THURSDAY, MAY 9, 1912.

MEDICAL MORPHOLOGY.

Morphologie Médicale: Étude des quatre types humains. Applications à la clinique et à la thérapeutique, par A. Chaillon and L. Mac-Auliffe. Pp. iv + 248. (Paris: Octave Doin et Fils, 1912.) Price 5 francs.

THE title of "Morphologie Médicale," which the distinguished French authors have given to their book, did at first suggest to the reviewer that he was to have the pleasure of making a new subject of research known to the readers of NATURE. The subject, however, is not a new but a very old one, for in its essential nature "morphologie médicale" is really a resuscitation of the old doctrine of "constitutions" or "temperaments," which was so beloved by physicians who lived before the days of Pasteur and Lister. The names are changed with the times; certain "physical types," not "constitutions," are recognised. The exact methods of the anthropologist are employed to distinguish one type from the other.

Patients in the cliniques, according to our authors, can be classified into four types:—the respiratory, the digestive, the muscular, the cerebral. The names at once suggest the underlying characteristic of each type: in the first the respiratory is the dominant system of the body; in the second the digestive, and so on. The head offers certain features which assist the clinician to recognise these types. Two transverse lines are drawn across the face—one at the root of the nose, the other at the junction of the nose and upper lip. The zone between these two lines, containing the nose, is the respiratory zone; the segment above—the forehead and vertex of the head—represents the cerebral zone; the one below, comprising the mouth and chin, belongs to the digestive zone. The predominance in size of any of these three zones of the head helps to indicate the type to which the individual belongs.

Similarly as regards the trunk; if the thoracic part is relatively long, the individual is of the respiratory type; if the abdomen is unduly developed, then, of course, the patient is of the "digestive" type. The muscular type is represented by gymnasts and athletes with brawny limbs. It is strange that the authors cite the great Napoleon as an example of this type, and Edison as a representative of the cerebral type. Rossini, the composer, is their selected example of the "digestive" type, and Spinoza of the "respiratory."

The classification seems altogether unscientific and really unworkable, but at the same time one must confess that such types are clearly recognisable from the descriptions given by the authors. If the members of our Cabinet were to visit Paris and enter a clinique where this doctrine of type is put in practice, there could be no doubt as to which type some of the Ministers belong. The War Office would provide an excellent example of the digestive type; the Admiralty a representative specimen of the "cerebral"; the Foreign Office of the "respiratory"; and the head of the Local Government Board could stand as a fair example of the "short muscular" type. The difficulties arise when we come to the others; the Chancellor of the Exchequer cannot be fitted in anywhere; nor the Premier, nor the Home Secretary, and so with the others. The authors confess that the types are apt to be mixed. Indeed, it is not too much to say that 60 to 70 per cent. of men and women are so ill suited to fit the classification proposed that no two physicians or anthropologists would likely agree as to the types to which this great indeterminable class should be assigned.

In this work there are all the defects which were inherent in the work of Lavater and of Gall and Spruzheim. Yet for two things anthropologists will be indebted to MM. Chaillon and Mac-Auliffe: first for a very clear exposition of the manner in which they make their measurements; second, for the tables which include their anthropological data. In our opinion, the anthropological researches which have been carried out in connection with our hospitals are more satisfactory in method and in aim than those of the French authors. Two of these may be cited: the inquiry which Dr. Shrubsall made several years ago on the out-patients of St. Bartholomew's Hospital, and the research published in a recent number of *Biometrika* by Dr. David Macdonald. In both these papers the biometrical methods were employed to ascertain if there was any co-relationship between anthropological type and disease. The results obtained suggested there was such a relationship, and one which was capable of exact mathematical expression.

A. K.

HISTORY OF DETERMINANTS.

The Theory of Determinants in the Historical Order of Development. By Dr. T. Muir, C.M.G., F.R.S. Vol. ii.: The Period 1841 to 1860. Pp. xvi + 475. (London: Macmillan and Co., Ltd., 1911.) Price 17*s*. net.

THE period covered by this volume is a very important one; it practically settled the notation, and, owing mainly to the rise of the calculus of forms, it brought into prominence

L

various special types of determinants with their corresponding properties.

Too much stress can scarcely be laid on the matter of notation; again and again Dr. Muir, in his notes on a paper, brings out the essential meaning of its results by translating it, so to speak, into a more perspicuous language. On the whole, the merit of choosing a suitable notation appears to be mainly due to Cayley, although Cauchy and Grassmann must not be forgotten; their symbolical expressions are often extremely convenient, and are in every case nearly as economical as the current ones, although not quite so convenient typographically. The crowning advantage of the current notation is that $|a_{nn}|$ can be used as a symbol for a general determinant of n rows and columns.

As an expounder of symmetrical algebra, Cayley is unsurpassed, both in power and elegance; it is not surprising, therefore to find that nearly fifty of his papers are referred to. Mainly, these give examples of the application of determinants to particular problems; but as a contribution to the general theory we have the initial discussion of skew determinants, and various important notes on orthogonants.

On the other hand, Sylvester occupies a very curious position. The properties of compound determinants are a very important part of the general theory; some of them were discovered by Cauchy, and Sylvester more than once asserts that he had discovered a general theorem, including Cauchy's as particular cases, and virtually comprehending all properties of determinants. Now, when we turn to Sylvester's published papers on compound determinants, we are more than usually baffled by his inveterate habits of inaccuracy, stating theorems without proof, and hastily jumping at conclusions. Even Dr. Muir confesses (p. 197) that he cannot find or conjecture this all-embracing theorem. He does, however, point out what Sylvester has stated which is really true, and has put it into a more intelligible form; in fact, all his notes on Sylvester will be very useful to those who study the original papers.

Turning to other writers, we have Hesse and Jacobi, who have left their names permanently connected with the subject, developing it from the sides of geometry and differential equations; Hermite also, in his memoirs on ternary quadratic forms, contributes to the theory of orthogonants. Oddly enough, there is only one paper by Clebsch, although (at a later period) he applied determinants to geometrical theory with a mastery equal to Cayley's. Among the Italians we may specially note Brioschi and Faà di Bruno.

As to the arrangement of Dr. Muir's book, we may note that chapter i. contains references to two unimportant papers omitted in vol. i.; chap. ii. is on determinants in general, and the remaining fourteen deal with special types, such as alternants, &c.

There is a list of authors, showing at a glance to which parts of the subject each person has contributed; to find out any particular theorem, the reader has to rely on the table of contents, and this means looking through one or more sections. But from the nature of the case this is about all that could be expected; it is practically impossible to index a set of analytical theorems.

As a mathematical history, so far as can be judged by one who has not gone over the same ground in detail, Dr. Muir's work seems irreproachable in the cardinal points of proportion, completeness, and lucidity. He displays no bias, and his critical remarks are always to the point; while his analyses of the various papers are remarkably concise as well as clear. G. B. M.

CHEMISTRY OF CELLULOSE.

Die Chemie der Cellulose unter besonderer Berücksichtigung der Textil- und Zellstoffindustrien. By Prof. C. G. Schwalbe. Zweite Hälfte (Schluss des Werkes). Pp. 273–666 + xii. (Berlin: Gebrüder Borntraeger, 1911.) Price 14.80 marks.

THIS second volume is closely consistent with the former, reviewed in NATURE, vol. lxxxv., p. 67, and as a completed work we must assign it a high place in technical literature, principally, however, from the point of view of the German technologist, who now finds himself for the first time in possession of a full bibliography *in propria lingua* of this rapidly growing subject. Of an exhaustive and most carefully edited bibliography, in which equal prominence is given to all recorded investigations, and the authors allowed to tell their own story, little more can be said to commend it to the specialist as an indispensable addition to his library equipment.

A more important function, however, of authorship in this field is to influence the rising generation of students and workers, and for this a bold and critically constructive handling of the material was called for.

We may illustrate by selecting a section of the work dealing with the quantitative estimation of cellulose (pp. 613–624).

It should have been shown that the analytical processes available are sharply defined by the general principles of classifications now recognised; and that they are "normal" so far as they are based upon reactions, specific to the non-cellulose, that is, to its characteristic groups, and quantitatively accounted for. From this point of view the "Weende" method (Henneberg and Stohmann) of estimating "crude fibre" or "Rohfaser" has no place as a "cellulose" method.

Nevertheless, it is fully described, as is Dmochowski's modification (Diss, Göttingen, 1909), which consists in digesting these residues with nitric acid at 80°, and further purifying from soluble products, the final residue duly weighed being converted into cellulose by applying the correcting factor 1·1. These methods are not without interest for what they are, that is, as crude measures of resistance to hydrolysis and oxidation. But they should be assigned a corresponding position as representing the empirical or conventional, and of small utility in systematic research.

On the other hand, the author gives full value to the investigations of M. Renker, and of the International Commission. But it might have been pointed out that the formal endorsement of the chlorination method follows many years after its general adoption by specialists.

In other special sections the absence of critical effort on the author's part, and therefore of co-ordinated selection of matter, imposes a considerable strain upon the reader in assigning the proper values to the records of experimental work. Thus, in reviewing the various contributions to the "Constitution of the Lignocelluloses" (pp. 538–554), the views of Klason and Czapek, which are not without suggestiveness but demonstrably untenable, are reproduced at length. The classification of Fremy, long since rejected, finds a place.

As a conspicuous omission from this section, the author has overlooked the suggestive researches of W. J. Russell on the autoxidation of the lignocelluloses, and the action of wood surfaces on photographic plates (in absence of light).

In describing the cereal straws it is implied that they are lignocelluloses. But a straw is a heterogeneous assemblage of tissues, fibres and cells, and cannot be treated on the same plan as a homogeneous tissue, such as jute bast.

We mention this as an instance of the difficulty of treating "cellulose" as a matter of chemistry only, and disregarding structural essentials.

We revert to our more general criticism, which we make in the interest of progress. To attract the young workers, it appears to us a first duty of teachers to aim at didactic directness, even if sometimes at the expense of comprehensive exactitude. The author has, we think, inverted this order of ideas in defining his task and duty.

Hence a volume of very great value as a full record, not merely of the living, but of the moribund, and even stillborn; moreover, a very substantial evidence of the author's industry and capability, and, may we say, modesty; a volume invaluable to the specialist, but to the young student invaluable in the other sense, that is, he will not know how to value it. The author, we hope, may use this exhaustive compilation of records in producing a text-book based on a vital and vitalising ground plan, that is, designed to mould the student mind, equipping it with a critical basis for research work in a field which is one of the most attractive and least exhausted of any branch of natural history.

AN ASTRONOMICAL POET.

Manili Astronomicon Liber II. Edidit H. W. Garrod. Pp. xcix+166. (Oxonii: E Typographeo Academico, 1911.) Price 10*s*. 6*d*. net.

MR. GARROD has by this volume deserved the gratitude of every student of astrology, and in a less degree of every student of ancient astronomy, which is constantly illustrated by astrology. If the book which he has edited is of small value for the history of astronomical science, it is entitled to a high place in astronomical poetry, and Manilius's imagination may appeal to many who have no independent interest either in astrology or in the history of astronomy. As Mr. Garrod points out in his preface, the second book of Manilius is at once the longest and the most difficult. It requires close attention to geometrical ideas of no value to modern science, and these ideas are made the more difficult through being expressed in verse, and in a verse teeming with poetic metaphor, instead of in prose. "And not only is the second book hard, but the commentaries upon it are hard too. No one commentary suffices," says Mr. Garrod. This criticism might now be more appropriately expressed in the past tense. The Latin text of the second book is hard, though Mr. Garrod's painstaking study of the text has done much to make it easier, but there is no difficulty in following it with the aid of the translation and commentary that Mr. Garrod has supplied. In fact, the translation might be read with interest by one who has forgotten his Latin.

Mr. Garrod has brought to his work a rare combination of qualities. This is not the place, nor am I the person, to do justice to his gifts or achievements in the department of textual criticism, though it is here that the chief value of his work probably lies, and it is certainly this part of his work that will attract most attention from other scholars. Questions of grammar and prosody arise less often, but Mr. Garrod is a master of all these. He has, moreover, what is rare in these days, a taste for astrology, and, what is happily less rare, a genuine poetic feeling, which shows itself, not only in the taste of his renderings, but in his very pretty preface, and perhaps finds its best expression in the verses on the constellation Engonasin, the modern Hercules, with which the preface concludes. These verses are a perfect gem and an important addition to our not too large store of astronomical poetry. Another feature of the preface to which I would invite the attention even of those who do not wish to read the book is the brief, but critical, bibliography of modern works on ancient astronomy and astrology (pp. ix, x). Perhaps it is not too much to hope that the editor will permit this bibliography to be reprinted along with his verses in some astronomical journal, where they may interest readers who are not likely to see the present volume. J. K. Fotheringham.

OUR BOOKSHELF.

Practical Mathematics and Geometry. A Text-book for Advanced Students in Technical and Trade Schools, Evening Classes, and for Engineers, Draughtsmen, Architects, Surveyors, &c. By Edw. L. Bates and Fredk. Charlesworth. Part iii., Advanced Course containing numerous Practical Exercises, with Answers, and about 300 Illustrations. Pp. viii + 447–776. (London: B. T. Batsford, 1911.) Price 3*s*. net.

This volume is in continuation of the subjects treated in parts i. and ii. by the same authors; these were reviewed in Nature of February 9, 1911. The mathematical part of the present volume comprises sections dealing with trigonometry, mensuration, algebra, and rates of increase. The geometrical portion includes tangential arcs of circles, loci, conic sections, vectors, and descriptive geometry. The difficulty of coordinating successfully the two main branches of the subject is evident in this volume as in its predecessor. Chapters dealing with geometry stand isolated among others of a mathematical character, there being no apparent connection. Perhaps the chapter on conic sections is the only one showing a real attempt at coordination. The trigonometrical portion is very brief, containing little more than the definitions of the functions of an angle and the solutions of triangles. It would be useful to have the relations of the sum and difference of two angles included in this volume. In many cases the authors are content with the mere statement of a rule; this probably is the result of taking cases from practice, not in illustration of principles already discussed, but as problems needing a solution.

Descriptive geometry occupies the last seven chapters, and these may almost be regarded as a separate book. The matter includes projections of simple figures, planes, and plane figures in space, intersecting planes and lines, plane sections, and developments of surfaces. The treatment of this portion of the volume, apart from what has preceded it, is good, and will give the student reasonable grounds for believing that he is acquiring some systematic knowledge of practical geometry.

Principles and Practice of Poultry Culture. By John H. Robinson. Pp. xvi + 611. (London and Boston: Ginn and Co., n.d.) Price 10*s*. 6*d*.

Mr. John H. Robinson is one of the best-known poultrymen and one of the best-known writers on poultry matters in the United States. To say that his present work will be popular in the ordinary acceptation of the word with the British reader is perhaps saying too much. With the student, and more especially on the shelves of the professor of animal industry and in the college library, there it should be found, and not only found, but read.

The chapters one would particularly like to mention for special quotation (if space permitted) are: iii., economic aspects of poultry culture; iv., the poultry keeper's problems; vii., systems of poultry keeping; xii., poultry foods; xiii., rations and methods of feeding; xxi., types, breeds, and varieties of fowls; xxii., turkeys; xxiii., ducks; xxv., phenomena and principles of breeding. It must be remembered that America has given us the Rock, the Wyandotte, the Rhode Island Red, and one of the best utility types of Leghorn.

The Philo system of housing, the "dry feed" and "dry mash," and the score card for teaching purposes all emanate from the States. This country has learnt much from the "other side."

Even for the illustrations alone, the book is well worth buying. We have purposely omitted to comment on the somewhat elaborate plants, as the climate in this country does not warrant such expense. As indicated above, the thoughtful reader will find much food for reflection, while the purely practical man will devour eagerly the definite directions, particularly those referring to ducks, geese, and turkeys.

Geographical Pictures (from Photographs). Series iii.: Sculpture of the Earth's Crust. Packet No. 1. Plates 1–6. Packet No. 2. Plates 7–12. (London: A. and C. Black, n.d.) Price 6*d*. per packet of six pictures.

