and modern navigation by aid of the compass, the sextant, and the nautical almanac.

(3) When the institution was organised there was a widely spread opinion that much of its work would prove to be transitory, requiring here and there temporary subsidies to complete investigations already started and to publish conclusions already formulated. It was also commonly held that the institution could act as a sort of promoter, starting by aid of initial grants many worthy undertakings and leaving them for subsequent support to the grantees themselves or to the establishments with which the grantees were connected.

Closely related to these opinions was another to the effect that a large amount of valuable work could be accomplished under academic guidance by needy students who might thus earn from the institution small stipends while doing the drudgery and acquiring the inspiration of research. But these plausible theories, praiseworthy enough in the abstract, failed to meet the requirements of conditions as they actually developed. It soon appeared that the completed investigations, or those nearly ready for publication, were not numerous. It was found that stimulating promising enterprises in other establishments by means of initial grants called, in general, for sustaining subsidies; and that in some instances such subsidies from the institution had the sinister effect of decreasing independent support for research. And as for the students from whom so much for so little was expected, it turned out that they were preoccupied as a rule with the elementary notion that research means that modicum of investigation which leads to higher academic degrees.

Thus the institution was compelled to recognise, in the face of much popular protest, what is clearly evident on reflection, both from *a priori* argument and from common experience, namely, that productive research, like any other constructive work, requires arduous, persistent, and, above all, sustained effort under the direction of disciplined experts. Coruscations in science occur frequently enough, but unfortunately most of them, as every investigator knows, are *ignes fatui*. It is more rational, therefore, in the interests of progress to provide for continuity in research than to give special attention to the excessively rare events of sudden discoveries and inventions which prove to be of permanent value. These advances *per saltum* will take care of themselves; but the surer and more rapid process of general advance, and the one on which attention should be concentrated, in order to build for the future as well as for the present, is the process of summation of increments of knowledge, each relatively infinitesimal in comparison with the possible aggregate.

Science is unable to assign an epoch for the beginning of research and may not venture to predict an end thereof; it may assert confidently only that its methods, which have proved effective and trustworthy in the past, will prove still more effective and trustworthy in time to come.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

BIRMINGHAM.—The project of establishing a chair of Russian language in the University is now on the way to realisation. The Birmingham Chamber of Commerce has issued an appeal to its members for contributions to a fund for the endowment of such a chair, and of the sum of 12,000*l.*, which is aimed at, more than half has already been promised. It is significant that the list of donations includes handsome contributions from Wolseley Motors and Electric Ordnance Accessories Company and the Birmingham Small Arms Company, together with Lloyd's Bank and the London, City and Midland Bank. The realisation by such firms of the help which the University can give to the fostering of commercial relations with Russia augurs well for the early success of the scheme.

THE *Times* reports that the Government has set up a Royal Commission to inquire into the co-ordination of the work of the three Welsh University Colleges and the University of Wales.

THE Teachers' Registration Council announces that the meeting which was to have been held in the Caxton Hall to-morrow, April 14, is unavoidably postponed, as Mr. Arthur Henderson, President of the Board of Education, now finds that it will be impossible for him to speak on that day. It is expected that the meeting will be held soon after the Easter vacation. The exact date will be announced in due course.

THE Executive Committee of the City and Guilds of London Institute has appointed Prof. G. T. Morgan, F.R.S., of the Royal College of Science, Dublin, to the chair of chemistry at the Institute's Technical College, Finsbury, rendered vacant by the death of Prof. Meldola. Prof. Morgan was a former student at the college under Prof. Meldola, and later for some years chemist in the works of Messrs. Read, Holliday and Sons. He is a recognised authority on synthetic chemistry and dye-stuffs, on which subjects he has published many original papers. He will take up his duties at the college after Easter.

