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

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THE BIOLOGICAL PROBLEM OF SEX.

The Determination of Sex. By Dr. L. Doncaster. Pp. x+172. (Cambridge: At the University Press, 1914.) Price 7s. 6d. net.

DR. DONCASTER deals in a masterly way with a problem as difficult as it is fascinating, and his book is a fine illustration of scientific method. He states a theory and presents the evidence, and when the reader has just begun to enjoy a sense of satisfaction, more facts are brought forward which show that the theory breaks down, and that we have still much to learn regarding the determination of sex. It is a pleasure to follow a discussion which is so keenly critical and at the same time open-minded. Those who know Mr. Doncaster's book on heredity will expect lucidity in his treatment of a cognate subject, and they will not be disappointed. He goes deeply into things, but it is all clear, including the glossary. The illustrations are interesting and instructive. An indication of the scope of the book may be given in the chapter-headings: The problem; the nature and function of sex; the stage of development at which sex is determined; sex-limited inheritance; the material basis of sex-determination; the sex-ratio; secondary sexual characters; the hereditary transmission of secondary sexual characters; hermaphroditism and gynandromorphism; general conclusions on the causes which determine sex; the determination of sex in man. The author does not deal with the subject in its entirety, the case of plants, for instance, being deliberately left out, but selects for illustration and discussion the lines which seem to him most promising.

Dr. Doncaster's general position may be stated. In some cases sex appears to be determined already in the unfertilised ovum, for male-producing and female-producing ova are formed. In other cases sex seems to depend on the spermatozoon, and to be fixed at fertilisation; thus, to take a simple case, the unfertilised ova of the hive bee develop into males, and there are many instances now known of two kinds of spermatozoa differing in respect of their chromosomes. In a few cases there is evidence that sex may be modified during embryonic development or even later. Many facts point to the conclusion that a sex-determining factor sometimes resides in special sex chromosomes, and is inherited like a Mendelian character (as was first suggested by Bateson and by Castle). Individuals which receive it from both parents would be of one sex; those to which it is transmitted by one parent only would be of the other sex.

But the author goes on to point out that there are many facts which do not fit in with this theory. There is evidence that the ovum may influence the sex in cases in which observations on the chromosomes indicate that the sex should be determined by the spermatozoon; and there is evidence that the sex may in some cases be modified after fertilisation by influences acting on the embryo or some later stage. Therefore the author is inclined to give up the simple hypothesis of an unchangeable hereditary entity, the presence of which always causes one sex and its absence the other. He supposes that sex is dependent on a physiological condition of the organism, depending on the interaction of certain chromosomes with the protoplasm of the cells, and therefore determined, in the absence of other disturbing factors, by the presence or absence of these particular chromosomes. But where the determination expressed by the chromosome difference is not decisive, other conditions may have their influence. "Put in different words, every germ-cell would bear a sex-determining factor, but when this factor has relatively small intensity of action, its effect may be counterbalanced by other causes which alter the physiological relation on which sex-determination depends."

As to Man, the evidence from the study of chromosomes is at present unsatisfactory, but it is maintained by some that Man is one of those species in which the male has one chromosome less than the female; all the ova contain an X-chromosome (supposed to have a sex-determining function), while half of the spermatozoa have it and half have not. When two X-chromosomes are present in a fertilised ovum it develops into a female; when only one, into a male. But apart from the chromosomes, there are some other facts which point to the conclusion indicated. The most important of these is the sex-limited transmission by the male, as seen in the inheritance of colour-blindness, night-blindness, and hæmophilia. "If a man transmits certain characters always or nearly always to his daughters, the conclusion can hardly be avoided that he produces two kinds of germ-cells, female-producing which bear the factor for these characters, and male-producing which do not." If sex in man is determined solely by the spermatozoon, "there is no hope either of influencing or of predicting it in special cases." But if the ovum has some share in the effect, as some other facts suggest, if there are two kinds of ova, or if the physiological condition of the ova is alterable, the possibility of influencing the sex of the offspring through the mother is not excluded. The author regards "the control of sex in Man as an achievement not entirely impossible of realisation."

As regards the differences between the sexes, with which the author is not specially concerned in this volume, the view is entertained that "the physiology of the female is relatively anabolic, that of the male catabolic in character. That this should be so is perhaps a necessary consequence of the difference in function between the sexes. . . . It is interesting to speculate, however, whether the active, vigorous habits of the male and the restless movement of the spermatozoon on the one hand, and the quieter habit of the female and the passivity of the egg on the other, may not each be due to fundamental catabolic and anabolic tendencies, characteristic of maleness and femaleness, quite apart from the exigencies of reproduction."

This speculation is luminous and interesting, but we should have liked it better if reference had been made to the fact that it was advanced more than a quarter of a century ago by Prof. Patrick Geddes. It may be, however, that this is just another illustration of great minds thinking alike.

X-RAYS AND CRYSTALS.

X-Rays and Crystal Structure. By Prof. W. H. Bragg and W. L. Bragg. Pp. vii+229. (London: G. Bell and Sons, Ltd., 1915.) Price 7*s*. 6*d*. net.

A BOOK in which are gathered together the results so far obtained in the new field of research concerning X-rays and crystals is particularly welcome at the present time, and especially from Prof. Bragg and his son. For not only have they carried the subject very much further than its initiators, Drs. Laue, Friedrich, and Knipping, but they have also given us an entirely new mode of experimenting. Indeed, in the hands of the English observers the investigation has already borne surprisingly important results, both as regards experimental confirmations of the views of crystallographers based on crystal measurement and as regards the nature of the X-rays themselves. The book will be gladly received by all who desire to explore the possibilities of the new method of attack, as it affords much-needed detailed descriptions of the apparatus employed, and instructions for its use.

The photographic diffraction method of Laue only receives a relatively small amount of attention, as the Bragg method, which involves the use of the X-ray spectrometer, is shown to be much more capable of affording indications of the internal structure of the crystal in the more complicated cases. It is clearly shown, however, that the two methods are mutually complementary, and lead to essentially the same result, with the advantage of detail on the side of the spectrometer, and permanence of record on the side of the photographic radiogram.

The whole subject is still so fresh that it might have been considered premature that a book should yet be written concerning it. But the results obtained already are so clear, and the stage reached may so truly be said to be one at which the initial difficulties have been overcome in the simpler cases tackled, that this book is in reality fully justified, and should prove of great use in attacking the immense difficulties which are presented by the more complicated crystalline chemical compounds. It may be that our first transports over the opening-up of so remarkable a new field of research may have to be modified, as it appears to be only capable of yielding unmistakably intelligible indications in the very simple cases, those of the chemical elements and their binary and ternary compounds, and not to be generally capable of indicating hemihedrism. For Friedel has shown that only eleven different types of radiogram are afforded by the thirty-two classes of crystals. It was hoped that it might throw a clear light on the much-discussed Pope-Barlow conception of valency, as dependent on the relative volumes of the spheres of influence of the various elementary atoms in a crystalline compound. But so far the indications are not favourable to that theory, and have led its propounders to doubt the value of the X-ray results. The chief substance studied which has afforded indications is the diamond, the analysis of which with the aid of the X-ray spectrometer is perhaps the most brilliant piece of work carried out by the Braggs. Whatever its indications may be as to the nature of the packing of the atoms and the sizes of their spheres of influence, there can be no doubt that the structure arrived at in the case of this, the most interesting, form of carbon is one which must commend itself both to the crystallographer and to the organic chemist as bearing the impress of truth.

The book will be found to afford much information concerning the properties of X-rays, as revealed by the Bragg spectrometer, and details of the investigations of all the simple crystalline substances which they have studied by its aid. The main work of the authors has been to show that the different orders (first, second, and third) of reflection, at the specific angles for maximum effect experimentally found for certain "monochromatic" X-radiations, correspond to reflections from different sets of planes among the whole parallel series of planes of atoms present in the part of the crystal penetrated by the rays, that is, to consecutive planes, alternate planes, and sets composed of every third plane; and from the intensity (if present) or absence of the different orders of reflection most important conclusions have been derived as to the constitution of these several planes of atoms, that is, as to the distribution in them of the atoms of the different chemical elements present in the crystallised substance. Moreover, the actual distances apart of the planes, and therefore of the contiguous atoms, have been calculated.

As regards the crystallographic bearing of the work described in this book, it may be unhesitatingly affirmed to afford ample confirmation of the structure of crystals which has been accepted during the last decade, as being indicated by the combined results of the work of experimental crystallographers and theoretical geometricians; this is certainly true so far as that structure has been authoritatively stated in such works as the latest edition of von Groth's "Physikalische Krystallographie," Miers' "Mineralogy," or the "Crystallography and Practical Crystal Measurement" of the writer of this review. It thus proves up to the hilt the solid ground-work on which the science of crystallography is now built, while throwing little light upon, and giving as yet no countenance to, the more speculative theories which are the matter of current discussion. It reveals crystallography more than ever as the handmaid of chemistry, and enhances a hundredfold the necessity for a much more universal study of crystals than has hitherto been recognised. Crystallographers are deeply grateful to Prof. and Mr. Bragg for their highly interesting and timely book.

A. E. H. TUTTON.

SIR HIRAM MAXIM.

My Life. By Sir Hiram S. Maxim. Pp. ix+322. (London: Methuen and Co., Ltd., 1915.) Price 16*s*. net.

TO write in the first person singular is not according to the English temperament; even the best autobiographies annoy us, and the more we admire a man the sorrier do we feel when reading his life. Therefore it is thought to be better "form" to let a friend write one's life. But if we are to know Sir Hiram Maxim, we must listen to him telling his own story in his own way; we must not only bear with him when he shows pride in his performances, we must try to sympathise with him. He is a naturalised British subject; he was knighted; he is known in good society; he has received many orders and honours and hospitality from our own and foreign rulers. He is proud to be a British subject, and we are proud of the reasons he has given in this book for his change of citizenship, but in every line he shows that he is an American. He reveals himself as no Englishman dare do, but if the reader will only call to mind the fact that there are other formulæ of behaviour than his own, he will find the book well worth reading.

Sir Hiram Maxim was born in 1840 in the State of Maine; he had very little school education; he had a childhood and youth full of hard work. We know from many sources the conditions of young life sixty years ago in Maine and the New England States. In many ways it resembled the conditions in country places, not in England, but in Scotland and the North of Ireland, only that in Maine there were no rich people and there were few who were even moderately well to do. There was almost no money; wages were paid in kind, in orders upon shops for provisions. Everybody had a rather hard life full of manual labour, and therefore young Maxim did not in the least repine at his lot, which might seem to some of us a very hard lot. He is still proud of his muscular strength, which is greatly due to the work of his youth. He recounts with pride how, when quite young, in woodwork, lathe work, and work with various hand-tools to which he was sometimes unaccustomed he greatly outstripped other and much older workmen. Whatever chances of school there were he seized, in spite of long working hours. In Maine and Canada there was little skilled labour, so that the ingenious, energetic young man found that he could make a reputation quickly in any trade that he took up, and he succeeded in many trades, even in what may elastically be called landscape painting.

To such a boy everything gave occasion for thought and invention, and the inventions which he seems to be most proud of are those early inventions with which his name is not much connected now. Many of them have been greatly developed, but he reaps no share of the large fortunes that they have created. He had plenty of opportunity of studying human nature. He was evidently always abstemious himself, but he even had the experience of tending a drinking bar for a short time. He was peace-loving, but he was compelled on many occasions to show that he could fight, and he seems to have been a fine fighter. He gives few dates, and his age when any particular event happened can only be guessed at very roughly. This does not much matter, because at the age of twenty and at the age of forty he was the same independent, optimistic youth, eager for work and invention, gradually becoming skilled in the use of the best tools in doing fine metal work, able to turn his hand to glass-blowing and draughtsmanship and half-a-dozen other arts, with a good working knowledge of chemistry, electricity, and other parts of physics; he was always proud of his strength and health.

He made many inventions: mousetraps, gas machines, sprinklers to put out fires, a steam trap, locomotive head-lights, incandescent platinum and carbon electric lamps, the electric regulator for which he received the Légion d'Honneur; he demagnetised watches, and did many other interesting things. He relates many amusing anecdotes which illustrate the condition of things fifty years ago in Canada and the northern and also in the southern States.

He was probably thirty-eight when he discovered that heating carbon in a hydrocarbon atmosphere caused carbon to be deposited in a very hard form; we are not sure that he really claims the method of "flashing" a carbon filament by keeping it hot in a hydrocarbon atmosphere, but the suggestion of a claim is evident. About the age of forty he was greatly engaged in the manufacture and use of dynamo machines, and he exhibited excellent lamps at the Paris Exhibition of 1881. Soon after this, in London, he invented and exhibited his automatic gun; a single barrel which discharged more than six hundred ordinary rifle shots per minute, and for the next twenty years his time was mainly taken up in developing automatic guns of greater sizes. He records some of the praise which has been bestowed upon his gun; no praise can be too great for it. We remember a toast which was drunk enthusiastically in London when the news of a certain conquest had just been published "To the Conqueror of Matabeleland, Hiram Maxim."

He made discoveries about gunpowder and other explosives. He seems to be the first inventor of a smokeless powder. He describes all these things, but does not seem to think them of much more importance than his experiments on the roasting of coffee.

He seems to have been the first to see clearly how a flying machine might be made to work, and spent a very great deal of money in driving inclined planes horizontally through the air by means of an engine and air propellers, so that there should be sufficient vertical lifting force upon the planes. His machine did lift, and he seemed to be succeeding slowly, but his real difficulty was in the great weight of engine required. The invention of the petrol engine easily made the aeroplane a real flight machine. His fellow directors seem occasionally to have thought that there was a loss of dignity in his allowing advertisements to appear of such things as his inhaler for asthma, and scientific friends deplored his "prostituting his talents on quack nostrums." His own comment upon this is that from their point of view the invention of a killing machine was very creditable, but it was a disgrace to invent an apparatus to prevent human suffering. Just so, there are the two points of view. All through his life Sir Hiram was keen upon inventing anything that might be useful. He does not feel a loss of dignity in describing how he invented a simple, thoroughly good method of giving a proper surface to a black-board in a school, and he is no more ashamed of advertising his inhaler than of advertising his gun.

His experience of lawyers and business men in America seems to make him rather bitter towards Americans. It is gratifying to find him saying: "The reception that I received in England and the straightforward honesty of the gentlemen with whom I had to deal, gave me a very favourable opinion of the English character." J. P.

APPEARANCE AND REALITY.

(1) *William James and Henri Bergson: A Study in Contrasting Theories of Life.* By Dr. H. M. Kallen. Pp. xi+248. (Chicago: University of Chicago Press; London: Cambridge University Press, 1914.) Price 6*s*. net.

(2) *The Mirror of Perception.* By L. Hall. Pp. 129. (London: Love and Malcomson, Ltd., 1914.) Price 2*s*. 6*d*.

(3) *What is Adaptation?* By Prof. R. E. Lloyd. Pp. vii+110. (London: Longmans, Green and Co., 1914.) Price 2*s*. 6*d*. net.

(4) *The Story of Yone Noguchi: Told by Himself.* Pp. xi+255. (London: Chatto and Windus, 1914.) Price 6*s*. net.

(1) NOT the least useful contribution to philosophy made by William James was a negative one, viz., the ignoring of the traditional antithesis between reality and appearance. This antithesis may safely be said to have been the original sin of metaphysics since meditation began, and James's philosophy may most fruitfully be studied from this starting-point. The older philosophers, logical and static, discriminated between appearance and reality "in one or all of the compensatory terms of God, freedom, immortality, and cosmic unity"; and later, "in response to the pressure of rapidly growing sciences, men faced fact, only to change it in such wise as thereby to satisfy the inner need for logical consistency." But James "insisted

that each event of experience must be acknowledged for what it appears to be, and heard for its own claims. To neither doubt nor belief, datum nor preference, term nor relation, value nor fact, did he concede superiority over the others. . . . Pure experience knows no favourites. He admits into reality . . . evil as well as good, discontinuities as well as continuities, unhuman as well as human, plurality as well as unity, chance and novelty as well as order and law."

Though between James and Bergson there is no little spiritual sympathy, a profound difference exists in the methodology of the *Weltanschauung* of each thinker. "Where," says Dr. Kallen, "Bergson beholds a universe, James sees a multiverse. . . . James is a democrat in metaphysics. Bergson, on the contrary, is a monarchist. For him the distinction between appearance and reality is aboriginal and final. For James it is secondary and functional." For James, "being is neutral," and he ignores, practically, the difference between "being" and "not being." Hegel laboriously proved them to be the same. James deals with reality just as it comes to cognition. Reality to him is "alogical," as Dr. Kallen puts it. Kant began the attack on logical metaphysics, inventing "epistemology" to assist him towards a *locus standi*. He, no less than any of the ancients, would have nothing to do with "common-sense reality." And no one expects any philosopher to consider it. But, to return to Bergson and his notion of philosophical reality, it is remarkable with what *élan* the French thinker embraces his self-found "truth." It is *durée réelle* (pure duration), a *poussée formidable* (a formidable thrust), the *élan vital* (the onrush of life); but its eternal enemy is matter and space, which distort it and by which it is distorted. Bergson's "flux" is a richer concept than that of Heraclitus, but it is of the same order. You would expect him to prefer instinct to intellect. But no one nowadays would place intellect, reason, first in the cosmic hierarchy. Both Bergson and James have contributed to this result. From the pragmatist point of view truth is "what we live by"; "common-sense, religion, art, and science are tools and modes of life, and therefore pragmatic." But, for Bergson, "truth is absolute," and his "truth" is vitalism writ large, after a course of Plotinus, Driesch (?), and Darwin.