Messrs. Black issue these illustrations, which measure about six by five inches, as part of their scheme of school geography. Packets 1 and 2 are concerned with processes of weathering, and the pictures are described by Miss S. M. Nicholls. Their low price allows of the use of several copies in a class, the teacher pointing out the salient features, and the pupil following his remarks with the aid of the abridged description on the plate. The views of granite in the Scilly Isles, of wind-carved rocks in Colorado, and of the interior of a cave at Cheddar, seem particularly happy. The text is clear and to the point, though the two attempts to spell the Snowdon buttress, Crib-y-Didysgl and Cribs-y-Dysgl, will not please Welshmen. G. A. J. C.

LETTERS TO THE EDITOR.

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

The Solar Eclipse of April 17.

THE study of the article by G. Fayet in the *Revue Scientifique* of March 30, an account of which was given in NATURE, convinced me that, with favourable weather, the solar eclipse of April 17 would prove to be interesting, although its totality was extremely doubtful.

I went to Paris on April 16 and put up at the Gare du Nord. At 10 a.m. on April 17 I took a suburban train from that station to Eaubonne, which was on the central line, as shown in the map given in Fayet's article. I arrived there about 10.35, and after looking round I took up a station at a seat by the roadside in front of the school. When I arrived the boys and girls were being dismissed, by order of the Minister of Education, so that they might see the eclipse. Some of them came round me while I was looking out for the first contact. They were much interested, and were very well behaved. They all had the red glasses supplied by an advertising firm, but they had a curiosity to see the sun through my glass, which showed it in its natural colour, and they were delighted with the effect.

During the first hour they played about, because watching the gradual encroachment of the moon on the sun was tedious. When the diminution of daylight made itself felt they began to gather round me; so I told them they must not look at me but look at the sun and moon, and notice all that they saw, and that, while the eclipse was going on, they must not speak to me or to each other. "*Ne pas parler?*" "Yes," I said, "*ne pas parler*—you must look and do nothing else." They retired into the back part of the playground and stood in a group, and they no doubt looked, for they were quite silent.

When the central phase was over and I had taken my glass away from my eyes, they rushed up in a body and surrounded me, and I asked them if the sun had become quite dark or if there had been some light all the time. Their opinion was divided. From this I concluded that the sun had been at no time completely obscured, for this would certainly have impressed them.

As I was working alone it was useless to try to take the times of contact. Moreover, the second and third contacts, which are the most important, would happen so close to each other that, if I attempted to time them, it would interfere with my seeing what happened. I therefore devoted myself entirely to following the eclipse and observing as well as I could everything that took place. It was certain that "Baily's beads" would be a feature of the eclipse, and I had great curiosity to study them.

The sky was cloudless and the sun very powerful. I had with me an ordinary binocular of low power, which I hoped to find useful when the short-lived central phase, whether total or annular, arrived. In order to be able comfortably to follow the eclipse from the beginning to the end, I had the hand glass which pleased the school children. It was a combination of three coloured glasses measuring 110×35 millimetres, so that the sun could be observed through it, using both eyes, whether it was used alone or in conjunction with the binocular. The effect produced by this combination of colours was that the sun, viewed through it, appeared of its natural hue. The density of the coloured medium was such that nothing but the sun's direct rays penetrated it, and the sky, in which the sun appeared to be set, was quite black.

I bought this glass of a hawker in the streets of Barcelona on the eve of the total eclipse of August 30, 1905, and I found it very useful, although the interest of that eclipse centred almost entirely in the total phase, which lasted nearly four minutes, and during it reducing glasses were not required. Very fortunately I was able to lay my hands on it before starting for Paris, and it was indispensable during the eclipse.

The three glasses have an aggregate thickness of 7 millimetres, and they consist of one green glass 3 millimetres thick and two pink glasses, the external one being 2½ and the internal or middle glass being 1½ millimetres thick. These seem to be pieces of the same glass, and differ from each other only in thickness. They have the same colour, which is very nearly that of a dilute solution of permanganate of potash. The colour of the green glass is a chromium-green, and the colour-intensity of its thickness of 3 millimetres has been successfully compensated by a 4-millimetre thickness of the pink glass. The result of the combination was most satisfactory.

Having noticed that first contact had taken place, I settled down to follow the progress of the eclipse, and I continued making observations every five minutes. The rate of encroachment on the periphery of the sun became less and less, though the augmentation of the area eclipsed proceeded rapidly.

At 11h. 35m. the eclipse appeared to be affecting the general illumination, and I looked round at the school-house to the north of me. The ultramarine blue of the sky was getting darker and more of an indigo. Looking towards the horizon, which was masked by trees, the illumination was becoming decidedly fainter. The indigo colour of the sky spread round and became deeper as the eclipse went on, and, by 11h. 50m., there was an impression of approaching nightfall.

At 11h. 40m. the invasion of the sun's disc had reduced it to a crescent with very sharp cusps. The limb of the moon still looked quite circular, but at 11h. 45m. it became somewhat ogival, and by 11h. 50m. this effect was very marked. By this time the schoolboys were observing the sun without coloured glasses.

I now noticed the peculiar appearance of the shadows of the foliage of a tree cast on the ground close to my station. I also noticed that the illuminated surface of the dusty playground became more and more sombre, while the shadows under the trees preserved the same tone, so that, while the illumination of the exposed ground diminished rapidly, that of the ground in the shade of the trees had already nearly reached its minimum of illumination before the eclipse was complete.

After this my attention was confined entirely to what was taking place in the sky. I was now using the binocular with the reducing glass in front of the eyepieces. With it the rapid diminution of the luminous crescent could be easily followed and the view furnished was very sharp.

As the area of the luminous crescent diminished rapidly before the advance of the dark lunar disc *the colour of its light suddenly changed to red.* This suggested to me that a brilliant display of protuberances might be expected. The tone of the red reminded me, at the moment, of that of nitrous fumes escaping into the air; it was therefore a very pure red. It became visible only after the overwhelming intensity of the relatively white light of the middle of the sun's disc had been screened off by the interposing moon; but it would have been impossible to perceive the red colour, intense though it was, had it not been for the perfection of my reducing glass, which, while it reduced the intensity, preserved the natural colour of the sun's light.

Before the most striking phenomena of the central phase began to crowd across my view, I noticed the beginning of the phenomenon which most impressed me when witnessing the eclipse of May, 1882, in Egypt. In the last moments before totality the rate of extinction of light was very great, and I compared it with that which would take place in a well-illuminated room when a shutter is rapidly drawn down over the window. In the case of the 1882 eclipse the shutter was drawn quite down, and nocturnal darkness was produced with the appearance, not only of all the principal stars, but also of an unsuspected comet in the immediate vicinity of the sun. In the case of the present eclipse the shutter was at first being drawn down quite as rapidly, but it stopped short, and was almost immediately pulled up again. I have no doubt whatever that if the eclipse had been total, it would have been a very dark one.

The central phase was now close at hand, and the appearance of the luminaries changed so rapidly that it was impossible to time the changes. After the light of the whole solar crescent had become quite red, my attention was attracted to the lower (S.E.) luminous cusp, which seemed to become indented by black bands or teeth. Then the upper (N.W.) cusp showed a similar phenomenon; and, almost in a moment, the black teeth spread over the whole crescent, which then offered a magnificent spectacle. The bands or teeth did not span the crescent always by the shortest path, but they crossed and intersected each other like a crystallisation. There was, however, but little time to study them. Very quickly the dark disc of the moon advanced and pushed the beautiful network over the eastern edge of the sun, which it totally obscured, and, apparently at the same moment, the network reappeared, coming over the western edge of the sun, attached to the black limb of the moon, and at the same time held by the limb of the sun. In a few moments the uncovered crescent of the sun had increased so much that the delicate lacework could no longer bear the tension; it parted and disappeared instantly, while at the same moment the dark limb of the moon recovered its perfect smoothness of outline.

The central phase of the eclipse was over, and I could not say that I had seen either a total eclipse or an annular one, but I had witnessed a very remarkable natural phenomenon.

All the phenomena were so astonishing and followed each other so closely that it was impossible to pay attention to every detail. The two crescents, the disappearing and the reappearing one, seemed to be situated diametrically opposite to each other. I perceived nothing on the upper (N.) or the lower (S.) edge of the common disc, but there might have been a thread of light or a string of minute "beads" on one or both of them; and, consequently, I cannot say if the light of the disappearing crescent passed round the northern or the southern limb of the common disc and so preserved continuity between the departing and the arriving crescents, or if it passed round at all. All that I *saw* was the extinction of the departing crescent, and, *post saltum*, the illumination of the arriving crescent.

When the moon is in conjunction and the sun is behind it, the mountains cut by a tangential surface cannot be very evident, because *they can only be the summits of the very loftiest peaks. The valleys are wholly masked.* My binocular, the magnifying power of which is only twofold, shows the mountains and valleys beautifully when the moon is in quadrature, but during the eclipse it made the edge of the lunar disc appear as a smooth and continuous line. The mountains were perfectly invisible on it; yet what we take to be their images were enormous. The phenomenon is not a subjective or an instrumental *spectre*, because it is seen by everybody, with every kind of instrument and without any instrument at all. It is a reality; it must therefore be due to a substantial cause, and to one which can be shown to be capable of producing the effect. May not this substance be the often suggested lunar atmosphere; and, if so, what is its exact specification?

May 3. J. Y. BUCHANAN.

The Distastefulness of Anosia plexippus.

REFERRING again to the above topic (NATURE, December 21, 1911), I wish to make clear my position on the subject. Mr. Pocock's experiments indicate that *Anosia plexippus* is distasteful to many birds, but it is desirable to know whether or not *Basilarchia archippus* is palatable to birds, and it is absolutely necessary, before the usefulness of this case of mimicry can be shown, to know that North American birds eat some butterflies, but scarcely, if at all, molest these two forms.

My former letter was prompted by the evident assumption in the note of October 12 that the case was necessarily one of useful mimicry.

The only case I know of North American birds taking butterflies to any extent only serves to emphasise the lack of attractiveness of butterflies to birds. In this case (referred to by the observer in NATURE, February 15, 1912) only five out of forty-five species of birds observed could be found by direct observation and stomach examination to eat the *Eugonia californica*, which occurred in such countless numbers as to constitute a pest. Two species of fly-catchers captured them to some extent, meadow larks were shown to take them sparingly, and the omnivorous blue-fronted jay, so far as the evidence went (two stomach examinations) ate the butterflies to the extent of one-third of their food. But the only avian species which was shown generally and extensively to utilise these butterflies as food, notwithstanding their excessive abundance everywhere, and the exceeding ease of their capture, was the Brewer blackbird (an omnivorous bird which habitually eats whatever is most easily available, from flies and stinkbugs to seedling grain and fruit), which, in common with the farmyard chickens and ducks, took them in great quantities. Even this rather moderate attack upon butterflies by North American birds (under conditions so exceptionally favourable) far surpasses the aggregate of all previous records.

That North American birds *very* rarely molest adult butterflies is indicated by at least two lines of evidence. In the first place, observers seldom or never see a butterfly pursued or eaten by a bird. One cannot ordinarily by field observation distinguish the insects taken by birds, because the majority of them are inconspicuous forms. But if butterflies were taken, even uncommonly, field naturalists should be able to note the fact more often than once or twice in a lifetime. It is a noteworthy fact to American observers how very seldom, if ever, they see a butterfly taken by a bird.

For a number of years trained experts of the United States Department of Agriculture have been engaged in determining the food of native birds by examination of the contents of thousands of bird stomachs collected in all sections of the country and in all seasons of the year. The bearing of these findings upon the question of butterflies as food for birds has recently been summed up by one of these experts as follows:—"Four records of birds eating butterflies are all that are afforded by the records of the examination of more than 40,000 stomachs in the Biological Survey, and one of these probably relates to the capture of a very recently emerged specimen, or to one torn from the pupa before emergence, as it was accompanied in the stomach by a pupa of the same species. This was an *Epargyreus tityrus* taken by a crow. The other records are *Eudamus* (sp.?) eaten by a yellow-billed cuckoo, and two pierid butterflies captured by king birds" (W. L. McAtee, *The Condor*, January–February, 1912).

Such a mass of evidence (obtained by most careful and painstaking methods from the time the bird is shot *in its natural habitat* until the last recognisable portion of the stomach contents is identified and tabulated) demonstrates that as a food for North American birds butterflies are negligible, so that the distastefulness of *Anosia plexippus* and its close resemblance by *Basilarchia archippus* appear of no possible advantage to these species so far as birds are concerned. Nor can this be lightly pushed aside as "negative evidence." It shows *positively* that our birds do not eat butterflies to an appreciable extent, else immensely more than four butterflies should be found in more than 40,000 stomach examinations.

In a recent article relating to the palatability of insects to birds (Proc. Zool. Soc., September, 1911) Mr. Pocock explains that the behaviour of birds experimented upon in the Zoological Gardens was probably due in a measure to "inability in the gardens to feed the birds on living insects other than meal worms. The living prey was evidently a great treat to them, and over and over again I was impressed with the persistence shown by birds in persevering with insects that were obviously not to their liking, returning to the morsels repeatedly as if food of such a nature was too good to be wasted." But in the first succeeding paragraph he says:—"The insectivorous birds in our aviaries seemed to know at once what the butterflies were; they were on the alert the moment one was liberated and pursued it with determination and precision, following its every turn and twist, and either catching it upon the wing or pouncing upon it after settling. It is true that this predatory deftness may have been acquired in relation to the chase of insects other than Lepidoptera, but unless the birds recognised butterflies in general—a group which cannot be mistaken for other insects—as part of their natural prey, it is difficult to understand their eager excitement at the sight of those I offered them."

As an explanation for the conduct of the birds in Mr. Pocock's experiments the first quotation above seems to me sufficient as regards the avidity with which the birds in the gardens pursued butterflies. As regards the deftness with which the birds caught them, it would seem very remarkable indeed if an insectivorous bird normally taking its prey upon the wing could not catch insects relatively so slow and clumsy on the wing as butterflies. The highly theoretical suggestion that "birds recognise butterflies as part of their natural prey" seems to me fanciful, entirely unnecessary, and certainly not preferable to Mr. Pocock's first explanation for the eagerness with which all insect food was received by the captive birds.

As to the converse, it would seem more reasonable and plausible to attempt to explain the deftness of the dodging butterflies as arising from the admittedly frequent pursuit of butterflies by one another rather than from the supposed attacks by birds.

The pertinency of experiments made under such abnormal conditions and the validity of conclusions reached from them are open to serious question. McAtee (*Journ. Econ. Entom.*, vol. iii., pp. 437–8, 1910) has very well shown the futility of basing conclusions as to their natural food upon experiments with birds removed from their natural environment. He cites a number of cases of captive birds which refused specific articles of food known to constitute a large part of their normal diet, and of others which willingly accepted food which they never get in their wild state. For examples, a confined blue jay refused acorns and beech nuts; a captive bluebird refused one of the ground beetles, *Scarites subterraneus*, and a caged song sparrow refused seeds of lamb's quarter and smartweed; yet these birds in a wild state are known to take these respective foods in quantity. On the other hand, a captive shrike willingly accepted and devoured a goldfish and a black bass, food it probably never takes in the wild state.

Since Mr. Pocock implies that I am one of "the dwindling minority of mimicry sceptics," I should like to suggest that before he assumes too much regarding this "dwindling minority," he make a census of the opinions of working zoologists (with reference to the usefulness of this particular case of mimicry, for example) and learn where the majority actually stands and toward which side of the question the dwindling really tends.

A. M. BANTA.

Cold Spring Harbor, N.Y.

FROM Mr. Banta's concluding paragraph I am afraid my reference to the disbelievers in mimicry as a dwindling minority hurt his feelings. I hasten, therefore, to explain that it was written in a spirit of "chaff," without any intention to give umbrage. Apart from this, there is nothing in my contributions to the question of the distastefulness of *Anosia plexippus* which, in my opinion, needs explanation or qualification. The statistics Mr. Banta quotes to prove that North American birds do not eat butterflies are full of interest. They show at all events that the birds examined had not eaten butterflies within a few hours of being shot, and they justify the belief that the birds in the areas investigated do not trouble themselves to catch butterflies when other insects are obtainable. It would be very interesting to know if the Department of Agriculture found empty stomachs in any birds shot in districts where butterflies of various kinds were plentiful and other insects scarce. That would be a very important piece of evidence in favour of the contention Mr. Banta upholds.

