THURSDAY, MAY 9, 1907.

IS THE ELECTRONIC THEORY OF MATTER LEGITIMATE?

Electrons, or the Nature and Properties of Negative Electricity. By Sir Oliver Lodge, F.R.S. Pp. xv+230. (London: George Bell and Sons, 1906.) Price 6*s.* net.

AT the present time there are few more absorbing topics among physicists and chemists than the electron and its relation to matter, and none on which a more complete mystification exists. A book on the subject by so illuminating and inspiring a publicist as Sir Oliver Lodge is therefore doubly acceptable at the present time.

A few words on the existing situation may be of general interest. It will be recalled that the researches in optics on the one hand, culminating in the discovery and elucidation of the Zeeman effect, and in the phenomena of the Crookes's tube on the other, resulting in the isolation of the free electron and the measurement of its constants by J. J. Thomson, made the scientific world familiar with the conclusion that the same electron or atom of negative electricity is *an* ultimate constituent of all atoms, and possesses, in virtue of the magnetic field it creates in motion, inertia which, though small, is definite and indistinguishable in ordinary circumstances from the inertia possessed by ordinary matter. There is little that would to-day be generally considered as controversial in these two conclusions. On the contrary, the researches which have led to them have received the unstinted admiration of all. But upon these conclusions are based others, concerned, not with the nature of electricity, but of matter, in the highest degree controversial and speculative, which regard the electron as the universal unit out of which all matter is essentially built up, and mass as an electromagnetic phenomenon due to a vast assemblage of constituent electrons grouped together in stable configurations constituting the atoms. This view of atomic structure was developed by J. J. Thomson in two papers (*Phil. Mag.*, December, 1903, and March, 1904). He regarded the atom as composed of a uniform sphere of positive electrification containing an electrically equivalent number of electrons revolving in regular motion about the centre, and showed that according to the numbers of the electrons periodic sequences of properties of the systems would occur strikingly similar to the periodic sequences in the properties of the atoms of the actual elements themselves.

One of the most enthusiastic supporters of the universal extension of the electronic theory to explain the properties of matter has been Sir Oliver Lodge himself, who saw in the instability, natural to a system constituted of electrons in constrained motion, due to the external radiation of energy that must be supposed to take place, a possible cause of radioactivity and of the observed disintegration of the radioactive elements. Some few months ago, however, J. J. Thomson (*Phil. Mag.*, June, 1906) published the results of an investigation into the actual number of electrons existing in an atom of matter by three independent methods, which led to the uniform and unexpected conclusion that the number of electrons is of the same order as the weight of the atom in terms of that of hydrogen as unity. Since then it may be safely said that no one has known quite what to think with regard to the electronic theory in its application to material phenomena, and the present book, from the pen of a writer to whom so often in the past the student has looked for light and leading in difficult places, will therefore be opened with curiosity and read with eagerness.

The effect of the profound changes which have come over the subject in the last few months is evident in the preface, where we read:—

"A proof that the atom of matter is essentially composed of such electrons, and that its mass, too, is of purely electromagnetic nature, is lacking; the electromagnetic theory of Matter . . . must be regarded for the present as no better than a working hypothesis. It is a hypothesis of stimulating character, and of great probability, but its truth is still an open question that is probably not going to be speedily closed."

The extract may be said to give the keynote to the treatment in the book. It is evident that the writer himself has not lost confidence in the ultimate triumph of the electron theory in its universal aspect, and although he is aware of, and does not attempt to minimise the magnitude of, the recent difficulties which have arisen, his enthusiasm is still undamped. In a chapter towards the end of the book, devoted to a consideration of some of these difficulties, he himself describes the recent paper of J. J. Thomson, to which reference has been made, as "the most serious blow yet dealt at the theory, at least in its simpler and cruder form" (p. 194); and again (p. 151), "it has tended to reduce the whole subject to a state of exaggerated uncertainty." But his final conclusion is (p. 200):—

"The most exciting part of the whole is the explanation of matter in terms of electricity, the view that electricity is, after all, the fundamental substance, and that what we have been accustomed to regard as an indivisible atom of matter is built up out of it; that all atoms—atoms of all sorts of substances—are built up of the same thing. . . . But it must be remembered that although this solution is strongly suggested it is not yet a completed proof. Much more work remains to be done before we are certain that mass is due to electric nuclei."

No excuse need be offered for dwelling on this side of the book, for the attitude of the leading exponents to the recent developments of the electronic theory of matter is topically the most interesting to the scientific reader at the moment. But attention must not on that account be diverted from what is, after all, the main subject of the book, not the nature of matter, but that of electricity. The major part is devoted to an admirable and inspiring treatment of those solid results of experiment and analysis elucidating the nature and properties of negative electricity,

which have led to the establishment on a firm basis of the atomic theory of electricity. It is only the last third which is devoted to the speculative and controversial side in which the electron becomes also a material conception replacing the "*urstoff*" or "protyle" of earlier similar speculations. Some of the points touched upon in the text are treated at greater length in a series of appendices, but no index has been furnished, which is a decided omission.

Of the chapters presenting special features of interest may be mentioned chapter ix., which is largely concerned with the size of the electron and its power of penetrating matter, the effects of a collision between electron and atom, and the ratio of the distribution of the energy of collision between heat and X-rays; chapter xi., which deals with the magnetism of light, and affords a very clear exposition of the nature of the action, which "has opened up a new branch of physics, a new department, as it were, of atomic astronomy, with atoms and electrons instead of planets and satellites"; and chapter xiv., which contains a full treatment of the experimental work of Kaufmann on the high-velocity β-ray electrons expelled by radium. In chapter xv. no less than five alternative views of the constitution of the atom are considered, which emphasises, to use the author's own expression, the "painfully indefinite character" of the theory applied to matter. Exception must be taken to chapter xviii., entitled "Summary of other Consequences of the Electron Theory," which begins with a section headed "Radio-activity" (!). Now this is surely unfair to a great and independent experimental subject, because not only has radio-activity taught us something really definite and fundamental about matter as distinguished from electricity, but also it has at the same time furnished, for example, in the penetrating power of the α and β rays, the most damaging evidence against the possibility of an electronic constitution of matter.

Sir Oliver Lodge's well-known forceful and attractive style is always in its element in dealing with the conquests achieved in physical science, but the concluding passage is something of the nature of a parting shot at the reader.

"Especially must the inner ethereal meaning both of positive and negative charges be explained: whether on the notion of a right-and-left-handed self-locked intrinsic wrench-strain in a Kelvin gyrostatically-stable ether, elaborated by Larmor, or on some hitherto unimagined plan. And this will entail a quantity of exploring mathematical work of the highest order."

To explore the inner ethereal meaning of this right-and-left-hander elaborated by the author demands a brain of unquestionable gyrostatic stability.

Having dealt with the author's book as the exposition of his views of the nature of electricity and matter, and having first fully acknowledged the debt the reading public owe to Sir Oliver Lodge for the leading part he has taken in the public work of advancing and expounding the new doctrines, it may not be considered ungracious to touch a little less enthusiastically than the author does on certain aspects of the new theories themselves here so powerfully advocated.

Without in the least wishing to minimise the importance of the part played by imagination and hypothesis in experimental science, the question may fairly be asked whether these persistent efforts to "simplify" matter and reduce it to a single fundamental existence have a place in the legitimate scientific thought of the present day, or whether they are not a continually recurring phase of an apparently innate primitive mental aspiration, the origin of which is to be sought, not in the phenomena themselves, but in the predilections of the human brain. The rule that where one conception suffices it is superfluous to use more than one may be fully granted. But it is surely still something of a mental luxury to believe that these ideas of the essential unity of matter and its ultimate reducibility to a single type, which exist deep down in the most ancient mythologies, and may be said to form part of the common stock of original ways of thinking, have as yet any other than this foundation. Matter continues to be experimentally incomprehensible, and as recent work in radio-activity has shown, the possibilities of its complexity are far from exhausted by the eighty or more recognised elements. The attempts, for example Prout's hypothesis, to reduce matter to one common basis testify rather to the aspiration for that kind of explanation which to our ideas seems appropriate. It is undoubtedly satisfying to picture all matter as built up of some one unit, because an ingrained bias exists in the mind towards the simplest possible origin of phenomena. There is, however, evidence that our natural subjective impressions of what is fit and appropriate are, when they are traced to their source, derived in the first place from an insufficient study of the operations of Nature, which fuller knowledge usually dispels. It is, of course, possible that with the even fuller knowledge of the future some such doctrine as a connection between what is mentally harmonious and what is physically true may transpire, and the doctrine find a legitimate place in the theories of pure physics. But for the present the supporters of the electronic theory of matter have to show that they have not allowed their enthusiasm to betray them into an attitude of mind which belongs rather to the past than to the future of scientific thought. FREDERICK SODDY.

THE COLONISATION OF VIRGINIA.

The Generall Historie of Virginia, New England, and the Summer Isles, together with the True Travels, Adventures and Observations, and a Sea Grammar. By Captaine John Smith. Two vols. Vol. i., pp. xxxiii+396; vol. ii., pp. xix+330. (Glasgow: James Maclehose and Sons; London: Macmillan and Co., Ltd., 1907.) Price 25*s.* net.

AT the time of writing (April) the warships of the Powers are gathered together in Hampton Roads to honour the tercentenary of the founding of the Commonwealth of Virginia, and the Jamestown Exposition (held at Norfolk) will soon be opened for

all the world and his wife to come and see what Virginia can show them after three hundred years of existence, in spite of the grievous calamity of forty years since. What the warships of the other Powers have to do with the celebration is not quite clear; one would have thought that this would have been a domestic event to be celebrated by the navies and peoples of the United States and Great Britain alone. For there was no foreigner, barring a recalcitrant Dutchman or two, concerned in the settling of Jamestown and the creation of Virginia in the fair land of Wingandacoa, in the year of grace 1607.

For although Wingandacoa had been discovered by the emissaries of Sir Walter Raleigh, and its name changed to "Virginia" by "Her Maiesties Grace" in honour of her glorious self, in 1584, it was not until 1607 that the permanent settlement was made, and called Jamestown in honour of the "Solomon" who now presided over the destinies of the British nation. It was odd that the name of his tobacco-hating majesty should have been given to the first capital of the country which has always produced the bulk of the obnoxious weed!

With the expedition which set sail from Blackwall in December, 1606, came Master John Smith the redoubtable, who bore for his arms the three Turks' heads granted to him by Sigismundus Bathory, "by the Grace of God Duke of Transilvania, Wallachia, and Moldavia, Earle of Anchard, Salford, and Growenda," in commemoration of his great exploit in the service of that prince, when, "with his sword, before the towne of Regall, in single combat he did overcome, kill, and cut off" the heads of three Turkish champions. In memory of which exploit the three isles off the American coast called the "Turks' Heads" were also named by Master John Smith himself. Smith was a man of the most indomitable energy and determination, as his fellow-voyagers to Virginia, Mr. Edward-maria Wingfield and the rest, soon found; and it was not very long before the hero of the Turks' heads was in full command of the colony, very much for its good, and Wingfield and Smith's enemies returned to England to sow the seeds of opposition which eventually made the position of the masterful governor untenable.

Smith himself tells the story of his work in his remarkable "Generall Historie," of which Messrs. Maclehose have issued the present admirable reprint just at the right moment, when the tercentenary of the founding of Jamestown is being celebrated in Virginia. Egotistical the book is, but when he wrote it Smith was smarting under the undeserved reproach of the enemies that his energy had made for him, and his purpose was to assert to the world what he had done, and to show, what none will gainsay, that but for him the Commonwealth of Virginia would never have been securely founded. Enemies he may well have made, for he called a spade a spade, and could not suffer a fool gladly; the gentlemen of the Virginia Company at home were roundly trounced in his despatches to them for their foolish desires for non-existent gold, when all that Virginia could give them was fish, tobacco, and a little copper; and why not raise revenue and gain honest profit from fish and tobacco? says he. Rough with the natives he was said to be, but that is the way of the pioneers, and we can see from many passages in his book that Smith was really a most kindly man, and liked the "salvages." We know in our own time how accusations of roughness to "natives" are made against men of the type of Smith by people whose knowledge of foreign lands is derived from books and their own brains, and have never themselves come into personal contact with the less civilised races in their own home. Of his truly scientific quality of observation and deduction Smith's book is eloquent proof; he knew what he was talking about. But that he was tactless and undiplomatic in dealing with his own fellows, however well he may have understood the natives, is equally evident. And the man who knows, but is impatient and tactless in trying to drive others to realise his knowledge for their own good, often sees his work torn from him before he can complete it. This was the case with Smith, who never returned to Virginia after he left it, wounded and discouraged, in 1609. To New England he went, and had much to do with the constitution of the northern colony; but though during the rest of his life he never wearied in strenuous advertisement of the Virginian settlement, he did not re-visit it.

The picture of the people of Wingandacoa which Smith gives us is well known. Powhatan the "mighty emperour" and his werowances or chiefs; Pocahontas his daughter, who saved Smith's life when he was a prisoner and her father would have tortured him to death, that Pocahontas who, after Smith left, married Master Rolfe, came to England, was presented at Court, and died when leaving to re-visit her home; the marvellous incidents of Smith's imprisonment and the discoveries of himself and his men; his descriptions of all these have been known to many generations of lovers of tales of adventure, and have furnished much material to the modern writers of them. Yet to read Smith's own narrative again, with its naïf comments on men and things, its quaint spelling, and its Wegg-like "droppings into poetry," by himself and his friends, mostly very bad and merely inserted "seeing there is thus much Paper here to spare, that you should not be altogether cloyed with Prose"—is always amusing, and in the present year most interesting. So we may thank Messrs. Maclehose for their reprint, which includes, besides the timely "Generall Historie," also Smith's story of his own adventurous life in other lands than America, and his very curious "Sea-Grammar," which may well have supplied Swift with some of the material for his utterly unintelligible description of a storm in Gulliver's "Voyage to Brobdingnag"!

The book is a handsome one, and the paper and type have an air of archaism which well suits the subject. Smith's own maps are reproduced, and the famous portrait of Pocahontas, called "Matoaka alias Rebecca filia potentiss: princ: Powhatani Imp: Virginiae," or "Emperour of Ananoughkomouck, *alias* Virginia," besides the original illustrations of Smith's adventures among the "salvages."

THE LIFE-WORK OF AN EMINENT METEOROLOGIST.

Gesammelte Abhandlungen aus den Gebieten der Meteorologie und des Erdmagnetismus. Von Wilhelm von Bezold in Gemeinschaft mit A. Coym. Herausgegeben vom Verfasser. Pp. viii+448; illustrated. (Brunswick: F. Vieweg and Son, 1906.) Price 14 marks.

PROF. VON BEZOLD'S position as the late head of the Prussian Meteorological Institute suffices to make the publication of his collected works on meteorology and terrestrial magnetism an event of importance. His papers on electricity and physiological optics remain apparently to be dealt with. In preparing the present work for press, he had the assistance of Dr. Coym, formerly of the Meteorological Institute. The collection includes twenty papers; in some, slight alterations have been introduced and some notes have been added.

Only the earliest paper, written in 1864, represents von Bezold as himself an observer. It treats of the phenomena visible after sunset, especially of what von Bezold terms the "Purpurlicht." An appendix refers to recent authorities, and especially to the effect of volcanic ejecta on the richness of the phenomena.

The next three papers deal with the frequency of thunderstorms. It is explained in an appendix, pp. 83–90, that much of von Bezold's writings on this subject seemed of too local interest to reproduce. In the first paper, after dealing with statistics from a number of stations—mostly in central Europe—von Bezold decides in favour of a connection between thunderstorm and sun-spot frequency. His conclusion on p. 59, repeated in the last thunderstorm paper, p. 82, is that thunderstorm and auroral frequency follow opposite courses, thunderstorms being least frequent in years of sun-spot maximum, when auroras are most numerous. This conclusion must be regarded with some reserve.

In the next paper, dealing with sun-spot data from Bavaria and Württemberg, von Bezold considers the evidence favourable to the reality of a twenty-six-day period in thunderstorms. A footnote dated 1905 qualifies this, pointing out that it would be natural to look for the source of a twenty-six-day period in the sun, and as it is probable that the seat of greatest activity in the sun changes its position, the twenty-six-day period will naturally change its phase, and so be recognisable only in statistics covering a comparatively short period. This seems the same position as has been taken up in the case of magnetic storms by Maunder, who, however, finds a period of about 27¼ days. The reality of a period the phase of which alters in an indefinite way is rather a difficult matter to decide.

The third of the thunderstorm papers suggests an extraordinary increase in damage by lightning in Germany. In Bavaria the percentage of (insured) houses struck by lightning was fully six times as great in the decade 1893–1902 as in the decade 1833–1842. Von Bezold appears to accept the increase as proved all over Germany. Other German authorities, it may be added, have expressed some doubts as to the true significance of the insurance statistics; the phenomena may not be purely meteorological.

Papers v.–ix., pp. 91–220, form a group devoted to the thermodynamics of the atmosphere. The elementary portion of air contains moisture which may be wholly gaseous, or partly condensed in raindrops, in snow, or in hail. Also the air element resembles a compartment of a train in that its original occupants may leave it at intermediate stations, whilst new occupants may come in. Change of state in the water contents implies evolution or absorption of heat, and the five papers aim at tracing the various possible modifications and identifying them with the phenomena of cyclones, anticyclones, Föhn winds, and so on. The reader to whom German presents difficulties will find an English translation of the first three papers of the group in Prof. Cleveland Abbe's "The Mechanics of the Earth's Atmosphere"; he must, however, be on his guard against misprints. The present reprint contains some fresh notes, and shows some alterations, *e.g.* on pp. 123 and 125, dealing with cyclonic and anticyclonic phenomena. These thermodynamical papers represent a product which the typical English meteorologist will contentedly deny himself. If, however, the Cambridge mathematical meteorologist ever comes into being, he ought to read these papers as part of his preliminary education. If he reads them critically in the light of recent meteorological knowledge he will—whether he agrees wholly with the author or not—have done a good deal to qualify himself for profitable research in the dynamics of the atmosphere.