IT is announced in the *London University Gazette* that a course of five lectures and demonstrations on "Some Vegetable Products of Economic Importance" will be given by Mr. A. W. Hill, at the Royal Botanic Gardens, Kew, at 11 a.m. on Saturdays, beginning on May 6. The lectures will deal with some of the better-known economic plants and their products, such as tea, cinchona, cacao, rubber-yielding plants, oil-yielding plants, etc. The lectures, which will be illustrated by means of specimens from the living collections at Kew and also by examples of the products referred to from the museums, will be addressed to advanced students of the University and to others interested in the subjects dealt with. Admission is free, without ticket.

THE 360,000*l.* of "University Building Bonds" voted by the people of California for additional building work at the University of California have, we learn from *Science*, been allocated by the regents of the University as follows:—Benjamin Ide Wheeler Hall, a class-room building with a capacity of 3500 students, its exterior to be of white granite, 140,000*l.*; completion of the University library, of which the present portion was built at a cost of 168,000*l.*, 105,000*l.*; second unit of the group of agricultural buildings, 70,000*l.*; first unit of a group of permanent buildings for chemistry, 32,000*l.*; new unit for the heating and power plant, 14,000*l.*; furnishings and equipment for the four structures first mentioned, 26,800*l.* Our contemporary also states that the Committee on Agriculture of the Massachusetts Legislature has obtained the full grant of 76,400*l.* asked for new buildings this year by the Massachusetts Agricultural College.

THE President of the Board of Education has appointed a Departmental Committee to consider what steps should be taken to make provision for the education and instruction of children and young persons after the war, regard being had particularly to the

interest of those :—(i) Who have been abnormally employed during the war; (ii) who cannot immediately find advantageous employment; (iii) who require special training for employment. The committee consists of :—Mr. Herbert Lewis, M.P., Parliamentary Secretary, Board of Education (chairman); Mr. W. A. Appleton, secretary, General Federation of Trade Unions; Mr. R. A. Bray, L.C.C., chairman, London Juvenile Advisory Committee; Mr. F. W. Goldstone, M.P.; Mr. Spurley Hey, director of education, Manchester; Alderman Hinchcliffe, chairman, West Riding County Council; Miss C. Martineau, member, Birmingham City Council; Lady Edmund Talbot; Mr. H. M. Thompson, vice-chairman, Cardiff Education Committee; Mr. Christopher H. Turnor, member, Lincolnshire (Lindsey) County Council; together with the following representatives of the Government Departments concerned :—Mr. C. E. B. Russell, of the Home Office; Mr. J. S. Nicholson, of the Board of Trade; Mr. A. B. Bruce, of the Board of Agriculture; Mr. E. K. Chambers, C.B.; and Mr. F. Pullinger, C.B., of the Board of Education. Mr. J. Owen, H.M. Inspector, will act as secretary to the committee, and all communications should be addressed to him at the Board of Education, Whitehall, London, S.W.