There is perhaps nothing so impressive in connection with the theory of mimicry as the vast amount of corroborative evidence that has been accumulated since it was first propounded. This stands out in strong contrast to the complete inadequacy of the explanation of the facts on which it is based put forward by its opponents. The repetition of this truism is prompted by Mr. Banta's suggestion that the skill butterflies display in evading the swoop of insectivorous birds has been acquired, not, be it observed, in connection with the pursuit of voracious enemies, but in connection with the apparently often sportive chase of one butterfly by another. If we push this argument to its logical conclusion, we must also explain the vanishing of many butterflies when they alight as the result of that same factor. With this view I can only say that I do not agree.

R. I. POCOCK.

Zoological Society, April 27.

Clouds and Shadows.

IN a letter to NATURE (April 18) Mr. Chas. Tilden Smith directs attention to a peculiar shadow he noticed in the western sky last Easter Monday after sunset, and which he no doubt correctly attributed to "some unseen object intercepting the sun's rays," and so casting a shadow on the high and still directly illuminated stratus he mentions.

Such shadows are by no means uncommon in lower latitudes, and are certainly caused either by clouds, especially the towering columnar cumuli (so common in the Caribbean Sea) or by mountains. For many years past the writer has been collecting data regarding such shadows and working out the position, size, and shape of the objects causing them. He has succeeded in (*a*) predicting correctly the form, position, and duration of the shadows caused by *mountains* for a sunset viewed from a known position (supposing that clouds did not interfere), *e.g.* from a ship to the east of Cuba, in which case it was possible to assign some of the observed shadows to definite peaks; and (*b*) he has succeeded in (conversely) deducing from the observed positions and forms of these shadows the general configuration of the mountain ranges which caused them—*e.g.* off the eastern coast of Brazil.

Such shadows to be seen well require (1) a clear lower atmosphere, and (2) a reflecting layer at a considerable height—*e.g.* six miles.

The writer hopes to be able before long to publish these and many other observations and deductions, together with the formulæ necessary for the analysis of this part of a sunset. T. C. PORTER.

Upton, Slough, May 3.

THE ROYAL ACADEMY AND NATURE-STUDY.

THE annual exhibition of pictures at the Royal Academy always affords a good opportunity of examining the works of the several contributors as far as they may be considered representations of natural phenomena.

The following notes have therefore been made regarding such points as clouds, sun, moon, sunset skies, &c., and these are brought together under their respective heads.

MISTS.

163. *The Cradle of the Storm. Frank T. Carter.* The mist or low drifting cloud about the mountains is here beautifully portrayed, and the swirl-forms indicate local eddies; the lighting is very true.

190. *A Highland Loch. Peter Graham, R.A.* Beautifully graded mists on the mountain sides, and the effect of the rift, which is an important feature in the picture, is well indicated.

CLOUDS (NIMBI OR RAIN CLOUDS).

22. *The Midlands. C. E. Johnson.* Cloud forms and colour very good. Excellent representation of a rain squall on the right.

169. *The Hunters. C. Napier Henry, R.A.* Form and colour and general arrangement of the clouds quite natural.

170. *Dryslwyn. T. Hodgson Liddell.* The cloud forms here are accurately shown, but the falling rain is not well represented, being not sufficiently transparent for such a close squall.

184. *A Passage Perilous Maketh a Port Pleasant. W. L. Wyllie, R.A.* The cloud forms and colour here are very natural, and the reflection on the water true.

189. *The Passing Snowstorm. Ernest Procter.* The clouds here are too dark and coarse. (When looked at from some distance the effect is improved.)

193. *Bredon on the Avon. Alfred Parsons, R.A.* Both form and colour of the clouds beautifully represented. A fine cloud study and one to be copied.

221. *Rain Clouds: Bosham. Moffat Lindner.* The large nimbus is far too solid-looking and lacking in detail. Such a cloud in nature is full of detail, both in structure and light gradations. As here depicted it looks like a lump of dough.

285. *The Approaching Shower. Beatrice Bland.* Both the clouds and falling rain are well represented. The shower, however, is not approaching but travelling nearly from left to right, as indicated by the slant of the falling rain.

117. *The Approaching Gale. Julius Olsson.* The clouds and waves are both good in form, but why the violet colour in both?

359. *Stormy Evening on the Cornish Coast. Julius Olsson.* This picture, like 117 above, is too violet all over.

360. *Evening on the Nebelhorn, Bavaria. Edward T. Compton.* The contrast between the fair weather on the right of the picture, the approaching rain clouds on the left, and the brightly illuminated snowfields in the foreground is well thought out and rendered very true.

CLOUDS (CUMULI, FINE WEATHER CLOUDS).

20. *Woodland and Hill. Sir E. A. Waterlow, R.A.* Very fine representation of clouds with excellent detail and gradation. Perhaps some of the upper portions of them are not white enough.

40. *The Incoming Tide: Porth, New Quay. B. W. Leader,* R.A. Good cloudscape, but must not be looked at too closely to obtain desired effect.

81. *Submarines and Torpedo Craft: Old Portsmouth. W. L. Wyllie, R.A.* Most excellent clouds, showing the result evidently of much observation. Indications of ascending air and upper horizontal air currents very natural. Reflection on water well graded.

115. *The Hills of Appin. J. Campbell Mitchell.* Forms of clouds most unnatural. Too much drawn out vertically, and little detail shown.

162. *Marazion Marsh, Cornwall. J. Noble Barlow.* Clouds badly formed, and, like those in 115, too vertical.

323. *The Home of Labour. E. Blair Leighton.* No idea of cloud form, and lighting all wrong. Clouds are drawn out like 115 and 162.

393. *"The Toiling Year's Last Breath." Frank Walton.* The clouds are good, both in form, detail, colour, and gradation. Their lower flat surfaces should be horizontal and not all inclined similarly.

461. *The Walls of England. R. Gwelo Goodman.* Absolutely impossible skyscape.

582. *Spring Sunshine. Alfred Parsons, R.A.* The cumuli clouds and sky are here very naturally depicted, and the artist has blended the sky with the landscape most successfully. The tints of the blossoms on the trees are true and admirably represented.

755. *A Fine Morning on the Sussex Coast. B. W. Leader, R.A.* A well-painted and natural skyscape with the same proviso as 40.

129. *The Mass at Dordrecht. Moffat Lindner.* Well-shaped cumuli and good reflections of clouds in water.

198. *Skirt of the Dunes at Condette, Pas-de-Calais. H. W. B. Davis, R.A.* Gradation of blue sky from horizon upwards is possibly changed too suddenly.

CLOUDS (CIRRUS, HIGH CLOUDS).

390. *A Gentle Breeze. Hon. Duff Tollemache.* Form and colour of the cirrus cloud very natural.

505. *Fifteen-metre Yachts Rounding the East Lepe Buoy: Cowes Regatta. Alice Fanner.* The cirrus cloud in this seascape is very good. The small cumuli and wisps of cirrus very natural.

689. *Six-metre Yachts Racing at the International Regatta, Solent,* 1911. *Alice Fanner.* The cirrus clouds are well represented.

SUNSETS, SUNRISES (SKY).

13. *Scur-na-Gillian, Sligachan. Finlay Mackinnon.* A beautiful picture with a bold effect of sunset. Is not the near side of the right-hand peak too much illuminated?

55. *Evening on the Sands of Towyn. B. W. Leader, R.A.* A fine sunset sky; shape and colour of clouds very true. Reflection in water and breaking wave very effective. A fine picture.

147. "*The Day was Sloping towards his Western Bower.*" *Joseph Farquharson, A.* Have we not here a too great diversity of colours? Should not the yellow tinge be more universal and be more represented on the hill on the left (which seems too pink) and also on the under portions of the clouds?

205. *Evening's Last Gleam. B. W. Leader, R.A.* A fine study and lighting excellent. The sunlight on the upper portion of the clouds very effective.

429. *The Matterhorn, from the Triftkummen: Sunrise. Edward T. Compton.* The colours here are very true in tone, and the wisps of mists on the mountains appear already to be in the process of being dissipated.

465. *The Prize. Donald Maxwell.* A bold picture. Very striking sunset effect, both in the sky and by reflection. Excellent colouring.

669. *A Peaceful Valley. Hon. Walter James.* This sunset scene is accurately painted, and the cloud forms, colouring, and general gradation of the tones very true. The atmospheric absorption in the distant landscape naturally indicated.

790. *Into the West. Robert W. Allen.* The sequence of the colouring at the different altitudes very natural. The type of cloud represented is true, but there is not sufficient of the sunset colours reflected in the water.

SUN'S DISC.

29. *The Wane of an Autumn Day. J. Coutts Michie.* The disc of the sun is very much too large, and, judging by the angles subtended by the objects in the foreground, it is more than twice the size it should be.

MOON.

353. *Moonrise: the Dunes, Pas-de-Calais, France. H. Hughes-Stanton.* The full moon much too large, judging by the trees in the foreground.

369. *Moonlight on the Cornish Riviera. R. Borlase Smart.* Moon too large for similar reasons; also sky around the moon too blue.

782. *Moonrise over the Marsh. Stuart Lloyd.* The moon here is more natural, but still a little too big judging by the trees in the foreground.

122. *Evening. William Brock.* In this picture only a small portion of the upper part of the moon is seen above the horizon. By its horizontal extent and curvature it is very much too large, and calculations suggest that if the whole disc were visible it would be three or four times too large.

123. *Twilight. Fred Hall.* The size and colour of the moon are good. The woman and cattle in foreground are perhaps too much illuminated.

151. *An Autumn Evening in the Alps. Adrian Stokes, A.* The sun is here supposed to be below the horizon on the right, consequently the visible illuminated portion of the moon ought to be leaning slightly over to the right also, and not as shown. The clouds are also too bright relative to the moon.

RAINBOW.

468. *The Home Port. W. Ayerst Ingram.* This would be a fine picture if the rainbow were omitted. The sun is setting on the right of the picture more than 90° away from the observer. This can be gathered from the position and sunlight on the ship in the centre of the picture and other illuminated objects. As one of the fundamental conditions for seeing a rainbow is that the sun should be at the back of the observer, it is not possible for a rainbow to be included in the picture under the existing sunset position.

REFLECTIONS.

167. *A Little Mishap. Sir E. J. Poynter, Bart., P.R.A.* An excellent study of reflections.

WILLIAM J. S. LOCKYER.

INTERNATIONAL ASSOCIATION OF CHEMICAL SOCIETIES.

THE International Association of Chemical Societies held its first formal meeting in Paris in April, 1911, when the delegates nominated by the French, German, and English Chemical Societies met and ratified the statutes of the association, the council of which as at first constituted consisted of Profs. Béhal, Hanriot, and Haller representing the *Société Chimique de France*, Profs. Jacobson, Ostwald, and Wichelhaus representing the *Deutsche chemische Gesellschaft,* and Profs. Frankland, Meldola, and Sir Wm. Ramsay representing our Chemical Society.' The second conference was held in Berlin last month, under the presidency of Prof. Ostwald and the vice-presidency of Prof. Wichelhaus, when the council was further enlarged by the addition of Profs. Carrara, Oglialoro, and Paternò representing the Italian Chemical Society, Profs. Kurnakow, Tschugaeff, and Walden representing the Russian Chemical Society, Dr. Day and Profs. Noyes and Richards representing the American Chemical Society, and Profs. Fichter, Guye, and Werner representing the Swiss Chemical Society. Certain other societies representative of Holland, Denmark, Austria, and Norway were also affiliated, but were not directly represented on the council. Prof. Meldola, having been unable to attend the meeting, withdrew from the representation of the Chemical Society, and was replaced by Prof. Crossley.

The first work of the Association is the consideration of the nomenclature of inorganic and organic chemistry and the unification of the notation of physical constants. In connection with the latter part of the programme, the committee has been strengthened by the addition of M. Marie, of the French Society of Physical Chemistry. The English committees appointed to report upon these preliminary branches of work are, for inorganic nomenclature, Sir Wm. Ramsay, Dr. J. C. Cain, and Dr. Harden; for organic nomenclature, Profs. Kipping and Wynne and Dr.

Cain; and for physical constants, Drs. Wilsmore and Cain and Prof. Findlay. Dr. Cain's services have been secured for all three committees in view of his editorship of the publications of the Chemical Society. The other chemical societies have also appointed influential committees to deal with these same subjects, and the reports of these committees were considered at the Berlin congress last month. At this gathering thirteen societies having a total membership of 18,000 were represented. The next meeting of the Association is to be held in London in September, 1913, under the presidency of Sir Wm. Ramsay, when, in addition to the subjects already being dealt with, the question of the possibility of arriving at an international understanding with respect to editing and to the publication of abstracts will be considered.

In view of the overlap and duplication of publication now being carried on by several societies all doing the same kind of work, it will be seen that great need exists in the interests of chemical literature for making a serious effort towards centralisation. This can only be done by international co-operation, and it is to be hoped that some practical scheme may be developed as one result of the useful and valuable labours which the new Association has entered upon.

MR. JOHN GRAY.

WE announced with regret last week the death of Mr. John Gray, one of the examiners of the Patent Office, and well known for enthusiastic and painstaking efforts on behalf of anthropology. Mr. Gray was born at Strichen, Aberdeenshire, on January 9, 1854. He was educated at the Aberdeen Grammar School and at Edinburgh University, where he took the second prize in Prof. Fleeming Jenkin's class in 1873. He obtained the first Royal Exhibition at the Royal School of Mines, London, in 1875, and later received the associateship in metallurgy. He took his degree in Edinburgh in 1878, and entered the Patent Office in that year.

Mr. Gray made a study of many electrical problems, especially those bearing on electrical influence machines. He published a book on this subject, in which he traced the historical development of influence machines, and described such modern forms as those of Kelvin, Voss, Holtz, and Wimshurst. He was well known for his connection with physical anthropology, and took an active part in all recent efforts to secure its recognition by the State. He was elected treasurer of the Royal Anthropological Institute in 1904, and his efforts to improve the financial condition of that body were crowned with complete success. In 1904 he gave evidence before the Interdepartmental Committee on physical deterioration, and, in conjunction with the late Prof. Cunningham, submitted a scheme for a national anthropometric survey.

At the request of the Royal Anthropological Institute, Mr. Gray organised a deputation to meet the late Sir Henry Campbell-Bannerman, the object of which was to impress on the Government the necessity of carrying out the recommendation of the Physical Deterioration Committee with regard to a national survey. He designed a number of novel anthropometric instruments, some of which are extensively used by anthropologists, and for which he received a diploma of honour at the Franco-British Exhibition.

Mr. Gray took a deep interest in his native county, and, in conjunction with Mr. J. F. Tocher, conducted a series of anthropometric measurements on the population of Aberdeenshire from 1895 to 1899, the results of which were published in the Journal of the Royal Anthropological Institute, and in the Transactions of the Buchan Club, of which he was president in 1899. In 1901–1902, along with Mr. Tocher, he advocated a survey of the colour characters of school children of Scotland, and joined the Scottish committee on its formation, the other members being Sir William Turner, K.C.B., F.R.S., Prof. R. W. Reid, and Mr. Tocher. Both he and Mr. Tocher published memoirs bearing on the results of the survey from different viewpoints. Mr. Gray's memoir appeared in the Journal of the Royal Anthropological Institute (Vol. 37, 1907). In this memoir Mr. Gray gave his views on the distribution of colour in Scotland, and displayed local groupings by a system of contour lines in a series of maps.

Mr. Gray's many contributions to anthropological literature include the following:—"Measurements on Papuan Skulls" (J.R.A.I., 1901), "Indian Coronation Contingent" (B.A. Report, 1902), "England before the English" (B.A. Report, 1906), "A New Instrument for Determining the Colour of the Hair, Eyes, and Skin" (*Man*, 1908), and "Who Built the British Stone Circles?" (NATURE, December 24, 1908). Mr. Gray is survived by a widow and one daughter.

NOTES.