Papers x.–xv. are also in the main theoretical, but they contain information from balloon ascents as to temperature and moisture in cyclonic and anticyclonic weather at different seasons of the year. Paper xvi. gives statistics from various sources as to the mean annual values of temperature, pressure, rainfall, and cloud round parallels of the earth. To obtain zones of equal area, the author takes as parameter the *sine* of the latitude. This paper leads naturally to xvii., the first of four papers, pp. 371–448, devoted to terrestrial magnetism, in which von Bezold considers what he calls the "isanomalies" of the magnetic potential, *i.e.* the departures from the mean value round a parallel of latitude. Paper xviii. deals with what the author calls the *normal* earth's magnetism. Paper xix. treats of the foundations of the Gaussian theory as based on the vanishing of line integrals taken round areas on the earth's surface, and discusses the diurnal variation, in the light of Prof. Schuster's variation potential, and its representation by vector diagrams.

The final paper advocates the taking of magnetic observations round a parallel of latitude, which von Bezold suggests might pass through the south of England. To a magnetician familiar with the Gaussian analysis and with Schuster's work on the diurnal variation, von Bezold's contributions to the subject will appear to be rather a matter of definitions and identifications than of original ideas. To those, however, who have a difficulty in grasping the physical significance of abstruse mathematics, they may serve a useful purpose, provided it be clearly

understood that anything like a complete treatment of the diurnal variation requires a careful study of the influence of the season of the year as well as the relation to sun-spot frequency. The proposal advocated by von Bezold and others to effect a line integration round a parallel of latitude ought before its adoption to receive careful consideration from the side of atmospheric electricity. It should be remembered that the earth-air currents required to invalidate the hypothesis embodied in the Gaussian potential are not transient currents varying with the hour of the day or with the weather—such currents could only modify the magnetic diurnal inequality or cause irregular disturbances—but currents of practically constant value and direction over large areas.

Since the above was written, science has had to mourn the death of the distinguished author, Prof. von Bezold, a fact already announced to the readers of NATURE (February 21, p. 397).

CHARLES CHREE.

THE COLLOIDAL THEORY OF DYEING.

The Chemistry and Physics of Dyeing. By W. P. Dreaper. Pp. viii+315; illustrated. (London: J. and A. Churchill, 1906.) Price 10*s.* 6*d.* net.

WHEN it is remembered that dyeing has become a highly scientific process, it is somewhat strange to note what a small part theoretical considerations have played in the practical development of the art, a fact no doubt largely due to the lack of definite knowledge of the chemical constitution of textile fibres. Most manuals of dyeing have been written for practical ends, and have devoted small space to the consideration of the various theories of dyeing which have been put forward, since, as before remarked, these have helped but little in the practical solution of dye-house problems. Our knowledge of the nature of fibres has, however, now reached a point when it is undoubtedly of value that the scientific dyer should make himself acquainted with this side of his subject, and recent work on the nature and properties of colloids certainly appears to throw much new light on the intricate nature of dyeing processes.

It has, of course, long been known that one and the same kind of fibre acts differently towards various dyes, and that dyestuffs may be classified into groups on the basis of this differentiation. To a considerable extent this grouping is found to correspond with fundamental similarities in the chemical constitution of the dyes, and this broad fact has lent strong support to the chemical theory of dyeing.

The older theories of dyeing could be broadly classified into two groups, those assuming a chemical reaction between fibre and dye, and those in which dyeing phenomena are explained by the physical properties of the reacting bodies. To a great extent these theories are antagonistic, and yet upholders of each are able to put forward incontrovertible facts in their support. It is, however, far from satisfactory to have to assume that similar phenomena can be explained in one case by a certain theory and in a second by an opposite theory, and the time is ripe for a wider view which shall embrace and reconcile all well-established facts concerned with dyeing processes. How far the colloidal theory of dyeing is successful in doing this may be gathered from a perusal of the book under review. Much of the experimental work mentioned lacks precision, and the various researches are somewhat detached, but the present knowledge of colloidal conditions and functions, incomplete as it is, throws much light on earlier work, and from further work in this direction a satisfactory explanation of dyeing processes may eventually emerge. In the past many difficulties, in regard to dyeing theory as in other directions, have arisen from an attempt to draw a hard and fast line between chemical and physical action, and the blending of the two may be considered as the characteristic feature of the reactions of colloids.

The book is arranged in twelve chapters, of which the first is devoted to a historical introduction, which might with advantage have been considerably extended. The properties and reactions of fibres, dyes, mordants, and assistants are dealt with in chapters ii.–v. Chapter vi. contains an excellent summary of the recent work on the properties of colloids. Chapter vii. gives facts in support of the old mechanical theory of dyeing which reached its final development in the solid solution theory of van 't Hoff and Arrhenius, which was applied to dyeing processes by O. N. Witt. Chapters viii. and ix. give a similar summary of facts supporting the chemical theory of dyeing. Then follows in chapter x. an attempt to show the application of the colloidal theory, and in this the incompleteness of the evidence becomes apparent, though as a suggestive contribution it is very interesting. A chapter on the action of light on dyeing operations and dyed fabrics appears to have little connection with the central theme of the work.

The many inaccuracies in the book lay it open to a good deal of minor criticism. For example, on p. 14 several of the formulæ are altogether inexplicable. On p. 33 it is stated that Bancroft divided dyes into *subjective* and adjective, the term used by Bancroft being *substantive*. A fair summary of the work of various investigators is usually given in the text, but it is often difficult to ascertain at what point the summary ends and the author's comments begin. There is thus some danger of injustice to one or other. Since both centigrade and Fahrenheit thermometric scales are used in the book, some confusion arises in the frequent cases where a temperature figure is given without indicating which scale it refers to. Amongst mis-spelt authors' names may be mentioned Verquin for Verguin, Pokorng for Pokorny (several times), Prager for Perger, Brand for Brandt, Boettinger for Böttiger, and Hirst for Hurst.

The general plan of the book is excellent, and the author's work, though somewhat unequal, is on the whole very satisfactory. The production of such a book would have been impossible a few years ago, and it marks a distinct advance in the linking up of one of the most ancient arts with modern scientific

theory, and shows a common ground where the practical dyer, the chemist, and the physicist may meet. Its study will well repay all students of dyeing and those practically engaged in the textile trades who have been able to keep in any way abreast with recent work. WALTER M. GARDNER.

THE WAYS OF WILDFOWL.

Practical Wildfowling. A Complete Guide to the Art of the Fowler, with Descriptions of the Various Birds usually met with. By W. J. Fallon. Second edition, revised and greatly enlarged. Pp. 248; illustrated. (London: L. Upcott Gill; New York: Chas. Scribner's Sons, 1907.) Price 6*s*.

THE new edition of Mr. Fallon's useful little handbook of practical wildfowling has been brought up to date, and a considerable amount of new matter and many new illustrations have been added. Thoroughly to enjoy his sport the wildfowler must be a good field naturalist, and this little work aims, *inter alia*, at making easy the identification of those species of birds he is most likely to meet with. The enjoyment of wildfowling lies not only in killing, but in seeking to kill by pitting one's endeavours and skill against the cunning and wariness of the fowl. Unlike pheasants and partridges, they cannot be brought over the guns. Herein lies the essence of the sport, and hence the absolute necessity of understanding the life-habits and peculiarities of the various kinds of wildfowl.

With the first part of this excellent manual, which deals fully with the guns, boats, ammunition, and other outfit and accessories necessary for the pursuit, we are not immediately concerned, but pass on to the chapters on the art of wildfowling, for therein much may be learned about the habits of some of the shyest of birds. To be a successful wildfowler, a man must have an intimate knowledge of the birds' ways and behaviour under the varying conditions of time, tide, and weather. He must also be able to identify the fowl, not only when in hand, but when at a distance. His skill in handling the gun will avail him little if he cannot distinguish a jack snipe from a sandpiper, curlews from gulls, or ducks from divers, for all these and others must be attacked with a different strategy. To know birds, when at a little distance, by some peculiarity of motion, shape, or flight, is a great part of the fowler's craft, for the tactics adopted to secure one kind of duck may be quite inadequate in the case of some other species of this family. He must be familiar, too, with the food and the feeding-ground of the various ducks, geese, and shore birds in order to know where they may be found, and at what time of the day or night.

Naturalists, indeed, are indebted to the wildfowler for much that they have been able to record as to the habits of various wildfowl; and as Mr. Fallon essays, and very successfully, to instruct the tyro in all these things, his book appeals strongly to the field naturalist. In this part of the book the subject is treated under the heads of wild swans, wild geese, wild ducks, and shore birds, and the plan adopted is to describe each species of these groups likely (or even possible, for the rare kinds which *may* turn up any day are included) to be met with, and then to deal with the various methods of approaching and shooting them.

The identification of the different species is rendered more easy by the introduction of some very life-like figures, while in reading about the way to get at them we find ourselves learning a good deal about their individual peculiarities. In going through the book we come upon many good notes and original observations on the food and feeding habits of geese, ducks, and shore birds, and would instance the interesting remarks on the grain-feeding habits of the pink-footed goose. Many another out-of-the-way scrap of natural history, too, can be gleaned; for example, the curious habit of sheldrakes choosing as a nesting site the straw stacks which are placed in the fields as shelter for the cattle in some marshy districts. If we were disposed to be critical, we might suggest that the curlew sandpiper should not be described as of similar plumage to the dunlin, and that the white patch on the lower part of the back, so conspicuous when the former bird is flying, is a mark distinguishing the two species. Also that it is not up to date to say that a clutch of knot's eggs does not exist in any collection; not that this matters to the wildfowler. There have been many books written on wildfowling since the days of Hawker, but it is doubtful whether any of them give so much information in so small a compass as this little handbook. There is a good index, and we cannot withhold a word of especial praise from the delightful picture with a heron in the foreground.

O. V. APLIN.

OUR BOOK SHELF.

Hypnotism and Suggestion. By Edwin Ash. Pp. 134. (London: J. Jacobs, 1906.) Price 4*s*. net.

IN the preface the author tells the reader that the objects he had in view in writing this book were to explain the technique of experimental hypnotism and suggestive therapeutics, and at the same time to endeavour to divest the subject of the air of mystery with which it is popularly invested. In an introductory chapter he briefly alludes to certain general questions connected with hypnotism. He considers that telepathy is at present "non-proven," and, further, he does not believe in a "magnetic force" for curative purposes.

The author carefully describes the methods employed in the production of hypnosis, and the earlier and later phenomena to be observed when this condition is brought about. He discusses the various stages of hypnosis, and points out the difficulties of arranging an accurate classification. In considering the use of hypnosis for surgical anæsthesia, he recognises its limitations, and although he fully realises its value, nevertheless, from the practical standpoint, the difficulty of producing it rapidly and deeply is a serious objection in the way of bringing it into general use. Post-hypnotic influence forms the subject-matter of another chapter, and its possible relationship to criminal acts is referred to. Dr. Ash agrees with many observers that

suggestions which are incompatible with the moral sense of the subject are in most cases at once rejected. Nevertheless, it must be admitted that if it is possible by means of hypnosis to suggest crime to a person whose moral sense is defective, then this is a factor which might become of vast importance if hypnotic suggestion ever became a remedy of general use.

The author gives an interesting chapter on "suggestive therapeutics," and in it he shows the power of suggestion of one mind upon another, and even in the same person the influence of the conscious mind upon the subconscious. He believes that Christian science is largely a system of auto-suggestion.

Dr. Ash strongly urges that there should be introduced into the medical curriculum a compulsory course of psychology and lectures on the principles of "suggestive therapeutics." We cordially agree with the former recommendation, for it is lamentable to find the ignorance that still exists regarding the normal mind, and some knowledge of this subject is a matter of growing importance, both from the evolutionary and dissolutionary standpoints.

For those who wish to learn some of the practical points regarding hypnosis and suggestion, Dr. Ash's book will be found most helpful, for although it is small it contains much information.

Domaine de Tervueren—Arboretum—Types de Forêts des Régions tempérées représentés dans leur Composition caractéristique. By Ch. Bommer. Pp. 211. (Brussels: Imprimerie F. and L. Terneu, 1905.)

THE site of the above arboretum was generously given by the King of the Belgians to the people. At the time of the gift His Majesty expressed the opinion that it was very useful, not to say indispensable, to create or to preserve open spaces with natural decoration near large towns, both from an æsthetic and hygienic point of view. M. Ch. Bommer was entrusted with the task of laying out the arboretum, and this he has evidently done in a scientific and practical manner. The various plots or groups have been formed to illustrate the principal types of vegetation in the temperate zone of the old and new worlds. Even the bushes and herbaceous plants characteristic of these zones have been added to complete the picture, thus very clearly illustrating the characteristics of the various species and their geographical distribution. The arboretum also forms an excellent centre for testing the acclimatisation of exotic trees. We have also in the above book a detailed account of the individual species which includes synonyms, size, habit, general characteristics, and uses of wood, &c. Numerous photographic plates are included illustrating various groups and points of general interest. Plans of the arboretum and maps showing the geographical distribution of the species are given at the end of this very useful and interesting book.

Elementary Science for Pupil Teachers. Physics Section by W. T. Clough. Chemistry Section by A. E. Dunstan. Pp. vi+183. (London: Methuen and Co., 1907.) Price 2*s*.

PUPIL teachers who have opportunities of doing practical work will, if they perform the experiments in this book and follow the guidance it gives, obtain sound preliminary ideas of physics and chemistry. The physics section comprises the measurement of lengths, areas, volumes, and masses, simple hydrostatics, and an introduction to the study of heat. The chemistry section covers the subjects arising from a careful study of air, water, and other common substances. The volume is on the whole attractive, but the smaller of the two types is likely to try the eyes of readers.

A First Geometry. By W. M. Baker and A. A. Bourne. Pp. viii+128+vi. (London: George Bell and Sons, 1907.) Price 1*s*. 6*d*.

WITH the exception of a dozen theorems at the end, this book is a simple course of experimental geometry designed to familiarise young pupils with fundamental geometrical conceptions by setting them to draw with mathematical instruments and to construct simple models for measuring angles and constructing plans. The lessons are interesting, and arranged in a manner that shows the authors to be well acquainted with the needs and capabilities of beginners.

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.*]

Radium and Geology.

PROF. JOLY'S interesting discovery (NATURE, May 2, p. 8) that typical rocks in the Simplon Tunnel contain quantities of radium considerably in excess of the average of igneous rocks raises a question. From Mr. Strutt's investigations it appears that the average content of igneous rocks would be sufficient to account for the ordinary temperature gradient in the earth's crust were it due to radium. It seems, therefore, that, if the temperature was so caused, the gradient in the Simplon Tunnel ought to have been higher than the average, viz. 1° F. for between 50 feet and 60 feet. But, in fact, as beneath other mountains, it was considerably lower. In NATURE, October 27, 1904, it is stated that the temperature of the rocks in the advanced gallery was 108° F. where the cover was 7005 feet. This gives 1° F. for 92 feet. In the St. Gothard Tunnel it was 1° F. for 102 feet, and in the Mt. Cenis Tunnel 1° F. for 100 feet. That the gradient in the Simplon Tunnel, though low, was somewhat higher than in the other two was probably caused by the spring 23° hotter than the rock, which brought up heat from a lower level. I think I have shown in my "Physics of the Earth's Crust," chapter xvi., that these low gradients can but very slightly be attributed to the convexity of the surface.

Is not, therefore, the result of Prof. Joly's examination of the Simplon rocks rather unfavourable than otherwise to the hypothesis that the heat of the earth's crust is due to radium? O. FISHER.

Graveley, Huntingdon, May 4.

Ethnological Notes on the Aboriginal Tribes of New South Wales and Victoria.

A REVIEW of the above work appeared in NATURE of May 31, 1906 (vol. lxxiv., p. 100), to which I wish to reply briefly. The review opens by saying that my works "have either been ignored or dismissed in a footnote by experts such as Dr. Howitt and Prof. Spencer." Whilst the reviewer was quite aware of the obscure "footnote," he was quite silent regarding my reply to it, dated June 27, 1905.[1] The opinions of the two men named do not perturb me, but when such an injurious statement appears in the "thunderer" of scientific journalism, I crave fair play and the right of reply.

[1] The Queensland Geographical Journal, vol. xx., pp. 73-75.

For nearly forty years I have practised as a land surveyor in Australia, and through my professional duties I have been much in contact with the aborigines over all the eastern half of this continent. In my youth I became fascinated with the study of local ethnology, and my enthusiasm has never flagged since, so that I can claim to be no tyro in the science. Having had exceptional opportunities of studying my subject on the spot, I claim a little consideration. More than one hundred of my contributions have already been published by various scientific societies in Australia, England, France, Prussia, Austria, and the United States, so that my work has met with some appreciation. I mention these few facts about myself, not egotistically, but as *bona fides*, because Australia is so far removed from the centre of scientific civilisation that a quiet worker is apt to be overlooked unless he presents his credentials.