(2) It is somewhat stimulating to find a disciple of Berkeley crying in the wilderness of to-day. Mr. Leonard Hall puts forward a "metaphysical theory" which is "a particular form of psychophysical parallelism, in which it is maintained that the physical world is the appearance, or image, of the psychical world, *in the distorting mirror of perception*" (my italics). It is a clever *tour de force*, though it is apparently quite serious. Granted the major premiss, everything comes out satisfactorily. Mr. Hall commences with the old antithesis of appearance and reality, and argues that "the initiating cause of all perceptions of the same material body is, not the body itself, but a reality of which the body is the image in the distorting mirror of perception." For Berkeley the initiating cause was God; for modern science "the initiating cause of all perceptions of the same body is the body itself," which, by the way, is not the case; science does not dogmatise here. Material bodies are "unreal . . . they are the transfigured appearances, or images, of underlying realities. Further, according to this theory, space is unreal, a material body, like the image of an object in a mirror, being in unreal space." Mr. Hall concludes that every organism, from the protozoa upwards, is a "mind"; that man is the super-conglomerate of "minds," and that this hypothesis of summated minds explains evolution and the organic world.

(3) Prof. Lloyd has written a suggestive little book on adaptation. The proposition of the selection theory that "competition causes evolution" was made in order to explain adaptation and life in general. It regards organisms as fitting into something, which is called their environment, . . . and that this correspondence was brought about by the elimination, from the one side, of all that would not fit." But adaptation, according to Prof. Lloyd, does not, any more than life, require explanation. It is the teleological bias of man, the machine-maker, that institutes the wonder which leads to design, purpose, and adaptation theories. But adaptation is "its own explanation, since an unadapted thing could not live."

(4) The *Weltanschauung* of many philosophers has been based on æsthetic axioms. And in his way the artist is a philosopher; "the marbles of Phidias and the philosophy of Plato . . . obey the same impulse and express the same will—an impulse to make over unsuitable realities into satisfactory ideas, a will to remodel discordant nature into happy civilisation." The reminiscences of the Japanese poet, Mr. Yone Noguchi, are a case of æsthetic pragmatism. "Do you know," he says, "I am a shy, without-knowledge-of-the-world poet"? All his experiences have been acquired from the point of view of beauty. His description of Chicago is a good example. "Smoke means Chicago as flower means Japan; money means Chicago as art means Japan."

A. E. CRAWLEY.

OUR BOOKSHELF.

A Manual of Oils, Resins, and Paints, for Students and Practical Men. By Dr. H. Ingle. Vol. I., Analysis and Valuation, by the author and J. A. L. Sutcliffe. Pp. 129. (London: C. Griffin and Co., Ltd., 1915.) 3*s.* 6*d.* net.

This small volume is intended for students, analysts, and works chemists who are familiar with general chemistry but have had little or no practical experience in analysing oils, or preparations which contain oils. It includes much of what one would put in a good notebook intended for personal use in the laboratory. A short introduction serves to refresh the reader's memory upon points in organic chemistry specially relevant to oils and fats, after which the authors give short accounts of the most approved chemical and physical methods used in examining these bodies. Theoretical explanations are included as well as practical details. For example, the chemical reactions concerned in the absorption of iodine by oils are described more fully than usual—though it is true that we have to look in more than one place for them. A chapter on technological analysis deals not only with oils, fats, and waxes as such, but with articles such as paints, pigments, and varnishes which may contain oil as an ingredient, and with allied substances, such as turpentine and gum-resins.

The correct interpretation of the results obtained would often require much more knowledge than could be obtained from the descriptions given. Information as to the origin and methods of preparation of the various oils is not within the scope of the work. It is understood, however, that further volumes are to follow, dealing with these matters. The book is a useful introduction to laboratory work in the subject.

Potting, for Artists, Craftsmen, and Teachers. By G. J. Cox. Pp. ix+200. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1914.) Price 5*s.* 6*d.* net.

The book will prove a distinct help to an artist craftsman who wishes to "do something" with clay. The author is right in saying: "Too much stress cannot be laid upon the importance of close study of the best work, both ancient and modern, for it is a truism that however handily a craftsman may work, his output will be worthless if he has not, with his increasing powers of technique, developed a sound judgment and refined taste." The description of the various simple processes of pottery work is very exact, and the illustrations are admirable.

The book, indeed, is a simple, though thorough and concise, first tutor to an artist craftsman, and should, to use the author's words, "set one or two sincere students to the making of some of the many beautiful objects of utility and art with which the craft abounds."

The list of pottery terms is useful, though there are a few which are not employed in this country in the sense given by the author, for example, *clammings* in England means the doors of the kiln, and not simply the sand or siftings applied to the cracks in them; *pug* in this country is used to mean the mechanical wedging of clay; *galena* is classed by the author as highly poisonous, and lead as poisonous, whereas galena is practically safe to use, but there may be considerable danger in using white lead carelessly.

Bernard Moore.

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.*]

The Principle of Similitude.

When Lord Rayleigh directs attention to the neglect among physicists of the principle of similitude (Nature, March 18), he has perhaps forgotten the excellent paragraph in which Tait deals with the question in his "Properties of Matter." Curiously enough, one of Lord Rayleigh's first illustrations is also Tait's, namely, the fact that the velocity of waves on deep water is as the square root of their lengths, to which Tait adds the corresponding fact that the velocity of ripples is inversely in the same proportion.

The principle is of great use in biology, as Herbert Spencer was the first to show. By its help we understand how there is a limit set to the possible growth in magnitude of terrestrial animals; how, on the other hand, the whale gains in activity and speed the bigger it grows; why the ostrich is unable to fly; why the bee's wing vibrates so much quicker than a bird's; and why the flea can jump well-nigh as high as a man. And not less does the principle deserve to be borne in mind when we consider what must be the conditions of life in the most minute organisms: especially if there be any so small as that Micrococcus of the rabbit, the diameter of which is given in the books as only 0·00015 mm., or not far from the limits of microscopic vision.

D'Arcy W. Thompson.

It is rather curious that Prof. D'Arcy Thompson should refer to Tait's "Properties of Matter," for I fancy I might claim some part of the credit for the paragraph in question. In a review of the first edition (Nature, vol. xxxii., p. 314, 1885) I wrote:—"There is one matter suitable to an elementary work which I should be glad to see included in a future edition, viz., the principle of dynamical similarity, or the influence of scale upon dynamical and physical phenomena. It often happens that simple reasoning founded upon this principle tells us nearly all that is to be learned from even a successful mathematical investigation, and in the numerous cases where such an investigation is beyond our powers, the principle gives us information of the utmost importance."

And, after an example or two: "I feel sure that in Prof. Tait's hands this very important and fundamental principle might be made intelligible to the great mass of physical students." Though I believe I was in correspondence with him at the time, I do not remember to have seen Tait's second (or later) edition, and I can only wonder that it has not had a more marked effect in popularising the general principle.

Prof. Thompson's illustrations from biology (attributed in part to Spencer) are, of course, of first-rate importance.

RAYLEIGH.

The Age of the Earth.

SOME fifty years ago Kelvin announced that the temperature of the earth could not have been anything like its present value for more than some 20–30 million years. This estimate was based upon three independent considerations, namely, the temperature gradient inside the earth's crust, the amount of tidal friction, and the total amount of energy radiated by the sun.

The first of these arguments has been invalidated completely by the discovery of the radio-active elements. The other two arguments are scarcely affected by this event.

The geologists always found some difficulty in compressing the history of the earth, more especially of the sedimentary strata, into the period allowed them by Kelvin. Prof. Harker's presidential address before the Yorkshire Geological Society, reprinted in your issue of March 25, seems to show that there is a general impression abroad that Kelvin's estimates have been superseded, and that the discoveries in radio-activity allow one to assume a period of the order of thousands of millions of years since the earth has reached a constant state as regards climate. I should like to be allowed to state as succinctly as possible what difficulties this view entails.

The mean temperature of the earth is about 280° absolute. It therefore radiates about $1{\cdot}7 \times 10^{24}$ ergs per second into space.

Assuming the latest value $1{\cdot}92 \frac{\text{cal}}{\text{cm.}^2\text{min.}}$ for the solar constant, the earth receives $1{\cdot}72 \times 10^{24}$ ergs per second from the sun. Therefore the radiation from the sun just compensates the amount lost by the earth; in other words, the temperature of the earth is determined by the temperature of the sun. The possibility that the earth's temperature might have been maintained by radio-active processes before the sun was incandescent, and that the radio-active substances have died off since then need scarcely be discussed seriously. For quite apart from the well-known sterilising effects of the rays, any radio-active substances with a sufficiently long life to keep up the temperature of the earth for any considerable length of time would not disappear quickly. Uranium, for instance, only diminishes at the rate of about 1·5 per cent. in 100 million years.

One may conclude, therefore, that the time during which the earth can have existed in its present state cannot be greater than the time since which the effective temperature of the sun has been about 6000°, its present value. This time cannot exceed about thirty million years. For the sun loses energy at the rate of about $3{\cdot}8 \times 10^{33} \frac{\text{ergs}}{\text{sec}}$, and the total energy to be gained by a mass of $1{\cdot}97 \times 10^{33}$ gm., contracting to a radius $6{\cdot}96 \times 10^{10}$ cm., is $2{\cdot}2 \times 10^{48}$ ergs, assuming approximate homogeneity. (Taking the increase in density towards the centre into account does not alter these figures much.) Now even if one assumes that the whole of this energy was radiated at a rate of about $3{\cdot}8 \times 10^{33} \frac{\text{erg}}{\text{sec.}}$, *i.e.*, at the present rate, it will only last 18·3 million years. But any other supposition, namely, that the sun at one time emitted more or less energy per second, leads to a shorter period for the earth in its present state.

To explain a greater age it was necessary to find other sources of energy, and since neither the heat of chemical combination nor any possible increase in the specific heat was anything like large enough, the heat of radio-active transformations was invoked. This was perhaps excusable in the early days before very much was known about the laws governing these processes, but it seems quite inadmissible to-day.

It has been suggested that at the enormous pressure and temperature inside the sun radio-active processes might be modified, and even that ordinary elements might break up. A consideration of the quantitative relations involved shows that this is most unlikely. Though one can scarcely apply ordinary thermodynamics to radio-active processes one can certainly apply the general rule, which may also be developed from the quantum theory if desired, namely, that a reaction the energy of which is A ergs per molecule is affected chiefly by the collisions of atoms of energy of the order A. Now A is of the order 10^{-5} ergs in radio-active processes, and one can therefore only expect the temperature to affect those if an appreciable number of atoms have an amount of energy of this order. The average energy of an atom would be 10^{-5} ergs at about $5{\cdot}10^{10}$ degrees. Therefore even at 500 million degrees only one atom amongst 10^{40} would be moving fast enough to influence a reaction which liberates 10^{-5} ergs. Obviously 500 million degrees is quite beyond the bounds of possibility in any part of the sun. One must conclude, therefore, that any process which liberates anything like the requisite energy is unaffected by solar conditions, and takes place at the same rate on the sun as on the earth. Thus one must fall back upon the ordinary radio-active materials, and as Sir Ernest Rutherford has pointed out, one would only gain a paltry five million years even if the whole sun were composed of uranium. The only way out would seem to be to suppose that the sun was created some 10^9 or 10^{10} years ago out of special radio-active material which produces an enormous amount of energy, and that it has been breaking up ever since. This material does not exist on the earth though, so the earth would have to be the object of a special creation. Such an assumption, of course, can neither be controverted nor even discussed. But unless some such hypothesis is introduced, *i.e.*, unless the presumably radio-active solar material which liberates a quantity of energy sufficient to keep up the sun's heat for the desired 10^9 or 10^{10} years, is supposed to have been created by some inconceivable force at the epoch at which the sun is supposed to have begun to radiate, this material would have disintegrated long ago. It might be objected that the same holds good of uranium, that the fact that uranium exists in measurable quantities proves that it has not existed for a time great in comparison to $5{\cdot}10^9$ years.

This is doubtless true, but there is no real difficulty about assuming uranium or other radio-active substances to have been produced if one supposes the solar system to have been formed by the collision of two stars.

At the moment of collision the velocity of two stars half the mass of the sun would be $\frac{1{\cdot}15 \times 10^{13}}{\sqrt{r}} \frac{\text{cm}}{\text{sec.}}$, r being the distance between the centres of gravity. Suppose they both contained some lead, this would reach a temperature of the order $\frac{1{\cdot}1 \times 10^{20}}{r}$, *i.e.*, of the order $2{\cdot}10^9$ degrees at the moment of collision. As has been shown above, an appreciable quantity of radio-active material might be formed at such a temperature if some helium were present.

But of course the heat used up in forming these substances would cool the rest of the mass: any energy gained in radio-active form would be lost in the form of heat. It could never avail to explain a solar constant such as has been measured for longer than Kelvin's 20 million years. In other words, radio-active substances produced would act only as accumulators of energy, not as primary batteries.

To recapitulate: As Kelvin showed, gravitational energy can only account for 18·3 million years of sunshine at the present rate. Invoking radio-activity as a source of energy implies the assumption that unknown radio-active materials liberating considerably more energy than uranium were created by some unknown agency within a measurable period of time, and that these are now breaking up. This assumption is not necessary to account for the existence of uranium, as it is quite conceivable that a certain amount of radio-active matter might be produced afresh during every stellar collision. The energy of substances formed in this way would not be available to explain a greater amount of energy on the sun as their energy is abstracted from the gravitational energy, and has already been taken into account.

F. A. Lindemann.

Sidholme, Sidmouth, April 5.

Harmonic Analysis.

In a paper which I read to the Physical Society last January (see Nature, February 11, p. 662) I suggested that the best way of analysing a wave, the graph of which was given, was to apply the rules for the mechanical quadrature of integrals which are given in treatises in the calculus of finite differences. I am convinced that these methods when applied intelligently are much simpler and ever so much more accurate than most, if not all, of the methods in everyday use.

In the paper referred to above I applied a well-known method of mechanical quadrature (Weddle's rule) to the case of a semicircular alternating wave, the equation to the positive half of which is $y=\sqrt{x-x^2}$. I chose this wave because I found that the evaluation of the Fourier integrals for it by analysis was laborious. Prof. A. E. Kennelly, of Harvard University, has kindly written to me to point out that the equation to the curve can be readily put in the form—

$$y=J_1(\pi/2)\sin\pi x-(1/3)J_1(3\pi/2)\sin 3\pi x+(1/5)J_1(5\pi/2)\sin 5\pi x-\ldots$$

where $J_1(x)$ is the Bessel's function of the first order. Hence from tables of these functions we get:—

$$y=0{\cdot}567\sin\pi x+0{\cdot}0939\sin 3\pi x+0{\cdot}0422\sin 5\pi x+0{\cdot}0252\sin 7\pi x+0{\cdot}0171\sin 9\pi x+\ldots$$

Very close approximations to these numbers can be obtained very simply by Weddle's rule. For example, if b_1 denote the amplitude of the first harmonic, we have:

$$10b_1=5y_{1/6}+\sqrt{3}y_{1/3}+6y_{1/2},$$

where $y_n=\sqrt{n-n^2}$, and hence $b_1=0{\cdot}568$.

To get an accuracy of the same order for the third, fifth, seventh, and ninth harmonics we must calculate or measure the lengths of 8, 13, 18, and 23 ordinates respectively. Doing this, we find that $b_3=0{\cdot}0942$, $b_5=0{\cdot}0423$, and that b_7 and b_9 are given correctly. It will be seen that from the practical point of view the simplicity and accuracy of the method in this case leave little to be desired. It has the great advantage that the amplitude of each harmonic can be computed independently of the others.

When the wave passes smoothly through the extremities of the ordinates we measure, we can apply the rule with confidence. Jagged or very distorted waves must be treated more carefully. For example, if we apply the rule to a rectangular alternating wave of height unity we find from the formula given above that $10b_1=11+\sqrt{3}$, and so $b_1=1{\cdot}27321$ approx. The true value is $4/\pi$, *i.e.*, 1·27324 . . ., and hence the error is less than 1 in 40,000. For a triangular alternating wave of height unity, however, if we apply the rule intelligently we get $b_1=0{\cdot}88$ . . . instead of 0·81057 . . . The error in this case arises from applying Weddle's rule through a point of discontinuity. If we apply it over one-quarter of the wave, it being necessary to measure six ordinates instead of three, we find that $b_1=0{\cdot}81056$ . . .

Alexander Russell.

Faraday House, Southampton Row, W.C., April 12.

A Mistaken Butterfly.

Referring to Prof. Barnard's letter so titled in Nature of April 15, which describes the apparent mistake of a butterfly in visiting a peacock's feather as if expecting to "extract food," I think it probable that there are no animals that do not make mistakes at times. I observed an analogous mistake made by a species of Pieridæ—*Appias nero*—in Sumatra, as I have recorded in "A Naturalist's Wanderings," p. 130:—"In the open paths I netted scarlet Pieridæ . . . often flying in flocks of over a score, exactly matching in colour the fallen [withered] leaves, which it was amusing to observe how often they mistook for one of their own fellows at rest, and to watch the futile attentions of an amorous male towards such a leaf moving in the wind."

Henry O. Forbes.

Redcliffe, Beaconsfield, Bucks, April 17.

The "Green Ray" at Sunset.

Prof. A. W. Porter, in Nature of February 18 (vol. xciv., p. 672), seems to think that the "green ray" is more of a subjective phenomenon than anything else, or at least often is so; but the fact that it is seen at sunrise also shows that in this case at least it is not a result of complementary colours. Besides, if it were a subjective phenomenon, one would expect to see it on every occasion when the sun set behind a clear horizon, whereas the sight is somewhat rarer. I once saw a lovely blue flash, and I read a description recently of a sunset in Palestine where the writer speaks of the sun vanishing like a blue spark. If you hold a lens almost edgeways on between your eye and a light and move it until it is quite edgeways on a few discs of light will be seen, and at last these vanish in a green or blue flash, the effect of dispersion.

35 Roeland Street, Cape Town, March 17.

HEALTHY ATMOSPHERES.