THE question of the part science should take in the education provided in our schools and colleges is further discussed in the correspondence columns of the *Times* Educational Supplement of April 4. Mr. C. L. Bryant, of Harrow, describes how the organisation of the Association of Public Schools Science Masters has been employed to introduce in many of the public schools instruction in science of a utilitarian kind along the lines suggested by the Director of Military Training, not only to those boys who would be learning science if times were normal, but also to all boys who are within measurable distance of leaving to join the Army. Prof. Percy Gardner comments on the recent memorandum on the neglect of science. His position is clear from the following paragraph from his letter :—"I am no hard-and-fast defender of the classics. I should allow that in the teaching of the sciences which deal with nature as well as in the teaching of those which deal with man, and with language and history, we need more scientific method, more system, more modernity. And the natural and human sciences may well claim in the future some of the time now given to the classics. Some knowledge of the scheme of the physical universe has become a part of all complete education. But premature specialism in natural science is not a desirable thing; and that would be the inevitable result of such impatient legislation as the memorial demands." Mr. R. W. Livingstone attributes the scientific success of Germany to the admirable provision for the teaching of applied science in her Technische Hochschulen, to the fact that many more people receive a university education in Germany than is the case with us, and that in Germany research work is an essential part of a university education for the best students. Mr. H. Cradock-Watson, writing of the position of science in the smaller schools, maintains that science has its proper place in their time-tables already, and that when the commercial and manufacturing worlds are ready to employ and pay adequately the university science graduate, when the scientific expert can command the remuneration and the openings that he can —or could—in modern Germany, then the teaching of science will come into its own. Mr. O. H. Latter directs attention to the discontinuance of a science paper in the common entrance examination for public schools, and the consequent discouragement of science teaching in preparatory schools.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 6.—Sir J. J. Thomson, president, in the chair.—J. H. **Jeans** : The instability of the pear-shaped figure of equilibrium of a rotating mass of liquid. The form of the pear-shaped figure of equilibrium was calculated so far as the second order of small quantities by Sir G. Darwin, who believed he had shown it to be stable. In a recently published paper (Phil. Trans., A, 215, p. 27) it was shown that the stability could only be finally decided upon after the figure had been calculated to terms of the third order. In the present paper these third-order terms are evaluated, and the pear-shaped figure is definitely shown to be unstable.—Sir William **Ramsay** : A hypothesis of molecular configuration in three dimensions of space.—J. **Proudman** : The motion of solids in a liquid possessing vorticity. This paper contains investigations on the motion of a homogeneous frictionless liquid by the methods of theoretical hydrodynamics. The principal subjects considered are two-dimensional motion with uniform vorticity and three-dimensional motion with varying vorticity, the positions of the solids being specified by generalised co-ordinates. The general work consists in reducing solutions to those of Neumann's potential problems.—Dr. S. J. **Lewis** : The ultra-violet absorption spectra of blood sera. The work described in this preliminary paper has for its object the investigation of the absorption spectra of blood sera in the ultra-violet region of the spectrum. Modern spectrophotometers are used to determine the absorption values on passing ultra-violet light through a prescribed layer or solution of serum. With these values as ordinates and wave-lengths as abscissæ an absorption curve is drawn. With normal serum the general characters of the curve are constant, and there is very little variation in detail. With certain pathological sera the curves show much greater modifications, and some of these are well defined and appear to be peculiar to given diseases. It is found that the major part of the absorption is due to the proteins.—G. W. **Paget** and R. E. **Savage** : The growth-rings on herring scales. This communication brings forward morphological evidence as to the structure and significance of the so-called "growth-rings" on herring scales. At present the interpretation of these rings as rings of growth depends, in the main, upon statistical data. Morphological evidence of a differential growth-rate of the scale as a whole is altogether lacking. The present observations place upon a sure foundation the view that the transparent rings do indeed, mark a recurring period of minimum growth.

Geological Society, March 8.—Dr. Alfred Harker, president, in the chair.—H. **Bolton** : Fossil insects from the British Coal Measures. The author describes six insect-wings found in the Coal Measures of Northumberland, Lancashire, and South Wales. Three of these have been previously named, but not described in detail; the remaining three are new to science. *Aedoeophasma anglica,* Scudder, has been examined in detail, and is now regarded as a primitive type of the Proto-Orthoptera, in contradistinction to Scudder's view that it is a Protophasmid, and to that of Handlirsch, who had removed it to a group of unplaced Palæodictyoptera. *Palaeodictyopteron higginsi* is shown to be related to the Dictyoneuridæ. A new genus and species is created for a finely-preserved wing, intermediate in character between the Dictyoneura and Lithomantis. Among the varied fauna obtained from ironstone nodules in the Middle Coal Measures at Sparth Bottoms, Rochdale (Lancashire), is a basal fragment of a wing recognised as a new species of Spilaptera, and this is now described. An

unusual type of wing from the Northumberland Coalfield is very suggestive of the Protodonata, and is described as a representative of a new genus and species.