Now, as regards the "ignoring" referred to by the reviewer. Dr. Howitt does not mention me in his book published in 1904, but he reports, at p. 92, the names Kulpuru and Tiniwa as phratries of the Yantrawanta tribe. He omits to say, in fine he "ignores," that I reported these same phratry names in 1899,[1] and again in 1900.[2] At p. 138 he says that "Tiniwa is the same as Kararu and Kulpuru as Matteri," but he "ignores" that I reported this self-same equivalence in 1900.[3] At p. 107 he stumbled across the word Mukulu (my muggulu), which he mistook for a phratry name instead of a blood division, a thing he had apparently never heard of. At p. 211, in speaking of the Wiradjuri sociology, he says that Ippai can marry Matha as well as Kubbitha, but he "ignores" my report to the same effect in 1896, eight years before.[4]

Then again, in his account of the Dora ceremony (my Toara or Doara), at pp. 599–606, Dr. Howitt "ignores" that I described that rite in January, 1900.[5] If he did not avail himself of my work, which appeared four years earlier than his, then there is a wondrous agreement in our details.

And yet again, Dr. Howitt at p. 44 gives a sketch-map showing the habitat of certain tribes in South Australia, but he "ignores" that I published substantially the *same* map in 1900,[6] four years earlier. In comparing the two maps and the explanatory letterpress accompanying mine we observe a marvellous coincidence. Many other examples could be cited, but exigencies of space force us to pass them over for the present.

I do not particularly object to all the above instances of "ignoring," because they have the effect of confirming the accuracy of my earlier reports; my objection applies to the damaging way in which reference is made to them in NATURE.

Regarding Prof. Spencer's "footnote," I refer your readers to my reply thereto in the Queensland Geographical Journal, vol. xx., pp. 73–5. No doubt he was very much cut to find that I had forestalled him by describing the eight sections of the Wombaia (his Umbaia) tribe in 1898;[7] that I had dealt with the Binbingha sociology in 1899;[8] and that I had reported the sociology of the Chingalee in 1900,[9] with a comprehensive map showing the location of these and other tribes. The publication in 1901 of my "Ethnological Notes on the Aboriginal Tribes of the Northern Territory"[10] probably increased his irritation and disappointment.

Fault is found in the review with my statement that nothing important has been added to our knowledge of the Kamilaroi organisation since the time of Ridley and Bridgeman. I beg to repeat that Ridley showed that Ippai married Kubbitha or Ippatha, and that there were totems with female descent. He also gave many illustrations of the intermarriages of the four divisions. Bridgeman stated that certain pairs of sections had a phratry name as well. I am still of opinion that nothing new or important had since been added by anyone until I reported the Blood and Shade divisions. The reviewer mentions Dr. Howitt's book, but his work is merely confirmatory of the previous reports of Ridley and Bridgeman.

It is stated in the review that Mrs. Langloh Parker's phratry names are identical with my Blood divisions; such is not the case, because she mistook the names of the Blood divisions for the phratries. I have known the Yuăleai (Mrs. Parker's Euahlayi) tribe for many years, and have been through most of their country. When publishing a grammar and vocabulary of their language in 1902[1] I stated that their social organisation and initiation ceremonies are the same as those of the Kamilaroi, thus anticipating much of Mrs. Parker's book, which did not appear until 1905.

Much more could be added, but it is thought that enough instances have been given to show that in original research among the Australian blacks I have often been first in the field; that probably my published results have been used and "ignored" by others; and, above all, that my work will stand the most rigorous criticism.

I have explained to the editor of NATURE the cause of the delay in my replying to the review in question.

R. H. MATHEWS.

IF I have done Mr. Mathews an injustice in my notice of his book, I can only express my regret for it and offer such reparation as a statement of my present view of the matter may make.

In directing attention to the fact that Mr. Mathews is ignored by Dr. Howitt and Prof. Baldwin Spencer, I merely stated a fact; if I had seen his reply I would have mentioned it. As to the reason why he is ignored I know nothing; a closer examination of Mr. Mathews's contributions than I had at the time of writing the notice been able to make leads me to think much better of his work; his readiness to acknowledge and withdraw his errors is worthy of the highest praise; and if his work is ignored solely on the ground that it is untrustworthy, it seems to me that this readiness is a sufficient reply to his critics. If there are further reasons, it is for Mr. Mathews's fellow-workers in Australia to state what they are. I personally have never heard of any further reason, and it seems to me that we in England are entitled to have one, if one exists. I may add that in my recent work, "Kinship and Marriage in Australia," I quoted Mr. Mathews as freely as any other author; at the same time, I have expressed dissent from some of his inferences.

Mr. Mathews makes good in the foregoing remarks his claim to priority on many points. His discovery of the "blood" divisions, of which Dr. Howitt knows nothing, seems to me especially important. In order to realise exactly what the situation is, we need a complete genealogy of a tribe for several generations back, showing both phratry, class, blood, and totem names of each individual. If Mr. Mathews can provide this material we shall owe him much; failing that, I hope it may be possible for some trained anthropologist, familiar with the modern genealogical method, to investigate the matter. I may add that Mr. Mathews has invited me to verify in person all the statements in his works which he bases on his own observations; this in reply to the review which called forth the above protest is surely a guarantee of good faith. I much regret that no money is forthcoming in England for anthropological work; if the financial part of the business could be settled, I would gladly accept Mr. Mathews's offer.

Nothing was further from my mind than to hurt Mr. Mathews's feelings, and if my notice was somewhat sharp in tone, I must plead in excuse the somewhat emphatic self-assertion of the passages I quoted. I hope that any future criticisms of mine will be such as to call for no protest on Mr. Mathews's part.

NORTHCOTE W. THOMAS.

1 Journ. Roy. Soc. N.S.Wales, xxxiii., 108; Proc. Amer. Philos. Soc., Philadelphia, xxxviii., 79.
2 Proc. Amer. Philos. Soc., xxxix., 83.
3 *Op. cit.*, p. 84.
4 American Anthropologist, ix. (1896), 413; Journ. Roy. Soc. N.S. Wales, xxxi., 173–174.
5 American Anthropologist (1900), ii., New Series, 139–144.
6 Proc. Amer. Philos. Soc., xxxix., 90–93.
7 Journ. Roy. Soc. N.S.Wales, xxii., 75; Proc. Amer. Philos. Soc., xxxvii., 152.
8 Proc. Amer. Philos. Soc., xxxviii., 77.
9 American Anthropologist, ii., New Series, 495, with map.
10 Queensland Geographical Journal (1901), xvi., 69–90.

1 Journ. Roy. S c. N.S.Wales, xxxvi., pp. 137–190.

FRENCH EXPERIMENTS ON RIVETING.[1]

A STUDY of the most elementary form of connection used by the engineer may not appear to offer anything in the way of novelty or scientific value, as a contrivance at once so old and so simple as a rivet seems at first sight not likely to afford much scope for an investigation considered as a unit apart. Indeed, the chief interest has rather been in the grouping and arrangement of rivets, and the analysis of their behaviour under stress when assembled in the various joints and connections used by engineers in boilers, bridges, and the like. In the present instance the author, keeping strictly to the simpler problem, has produced a memoir of great interest.

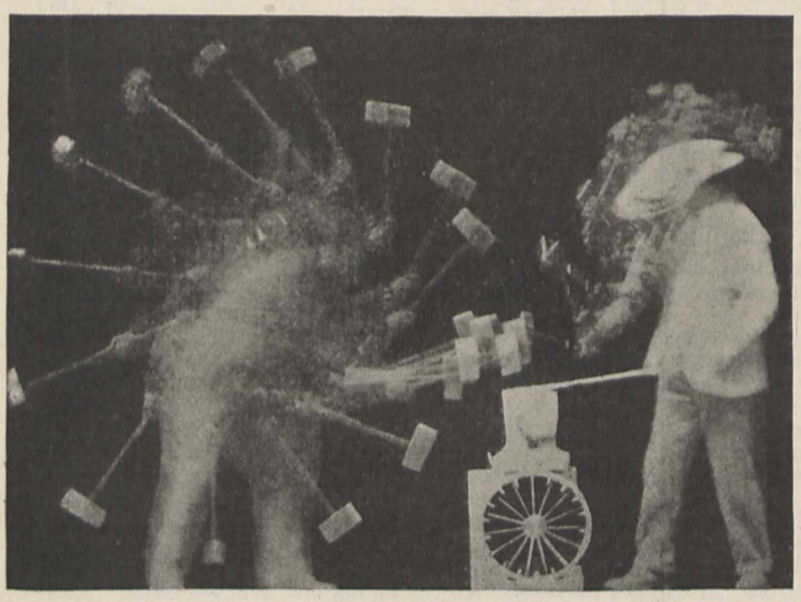

FIG. 1.—Composite photograph of a smith and striker for one swing of the hammer.

In the early pages the ordinary processes of hand riveting are described, and a series of measurements and photographs, after the manner of Marey, shows in an interesting way that the well-known preference of the striker for the full swing of the hammer for long-continued effort as compared with the short swing and greater number of blows is an instinctive solution of the problem of obtaining the maximum effect for the effort exerted.

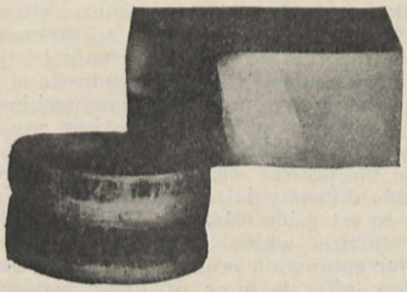

FIG. 2.—Punching from a thick plate.

The section following traces the growth of riveting machinery, and describes the characteristic effects produced when steam, air, or water is employed as the working fluid. Specimens of riveting obtained from various types of machines are noteworthy as showing that the shank of the rivet does not, as a rule, bear against the plates, and that eccentricity in the rivet head is common even in the most favourable circumstances. The essential difference between riveting by hand and that produced by a riveting machine is made clear by photographs of sections of rivets at different stages of their formation, the surfaces being prepared by polishing and etching in the usual way. The superficial effect of a blow, as compared with the squeeze of the pressure machine, is apparent in all the illustrations shown in the memoir.

The interesting question of the pressure required to produce the head of a rivet is taken up, and the various circumstances which influence this are the subject of much experimental study. These include the influence of temperature, the chilling of the metal by the die, the influence of the time in which the head is formed, and the effect of an excess of material in the shank, whereby waste material is squeezed up and forms a ring round the rivet head proper.

In addition, the diagrams drawn by the recording gear give precise information as to the work done on the rivet when the time of formation of the rivet-head is varied; they also show the effect of the cooling in drawing the plates together.

A detailed examination of the strength of the rivet gives special attention to the behaviour of the head and the way it ruptures under stress, and as a result a form of head is recommended having a radius of 0.86 the diameter of the rivet and a height of two-thirds the diameter.

The author, all through, has made great use of photographs of sections of pieces of material, but without magnification, and it seems possible that this side of the investigation would have yielded still more interesting results if it had included a detailed examination of the sections under the microscope.

As an instance of this, the accompanying figure shows the well-known form of punching produced from a thick plate, in which the characteristic sharp edge appears near the middle of the depth. Sections of such punchings would be well worth examining under the microscope, and, in fact, the possibilities of further research, with the microscope pressed into service, seem well worth consideration.

E. G. C.

[1] "Etude expérimentale du Rivetage." By Ch. Frémont. Pp. 142; 183 figures in text. (Paris: Society for the Encouragement of National Industry, Rue de Rennes, 1906.)

BIG GAME PRESERVATION.

A BLUE-BOOK containing correspondence relating to the preservation of wild animals in Africa was issued at the close of 1906, and sets forth ten years' official work in the British Empire, and in the dominions of other European nations in Africa, for the preservation of wild animals.

The Blue-book is not a satisfactory example of careful printing. It is extraordinary that before being issued, apparently from the Colonial Office, the proofs should not have been submitted to a zoologist for revision and correction. The names, in

Latin and in the vernacular, of beasts and birds are constantly disfigured by printers' errors of a childish description.

So far back as 1890 a movement began in Great Britain in favour of preserving wild life in lands under British control rather than allowing it to be exterminated by ruthless shooters. To some extent this movement was inspired from the United States. The creation of the National Park of the Yellowstone district, which was to lead to the formation of a "paradise" for the nearly extinct bison, bears, prongbuck, deer, and wolves of central North America, suggested to several sportsmen-naturalists of Great Britain similar preserves in tropical lands, especially in Africa. Of course, long antecedent to that, British naturalists had at last induced the State to legislate for the preservation of the scanty remains of the British fauna, and although our measures in this respect are still woefully inadequate, and a limited and old-fashioned class is allowed to push certain forms of sport at the expense of the wild fauna of these islands, still we have saved much; and in some districts of Great Britain birds and the smaller mammals really form constant and charming features in the landscape.

The great invasion of Africa, however, which began in earnest in 1890, directed public attention to the coincident slaughter of big game which everywhere accompanied the pioneering parties of the British. Just as Great Britain had been the greatest sinner in the slave trade, and was consequently the greatest and most enthusiastic among abolitionist nations, so her people, having gone far beyond any other nationality in the destruction of wild beasts and birds, are now foremost (though the United States is running almost neck and neck) in the world-movement for the preservation from extinction of all but the most harmful animals. We are rapidly appreciating the principle that just as "man does not live by bread alone," so we cannot be contented æsthetically with beef, mutton, poultry and pheasants, with cereals, tubers and cabbages, but that to complete the interest of our lives we must have beautiful wild things around us to admire and study; there must be a niche in our society for the rhinoceros, the lion, the tiger, and even the wolf. The hippopotamus and the walrus cannot be allowed to die out completely, still less the elephant. With improved methods of travel and rapid sea transit, we want to be able to contemplate birds of paradise, alive and well, in their New Guinea setting, and not see them in women's hats. A flock of flamingoes should be looked upon as a commercial asset of real value in Mediterranean lagoons or on West Indian beaches.

The leaders of this movement in Great Britain were mostly of the "converted-burglar" type—men like Selous, E. N. Buxton, Alfred Sharpe, and Lord Delamere—who, having had glorious sport with the rifle and killed specimens of all the great or rare beasts of Africa from north to south, had gradually transferred their interest from the mere passion of pursuing and killing to the contemplation of life-habits, to the study of the living animal. Photography—especially with the telephotographic lens—was a potent agent in their reformation. Mr. E. N. Buxton especially has grown to grace, and led others with him up the pilgrims' way, through the new sport of snapshotting. An unconscious disciple of Mr. Buxton's has been Herr Schillings, whose beautiful study of wild life in East Africa ("With Flashlight and Rifle") has done much to advance the cause of game preservation in those regions. A very great share, however, in this important movement has been taken—perhaps unknown to the author himself—by Mr. J. G. Millais His book, "A Breath from the Veldt," published in 1895, was an epoch-making work. Many date their conversion to the new gospel from the days in which they first studied Mr. Millais's work. Though a sportsman of the truest type (and sport in this sense means far more than mere accurate shooting with rifle or gun), Mr. Millais realised himself, and taught those who gazed at his pictures, that it was far more profitable to our enjoyment and education to *watch living creatures alive* and study their habits with accuracy than to kill them and stuff their dead bodies.

How far the official world is in earnest about big-game preservation—in our own or any other Governments—it is difficult to say, there being so much humbug about the attitude of all Governments towards questions of art, science, and morals. Officialdom, as represented by Ministers that come and go, has taken a certain amount of tepid interest in the preservation of the African fauna. Some of the permanent officials (as distinguished from the parliamentary), like Sir Clement Hill, have displayed a praiseworthy persistency in pressing this matter on the attention of Secretaries of State, Governors of Colonies, and Commissioners of Protectorates. Sir John Kirk and the late Herr von Wissmann worked hard in the same direction. Sir Charles Eliot during his Commissionership in East Africa gave practical effect to regulations which had sometimes fallen into abeyance; the writer of this review (together with Sir Alfred Sharpe) between the years 1892 and 1901 created a number of game reserves in British Central-, British East Africa, and Uganda, the reserves ranging from an area of thirty to several thousand square miles in extent.

The policy of "game reserves" has been called much into question at different times by settlers and tourists. Settlers in regions adjoining these reserves complain that the wild game harbours the tsetse-fly, or that lions and leopards stray from the area of the reserve and become dangerous to the inhabited regions outside. Tourists, especially those who are naturalists and judicious sportsmen, complain that the "game reserve" (at any rate in Somaliland and parts of the Sudan) simply becomes a "game *preserve*" for the military officers on duty in those regions. On the other hand, if there is no special "national park," "paradise," or region set apart for the unfettered existence of wild beasts and birds, then, as Africa becomes opened up, an almost complete destruction of wild life ensues. Regulations may be framed and printed, but to attempt rigidly to enforce them is to incur constant friction, and even serious trouble, with Europeans and natives, both of whom are more or less reckless about "shooting for the pot" or destroying any creature that may threaten their crops or livestock. It has seemed to the present writer that the only real solution of this difficulty is to create and enforce game reserves—to set aside relatively large areas here and there in Africa which are not particularly well adapted for cultivation or settlement, but which may nevertheless offer features of great picturesqueness or interest, and thus become national parks where live creatures of every description are allowed to lead an unfettered life. But, naturally, in creating these game reserves the writer has not intended that their sanctity should be infringed by anyone with a gun—official or non-official. Many specially protected beasts or specially reserved areas are relieved of protection when a very distinguished or influential applicant applies for exemption from the regulations. The present writer would have the sanctity of these reserves rigidly adhered to; on the other hand, he would not attempt to enforce too drastically the preservation of game in the settled districts *outside* the

reserves, though he would do everything in his power to discourage the needless killing of any beast, bird, reptile, or even insect that was not markedly harmful to the interests of man. Creatures of extraordinary beauty or interest, like the tiger, lion, moose, or elephant, should be allowed considerable latitude, and the State should compensate the cultivator or the passing tourist for annoyance because of the general interest felt by the community in the splendid development of these remarkable mammals.