PHYSIOLOGICAL research has proved that the cause of discomfort felt in close, ill-ventilated rooms is due to the physical, and not to the chemical, properties of the atmosphere. We exclude gross contamination by products of imperfectly combusted coal gas, *e.g.* from defective gas fires imperfectly flued. These chemical products irritate the nose and throat, and one of them—carbon monoxide—is a poison. We exclude too, those mines and factories wherein certain poisonous products of industry may pollute the atmosphere. We are writing of rooms crowded with human beings, of over-heated, windless rooms. The percentage of oxygen in such crowded rooms is never reduced by more than 1·0 per cent., and at any of the mountain health resorts the concentration of oxygen is reduced considerably more owing to the attenuity of the air. Similarly the percentage of carbonic acid is never raised in crowded rooms to such a level that it has the least toxic effect. Within the lungs a constant concentration of carbonic acid of about 5 per cent. of an atmosphere is maintained. The acidity of the blood regulates the action of the breathing mechanism, so that both it and the concentration of carbonic acid in the lung are kept constant. The only result of breathing an atmosphere containing 0·5–1·0 per cent. of carbonic acid—the most crowded room does not contain more—is a slight deepening of the respiration by which the concentration in the lung is kept at the normal figure. It becomes difficult to maintain the normal concentration in the lung when the concentration in the atmosphere rises above 3·0 per cent.; the breathing of even a resting man then becomes over-laboured. The crew of a submerged submarine feels the need for fresh air when the CO_2 concentration rises above this level.

Exact experiment, made by many competent researchers, wholly fails to confirm the assertion, so confidently made in all popular books of hygiene, that the expired air contains a subtle organic poison. The air of a crowded room smells offensive to one coming in from the fresh ar. and it may, and often does, infect us with the living germs of disease, sprayed out from the mouth, or nose, of those who cough, sneeze, or speak, but it contains no organic chemical poison, and the fatigue and headache felt by the more sensitive occupants is certainly not due to such. These effects are produced by the physical properties of the atmosphere acting upon the nose and skin, on that enormous field of sensory nerves which supplies the surface of the body, contributes so greatly to our feelings of well-being, and regulates the metabolism of our bodies. The cutaneous and nasal sense-organs are influenced by the temperature, movement, and vapour pressure of the air, and the physical qualities of the atmosphere, which control the loss of body heat by convection or evaporation. Out of doors we are ceaselessly stimulated by the play of wind; cloud, and sunshine, cold and heat, wet and dry alternate; monotony, the curse of the nervous system, is repelled. Cool, moving air braces us up; we are made active, eat more, and breathe more to keep up our body furnace. The daily turnover of the body is thus enlarged, the appetite is stimulated, and the food eaten is completely utilised and does not become dross and waste, the generator of bacterial decomposition in the bowel. The blood is refined out of a larger choice of foodstuffs, and the organs receive from it an ampler supply of the more precious and rarer building stones; the muscular exercise which we are compelled to take to keep warm, occasions the blood to circulate in ampler and quicker streams, and deepens the breathing, thus ensuring the proper expansion of the lungs, and the natural massage of the organs of the belly.

We are built to be active, and keep ourselves warm by muscular action. By over-clothing our bodies and over-heating our rooms we weaken our vigour, expose ourselves to nutritive disorders, and debilitate the natural mechanism of defence against infective disease. Moreover, in these heated, stagnant atmospheres we expose ourselves to massive infection by those carriers of disease who have in their respiratory tract some strain of microbe exalted in virulence, and thus spread "colds" or influenza, pneumonia, or phthisis. Mere exposure to cold does not cause these ills. Arctic explorers and shipwrecked people who suffer the extremes of exposure do not suffer in consequence from such illness. Excessive cold may cause local death and gangrene, or kill by cooling the whole body below a viable temperature, but our power to withstand cold is enormous, innate, the result of a million years of an evolution spent in struggling against the forces of nature. The inclement and dark wintry weather impels people to shut up windows, crowd into close, over-heated rooms, and thus expose themselves to massive infection.

The sedentary worker in heated, windless atmospheres runs his metabolism at a low level, and if he over-indulges in the pleasures of the table, easily becomes the sufferer from digestive and metabolic ailments. It is not the bad weather that causes the ill-health prevalent in the winter, but the excessive precautions most of us take to avoid exposure to cold. Only the very old and feeble, in whom the lamp of life burns low, want such protection. The young and the able-bodied require the stimulus of exposure to the weather; the discomfort arising therefrom soon results in vigorous health, and ceases to be felt. The soldiers of our new armies taken from shop, desk, or factory, and exposed in trench or camp, have been singularly free from disease which is supposed to result from chill, in spite of the hardship of cold, wet, and mud. Adequately fed, clothed, and rested, the open-air life has made the clerk, shop, or clubman twice the men they were, given them a healthy hunger, steady nerves, a clear, ruddy complexion, and increased weight, and yet for days together their clothes may have been damp.

The fear of cold and damp instilled in the nursery often checks the physical development of the young, and leads to a lessening of national vigour and health. The open-air school works wonders on the badly nourished, defective children, and should become the school of every child in the community. The camps of to-day placed in the wind-swept open spaces of the land are founded on the emergency of war, but should become the week-end playgrounds of the nation in times of peace. Our cities have been built so as to satisfy regulations based on the chemical theories of ventilation and the nursery-bred fear of cold. They should be re-planned so as to allow the maximum of sunlight and wind, affording baths and exercise grounds for all. The conditions of life at present wage a deadly war against us. We listen for the whirr of the Zeppelins, and take little heed of the silent sowing of the germs of preventible disease.

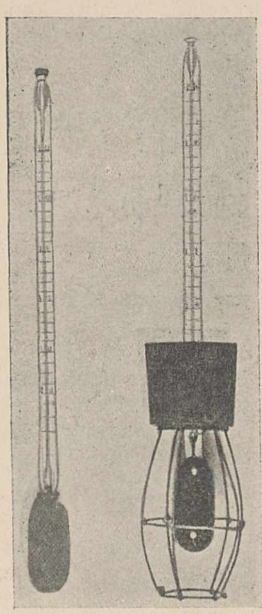

FIG. 1.—The Wet and Dry Katathermometer. The Dry instrument is shown enclosed in a wire cage, which was used for taking observations in investigations on clothing.

To secure these healthier conditions we require instruments which will measure the physical conditions of the atmosphere and make manifest the differences between confined and open air. The thermometer registers the average temperature of the surroundings; it gives us no information as to the rate of heat loss from the surface of the human body. It is the rate of heat loss which matters to us. Out of doors, on ideal spring days, the ground is warm and the wind scarcely moves at foot-level, while our heads are blown upon by a variable cooling breeze; the sun warms one side of us while the other is cool. The clouds chasing each other across the blue sky give us shade alternating with sun. Our feet are kept warm, our heads cooled, and our cutaneous nerves are continually excited by the ever-varying rate of cooling. There is no monotony, but an agreeable energising of our nervous system. When the heating and ventilating engineer gives us a uniform summer temperature of 63° F. by means of steam coil (so called) radiators, he secures us a warm atmosphere above and a cold floor below, cold feet and warm heads, and a deadly monotony of conditions. The right system of heating and ventilation would give us a warm floor and a variable, gentle, cool breeze moving round our heads.

In the House of Commons the engineer forces air, heated to 63° F., through a perforated floor, and thus, cooling the Members' feet, gives them conditions which lead to congestion of the mucous membrane of the nose and its air-sinuses, resulting in obstruction of the nasal airway, feelings of stuffiness in the head, and increased liability to infection by the germs of "colds" and influenza. A system more contrary to the outdoor ideal conditions could not have been invented. To measure the physical conditions outdoors and indoors we require an instrument which will measure the rate of cooling by radiation, convection, and evaporation, and will tell us whether the atmosphere is monotonous or not. The present writer has introduced the katathermometer for making these measurements, and with Mr. O. W. Griffith has introduced an electrical instrument, the caleometer, for the purpose of recording not only rate of cooling, but indicating whether the atmosphere is monotonous or lively.

The katathermometer (Fig. 1) is a large-bulbed spirit thermometer, made (by Mr. J. Hicks, 8 Hatton Garden) as nearly as possible of a standard size. Each instrument is tested against a standard one, and a constant obtained by which the rate of heat loss can be deduced in calories per sq. cm. of surface. The katathermometer is heated in warm water until the spirit just rises into the top bulb, and the column is free from bubbles. The instrument is then wiped dry and suspended in the atmosphere, and the time observed taken by the meniscus in falling from 100° F. to 95° F. This gives the rate of heat loss by convection and radiation, the instrument being approximately at body temperature. A muslin finger-stall is then drawn over the bulb and the operation repeated after heating the instrument and jerking the excess of water off the muslin cover. The time taken in this case gives us the heat loss by radiation, convection, and evaporation. The difference between the dry and wet readings gives us the heat loss by evaporation only, and from this, when the readings are taken in still air, the vapour pressure can be determined.

The value of rate of heat-loss measurements are seen by the following examples:—(1) Inside a cottage room on the East Coast and outside on the cliff edge the summer temperature was the same, but outside the katathermometer cooled much faster. It registers just as the human body feels the bracing effect of the moving air. It acts as an anemometer, sensitive not only to currents in one direction, but to every eddy which the ordinary anemometer fails to register. The instrument shows the vast difference between the conditions of the indoor and outdoor worker. (2) In the debating chamber of the House of Commons the thermometer registers a temperature of 63° at foot and head level, but the katathermometer shows the rate of cooling is 50 to 100 per cent. greater at foot level than at head level. When the conditions were experimentally altered in one part of the House so that all floor inlets were closed, and the air introduced at the gallery level, the rate of cooling became slower at foot level than at head level. Then the congestion of the nose was relieved as the feet became warm and comfort was secured. (3) In a room heated by a gas (so-called) radiator with window open at top a few inches, and three doors, beneath

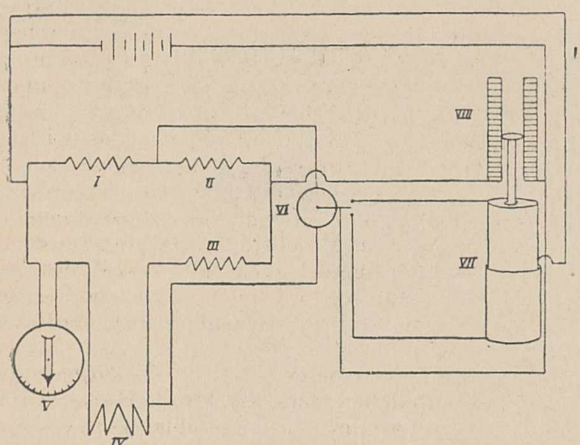

FIG. 2.—Diagram of the Caleometer. I., II., III. and IV. are the arms of a Wheatstone Bridge. When the caleometer coil IV. becomes warmer than 40° C. the index of the galvanometer VI. (used as a relay) goes upwards in the diagram and completes the circuit which includes the upper half of the electro-magnetic coil VII., the soft iron plunger moves then upwards and increases the resistance in VIII., less current then passes and the coil IV. cools. When the caleometer coil IV. cools below 40° C. the index of the relay VI. moves downwards and completes the circuit which includes the lower half of the coil VII. and this pulls down the slider and lessens the resistance in VIII. V indicates the watts or calories required to keep IV. at 40° C.

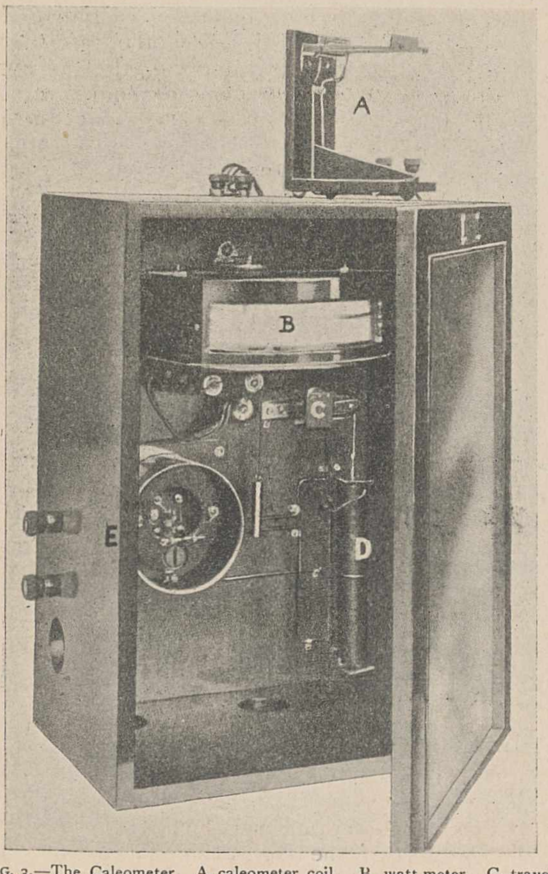

FIG. 3.—The Caleometer. A, caleometer coil. B, watt meter. C, travelling slider. D, magnetic coils surrounding soft iron plunger which moves in oil-bath. A string passes from the plunger over a pulley wheel on the slider to a counter-balancing weight and actuates the slider. E, the galvanometer acting as relay.

which the draught entered, the feet felt very cold and the head felt stuffy, the nose was congested, and the conditions for comfortable mental work at a desk were bad. The katathermometer showed that the rate of cooling at foot level was 40 per cent. greater than at head level. On heating the same room by a properly flued gas fire, and securing warm feet by exposing them to its radiant heat, comfort was at once secured. The katathermometer showed that the rate of cooling at the level where the feet were was 30 per cent. slower than at head level.[1]

The caleometer, by its automatic action, indicates the amount of heat energy required to keep a small coil of wire at body temperature. The oscillations of the indicator show the cooling effect of moving air and the variations of air currents. If the atmosphere is still and monotonous, the oscillations of the indicator will be small and few in number.

Records of any number (up to eight) of caleometer coils, placed in different parts of, say, a factory, can be taken by using a self-recording watt-meter.[2] The instrument is seen in Fig. 3.

LEONARD HILL.

AIDS TO NATURE-STUDY.[3]

(1) THE entomologist's walk in life is in many respects an enviable one, for it is his particular business to study creatures which often exhibit great beauty, amazing variety, and a strange subtlety of behaviour. The current of research as regards molluscs or mammals, let us say, has a strong, quiet flow, but that in entomology recalls a mountain stream with novelties and surprises at every turn. We feel this more than ever as we read Mr. Step's fascinating "Marvels of Insect Life." With the aid of beautiful photographs, many of them from his own camera, he gives us a lively sense of the wonderful intricacy of insect-behaviour, which often seems like a caricature of that of higher animals. But no one knows what its most accurate psychological interpretation may be.

The author writes with clearness and accuracy, and there is no fussiness in his enthusiasm. He is to be congratulated on having secured Mr. Theo. Carreras as a draughtsman, for the full-page plates are exceptionally clever, and most of those in colour are as successful as they are daring. In its whole get-up the book is certainly at high-water mark. Two minor features may be mentioned which show that there has been careful consideration of what an intelligent reader reasonably expects and rarely gets. One is that the technical names of the insects dealt with are

[1] Volunteers who will undertake daily readings with the katathermometer are asked to communicate with the writer (London Hospital Medical College, E.). He is seeking to secure during the next six months records of open-air conditions in representative parts of Britain, and of those conditions which obtain in houses, schools, and factories.

[2] The instrument is made by Mr. Robert W. Paul, Newton Avenue Works, New Southgate, London, N.

[3] (1) "Marvels of Insect Life. A Popular Account of Structure and Habit." Edited by E. Step. Pp. viii+486. (London: Hutchinson and Co., n.d.) Price 10s. 6d. net.

(2) "Nature Notes for Ocean Voyagers." By Capt. A. Carpenter and Capt. D. Wilson-Barker. Pp. xvi+181. (London: C. Griffin and Co., Ltd. 1915.) Price 5s. net.

(3) "The Drama of the Year." By Mary Ritchie. Pp. x+118 (London T. C. and E. C. Jack, 1915.) Price 2s.

always given (at the foot of the page in this case); the other is that the illustrations are furnished with adequately detailed descriptions in small but clear type. We have but one fault to find, that we can discover no order in the marvels. They form a delightful volume, but not a unified book. Or are we overlooking some arrangement which is subtle as insect behaviour itself? Perhaps we are ultra-sensitive, but we like to be orderly, even in our pleasures. It is interesting to find that Mr. Step vouches for the mother-earwig's hen-like care of her offspring, as to the reality of which Mr. Brindley's careful observations recently raised some doubts. We may also note that the author's account of cuckoo-spit (Fig. 1) is not quite up-to-date.

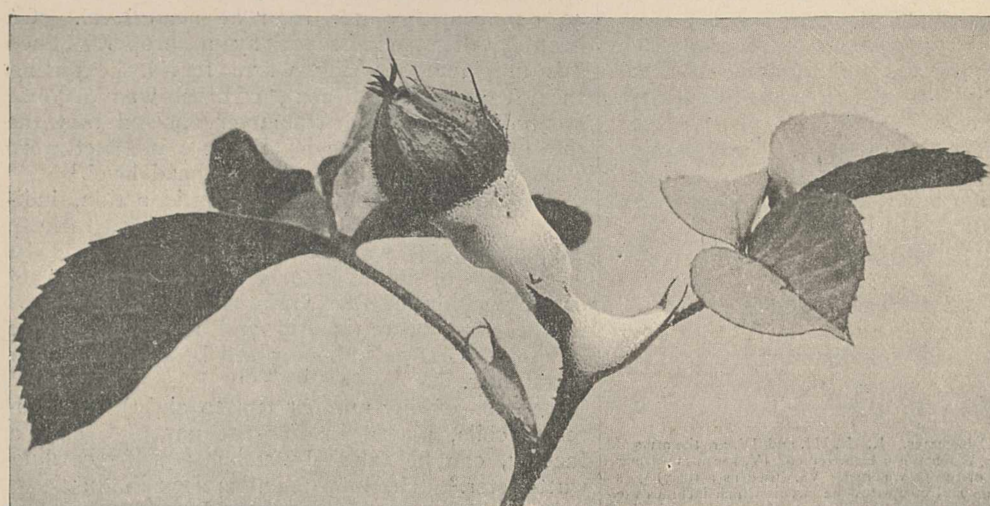

Photo.] FIG. 1.—"Cuckoo-spit." From "Marvels of Insect Life." [*H. Bastin.*

These are small points, however, and what we particularly wish to say is that we can think of no introduction to entomology which surpasses the volume before us in its capacity of gripping the beginner and prompting observation. Would one know of the mouse-catching locust from the Congo, of the Kanchong Mantis which is so like a flower that butterflies visit it, of nightmare insects that look like jokes in morphogenesis, of the big blue wasps of Texas which are able to overcome the huge bird-spiders, of the growth of the caterpillar of the privet hawk-moth which increases its weight nearly ten thousand times in thirty-two days, of the long-necked ant-lion of the pyramids which has its prothorax pulled out into an instrument for reaching down into crevices, of the whimsical leaf-legged bug of South America (Fig. 2), of the maternal bug of the birch-tree which covers her offspring as a hen her chicks, of the peculiar aquatic larvæ of the fly whose bite is said to cause the strange skin disease called pellagra, of the stalk-eyed fly that has its eyes and minute antennæ borne on relatively long lateral extensions of the head, of the quaint way in which the larvæ of the pear-tree hover-fly deal with aphides, of the giant water-bug of Trinidad which sometimes kills frogs — of these and a hundred other marvels, is it not written in the captivating book of Mr. Step?