THE French Ambassador took the chair on May 3 at the first of the series of four lectures being delivered by M. Henri Poincaré on mathematical subjects at the University of London: the two remaining lectures will be given on May 10 and 11. M. Poincaré, who was born in 1854, was educated at the lycée at Nancy, entered the École Polytechnique, being placed first on the list, and on leaving it became a Government mining engineer (*ingénieur des mines*), this employment being reserved for those who occupy very high places at the *examen de sortie* of the school. He exercised this profession only for a short time; in 1881 he was appointed to a lectureship in pure mathematics at the Sorbonne, and when M. Lippmann exchanged the chair of mathematical physics for a chair of experimental physics, M. Poincaré succeeded him. Later, on the death of M. Tisserand, M. Poincaré succeeded to the chair of mathematical astronomy. He has made contributions of the greatest importance to pure and applied mathematics, astronomy, and mathematical physics, and also to scientific method, with which he has dealt in his books, "Science et Hypothèse" and "La Valeur de la Science." There is no mathematician living of greater eminence, and probably none whose writings cover so wide a field. It is the historic custom of the French Academy to number amongst its members one or two of the members of the Academy of Sciences whose reputation is best known to the world at large, and after the death of M. Berthelot (though not, we believe, as his successor) M. Poincaré was appointed to that body. M. Poincaré is a cousin of M. Raymond Poincaré, the French Premier.

THE Bill for the Protection of Ancient Monuments, introduced by Earl Beauchamp, has now passed its second reading in the House of Lords. The provision by which the right of pre-emption of valuable sites in the event of sale is reserved to the State was opposed by Lord Curzon in an impressive speech, in which he urged that the example of the destruction of historical buildings like Temple Bar and Tattershall Castle justified the extension of the powers at present possessed by the Government in such matters. But he pointed out the improbability of the Treasury granting funds for the purchase of such monuments, and he urged that the Society for the Protection of Ancient Buildings, which had been in existence for nearly forty years, should have a representative on the Advisory Board, and that a subordinate board should be formed in Scotland to report to London. Further additions to the staff of inspectors were also advisable. He made the startling suggestion that, as matters stand at present, the vicar and churchwardens of Stratford-on-Avon might remove the bust of Shakespeare from the church under their control. The Archbishop of Canterbury remarked that a faculty was necessary in the event of such a proposal, but he seemed to be inclined to admit that more rigid supervision over restorations and the disposal of church plate and stained glass should be provided through the diocesan courts.

IN a recent letter to *The Times*, apropos of a case in the Law Courts, Dr. G. F. Herbert Smith commented on the difficulty with which jewellers are confronted owing to the success that has been achieved in the manufacture of rubies. In the case in question the stones were styled reconstructed, but they were no doubt synthetical stones formed by the fusion of alumina powder by the method described by Prof. A. Verneuil in 1904. The former term is properly restricted to the cloudy, inferior stones resulting from the fusion of fragments of natural rubies. In both processes the colouring agent is chromic oxide. According to one witness, an expert jeweller could immediately detect a reconstructed ruby, because it had a different colour and lustre. While possibly true of the reconstructed, it is certainly not true of the synthetical stones. Owing to the essential identity of the molecular constitution the latter have the same lustre as natural rubies, and, although the artificial stones are usually made of one particular shade of red, yet the same tint is common in natural stones. Discrimination is, however, easy, because the synthetical rubies invariably contain faint curved markings and a few tiny, spherical bubbles. A simple and trustworthy test of this kind is very important on account of the great disparity between the prices of the two kinds of rubies. Men of science may consider the synthetical stones of greater interest; the general public views them otherwise.

APRIL, with its total rainfall of 0·02 in. at Greenwich, is not only the driest April on record, but it is drier than any month at any period of the year during the last 100 years. The absolute drought at Greenwich, which has now been brought to a close, continued for twenty-three days, from April 10 to May 2, which is the same length of time as the longest drought in the memorable summer last year, when no rain fell from July 1 to 23. The London area has only experienced about five droughts of a longer period during the last fifty years. The aggregate rainfall at Greenwich from March 24 to May 3, a period of forty-one days, was only 0·10 in., and the total fall from March 24 to May 6, a period of forty-four days, yields 0·29 in. The partial drought, not exceeding 0·01 in. per day, may be prolonged into May, but it cannot claim to be thrown further back into March. Some further results yielded by the observations published in the Daily Weather Report of the Meteorological Office show Oxford to have experienced an absolute drought for twenty-three days, and a partial drought from March 24 to May 3, with 0·18 in. of rain, whilst the total to May 2, a period of forty-one days, only measured 0·07 in. At Nottingham the absolute drought continued for twenty-two days, from April 11 to May 2; at Jersey twenty-two days, from April 12 to May 3; at Bath, twenty-one days, from April 13 to May 3, and the aggregate fall at Bath from March 24 to May 6, a period of forty-four days, is 0·57 in. The copious rains during the early part of March and throughout the past winter naturally rendered the recent drought far less serious than many previous spring droughts of somewhat recent years. An entirely different type of weather seems now to have set in, and the conditions have become favourable to a series of disturbances arriving over us from the Atlantic, so that fairly copious rains may be anticipated.

ONE of the chief objections to the Daylight Saving Bill is the dislocation the scheme would effect in the zone system of time reckoning established by international conferences held successively in Rome and Washington thirty years ago. Mr. W. Ellis, F.R.S., refers particularly to this point in a short article in the March number of *The Horological Journal*. At present the prime meridian of Greenwich regulates the time of the civilised world. If the clocks of Great Britain are put forward one hour in summer, as proposed by the Bill, they will not show Greenwich time, but mid-European time; that is to say, our prime meridian, accepted by nations as regulating the time of the world, will be discarded by us for five months in every year, in total disregard of existing well-considered and well-established international relations. An Act to enforce the alteration of clocks by putting them forward for one hour in summer would introduce confusion in a scientific system and disturb accepted international standards. We cannot believe that such a proposal will ever be seriously entertained by Parliament. A more promising subject to which attention may usefully be directed is the reckoning of hours from one to twenty-four in order to avoid the designations of a.m. and p.m. The Nord and Est Railway Companies of France have just introduced this twenty-four hour system for their clocks and time-tables, and the Orient express is now timed to leave the Paris Gare de l'Est at 19h. 13m. instead of 7.13 p.m. as heretofore, while on the station clocks the figures from 13 to 24 have been inscribed on the face within the outer circle of the existing hour figures. It would be a decided advantage if the 24-hour method of describing time were adopted in Great Britain.

AT the meeting of the Institution of Electrical Engineers on May 16, a marble bust of the late Lord Kelvin will be presented to the institution on behalf of Lady Kelvin.

THE governing body of the Imperial College of Science and Technology has appointed Mr. W. Frecheville to be professor of mining in the Royal School of Mines, in succession to Prof. S. Herbert Cox, who is about to retire.

MR. WALTER E. ARCHER, C.B., who, as assistant secretary, has been in charge of the Fisheries Division of the Board of Agriculture and Fisheries since its establishment in October, 1903, has been compelled to retire from the public service owing to ill-health. His retirement took effect on May 1.

WE are informed by Dr. Shaw, director of the Meteorological Office, that the superintendent of the observatory at Eskdalemuir, Dumfriesshire, reports that the seismographs at the observatory recorded a violent earthquake on May 6, at 7 p.m. The position of the epicentre is 63° N. latitude, 21° W. longitude, which indicates a place in the Atlantic not far from Iceland, to the south-west of the island.

MR. H. C. K. PLUMMER has been elected by the Board of Trinity College, Dublin, to be Royal Astronomer in Ireland, in succession to Dr. E. T. Whittaker, who was recently elected professor of mathematics at Edinburgh University. Mr. Plummer is the son of Mr. W. E. Plummer, director of the Liverpool Observatory, and has been second assistant to Prof. H. H. Turner at the Oxford University Observatory since 1901.

ON Tuesday next, May 14, Prof. W. Bateson will begin a course of two lectures at the Royal Institution on "The Study of Genetics," and on Thursday, May 16, Prof. H. T. Barnes will deliver the first of two lectures on "The Physical and Economic Aspects of Ice Formation in Canada." The Friday evening discourse on May 17 will be delivered by Mr. W. Duddell on "High-frequency Currents," and on May 24 by Mr. A. D. Hall on "Recent Advances in Agricultural Science—the Fertility of the Soil."

THE services of the official guide to the collections at the British Museum, Bloomsbury, have been so highly appreciated that a similar officer has been appointed, experimentally, at the Natural History Museum, South Kensington. Mr. J. H. Leonard has been selected for the position, and he will probably take up his duties before Whitsuntide. The guide will make two tours of the museum daily, each tour lasting an hour. Provision will also be made for special tours, and for these, special application will have to be made.

AT the annual general meeting of the Institution of Civil Engineers held on April 30, the following were elected president and vice-presidents:—*President*, Mr. Robert Elliott-Cooper; *vice-presidents*, Mr. A. G. Lyster, Mr. B. H. Blyth, Mr. J. Strain, and Mr. G. Robert Jebb. The council of the institution has made the following awards for papers read during the session 1911–1912:—Telford gold medals to Messrs. E. and W. Mansergh; a George Stephenson gold medal to Mr. R. T. Smith; a Watt gold medal to Mr. A. H. Roberts; Telford premiums to Messrs. J. Goodman, A. B. McDonald, G. M. Taylor, D. C. Leitch, W. C. Easton, and D. H. Morton; and the Manby premium to Mr. S. H. Ellis.

IN the report of the council of the Chemical Society presented at the annual general meeting on March 28, and published in the last number of the Proceedings, it is stated that in the opinion of counsel any person using the letters "F.C.S." without authority and for the purpose of wrongfully assuming the status of a fellow of the Chemical Society, can be restrained by injunction from so doing. Mention is made that the Becquerel memorial lecture is to be delivered by Sir Oliver Lodge in the place of Prof. Rutherford. In connection with the publication of the Journal it is stated that the cost is about 5200*l.* a year, which represents about five-sevenths of the society's income. The congratulations of the council have been offered to Mr. E. Riley, who has completed sixty years of fellowship, and to Major C. E. Beadnell, R.A., Mr. H. O. Huskisson, and Mr. F. Norrington, who, during 1911, attained their jubilee as fellows.

FURTHER particulars have been received of the arrangements in connection with the International Congress of Applied Chemistry, to be held in Washington and New York next September, to which reference has been made on previous occasions. It is stated that 573 papers have now been definitely promised to the respective sections. Five general lectures have been arranged: Mr. George T. Beilby, F.R.S., of Glasgow, on "Some Physical Aspects of Molecular Aggregation in Solids"; Prof. Gabriel Bertrand, of Paris; "Des rôles des infiniment petites chimiques en chimie biologique"; Prof. Carl Duisberg, of Eberfeld, "The Latest Achievements and Problems of the Chemical Industry"; Prof. Giacomo Ciamician, of Bologna, "La foto chimica dell' avvenire"; and Prof. Ira Remsen, of Baltimore, "Priestley in America."

MR. W. J. L ABBOTT contributes to the July-December issue of the Journal of the Royal Anthropological Institute a useful article on the classification of the prehistoric British stone industries. He points out the danger of assuming that the evolution of culture has progressed along a line of unbroken chronological sequence, and he shows that the evidence derived from our river deposits must be accepted with the qualification that in different areas there have been tectonic movements and phenomena attending differential elevation, depression, and denudation, which have contributed to destroy a consecutive altitudinal chronology. Palæolithic man being a nomad, he constructed his implements according to hereditary custom, while discoveries of improved methods were not easily disseminated over the wide areas occupied by these wandering groups. In the course of the discussion he suggests a new series of terms to designate various forms of implement. It is obvious that innovations such as these, unless accepted by a congress of anthropologists, are likely to lead to further confusion, and his proposal to assign the name "Prestwich" to one and "Evans" to another type, after two distinguished geologists and antiquaries, though based on the analogy of terms like "ohm," "watt," or "farad," is scarcely likely to meet with general acceptance.

To *The Field* of April 17 Mr. Lydekker contributes extracts from a letter from the British Resident in Nepal in regard to the so-called unicorn rams of that country, of which examples were exhibited some years ago in the London Zoological Gardens. Mr. Lydekker had previously suggested in the same journal that the fusion of the horns is due to artificial manipulation of those of young lambs of the barwal breed; and this is fully confirmed by the inquiries instituted by the Prime Minister at the request of the Resident. The budding horns of young lambs are seared with hot irons, and treated with soot and oil, after which, instead of spreading outwards, they coalesce and grow backwards.

IN connection with the treaty between Great Britain, the United States, Russia, and Japan for the suppression of pelagic sealing, Dr. F. A. Lucas contributes to the *American Museum Journal* for April an article on the Alaskan fur-seal. "The fur-seal," he observes, "would long ago have been swept out of existence but for the fact that the breeding-grounds are carefully guarded, and while the herd is but a tithe of its former size, it still comprises many thousands. If pelagic sealing can be brought to an end, the seal-herd will recuperate rapidly, even though the death-rate is high, and not more than half the seals born in any one season live to return the next. Whether or not this desirable end can be brought about remains to be seen, and some of us are not very hopeful."

THE twenty-second annual report of the Missouri Botanical Garden contains two long papers on the genus Agave, by Dr. Trelease, who also contributes a shorter paper on two new Yuccas. The Agave memoirs are illustrated by no fewer than eighty fine photographic plates, numerous new species being described, chiefly from Lower California. A further instalment of Griffiths's studies on the genus Opuntia is also included; this is illustrated by seventeen beautiful plates, representing ten new species.

FROM two articles on *Podophyllum emodi*, in *The Indian Forester* (April, 1912) and the Forest Bulletin (No. 9), by Puran Singh, it would appear that the Indian species has strong claims on many grounds for inclusion in the new edition of the British Pharmacopœia, which is now being revised by a committee of the Pharmaceutical Society. It has been definitely established that the Indian species yields a considerably higher percentage of resin, containing the active cathartic and purgative principle podophyllotoxin, than the American species (*P. peltatum*) which has hitherto been universally employed as the source of the drug podophyllin.

No. 48 of the Scientific Memoirs of the Government of India, by Major D. McCay, details investigations into the jail dietaries of the United Provinces. It contains a mass of statistical and analytical data on the subject which will be of the greatest value. The nutritive values of the diets at present in use, and the coefficients of protein and carbohydrate absorption of the different materials entering into those dietaries, have been determined, and from the data obtained eight new dietaries of practically identical nutritive values have been framed. Certain side-issues have also been investigated. The percentage of nitrogen in the fæces is practically constant, whatever the type of diet may be, and when inferior vegetable food-stuffs are made use of the loss of protein by the fæces is very great. A final conclusion is of considerable importance: from the facts collected with regard to the inhabitants of the United Provinces and martial races of the plains, it would appear that, other things being equal, diet is the all-important factor in determining the degree of physical development and general well-being of a people, and that with a low level of nitrogenous interchange deficient stamina, morally and physically, must be expected.

The meteorological chart of the North Atlantic for May, issued by the Meteorological Office on April 18, includes synoptic weather charts for April 8–17. During this period a large anticyclone moved north-eastward from the southern part of that ocean. The weather was fair over western Europe, but to the westward of longtitude 30° W. conditions were changeable and showery. The latest ice reports from Canada referred to the existence of heavy, close ice and numerous bergs in Belleisle Strait; off Cape Race (Newfoundland) no ice was visible. Mention is made of the fact that the bergs which appear annually in the North Atlantic have their origin, as a rule, in western Greenland; only a few come from Spitsbergen, and still fewer from Hudson's Bay. The mean limits of field-ice and of icebergs in May are laid down on the chart, the extreme boundaries being about 42° N., 45° W., and 39° N., 40° W. respectively.

A LECTURE on daylight delivered by Prof. E. L. Nichols before the Franklin Institute is reproduced in the April number of the Journal of the Institute. In addition to a summary of the facts about daylight, which are comparatively well known or can be found in a standard work like Pernter and Exner's "Meteorologische Physik," it contains an account of the measurements made by the author at home and in Switzerland by means of a spectrophotometer. These cover such subjects as the relative brightness of clear and partially or wholly clouded sky, the distribution of light of different wave-lengths in daylight at dawn and later, the effect of mist or an approaching storm on the distribution, and, lastly, the means taken in artificial illumination to imitate daylight.