The writer of this review deeply regrets that no efficient steps have been taken to create on a small scale national parks within the limits of Great Britain and Ireland for the preservation of wild life under wild conditions. He pointed out several years ago how admirably adapted for such a purpose is Achill Island, off the west coast of Ireland, a place which is fortunately still a refuge for many of the rarer and more interesting British birds.

H. H. JOHNSTON.

THE INTERNATIONAL UNION FOR CO-OPERATION IN SOLAR RESEARCH.

A MEETING of the International Union for Co-operation in Solar Research will be held in Meudon, near Paris, during Whit-week, and a provisional programme of the proceedings has been sent to those who have accepted invitations to attend. The meeting will open on May 20, when formal business will be transacted in the morning. In the afternoon it is intended that all new proposals for joint work shall be submitted to the meeting, so that members will have an opportunity of privately discussing the desirability of adopting the proposals before a final decision is taken towards the end of the week.

The mornings of Tuesday and Wednesday, May 21 and 22, will be spent in receiving the reports of the committees appointed at the Oxford meeting in 1905. It is understood that Prof. Pérot is ready to submit his measurements of the wave-length of the red cadmium line, and that his results are in such good agreement with those previously obtained by Michelson that the meeting probably will be able to adopt finally a primary standard of wave-length. Other reports deal with the observations of sun-spot spectra and the organisation of the systematic application of the spectroheliograph to solar work. A question of interest to which several members of the union have given considerable attention consists in fixing the best methods of measuring the areas of flocculi. This matter has been under consideration at some of the American observatories, as well as at the Solar Physics Observatory at South Kensington and at the University Observatory, Oxford, so that an interesting and fruit-bearing discussion may be expected. On Tuesday evening, Dr. Janssen, the president of the congress, will give a banquet to the members at the Hôtel d'Orsay, in Paris, and on Wednesday afternoon Prof. Julius will demonstrate in the physical laboratories of the Sorbonne some of his experiments on anomalous dispersion. Arrangements have also been made to visit the Observatory of Paris in the same afternoon.

It is hoped that the scientific work of the meeting will be concluded on Thursday, May 23, and an excursion to the Château de Chantilly has been arranged for the Friday. A formal business meeting on Saturday, May 25, will bring the meeting to a close.

UNIVERSITY NEEDS AND THE DUTY OF THE STATE.

THE Chancellor and Vice-Chancellor of Oxford University have just appealed through the medium of the Press for at least 250,000*l.* to enable our oldest university to meet the demands that are made upon it by the ever-expanding requirements of modern learning. This appeal, coming so soon after a similar plea for a million and a half pounds, put forward recently by the Duke of Devonshire on behalf of the University of Cambridge, again brings into prominence the general question of the place of the university in the modern State and the duty of a Government in relation to the financial needs of institutions of higher learning.

In both cases appeals are made to the generosity of the wealthy public, and there is no suggestion that any responsibility attaches to the Government for the comparative poverty of these universities, in which Englishmen profess to feel great pride. The Oxford Chancellor and Vice-Chancellor, indeed, say of the needs of their university:—"In this country it is of no avail to look to the State for the satisfaction of those requirements; and it is to private generosity that the appeal must in consequence be made." It will be instructive to examine this attitude of mind towards one of the gravest questions confronting the nation at the beginning of the twentieth century, to analyse the appeals made in the light of recent experience, and to compare the results obtained with the experiences of university authorities in other great countries of the world.

In February last, in his letter to the public asking for a million and a half pounds for the University of Cambridge, the Duke of Devonshire reviewed the bequests, benefactions, and gifts received by the university since 1899, when the Cambridge University Association was formed at Devonshire House to promote the re-endowment of Cambridge University. From the sums received from our men of wealth the association was able to transfer to the university a total amount of 115,000*l.* In other words, during the seven years in which private generosity was being trusted to provide adequate means for the multifarious demands of a great university, an annual sum of about 16,430*l.* was forthcoming. That is to say, if private generosity could be trusted to display itself equally lavishly throughout so long a period, it would take more than ninety years to collect the million and a half pounds in which the University of Cambridge stands in pressing need to-day.

Similar particulars of a precise kind are not forthcoming in the case of Oxford, but it is, fortunately, possible to form some idea of the demands which are to be made upon private generosity to meet existing needs as enumerated by persons in authority in the university. The present appeal is for 250,000*l.*, and the letter signed by the Chancellor and Vice-Chancellor states two significant facts in connection with it. First, the ordinary university accounts for 1905 showed a balance of 5*l.* 17*s.* 6*d.*, and in 1906 there was "a further improvement, but the increased revenue is already allocated or pledged, and it is obvious that little more can be done in this way." Secondly, the constituent colleges contribute annually to university and academic purposes some 40,000*l.* An article was published in NATURE on July 6, 1905 (vol. lxxii. p. 231), in which a detailed account was given of the needs of Oxford University, drawn up by the professors and heads of departments, and in the article an estimate was made of the capital outlay and the annual income required to meet the needs

enumerated. The scheme outlined on that occasion was of a more ambitious character than the present, and involved an expenditure of more than half a million pounds; and for its effective execution an annual income of about 93,000*l.* was demanded. It seems clear, therefore, that in order to establish the University of Oxford on a scale commensurate with modern requirements—supplementing its existing departments and providing accommodation and equipment for the study of branches of knowledge of recent development—there must be found, in addition to a very substantial increase in the capital outlay, a further 50,000*l.* a year by way of income.

If it is supposed that the response made by our men of wealth particularly interested in Oxford will be on something like the same scale as that with which the appeal of the Cambridge University Association was met, it is not difficult to form a good working idea of the length of time which will be required to provide, from this source, sums of money enough to make it possible to place Oxford University in a position to invite comparison with the great universities of other countries.

The fact is, if we are to rely entirely upon private generosity to secure for this country the advantages of an adequate number of universities, planned, equipped, and financed on a scale liberal enough to meet modern needs, our chances of obtaining a supply of places of higher education comparable with that in Germany and the United States are small indeed. The vital importance of higher education in the international competition for imperial and industrial supremacy is conceded by all competent judges; and yet our statesmen hesitate to decide that what is so much worth having is worth paying for. In this country we cannot depend upon private effort to put matters right.

In his presidential address to the British Association in 1903, Sir Norman Lockyer reminded us that our universities and other institutions of higher instruction are as much a line of national defence as our Army and our Navy. The national responsibility, so far as the efficiency both of Navy and Army is concerned, is fully recognised by all political parties, and there is little difficulty in meeting the enormous financial demands which such efficiency in the services entails. As Sir Norman Lockyer pointed out, other countries are building universities even faster than they are building battleships; are, in fact, "considering brain-power first and sea-power afterwards." It is a saddening reflection how long it takes British statesmen to appreciate facts which have long been fully grasped by other nations. To leave to private enterprise the provision of necessary funds for the endowment of universities and research is as foolish as it would be in these days to relegate to private patriotism the duty of finding the money for the equipment of a modern army and an up-to-date navy.

What is the view of these matters taken in the United States? A recent publication [1] gives illuminating particulars as to the relative amounts provided in the United States for certain State universities, by the State on one hand and by private benefactions on the other. It is well to state here parenthetically that the bulletin deals only with State universities; there are, in addition, many other American universities—including Harvard, Yale, and others, the names of which are household words—which are not dealt with by the writer of the report. But the statistics provided supply ample information as to the share taken by the State in the encouragement of higher education in the United States. Details are available concerning forty State universities, but it will be sufficient for the purposes of comparison to refer to a quarter of them only. The amounts stated are approximate in every case. The University of South Carolina has received from Government support a total of 511,000*l.* and nothing from private sources. The University of Indiana has received from the former source 500,000*l.* and from the latter 20,000*l.* Corresponding numbers in the case of the other universities selected are:—University of Michigan, 1,281,000*l.* and 164,000*l.* respectively; University of Iowa, 705,000*l.* and 11,000*l.*; University of Wisconsin, 1,321,000*l.* and 18,000*l.*; University of Illinois, 1,290,000*l.* and 5000*l.*; University of Minnesota, 1,072,000*l.* and 40,000*l.*; University of Nebraska, 761,000*l.* and 14,000*l.*; University of Columbus (Ohio State), 976,000*l.* and 56,000*l.*; University of Texas, 758,000*l.* and 30,000*l.* respectively.

Speaking generally, the reliance placed upon private benefactions for the provision of university education in the United States is small compared with what the Government is expected to do. Moreover, during the last decade there has been a steady increase in the amount received from the Government by American State Universities. The Western Universities in the United States may be taken as an example. The total annual amount received from Government sources by these ten State universities during the last decade shows a substantial increase of about 600,000*l.* The annual amount thus received by the University of Michigan has increased from 45,000*l.* to 87,700*l.*; that by the University of Missouri from 25,500*l.* to 73,000*l.*; by the University of Iowa, from 20,300*l.* to 85,900*l.*; by the University of Wisconsin from 62,600*l.* to 159,300*l.*; by the University of Kansas from 21,000*l.* to 60,400*l.*; by the University of California from 63,400*l.* to 135,600*l.*; by the University of Illinois from 28,900*l.* to 165,000*l.*; by the University of Minnesota from 40,000*l.* to 69,000*l.*; by the University of Nebraska from 14,000*l.* to 71,000*l.*; and by the University of Colorado from 17,300*l.* to 28,000*l.*

The semi-official bulletin from which the figures quoted have been taken leaves no doubt as to the results of American experience. To quote a remark which follows the figures we have cited, "the State University which has attempted to combine the policy of public service with the policy of appeals for private support has fallen between the two." Speaking of the eight institutions which represent the strong State universities of the Central West States, the bulletin remarks: these institutions "have received somewhat less than five per cent. of their total support since their foundation from private sources, and this support has come in the main to a few institutions."

University authorities in the United States may well smile when they read the opinion of the Chancellor and the Vice-Chancellor of the University of Oxford:—"In this country it is of no avail to look to the State" for the satisfaction of University requirements.

The same principle is conceded generously in Germany. An article, published in NATURE on March 12, 1903 (vol. lxvii., p. 433), showed that the ordinary total income of all the German universities, excluding Jena, was for the year 1891–2 about 939,000*l.*, of which nearly 709,000*l.* was derived from State funds.

Surely the lesson of these facts is plain to the least reflective citizen. The future struggles for supremacy among the nations of the world will be contests between minds, and muscles will be at a discount. The nations which have sacrificed present luxury in order suitably to train their young men by attendance at modern universities will reap the

[1] "Bulletin of the Carnegie Foundation for the Advancement of Teaching." No. 1. (Published by the Foundation, March, 1907.)

advantages of their forethought and prescience; and those countries which, content with ancient prestige and former prowess, have neglected their duty to higher learning and have left their universities to languish on the doles of patriotic benefactors will sink into subsidiary places, and their part for the future will be to serve the men of brains with whom they have had to contend on such unequal terms.

SCIENCE AND THE EMPIRE.

IT was a happy idea which resulted in the association of the British Empire League and the British Science Guild to pay honour to the Colonial Prime Ministers during their visit to this country. The cooperation of men of science with statesmen whose special work is to govern and develop the constituent parts of the Empire can result in nothing but increased national efficiency, and the presence of Sir Wilfrid Laurier, Mr. Deakin, Sir Joseph Ward, Sir William Lyne, Mr. F. R. Moor, and Mr. T. Bent at the banquet held on May 2 is a gratifying sign that the need for applying the methods of science to affairs of State becomes year by year more fully recognised. The banquet provided the only opportunity the Prime Ministers have had of meeting men of science and others interested in the progress of knowledge and desirous of introducing the scientific spirit into the administration of Imperial affairs.

Lord Derby occupied the chair at the banquet, and about 260 guests were present, including many men of science and distinguished representatives of the Imperial service and administration, and of law, art, and other departments of intellectual activity. Mr. Haldane, who was to have represented the united interests of the British Empire League and the British Science Guild, was, unfortunately, unable to be present; and his place was taken by the Vice-Chancellor of the University of Oxford, Mr. T. H. Warren, who, in supporting the toast of "Our Guests," proposed by Lord Derby, referred to the relation of universities to the Empire and national progress as follows:—

Why do the universities and the educational interests wish to add their greeting to those which have been pressed, I am afraid, in overwhelming and almost surfeiting measure, on those distinguished men who have crossed the ocean to visit us? I can assure them that no welcome can be more warm, but that is not enough. I think it is because we feel that to the instinctive and intuitive welcome which has manifested itself so spontaneously from every portion of English society we have some little to add. We feel that learning and science have something to say to Empire. We feel that, more and more, nowadays scientific training and thorough study of history, of the science of history and of sociology, is necessary to the proper carrying out of every great enterprise, and that Empire is one of the greatest enterprises on which man, intrepid man, has advanced. The student of history sees, or thinks he sees, a development, an evolution in the political as in the animal kingdom. The family, the clan, the city, the kingdom, the Empire, as they unravel themselves in the long series of sequences, need a corresponding advance in trained and educated intelligence. Now, we in our universities, and in the learned societies study these questions in the abstract. It is our duty and privilege in the insulated detachment, in the clear and calm life of academic tranquillity, to study these problems, and to try to find the solution of them; to study economic problems apart from the bias and prejudices of party and of commercial interest, and to study science in that spirit of disinterested devotion which, after all, I think Sir Norman Lockyer will agree with me, in the long run has the promise of this world, and, in a sense, of the other—of the world alike of truth and the world of success. But universities have now, not only an abstract, but a personal part to play. It is their privilege to bring together, and their duty to bring together, the brightest minds, at the most impressionable age, of those who will be in the future the leaders, whether in thought or in action, of the Empire. The university has had in the past a great part in bringing our leading men together in their early days and giving them common sentiment and common loyalty and knowledge of each other. May it not be so still more in the future on a wider scale and in a wider way? I hope that the universities, and the learned societies, and the educational establishments of this country feel, I believe I can say they do feel, that they have new and extended duties. Already Oxford and Cambridge, and the old universities of which I have spoken, realise that they are not only universities of a kingdom, but universities of an Empire. In future, no doubt, other universities of the Empire more and more will play their part—the universities of Montreal, of Melbourne, of Sydney, of New Zealand, and of the Cape. They, too, will have their traditions and their opportunities. There will be special opportunities of science and of learning, a special atmosphere and special surroundings in one place more than another, and I look forward to and from one university to another. Meanwhile, let us make the beginnings, let us attack at once this great future which lies before us, let us take those steps which are now possible and promising. Let us use every opportunity of getting to know and to understand each other, and then I think that this great gathering of 1907 will prove not less fruitful in the scientific, and in the learned, and in the academic, than it has proved and is proving in the political and social sphere.

The toast was responded to by Sir Wilfrid Laurier, the Hon. Alfred Deakin, and Sir Joseph Ward. In the course of his remarks, Mr. Deakin said:—

Of all the meetings which we have been able to attend this has perhaps the most distinctive character. Never before in my experience have we seen blended the two sections of an Empire League of patriotism united to a body of scientific men whose immense abilities, whose sterling achievements, are the pride of the last century and the promise of this, and who are content to descend from those exalted heights, in which they unravel the mysteries of the universe, to find themselves perplexed by the truisms of politics. And if, as has been suggested, this union be typical, surely it is most fortunate, and certainly most necessary. If there is anything on this earth in human action which is casual and empirical, which is go-as-you-please and happy-go-lucky, it is the British Empire. Exactly how it came to be, precisely what it is, and what on earth it is going to be, no scientific prophet can tell. On the other hand, we have the men of science, calm and luminous, rigid and regular—I mean in their professional studies—aiming above all things at method, at principle, at organisation, the last three things we seem incapable of introducing into our Empire. And yet, though imperceptible, though unchangeable, there are manifest forces of cohesion, which even the finest instruments cannot measure, which keep this Empire as an Empire together. There are a series of rudimentary, of imperfect, of catch-as-catch-can organisations, by means of which, in some mysterious manner, this unwieldy, this gigantic and inexplicable combination, manages to survive. Surely we shall yet be found willing to sit at the feet of our scientific teachers and to endeavour, at all events at the outset, to acquire that knowledge in scientific manner, and by scientific methods, which shall enable us to appreciate, in the first place, the vast, the incalculable natural resources which are at present in our possession under the Flag—the means of utilising these instruments of material power for the benefit of our race. That appears to me to be the task of Empire, the task of scientific conquest of its physical, and shall we not be bold and say, ultimately of its political problems? The Empire rests upon the individual citizen—the individual citizen that has great capacity for service, providing you permit him to have access to these means of knowledge, to that stored-up wisdom of the ages, to these lessons and teachings which science can place in our hands. By these

means we annihilate distance and draw the Empire together. By these means we enable them to conquer the wilderness and still carry with them the necessities of civilisation. By these means, in the tiniest hamlet, we plant almost first the schoolhouse to which the children go, and, when the principle of a scientific system of education is really in practice, the Empire will be marching indeed. Therefore I hail to-night, sir, the presence here of the intellectual men who are representatives of the scientific movement, and their blending with the British Empire League I take as one of the happiest auguries of our future.

NOTES.

THE managers of the Royal Institution have awarded the Actonian prize of one hundred guineas to Madame Curie, as the author of the essay "Recherches sur les Substances Radioactives."