(2) Captains Carpenter and Wilson-Barker address themselves to the voyager who wishes to know something, but not too much, about what is to be seen from a ship's deck—the ocean itself and all that in it is. They deal in an interesting way, without going very deeply into things, with the physical features of the sea, with the whales

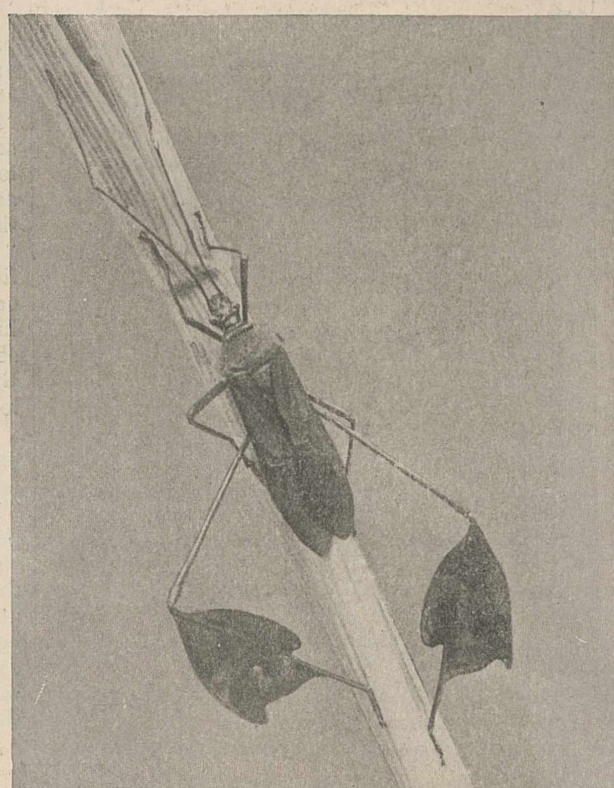

Photo.] [*H. Bastin.*

FIG. 2.—Leaf-legged insect from South America. The very long and slender hind-legs spread out at the top of the shank into prettily-coloured leaf-like growths which must tend to disguise the insect's true nature when seen upon foliage. From "Marvels of Insect Life."

and seals, the petrel and the albatross, the fishes and cephalopods, the Portuguese Man of War and the coral reef, with the seaweeds, the microscopic plankton, and the phenomena of phosphorescence, with the winds and the clouds, with the waves and their measurement. They have also something to say regarding old sea monsters and old sea customs and chanteys.

Captain Carpenter was a lieutenant on the *Challenger*, and has had other opportunities of deep-sea work; his collaborator, Captain Wilson-Barker, served afloat for twenty years, in part in connection with deep-sea telegraph cable work; so the joint authors have been for a long time in intimate association with the life about which they write. There is a pleasant directness in the book, and a not less pleasant smell of the sea. There are numerous excellent illustrations, many of them old friends, others delightfully fresh (Fig. 3). We believe that many amateurs will enjoy this book very much and profit by it in proportion. It ought to be in all ship libraries.

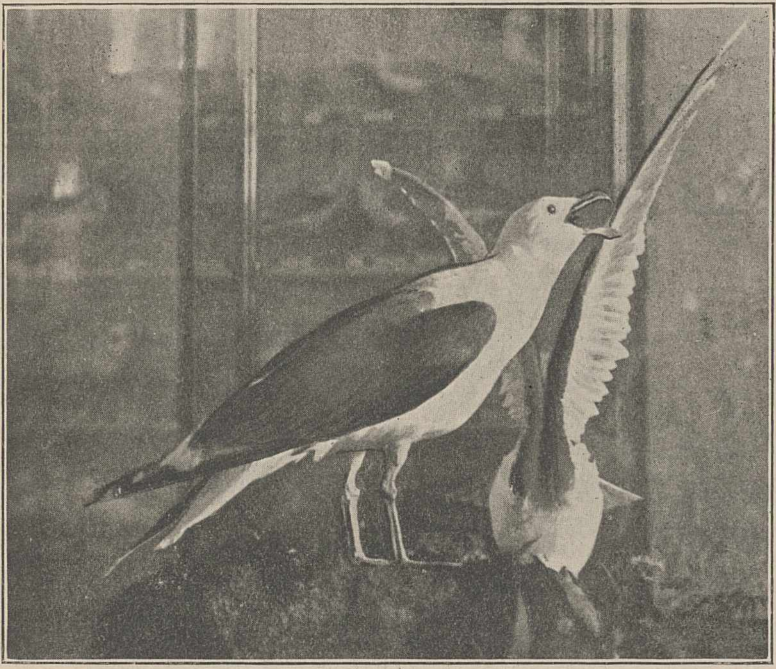

FIG. 3.—Black-backed gull. From "Nature Notes for Ocean Voyagers."

We must note, however, that the authors would have been well advised if they had availed themselves of the services of some competent naturalist to remove numerous inaccuracies which are as flies in the ointment. Thus it is a blemish to speak of the parrot's beak of the sea-egg, of the air cells beneath the gannet's skin being the main factors in the bird's powerful flight, of the parrot-like beaks of the puffin, of the Ctenophora progressing by small hairs (cilia) which outline their bodies, or of Noctiluca as a small jelly. The figure of the octopus (on page 81) with irregularly branched arms requires some explanation.

(3) Miss Ritchie has written a delightful informal introduction to nature study in South Africa, which will take teachers and pupils in that interesting country further into the heart of things than a more informative primer is likely to do. While it is thoroughly objective, dealing mainly with the succession of flowers in a country with a fascinating flora, it touches things imaginatively as well as scientifically, and aims at the culture of appreciation and delight as much as at the diffusion of knowledge. There is a very interesting foreword by Prof. Patrick Geddes, and Mr. Allerston has supplied a fine set of illustrative photographs of characteristic South African plants. We wish the book good speed.

THREE NATURALIST-TRAVELLERS.[1]

THE chief feature common to these three books is that they deal with the researches of British naturalists in the belt of country which, from the Arctic Ocean to Equatorial Africa, lies along the boundary between Eurafrica and Asia.

(1) Mr. Bury's "Arabia Infelix" describes the eastern wall of the Great Rift Valley in south-western Arabia. The land lies low for about thirty miles from the Red Sea at Hodeida; it then rises by bold precipices to the height of from eight to ten thousand feet, whence the plateau sinks gradually eastward to the Great Red Desert of Arabia, at the level of from three to four thousand feet. The road inland to Sanaa begins its steep ascent through "The Gate of the Mountains," where a huge rock has fallen across the ravine and made a natural arch. By scaling cliffs of appalling steepness, up which the Turks have had the temerity to plan a railway, it rises to the height of 9000 ft. It passes through various zones of vegetation. The spurs and ravines are terraced for coffee or clad in thick jungle. The ravines are so steep and narrow "that one may almost touch the tree-tops which grow out of them, and so overgrown that only a green twilight penetrates to their recesses, where the lurid blooms of the snake-onion flame among the fern and the giant cobra drowses in the hush of noon." So steep are the precipices that "it gives one a crick in the neck to count the coffee-gardens up those outrageous steeps, while wondering if they are garnered with a derrick."

Mr. Bury writes with a unique knowledge of this part of Arabia, and his short book is packed with information. Unfortunately there are scarcely any references to the former literature,

[1] (1) "Arabia Infelix; or, The Turks in Yamen." By G. W. Bury. Pp x+213. (London: Macmillan and Co., Ltd., 1915.) Price 7*s*. 6*d*. net.
(2) "Alone in the Sleeping-Sickness Country." By Dr. F. Oswald. Pp. xii+219. (London: Kegan Paul, Trench, Trübner and Co., Ltd., 1915.) Price 8*s*. 6*d*. net.
(3) "A Summer on the Yenesei (1914)." By M. D. Haviland. Pp. xii+328. (London: Edward Arnold, 1915.) Price 10*s*. 6*d*. net.

and no account of the structural geography, which is perhaps its most interesting feature. Mr. Bury is an ornithologist, and the natural history notes of most value are those dealing with the birds, the agriculture, and the climate. The book is enlivened with many flashes of humour, partly his own and partly quoted from the Arabs, such as the letters found on the bodies of those who fell in the war of 1871. "To my brother Gabriel. ——, son of ——, is coming to you; admit him to Heaven. (Signed) Mohamed Eyad, Emir of the Faithful."

Mr. Bury begins with a synopsis of the history of Yamen, and ends with a forecast of its political future. He hopes, in the interests of both Turks and Arabs, that the present war will lead to its independence, though he is obviously very doubtful whether the natives can manage the country by themselves. He appears to think that the best hope for Yamen is its annexation to the Aden Protectorate. He recognises the sterling merit of the individual Turk, and refers to Turkey's disastrous plunge into war with sympathetic commiseration; he attributes it largely to national anger at our retention of the two new battleships, for they had been built by public subscription, to which the Turks contributed their utmost as a religious duty. As he remarks, we should not like our subscriptions for a new cathedral to be arbitrarily diverted for the building of a mosque.

(2) Dr. Oswald, who is well known from his work on the geology of Armenia, visited the eastern shore of the Victoria Nyanza to search thoroughly some Miocene deposits which have yielded fragments of *Dinotherium hobleyi*, the most important palæontological discovery yet made in British East Africa. Dr. Oswald ransacked the beds, and traced them further inland, and obtained fragmentary remains of a fossil tortoise, an extinct elephant, the first baboons found fossil in equatorial Africa, and the first fossil Protopterus. He also found evidence of the once larger size of the Victoria Nyanza, as its beaches occur three hundred feet above the present lake level. He contributes a very interesting account of his experiences. He unintentionally interviewed a leopard, and was discovered by the ticks that carry relapsing fever, by tsetse fly, and other disease-spreading insects. He writes about the country with a naturalist's sympathy and insight. Even the white ants impressed him more as useful soil-makers than as destructive pests. He is too fond of animals to help the reduction of the diminishing herds of antelopes, and he strongly condemns the uselessness of killing the game to prevent the spread of sleeping sickness, since other animals and even insects can harbour the infection. The author has proved that the Miocene beds which he went to examine are disappointingly barren; but he has contributed a very useful addition to the geology of this part of British East Africa.

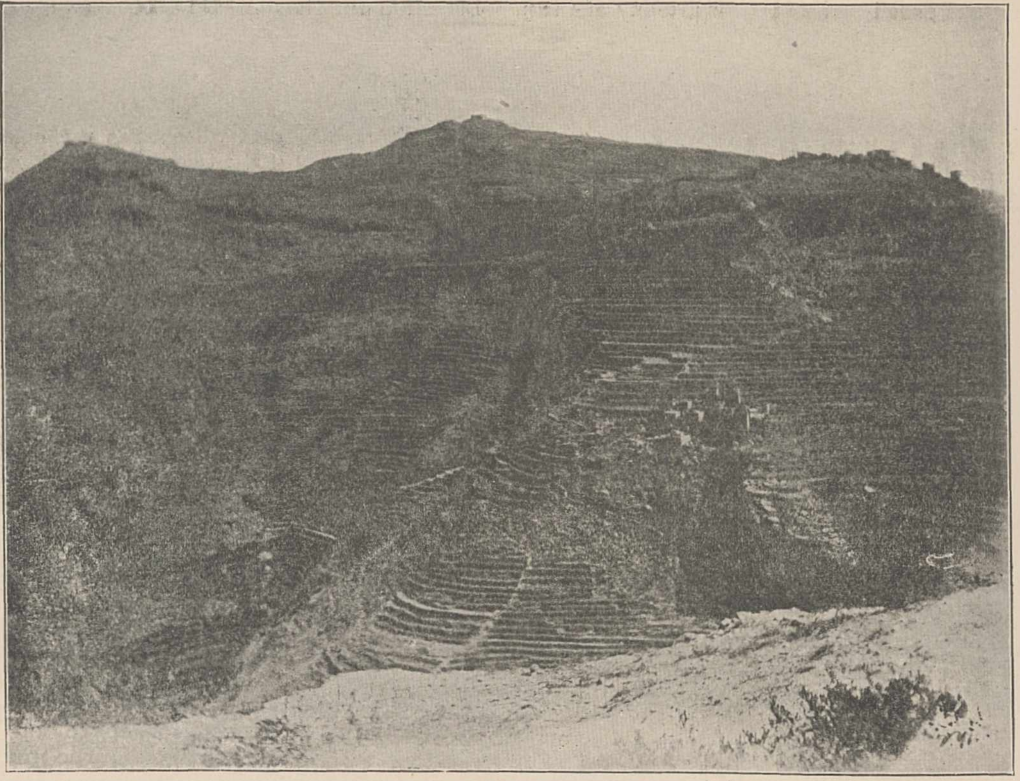

FIG. 1.—Field Terraces. From "Arabia Infelix; or, The Turks in Yamen."

(3) Miss Haviland is a well known ornitholo-

NATURE.

The number for **last week (April 15)** contained:—

Colour Vision.
The Experimental Method in Medicine and Surgery. By STEPHEN PAGET.
Pure Mathematics. By G. B. M.
Psychology and Philosophy.
Our Bookshelf.
Letters to the Editor:—
The Thermionic Current. Prof. A. S. EVE.—A Mistaken Butterfly. Prof. E. E. BARNARD.
British Supply of Drugs and Fine Chemicals. By Prof. H. B. BAKER, F.R.S.
Home Forestry and the War. (*Illustrated.*)
The Carnegie Trust.
Inexact Analogies in Biology. By Dr. F. A. BATHER, F.R.S.
Prof. Otto N. Witt. By Sir T. E. THORPE, C.B., F.R.S.
Notes.
Our Astronomical Column.
Experimental Study of the Mechanism of Writing. (*Illustrated.*)
Flora of Aden. By F. C.
Ornithological Notes. By R. L.
Mountain Geology.
Blood-Parasites and Fleas.
Changes of Relative Levels of Land and Sea. By J. W. J.—Preliminary Report on a Shaler Memorial Study of Coral Reefs. By Prof. W. M. DAVIS.
Formulas for Glass Manufacture.
University and Educational Intelligence.
Societies and Academies.
Books Received. Diary of Societies.

Copies can be obtained through any bookseller or newsagent, or post-free from the Publishers, St. Martin's Street, London. W.C., on receipt of 6½*d.* from residents in the British Isles, or of 7½*d.* from residents abroad.

NOTICE.

For the convenience of readers of NATURE wishing to inspect books *published abroad* which have been reviewed in NATURE it has been decided to keep such volumes for the period of six months at the publishing office of the journal. The books will be retained for the purpose of examination free of charge. The display of books began with those reviewed in NATURE of January 7.

St. Martin's Street, London, W.C.

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

gist, who visited the northern Yenisei to continue the researches of Seebohn and Popham on the nesting habits of the birds which breed there. She tells the story of her expedition in a brightly-written volume, illustrated by excellent photographs, but lacking a map. The party consisted of four, of whom two, Miss Czaplicka and Mr. Hall, are wintering in the country of the Ostiaks, and may thus throw further light upon the affinities of these people. The declaration early in the book that "the journey across Asia by the Trans-Siberian Railway can never be anything but unspeakably tedious" is not an encouraging start; for though the author only saw the line in its most uniform section, the statement shakes faith in her geographical insight. But as soon as she reaches the Tundra she shows a truer appreciation of the country, and in many a graphic sentence expresses the charm of the northern nights, "when darkness was never deeper than a soft twilight glow, and the mysterious shining spears

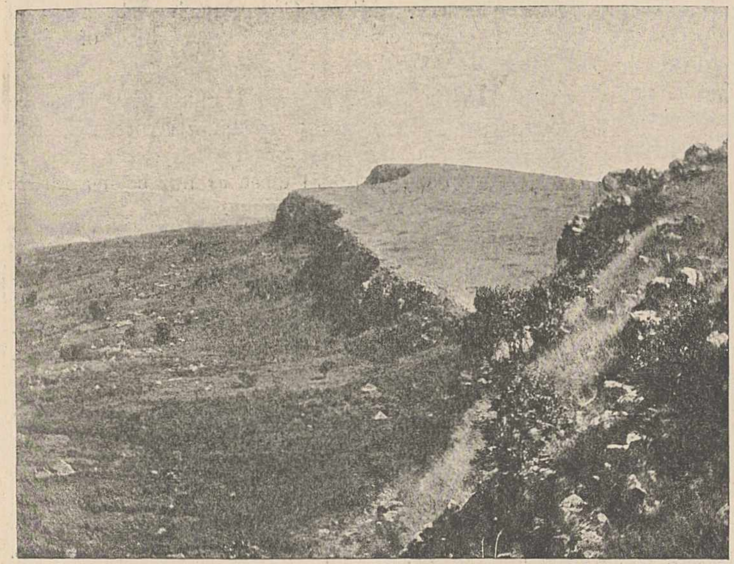

FIG. 2.—Manga escarpment, seen from the south-west. Note the numerous huts of the fertile district of Kitutu at the foot of the cliffs. From "Alone in the Sleeping-sickness Country."

of the Aurora Borealis mingled with the glamour of a night-long dawn." She is very sympathetic to the people, though she gives a lurid picture of the prevalent drunkenness, for her visit was before the famous Ukaz of the Tsar which stopped the sale of spirits. She aptly summarises some of the most striking features in Russian conditions and culture. Russia she describes as "a country of enormous possibilities, of the crudest paradoxes. With the most autocratic government, hers is the most democratic society in the world; with a Church whose function has dwindled into the effete repetition of ritual, religion is the very fibre of her people."