IN the February number of the Bulletin of the Academy of Sciences of Cracow, Prof. Natanson has an article on the energy content of material bodies in which he points out an important distinction between Prof. Planck's theory of radiation and Prof. Einstein's idea that every material body consists of an assemblage of Planckian vibrators, the energy of which constitutes the heat energy of the body. While in the general theory of radiation it is unnecessary to inquire how many vibrators of a given period are present per gram of a material, so long as the interchange of energy of different wave-lengths can be effected by their means, in the latter theory it is of fundamental importance to determine the number of each kind present. Without this knowledge Prof. Einstein's interesting theory cannot be pursued further.

IN the course of a valuable paper on "Some Aspects of Diesel Engine Design," read by Mr. D. M. Shannon at the Institution of Engineers and Shipbuilders in Scotland, the author takes up the important question of the proper design of cams for operating the valves. The noise caused by some cam and roller gears is due principally to two causes, the first and greater being the speed with which the cam strikes the roller, and the second being the valve striking the seat. The latter need cause no inconvenience, since it occurs inside the cylinder, and is therefore of a muffled nature. To get rid of the former cause, the flat part of the cam profile should slide under the roller at a tangent, and should grip the roller with no velocity. If this is done, the valve can then be pushed open as rapidly as desired. The closing of the valve should be obtained in a similar manner. Diagrams are given showing the abrupt changes in speed and acceleration produced by a badly designed cam, and are contrasted with the curves given by a cam properly designed. There are many makers of internal-combustion engines who might profit by a careful study of Mr. Shannon's paper.

MESSRS. J. AND A. CHURCHILL have just ready for publication vol. vi. of the new edition of "Allen's Commercial Organic Analysis." This volume has been rewritten under the editorship of Mr. W. A. Davis and Mr. S. S. Sadtler.

AMONG the new books and new editions announced for publication by Messrs. C. Griffin and Co., Ltd., are the following:—"Practical Agricultural Bacteriology," Prof. Lohnis, translated by W. Stevenson; "Notes on Foundry Practice," J. J. Morgan; "Modern Road Construction," F. Wood; "Modern Pumping and Hydraulic Machinery," E. Butler; "Calculations on the Entropy Chart," Dr. W. J. Crawford; "The Evolution of the Internal Combustion Engine," E. Butler; "The Gas Turbine, Theory, Construction, and Working Results of Two Machines in Actual Use," H. Holzwarth, translated by A. P. Chalkley; "A Manual of Marine Engineering: comprising the Designing, Construction, and Working of Marine Machinery," A. E. Seaton; "A Treatise on Mine Surveying," H. Brough, revised by Prof. S. W. Price; "Electrical Photometry," Prof. H. Bohle; "Celluloid," a translation from the French of Masselon, Roberts, and Cillard, by Dr. H. H. Hodgson; "A Handbook on Metallic Alloys," G. H. Gulliver; "Mathematics and Mechanics for Technical Examinations," C. A. A. Capito.

OUR ASTRONOMICAL COLUMN.

A BRILLIANT METEOR.—A meteor of unusual brilliance and low velocity was observed by Mr. Rolston at South Kensington at 9h. 46m. (G.M.T.) on May 2. The approximate commencement and end of the flight were at $150°+14°$, and $142\frac{1}{2}°$, $0°$, respectively, and the time occupied in traversing the path was estimated as at least two seconds. Both in colour and brightness the meteor was very like Arcturus, and no train was visible along which it had passed. The position of the commencement of the apparition is a little uncertain, because Mr. Rolston was not actually engaged in watching for meteors, his attention being first directed to the phenomenon by its extraordinary brightness.

NOVA GEMINORUM, NO. 2.—In No. 4569 of the *Astronomische Nachrichten*, Prof. Max Wolf publishes some remarks on the apparently periodical changes in the structure of the complicated hydrogen bands in the spectrum of Nova Geminorum. As Prof. Iñiguez has pointed out, the most intense portion of each band has changed its position in the band, and Prof. Wolf finds that a certain periodicity is displayed by the variations. The brightest part moves gradually, first towards the red and then towards the violet, the changes taking place in regular steps in about fourteen, or seven, days. Thus on March 15 and 29 the dark absorption line in the $H\delta$ band, at $\lambda 4093$, became obvious, and on April 13 the structure of the band was similar to that which obtained on March 17. It is suggested that the seven-day magnitude variation remarked by Dr. Kritzinger may be related to these changes in the structure of the spectral bands.

FAINT STARS WITH LARGE PROPER MOTIONS.—The comparison of photographs of several star clusters taken in 1909–10 with the large Pulkowa astrograph with similar plates taken eleven to fifteen years earlier has disclosed a number of large proper motions, of which Herr Kostinsky gives particulars in No. 4569 of the *Astronomische Nachrichten*. The magnitude of the proper motions was measured in the first place with a Zeiss stereocomparator, and was shown in every case to be more than $10''$ per century on a great circle. The annual motions of the seven stars described range from $0.113''$ to $1.111''$ on a great circle. Four pairs of plates, having intervals of about one year, show that the star BD$+53°$ 2911 (mag. 9.5) has a mean annual proper motion of $1.23'' \pm 0.04''$; this star appears on the photographs of the Nova Lacertæ (1910) region, its position (1911.0) being 22h. 29m. 10.2s., $+53° 20' 3''$.

SOLAR PROMINENCES IN 1910.—Prof. Riccò publishes his annual (1910) summary of the prominences observed at Catania in No. 3, vol. i., series 2, of the *Memorie della Società degli Spettroscopisti Italiani*. It shows that while from month to month the mean frequency of prominences varied irregularly, there was, on the whole, a regular decrease in the northern hemisphere, while the frequency was fairly constant in the southern. For the four trimestres the frequencies were:—N. hemisphere, 2.3, 1.5, 1.1, and 0.4; S. hemisphere, 1.4, 1.3, 1.3, and 1.3, respectively, the mean frequencies for the year being 1.3 in each hemisphere. This gives 2.6 as the mean frequency for both hemispheres, a value notably smaller than that for the immediately preceding years; the dimensions of the prominences showed a similar decrease, while the mean latitude was a little higher, and the prominences more evenly distributed, in both hemispheres.

THE ECLIPSE OF THE SUN, APRIL 17.

REFERRING to Dr. Marie Stopes's observation of a halo about the eclipsed sun on April 17, Mr. Patrick Hepburn writes that Mrs. Hepburn, observing from near the central line in France, noticed what seemed to be rather of the nature of a corona than a halo, although they concluded that it had no connection with the true solar corona; it was coloured, with the violet outwards. Mr. C. O. Bartrum also discusses this phenomenon, and from two friends, one of whom saw the eclipse from near Paris, the other from Highgate, he gathers that "the appearance of a circle round the sun" seems to have been a corona due to diffraction, the colours appearing purer and brighter than usual because of the reduction in the effective size of the sun.

On photographs taken at Funchal (Madeira), and sent to us by Mr. Michael Grabham, there is obviously light cloud producing a "corona" effect around the sun, but the halo so plainly shown on them is palpably a photographic halation phenomenon. Another photograph shows several excellent crescentic images projected on to a wood floor through the foliage of stephanotis.

Mr. A. A. Buss writes that the time of his prominence observations (NATURE, April 25, p. 193) was from 8.0 to 8.30 a.m. The positions he gave agree very well with prominences photographed by M. Deslandres (NATURE, May 2, p. 221), although Mr. Buss did not note the large prominences in 47° N. lat. (E.) and 47° S. lat. (W.) as being especially conspicuous; the position angles would be about 17° and 197° respectively. But Mr. Buss observed visually in $H\alpha$ radiation, while M. Deslandres used the K (calcium) radiation for his spectroheliograms; this and the difference in time would readily explain the apparent changes, especially as the fact that considerable prominence activity occurred on the day of the eclipse is confirmed by both observers. Mr. Buss states that prominences were seen near p.a. 117° from April 14 to 29, thus forming a chain extending more than half-way round the sun; the western extremity of the chain was detected at the W. limb towards the end of the month. Possibly the $H\alpha$ spectroheliograms taken during this period will show magnificent "filaments" in the position indicated. Mr. Buss pictures the grandeur of such phenomena could they be spectroscopically observed from a position in space on the sun's axis prolonged.

Mr. Worthington, who, with Mr. Slater, was operating near Ovar, secured a photograph of the bright chromospheric arcs, which shows a large number of lines between λ3100 and D. Only the lower halves of the chromospheric circles are shown, the upper halves being lost in continuous spectrum, probably produced by portions of the sun which remained uncovered at the moment of exposure. The original negative is deposited at the Royal Astronomical Society's rooms, as were those secured at Vavau last year, where it may be inspected by anyone interested in the matter.

Several papers dealing with the eclipse appear in the *Comptes rendus* for April 29 (No. 18). MM. Carimey, Raveau, and Stablo describe bands of darkness which they observed from near the central line on the plateau de la Beauce. Comte de la Baume-Pluvinel was at St. Germain-en-Laye, and took a large number of kinematograph pictures of the eclipse, with a chronometer alongside, at the rate of 13 or 14 per second. A study of these gives the time of central eclipse at 12h. 10m. 4·5s. ± 0·2s., but this may be a little modified if the lunar depressions on opposite sides were not equally deep; for last contact the time determined was 1h. 32m. 7s. Four plates taken with an objective of 1·5 metres focal length show a slight aureole attributable to the corona, but no details of coronal structure. A three-prism spectroscope, with a wide slit, was directed to part of the chromosphere between two Baily's beads in p.a. about 130°. A considerable number of monochromatic images of the chromosphere were shown between λ486 and λ389, about forty appearing between H and K. At Clayes (long. 0° 21′ 9·8″ west, lat., 48° 49′ 13″ N.), MM. R. Jouast and P. de la Gorce determined the variations of the intensity of the light on a horizontal plane during the eclipse. There was a steady decrease from 50,000 units at 10h. 55m. 15·5s. to 16 units at 12h. 9m. 55·5s., then a more rapid increase to 50,000 units at 12h. 50m. 49·0s. Kinematograph pictures were taken by MM. Vlès and J. Carvallo at Cacabelos, in Spain.

MATTER AND MIND.

SIR GEORGE REID is known to be a versatile thinker, and he shows himself to be also a philosopher in an address on "The World of Matter and the World of Mind" delivered by him recently before the Royal Scottish Geographical Society. We live on a single globe among millions of similar bodies, and we have no direct evidence of life elsewhere in space. Yet, "If living things exist only on this globe, living things are the loneliest of all the objects which the telescope can reach, or the microscope reveal, or the mind of man conceive. Man would be the loneliest of all, for he stands alone even among the living things of his own planet." Moreover, the achievements of man in the few thousand years of historic time are so brilliant in comparison with what was accomplished in the million years or so of geological man that Sir George Reid considers the argument derived from the remains of a physical structure resembling our own furnishes no conclusive proof that we are in body and soul the lineal descendants of fossilised ancestors. The principle of continuity breaks down when the evolution of mind is considered; if a Plato, Newton, or Darwin can be developed from a cave-dweller, "is not such an evolution a greater tax on human faith than the marvels of a direct creation can be?" Man, the intelligent centre of progressive life, is conscious of directive control: the will is merely the executive officer of the mind, and behind it there must be "some sort of pilotage."

This position is not new, and has been occupied by many philosophers from Aristotle to Bergson without any completely satisfactory view being obtained from it. The rise and progress of mental life, the emergence of volition, or the will to decide between reason and desire, and the idea of will behind phenomena, find no clear place in the naturalistic scheme of human evolution. Matter—whether organic or inorganic—is yielding to the importunate efforts of scientific investigators, but mind as a subject of serious study is given little attention even at the universities. Sir George Reid pleads for greater encouragement to the work of psychologists in these seats of learning, and his address should do something to save the Cinderella among the sciences from her present condition of neglect.

AERIAL FLIGHT.[1]

BEGINNING with balloons, as having the priority in point of time, it may be remarked that the whole subject is included in the last 130 years dating from the experiment of the Montgolfiers, who made their first ascent in 1788, but were at work for some years before this, and that other designs quickly followed containing in principle most of the appliances which are in use to-day. The ballonet, for instance, was proposed and tried by Charles and Robert. We find also designs for dirigible balloons of much the same shapes as are now familiar to us.

All attempts at propelling these vessels naturally failed for want of adequate power, and in some cases the proposed form of propulsion was impracticable, but in others a screw of nearly the same proportions as that now in use was actually tried. It was soon found, however, that the speed which could be developed by man-power or by any engine that the balloon could lift only amounted to a few miles an hour, less, that is, than the speed of a very light breeze. Thus, so far as directing the course of a vessel was concerned, the mechanism was almost useless, and few further attempts at mechanical propulsion were made until the advent of the internal-combustion engine.

Independently of outward form, balloons may be divided into two classes, according as the lifting gas carried is (*a*) constant in mass, or (*b*) constant in volume, and these again may be subdivided according to the relation of the pressure or density of the enclosed gas to that of the surrounding air.

All the conditions, however, may be conveniently represented by supposing that the gas is contained in a massless vertical cylinder closed at the top by a fixed cover and below by a movable piston. The piston may be supposed to be free or clamped, and to be acted on by the gaseous pressures only or by any other additional force.

I do not propose here to go into the questions of the relative merits of the rigid and non-rigid forms, questions which turn on structural details rather than on general principles, but something may be said on the nature of the envelope used for retaining the hydrogen which is now usually employed for lifting purposes.

The best information on the subject is due to work recently carried out at the National Physical Laboratory at the request of the Advisory Committee for Aëronautics, and will be found in detail in their published reports.

It appears that among the fabrics in use there are enormous differences in their retentive power (that is, in the rate of the diffusion of hydrogen through them irrespective of actual leaks), differences of nearly two hundredfold appearing between the worst and best specimens.

Indiarubber coatings are the least satisfactory, allowing an escape in some cases of more than 0·7 cubic foot for every square foot of material in twenty-four hours when new, and deteriorating as time goes on. The most retentive hitherto tested are various oiled silks, goldbeaters' skin, and some other artificial membranes.

When the large surface which all dirigible shapes expose to the air is considered, it will be seen how important is the choice of material, and that with the best the necessary hydrogen renewal is not a small matter, even if no ascents are made, and may well be more than 1000 cubic feet a day for a moderately large vessel.

Much more than this, however, must be lost when the dirigible is in use. A thousand cubic feet of hydrogen gives a lifting force of about 75 lb., and the engines of one of the larger dirigibles will part with many times this weight in fuel and other ways in less than twelve hours. To keep the vessel at a constant height the lift has to be diminished or the downward force increased at the same rate. While travelling this may be effected to some extent by steering, but when stationary the balance can only be obtained by allowing the equivalent amount of gas to escape. To rise again an equal amount of ballast must be discharged. The number of ascents, therefore, which can be made without a fresh supply of hydrogen is limited by the quantity of ballast which can be carried.

We may now direct our attention to the more promising field presented by true flying machines—machines, that is, which are heavier than air and are supported by the reaction of a downward current of air called into existence by the engines in ordinary flying or by the diversion of natural upward components of the wind in soaring. It is theoretically possible also to maintain flight (without expenditure of work on the part of the flying machine) in a horizontal wind the velocity of which increases with the altitude or varies from place to place at the same level. In this case the flying machine has to descend in the direction of the wind and then turn and ascend against it. In each such cycle work is gained, and the work is obtained from the difference of wind velocities.

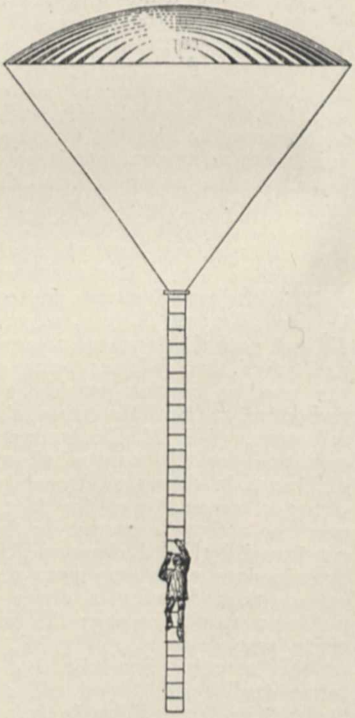

FIG. 1.