SIR WILLIAM RAMSAY, K.C.B., F.R.S., has been elected an honorary member of the Academy of Sciences of Christiania; and the Società italiana delle Scienze (known as the Society of the Forty) has conferred upon him the Matteucci gold medal for 1907.

THE North Sea Investigation Commissioners will be entertained by the Corporation at the Guildhall on Friday, June 14, the Lord Mayor presiding. The Fishmongers' Company will give a dinner in their honour on the previous evening at Fishmongers' Hall.

THE Government of Chili has appointed Count de Montessus de Ballore, of Abbeville, France, to institute a seismological service of the first rank. This action on the part of the Chilian Government is, says *Science*, a direct result of the disastrous Valparaiso earthquake of last August. The service in question will, at the beginning, include one station of the first rank and three of the second.

PROF. IRA REMSEN, president of the Johns Hopkins University, has been elected president of the National Academy of Sciences, in succession to Mr. Alexander Agassiz. The vacancy thus created in the vice-presidency has been filled by the election of Dr. C. D. Walcott, secretary of the Smithsonian Institution. Sir James Dewar, F.R.S., Prof. A. R. Forsyth, F.R.S., Prof. D. Hilbert (Göttingen), and Prof. J. C. Kapteyn (Gröningen) have been elected foreign associates of the academy.

THE University of Geneva will celebrate with appropriate pomp and circumstance the 350th anniversary of its foundation, which falls in 1909. We learn from the *British Medical Journal* that a committee has been appointed to arrange for the proper solemnisation of the festal rites, to which representatives of foreign universities will be invited. The "Academy," founded by John Calvin in 1559, retained that title until 1798. It was afterwards erected into a university, and reached its full development, with faculties of theology, law, physic, philosophy, and science, in 1873.

REUTER reports that the Observatory of Catania and Etna has issued the following statement:—"The activity of Mount Etna is increasing. The mouth at the base of the central crater is emitting vapour and small incandescent stones. On May 4, at 11.10 a.m., another mouth of smaller dimensions opened and threw up boiling lava. At the observatory the sound of an almost continuous eruption has been heard up to May 6. At Nicolosi a reddish vapour was seen rising from the volcano."

THE professors of the National Museum of Natural History of Paris have decided to open an international subscription with the object of offering a worthy tribute to the memory of Lamarck, by erecting his statue in the Jardin des Plantes. Subscriptions may be sent to Prof. Joubin, at the National Museum of Natural History, Paris. The committee has decided to offer to all subscribers of not less than twenty francs a reproduction in heliogravure of an authentic unpublished portrait of Lamarck, which was painted for his family by Thévenin in 1801. To all subscribers of not less than 200 francs a plaster cast of the bust of Lamarck by the sculptor Fagel (to whom is entrusted the execution of the proposed monument) will be presented. The scheme has already received distinguished support, and a comprehensive committee comprising representative men of science of all nationalities has been formed. Among the list of the committee we notice the names of Sir John Evans, K.C.B., Sir Archibald Geikie, Prof. Ray Lankester, and Sir John Murray, K.C.B.

THE New York Academy of Sciences will celebrate on May 23 the 200th anniversary of the birth of Linnæus. The anniversary celebrations will begin at the American Museum of Natural History with an exhibition of American animals known to Linnæus. Letters concerning the anniversary received from scientific societies will be read at the beginning of the morning session, and afterwards an address on North American geography in the time of Linnæus will be delivered by the president of the American Geographical Society. Dr. J. A. Allen has been invited to speak on Linnæus and American zoology. In the afternoon there will be an exhibition of American plants known to the Swedish naturalist, and an address on Linnæus and American botany will be given by Dr. Per Axel Rydberg. A bronze tablet in memory of Linnæus, a gift to New York from the Academy of Sciences, will be unveiled at the bridge—which is to be dedicated to Linnæus—over the Bronx River in Pelham Parkway, between the Botanical Garden and the Zoological Park. Numerous addresses will be delivered in connection with the unveiling ceremony. In the evening, at the museum, the director of the museum of the Brooklyn Institute will deliver an address on Linnæus and American natural history. The various meetings will be open to the public.

WE have to acknowledge the receipt of a copy of the first part of a memoir on the caterpillars of French Lepidoptera ("Les Premiers États des Lépidoptères Français"), by Prof. C. Frionnet, of the College of Natural Science at St. Dizier. The memoir is being published in the *Mémoires* of the Society of Letters, Sciences, &c., of St. Dizier, the first part, which deals with the caterpillars of butterflies, being dated 1906. Unfortunately, there are no illustrations.

IN a report on Antarctic birds collected by the *Scotia* Expedition contributed to the *Ibis* for April, Mr. Eagle Clarke has added four species—the Arctic tern, the blue petrel, the short-winged petrel, and Hutton's sooty albatross—to the nine previously recorded from within the Antarctic circle. Petrels and their relatives are attracted, it is suggested, so far south by the extraordinary abundance of food to be found immediately north of the ice-barrier, some of these visitors making their appearance in autumn after the breeding season, while others may be non-breeding birds which spend the whole summer in the South Antarctic. That the Arctic tern, after breeding in the far north, should visit the opposite pole is a most remarkable fact.

IN reference to a suggestion that Fair Island, an outlying member of the Shetland group, is specially favoured by migratory birds, Mr. Eagle Clarke, in a paper pub-

lished in the April number of the *Annals of Scottish Natural History*, points out that we should rather consider the island specially favourable to the observer. Despite the number of trained observers, the writer considers that "we in Britain see only an infinitesimal number of the migrants which visit our shores: far fewer than is generally supposed, and this is especially the case on the mainland." In addition to recording, for the first time, the red-rumped swallow as a visitor to the British Isles, Mr. Clarke was fortunate enough to observe a number of rare birds, several of which were previously unknown to visit the Shetlands.

AMONG rare birds recorded in Norfolk by Mr. J. H. Gurney in his ornithological report for 1906, published in the April number of the *Zoologist*, are five glossy ibises, which made their appearance on Breydon Broad on September 3. It is believed that three birds of the same species, killed shortly afterwards in Ireland, together with one shot in Sussex, represented this flock. Immediately following the ibises came a flock of thirteen red-headed pochards, which settled on Breydon, where they were soon destroyed. The movements of these birds were connected, in the author's opinion, with a wave of heat which occurred at the same time. A pelican and a couple of flamingoes were also among the summer arrivals, but the latter appear to have been birds which escaped from Woburn, and there can be little doubt that the former had likewise been in captivity. The occurrence on the coast of an example of a bulbul, *Liothrix lutea*, may apparently be accounted for by the fact that a number of these birds were turned out at Woburn.

THE Journal of the Society of Arts for December 14, 1906, contains a paper read before the council of the National Fruit-growers' Federation by Mr. C. H. Hooper, on fruit-growing and bird-protection. The paper is also in course of publication in the *Gardener's Magazine*, of which the issue for April 20 contains the first instalment. It is satisfactory to see that Mr. Hooper speaks his mind plainly, without any attempt at special pleading for species which are notoriously harmful; and while admitting that birds are, on the whole, beneficial to the agriculturist and horticulturist, advocates the relentless destruction of certain kinds and a restriction of the numbers of others. Another author has already advocated the most stringent measures for the extermination of sparrows, wood-pigeons, and stock-doves as being distinctly injurious, and pleaded in favour of permitting, or rather encouraging, the taking of the eggs of the chaffinch, greenfinch, and bullfinch. Mr. Hooper, in addition to reducing the numbers of the species just named, urges that in fruit-growing districts it may be absolutely essential to kill off a percentage of blackbirds, starlings, and even missel-thrushes, thrushes, and rooks. On the other hand, hawks, owls, and strictly insectivorous birds of all kinds should be religiously protected. A few more straightforward and outspoken addresses of this description, and there would perhaps be less nonsense talked and written about the duty of encouraging and protecting birds even where they are eating the unfortunate gardener and farmer out of house and home.

IN a paper read before the Epidemiological Society, Colonel Bruce, F.R.S., details recent researches into the epidemiology of Malta fever, showing that goats' milk is the principal source of infection. One-third of the cases of Malta fever in the Navy could be traced to residence in the Royal Naval Hospital, Malta, but since the use of goats' milk has been prohibited not a single case has occurred there.

THE making of models of microscopic objects by means of wax reconstruction plates has taken a recognised place in morphological, embryological, and pathological research. The cutting out of the plates by means of a scalpel, the usual method, has disadvantages, and Mr. Mark has devised an electric wax-cutter in which a platinum wire, electrically heated and mounted in a sewing machine, performs the work expeditiously and efficiently (Proc. Amer. Acad. of Arts and Sciences, xlii., No. 23, March).

IN the *Bio-Chemical Journal* for April (ii., No. 4) Mr. Lovatt Evans discusses the catalytic decomposition of hydrogen peroxide by the catalase of blood. His experiments suggest that the reaction velocity may be explained by the hypothesis known as the "active system" theory, first suggested by Prof. Adrian Brown and subsequently by Prof. Armstrong. Dr. Maclean describes experiments on the influence of kreatinin in modifying certain reactions of sugar in urine, and Dr. Spriggs discusses the excretion of the same substance in pseudo-hypertrophic muscular dystrophy. Messrs. Bearn and Cramer detail observations on zymoids, substances present in enzymes which have the property of combining with the substrate without the power of destroying it, and obtain evidence of their existence in pepsin, rennin, emulsin, and takadiastase. Mr. Coleman describes the effect of certain drugs and toxins on the coagulation of the blood.

A PRELIMINARY list of higher fungi collected by Mr. N. M. Glatfelter in the vicinity of St. Louis during a period of eight years is published as vol. xvi., No. 4, of the Transactions of the Academy of Science of St. Louis. Of about five hundred species enumerated, the majority are basidiomycetes. The determinations authenticated by Prof. C. A. Peck include twenty new species.

AN account of an instruction camp organised by Mr. J. A. Leach for members of the Field Naturalists' Club in Victoria appears in their journal, the *Victorian Naturalist* (March). The camp was pitched at Mornington, on the eastern shore of Port Phillip Bay. Each day was devoted to the study of one or other branch of natural history under the direction of special leaders, and lectures were arranged in the evening. The reports of the excursions made each day and the evening lectures are printed in the journal.

THE reports of the director and other Government officials connected with the Royal Botanic Gardens, Ceylon, are published as a consecutive series, beginning with No. 20, in vol. iii. of the *Circulars and Agricultural Journal*. Mr. T. Petch, in his report as Government mycologist, refers to a number of fungi infesting tea bushes; of these, a new species, *Massaria theicola*, producing a stem-disease, is under examination, also the horse-hair blight, generally attributed to *Marasmius sarmentosus*. The most serious outbreak of fungal disease was caused by a Phytophthora growing on the fruits of Para rubber trees, inducing decay and rot. The disease spread rapidly during the rains in June, and seemed likely to cut short the supply of seed, but was checked by the dry weather in July. The most dangerous insect pests mentioned by Mr. E. E. Green were the tortrix, *Cafua coffearia*, and shot-hole borer, *Xyleborus fornicatus*, both pests of the tea plant; a leaf-rolling caterpillar was fortunately restricted to the Funtumia rubber trees. Mr. Green also alludes to experiments for introducing the eri-silkworm, *Attacus ricini*, and European bees into Ceylon.

THE importance of a closer alliance between science and industry was again strongly emphasised by Sir Alfred Jones at Liverpool on April 8, when, at his invitation, a number of prominent men of science and commerce met at a luncheon given in honour of Mr. Herbert Wright, the author of a valuable work on the rubber industry. Mr. Wright gave a brief account of the progress and methods of rubber cultivation in the British Empire, quoting, as an example of the benefits accruing from the adoption of scientific methods, the enormous advances made by the industry in the Indo-Malayan area during the past decade. Ceylon alone, in a few years' time, may be expected to produce some 5000 to 7000 tons of rubber annually, and our other possessions in the East are developing similarly.

IN the Transactions of the Royal Society of Canada (vol. xii., pp. 267–288) Dr. R. W. Ells gives some useful notes on the mineral fuel supply of Canada. He shows that in the western half of the Dominion the supplies of mineral fuel are practically inexhaustible. The analyses of these coals show that their quality is greatly superior to that of those now mined in the Pacific States of the American Union.

THE Transactions of the Institution of Engineers and Shipbuilders in Scotland (vol. l., part vi.) contain a suggestive paper by Mr. R. Royds on the most economical mean effective pressure for steam engines. He appends a bibliography of papers dealing with the steam-engine problem, all of which are based upon direct experimental evidence. These should be studied by all concerned with the generation of motive power.

THE demolition of the Great Wheel at Earl's Court, which for twelve years has formed so conspicuous a feature in the London landscape, is now completed. The work, which is described in detail in *Engineering* of April 26, has been one requiring the exercise of much ingenuity in the devising of safe methods of procedure. The wheel was a pin-jointed structure 300 feet in diameter, weighing, with the cars in position, 1000 tons, whilst the two standards on which it was mounted weighed 400 tons more. The whole structure was demolished in less than six months, which, considering that every rivet had to be sawn through, as every nut was completely set in rust, reflects great credit on all concerned.

THE address delivered by the president, Mr. T. Hurry Riches, to the Institution of Mechanical Engineers on April 25 forms a valuable work of reference on rolling stock and the machinery used in railway engineering, its value being enhanced by the seventy-six illustrations accompanying it depicting the locomotives and rolling stock of the railways of Great Britain at the present time. It is evident from these illustrations that modern requirements are gradually bringing the locomotives on the railways more and more into accord with one another when the work to be done is similar.

AN interesting set of models, showing the development of the rack-rail locomotive from Blenkinsop to Abt, has lately been placed on view in the mechanical engineering collection of the Victoria and Albert Museum. The models, which are described in detail in the *Engineer* of April 26, comprise Blenkinsop's original model of the Middleton colliery locomotive of 1812, and models, made at the museum to a scale of 1 to 16, of the Fell centre rail engine of 1867 for the line over the Mont Cenis, of Riggenbach's system of a ladder-rack midway between the running rails (1874), and of Abt's improved form of rack (1882). The three models are admirably adapted for the use of engineering students, and throw much light on a somewhat complex subject.

THE new island in the Bay of Bengal, referred to in Admiral Field's letter in NATURE of February 28, is the subject of a detailed account, by Lieut. E. J. Headlam, R.I.M., in the April number of the *Geographical Journal*. By the courtesy of the editor we are permitted to reproduce one of the illustrations, which gives a good idea of the general appearance of this mud-bank. An illustration to some notes on the San Francisco earthquake, by Jacques W. Redway, in the same number, gives a very good idea of the ploughed land along one of the faults, where this shows at the surface as a belt of shearing instead of as a simple fracture.

FIG. 1.—General appearance of the new Island in the Bay of Bengal from the eastward, at a distance of about half a mile.

Photo.] [*R. S. Holway.*

FIG. 2.—The San Francisco Earthquake: Ploughed land along the earthquake rift.

IN a letter to NATURE of February 14 (p. 368) Mr. Charles G. Barkla described experiments which indicated that nickel must have an atomic weight of about 61·3

instead of the value 58·7 generally accepted by chemists. This result, which is confirmed in a letter just received from Prof. B. Walter, of Hamburg, is based on the law that the secondary Röntgen rays from a chemical element have a specially high penetrative power with regard to the material from which they originate; for other elements this specific penetrative power falls off proportionately as the atomic weight of the element differs from that of the substance producing the rays. Prof. Walter points out, however, that the general properties utilised by Mr. Barkla as a basis for his considerations were in the main published by him in the year 1905 (*Annalen der Physik*, Bd. 17, p. 561; *Fortschritte auf dem Gebiete der Röntgenstrahlen*, Bd. 8, p. 297). Referring to the fact that Mr. Barkla does not accept a specific power of penetration such as Prof. Walter suggested, but holds the opinion which was generally accepted previously, that a selective absorption takes place, Prof. Walter says that this assumption is shown in his papers to lead to contradictions in the case of the *primary* Röntgen rays. In his opinion, it cannot be correct in the case of the *secondary* rays, because the phenomena in question become all the more apparent for these rays the *thinner* the absorbing laminæ be made. According to Mr. Barkla's conception, exactly the opposite should be true.

WHILST cuprous chloride and bromide have long been known, the existence of cuprous sulphate has been recognised mainly as a disturbing factor in the copper voltameter. Owing to the formation of this salt, the copper deposited on the kathode is liable to be partially redissolved $Cu+CuSO_4 \rightleftarrows Cu_2SO_4$, causing the deposit to be too light; on the other hand, if the cupric solution has been saturated with metallic copper, the deposit is too heavy, since twice as much copper is deposited per coulomb from the cuprous as from the cupric salt. The recent experiments of Foerster and Blankenberg (*Berichte*, xxxix., 4428–4436) have added much to our knowledge of this salt. By enclosing ammonium cupric sulphate with metallic copper in sealed tubes they were able to ensure the formation of a large proportion of cuprous sulphate, and actually succeeded in isolating a double salt of the formula $Cu_2SO_4,4NH_3,H_2O$. When quite dry, the salt can be kept for some weeks in sealed tubes, but it is immediately decomposed by dilute sulphuric acid, giving rise to metallic copper and cupric sulphate. It is of interest to note that a solution containing initially 0·05 mol. $CuSO_4$, 0·95 mol. NH_3, and 0·15 mol. $(NH_4)_2SO_4$, became quite colourless when saturated with metallic copper, and when electrolysed gave a kathode deposit 55 per cent. greater than that obtained from a cupric solution in series.

A POPULAR article upon the planet Saturn and its system, by Mr. E. V. Heward, appears in the May number of the *Fortnightly Review*.