In illustration of the severity of the climate Miss Haviland repeats the widespread saying that the population would die out at the third generation if not renewed by immigration; the statement is probably as trustworthy for Siberia as it is when asserted to prove the unhealthiness of city life and the impossibility of European settlement in the Tropics.

Miss Haviland spent most of her time photographing the nesting birds around Golchika on the estuary of the Yenisei; her chief prize was a curlew-sand-piper's nest, which was first taken by Popham in 1897. From that district she returned on the timber ships by which Mr. Jonas Lied is endeavouring to maintain annual communication between the Yenisei and western Europe, an enterprise on which depends the future of several Siberian industries. Her account of the Kara Sea in September will be a useful supplement to Nansen's account of his outward voyage with Mr. Lied at the beginning of the season.

J. W. G.

PROF. W. GRYLLS ADAMS, F.R.S.

BORN at Laneast, Cornwall, on February 16, 1836, William Grylls Adams, Emeritus Professor of Natural Philosophy in King's College, London, died at Broadstone, Dorset, on April 10, 1915, aged seventy-nine years. He was educated in a private school in Birkenhead, and entered St. John's College, Cambridge, of which afterwards he became a fellow. In 1865 he was elected professor of natural philosophy and astronomy at King's College, London, in succession to Clerk Maxwell, who had been appointed to the Cavendish professorship at Cambridge. In the same year he contributed to the *Philosophical Magazine* an article on the application of the principle of the screw to the floats of paddle-wheels, his sole contribution to applied mechanics. He took part in the eclipse expedition of 1871 to Sicily. In that year he investigated the action of a bundle of parallel glass plates on the polarisation of light, the results being published in vol. xli. of the *Philosophical Magazine*.

The next few years of Adams's life were very active. In 1872 his scientific merits were recognised by his election to the fellowship of the Royal Society. In 1875 he delivered the Bakerian lecture, on the forms of equipotential curves and surfaces, and lines of flow. The lecture was an exposition of an almost entirely experimental investigation of the curves which result when electric currents are passed through sheets of tinfoil between electrodes placed at different points; but some attempt was made to realise also some cases of three-dimensional flow. This paper has proved to be one of classical interest. In the same year he communicated to the Proceedings of the Royal Society a paper on the change of resistance produced by magnetisation in iron and steel. He observed a difference between the effects of longitudinal and transverse magnetisation. When the magnetisation was longitudinal, the electric resistance of hard steel was diminished, while that of soft steel or soft iron was increased; and in both cases the effect was approximately proportional to the square of the magnetising force. When the magnetisation was transverse a similar effect was observed.

The next subject investigated by Adams was the phenomenon of the effect of light in reducing the resistance of selenium, which had recently been discovered by Mayhew. With great patience and experimental skill he showed that the effect was not due, as had been supposed, to any heating of the selenium, but was a genuine result of illumination; and he proved that the change of resistance was greater for yellow-green rays than for any other part of the spectrum.

Adams was one of the founders of the Physical Society, in 1875; and to its first volume of Proceedings he contributed a description of a new form of polariscope for determining the angle between the optic axes of biaxial crystals. The crystal slice to be examined was placed between two pieces of glass, one being a hemisphere and the other a shallower section than a hemisphere, the convex surfaces having a common centre in the crystal slice. The combination was placed in oil between the usual crossed Nicol prisms, and could be tilted through any desired angles so as to bring first one and then the other of the optical axes of the crystal into alignment with the axis of the instrument, thus enabling the angle between the axes to be accurately measured without corrections for the refractive index.

In 1880 Adams was chosen president of section A of the British Association, and delivered an address dealing generally with recent progress in physics. He also presented a report of a comparison between the magnetograph curves from the magnetic observatories of Kew, Stonyhurst, Lisbon, Coimbra, Vienna, and Petrograd. In the following year he continued his magnetic investigations with a paper on the connection between magnetic disturbances and earth-currents. He wrote also on the development of lighthouse illumination, and with Dr. Hopkinson examined the performance of the De Meritens dynamos at the North Foreland lighthouse. As president, in 1884, of the Institution of Electrical Engineers, he took for the subject of his inaugural address the topics of the growth of electrical science and the testing of dynamo machines and incandescent lamps. He wrote a series of articles on electric light and atmospheric absorption, and another on lighthouse illuminants and apparatus, for publication in the *Electrician* in the years 1885 and 1886. After some years he returned to the subject of magnetic disturbances as recorded simultaneously on the magnetographs at several observatories, in a paper which was published in the Philosophical Transactions (vol. cviii.) in 1893. To the British Association report of 1898 he contributed an account of the determination of the Gaussian magnetic constants made many years previously by his elder brother, the astronomer, John Couch Adams.

Grylls Adams served on the council of the Royal Society from 1882 to 1884, and again from 1896 to 1898. He was president of the Physical Society in 1879. In 1883 he delivered a series of Cantor lectures on the subject of electric lighting. He retired from the professorship at King's College in 1906. He has left a widow, three sons, and one daughter.

NOTES.

We record with much regret the death on April 16, at sixty-five years of age, of Mr. Richard Lydekker, F.R.S., distinguished by his original work and numerous writings on all aspects of natural science, and a constant contributor to Nature for many years to within a few days of his death.

The Paris Geographical Society has just made a special award of a gold medal to Dr. J. Scott Keltie, for his long and distinguished services to geographical science.

Colonel G. W. Goethals, engineer of the Panama Canal, and Sir Thomas Shaughnessy, president of the Canadian Pacific Railway Company, have been elected honorary members of the Institution of Civil Engineers.

The *British Medical Journal* announces that the Louis Livingston Seaman medal for progress and achievement in the promotion of hygiene and the mitigation of occupational diseases has been awarded to Major-General W C. Gorgas.

The Warren prize of the Massachusetts General Hospital, of the value of 100*l*., and awarded triennially, is offered for the year 1916 for the best essay on some special subject in physiology, surgery, or pathology. Further particulars are obtainable from Dr. F. A. Washburn, at the hospital named.

We learn from the *Lancet* that the Hutchinson Museum has been acquired by the Medical School of Johns Hopkins University. The collection comprises original coloured drawings; coloured plates taken from atlases, books, and memoirs; engravings, woodcuts, photographs, and pencil sketches, in some cases with the letterpress or manuscript notes attached. The collection illustrates the whole range of medicine and surgery, but particularly syphilis and skin diseases.

Sir Thomas Clouston, a leading authority upon the subject of mental diseases, died in Edinburgh on April 19, at nearly seventy-five years of age. He was lecturer on mental diseases at Edinburgh University, and was the author of a number of important works on disorders of the mind. He was president of the Royal College of Physicians, Edinburgh, in 1902–3, and was for some time editor of the *Journal of Mental Science*.

The death is announced of Mr. J. B. A. Légé, who made the first tide-predicting machine for the late Lord Kelvin. He was the constructor of signalling lamps and other apparatus invented by Admiral Sir Percy Scott and used in the Navy. Among Mr. Légé's inventions may be mentioned horological mechanisms, torpedoes, and direct-acting petrol engines.

An International Engineering Congress will be held during the week September 20–25 next, at San Francisco, under the presidency of Colonel G. W. Goethals, chairman and chief engineer of the Isthmian Canal Commission, and under the auspices of the leading American technical and scientific societies. Applications for further information should be addressed to Mr. W. A. Cattell, secretary-treasurer, Foxcroft Building, San Francisco, U.S.A., from whom circulars and reply forms may be obtained.

The Christiania correspondent of the *Morning Post* announces the death of Prof. G. Gustafson, professor of Norwegian archæology in the University of Christiania. Prof. Gustafson was born at Gotland, Sweden, in 1853, and went to Norway in 1889 as keeper of the antiquarian section of the Museum at Bergen. He was appointed in 1900 professor of archæology at the University of Christiania, where he reorganised the archæological and prehistoric museum and conducted numerous excavations.

At a special meeting of the Conchological Society held at the University of Manchester in lieu of the ordinary February meeting, an illuminated address was presented to Mr. J. W. Taylor on attaining his seventieth birthday. The address directs attention to the fact that it is forty-one years ago since Mr. Taylor undertook the publication of the *Quarterly Journal of Conchology*, which later led to the inauguration of the Conchological Society. Mr. Taylor's great work has been the "Monograph of the Land and Freshwater Mollusca of the British Isles," of which three volumes are now completed.

We learn from the *British Medical Journal* that Dr. S. von Prowazek, director of the department of protozoology in the Institute of Marine and Tropical Diseases at Hamburg, has died at Lima of typhus fever contracted in the course of a research on the pathology of that disease. He was thirty-nine years of age, a native of Austria, and studied under Ehrlich, Hertwig, and Schaudinn. We notice also the announcement of the death of another worker in the field of tropical diseases, namely, Lieut.-Col. W. S. Harrison, formerly assistant-professor of pathology at the Royal Army Medical College. Lieut.-Col. Harrison was only forty-three years of age; and he appears to have contracted the disease from which he died on April 12 during research work in connection with tropical diseases in India and Jamaica.

The annual meeting of the Iron and Steel Institute will be held at the Institution of Civil Engineers on May 13 and 14. The Bessemer gold medal for 1915, which has been awarded to Mr. Pierre Martin, formerly of Sireuil, near Paris, will be received on his behalf by M. Paul Cambon, the French Ambassador, during the first meeting, and in the afternoon of the same day Prof. Hubert, of Liège University, will lecture on large gas engines. During the morning of the second day the Andrew Carnegie gold medal for 1914 will be presented to Mr. E. Nusbaumer, of Paris, and the award of research scholarships for the current year will be announced. Papers will be read and discussed on both days. The council of the institute has decided on account of the war that it will be inadvisable to hold the annual dinner this year. It has been decided provisionally that the autumn meeting of the institute shall be held in London during the week ending September 25.

It is proposed to place a bust of Sir Archibald Geikie in the Museum of Practical Geology, Jermyn Street, where there are already busts of all previous occupants of the post of Director-General of the Geological Survey and of the museum, as well as of several other distinguished geologists. Sir Archibald Geikie was connected with the Geological Survey for nearly forty-six years, during nineteen of which he was Director-General. A committee representative of the universities and the principal scientific institutions and societies of the United Kingdom has been formed to carry out the proposal. It is estimated that the cost of a bust and of a replica to be presented to Sir Archibald Geikie will be between 400*l.* and 500*l.*; and the committee invites subscriptions towards this sum. There should be no difficulty in securing the amount required for this modest form of memorial of a geologist of world-wide distinction, who was connected for so many years with the institution in which the bust is to be placed. Contributions for the fund should be made to the honorary treasurer, Mr. J. A. Howe, curator of the Museum of Practical Geology, Jermyn Street, S.W.

The South African Institute for Medical Research has issued a valuable monograph, "Anthropological Notes on Bantu Natives from Portuguese East Africa," prepared by Mr. C. D. Maynard, statistician and clinician to the institute, and Dr. G. A. Turner, medical officer to the Witwatersrand Native Labour Association, who have had excellent opportunities for studying these people. The paper supplies an elaborate series of measurements of this very mixed race—stature, brain weight, skull thickness, cephalic and cranial indices, spleen, liver, and kidney weights. The correlation of stature and brain weight is found to be only partially established, and the Bantu cerebrum appears to be rather lighter in relation to stature than that of the European. The current impression that the native's skull is thicker than that of the European is found to be incorrect. The article is provided with a useful bibliography of the subject.

The Smithsonian Institution has just issued an account, by Dr. J. W. Fewkes, of a collection of beautiful pottery from the Mimbres Valley of New Mexico, dating back to prehistoric times. This is the first collection received by the museum from this valley, and this type of pottery is unrepresented in other collections. Its importance lies in the fact that a comparatively large number of specimens have human or other figures painted upon them, and that they resemble those from Casas Grandes in Mexico. An interesting and significant custom of these people is that they buried their dead in urns, under the floors of their houses in a sitting posture, with a bowl inverted over the head like a cap, or, when the body is extended, over the face. Such bowls have always a small round hole in the bottom, which has been interpreted as due to the belief that pottery possesses spirits which can escape only when the vessels have been "killed"; possibly it is a mode of releasing the ghost of the dead man.

DR. V. IVANOF has ascertained by microscopic observation the existence of leaves in saxaul (*Haloxylon ammodendron*). Other botanists have described the shrub as completely leafless or provided only with small, scaly growths. The leaves grow closely into the stem, and the apical parts and stalks form a continuous whole (Proceedings of the Society of Naturalists at the University of Kazan, 1912–13).

IN the Journal of the Philadelphia Academy of Sciences for January, Mr. Matsumoto gives a preliminary account of a new classification of the feather-stars, or Ophiuroidea, the full details of which are to be published in Japan. The author, who has received valuable advice and assistance from Prof. H. Clark, finds that ophiuroids must be divided into two main groups, the first of which (Œgophiuroida) is mainly Palæozoic, and lacks most of the structural features by which Ophiuroidea are distinguished from Asteroidea.

ACCORDING to an article by Prof. T. D. A. Cockerell in the issue of the Proceedings of the Philadelphia Academy for December, 1914, the well-known Miocene insectivorous beds of Florissant, Colorado, continue to yield a number of new forms, so that the time is still distant when it will be possible to publish a complete list of the fauna. Compared with the rich insect-bearing beds of Œningen, Baden, and of the neighbouring village of Wangen, on the Rhine, the Florissant fauna is markedly the richer, so far as definitely named species are concerned. The Œningen fauna, for example, comprises 250 beetles, 80 Hemiptera, 60 Hymenoptera, and 30 flies, but the members of these groups already named from Florissant number, respectively, about 494, 230, 220, and 100.

THE Termites (so-called "white ants") afford unfailing interest to the entomologist. A valuable account of the bionomics of the species of these insects found in the eastern United States has been lately issued by T. E. Snyder (U.S. Dept. Agric. Entom. Bulletin, No. 94). Two species of the Leucotermes (*L. flavipes* and *L. virginicus*) form the subject of most of the observations recorded. The forms of these termites and the general course of their development have been fairly well known for many years past. Mr. Snyder has directed especial attention to the fate of the winged, sexual individuals that "swarm" from the nests at certain seasons. The survivors — often comparatively few — of these "swarms" usually cast their wings before courtship begins, and do not actually pair until they have established themselves in a new "royal chamber," which, in the case of Leucotermes, is a cavity in wood. It is not necessary for these "royal pairs" to be established by foraging workers and soldiers; they are apparently, as a rule, independent of help in the foundation of a new community. The provision of "neoteinic" royal individuals is associated with the foundation of fresh communities from old overcrowded societies.

IN *Meddelelser fra Kommissionen for Havundersøgelser*, Serie Fiskeri, Bd. iv., No. 7, Dr. Johs. Schmidt discusses the classification of fresh-water eels (Anguilla). A considerable number of specimens from various localities have been investigated as regards the amount of variation occurring in different characters, the characters being additional to those which were discussed in a previous paper. It has proved possible to distinguish between three species, *A. vulgaris, A. rostrata*, and *A. japonica*. All European fresh-water eels belong to one and the same species, within which no constant local races can be shown to exist.

AN attractive article in the April issue of *Wild Life* is one by Miss F. Pitt, illustrated by four reproductions of photographs, of the marten, in which particulars are given with regard of the past and present distribution of that species in Great Britain. Many readers of the same number will doubtless also be interested in a well-illustrated article by Mr. F. J. Stubbs on the plague-flea, and how it is carried about by rats, as well as the way in which it becomes infected with the plague-bacillus. It might have been added that the ultimate source of plague appears to be the indescribably evil-smelling burrows of the bobac marmot of the steppes of eastern Europe and western Asia.

IN the January issue of the Journal of the Philadelphia Academy of Sciences Miss A. M. Fielde gives further particulars with regard to her investigations of the functions of the antennæ of ants. It has already been shown by the author that the function of these appendages is olfactory, and it is now demonstrated that their constituent segments take up particular kinds of odours. The distal segment, for example, warns an ant from approaching any colony other than its own. Again, the penultimate joint deals with the odour which renders one ant-colony inimical to others of the same species. Another segment serves to guide an ant on the homeward track by enabling it to pick up the scent left on the ground during its outward journey, while the function of yet another is to recognise the whereabouts of the queen and her undeveloped progeny on the part of a worker, and so on with other items in the olfactory functions of these insects.

WHEN he first named a gigantic ungulate, with somewhat Dinotherium-like teeth, from the Lower Tertiaries of Patagonia, under the name of Pyrotherium, the late Dr. F. Ameghino regarded it as a proboscidean. His views have not, however, been accepted by the majority of palæontologists, and no mention of the genus is made by Dr. Andrews in his summary of the evolution of the Proboscidea in the "Guide to the Elephants in the British Museum." During a recent expedition to Patagonia, dispatched by Amherst College, Prof. F. B. Loomis obtained a couple of skulls of Pyrotherium, which he has described in a volume, published by Amherst College, under the title of "The Deseado Formation of Patagonia." He concludes that the genus is really proboscidean, but his views (which are supported by Señor C. Ameghino in *Physis* for December, 1914) are disputed in a review by Mr. R. S. Lull in vol. xxxviii., p. 482, of the *American Journal of Science*, where it is urged that the characters relied upon by Prof. Loomis are not of taxonomic value, and that Pyrotherium is not entitled to a place among the Proboscidea. The question has an important bearing, not only on the phylogeny and "radiation" of that group, but on mammalian distribution in general.