One or two examples may be given illustrating the dependence of the power required on the terminal velocity.

First take the case of a parachute, which may be supposed to be massless and to carry a long ladder up which a man climbs (Fig. 1). If the man is to maintain a constant elevation above the ground he must be able to climb as fast as the parachute falls. Now it is known from experiment that a surface such as a parachute experiences a resistance while falling through the air equal to about 14/1000 of a pound for every square foot of area at a speed of 1 foot per second. If we give the parachute a diameter of 36 feet, its area will be about 1000 square feet, and if we suppose the man to weigh 150 lb., the terminal velocity will be given by $v^2=\frac{150}{14}$, or $v=3{\cdot}3$ feet per second. This, of course, is much more than a man can do.

If we take a man-power as one-tenth of a horse-power, 55 feet per minute, or, at the outside, 1 foot per second, may be taken as the rate at which he can raise his own weight for any considerable length

[1] Abridged from the "James Forrest" Lecture, delivered before the Institution of Civil Engineers on April 19 by H. R. A. Mallock, F.R.S.

of time. The area which, when loaded with 150 lb., drops at the rate of 1 foot per second, is $\frac{150{,}000}{14\cdot 0}$, or 10,600 square feet, that is, a circle of 113 feet diameter.

With such a parachute a man could by climbing keep himself stationary in the air.

It is not necessary, in order to impart this momentum to the air, that the surface should itself have this area of 10,600 square feet. The same momentum may be given by a much smaller inclined surface moving horizontally.

If a perfectly efficient screw or inclined plane were a physical possibility, there would be nothing to prevent people from flying by their own muscular effort, and it is worth while to examine the causes which prevent the realisation of such a result.

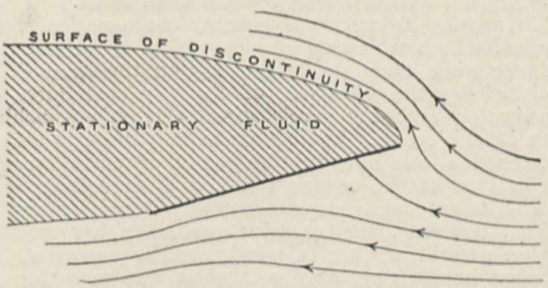

FIG. 2

We will now consider more closely the causes which produce the very marked difference between the theoretical curves given in Fig. 2 and the corresponding quantities as determined by experiment.

It is well known that the fluid with which mathematicians deal, and which is supposed to surround the plane in Fig. 2, is an ideal body which is without viscosity (that is, opposes no resistance to shear), and that in contact with a solid it experiences no frictional retardation.

In such a fluid pressure and velocity are connected by an invariable law, the sum of the potential and kinetic energies of any portion of the fluid remaining constant for all time.

This law, together with the necessary condition of continuity, which for an incompressible fluid merely implies that the volume of a given mass of fluid remains constant, no matter what shape it takes, constitutes the foundation of all the propositions regarding the stream lines of a perfect fluid which have hitherto been worked out, and for such a fluid the stream lines indicated in Fig. 2 are an exact solution of the problem.

Now real fluids differ from the perfect fluid in having both viscosity and surface friction. They require that work should be done if distortion is going on, and they adhere to the surfaces of solids immersed in them. Thus a plane which, if moving edgewise in a perfect fluid, would meet with no resistance, does meet with resistance in a real fluid on account of the adherence of the fluid to the solid surface and the consequent distortion produced in the neighbouring layers of the fluid.

It is true that for fluids such as water and air the viscosity is so small that the direct effects would hardly be noticeable. Indirectly, however, they have immense influence, and it is not too much to say that the most remarkable features in the flow of the winds, tides, and streams are due to the modification of stream-line motion set up by fluid friction and viscosity.

The indirect action referred to depends on the fact that when a stream is retarded by friction the velocity is reduced, although the pressure remains unchanged, and thus the fundamental relation which connects velocity and pressure in a perfect fluid is violated. So long as the stream concerned is of constant section and is neither accelerating nor retarding, as, for instance, when the flow is through a straight pipe of uniform bore, the effect of friction shows itself merely by rendering the stream lines irregularly sinuous, in a way which has not yet been investigated, and as giving rise to a resistance which is proportional to a power of the velocity something rather less than the square, *i.e.* to the 1·85th or 1·9th power.

When, however, the stream is divergent (so that in the absence of friction the velocities and pressures, although constant across each section, change from one section to another, but keep the total energy of the flow across each section the same), the effect of friction and viscosity is much more conspicuous.

On the up-stream side of the plane friction does little to modify the conditions except in the neighbourhood of the edges, but down stream we find, instead of a pond of still fluid, a complex wake consisting of a central current moving forwards towards the plane, bordered by a series of eddies the origin of which is of the same nature as those just referred to in the expanding channel, namely, to degradation of the streams passing round the edges of the plane, which, having insufficient velocity to follow the stream-line path of Fig. 2, are deflected inwards and become involved with the reversed central stream, about half the fluid in each eddy being supplied from up stream and half from the wake.

The eddies are formed periodically, growing to a certain size, and then, breaking away from their place of birth, they form part of the train which borders the wake current. The wake current itself is due to the constant removal of fluid in this way from the back of the plane, and the fact that the outflow from the back has its maximum velocity close to the edge where the composite eddy is being formed shows that the pressure on the back of the plane is lower at the edges than in the centre. Hence it could be stated with certainty, even without any experiment, that the total resistance of a plane must be greater than $\rho v^2 \frac{\pi \sin \alpha}{4+\pi \sin \alpha}$, which assumes that the pressure over the rear surface is uniform and equal to the general pressure at a distance.

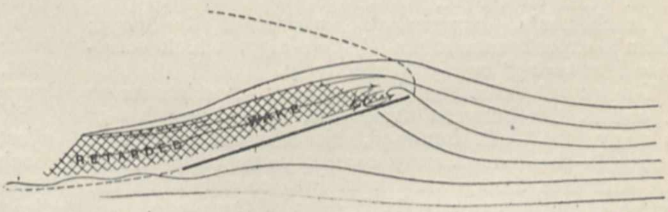

FIG. 3.—Frictional flow: stream oblique to plate.

Experiment, however, is required to determine the actual resistance, and when the plane is broadside to the stream this is found to be about half as much again as the head resistance alone, or about 20 or 25 per cent. greater than the dynamic head × the area of the plane.

When the angle α is small, as it always is in flight, the character of the wake takes the form shown in Fig. 3. Here the wake stream is only recognisable as a reversed current quite close to the plane, and the small eddies as fast as they are formed are so rapidly degraded that after travelling a short distance they are merely recognisable as slight variations in the direction of the general current.

The abstraction of wake water by eddy-making continues, however, even for very small values of α, and has the effect of deflecting the upper boundary of the wake as shown.

The deflection may be considered from another point of view as the outcome of the defective pressure on the down-stream surface of the plane.

This short account gives a general explanation of the observed difference between results calculated for the discontinuous flow of a perfect fluid and those actually found by experiments in air and water, and if the nature of the flow over the back surface were accurately known, the value of α for the maximum of L/R could be predicted. Even in the absence of this knowledge, the assumption that surface friction varies as v^2 and acts only on the up-stream side, leads to a value of α that is not far removed from truth.

Let AB, Fig. 4, be the plane making a small angle α with the stream, and let L and R be the lateral force and resistance which would be experienced if there were no friction.

If L′ and R′ are the same quantities, taking friction into account, and putting Fv^2 as the frictional force parallel to AB, we have $L' = L - F\alpha$ and $R' = R + Fv^2$, and since $L = R_n \alpha$, and $R = R_n \alpha^2$, R_n being the normal resistance Av^2,

$$L' = L - F\alpha = \alpha v^2 (A_n - F),$$

and

$$R' = R + Fv^2 = v^2 (A\alpha^2 + F);$$

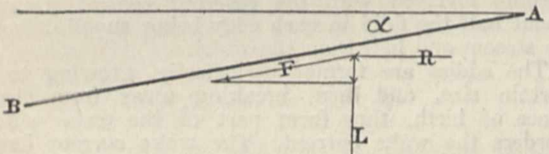

FIG. 4.

hence $L'/R' = \alpha(A - F)/(\alpha^2 A + F)$, and this is a maximum when $\alpha = \sqrt{F/R}$.

Lanchester's experiments make $F/R = 0{\cdot}0075$; Zahn's experiments make $F/R = 0{\cdot}0037$, which correspond to $\alpha = 6{\cdot}5^\circ$ or $3{\cdot}5^\circ$ respectively.

The actual value found from direct experiments on L and R lies between these two, and although $6{\cdot}5^\circ$ is nearer the truth than $3{\cdot}5^\circ$, this does not imply that $0{\cdot}0075$ is the more nearly correct value of F/R, for the complete theory must take into consideration the action of the streams on both sides of the plane.

If ascending currents can be found, or if use can be made of differences of speed in the wind at different levels, there is no reason why engineless flight should not succeed, but the opportunities are rather limited.

The heaviest birds which can fly (great bustards, turkeys, and some of the vultures, eagles, and pelicans) weigh between 20 and 30 lb. Of these, bustards and turkeys are short-winged, and the load is more than 2 lb. to the square foot of wing. But their flights are short and their wing movements rapid, and the power expended while rising from the ground must be very great in proportion to their size.

The large birds which make long flights have wing areas giving a load of less than 2 lb. per square foot, and are all adepts at making use of ascending air currents, so that for the most part of their time in the air they have but little work to do.

Much controversy has arisen on the question of the sufficiency of upward currents or upward components of currents of air to account for such flights, but the more the circumstances are examined the more clearly it appears that soaring is in most cases effected in this way, although the origins of the ascending currents are very various. Sometimes they are caused by natural obstructions in the path of the wind, such as cliffs, hills, the sides or sails of a ship, or the slope of waves, but on a larger scale they are chiefly the result of air ascending after having been warmed by contact, direct or indirect, with the ground. At low levels such vertical movements are very small, and at the surface of the ground any motion must, of course, be parallel to the surface; but at considerable heights, especially in sunny countries, these convection currents must always exist, even when the weather is calm, except in the rare event of large tracts of sea or country having the same temperature as the air in contact with them.

To anyone flying at a height, the sense of true vertical which we have, and by which we adjust our balance when standing or moving on the ground, is replaced by the direction of the resultant force of gravitation and any acceleration which the machine may be subject to. In still air or in a uniform wind, acceleration can only be the result of an alteration of level or of the engine speed, and the effects due to the latter cause cannot be very large or rapid. When, however, the machine passes quickly from a region of still air into a wind, or *vice versâ*, which is what happens practically in gusts, the sensation of vertical direction is lost, and although the speed and direction of travel of the machine only change gradually, the resultant of the forces acting on it does so instantaneously, not only in direction, but in magnitude.

The three diagrams in Fig. 5 show the direction in which a short pendulum at the centre of gravity of the machine would point (*a*) when the flight is in uniformly moving air, (*b*) when in an overtaking gust, (*c*) in an opposing gust.

The connection between the angle (θ) which the pendulum makes with the true vertical being

$$\tan \theta = \frac{\text{Propulsive force} - \text{Resistance}}{\text{Lifting force}}.$$

It is hardly to be wondered at that such changes in the apparent vertical should be confusing to the pilot, and that accidents, which are often fatal, should happen while experience is being acquired.

Side gusts may produce still more embarrassing effects, the character of which depends on the class of machine and the disposition of the wings to a greater degree than is the case with gusts in or against the direction of motion.

At the present time the wings and framework of all machines are made as rigid as possible by wire stays, &c., with the result that the breakage of any one part is likely to wreck the whole, and it is probable that as time goes on more attention will be directed to increasing their pliability so as to allow a reasonable amount of distortion without crippling the structure. The problem of determining the greatest possible flexibility which can be given to a structure of a definite shape, size, and weight, which is also to have a definite initial stiffness, is theoretically capable of solution in terms of the strength, density, and dynamic worth of the materials (by dynamic worth is meant the worth which can be stored elastically in the unit volume), and although I am not aware that any case has been worked out, the subject is worthy of investigation.

The most important questions which can be raised about flying machines relate to their stability in flight and the ease or difficulty of starting or stopping them, and on each of these questions I will say a few words. First, as to the theories of stability which have been given from time to time. Some of these I believe to be correct so far as they go, but none of them are anything like complete, since they are all based on the pressures and variations of pressure acting on the up-stream surfaces of wings and omit the variations due to the eddy formation which goes on on the down-stream side.

Before proceeding further, it will be as well to define what I mean by stability in connection with flight. A flying body is stable if, when acted on by a propulsive force and the reactions of the air (but not steered), any small angular velocity imposed about a horizontal axis tends to die out, and any small displacement about a vertical axis to reach a constant

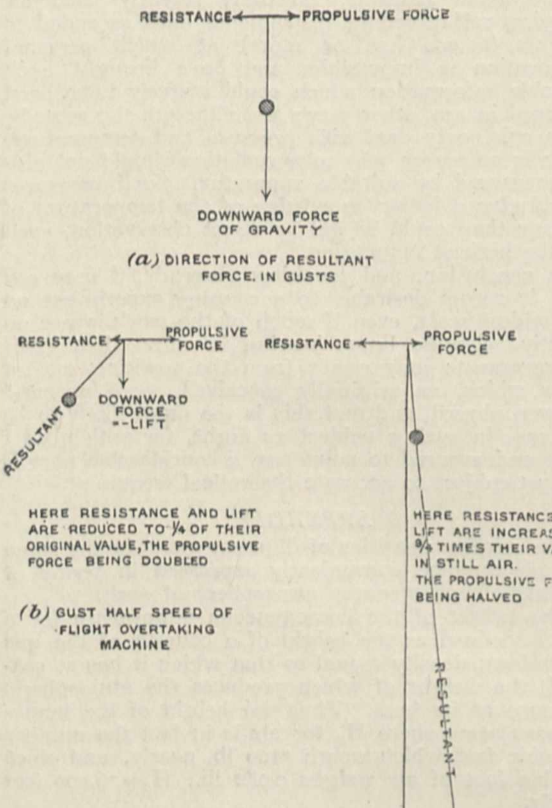

FIG. 5.

value. Or, in other words, any accidental motion of the nature of pitching or rolling must tend to disappear, while an arbitrary twist to the right or left must put the machine on a new, but straight, course.

Technically, stability is compatible with the presence of forces which produce increasing oscillations as the result of disturbance; but for the present purpose not only must the average force so called into play be a restituent force, but the disturbing motions must also tend to die out. The oscillations, in fact, must be damped, and not maintained.

None of the flying machines at present in use are stable in the sense in which the word is here used, but in the ordinary conditions of flight the eddies formed behind the wings are small and their period of formation so rapid that the change in the attitude of the wings (that is, in the angle α) which they can produce in one period is inconsiderable, and the stability or instability depends chiefly on the distribution of pressure on the up-stream surfaces, but the case is very different when the machine is passing through variable currents and the angle at which the air meets the wings is liable to large and rapid changes. The alterations in the arrangement of the pressures on the back surfaces are then much greater and take longer to go through their phases—long enough, in fact, to make the process of correction exceedingly baffling.

That flying machines should be unstable in ordinary circumstances is really of very little consequence. The same objection applies to walking. No conscious effort, however, is required to keep upright on *terra firma*, but on the deck of a small vessel in seaway we all know that sea legs are only got by practice, often involving many falls.

The flying machine in gusty weather is much in the same condition, but the falls have more serious consequences.

I think it very unlikely that any type of flying machine will be evolved which, without guidance, will be safe in bad weather, but it is quite possible that the necessary corrections should be applied by an automatic device, and if flight is to be anything but a fair-weather pastime, something of the kind will probably be found necessary.

What is required is an apparatus which will so trim the wings as to keep the machine related in a definite manner, firstly to the true vertical, and secondly to the direction of the resultant force at the time.