EXCELLENT work is being done by the Central Technical College Old Students' Association, the official organ of which, the *Central*, forms a very creditable addition to periodical engineering literature. In the current issue (vol. iv., No. 11) there are original articles on the construction of a new railway, by Mr. A. C. Cookson, and on electrical test-shop measurements, by Mr. Percy Good.

WE have received from Mr. C. Baker, of High Holborn, London, an advance proof of his new quarterly catalogue of second-hand scientific apparatus. The list contains particulars of more than a thousand separate items, and is worth examination.

OUR ASTRONOMICAL COLUMN.

COMET 1907*a* (GIACOBINI).—No. 4173 (p. 336, April 27) of the *Astronomische Nachrichten* contains a new set of elements for comet 1907*a*, computed by Miss Lamson, in which the time of perihelion passage is given as March 17·66. A daily ephemeris, calculated by Prof. Kreutz and based on these elements, is also given, and extends to May 22. The comet is at present apparently travelling very slowly and nearly due north in the northern limits of Orion, its computed positions for May 9 and May 22 respectively being $\alpha=6h.\ 11m.$, $\delta=+14°\ 7'·4$ and $\alpha=6h.\ 14m.$, $\delta=+17°\ 5'·8$. The brightness of this object is now about one-quarter of that at the time of discovery, when it was of the eleventh magnitude.

THE TEMPERATURE OF THE SUN.—An excellent popular description of the apparatus and methods by which MM. Millochau and Féry determined the solar temperature during 1906 is given by the former observer in *La Nature* (No. 1770, p. 338, April 27). As previously recorded in these columns (see NATURE, No. 1932, p. 40, November 8, 1906), the observations were made at Meudon, Chamonix, the Grands Mulets, and the summit of Mont Blanc during July and August last. The instrument used was the pyrheliometric telescope devised by M. Féry in 1902, and described and illustrated in the paper under notice. Essentially it consists of a reflecting telescope, having a mirror of 103 mm. diameter and 80 cm. focal length, in the focus of which is placed a thermoelectric couple, which is connected with a galvanometer reading directly to about one-hundredth of a millivolt. The couple is composed of two wires, one of iron, the other of constantan, soldered together at their point of intersection, the joint being covered with a carefully blackened, very small and very light disc. A bent eye-piece, placed behind the reticule bearing the couple, enables the observer to direct the telescope to any desired portion of the solar disc. The results obtained gave a temperature of 5663°, absolute, for the centre of the solar disc, considering the sun as an ideal black body, or, as M. Guillaume terms it, an "integral radiator." Correcting this value for the probable absorption in the solar atmosphere, M. Millochau obtains 6130° absolute as the effective temperature of the sun's interior.

PHOTOGRAPHY OF THE INFRA-RED SOLAR SPECTRUM.—In No. 14 (p. 725, April 8) of the *Comptes rendus* M. Millochau records some results he has obtained in the photography of the infra-red region of the solar spectrum. The plates employed were specially prepared by plunging them for about ten minutes into distilled water to which several drops of acetic acid had been added, then into a saturated alcoholic solution of malachite green, and finally washing and drying them. They were then rendered much more sensitive by exposing them for 30 seconds at a distance of 75 cm. to a 4 candle-power electric lamp, according to the method suggested by Major-General Waterhouse in 1875.

With plates thus prepared the solar spectrum was photographed, in the region 0·750 μ to 0·950 μ, on such a scale that one Ångström unit = 0·1 mm., the photographs showing that the structure of the A band in the solar spectrum is identical with that of the B band. Another photograph showed the Z band resolved into lines.

A plane-grating spectrograph of 3 cm. aperture and 60 cm. focal length was employed, and with this apparatus the A band, under good conditions, could be photographed in ten, and the extreme region in thirty, minutes.

THE ORBIT OF α DRACONIS.—The following elements have been found for the orbit of α Draconis from spectrograms secured at the Dominion Observatory, Ottawa, by Mr. J. S. Plaskett:—period = 51·42 days, $\epsilon=0·322$, $\omega=20°·3$, $m_0=294°$, T = 1906 July 11d. 4h., velocity of system = −18·4 km. per sec.

In No. 2, vol. i. (March–April) of the Journal of the R.A.S. Canada, where the above is published, Mr. Plaskett also gives a very interesting description of the methods employed in adapting a Brashear universal spectroscope to the requirements of line-of-sight spectrography.

RUSSIAN GEOGRAPHICAL WORKS.

THE labours of the great Prjevalsky have been continued by his lieutenants and others who participated in his explorations of Central Asia, and we have already mentioned the achievements of Mr. P. K. Kosloff. Mr. V. I. Roborovsky conducted an expedition, under the auspices of the Imperial Russian Geographical Society, largely along previous lines, during 1893–5, and the records are published in three volumes, viz. :—(1) the report of the head of the expedition; (2) that of his assistant, Mr. P. K. Kosloff; and (3) embodying the scientific results. We have received the three parts of the first volume, (*a*) from Tian-Shan to Nan-Shan; (*b*) Nan-Shan and Amne-Matshin; and (*c*) from Amne-Matshin to Zaisan. Elaborate preparations were made, and the best procurable instruments were placed at the disposal of the expedition. It is interesting to note that Messrs. Vladimir and Eugene Prjevalsky, brothers of the pioneer, cooperated with Mr. Roborovsky and furnished some instruments used on former occasions. A halt was made at the tomb of Prjevalsky, on the shore of the lake Issik-kul, near Prjevalsk, where a requiem was held. It was found that camels, valuable for arid desert transport, suffer severely in cold and damp regions, whereas yaks are most at ease in mountain travelling.

The sands of Kum-tag cover a legendary city of vice, destroyed beneath a shower of sand, one righteous man escaping, as in the case of the cities of the plain. At Sa-tshzhoy the expedition met with M. Splingaerd, a Belgian in the Chinese service, whose knowledge of the Chinese and their life is probably unique after many years' residence. Gold is found in the mountains near the Sa-tshzhoy oasis, of which unscrupulous advantage is taken by officials and citizens to the detriment of the revenue. The Shan-rdi lama, visited by the party, previously thought that Russians and English were the same people. Mongols and Tanguts call every European a Russian. The Tanguts, who seem to live by cattle-lifting, are dreaded by the Chinese and Mongols, and more than once attempted to raid the expedition. A chapter is devoted to the social and marriage customs of the Tanguts, with whom polyandry is rife and the expression "illegitimate" has no meaning. The Mongols showed Mr. Roborovsky a large portrait of Genghis khan, whose re-appearance is expected before long. Marriage among the lamas is prohibited in most Buddhist countries, but is regarded lightly at Tsaidam, where many lamas settle. The city of Luktshun and the Chantu people form the subject of a long chapter. A preparation of stags' horns is a feature of Chinese medicine. Wild stags are said to feed on a mythical herb which no man can find, giving them special strength and vigour. The horns are cut, dried, and smeared, then taken as a tonic by men who feel their powers decay. "Three days' weeping" is a strange remedy for scorpion bite, suggested by a Sart named Abdurahman. Sickness of men and beasts seriously hindered progress, and sympathy will be felt for the courageous leader, whose breakdown led to an earlier return from exploration and delay in publication of these volumes. Elegant phototypes of scenery add to their interest, together with meteorological and botanical observations.

In the first issue of the Transactions of the Imperial Russian Geographical Society for 1906 appears a lengthy and interesting illustrated article by the botanist Mr. V. I. Lipsky, author of "The Flora of Central Asia," on his journeys in Russian Turkestan (Tian-Shan) in 1903. Travelling was difficult, and many hardships had to be surmounted, including locusts and piercing cold. Part of the journey was "by Dunganin," *i.e.* the Dunganins are a tribe of Chinese Mussulmans who have settled in Russian territory, and gain a living by horse transport of goods and passengers. Though progress is slow, it is not unpleasant, and these people bear a high reputation for honesty. The Aksai country resembles the better-known Pamir region. Mr. Lipsky records the fact as remarkable that in the mountain lake Tshatir-kul, at a very high level, he found specimens of *Zostera marina*. This article concludes with some notes on the Kirghiz, in whom the author found strong Little Russian characteristics, both in customs and songs. Kirghiz women enjoy greater freedom than the rest of their Mussulman sisters, and attract involuntary attention when walking unveiled in the streets of Tashkend. In the same issue Mr. O. A. Shkapsky describes two journeys to the mountains of the Tashkend district. After inspection of the mountain pastures, where cattle are reared for the Ferghana and Tashkend markets, he attaches great economic importance to their more detailed survey, both as regards the food of the cattle and the customs of the breeders. Mr. Y. Edelstein contributes notes on the glaciers of the ridge of Peter the Great, where he marked indications for the guidance of future observers. There is also a translation of Prince P. Kropotkin's memoir of M. Reclus, and a memoir of Baron F. von Richthofen by Mr. K. Bogdanovitch. About twenty-five pages are occupied by a bibliography of Russian geographical literature, indicating a prolific output.

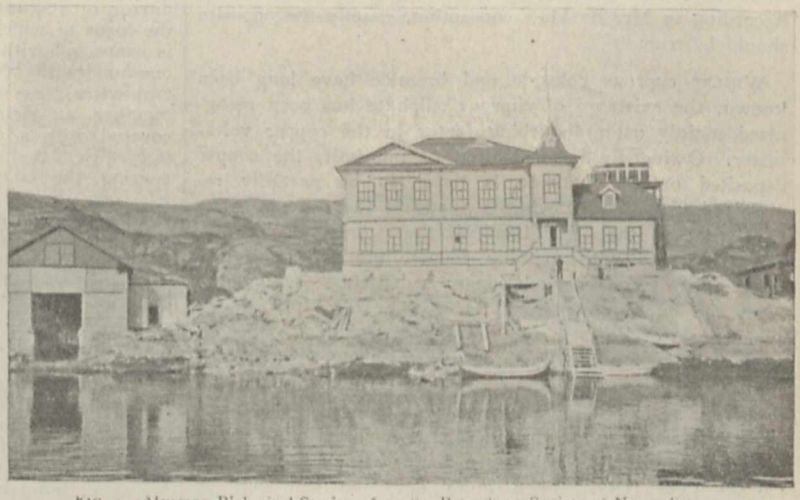

FIG. 1.—Murman Biological Station of the St. Petersburg Society of Naturalists.

Mr. Y. S. Edelstein made a geological excursion in the autumn of 1903 in the south-eastern districts of Mukden (Shentszin) province, including the Sin-tzin-tin, Fenghuang-chen, and Liao-yang districts, and has published a detailed account of his investigation of a semicircular route from Mukden to Liao-yang. He collected specimens of rocks and soil, but the outbreak of war prevented him from bringing these home. In consequence, Mr. Edelstein could only offer general deductions and a map of the broad features of the immediate areas through which his route lay. His justification for the publication of details more meagre than he could have wished is the increased interest attaching to Manchuria, and the fact that the Mukden province has been unvisited by geologists since Richthofen. In the early chapters of his work he traces his progress step by step, and sums up general conclusions in the final chapter. Mr. Edelstein thinks that serious gold-mining enterprise would be amply rewarded, but hitherto the Chinese have neither suspected the presence of gold in pyrites nor understood how to extract it. Without entering into particulars, he observes that there is a great future for this industry in Liao-dun. While there are no large coal areas like that of the Don basin, there is ample for local needs, while silver and lead veins were worked when this region was under Corean sway. Marble, copper, and asbestos are also reported, and the Chinese obtain sulphur from pyrites. Considering that the expedition was accomplished within one month, there is reason to believe

that a wide field of profitable research and future mining operations has been revealed by Mr. Edelstein's skilled labours.

No. 18 of the reports of the Zoological and Zootomical Cabinets of St. Petersburg University forms a very interesting report by Mr. K. M. Derjugin on the Murman Biological Station, a centre of activity for six years in the Kola gulf and peninsula. Previously, the station was on the Solovetsk Islands, and the band of naturalists came into contact, not free from misunderstanding, with the authorities of the famous monastery. The station consists of a main building with laboratories, library, museum, and aquarium; living quarters; houses for attendants; shed and dock, with ice-house; engine-house and workshop; pavilion above a granite basin; and small harbour, with fresh- and salt-water channels. The *Orca*, a small sailing vessel of Norwegian type, is used for cruising and exploration. The fauna resembles that of Spitsbergen, especially on its western side. The journey from Archangel, we learn, presents great interest and variety for the naturalist. In his enumeration of species of plankton, Mr. A. K. Linko remarks that a vast amount of material in the northern seas has not yet been studied, and promises future reports. The work contains tables of observations, records of temperature, plans and sketches, and a library catalogue.

Mr. V. V. Markovitch has described a botanical excursion from Ossetia to Colchis, including the sources of the rivers Ardon and Rion. His first chapter opens

FIG. 2.—Wood growing horizontally out of permanent snow mounds.

with an account of the great mountain range at different seasons, and of the gaudy sun-tints. The people of Ossetia, whose characteristics are respectively modified by proximity to Georgians or Kabardians, are generally grouped under the heads of Irontsi, Tualtsi, Digortsi, and Tagaurtsi, the central point being Alagir. As it was known that this region possessed silver-lead ore, and the Tsar Nicholas I. desired that the Russians should depend upon their own resources for lead in time of war instead of upon imports, this mining centre was established under the direction of the engineer Ivanitzky. This energetic official also started a nursery and fruit garden, the success of which has been so marked that the term "Alagirsky" denotes the highest type of fruit throughout the Caucasus. Passing along the Ossetian military road, traces of every geological period may be observed, including Palæozoic slates, but fossils are rare. Alagir itself is on the site of a huge glacier from the main crest of the Caucasus. Long experience convinced Mr. Markovitch that there is no marked difference between the northern and southern slopes of the Caucasus, but a gradual transition, and having received material support from the highest botanical authorities he was encouraged to study transitional forms. The most convenient time of year for exploration of the Ossetian mountains appears to be the end of July and the beginning of August, though botanists would need to go a little earlier. Throughout Ossetia sacred trees are found, into which pilgrims throw offerings of money and other gifts. This pagan survival is adapted to Christian saints' days, especially to the festival of the popular St. George, celebrated in November. A main conclusion of Mr. Markovitch's survey is that the differences between people living side by side on a limited area are greater than those in the flora, while in Russia the contrary is the case. Ossetians and Imeritians, who live together, are entirely distinct, while there is much similarity in neighbouring peoples along European frontiers. Contrary to former suppositions, the flora of the Colchis region varies very slightly from that of the northern Caucasus.

THE TEMPERATURE OF THE NORTH SEA.[1]

IN a Blue-book just published dealing with hydrographical work done in connection with the International Investigation of the North Sea, I have included a paper on some methods and results of hydrographical investigation, or, as it might perhaps have been more correctly termed, on some methods of representing hydrographical results.

We have from the work of our own vessel, the *Goldseeker*, quarterly observations at numerous stations in the northern part of the North Sea, and also monthly or six-weekly observations at some twenty other stations off the east coast of Scotland as far to the eastward as 1° east. At these stations, some fifty in all, we have observations at all depths, both as to temperature and to salinity. In addition to this work of our own, we receive from a large number of passenger captains frequent observations as to temperature and a smaller number of samples for the determination of salinity, taken at the

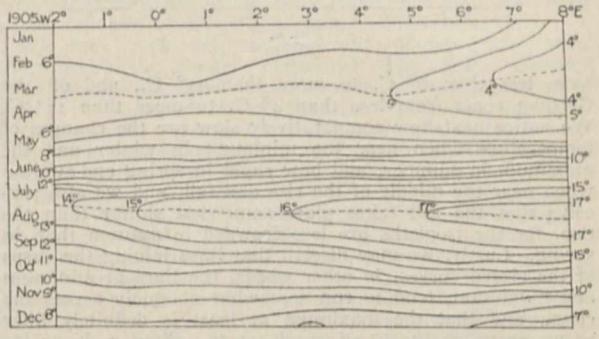

FIG. 1.

surface along many important routes crossing the North Sea. In the present paper temperature-phenomena alone are dealt with, and the results are based mainly upon our own work with but little attempt as yet to include or correlate the work of our foreign colleagues.

From a large number of observations such as we receive, from our own vessel and from the captains of liners—observations made at varying dates, and, in the case of the voluntary observations, at shifting points along particular lines—it is necessary in the first place to obtain, by interpolation, approximate data for given dates and localities. These data may then be diagrammatically represented in various ways.

Fig. 1 is a diagram of surface temperatures on the route from Leith to Hamburg, from January to December, 1905. It is constructed on a method devised some sixty years ago by Lalanne. The coordinates are time and distance along the given line, and over these coordinates are superposed contour lines, or "isopleths," representing temperature. It will be seen that from this diagram we can read at a glance many things; we see, for instance, that in early summer and late autumn there is little or no difference of temperature all the way, while, on the other hand, about March the sea gets gradually colder and about August gradually hotter as we travel eastward towards the

[1] Abstracted from the Second Report (Northern Area) on Fishery and Hydrographical Investigations in the North Sea and Adjacent Waters, 1904-1905 [Cd. 3358]. (1907.)