GREAT interest attaches to an article by Mr. A. H. Clark in Smithsonian Miscellaneous Collections, vol. lxv., No. 1, on the distribution of Peripatus and its allies, collectively constituting the group Onychophora. This group, which is apparently an ancient one, though there is no direct evidence on this point, occurs in the Malay Peninsula and Sumatra; Ceram, Papua, New Britain, Australia, Tasmania, and New Zealand; Ethiopian Africa; and Central and South America, and the West Indies. The distributional area is thus limited to countries with a mean annual temperature of from approximately 50° to 80° F.; most of the species, however, occur in countries where the mean is from 60° to 70° F. All the species are restricted to the region south of the tropic of Cancer, while the great majority are confined to the southern hemisphere, the West Indies and Central America being the only localities where an appreciable number of species occur north of the equator. The group is divided into the two families, Peripatidæ and Peripatopsidæ, and nowhere, so far as known, are species of the two families found in the same area. Moreover, the two subfamilies into which the Peripatidæ are divided are sundered by the entire breadth of the Indian Ocean. Then, again, the two subfamilies of the Peripatopsidæ inhabit separate areas in the Australasian region, one being restricted to Papua and the neighbouring islands, while the other is found in Australia, Tasmania, and New Zealand; both groups, however, co-exist in South Africa.

No. xxxix. of the Notes of the Royal Botanic Garden, Edinburgh, contains papers on some new Japanese mountain plants, by Mr. H. Takeda, an enumeration of the Chinese Astragali by Mr. N. D. Simpson, and contributions to the knowledge of the Asiatic Polypodiums by Mr. Takeda. The mountain plants come from the mountain group, Yûparodake in the island of Yezo, some 6000 ft. high, which has not been properly explored botanically before, and a great many interesting records have been obtained and new species collected, salient details of some of which are figured. Mr. Simpson's paper on a very difficult genus is of considerable value, since he has given a careful synopsis of the Chinese species, setting them out in clearly defined sections, and has assigned the specimens to their respective species. Seventeen new species, chiefly from Yunnan and Szechuan, are also described.

IN the *Philippine Journal of Science* Mr. Frank G. Gates gives an account, illustrated by a map and plates, of the re-development of vegetation on Taal Volcano, a low mountain in the middle of Bombon Lake, Batangas Province, Luzon. The lake is 22 km. long by 14 km. wide, and the island is therefore not a very great distance from the surrounding shores. The devastating earthquake occurred on January 30, 1911, and the progress of the re-growth of vegetation has been carefully noted. Strand plants, *Ipomaea Pes-Caprae* and *Canavalia lineata,* first appeared, due to water transport of seeds, then grasses became established from wind-borne seeds. In contrast to Krakatoa, very few ferns have appeared, probably as only a few are found on the mainland. After the grasses came shrubs and small trees, and the latter are followed by trees and bamboos. The plants found are discussed in connection with the ecological formations in which they may be grouped.

THE annual report on the Forest Administration of Southern Nigeria for the year 1913, recently received, is, like its predecessors, an interesting document, though it records much that is to be deplored. The destruction of forest which is taking place to give more land for cultivation is a very serious matter, for whole ranges of hills have been denuded of forest growth right up to their crests, and the sources of their many streams have been exposed. The result of this forest destruction will mean, not only the washing away of the soil from the slopes, but, even more important, the loss of a proper water supply to the fertile valleys. With bare hills, the rain precipitated will at once run off instead of being conserved by the forest and released gradually, and the cultivation of cacao and kola in the valleys will become impossible. The chief conservator, who has toured widely through the country, records the same tale of reckless destruction of forest on all sides. It is to be hoped that prompt action will be taken, as was done in India when roads and railways opened the country, to save the existing forest from the general wreckage and also ensure a continuous water supply.

THOUGH it has been usual to regard the great Hawaiian earthquakes of 1868 as of volcanic origin, Mr. H. O. Wood, in a valuable paper, has recently collected evidence which seems to show that they were tectonic, rather than true volcanic, earthquakes (Bull. Seis. Soc. America, vol. iv., 1914, pp. 169–203). He points out that the most violent earthquake of the series, that of April 2, was preceded and followed by numerous accessory shocks, that it disturbed an area of about 375,000 square miles, that the depth of its origin must have been considerable, and that it gave rise to important seismic sea-waves. In all these respects, it differed from earthquakes of the ordinary volcanic type, many of which, however, are probably not *directly* connected with volcanic operations, but are due to fault-slips along radial and peripheral fractures of the volcano.

IT has long been known that magnets are sometimes made to oscillate during the passage of earthquake-waves; and the phenomena, especially those observed with the Riviera earthquake of 1887, have given rise to considerable discussion. A recent memoir by Prof. H. F. Reid (Bull. Seis. Soc. America, vol. iv., 1914, pp. 204–14) ought to end the controversy. He shows that there are certain periods for horizontal and vertical disturbances that will cause marked oscillations of unifilar and bifilar magnets and magnetic balances; and that, if the periods of the earthquake-vibrations should approximate to any of these periods, they may cause the magnets to oscillate. Prof. Reid concludes that the broadening, blurring, or interruption of the magnetic trace at the time of earthquakes may be due to oscillation of the suspended magnets by purely mechanical vibrations, and does not require us to assume the existence of real magnetic forces or electric currents.

MR. N. L. BOWEN (*Amer. Journ. Sci.*, vol. xxxix., 1915, p. 175) describes and illustrates several interesting experiments which show that crystals separating from a molten silicate mixture tend to accumulate by gravitation in the lower layers of the mass. He thus gives strong support to Charles Darwin's view of gravitation as a factor in the differentiation of igneous rocks. Crystals of olivine have been gathered towards the bottom of a crucible, those in the lowest layers being smaller than those above them, since the latter have fallen through a greater depth of liquid. Both olivine and pyroxene crystals induce during cooling the formation of coats of amphibole round them. Seeing how quartz in lavas may become coated by a deposit of pyroxene, there is clearly room for further research as to these reaction-zones. The author has succeeded in separating tridymite in more highly siliceous mixtures, the crystals becoming in this case concentrated upwards by flotation.

THE January issue of the Proceedings of the Academy of Sciences of Philadelphia contains a summary, in French, by Mr. Stanislas Meunier of his views with regard to the general theory of glacial phenomena and the origin of polished and striated pebbles. In many respects these views are of a distinctly revolutionary type, and subversive of current theories. Especially is this the case with regard to striated pebbles, generally held to be of glacial origin, but which, in the author's opinion, are rather the result of "subterranean denudation," as exemplified by formations in the Vosges and elsewhere. It is remarked that these polished and striated fragments are almost exclusively calcareous, and that the scratches have been made by quartzitic and other hard rocks. A portion of surface-water, it is observed, sinks into porous soil, where subterranean denudation brings these slowly moving quartz-fragments into contact with irregularly shaped *débris* of calcareous rocks, which are eventually ground down into the polished and striated pebbles hitherto regarded as affording decisive evidence of glacial action.

THE replacement of limestone by hæmatite, so as to produce masses or beds of iron ore, has been long recognised. In a paper on the genesis of certain Palæozoic interbedded iron ore deposits, Mr. R. B. Earle makes a strong case for the similar replacement of sandstone by percolating ferruginous waters charged with carbon dioxide (Annals N. York Acad. Sci., vol. xxiv., p. 115). He uses the word "iron" freely in place of "iron oxide"; but we gather that the ore referred to is usually hæmatite. The Clinton formation that flanks the Appalachian Mountains includes oolitic iron ores, in which the nuclei of the oolitic grains consist of partly corroded sand-grains. The quartz can be seen in microscopic sections to be in various stages of discoloration and replacement. The crusts of ore finally protect the nucleus from complete decay. The removal of quartz from granite and its replacement by calcite has been noted in the north of Ireland; but a better parallel with the Clinton occurrences is to be found in the Karroo sandstones of the Orange Free State, as described by Prof. R. B. Young (Trans. Geol. Soc. S. Africa, vol. xvii., 1914, p. 55). Here nodules of pyrite have originated, in which the iron sulphide "is seen not only to fill the interstices between sand-grains, but also to replace the latter to a considerable extent, the metasomatic action being most intense as the centres of the nodules are approached." Felspar as well as quartz has been attacked in this case.

THE Transactions of the Naturalists' Society of Kazan University contain several articles on the botany of western Siberia and the Steppes—"In the Mountains and Valleys of the Altai" (vol. xlvi., No. 1), and "Researches into the Botanical Geography of Saissan in Semipalatinsk" (vol. xliv., No. 5), by V. A. Keller, and "Botanical and Geographical Investigations in Semipalatinsk" (vol. xlv., No. 3), by V. Krüger. Both authors give lists of the plants collected, with details of the localities where they were found and their environment. They also paid close attention to the temperature of the soil during the summer months when they were at work. Mr. Keller found the absolutely lowest soil temperature in the Altai in the upper part of the forest zone, and this zone seems to be in general colder than the mountain tundra which lies at a higher elevation. In the latter region the soil was considerably warmer where lichens abounded than in the tundra of bushes and mosses. The absolutely lowest temperatures (34·3° down to freezing point) were found in July in the section of the forest zone, where the vegetation was of a character intermediate between those of sphagnum peat swamp and wet mossy forest. The highest temperature (70·5°) occurred in the stony section of the mountain steppe. Mr. Krüger also ascertained the proportion of moisture in the surface soil, and found that in the following six areas indicated by their predominant forms of vegetation—(1) *Festuca sulcata*, (2) *Artemsia pauciflora*, (3) *Atriplex canum*, (4) *Obione verrucifera*, (5) *Halicnemum strobilaceum*, (6) *Salicornea herbacea*—the percentage increased from (1) to (6). At about a foot below the surface the proportion also increased, but in a smaller ratio. The salinity of the soil was also smallest in the first and largest in the sixth area.

DISCUSSIONS of the anemographic observations recorded at Port Blair and at Dhubri by Mr. W. A. Harwood are given in the Memoirs of the Indian Meteorological Department, vol. xix. In an introduction, Dr. G. T. Walker explains that the analysis of the winds at Port Blair was almost completed by Sir John Eliot prior to his death. The Port Blair discussion, which embraces the observations for ten years, September, 1894, to August, 1904, is of special interest, as it is the only purely insular and tropical station at which anemographic data are recorded in India. The position of the station is well described, and the records are said to represent correctly the winds of the surrounding portion of the Bay of Bengal. At Port Blair winds from north-easterly directions predominate from November to March, or for five months of the year, and winds from south-westerly directions predominate during the five months from May to September. In the transition months of April and October, between the monsoons, winds are very variable. The discussion of the anemograph observations recorded at Dhubri is for seven years to May, 1896. The situation of the station is given in detail, and the anemograph was mounted on a tower, 45 ft. above the ground; its exposure is said to have been excellent. The height of the instrument above the tower is not given. The predominant winds at Dhubri are said to be those up and down the Assam Valley. During November, December, and May down valley winds very largely prevail, but up valley winds are more numerous than down valley winds in February, March, July, and August. Seasonal and diurnal movements of the air are given in tabular form for both stations.

A COPY of the annual report of the Board of Regents of the Smithsonian Institution, "showing the operations, expenditures, and condition of the Institution" for the year ending June 30, 1913, has been received from Washington. The volume runs to 804 pages, of which 140 are concerned with reports and proceedings. The bulk of the book consists of the general appendix which furnishes a miscellaneous selection of scientific papers, some of them original, embracing a considerable range of scientific investigation and discussion. Many of the papers are translations of contributions by distinguished foreign men of science. Among these translations may be mentioned: The reaction of the planets upon the sun, by M. P. Puiseux, astronomer at the Paris Observatory; modern ideas on the end of the world, by Prof. G. Jaumann, professor of physics at the Technical High School at Brünn; recent developments in electromagnetism, by Prof. Eugene Bloch, of the Lycée Saint Louis; oil films on water and on mercury, by Prof. H. Devaux, of Bordeaux; ripple marks, by M. Ch. Epry; the development of orchid cultivation and its bearing upon evolutionary theories, by M. J. Costantin; the problems of heredity, by Dr. E. Apert, principal at Andral Hospital, Paris; the whale fisheries of the world, by M. Charles Rabot; the earliest forms of human habitation and their relation to the general development of civilisation, by Prof. M. Hoernes; feudalism in Persia: its origin, development, and present condition, by M. J. de Morgan, of Paris; shintoism and its significance, by Mr. K. Kanokogi, of Tokyo, in *Zeitschrift für Religionspsychologie*; the economic and social *rôle* of fashion, by M. Pierre Clerget, of Lyons; and the work of J. H. Van't Hoff, by Prof. G. Bruni, of the University of Padua. As has been the case in former years, many of the articles in the appendix are illustrated by numerous beautifully executed plates.

MESSRS. JOHN WHELDON AND CO., 38 Great Queen Street, Kingsway, London, W.C., have issued a catalogue of books and papers on economic botany which they have for sale. The list, which is conveniently classified, contains particulars of books on commercial plants, tropical agriculture, food plants, and many other branches of economic botany.

THE following forthcoming books of science are announced by Messrs. Constable and Co., Ltd.:—"Textbook on Motor-car Engineering," by A. G. Clarke, vol. ii., Design; "Telegraph Engineering," by Dr. E. Hausmann; a new edition of "Wood Pulp," by C. F. Cross, E. J. Bevan, and R. W. Sindall. Mr. John Murray will shortly publish "Evolution and the War," by Dr. P. Chalmers Mitchell.

OUR ASTRONOMICAL COLUMN.

COMET NOTES.—The Ephemeris Circular of the *Astronomische Nachrichten* (No. 482) contains the elements and ephemeris of comet Mellish (1915*a*), communicated by Dr. Fischer-Petersen. As this ephemeris differs somewhat from that given last week the new positions for the current week are as follows:—

	R.A. (true) h. m. s.	Decl. (true) ° ′	Mag.
April 22	18 32 24	−6 58·7	7·6
24	35 9	7 47·2	
26	37 57	8 40·6	7·4
28	40 50	9 39·5	
30	18 43 48	−10 44·0	7·1

The comet lies towards the southern portion of the constellation of Aquila, in the neighbourhood of the stars 1, 2, and 3 Aquilæ.

The only information to hand regarding the observed return of Winnecke's comet is that mentioned in the *Morning Post* of April 15. It is stated that Dr. Thiele, of the Bergedorf Observatory, Hamburg, recorded its position on a photograph, the object being of the 16th magnitude. This comet has a period of about 5·8 years, and was first discovered in 1858. At the present return perihelion will not be reached until September, so that later the comet may be a good telescopic object.

Prof. E. C. Pickering, in *Harvard Circular*, No. 187, gives some early positions of comet 1914*e* (Campbell). This comet, as the circular states, appears to have been first seen on Thursday, September 17 (astronomical date), at one o'clock in the morning, by Mr. Leon Campbell, at the Arequipa Station of the Harvard Observatory. The comet was then visible to the naked eye. It was discovered independently a few hours later by Dr. Lunt, at the Cape Observatory, and by Mr. Westland, in New Zealand. Six photographs taken by Mr. Campbell were sent to Cambridge, and the positions have been measured and are here recorded.

THE ROTATION OF THE SOLAR CORONA.—M. J. Bosler, in the *Comptes rendus* for April 6 (vol. clx., No. 14, p. 434), describes the result he has obtained in an investigation on the velocity of rotation of the solar corona. The experiment was made during the solar eclipse of last August, and the apparatus provided the means of photographing the whole spectrum of the corona. It was thought that the green radiation at λ5303 would prove the most satisfactory line for measurement, but its absence rendered this impossible. However, the new red ray (λ6374·3) provided the opportunity for the determination, and the result obtained is here described. The photograph secured showed two strips of spectra of the corona at the east and west limbs, and, as comparison spectra, three other strips of spectra of diffused sky light were secured symmetrically on the same plate ten minutes after the eclipse. The resulting wave-lengths of the coronal line for the east and west limbs were found to be as follows, each wave-length being the mean of five complete series of measures entirely distinct:—

East λ 6374·43 (Rowland)
West λ 6374·59 ,,

Diff. 0·16

This difference corresponds to a velocity of 3·7 kilometres, and, making a correction for the inclination of the slit to the solar equator, gives an equatorial velocity of about 3·9 kilometres per second, a value correct to about 25 to 30 per cent. In the eclipse of 1898 Prof. Campbell, using the green radiation, deduced a tangential velocity of 3·1 kilometres a second (± 2 km. nearly), the diffuse nature of the radiation preventing further accuracy. M. Bosler points out that the corona moves in the same direction as the surface of the sun, and appears to rotate more quickly. The higher levels of the chromosphere show a similar tendency only to a less degree. An apparent increase in velocity with the elevation is thus proved.

The Annual of the Bureau des Longitudes, 1915.—The very useful annual for the current year published by the Bureau des Longitudes is as compact as ever, and contains a mine of valuable information very handy for reference. Besides the usual numerous tables useful to the astronomer, several new communications are included. Thus M. G. Bigourdan writes on the subject of the constellations, and after a brief historical sketch gives the co-ordinates of the principal stars and star charts down to 50° S. latitude. Quite a long article, devoted to stellar spectra and their classification, is written by M. A. de Gramont. The author describes Secchi's classification with illustrations of the type spectra, and then refers to more recent classifications, giving a table showing the correspondence with each other. Sir Norman Lockyer's classification is dealt with in a separate section of the article, and is compared with the Harvard College Observatory classification. A very valuable article, covering 162 pages, is that on "Methods of Examination of Mirrors and Objectives," contributed by M. Bigourdan. The article is illustrated by a large number of very useful figures, which will considerably help the reader. The preliminary chapter includes numerous historical references, and this is followed by chapters on general methods of examination, their application to all reflecting surfaces, the examination of mirrors mounted in telescopes, and, finally, a very complete account of the examination and testing of objectives.