Aristotelian Society, March 8.—Dr. H. Wildon Carr, president, in the chair.—T. Percy **Nunn**: Sense data and the physical object. A criticism of the view that physical objects are revealed in perception as existences of which we have immediate knowledge that they are the "sources" of our sense data. The author contended that the "source" is not in truth an "existence" beyond the sense data, but includes the whole collection of such sense data as can be directly apprehended by perceiving subjects under different conditions. Nothing is gained in simplicity and naturalness by invoking admittedly hypothetical "sources" in order to say about them something formally identical with what must in any case be said about indubitable sense data. For instance, the assumption of a "source" in order to explain why we attribute real shape to an object creates more embarrassment than it removes, for, while it may account for the sense data which resembled the "source" in shape, it affords no help in accounting for those that do not. The contention that sense data carry with them a reference to a "source," or always indicate a reality beyond themselves, breaks down when the attempt is made to deal with the problem of hallucination and error. The physical theory of matter does not necessitate the assumption of a "source"; for the molecules (and atoms) of matter are simply the molar bodies of everyday experience conceptually reduced in size. Whatever belongs to the latter may belong to the former also.

EDINBURGH.

Royal Society, March 6.—Dr. J. Horne, president, in the chair.—Prof. F. O. **Bower**: Leaf architecture as illuminated by a study of the Pteridophyta. A knowledge of leaf architecture may be gained (1) by a comparative study of adult leaves in a large number of different types; (2) by a study of the juvenile leaves and of their development towards the adult form; (3) by a further comparison with the fossil record. The first of these avenues has had priority, especially in relation to the higher flowering plants, leading unfortunately to an interpretation of the lower in terms of the higher. A careful study of the juvenile leaves of the Pteridophyta show that all the varied forms of leaf can be explained as a modification through growth of an original simple dichotomy. The dichotomy in juvenile leaves may be equal or unequal. In the latter case the system is commonly developed sympodially, and all gradations may be observed. This is well illustrated in Pteridium and Osmunda. The order of ontogenetic development is normally from equal dichotomy to sympodial dichotomy, and when the development of the leaf is strong there may be transition to monopodial branching. In higher vascular plants, after the arrest of apical growth, the most prominent factor is intercalary growth. This is effective in producing the petiole. A number of comparisons were instituted which indicated, as a general statement for vascular plants, that their leaf architecture is throughout referable to modifications of a branch system originating phyletically in a simple leaf subject to dichotomy.

PARIS.

Academy of Sciences, March 27.—M. Ed. Perrier in the chair.—The president announced the death of Léon Labbé, free member of the academy, at the age of eighty-four, and gave an account of his work in surgery.—A. **Blondel**: Remarks on the use of high potential continuous current for wireless telegraphy and telephony. With reference to a recent communication to the academy on this subject by MM. Girardeau and Béthenod, it is pointed out that the energy losses are greater than those calculated from the equations employed by Fracque. There are also practical difficulties connected with the use of high-tension continuous current, not present to the same extent when alternating current is used.—Lester R. **Ford**: The approximation of irrational complex quantities.—A. **Buhl**: Geometrical applications of Abel's theorem and Stokes's formula.—G. H. **Hardy**: The summation of Dirichlet's series.—J. **Guillaume**: Observations of the sun made at the Lyons Observatory during the fourth quarter of 1915. Observations were made on sixty days, the results being given in three tables showing the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—Louis **Roy**: The electrodynamics of absorbent media.—L. **Reutter**: The analysis of a Roman pomade. This pomade was found in a Roman amphora excavated near Lugano, and was found to consist of a mixture of beeswax and other fats, added to styrax and turpentine macerated in wine, with some henna.—Paul **Gaubert**: The growth of crystals. Remarks on a recent communication of C. Dauzère. The crystallisation of thymol under the microscope is periodic.—M. **Deprat**: Cycles of erosion and recent epeirogenic movements in south-western China.—Adrien **Guébhard**: The extension north of the department of Var of the tectonic formula of the neighbourhood of Castellane (Basses-Alpes), and the generalisation of its principle.—A. **Brives**: The relations of the Trias and metalliferous deposits in Algeria.—P. **Chaussé**: Researches on the persistence of Botal's cleft in some domestic animals. This malformation was found in 30 per cent. of the three months old calves examined, and was also common in grown cattle and in pigs. It was exceptional in the horse and dog.—A. **Lécaillon**: The existence of two annual generations in *Galeruca luteola,* and on the manner in which they succeed each other.—A. **Magnan**: Vaccination against paratyphoid fevers A and B.—A. **Trillat**: A calorimetric method utilised by the Romans for characterising soft waters. The Romans attached considerable importance to the quality of their drinking water, and appear to have chosen the softest water when more than one supply was available. From a remark by Hippocrates it seems that the bleaching of small quantities of red wine by the water was the test employed. It is shown that a series of nine waters is arranged in the same order of hardness by testing with wine or by the ordinary alkali-metric method.