German coast. We easily see the extent of difference in seasonal range of temperature, which near our own coast runs from less than 6° C. to more than 13° C., at 2° east

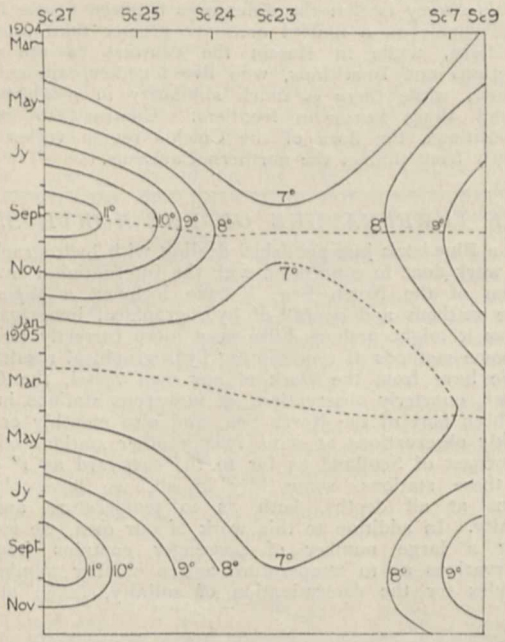

FIG. 2.

from less than 6° C. to more than 15° C., and off the German coast from less than 4° C. to more than 17° C. We notice next how comparatively slow are the changes of temperature when near the minimum in winter and the maximum in summer, and how rapid in spring and autumn when near the middle of the rise and fall, and we also perceive that the fall takes place somewhat slower than the rise, for the isopleths are less crowded in autumn than in spring. Lastly, we may discern that lines joining the cusps of the closed curves, in other words, the lines of minimum and maximum, tend to run somewhat obliquely across the chart, and that the maximum at least is definitely later as we approach the Continental coasts. Similar charts for various other routes show essentially the same phenomenon, and those drawn from the Scottish coast in the direction of Norway tend to show the influence of land at both ends of the route, the range of temperature being least in the middle.

Similar diagrams may be drawn for any given depth, and Fig. 2 is so drawn for a depth of 100 metres on a line from Buchan Deep, near Aberdeen, to the Viking Bank between Shetland and Norway. In this diagram we see that as we leave the coast the temperature-isopleths diminish rapidly in number, until in the neighbourhood of our station xxiii. (about 59° 40′ N., 0° 40′ E.) the seasonal change is only from something less to something more than 7°; but as we go further north we come again to a region of larger temperature variations, where the maximum is considerably higher and the minimum not quite so low. We notice also a retardation of dates, the maximum not being attained until well on in September.

Another series of diagrams, of a kind that has been more frequently employed, and notably by Dr. H. R. Mill in his work on the Clyde sea area, shows temperature plotted by means of isopleths over coordinates representing time and depth. While the former diagrams showed temperature changes along a line of stations during successive months, but for one depth only, these diagrams show the changes at all depths during successive months, but at one point of space only.

These and other methods of representing sea temperatures by means of diagrams may be supplemented by the use of empirical formulæ. The rise and fall of surface temperature at a given point is a very simple wave that can be suitably expressed as a sine-curve. In the periodic temperature-function

$$f(\theta)=A_0+A_1\sin(\theta+e_1)+A_2\sin(2\theta+e_2),$$

&c., θ is an angle increasing in proportion to the time, A_0, A_1, A_2 are constants expressed in degrees centigrade, and e is a phase angle of which each degree signifies approximately one day in advance or arrear of our starting point, namely (since we are dealing with monthly means), January 15. If we submit an annual series of temperature observations to harmonic analysis, we find that the first sine-factor differs but little from the actual curve, while the third and following factors are entirely negligible. If we deal with mean temperatures at a given point over several years, we find the simple sine-formulæ still more closely applicable. Thus, for the surface temperatures at Abertay, taking the mean of ten years, 1893–1903, we obtain the formula $f(\theta)=8{\cdot}43-4{\cdot}32\sin(\theta+60°)$, and find that results calculated from this formula for the middle points of the successive months differ in no case by so much as half a degree centigrade, and by a mean difference of only one-fifth of a degree centigrade, from the means of the observed temperatures for the said months. If we were to apply the next factor of our harmonic formula $[+0{\cdot}29\sin(2\theta+49°)]$ we should obtain calculated results showing a maximum discrepancy from observation of about a quarter of a degree, and a mean discrepancy of one-tenth of a degree.

After repeated trials of this kind we come to the conclusion that the sine-formula is a safe representation of the annual wave of temperature change. That it is a highly convenient one is obvious, for, in the first place, it gives us at a glance the three essential factors of the phenomenon, the mean temperature (A_0), the range or half-range of temperature (A_1), and the phase (e_1), which last we may briefly describe as the mean retardation of maximum and minimum. Furthermore, it enables us to compare these three factors very easily for a series of adjacent stations or for successive years. Thus if we work out our formula for points a degree of longitude apart on the route from Leith to Hamburg we obtain a table of which the following is a part:—

Table of Harmonic Constants for Surface Temperatures. Leith to Hamburg.

Long.	1904 A_0	1904 A_1	1904 e_1	1905 A_0	1905 A_1	1905 e_1
	°	°	°	°	°	°
W. 2	8·90	4·18	51	8·86	3·07	56
1	9·20	4·18	50	9·24	3·09	56
0	9·48	4·39	51	9·55	4·24	56
E. 1	9·45	4·49	52	9·62	4·50	59
2	9·45	4·88	51	9·62	4·70	61
3	9·50	5·47	52	9·62	5·10	62
4	9·70	5·70	49	9·76	5·45	61
5	9·81	5·60	48	9·98	5·73	58

This orderly succession of constants may then anew be transferred to diagrams, as in Fig. 3. Similar data may

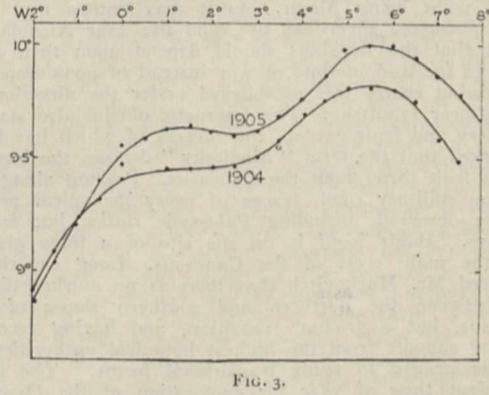

FIG. 3.

also be transferred to charts, of which a series is printed in the report.

Lastly, if it be granted that a sine-curve approximately

represents the actual succession of temperatures, we may modify our diagram of the annual wave by substituting for it a circle (Fig. 4), on which time and temperature may be read together. The centre of the circle is at a height above the base-line proportionate to the mean temperature, the radius is proportionate to the half-range, and when we shall have marked upon the circle a date-

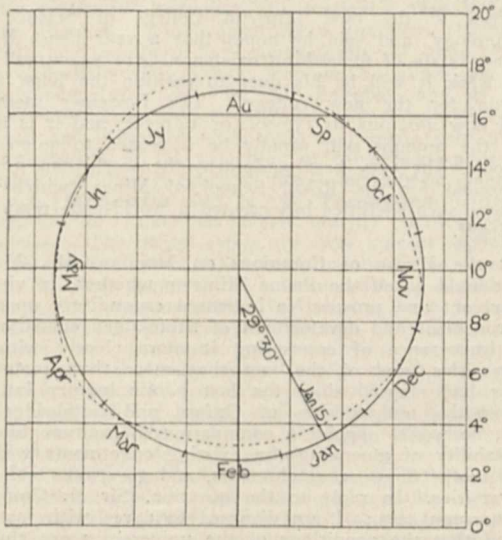

FIG. 4.

mark having reference to the phase, the temperature at a given date will be proportional to the perpendicular that falls on the base from a corresponding point of the circle. By superposing a number of such circles, or, better still perhaps, by combining them at proportionate distances in a solid model, we may represent all the various changes from point to point.

D'ARCY W. THOMPSON.

MAYA HIEROGLYPHS.[1]

BY way of encouraging the study of ancient documents having reference to the early history of the Mayas, the museum committee on Central American research purpose publishing translations of the more important papers that have appeared in connection with the deciphering of the Maya hieroglyphs. The most recent issue of this series is a translation of Dr. Förstemann's commentary on the Maya MS. in the Royal Library of Dresden, generally known as the Dresden Codex. The figures of the original manuscript may be known to students from the admirable reproductions due to Lord Kingsborough (London, 1831), and for the proper appreciation of the value of Förstemann's commentary, these plates or some other facsimile should be consulted. Without such assistance Dr. Förstemann admits that his description is of little value, and even with this aid, the book will scarcely be intelligible without some previous knowledge.

It is very much to be regretted that the committee has not seen its way to give some indication of the process by which the figures have been conjecturally deciphered, and to enable us to assign the degree of trustworthiness that can be placed on the suggested readings. This information is the more necessary, because research on Maya hieroglyphs is confined to a few experts, and the explanations that are now accepted cannot be regarded as final. We may confidently assert that these MSS. to some extent represent encyclopædias of astronomical or astrological lore, but, at the same time, it must be admitted that they include subjects of very diverse origin, the meaning of which is still obscure.

[1] Papers of the Peabody Museum of American Archæology and Ethnology, Harvard University. Commentary on the Maya Manuscript in the Royal Public Library of Dresden, by Dr. Ernst Förstemann. Translated by Miss Selma Wesselhoeft and Miss A. M. Parker. (Cambridge, Mass.: Published by the Museum, 1906.)

The key of the whole is the Tonalamatl. This is a period of time, determined by the combination of the numerals 1–13, with twenty different signs indicating as many days, consequently giving rise to a period of $20 \times 13 = 260$ days. The number 20 was the base of the ancient Mexican numerical system, and it was natural that for the measurement of time a count of twenty days should form the first unit of a higher order. The 13 is not so easily explained. Apparently it may be compared with a period analogous to our week. Such a period was but little suited for chronological purposes, since it was neither directly based on astronomical observation nor was it the expression of any uniform recurring motion in time. Yet, by its divisions and references to natural objects, such a calendric system was destined to become a useful artifice in the hands of the priestly caste for supporting forecasts and giving force to divination. Consequently, the chronological importance of the MS. merges into the astrological, and we find mixed up with the pictures figures representing gods, one of whom is delineated no less than 141 times, and several others who recur with greater or less frequency. It seems not impossible, therefore, that hidden under these symbols we have the essential part of the religious conception of the Maya peoples in a tolerably complete form; but, unfortunately, any connection between the figure of the god and the principle it represents remains vague and undetermined. The accounts of the Spanish authors regarding the mythology of the Mayas correspond very slightly with these figures of gods, and since all other conjectures respecting their significance are very dubious, the deities can only be safely and temporarily defined by alphabetical designations. Dr. Paul Schellas suggested this method of distinguishing, without describing, any particular deity, and this plan has been wisely followed by Dr. Förstemann in his commentary.

We may now ask whether the planets have been identified with greater certainty? The first reference to a planet is made in connection with "an inverted figure of a person in a squatting attitude, the head surrounded by stars, and a sign on the back, which may be a suggestion of the Sun glyph. In this figure I see the planet Mercury, and I believe that the planet's retrogression (which lasts 17–18 days) or disappearance into the light of the Sun during this week is the subject of this passage." The evidence, to those unused in the exercise of a vivid imagination in such matters, does not seem overpoweringly strong. The retrograde motion of Mercury, though variable in length, has a longer duration than seventeen to eighteen days. There is the suggestion of forced agreement here, but if we are to understand the time during which the planet remained invisible between the evening and the morning appearance, the construction is not impossible. But if it were the intention of the scribe to record such phenomena, it is difficult to understand why such symbols do not occur with some approach to regularity.

The references seem to be a little less obscure in the case of Venus. The author exhibits a series of numbers the law of formation of which, unfortunately, is not given in this treatise, which indicate that the Mayas were aware of the approximate equality of five synodic periods of Venus to eight solar years. Assuming the length of the solar year as 365 days, and the synodic period of Venus 584 days, 2920 days include both periods. This number occurs repeatedly. The author takes a further step, which also seems warranted. In a manner comparable with that by which the cycle of 7980 Julian years is determined, he proposes to bring in the Tonalamatl of 260 days by connecting it with the number 37,960 days. This number occurs in various combinations, and is equal to 146×260 (Tonalamatl), 104×365 (solar year), 65×584 (Venus, synodical period). This combination is sufficiently remarkable, and still more noticeable is the recurrence of higher numbers running into millions, in which it seems possible to trace this factor. But a very rigorous examination of the manner in which these numbers are formed is necessary before it can be concluded that they bear but one interpretation. It must also be remembered that the synodic period of Mars, taken at 780 days, is equal to precisely three Tonalamatls.

But if the instances of allusion to planetary periods are

remarkable, the omissions are not less so. The explanation that Dr. Förstemann offers for the absence of reference to Jupiter or Saturn in these hieroglyphs is that their synodic periods are too nearly equal to the solar year. This can scarcely be regarded as a satisfactory explanation. But still more curious is the small attention paid to the moon. It is true that the writer traces a reference to the synodic period of 29⅝ days, but the effort strikes one as rather forced, and the reference is by no means so prominent as in the case of Venus. There is, too, no mention of eclipses. In one passage Dr. Förstemann finds an allusion to clouds, and one need be very cautious how he disagrees with the opinion of so distinguished an expert. But it seems scarcely likely that such ordinary phenomena as clouds should be referred to, in what is evidently the production of considerable labour, intended for a permanent record. This omission is the more strange if we accept Dr. Seler's view that the Maya documents declare an advance on the Mexican pictorial writings, and possess greater accuracy, indicating more elaborate computation. For in a Mexican MS., Codex Vaticanus, No. 3773, we have a distinct reference to the sun being devoured by a jaguar, and causing or explaining a solar eclipse (Kingsborough, iv., 22).

The commentary offers many other instances in which ingenuity and resource are exhibited in deciphering or in assigning meanings to these pictures, but here we can do no more than express our admiration of the patience and skill, which have solved so many enigmas and offered so many interesting suggestions.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Robert Boyle lecture for 1907 will be delivered by Prof. Karl Pearson, on "The Scope and Importance to the State of National Eugenics," on Friday, May 17, at 9 p.m., in Balliol Hall.

The Herbert Spencer lecture for 1907 will be given by Mr. Francis Galton, on "Probability, the Foundation of Eugenics," in the Sheldonian Theatre on Wednesday, June 5, at 2.30 p.m.

Mr. C. G. Douglas, formerly Demy of Magdalen College, has been elected to an official fellowship in natural science at St. John's College.

CAMBRIDGE.—During their visits to England, it is proposed to confer the degrees of Doctor of Law upon the King of Siam and Prince Fushimi.

At a congregation to be held in June, the degree of Doctor of Science, *honoris causa*, will be conferred upon Sir Clements R. Markham, Colonel Sir T. H. Holdich, and Sir T. R. Fraser, professor of materia medica and of clinical medicine in the University of Edinburgh.

Prof. Hughes has been nominated to represent the University at the celebration of the centenary of the Geological Society of London in September.

Mr. A. D. Imms, Christ's College, has been appointed professor of biology at Allahabad University.

Prof. Nuttall will deliver his inaugural lecture in the anatomical lecture theatre on Wednesday, May 22, at 4.30 p.m.

An exhibition of 50*l.* a year tenable for two years is offered by the governing body of Emmanuel College to an advanced student commencing residence at the college in October. Application should be sent to the Master of Emmanuel not later than October 1.

The professorship of agriculture is vacant by the resignation of Prof. Middleton. The title of the professorship will in future be "The Drapers Professorship of Agriculture." The election of a professor will take place on Saturday, June 1, at the University Offices, St. Andrew's Street. Candidates for the chair are requested to communicate with the Vice-Chancellor of the University on or before Thursday, May 23.

THE Mercers' Company lectures on "The Internal Media of the Body and their Relation to the Tissues" will be given in the physiological department of University College (University of London) by Prof. E. H. Starling, F.R.S., on Fridays at 5 p.m., commencing Friday, May 10. These lectures are open to all students of the London medical schools, and to medical men on presentation of their cards.

IN the course of some remarks at the annual dinner of the Institution of Mining and Metallurgy on May 3, Mr. R. McKenna, M.P., President of the Board of Education, referred to the new Imperial College of Science and Technology, and said he hopes that a year hence it will be in a state of flourishing existence. He announced that this week it will be his duty to petition the King for a charter for the new college. The Bessemer memorial fund now amounts to 13,000*l.* or 14,000*l.*, and it is hoped that the amount will rapidly be increased to 30,000*l.* or 40,000*l.* The very best equipment the world can produce is needed for the Royal School of Mines, which even without such facilities has created a world-wide reputation for itself.

IN the House of Commons on Monday, Mr. Murray Macdonald asked the Prime Minister whether, in view of the recent and prospective increased expenditure upon the improvement and development of State-aided education, of the importance of connecting it more closely with the universities, and of the fact that more than twenty-six years had elapsed since the last public inquiry into the universities and colleges of Oxford and Cambridge was held, he would appoint a commission to examine into the desirability of amending the existing enactments with regard to the finances, emoluments, and government of these universities. In reply to the question, Sir H. Campbell-Bannerman said:—I am disposed to agree with my hon. friend that the conditions of the universities are ripe for a thorough and comprehensive inquiry, but I am not disposed to add, at the present moment, to the number of Royal Commissions already existing.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 28.—"On the Dispersion in Artificial Double Refraction." By Dr. L. N. G. **Filon.** Communicated by Prof. F. T. Trouton, F.R.S.

It is well known that glass compressed unequally in different directions behaves like a temporary crystal. If T_1, T_2 be the principal stresses in the wave-front, τ the thickness of glass traversed, then the relative retardation of the two oppositely polarised rays is $R=C(T_1-T_2)\tau$. C may be called the "stress-optical coefficient" of the glass.

The experiments described were undertaken in order to find out how C for borosilicate glasses varied with the colour of the light used and with the composition of the glass.