Chinese Records of Eclipses.—In the Proceedings of the Tôkyô Mathematico-Physical Society (January, 1915, vol. viii., No. 1) Messrs. Kiyotugu Hirayama and Sinkiti Ogura discuss the interesting records of early Chinese eclipses. Their working list extends from the earliest solar eclipses to those recorded in the Ch'un Ch'iu. In the case of the latter, the calculations are in progress, and are expected to be soon finished. In the present communication the general plan of the calculations consists in determining the central line and the limiting lines for each eclipse. The eclipses of Shu Ching and Shih Ching are dealt with, and diagrams are given showing some of the limits of visibility.

TEACHING OF ENGINEERING IN EVENING TECHNICAL SCHOOLS.

THE "Memorandum on the Teaching of Engineering in Evening Technical Schools" (Circular 894), recently issued by the Board of Education, is a very welcome manual of suggestions to teachers and organisers of schools which provide evening classes in mechanical and electrical engineering.

This Memorandum fills nearly sixty foolscap pages, and is divided into nine sections. An introductory section points out the limitations of part-time courses —courses intended for students whose ordinary employment occupies the greater part of their time— when compared with full-time day courses. The second section, after referring to the fact that some of the serious disadvantages which characterise part-time courses conducted in the evening may be avoided by the growing practice of holding such courses during the day (the junior employees being allowed "time off" in order to attend them), proposes to classify "a complete curriculum of evening instruction" into three stages: the junior course (fourteen to sixteen); the senior course (sixteen to eighteen or nineteen), and the advanced course (eighteen or nineteen to twenty, twenty-one, or twenty-two). Senior courses are to be of two kinds: a minor course, complete in itself, for apprentices to engineering trades; and a major course, incomplete unless it also includes an advanced course, for technical men. The third section of the Memorandum gives outlines of typical major (senior and advanced) courses in mechanical and electrical engineering, and of minor (senior only) courses in some engineering trades. After making, in the next section, some valuable suggestions upon laboratory and class instruction for adolescent evening students, the Memorandum proceeds, in the following four sections, to consider in more detail the teaching of the various subjects which constitute these outline courses. The accommodation and equipment required for the various classes of work already discussed are considered in the ninth and final section.

The Memorandum is thus concerned with all kinds of evening classes intended for persons employed in engineering work, from the apprentice who is beginning to learn a trade to the designer or manager who attends a course of evening lectures delivered by a university professor. By concentrating attention upon evening classes as such, and especially upon those classes which are primarily intended for boys and young men between sixteen and twenty-two years of age, the Board's inspectors have succeeded in producing a document which cannot fail "to assist teachers and organisers to mark out for themselves the schemes of instruction best suited to the conditions of their classes." But this very concentration, to which the Memorandum owes much of its usefulness, will disappoint education committees or directors of education who look to find in it some treatment of the wider educational and economic problems of engineering training, such as the following:—The selection, on democratic lines, of the most suitable boys for each different type of training which should be provided for the different positions in engineering industry; the respective parts to be played, in the preparatory (full-time) training of engineers, by the elementary school and the junior technical school, the lower secondary school and the senior technical school, and the higher secondary school and the university or technical college; the point at which works training should begin; the co-ordination of practical experience in the shops with instruction in classes inside the works and with outside schools and colleges; and, more generally, the effective co-operation between engineering firms and education authorities in establishing and administering schemes for the advancement of apprentices.

Perhaps the most important feature of the Memorandum is the distinction which it draws between the major and the minor course. Industrial training has suffered hitherto from a lack of proper appreciation of the differences between the training required by the future artisan (or "tradesman") on the one hand, and the future "technical" man (whether designer, manager, or commercial representative) on the other. The distinction now drawn does not, however, go deep enough. The Memorandum does not sufficiently discourage the prevailing notion that the ideal evening student first enters evening classes at fourteen, and continues to attend such classes for seven years. Thus, instead of insisting that the technical student should remain at a secondary school until he is at least sixteen, and then, perhaps, enter his major (senior) course when he enters works, the Memorandum contemplates that the technical student and the trade student shall both follow the same junior (evening) course from fourteen to sixteen. It would surely be better that the trade student's own minor course should begin at fourteen instead of at sixteen, and attract him, by its special adaptation to the circumstances of his particular trade, from the moment when he leaves his day school. Moreover, since the trade student will as a rule have less opportunity for general reading in later life, his minor course might well include some "citizenship" subjects, such as industrial history considered at first from the point of view of his particular trade.

More than half of the Memorandum is devoted to "outlines of work" for various recommended courses. This portion is full of most useful suggestions. Some, however, are open to objection, or, at least, to criticism. Thus there is a curious confusion between *weight* and *mass* on page 20 ("$g \times$ force = mass $\times$ linear acceleration," which would make g a pure number, independent of the system of units employed). It is also doubtful whether the conception of "work" is really so difficult as to justify the suggested postponement of its introduction until the second year of the senior course. Again, the four years' (major) course in mathematics outlined in the Memorandum might with advantage be less "practical" in its first two years, during which some time might well be found for geometry.

ENGLISH MATHEMATICS.

THE *Mathematical Gazette* has recently published a translation of an address delivered by Prof. Gino Loria to the International Congress of Historical Studies. This is a well-proportioned and detached estimate of the main contributions of England to the body of mathematical science, from the earliest available records to the present time. An important suggestion is made that it may be possible to find in some of our libraries manuscript works by some of those early writers who, unlike ourselves, did not hasten to publish their discoveries, and were often surprised by death. In this connection the names of Bradwardine, Richard of Wallingford, John Maudith, and Tonstall are mentioned. Another note is that James Gregory made lengthy stays in Italy, and was therefore probably acquainted with the work of Galileo; so the question arises how far Newton may have been influenced by the achievements of the great Italian philosopher. Prof. Loria suggests inquiry about this as an important piece of research.

Prof. Loria emphasises, with justice, the fact that the renascence of English mathematics in the nineteenth century coincided with a better knowledge and appreciation of work being done abroad. The greatness of Newton, like that of Euclid and Archimedes, had a sort of benumbing effect upon his successors, and even contemporaries; although, of course, there are exceptions, like Maclaurin and Brook Taylor and Waring. It is also pointed out that even now there are certain branches of mathematics which Englishmen persistently ignore, or else treat by obsolete and clumsy methods. The example given is descriptive geometry; and it is noted that Brook Taylor laid down the principles of this subject in a way perfectly analogous to that adopted long afterwards, and independently, by Fiedler. It is not stated by Prof. Loria, but it is a fact that most of our text-books on descriptive geometry are simply contemptible, from a scientific point of view, and not to be compared with Fiedler's treatise, or the classic work of Monge, which does in the main follow the lines of what we call descriptive geometry, in the restricted sense of orthogonal projection.

Even able students who use these books, and attain great practical efficiency, have no conception at all of the subject as a whole, and are baffled by the simplest problems about traces of lines and planes. So far as we know, there is only one good treatise on descriptive geometry in the English language, and that is in the "Penny Cyclopædia," where so many other treasures have been buried and forgotten. This leads to the remark that Prof. Loria has a proper appreciation of the works of De Morgan, and laments that they are so inaccessible; with this sentiment we cordially agree.

An Italian is as likely as anyone to sympathise with English modes of thought; so any conclusion drawn from this address is likely to be flattering rather than the reverse. We must remember, too, that, when we speak of English mathematicians, we are apt to include such men as Maclaurin, Rowan Hamilton, and Sylvester, who were not Englishmen at all. But even in this inclusive sense of the term "English" one cannot but feel that Continental opinion about English mathematics is almost bound to be analogous to that about English literature in general. Newton *is* English, and, like Shakespeare, or Dante, or Goethe, incomparable; but we have lesser men, of a more distinctly national type, who may, perhaps, be more justly appreciated at home than abroad. As an example, we may instance W. H. Fox Talbot, now only vaguely remembered in connection with photography. As a mathematician he is, of course, not to be compared with Abel; nevertheless he did investigate some cases of Abel's theorem in a very instructive and fundamental way, implicitly showing that the theorem is really a deduction from the known facts about symmetric functions of the roots of an equation, and the elementary theory of partial fractions. We are inclined to believe that the simplest proof of Abel's theorem will ultimately follow the lines that Talbot has indicated.

There are many points in the address to which we cannot refer; but one that deserves mention is that Newton is reported to have said that the style of the ancient geometers is the only one appropriate to any mathematical treatise worthy of the name. Judging by the "Principia," it is probable that this story is authentic. G. B. M.

PUBLIC HEALTH.

THE Medical Officer's Supplement to the forty-third Annual Report of the Local Government Board for 1913–14 (Cd. 7612, price 1s. 11*d*.), while it deals mainly with matters primarily of medical interest, of necessity includes within its scope much that is of value to all scientific minds.

The question of infant mortality occupies a prominent place, and one notes with satisfaction that the general trend of the curve continues in a downward direction. Greater provision is likely to be made in the near future for the care of expectant mothers, and the official recognition of an ante-natal state, though somewhat belated, is none the less welcome. Much good work has been done by voluntary agencies in the past, and the linking up of this with the various organisations dealing with child welfare must inevitably tend to a healthier future race.

Some interesting figures are given regarding vaccination returns. It appears that in England and Wales as a whole one-half of the children whose births were registered in 1912 have been vaccinated, and nearly one-third have been exempted from vaccination by statutory declaration of conscientious objection. When compared with the returns for 1911, these figures show a percentage reduction of 52·3 to 50·1 in the proportion of children born who are vaccinated. The percentage of children born who were exempted under certificate of conscientious objection increased from 28·5 to 32·1.

Inquiries have been made regarding certain outbreaks of enteric fever supposedly due to the consumption of infected shell-fish. The medical officer of health of a seaport town has repeatedly referred to the danger incurred by persons in collecting shell-fish of all sorts from areas obviously contaminated with sewage. While it is difficult in most cases to prove conclusively that an epidemic owes its origin to such a practice, yet, when local authorities have acted as if such were undoubtedly the case, the wisdom of such action has been abundantly shown by the non-recurrence of the disease.

Progress is constantly being made towards securing purer and more wholesome food for consumption in this country. A careful watch has to be kept at the various ports of entry to prevent so far as possible the import of unsound and even poisonous material. As an instance of what is continually happening it will suffice to quote the following occurrence. During the unloading of a cargo of sugar in the Port of London it was noticed that some of the bags containing the sugar were covered with borax, which had been carried in the same hold and had become loose during the voyage. Samples of this powder were taken, and analysis showed them to contain arsenic in considerable quantities. The whole of the sugar was rebagged, and that portion of it that had already been sent out was recalled for suitable treatment under supervision.

The effect of certain types of waters on lead has again been brought into prominence by an outbreak, extensive though mild, of lead poisoning in an urban district in Yorkshire. The waters most liable to act in this way are acid, peaty supplies, and it is even asserted as conceivable that the treatment applied with a view of destroying the plumbo-solvent properties of the water may tend in some way to increase the ability of the water to erode the lead. At all events, further investigation is being made, as the case in point has proved a very difficult one to deal with.

More research has been conducted on the subject of ferro-silicon with special reference to possible danger arising from its transport and storage. This substance, of certain percentage compositions, is liable to disintegration in the presence of moisture, and poisonous gases are given off in quantity sufficient to produce fatal results in human beings. It is suggested that liability to spontaneous disintegration with evolution of poisonous gases may be related to the amount of aluminium present in the ferro-silicon. Further reports are now issued on ferro-chrome and other ferro-alloys, with special reference to aluminium content.

The work of Prof. Leonard Hill on the effect of open-air and wind in the metabolism of man is referred to. He points out that the physical qualities of the air—heat, moisture, and movement—are of paramount importance to health. The stimulating effect of cool and variable breezes acting on the skin leads to improved health, while a stagnant, windless, over-warm atmosphere tends to depression and diminished vitality. Two new instruments are described—the kata-thermometer and the caleometer—which enable the rate of cooling of the body and the variability of the rate to be measured (see p. 205 of this issue of NATURE). Prof. Hill's researches on the physical condition of the atmosphere have done much to elucidate the problem of "stuffiness," to which so many ailments are undoubtedly due.

THE CARNEGIE INSTITUTION OF WASHINGTON AND SCIENTIFIC RESEARCH.

THE Carnegie Institution of Washington was founded by Mr. Carnegie in 1902, when he gave to a board of trustees an endowment of 2,000,000*l.*, to which he added 400,000*l.* in 1907, and a further 2,000,000*l.* in 1911. The articles of incorporation of the institution declare "that the objects of the corporation shall be to encourage, in the broadest and most liberal manner, investigation, research, and discovery, and the application of knowledge to the improvement of mankind," and already, as the annual reports of the president and the directors of the various departments show, the objects of the institution are being fulfilled admirably.

The trustees have inaugurated and developed three principal agencies to forward the aims of the institution. In the first place, the departments of research attack problems requiring the collaboration of several investigators, special equipment, and continuous effort. A second agency provides means to enable individuals to complete investigations requiring less collaboration and simpler apparatus; while a third division deals with the publication of the results obtained as the result of the work of the first two agencies.

The reports by the president, the directors of the various departments of research, and the executive committee, contained in the 1914 Year Book, recently received, give full particulars of the financial resources of the institution, and of the activities of its different departments, during the year under review. The Year Book provides convincing evidence of the success of the trustees of the institution in their endeavours to encourage and advance scientific research.

The following table shows the amounts of the grants made by the trustees for the current year, and the purposes to which they are being devoted:—

	£
Administration	10,000
Publication	12,000
Division of Publications	2,000
Departments of Research	138,462
Minor Grants	21,860
Index Medicus	2,700
Insurance Fund	5,000
Reserve Fund	50,000
Total	242,022

The next table shows the departments of scientific investigation to which the larger grants were made for the financial year 1913–14, and the amounts of these grants:—

	£
Department of Botanical Research ...	8,428
Department of Economics and Sociology	1,000
Department of Experimental Evolution ...	12,696
Geophysical Laboratory	17,100
Department of Historical Research ...	6,220
Department of Marine Biology	3,830
Department of Meridian Astronomy ...	5,036
Nutrition Laboratory	9,159
Division of Publications	2,000
Solar Observatory	44,178
Department of Terrestrial Magnetism ...	31,481
Researches in Embryology	5,380
Total	146,508

The following extracts from the *résumé* of the investigations of the year included in the report of the president, Dr. R. S. Woodward, will serve to indicate the nature and extent of the scientific work accomplished during the year.

Although the greater part of the work of the Department of Botanical Research is carried on at its principal laboratory at Tucson, Arizona, it is essential to a comprehensive study of desert plant life to explore distant as well as adjacent arid regions. Thus, having published during the past year the results of an elaborate investigation of the region of the Salton Sea, the department is now turning attention to similar desert basins, of which there are several in the Western States that have been studied hitherto in their geological rather than botanical aspects. These researches are entailing also many applications of the allied physical sciences not heretofore invoked to any marked extent in aid of botanical science. Hence there results properly a diversity of work quite beyond the implications of botany in the earlier, but now quite too narrow, sense of the word. The facilities of the Desert Laboratory have been enlarged during the year by the completion and equipment of a specially designed small building for studies in phyto-chemistry, which has been proved to play a highly significant *rôle* in desert life.

The observational, statistical, and physical methods applied by the Department of Experimental Evolution are constantly adding to the sum of facts and of inductions essential to advances in biological knowledge. The range of application extends from the lowest organisms, like fungi, up to the highest, as typified in the race to which the investigators themselves belong. Thus, during the past year, observations and experiments have been made on mucors, plants, pigeons, poultry, and seeds, while the director has continued his fruitful statistical studies in the relatively new field of departures from normality in mankind. The variety of agencies employed in this wide range of inquiry now includes a permanent staff of about twenty members and a physical equipment enlarged during the year by the completion of an additional laboratory and a power-house. Early in the year the facilities of the department were increased by the successful transfer, from Chicago to Cold Spring Harbour, of the remarkable collection of pedigree pigeons recently acquired by the institution from the estate of Prof. C. O. Whitman.

An instructive example of the favourable progress, which may be confidently expected in any field of research when entered by an adequately manned and equipped department devoted solely thereto, is afforded by the experience of the Geophysical Laboratory. In less than a decade this establishment has not only accomplished the formidable task of constructing the necessary apparatus and of preparing many of the pure minerals concerned, but has already begun the processes of analysis and synthesis which are leading to extensive additions to our knowledge of rock and mineral formations found in the earth's crust. Among the problems under investigation, one of immediate economic as well as of great theoretical interest may be cited here by reason especially of the fact that funds for its execution have been supplied by industrial sources; this is the problem of the "secondary enrichment of copper ores," and the success attained in its treatment demonstrates the practicability of advantageous co-operation between the laboratory and industrial organisations without restriction to scientific procedure and publicity. The section of the director's report devoted to this subject should be of special interest to geologists and to mining engineers as well as to copper-mining industries. A more comprehensive idea of the productive activities of the laboratory may be gained from its publications, which embrace forty-nine titles of papers which have appeared in current journals or are in the press, many of them having been published in German as well as in English.

In accordance with plans recommended by the director of the Department of Marine Biology and approved by the trustees in 1912, an expedition to Torres Straits, Australia, was undertaken in the latter part of the preceding year. Early in September, 1913, the director and six collaborators arrived at Thursday Island in the Straits, expecting to use this relatively accessible island as a base of explorations; but it was soon found advantageous to proceed to Maër Island, one of the Murray group, about 120 miles east-north-east, and near to the outer limit of the Great Barrier Reef. Here a temporary laboratory was set up in the local courthouse and jail, generously placed at Dr. Mayer's disposal by the British authorities. The region proved to be one rich in coral reefs and in marine fauna for the work contemplated. Observations and experiments securing gratifying results were carried out during the months of September and October, 1913. In addition to the critical data secured by Dr. Mayer with respect to the corals about Maër Island, for comparison especially with corresponding data from the corals of Florida waters, observations and materials for important contributions to zoology were collected by each of his collaborators. On returning to America from the southern hemisphere, the director was engaged, during April and May, in two minor expeditions with the departmental vessel *Anton Dohrn*. The first of these was in aid of the researches of Dr. Paul Bartsch, on cerions, and required a cruise along the Florida Keys from Miami to Tortugas and return. The second expedition was in aid especially of Dr. T. W. Vaughan, long associated with the department in studies of corals and related deposits, and required a cruise from Miami, Florida, to the Bahamas and return. It appears that during its first decade forty-nine investigators have made use of the Tortugas Laboratory, twenty-eight of these having returned two or more times, making a total of 108 visits to this relatively inaccessible centre of research. Of the publications emanating from the department, sixty have been published by the institution, while upwards of forty have been published under other auspices.