BOOKS RECEIVED.

The Moon, considered as a Planet, a World, and a Satellite. By J. Nasmyth and J. Carpenter. Cheap edition. Pp. xix+315. (London: J. Murray.) 2*s.* 6*d.* net.

Guida Allo Studio della Storia delle Matematiche. By Prof. G. Loria. Pp. xvi+228. (Milano: U. Hoepli.) 3 lire.

A Treatise on Electricity. By F. B. Pidduck. Pp. xiv+646. (Cambridge: At the University Press.) 14*s.* net.

The Fauna of British India, including Ceylon and Burma. Rhynchota. Vol. vi., Homoptera: Appendix. By W. L. Distant. Pp. viii+248. (London: Taylor and Francis.) 10*s.*

The Flowering Plants of Africa. By Fr. Thonner. Pp. xvi+647. (London: Dulau and Co., Ltd.) 15*s.* net.

Natural History of Hawaii. By Prof. W. A. Bryan.

Pp. 596. (Honolulu: The Hawaiian Gazette Co., Ltd.)

Memoirs of the Geological Survey. England and Wales. On the Thicknesses of Strata in the Counties of England and Wales, exclusive of Rocks older than the Permian. By Dr. Strahan, and others. Pp. vi+172. The Geology of the South Wales Coalfield. Part xii., The Country around Milford, being an account of the region comprised in Sheet 227 of the Map. By T. C. Cantrill, and others. Pp. vii+185. (London: H.M.S.O.; E. Stanford, Ltd.) 4*s*. 6*d*. and 2*s*. 6*d*. respectively.

The Sex Complex. By Dr. W. Blair Bell. Pp. xvii+233. (London: Baillière, Tindall, and Cox.) 12*s*. 6*d*. net.

Physiological Chemistry. By Prof. A. P. Mathews. Pp. vi+1040. (London: Baillière, Tindall and Cox.) 21*s*. net.

Brook and River Trouting. By H. H. Edmonds and N. N. Lee. Pp. 106. (Bradford: The authors.) 10*s*. 6*d*. net.

On the Relation of Imports to Exports. By J. Taylor Peddie. Second edition. Pp. xxiv+148. (London: Longmans and Co.) 5*s*. net.

Occupations: from the Social, Hygienic, and Medical points of View. By Sir T. Oliver. Pp. x+110. (Cambridge: At the University Press.) 6*s*. net.

The Dynamical Theory of Gases. By J. H. Jeans. Second edition. Pp. vi+436. (Cambridge: At the University Press.) 16*s*. net.

Records of the Survey of India. Vol. vii. Annual Reports of Parties and Offices, 1913–14, from 1st October, 1913, to 30th September, 1914. Prepared under the direction of Sir S. G. Burrard. Pp. ii+180+11 maps. (Calcutta: Superintendent Government Printing, India.) 4 rupees, or 6*s*.

Union of South Africa. Mines Department. Geological Survey Memoir No. 7: The Geology and Mineral Industry of South-west Africa. By P. A. Wagner. Pp. 234+plates xli. (Pretoria: Government Printing and Stationery Office.) 7*s*. 6*d*.

Forty-fifth Annual Report of the Deputy Master and Comptroller of the Mint, 1914. Pp. 191. (London: H.M.S.O.; Wyman and Sons, Ltd.) 3*s*. 6*d*.

An Introductory Course of Continuous Current Engineering. By Dr. A. Hay. Second edition. Pp. xii+360. (London: Constable and Co., Ltd.) 6*s*. 6*d*. net.