Polarised light was passed through a combination of glasses under flexure optically equivalent to a slab under uniform stress. It was then analysed by a Nicol and spectroscope. The spectrum was crossed by a dark band whenever R = integer multiple of λ. The measurement of λ then gave R and C.

It is found that, on the whole, the dependence of the stress-optical coefficient on the colour is very well expressed by the empirical formula

$$\left(\frac{C}{C_0}-1\right)\left(\frac{\lambda}{\lambda_0}-1\right)=1,$$

C_0, λ_0 being constants. This gives a hyperbolic law.

In certain glasses, however, systematic deviations from this law exist. These deviations are local in character, and their study suggests a strong analogy with the effect of absorption bands on the dispersion in single refraction.

With regard to the effect of chemical composition, it appears that an increase in the percentage of B_2O_3 increases C_0; an increased percentage of K_2O probably decreases C_0. λ_0, on the other hand, seems roughly independent of the composition, so that, for the glasses examined, the curves of C plotted to λ differ only in their scale; the dispersion increases with the stress-optical coefficient.

Chemical Society, April 18.—Sir William Ramsay, K.C.B., F.R.S., president, in the chair.—The magnetic rotation of hexatriene, $CH_2:CH.CH:CH.CH:CH_2$, and its relationship to benzene and other aromatic compounds, also its refractive power: Sir W. H. **Perkin.** Hexatriene was found to have the rotation 12·196, which, when reduced by 0·982, the constant due to the effect of ring formation, gives 11·214 for benzene as against 11·284 actually found for benzene. This indicates that benzene contains three contiguous unsaturated groupings (Kekulé's formula), and that these have substantially the same values as in open chain compounds.—Aromatic azoimides, part i., *p*-hydroxyphenylazoimide: M. O. **Forster** and H. E. **Fierz.** The properties of *p*-hydroxyphenylazoimide were described and compared with those of camphorylazoimide.—Measurements of the velocities of saponification of the *l*-menthyl and *l*-bornyl esters of the stereoisomeric mandelic acids: A. **McKenzie** and H. B. **Thompson.** *l*-Bornyl *d*-mandelate is saponified more quickly than *l*-bornyl *l*-mandelate. The bornyl esters are more quickly saponified than the menthyl esters.—The constituents of the essential oil of American pennyroyal. Occurrence of a dextromenthone: M. **Barrowcliff.** The oil has been found to consist of (1) an undetermined phenol; (2) *l*-pinene; (3) *l*-limonene; (4) dipentene; (5) *l*-methyl-3-*cyclo*hexanone; (6) pulegone; (7) *l*-menthone; (8) *d-iso*menthone; (9) a sesquiterpene alcohol; (10) esters of formic, acetic, octoic, decylic, and salicylic acids, and the ester of a dibasic acid of the probable formula $C_8H_{14}O_4$, together with formic, butyric, octoic, and decylic acids in the free state.—Studies in the camphane series, part xxiii., oximes of camphorylsemicarbazide and camphorylazoimide: M. O. **Forster** and H. E. **Fierz.**—The action of ethyl oxalate on thioacetanilide and its homologues: S. **Ruhemann.**—The action of tribromopropane on the sodium derivative of ethyl acetoacetate: T. E. **Gardner** and W. H. **Perkin,** jun.—Indican. Preliminary notice: A. G. **Perkin** and W. P. **Bloxam.** A process is described for the isolation of the glucoside from Indigofera leaves, and it is shown that the indican from *I. sumatrana* is identical with that from *I. arrecta.*—Cupric nitrite: P. C. **Rây.**—The action of hydrogen peroxide on potassium cyanide: O. **Masson.** The products of the action are potassium cyanate and potassium and ammonium carbonates.—The reaction between calcium carbonate and chlorine water: A. **Richardson.**—The density of hydrogen chloride: R. W. **Gray.** The highest value obtained for the weight of a litre of the gas at 0° and 760 mm. in London was 1·64091 grams, and the lowest 1·64026 grams. The mean value, corrected to lat. 45°, is 1·6397 grams, which is practically identical with the value 1·6398 grams found by Prof. Guye.—Di-iodocamphor: J. E. **Marsh** and R. de J. F. **Struthers.**—Acyl-ψ-derivatives of iminothiocarbamic acid and their isomerides: A. E. **Dixon** and J. **Taylor.**

Institution of Mining and Metallurgy, April 18.—Prof. W. Gowland, president, in the chair.—A visit to the goldfields of Orenburg, Russia: F. H. **Hatch.** Notes of a journey recently made through the district, with a brief review of its physical characteristics, the occurrence of gold in alluvials and quartz, and the systems of mining adopted.—The McMurtry-Rogers process for desulphurising copper ores and matte: communicated by T. C. **Cloud.** A description of this process as carried on at the Wallaroo Works. It consists in calcining sulphide ores containing a large proportion of silica or siliceous material in converters fitted with blast-pipes and air-holes, thereby allowing a strong current of air to pass through the charge; an important part of the process is the preliminary "swamping" of the ore and the materials to be treated with water.—The ironstone of Cleveland: A. E. **Pratt.** A brief account of the Cleveland ironstone beds, which produce 40 per cent. of the iron ore raised in this country. The author described the geology, mining, and calcination methods pursued at leading mines, with practical notes on the working of the Cleveland kiln.—Laboratory crucible and muffle furnaces: G. T. **Holloway.** An illustrated description, accompanied by a complete specification, of furnaces erected in the author's own laboratory.

PARIS.

Academy of Sciences, April 29.—M. A. Chauveau in the chair.—A suspended collimator giving the position of the zenith: G. **Lippmann.** A vertical collimator carrying a very fine hole in its focal plane is suspended by a very flexible spring in such a manner that it is perfectly free to oscillate in a vertical plane. The suspending spring is formed of steel ribbon, 1/20th of a millimetre thick, 1 cm. wide, and 20 cm. long. The system is damped by a set of plates dipping in oil, and ceases to oscillate in two minutes. The apparatus is not sensitive to slight earth tremors, and the luminous image returns to exactly the same spot even after violent shocks.—The representations of an integral by a sum of ten or twelve squares: G. **Humbert.**—The direct hydrogenation of allyl compounds: Paul **Sabatier.** The vapour of allyl alcohol in a current of hydrogen carried over reduced nickel maintained at a temperature of between 130° C. and 170° C. gives nearly pure propyl alcohol, the only impurity being a trace of propionic aldehyde. Reduced copper at 180° C. produces the same reaction, but both the yield and the quality of the product are inferior.—Observation of the eclipse of the sun of January 14, 1907, at the Observatory of Phu-Lien, Tonkin: G. **Le Cadet.** An account of visual observations, actinometric measurements, and barometric changes during the partial eclipse.—The distances of the satellites of Uranus and of Jupiter: Émile **Belot.**—The analytical nature of the solutions of certain partial differential equations of the second order: Charles **Goldziher.**—The development of hyperelliptic functions in trigonometrical series: Z. **Krygowski.**—The surfaces developed by a circular helix: E. **Barré.**—The most general representation of the equation of nomographical order 3 by a conical nomogram: Maurice **d'Ocagne.**—The sharp edge integrator: M. **Jacob.** This form of planimeter is capable of dealing with important questions arising from the equations of Abel and Riccati, and presents especial interest from the point of view of artillery.—The action of a horizontal aërial current upon a vertical vortex: Bernard **Brunhes.**—The direct determination of the absolute value of the electric charge of a monovalent electrolytic ion: H. **Pellat.** It has been shown by Townsend that the electric charge carried by a gaseous ion is the same as the charge carried by a monovalent ion during electrolysis; J. J. Thomson has determined the first of these two quantities, thus giving the second indirectly. In the present note a method is given for measuring the charge carried by a monovalent electrolytic ion without assuming any of the properties of gaseous ions. The numerical results are of the same order as those furnished by the Thomson-Townsend method.—The dielectric constant of ice and of water in the neighbourhood of 0° C.: F. **Beaulard.** It is found that the dielectric constant of ice is of the same order of magnitude as the square of the refractive index; the constant for water near 0° C. is about double that of ice.—An apparatus for measuring the rate of consumption of petrol in motors: M. **Krebs.** An acknowledgment of priority for a similar apparatus invented by M. Parenty.—The acoustic efficiency of the telephone: Henri **Abraham.** Leaving cases of resonance out of account, the best telephone does not transmit more than one-thousandth part of the energy which it receives to the line.—A new microscope and its applications to stereoscopic photomicrography: A. **Quidor** and A. **Nachet.**—The limit of inflammability of mixtures of ether vapour and air: O. **Boudouard** and H. **Le Chatelier.** Referring to a paper on this subject published recently by J. Meunier, the authors point out that they anticipated these results ten years ago.—Researches on the compressibility and vapour pressure of mixtures of methyl ether and sulphur dioxide; the formation of a compound between these two bodies: E. **Briner** and E. **Cardoso.** Data are given proving the existence under strong compression of a compound having the composition $(CH_3)_2O,SO_2$. The critical temperature and pressure of this compound were measured.—The temperature of formation of the carbides of strontium and barium: Morel **Kahn.** The reduction of baryta and strontia by carbon can be realised at a temperature near that of the fusion of platinum, with formation of the corresponding carbides.—The preparation and proper-

ties of a new variety of chromium: Binet **du Jassonneix.** At a high temperature copper dissolves about 1·6 per cent. of chromium, and this separates out during cooling in the form of a spongy mass. The chromium can be isolated by dissolving away the copper in nitric acid.—The limit to the proportion of silicon which can be taken up by copper: Em. **Vigouroux.** In the presence of lead, bismuth, or antimony, silicon in excess reacts with the copper only to form a copper silicide, the maximum percentage of silicon taken up being about 10 per cent.—The higher oxides of rubidium: E. **Rengade.** By the regulated action of oxygen upon rubidium, evidence is obtained of the formation of a black oxide intermediate between the dioxide and the peroxide, and of a composition approximating to Rb_2O_3.—The isomeric dioximidosuccinic acids: A. **Wahl.**—The dibromides of the allyl phenolic ethers; the formation of cyclopropanols: MM. **Tiffenau** and **Daufresne.**—The bitterness of milk: MM. **Trillat** and **Sauton.** The bitterness of milk, as of cheese, is produced whenever contamination occurs with any organism capable of producing both aldehydes and ammonia, or by several species of organisms, some of which are capable of producing ammonia, others aldehydes.—The presence of sympathetic ganglia situated below the spinal ganglia; micro-sympathetic and hypo-spinal ganglia: G. **Marinesco** and J. **Minea.**—The nephro-poïetical activity of the fœtal kidney: P. **Carnot** and A. **Lelièvre.**—The mode of action of sodium salicylate on the uric excretion: Pierre **Fauvel.** Salicylate of soda does not increase the amount of uric acid or xantho-uric products, but only exerts a modifying action on the secretion.—The discovery of a human jaw-bone in a Quaternary breccia: A. **Favraud.**—The relations between glacial erosion and fluvial erosion: Jean **Brunhes.**—The movements of sands along the coast-line: M. **Thoulet.**

DIARY OF SOCIETIES.

THURSDAY, MAY 9.

ROYAL SOCIETY, at 4.30. The Anatomy of the Julianiaceæ considered from the Systematic Point of View: Dr. F. E. Fritsch.—The Ascent of Water in Trees, Second Paper: Prof. A. J. Ewart.—Increase in the Complement-Content of Fresh Blood-Serum: Dr. J. Henderson Smith.—On the Periodic Variations of the Nile Flood: E. B. H. Wade.

ROYAL INSTITUTION, at 3.—Spectroscopic Phenomena in Stars, (1) Chemistry: H. F. Newall, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Telephonic Transmission Measurements: B. S. Cohen and G. M. Shepherd.

IRON AND STEEL INSTITUTE, at 10.30 A.M.—Presidential Address.—Electrically Driven Reversing Roller-Mills: D. Selby-Bigge.—(1) Steel Making from High Silicon Phosphoric Pig Iron by the Basic Bessemer Process: (2) Steel Making from Pig Iron containing Chromium, Nickel, and Cobalt: A. W. Richards.—The Use of Steam in Gas Producer Practice: Prof. W. A. Bone and R. V. Wheeler.

MATHEMATICAL SOCIETY, at 5.30.—Rational Expression of the Invariants of a Quintic by Means of Three: Dr. H. F. Baker.—Secular Stability: Prof. H. Lamb.—A Lemma connected with Fourier's Series: F. J. W. Whipple.

FRIDAY, MAY 10.

ROYAL INSTITUTION, at 9.—Recent Excavations on Forum Romanum, and the Forum Ulpium: Signor Com^{e} Giacomo Boni.

PHYSICAL SOCIETY, at 8.—Stereoscopy with long Base-line illustrated on the Screen: Dr. T. C. Porter

ROYAL ASTRONOMICAL SOCIETY, at 5.—On the Presence of Tin in Stellar Atmospheres: J. Lunt.—Tables to Accompany Mr. Innes's Paper on Computation of Secular Perturbations: F. Robbins.—Note on Certain Photo-visual Objectives: W. J. S. Lockyer.—On the Variable Stars *RV* and *RX Andromedæ*: A. Stanley Williams.—Note on Le Verrier's Tables of Saturn: A. M. W. Downing.—Note on the Range in Brightness at Maximum of Long-period Variables: H. H. Turner.—An apparent Influence of the Earth on the Numbers and Areas of Sun-spots in the Cycle 1889–1901: Mrs. A. S. D. Maunder.—Some Notes on the Classification of Long-period Variables: H. H. Turner.—*Promised Papers*: Distribution of Prominences in Latitude in the Year 1906: John Evershed.—Description of the 30-inch Reflector recently erected at the Helwan Observatory, Egypt: J. H. Reynolds.—Note on the Spectrum of α Orionis: H. F. Newall.—Observations of Jupiter's Sixth and Seventh Satellites from Photographs taken with the 30-inch Reflector in 1906–7: Royal Observatory, Greenwich.—Recent Work at the Kodaikánal Observatory: Prof. Michie Smith.

MALACOLOGICAL SOCIETY, at 8.—The Pairing of *Limnæa peugra* with *Planorbis corneus*: W. D. Lang.—Notes on *Achatina denisoni*, Reeve, and *Achatina magnifica*, Pfr.: E. A. Smith.—Review of the New Zealand Acmæidæ, with Descriptions of New Species and Sub-species: Henry Suter.

IRON AND STEEL INSTITUTE, at 10.30 A.M.—Sentinel Pyrometers and their Application to the Heat Treatment of Tool Steel: H. Brearley and F. Colin Moorwood.—Induced Draught with Hot-air Economisers for Steel-Works and Blast-Furnace Boilers: A. J. Capron.—The Influence of Process of Manufacture on Some of the Properties of Steel: F. W. Harbord.—The Distribution of Sulphur in Metal-Ingot Moulds: J. Henderson.—The Ageing of Mild Steel: C. E. Stromeyer.—Carbon-Tungsten Steels: T. Swinden.—The Nomenclature of Iron and Steel: Report of a Committee of the International Association for Testing Materials.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Consideration of the Patents and Designs Bill, 1907.

SATURDAY, MAY 11.

ROYAL INSTITUTION, at 3.—Scientific Work in the Sea-Fisheries: Prof. W. C. McIntosh, F.R.S.

MONDAY, MAY 13.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—An Expedition from the Niger to the Nile: Lieut. Boyd Alexander.

VICTORIA INSTITUTE, at 4.30.—Recent Discoveries in Palestine and Syria: Dr. Ernest W. G. Masterman.

TUESDAY, MAY 14.

ROYAL STATISTICAL SOCIETY, at 5.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—Exhibition of Australian Specimens and Photographs recently received from Dr. Ramsay Smith, of Adelaide: Prof. D. J. Cunningham, F.R.S.—Dolls: N. W. Thomas.

WEDNESDAY, MAY 15.

SOCIETY OF ARTS, at 8.—Trypanosomiasis or Sleeping Sickness: Dr. H. W. G. Macleod.

ROYAL METEOROLOGICAL SOCIETY, at 4.30.—The Standard Rain Gauge, with Notes on Other Forms: Dr. Hugh Robert Mill.—On a Method and Apparatus for Measuring Fog Densities: J. W. Lovibond.—Note on a Balloon Struck by Lightning, April 11, 1907: Colonel J. E. Capper.—Account of a Remarkable Excavation made by Lightning in Peat-earth on August 2 or 3, 1906: J. Nevin and A. S. Herschel, F.R.S.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Diffraction Rings due to a Circular Aperture: Prof. A. W. Porter and P. F. Everitt.—An Improved Vertical Illuminator: E. M. Nelson.

GEOLOGICAL SOCIETY, at 8.—The Origin of certain Cañon-like Valleys Associated with Lake-like Areas of Depression: F. W. Harmer.

THURSDAY, MAY 16.

ROYAL INSTITUTION, at 3.—Spectroscopic Phenomena in Stars, (2) Motion: H. F. Newall, F.R.S.

CHEMICAL SOCIETY, at 8.30.—The Relation Between the Crystalline form and the Chemical Constitution of Simple Inorganic Substances: W. Barlow and W. J. Pope.—Experimental Investigation into the Process of Dyeing: J. Hübner.—Some Derivatives of *p*-Pyranol allied to certain Derivatives of Brazilein and Hæmatein, Preliminary Communication: W. H. Perkin, jun., and R. Robinson.—Mixed Semi-ortho-Oxalic Compounds: G. D. Lander.—The Mechanism of Bromination of Acylamino-compounds, Preliminary Notice: J. B. Cohen.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Present State of Direct Current Design as Influenced by Interpoles: F. Handley Page and Fielder J. Hiss.

CONTENTS.