The various ways in which this could be done might furnish subjects for several lectures, and I will only say here that the many proposals which have been made to use pendulums or gyroscopes to act directly on the correcting mechanism are certainly bound to fail.

It is essential to the success of any automatic control that the forces called into play to make the corrections of trim should not react on the director of those forces, whether this is a pendulum or gyroscope or any other equivalent device. The only instance in which this condition has been fulfilled is the "steady platform" of the late Mr. Beauchamp Tower. In this Mr. Tower caused a gyroscope (which, in effect, was a pendulum with a very long period) to direct an axial jet of water on a group of openings connected by pipes to a series of rams in such a way that if the openings did not face the jet symmetrically water flowed into one or other of the pipes, and so altered the position of the openings until symmetry was restored, the restituent force having no tendency to alter the direction of the axial jet.

There may be other methods of attaining the same object in the case of wing-trimming or control for flying machines, but any device in which the correcting force tends to alter the position of the corrector is more likely to do harm than good.

The question of stability also becomes important when the flying machine is coming to the ground. In alighting, the machine either has to touch the ground at full speed and trust to retardation, supplied chiefly by the ground, for coming to rest, or it must alter the wing attitude with reference to the path so as to experience a greater resistance for a given lift. This latter method is adopted by birds when pitching on the ground, and in their case at the last moment is generally supplemented by flapping the wings when the velocity is so much reduced that the greatest lift the wing area is good for will not sustain their weight. Birds when pitching on any elevated perch, such as a bough of a tree or a rock, nearly always finish their flight in an upward direction; but neither this nor wing flapping is at present open to flying machines on account of the mechanical difficulties of construction.

Alteration of the trim of the wings, however, presents no great constructional difficulty, but when the angle between the wings and the path is large the effect of accidental variations of pressure due to eddy formation is more serious, and the instability is greater than when the angle in question is the gliding angle; and here, therefore, automatic correction would be very important. If this could be used successfully, a machine the flying speed of which was 40 miles an hour and which had a gliding angle of 1/7 could, as may be found from the resistance diagrams, reduce its velocity by alteration of the trim of the wings to 25 miles per hour before the weight ceased to be air-borne. Further, since for the whole time the resistance would average about one-fourth of the whole weight, the time taken in effecting the reduction of speed would be four times that required for gravity to generate the difference between 40 and 25, being 15 miles per hour. During this time—2·7 seconds—the average speed would be 32 miles per hour, and the machine would cover about 120 feet. These rough figures can be easily corrected from the curves giving lift and resistance for any particular machine, but there can be no doubt that it would be a substantial gain if the high speeds, which are becoming more and more common, could be quickly and safely reduced before reaching the ground.

It is quite possible to imagine a flying machine made with lifting screws which would rise vertically from the ground and remain poised and stationary in the air; but no success has hitherto attended any attempts in this direction, partly because the inventors have not realised the very large blade area necessary for reasonable economy of power. One way of realising the stationary condition would be to connect two flying machines travelling at the same speed in opposite directions with a length of rope and letting them circle round one another. No "banking" would take place, as the centrifugal force of each would be taken by the pull of the rope. If the latter were shortened as far as possible, the pair would, in effect, form a single machine with a lifting screw. The experiment would be dangerous, and is not recommended for trial, but is mentioned rather as indicating the size of the screw blades which the hovering type of machine would require.

In taking a general view of the present condition of the art of flying, it must be admitted that much remains to be done before it ceases to be a fine-weather sport, and I think the right course to pursue would be to try to evolve a type of machine which is fairly safe even in turbulent winds, and can arise and alight on the smallest possible area. When the essential features of the design which secures these results are recognised, the machines may be specialised for war or other purposes, and additional improvements may be introduced for convenience, comfort, or speed.

The opinion seems to be gaining ground that flying machines are more likely to be usefully developed than dirigible balloons, and in this opinion I fully concur, more especially as regards the larger dirigibles, which I have always considered too frail and too liable to accident to be of much real service.

All aircraft, whether heavier or lighter than air, will for some time to come be designed for the purposes of sport or war rather than for commerce, and although for war-machines cost takes a second place, it must be remembered that a dirigible costs rather more than a torpedo-boat, whilst a flying machine costs rather less than a torpedo. Further than this, there are very few services to be performed by a dirigible which could not be carried out as well, or better, by a flying machine, the only, and rather dearly purchased, advantages attaching to the balloon being its power of rising quickly and of leaving the ground without the necessity of taking a run; and I think the best policy for us would be, while recognising the occasional usefulness of dirigibles of moderate size (and building a sufficient number for experiment), to devote our attention chiefly to the elaboration of the most efficient means of destroying them.

From the purely scientific point of view it cannot be said that the ascents of any large balloon have added much to our knowledge.

The small balloons, however, recently used for carrying self-recording instruments have ascended to heights (60,000 feet or more) at which personal observation is impossible, and have brought back valuable information which could scarcely have been attained in any other way; and although the records, as a rule, only deal with pressure and temperature, there is no reason why solar radiation should not also be measured by suitable apparatus. Such measures would give a better knowledge of the temperature of the sun than could be got by direct observation, even on the highest mountains.

In conclusion, and speaking generally, I may say that it seems desirable to encourage experiment on the widest scale, even if much of the work is not on strictly scientific lines; bearing in mind that great improvements may result from the working out of ideas which, as originally conceived, were unsound or even absurd, and that this is the more likely to be the case in such a subject as flight, for which, as I have endeavoured to point out, a considerable part is not yet subject to accurate theoretical treatment.

APPENDIX.

The relative densities of different gases at the same altitude may be conveniently expressed in terms of heights of homogeneous atmosphere of each.

The height of the homogeneous atmosphere for a gas is defined as the height of a column of the gas of uniform density (equal to that which it has at sea-level) the weight of which produces the atmospheric pressure at its base. Thus the height of the homogeneous atmosphere H_a for air is in feet the number of cubic feet which weigh 2100 lb. nearly, and since 1 cubic foot of air weighs 0·080 lb., $H_a=26{,}000$ feet nearly.

For hydrogen $H_h=H_a \times$ the ratio of the densities of the two gases (namely, 16), so that $H_a=416{,}000$ feet nearly.

If the distribution of temperature in the atmosphere is isothermal, the actual height (h) above sea-level at which the pressure is p is $h=H\log\frac{p_0}{p}$. Thus when $h=H$ the pressure is p_0/e, and the pressure does not vanish until an infinite height is reached.

If, on the other hand, the temperature decreases according to the adiabatic law (that is, if the temperature of the air at height h and pressure p is what it would be if with surface temperature to start with it was lifted without loss or gain of heat to the given height),

$$h=H\frac{\gamma}{\gamma-1}\left(1-\left(\frac{p}{p_0}\right)^{\frac{\gamma-1}{\gamma}}\right), \text{ or } H\frac{\gamma}{\gamma-1}\left(1-\left(\frac{\rho}{\rho_0}\right)^{\gamma}\right).$$

In this case, therefore, there is a definite upper limit to the atmosphere, for when $p=o$, $h=H\frac{\gamma}{\gamma-1}$ (rather more than 17 miles for air and 275 miles for hydrogen).

What the actual limit of the atmosphere may be is not known, but experiment shows that for the lower strata, at any rate, the adiabatic distribution of temperature is not very far from the truth.

If we have two short columns, one of hydrogen and one of air, of the same length, and both at height h, then (putting $H\frac{\gamma}{\gamma-1}=K_a$ for air, K_h hydrogen, and N for the ratio of the densities, ρ_a/ρ_h at sea-level, the density of the air at h is $\rho_a(K_a-h)^{1/\gamma}$, and of the hydrogen $\rho_h(K_h-h)^{1/\gamma}$.

If the balloon carries no weight it will ascend until the densities are equal, which occurs when

$$h=NK_a\left(\frac{N^{\gamma-1}-1}{N^{\gamma}-1}\right),$$

or, since $N=16$ for air and hydrogen, and $\gamma=1{\cdot}41$, $N^{\gamma-1}=3{\cdot}1$, $N^{\gamma}=51$, and $K_a=17$ miles,

$$h=\frac{16\times17\times2{\cdot}1}{50},\text{ or }11{\cdot}5\text{ miles,}$$

and no hydrogen-filled balloon could ascend higher than this if the temperature was the adiabatic temperature.

The ascents of the balloons with recording instruments, however, lead to the belief that at heights exceeding 6 or 7 miles the temperature is constant, or nearly so, so that the practicable height of ascent may very considerably exceed the 11·5 miles just mentioned.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The General Board of Studies will shortly proceed to the appointment of a Stokes lecturer in mathematics, in succession to Mr. J. H. Jeans, who is resigning the lectureship. The appointment will be from June 24, 1912, to September 29, 1913. The annual stipend is 200*l*. Candidates are requested to send their applications, with a statement as to the branches of mathematics on which they are prepared to lecture, and with testimonials if they think fit, to the vice-chancellor on or before May 22.

DR. A. H. GARDINER, Laycock student of Egyptology at Worcester College, Oxford, has been appointed reader in Egyptology in the University of Manchester.

REUTER reports that the King of Siam has sanctioned a scheme for the establishment of a University of Bangkok. There will be eight faculties, including medicine, law, engineering, agriculture, commerce, pedagogy, and political science.

THE annual conference of the Association of Teachers in Technical Institutions will be held at Whitsuntide in London, at the Polytechnic, Regent Street. A paper will be read by Sir Alfred Keogh, K.C.B., on "The Relations between the Imperial College of Science and Technology and Technical Institutions." There will also be a discussion on the important question of the cooperation of employers in technical education, following a paper on this subject by Mr. E. A. Atkins.

THE Bethnal Green Free Library, one of the pioneer institutions of the free library movement in Great Britain, has now completed thirty-six years of work without endowment or State aid. We are informed that a million readers, borrowers, and students have used the library and attended the classes in connection with it. A plan is now on foot to secure the perpetuity of the work, and a reserve fund of 10,000*l*. has been started, to which the King has contributed. Donations may be sent to the treasurer, Mr. F. A. Bevan, 54 Lombard Street, London, E.C.; the bankers, Messrs. Barclay and Co., at the same address; or to the librarian, the Free Library, Bethnal Green, London, E.

IN the House of Commons on May 6, Mr. Runciman said, in reply to a question relating to agricultural education:—"I am carefully considering by what means the various agencies, actual and prospective, for the provision of agricultural education and research and of technical advice in agriculture may most effectively be brought into cooperation. I think it will probably make both for efficiency and for economy if county councils and agricultural colleges will combine for the purpose of joint action in respect of many of their agricultural activities. I am not yet, however, prepared to make a definite statement on the subject, as to which I shall hope, before taking any decision, to learn the opinions of county councils and agricultural colleges."

THE University of Chicago has established a system of retiring allowances for professors or their widows. A fund of 500,000*l*., says *Science*, taken from the 2,000,000*l*. Rockefeller gift of 1910 has been set aside for this purpose. This pension system will grant to men who have attained the rank of assistant professor or higher, and who have reached the age of sixty-five and have served fifteen years or more in the institution, 40 per cent. of their salary, and an additional 2 per cent. for each year's service over fifteen. The plan also provides that at the age of seventy a man shall be retired unless the board of trustees specially continues his services. The widow of any professor entitled to the retiring allowance shall receive one-half the amount due to him, provided she has been his wife for ten years.

THE University of the Philippines has, we learn from *The Manila Times* of March 7 last, conferred the honorary degree of doctor of science upon Father Jose Algue, director of the official weather bureau of the Government of the Philippine Islands. Dr. Algue, who was born in Manresa, Spain, in 1856, was in 1891 appointed assistant director of the observatory in Georgetown, D.C. In 1894 he became assistant director of the Manila Observatory, conducted by the Jesuit fathers, which in 1901 was made the official bureau. He held this position until the death of its founder, Father Faura, in 1897, when he was appointed director. Father Algue reorganised the meteorological service of the institution and perfected a system whereby the observatory receives daily telegraphic report from over thirty meteorological stations in the islands, ten in Japan, six in Formosa, four on the Chinese coast and three in Indo-China. He is a leading authority on earthquakes, and his observations in the Philippines, where seismographic phenomena are of such frequent occurrence, have been of great service. The University of the Philippines confers but one honorary degree each year, and its scroll at present bears only the names of Dr. Algue and one other honorary doctor.

THE experienced instructor appeals in teaching to as many of the pupil's senses as possible. The eye, for instance, is being more and more pressed into service to assist the ear in its work, and good lectures and school lessons are consistently illustrated by pictures and diagrams. The most recent of these pictorial aids is provided by the kinematograph, and it is satisfactory to learn that manufacturers and dealers are taking active steps to familiarise lecturers and school teachers with the possibilities of kinematography in increasing the value of their work as well as simplifying it. The proprietors of *The Bioscope*, for example, are organising a series of invitation demonstrations to be given at Cinema House, Oxford Street, London, on Wednesdays, June 5 and 12, and Saturday, June 15, at 11 a.m., to show the educational possibilities of kinematography. The first performance is exclusively for members of the medical profession, and the films shown will be purely technical; the second will be devoted to natural science, and the third to the educational uses of the kinematograph. Short addresses will be delivered by authorities associated with the particular subject of the demonstrations. Tickets may be obtained on application to the office of *The Bioscope*, 85 Shaftesbury Avenue, W.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 2.—Sir Archibald Geikie, K.C.B., president, in the chair.—Dr. Marie C. **Stopes**: Petrifactions of the earliest European angiosperms. The paper gives an account of the anatomy and the geological bearing of three new petrified angiospermic stems. These three fossils are all in the British Museum collections. Their age appears undoubtedly to be Lower Greensand (Aptian), and they are consequently the earliest angiosperms of which the internal anatomy is known. They are also of interest as coming from northern Europe at a time when angiosperms have hitherto been supposed not to have penetrated to that region. The three specimens differ so considerably in their structure that it seems justifiable to place them in three distinct, new genera.—Dr. F. **Keeble** and Dr. E. F. **Armstrong**: The distribution of oxydases in the plant and their *rôle* in the formation of pigment. The methods of investigation in general use do not admit of the determination in detail of the distribution of oxydases in the tissues of plants and animals. Hence the hypothesis that pigments are produced by the action of oxydases in colourless chromogens, though rendered probable by recent researches, cannot be regarded as established. Methods are now described which allow of the macroscopic and microscopic recognition of plant oxydases. By the application of these methods it is shown that in the Chinese primrose (*Primula sinensis*) the distribution of oxydases in the tissues coincides with that of the pigments of the flower and other parts of the plant. Thus, the hypothesis with respect to the *rôle* of oxydases in pigment-formation receives confirmation. It is proved that *P. sinensis* contains two peroxydases which differ from one another in their chemical reactions and in their localisation. It is proved definitely that dominant white flowers contain a substance which inhibits, but does not destroy, peroxydase. Experiments with recessive white flowers, the genetical behaviour of which indicates that they lack either peroxydase or chromogen, show that they contain peroxydase. Inasmuch as recessive whites contain no inhibitor of oxydase, failure to form pigment is to be attributed to lack of chromogen. The distribution of peroxydases in *P. sinensis* is to be regarded as typical of that in flowering plants generally, and the method appears to be capable of wide application in the study of the distribution of oxydases.—Dr. B. R. G. **Russell**: The manifestation of active resistance to the growth of implanted cancer. (1) The reaction which is evoked by the implantation of transplantable tumours of the rodent varies widely with different tumour-strains. The reaction has been determined by exercising all the growths in a series of animals on a given day, and then testing the suitability of the animals for the growth of a tumour-strain growing in 90 to 100 per cent. of normal animals. Some strains do not affect the natural suitability of the animals, others render every animal resistant to re-inoculation, and the remaining strains occupy intermediate positions. (2) The individuality of the animal inoculated may contribute to the development of the resistance, although not to so marked a degree as the tumour parenchyma. (3) Simultaneous inoculation of a tumour-strain which induces no resistance, and a strain which induces resistance, may be followed by marked inhibition of the growth of the former strain. (4) Mice bearing progressively growing tumours can be rendered resistant to re-inoculation, but the tumour first inoculated need not necessarily be affected. (5) Repeated inoculation of tissues, such as mouse embryo-skin, which renders animals resistant to subsequent inoculation, has not been shown to have a constant effect upon the growth of established tumours. (6) The conclusions drawn in (4) and (5) support the view previously expressed that immunity to cancer is directed mainly against the stroma-eliciting properties of the cancer cells.—Dr. Wm. H. **Woglom**: The nature of the immune reaction to transplanted cancer in the rat. The paper discusses the reactions to tumour grafts displayed by normal rats and by those rendered resistant through preliminary treatment with tumour or embryo skin. The elaboration of a stroma and the provision of blood-vessels observed in normal rats is absent in refractory animals, irrespective of the method of immunisation.—T. Graham **Brown** and Prof. C. S. **Sherrington**: The instability of a cortical point. The reflex reactions obtainable from simple spinal preparations, even when elicited from one and the same receptive "locus," are subject to a certain amount of variability. The variability is somewhat greater when preparations which are decerebrate are employed. With loci in the motor region of the cerebral cortex the variability is greater still. The experiments reported in this paper were undertaken to examine the nature and extent of the variability of response observable in the reactions from one and the same locus in the motor cerebral cortex. It is found that the inconstancy of response amounts under certain conditions to an actual reversal of the effect of the cortical point as examined in the muscles of the limb. The factors determining this reversal of cortical effect are examined, and the reversal itself is studied by graphic registration. A prominent factor in the conditions underlying the reversibility of the cortical effect appears to be the quiescence or activity of points of cortex antagonistic in their effect to the particular point under examination.—Dr. J. W. W. **Stephens** and Dr. H. B. **Fantham**: The measurement of *Trypanosoma rhodesiense*. The paper contains the results of the measurements of 1000 *Trypanosoma rhodesiense*, 400 of which were measured from different hosts, namely, man, monkey, horse, dog, rabbit, guinea-pig, mouse, while the remaining 600 trypanosomes were measured from rats only. The authors' chief conclusions are:—(1) That in the case of dimorphic trypanosomes, like *T. rhodesiense*, samples of twenty trypanosomes from a particular slide on a particular day are too small, because the average length may vary by as much as 4·7μ. (2) The day of infection on which the sample is taken is very important, as on one day 10 per cent. of stumpy forms may be found and on another day 95 per cent. The authors therefore recommend taking samples of trypanosomes from each day of infection of the host. (3) As the host from which the sample of trypanosomes is taken is probably also important, the authors suggest using the same animal throughout, *e.g.* a tame rat.