Wisconsin Geological and Natural History Survey. Bulletins Nos. xxviii.–xxxii. Soil Series, Nos. 2–6; Bulletins Nos. xxxvii+xl. Soil Series, Nos. 7–10; Bulletins Nos. xxxv and xliv. Economic Series, Nos. 17 and 19. Soil Maps, accompanying Bulletins 28 to 32 and 37 to 40 inclusive. Soil Series, 2 to 6 and 7 to 10 inclusive. (Madison, Wis.: Published by the State.)

Economics: an Introduction for the General Reader. By H. Clay. Pp. xvi+476. (London: Macmillan and Co., Ltd.) 3*s*. 6*d*. net.

Medical and Veterinary Entomology. By Prof. W. B. Herms. Pp. xii+393. (London: Macmillan and Co., Ltd.) 17*s*. net.

DIARY OF SOCIETIES.

THURSDAY, APRIL 13.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—*Discussion:* The Present Position of Electricity Supply in the United Kingdom; and the Steps to be taken to Improve and Strengthen it.

CHILD STUDY SOCIETY, at 6.—Experiments on Hand-writing in Schools: Dr. C. W. Kimmins, Mrs. Grainger, and Miss Golds. At 7.30.—Annual Meeting.

INSTITUTION OF NAVAL ARCHITECTS, at 11 a.m.—Subdivision of Merchant Vessels: Reports of the Bulkhead Committee, 1912–1915: Sir Archibald Denny.—Strength of Watertight Bulkheads: J. F. King.—Some Effects of the Bulkhead Committee's Reports in Practice: A. T. Wall. At 3.—Notes from a Collision Case: J. Reid.—Shipyard Cranes of the Rotterdam Dockyard Company: M. G. de Gelder.

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Night Marching by Stars: E. A Reeves.

OPTICAL SOCIETY, at 8.—Practical Workshop and Laboratory Measurements: S. D. Chalmers.—Some Further Notes on Focometry: T. F. Connolly.

FRIDAY, APRIL 14.

ROYAL INSTITUTION, at 5.30.—The Genesis and Absorption of X-Rays: Sir J. J. Thomson.

INSTITUTION OF MECHANICAL ENGINEERS, at 6.—Theory and Practice in the Filtration of Water: W. Clemence.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Observations of the Double Star Krueger 60: E. E. Barnard.—The Kinetic Energy of a Star Cluster: A. S. Eddington.—Catalogue of Radiant Points of Shooting Stars, 1898–1915: A. King.

PHYSICAL SOCIETY, at 5.—The Variation of Resistance with Voltage at a Rectifying Contact of Two Solid Conductors, with Applications to the Electric Wave Detector: D. Owen.—The Electrical Capacity of a Gold Leaf Electroscope: Dr. T. Barratt.

SATURDAY, APRIL 15.

ROYAL INSTITUTION, at 3.—Radiations from Atoms and Electrons: Sir J. J. Thomson.

MONDAY, APRIL 17.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Development of Rhodesia from a Geographical Standpoint: H. Wilson Fox.

TUESDAY, APRIL 18.

ROYAL STATISTICAL SOCIETY, at 5.15.

ZOOLOGICAL SOCIETY, at 5.30.—The External Characters of the Mongooses (Mungotidæ): R. I. Pocock.—The Poison-Organ of the Sting-Ray (*Trygon pastinaca*): Major H. Muir Evans.

INSTITUTION OF CIVIL ENGINEERS, at 5.30.—Annual General Meeting.

WEDNESDAY, APRIL 19.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Early Stages in the Evolution of Life: Prof. Benjamin Moore.—Studies in Marine Biology: F. Martin Duncan.—Some Suggestions regarding Visual Efficiency in the Use of the Microscope and other Optical Instruments: J. W. Purkiss.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—The Persistence of Wet and Dry Weather: E. V. Newnham.—Discontinuities in Meteorological Phenomena. Second Note. Prof. H. H. Turner.

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ST. MARTIN'S STREET, LONDON, W.C.

Advertisements and business letters to be addressed to the Publishers.

Editorial Communications to the Editor.

Telegraphic Address: PHUSIS, LONDON.

Telephone Number: GERRARD 8830.