The activities of the Department of Meridian Astrometry are concentrated on the derivation of stellar positions for the comprehensive catalogue in preparation, on supplementary measurements of stellar co-ordinates with the meridian circle of the Dudley Observatory, and on investigations of residual stellar motions. The latter have now become the most important element in the definition of stellar positions by reason of the extraordinary recent progress in sidereal astronomy, to which the department has contributed in large degree. Thus, along with the formidable computations required by the large mass of observations made by the department at San Luis, Argentina, researches are simultaneously continued on the problems of star-drift, including the speed and direction of motion of our solar system. In the meantime, the catalogue is progressing favourably and some portions of the observatory list of miscellaneous stars are approaching completion, although cloudiness during the past two winters has interfered with this part of the departmental programme. In the meantime, also, the manuscript of the zone catalogue of stars the positions of which were measured at the observatory during the years 1896 to 1900, is undergoing the final process of comparison and checking preparatory to publication.

The anticipations of a specially favourable environment, which were entertained when the Nutrition Laboratory was located in Boston near the Harvard Medical School and near several existing and projected hospitals, are now fully realised; and it would appear that the laboratory is reciprocally advantageous to the several establishments with which it is in immediate contact. Indeed, with this, as with all other departments of research founded by the institution, the only fears to be entertained seriously are those due to increasing capacity for usefulness and scientific progress, since such capacity tends quite properly to grow faster than the institution's income warrants.

Improvements have been made in the laboratory itself, and several additions to equipment have been installed. These latter include new respiration apparatus for studies of metabolism in muscular work of men and of small animals, a reconstruction of an earlier form of bed calorimeter, and additional apparatus for photo-electric registration of physiological action in subjects under observation, whether near by or at a distance.

As indicated in previous reports, the laboratory and its work are subjects of international as well as national interest, and many co-operative efforts are arising therefrom. Among the researches in progress by the laboratory staff, attention may be directed particularly to "The gaseous metabolism of infants with special reference to its relation to pulse-rate and muscular activity," by Francis G. Benedict and Fritz B. Talbot, and to "A study of prolonged fasting," by Francis G. Benedict.

The extensive operations of the Department of Terrestrial Magnetism on the oceans and in foreign countries have been adequately supplemented during the year by the new departmental laboratory, the completion and occupation of which took place nearly simultaneously with the beginning of the second decade of the department's existence. This laboratory and its site provide greatly enlarged facilities for research, as well as unsurpassed quarters for the resident departmental staff.

Near the end of the preceding year the non-magnetic ship *Carnegie* returned to New York City, where she underwent such extensive repairs as are always required by wooden vessels after long cruises in tropical waters. After refitting, she left New York, June 8, 1914, for a cruise in the North Atlantic. In this, the third of her expeditions, she traversed about 10,600 miles, making a first stop at Hammerfest, Norway, July 3, reaching the high latitude 79° 52′ off the north-west coast of Spitsbergen, touching at Reykjavik, Iceland, August 24, and returning to the base station at Greenport, Long Island, October 9, and to Brooklyn, New York, October 21. During this cruise the *Carnegie* was in command of Mr. J. P. Ault. She is now being refitted for a longer cruise during 1915–16, in southern latitudes (50° to 75°), where magnetic observations require supplementing.

An attempt at an ocean expedition into Hudson Bay was made under the charge of Mr. W. J. Peters during the past summer, but on account of unusual obstacles from ice this proved only partly successful. Entrance into the Bay with the auxiliary schooner *George B. Cluett*, chartered for this purpose from the Grenfell Association, was blocked until September 2, leaving less than a month's time available for surveys.

Determinations of magnetic elements on land have been continued in six parts of Africa, in as many States of South America, and in Australia, bringing the surveys of all these continental areas to a well-advanced stage.

With the end of the current year the Mount Wilson Solar Observatory, like most other departments of the institution, will have completed a first decade of its history. Quite appropriately, this establishment was founded at an epoch of maximum sun-spots, and a marked increase in solar activity during the past year furnishes similarly auspicious conditions for entrance into a second decade of research. But much more auspicious conditions are found in the extensive experience and in the effective equipment acquired along with the capital progress attained during this first decade. The most sanguine astronomer would have hesitated at the earlier epoch to predict that these latter conditions could be realised at the present epoch. Herein also is found a signal illustration of the superior effectiveness of establishments primarily designed for and exclusively devoted to research as compared with establishments in which research is a matter of secondary interest.

Progress in construction of the 100-inch telescope has been made as rapidly as could be expected in so formidable an undertaking. The delicate optical task of shaping the 100-inch mirror has been brought successfully by Mr. Ritchey to the stage of sphericity which precedes the final state of parabolisation. The difficulties due to distortion of the mass of the disc, referred to in previous reports, have been overcome, and other obstacles due to temperature inequalities in the optical room are likewise yielding to appropriate precautions. In the meantime, the foundations for this telescope have been completed, and the mounting and dome are expected to be ready for erection during the coming year. Several smaller parts and accessories for this instrument, requiring special exactness, are under construction at the shops of the observatory in Pasadena. Many additions and improvements in the apparatus already installed at the observatory have been made. The 60-foot tower telescope particularly, which was originally cheaply constructed in order to test the possible advantages of such a departure from earlier forms of telescopes, has been put in a state of efficiency comparable with that of the 150-foot tower telescope, leaving the latter free for the uses to which it is specially devoted. In these general improvements much attention has been given to rendering the plant on Mount Wilson more nearly fireproof. The mountain road has been repaired, widened, and strengthened in many parts in anticipation of the heavy traffic essential to transportation of the 100-inch telescope to its destination.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Adams prize for 1913–14 has been awarded to Mr. G. I. Taylor, Smith's Prizeman in 1910. The subject selected was "The phenomena of the disturbed motion of fluids, including the resistances encountered by bodies moving through them." The value of the prize is about 250*l.*

IT is stated in *Science* that by the will of General Brayton Ives, of New York City, the largest part of his estate is bequeathed to Yale University for its general purposes. The value of the bequest is estimated at from 150,000*l.* to 300,000*l.*

WE learn from *Science* that through the efforts of Dr. Ralph Arnold, and other alumni of the department of geology and mining, Stanford University has just added to its collections the working library and material of the late Prof. H. Hemphill, of Los Angeles. The collection contains between 8000 and 9000 specimens of shells and 150 volumes. The material is of great importance in the study of the Tertiary geology of the Pacific coast, and especially of the geology of the petroleum deposits of California.

THE March number of the *Nature-Study Review* (Ithaca, N.Y.), the official organ of the American Nature-Study Society, is devoted to an elaborate prospectus of courses in nature-study for elementary schools. It has been prepared by Mr. G. H. Travers and Miss H. M. Reynolds, of the Minnesota State Normal School, and it is copyright. The authors take a big view of their subject, and emphasise "the æsthetic, the social, the economic, and the hygienic" aims of nature-study. (The old-fashioned teacher will rather miss the intellectual aim!) To help the pupils to enjoy the world they live in, and to acquaint them with the useful and injurious forms of life, these we understand as the æsthetic and economic aims, but the social aim, so far as explained, seems to us far-fetched, and the hygienic aim is lugged in by sheer force. The "disciplinary theory" of training the powers of observation, memory, reasoning, and imagination must be given up, we are told, for the researches of modern psychology have shown it to be unsound. But it seems to reappear under another name. To more purpose, as it seems to us, the authors emphasise that the nature-study should deal with the material available in the child's environment, which in urban conditions requires to be enlarged artificially. The starting point should always be in the child's experience, and the material should be of interest or capable of becoming of interest to the child. Each study should concern itself with a child's problem, and the child should be guided to solve it. And the solution should mean something in the life of the child. "If the problem does not seem to allow of any application, we may well inquire whether the problem is really worth while." This may be pushed too far, for a stimulated imagination may be a great gain and a search for applications a bore. The graded outlines of courses are carefully thought out, and the general arrangement—following the seasons—is admirable. Teachers will find the outlines very suggestive and the introductory essay very provocative. We would particularly commend the consistent way in which the authors have sought to get at the child's point of view, and to keep to the Socratic method, not in the letter alone, but also in the spirit.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 25.—Sir William Crookes, president, in the chair.—Prof. B. **Moore**: The production of growths or deposits in meta-stable inorganic hydrosols.—Prof. B. **Moore** and W. G. **Evans**: Forms of growth resembling living organisms and their products slowly deposited from meta-stable solutions of inorganic colloids.—H. **Onslow**: A contribution to our knowledge of the chemistry of coat-colour in animals and of dominant and recessive whiteness. This research was undertaken in order to discover a chemical method of differentiating the two similar forms of white animals known as dominant whites and recessive whites, or albinos. Hitherto this has only been possible by observing their genetic behaviour. Dark animal pigments are believed to result from the oxidation of a colourless chromogen by an oxydase. The skins of young black rabbits were found to yield a tyrosinase which converted tyrosine to a melanin. By means of this tyrosinase it was possible to test extracts from white rabbits of both types. Briefly, extracts from dominant whites contained an anti-oxydase which inhibited the tyrosinase of the black rabbit extracts. Extracts from albinos, on the other hand, had no inhibiting influence, and were themselves incapable of producing any pigment. The anti-oxydase was also found in those white parts of rabbits which are dominant to colour, such as the white bellies of the wild rabbit and of the yellow rabbit carrying agouti. These results tend to confirm the Mendelian view that dominant whiteness is caused by a factor which inhibits the pigment-producing mechanism if present, and that albinism results from the partial or total absence of the factors necessary for the development of pigment. The experiments also revealed facts which suggest that the difference between pigments producing black, chocolate, and yellow hairs is quantitative rather than qualitative, for, after extraction, the pigments in all three colours appear identical. That variation in colour is a structural modification is supported by the fact that dilute colours, such as blue, are caused by a lack of pigment in the cortex. In the corresponding intense colours, such as black, pigment being present in the cortex, the white light reflected from the vacuoles is absorbed, thus deepening the colour.

PARIS.

Academy of Sciences, April 12.—M. Ed. Perrier in the chair.—E. **Guyou**: Remarks on the *Extrait de la Connaissance des Temps* for 1916. An account of the modifications introduced with the view of shortening and facilitating nautical calculations.—A. **Müntz** and E. **Lainé**: Study of the material brought down by watercourses in the Alps and Pyrenees. Determinations of the quantities of material carried by the principal watercourses in the Alps and Pyrenees. The erosion is much more intense in certain recent formations. The agricultural value of the deposits has still to be examined.—M. de **Forcrand**: A hydrate of hydrogen arsenide. The hydrate $AsH_3,6H_2O$ has been isolated and determinations made of its dissociation pressures at temperatures from 0° C. to 25° C. From these data, with the aid of Clapeyron's equation, the heat of formation has been found to be 17·75 calories. Comparisons are given for analogous data for the hydrogen compounds of sulphur, phosphorus, and selenium.—J. **Guillaume**: Observations of the sun made at the Observatory of Lyons during the third quarter of 1914. Observations were made of sixty-seven days, and the results are given in three tables showing the number of spots, the distribution of the spots in latitude, and the distribution of the faculæ in latitude.—S. **Chevalier**: The effect of atmospheric dispersion on the diameter of photographed celestial objects. Photographs of the sun and of Jupiter show that the effect of atmospheric dispersion on the diameter of a photographed celestial body depends very slightly on the brightness of the body or on the sensibility of the plates.—Ernest **Esclangon**: The limited integrals of a linear differential equation.—Ph. **Flajolet**: Perturbations of the magnetic declination at Lyons (St. Genis Laval) during the third quarter of 1914.—M. **Lubimenko**: Some experiments on the antioxydase of tomato fruits. Details are given of a method for estimating the amount of peroxydase in the tomato, and this method was applied to determining the proportions of peroxydase during the different stages of the ripening of the fruit. From the results obtained, it is concluded that the tissue of the tomato contains an enzyme which paralyses the oxidising action of the peroxydase. This is provisionally termed anti-peroxydase, and it is much more sensitive than the peroxydase to the influence of antiseptics. Even toluene destroys it fairly rapidly. The relations between these two enzymes during the ripening of the fruit is discussed.—A. **Jungelson**: Chemical intoxication and mutation of maize. Studies in the variations produced by treating the seed with a solution of copper sulphate.—H. **Vincent** and M. **Gaillard**: The purification of drinking water with calcium hypochlorite. Compressed tabloids of 0·015 gram calcium hypochlorite with 0·08 gram salt are used. These contain 3·5 mgr. of active chlorine, and one is capable of sterilising a litre of water in about twenty minutes. There is no appreciable taste. Bacteriological experiments are given showing the removal of pathogenic bacteria.—J. **Vallot**: An installation permitting the application of intensive heliotherapy, in winter, to wounded and military convalescents.—MM. **Hirtz** and **Gallot**: A new radioscopic method for the determination of the depth of a foreign body in the organism.

BOOKS RECEIVED.

Year Book of the Royal Society of London. Pp. 250. (London: Harrison and Sons.) 5*s*.

Imperial University of Tokyo. Calendar 2573–2574. (Tokyo: Z. P. Maruya and Co.)

Royal Societies Club. Founded A.D. 1894. Foundation and Objects. Rules and By-Laws. List of Members. Pp. 354. (London.)

Practical Irrigation and Pumping. By B. P. Fleming. Pp. xvi+226. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 8*s*. 6*d*. net.

The Design of Steam Boilers and Pressure Vessels. By Prof. G. B. Haven and G. W. Swett. Pp. vii+416. (New York: J. Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.) 12*s*. 6*d*. net.

Electrical Engineering. By Dr. T. C. Baillie. Vol. i., Introductory. Pp. vii+236. (Cambridge: At the University Press.) 5*s*. net.

DIARY OF SOCIETIES.

THURSDAY, April 22.

Royal Society, at 4.30.—Deep Water Waves, Progressive or Stationary, to the Third Order of Approximation: Lord Rayleigh.—A Chemically Active Modification of Nitrogen, produced by the Electric Discharge. VI.: Hon. R. J. Strutt.—The Difference between the Magnetic Diurnal Variations on Ordinary and Quiet Days at Kew Observatory: Dr. C. Chree.—The Effects of Different Gases on the Electron Emission from Glowing Solids: F. Horton.—Heats of Dilution of Concentrated Solutions: W. S. Tucker.—The Origin of the "4686" Series: T. R. Merton.

Royal Institution, at 3.—The System of the Stars: The Stellar System in Motion: Prof. A. S. Eddington.

FRIDAY, April 23.

Royal Institution, at 9.—Military Hygiene and the War: Major P. S. Lelean.

Institution of Mechanical Engineers, at 8.

Physical Society, at 5.—The Theories of Voigt and Everett Regarding the Origin of Combination Tones: Prof. W. B. Morton and Miss Mary Darragh.—Experiments on Condensation Nuclei Produced in Gases by Ultra-Violet Light: Miss Maud Saltmarsh.—The Self-Induction of Solenoids of Appreciable Winding Depth: S. Butterworth.

SATURDAY, April 24.

Royal Institution, at 3.—Modern Artillery: Lieut.-Col. A. G. Hadcock.

MONDAY, April 26.

Royal Geographical Society, at 8.30.—Geography of the War Theatre in the Near East: D. G. Hogarth.

Royal Society of Arts, at 8.—Foodstuffs: Dr. D. Sommerville.

Institute of Actuaries, at 5.—The New National Life Tables: G. King.

TUESDAY, April 27.

Royal Institution, at 3.—The War on Belgian Architecture: Banister Fletcher.

Zoological Society, at 5.30.—White Collar Mendelising in Hybrid Pheasants: Mrs. Rose Haig Thomas.—Two New Tree-Frogs from Sierra Leone, recently Living in the Society's Gardens: E. G. Boulenger.—The Foraminifera of the Kerimba Archipelago (Portuguese East Africa). Part II.: E. Heron-Allen and A. Earland.

Illuminating Engineering Society at 8.—Visibility: its Practical Aspects: C. C. Paterson and B. P. Dudding.

Institution of Civil Engineers, at 8.—Annual General Meeting.

WEDNESDAY, April 28.

Royal Society of Arts, at 8.—The Utilisation of Solar Energy: A. S. E. Ackermann.

Institution of Electrical Engineers, at 7.45 (Students' Section).—Annual General Meeting.

Geological Society, at 8.—A Composite Gneiss near Barna (County of Galway): Prof. Grenville A. J. Cole.—Further Work on the Igneous Rocks associated with the Carboniferous Limestone of the Bristol District: Prof. S. H. Reynolds.

THURSDAY, April 29.

Royal Society, at 4.30.—*Probable Papers*: The Transmission of Infra-red Rays by the Media of the Eye, the Transmission of Radiant Energy by Crookes's and other Glasses, and the Radiation from various Light Sources: H. Hartridge and A. V. Hill.—Surface Tension and Ferment Action: E. Beard and W. Cramer.—Surface Tension as a Factor controlling all Metabolism: W. Cramer.

Royal Institution, at 3.—Advances in General Physics: Prof. A. W. Porter.

Institution of Electrical Engineers, at 8.—The Bombay Hydro-Electric Scheme: A. Dickinson.

FRIDAY, April 30.

Royal Institution, at 9.—Emulsions and Emulsifications: Prof. F. G. Donnan.

Institution of Petroleum Technologists, at 8.—Oil Well Engineering: W. Calder.

SATURDAY, May 1.

Royal Institution, at 3.—Photo-Electricity: Prof. J. A. Fleming.

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