Geological Society, April 17.—Dr. Aubrey Strahan, F.R.S., president, in the chair.—H. H. **Thomas** and Prof. O. T. **Jones**: The pre-Cambrian and Cambrian rocks of Brawdy, Hayscastle, and Brimaston (Pembrokeshire). The district lies about eight or ten miles to the east of St. Davids, and consists of pre-Cambrian plutonic and volcanic rocks intimately associated with sedimentary rocks of the Cambrian system. The pre-Cambrian igneous and pyroclastic rocks are brought to the surface along an anticlinal axis which ranges in an east-north-easterly and west-south-westerly direction; they are divisible into two classes, an older volcanic series and a newer plutonic and hypabyssal series. The Cambrian has been divided into two main groups, the Welsh Hook group below and the Ford beds above. The Welsh Hook group consists of basal conglomerate, green sandstones, red shales, and purple sandstones. The position of the Ford beds, which are mostly shales, is not so certain. The basal bed of the Cambrian apparently rests upon rocks of different ages in different parts of the district, and indicates that the Cambrian reposes unconformably on a complex series of tuffs and lavas and of plutonic rocks intruded into these volcanic rocks. The structure of the district is that of a horst, faulted on all sides and surrounded by much younger beds. Much of the faulting is of pre-Carboniferous age.—Prof. O. T. **Jones**: The geological structure of central Wales and the adjoining region. This paper deals with the structure on a large scale of an area of about 1800 square miles, comprising the western portion of Wales, and is accompanied by a map, based partly on personal observations and partly on information gathered from various publications. There are two principal anticlinal axes, which follow in the main the valleys of the Teifi and the Towy, and are named after these rivers; between them is an important syncline (the central Wales syncline) which coincides nearly with the principal watershed of central Wales. Both the anticlines can be traced towards Pembrokeshire, but cannot be distinguished beyond the northern boundary of the area. The syncline becomes more important in a northerly direction, but is lost towards the south-west. The variation in the pitch accounts for the form of the outcrops.

Royal Anthropological Institute, April 23.—J. Reid **Moir** and A. **Keith**: Human skeleton found under a stratum of chalky boulder clay near Ipswich. The skeleton was discovered on October 6, 1911, at a depth of 4½ ft. below an undisturbed stratum of decalcified chalky boulder clay in the brickfield of Messrs. Bolton and Laughlin, about one mile north of Ipswich. The stratum of boulder clay under which the skeleton lay is part of the great sheet of chalky boulder clay found in East Anglia. The skeleton was embedded at the junction of the boulder clay and the underlying strata of mid-glacial sands, and the section of the strata showed no sign of having been disturbed, and it was therefore inferred that the skeleton must have been *in situ* before the deposition of the chalky boulder clay. In Mr. Moir's opinion, the upper part of the mid-glacial sands on which the skeleton lay represented an old land surface. In these strata and in the overlying deposits of boulder clay he had discovered flint implements which, in the opinion of M. Rutot, belonged to the pre-Strépyean type. The skeleton lay on its right side, in an ultra-contracted posture; nothing was found with the skeleton; there was no evidence of burial. The skeleton was that of a man about 1·800 metres (5 ft. 10 in.) in height, and probably between thirty and forty years of age. In the characters of the skeleton and skull the remains resembled modern man, and showed none of the marked features of Neanderthal man. The skull is estimated to have had a maximum length of 192 mm., maximum width 144, auricular height 111, cephalic index 75. The only peculiar feature was found in the shape of the tibia. In place of the anterior border being raised into a ridge or crest, it was flat, thus differing from all known tibiæ, ancient and modern. In the opinion of the speakers, the modern type of man, as represented by the Ipswich skeleton, the Galley Hill skeleton, the Bury St. Edmunds cranial fragments, and by numerous human remains found in France, was evolved long before the Neanderthal type of man became extinct in Europe.

Zoological Society, April 23.—Dr. S. F. Harmer, F.R.S., vice-president, in the chair.—C. H. **O'Donoghue**: The circulatory system of the common grass-snake (*Tropidonotus natrix*). Several interesting features correlated with the loss of limbs and the elongation of the body were stated to occur in the blood-vessels. The vessels, like the viscera they supplied, were asymmetrical; not only were those on the right anterior to those on the left, but they were also noticeably larger. No indication of the descent of snakes from a limb-bearing ancestry was to be found in the circulatory system, save perhaps a small pair of veins which might correspond to the pelvic veins in Lacertilia.—Julian S. **Huxley**: The courtship of the redshank (*Totanus calidris*). The first purpose of this paper was to direct attention to the many valuable results to be obtained by simple watching of very common British birds; and the second was to show how the facts observed in the redshank bore on the theory of sexual selection. In this species there was no rival display between several males at once: a single female was courted by a single male, as in man. But in quite 90 per cent. of observed courtships the female rejected the male, either during the pursuit or during the display, by simply flying away. Thus the consent of the hen was absolutely necessary if pairing were to take place, and this consent was usually withheld; in other words, selection by the female was a reality in the redshank. Other interesting points were as follows:—The plumage of the two sexes was identical, and was decidedly cryptic when the birds were at rest. During flight the white underside of the wings and the white tail were conspicuously revealed, and probably served as recognition marks. The significance of the red legs was unknown. During display the male directed attention to the underside of the wings by raising and vibrating them, to the tail by fanning it out, and to the red legs by his slow, high steps; besides this he uttered a note heard at no other time. Thus, since the actual colours and structures used in display were found in both sexes, the only peculiarly male possession—the only secondary sexual character of the redshank—was a special behaviour, devoted to showing off these common colours and structures in a special way. This seemed to show that secondary sexual differences in birds were originally differences of behaviour, and that only when these were established did differences of colour and structure come to be developed.—Mrs. E. W. **Sexton**: Brackish-water Amphipoda from Bremerhaven. Special reference was made to a new species of Gammarus, which inhabited both fresh and brackish water, and was interesting as showing in a marked manner the effects of environment on development.—C. Tate **Regan**: Descriptions of ten new species of South American fishes of the family Loricariidæ in the British Museum collection.

Challenger Society, April 24.—Dr. E. J. Allen in the chair.—Dr. H. Muir **Evans**: Poison organs and venoms of poisonous fishes. After reviewing previous work, the author pointed out that the researches of Briot were incorrect, and that this observer had obtained his results by means of a filtered glycerine extract of the spines of Trachinus (the weever). Dr. Evans had used fresh venom for his experiments, and found that hæmolysis took place with fresh venom alone, that is, without the addition of heated serum. But if fresh venom were mixed with glycerine and filtered through filter-paper, the results were similar to those of Briot; they were, however, different if a Berkefeld filter were used instead of filter-paper, just as the action of liver extract is affected according as it is filtered through cloth or through filter-paper. Dr. Evans then described the conclusions of Porta, from examination of sections of the spine of the sting ray (*Trygon pastinacea*), conclusions which had been disputed by Pawlowsky, who stated that Porta had confused glandular tissue with deformed blood-corpuscles, and denied that poison glands with groups of small cells existed in the spine of Trygon. By photomicrographs Dr. Evans then showed not only that Porta's triangular glands existed, but that they were only part of a large system present throughout the whole spine. The latter was described as consisting of (1) an intracaudal portion, of bony meshwork, containing round-celled glandular tissue and masses of secretion surrounded by flattened cells; (2) an intermediate portion with the ventral ridge still embedded in the tail, with gland follicles either radiating towards the convex surface or running longitudinally in the ventral prominence; formed secretion can be seen leading into the lateral grooves; (3) the free portion with the triangular glandular masses of Porta, and cavities occupied by small-celled tissues and formed secretion; towards the tip of the spine these become three, one in each lateral portion and one in the ventral ridge. The hæmolytic properties of these venoms were described, and in the ensuing discussion the painful toxic effects of the sting were described by one speaker from personal experience.

MANCHESTER.

Literary and Philosophical Society, April 2.—Prof. F. E. Weiss, president, in the chair.—J. **Mangan**: The presence of Maxillulæ in larvæ of Dytiscidæ. It was shown that in this family of water-beetles the mouth of the larval form is armed with a pair of strong processes, at the base of the mandibles, which appear to be homologous with the maxillulæ or superlinguæ of certain primitive insects.—Prof. W. H. **Lang**: The interpretation of the vascular anatomy of the Ophioglossaceæ. The author described the anatomy of the stem and leaf-trace of rhizomes of Helminthostachys of various ages; and the progression of the stele towards the mesarch condition was followed. The occasional development of accessory or secondary xylem was recorded. The distribution of the tissues in the stele was compared with that in the stele of Zygopteris, the centripetal xylem in Helminthostachys being regarded as corresponding to the inner xylem of Zygopteris. The departure of the leaf-trace also exhibits points of resemblance. The occasional development of centripetal tracheids forming a mixed pith was described for *Botrychium lunaria* and Ophioglossum, sp. The pith of the Ophioglossaceæ appears to be of intrastelar origin and not due to intrusion of cortex. Ophioglossaceæ and Cœnopterideæ appear to throw mutual light on one another as regards morphological and anatomical structure. The anatomical evidence supports the view that there is a real, though it may be a collateral, relationship between the two groups.

DUBLIN.

Royal Irish Academy, April 22.—Rev. Dr. Mahaffy, president, in the chair.—The following papers were read:—M. J. **Conran**: The Riemann integral and measurable sets. In this paper a method is given of extending the notion of integration to measurable sets without making use of any theory of generalised integration. Following the analogy of Young's treatment of the theory of content, the integral is first defined for a single interval, then for a set of open intervals, then for a closed set, &c. In applying the method to double integrals, it has been found necessary to examine the conditions under which the double and repeated Riemann integrals are equal when the region of integration has a frontier of positive content. This has been done, and some results of a fairly general character obtained.—W. **West**: Fresh-water algæ (in connection with Clare Island Survey). About 1100 species, varieties, and forms are enumerated, some with many localities, others being local. The research has proved that the district, lying on the older Palæozoic rocks, is a very rich one for this class of plants, and has resulted in the addition of a number of species, varieties, and forms new to science, as well as adding many others to the already known rich Irish algological flora. This is one of the most comprehensive reports of the investigation.—G. P. **Farran**: Decapoda (Clare Island Survey). The Decapoda of the Clare Island district include most of those recorded from the west coast of Ireland, with the exception of the burrowing forms. The majority of the species represented range from the Mediterranean to Norway, those having a distinctly northern distribution being very few.—W. M. **Tattersall**: Schizopoda and Cumacea (Clare Island Survey). Thirty-five species belonging to these groups of crustacea are enumerated from the Clare Island marine area. None are new to science, but one Mysid is new to the fauna of Ireland and eight Mysidæ to the area under consideration.—N. H. **Foster**: Land and fresh-water Isopoda (Clare Island). The terrestrial isopod fauna of Clare Island is similar to that of the adjoining mainland. Nine species were observed on the island, and of these eight have likewise been taken on the West Mayo mainland. Detailed notes are given respecting these species, and it is noted that many specimens of *Oniscus asellus* and *Porcellio scaber* are of larger size and brighter coloration than usually obtains in Ireland. *Asellus aquaticus* was the only fresh-water species found on the island.—R. **Southern**: Platyhelmia (Clare Island Survey). This paper dealt chiefly with the free-living Turbellaria of the district. Fifty species were found, five of which live in fresh water and forty-five in the littoral and shallow waters of Clew Bay and Blacksod Bay. Five of these had not previously been recorded from the British Isles, and twenty-nine were additions to the Irish fauna.

PARIS.

Academy of Sciences, April 29.—M. Lippmann in the chair.—M. **Bassot**: The compensation of the new meridian of Quito. Remarks on the memoirs of the geodesy expedition to the equator, dealing with the observations obtained in the measurement of the arc of the meridian of Quito and the reduction of these observations.—Maurice **Hamy**: The temperature regulator in use with the stellar spectrograph of the Paris Observatory. The expansion of creosote, contained in a long serpentine tube, actuates through a mercury column an electrical relay. The instrument is capable of controlling the temperature to about 0·01° C.—A. **Chauveau**: The *rôle* of the preponderating retinal impression in stereoscopic inversions.—MM. **Carimey, Raveau**, and **Stablo**: Observation of a shadow on the sky after the central phase of the eclipse of April 17.—A. de La **Baume-Pluvinel**: The observation of the solar eclipse of April 17. A kinematograph was arranged to photograph the sun and a chronometer simultaneously, with a velocity of thirteen to fourteen images per second. The times were checked by wireless signals from the Eiffel Tower.—R. **Jouast**

and P. de la **Gorce**: Photometric measurements made during the eclipse of April 17. The curve expressing the results is unsymmetrical with respect to the time of the maximum phase.—Fred **Vlès** and Jacques **Carvallo**: The kinematographic registration of the solar eclipse of April 17 on the Spanish portion of its trajectory.—M. **Tzitzéica**: Isothermal networks.—E. **Delassus**: Lagrange systems with principal parameter.—Émile **Borel**: Arithmetical and analytical models of apparent irreversibility.—G. **Ribaud**: The appearance of new lines in a Geissler tube containing bromine placed in a magnetic field. The change of colour is a secondary effect due to a modification in the nature of the discharge. In a Geissler tube, the magnetic field transforms the continuous discharge into a more or less condensed discontinuous discharge.—R. **Fortrat**: The structure of some spectral bands. An analysis of the green carbon band, the bands of hydrocarbons and of water.—Jean **Meunier**: Gaseous combustion in vortices and its analogy with the appearance of nebulæ and comets.—Paul **Bary**: The approximate value of the molecular weight of india-rubber. On the assumption that vulcanised rubber is $(C_{10}H_{16})_nS_2$, experiments on the least amount of sulphur required to vulcanise a fixed amount of rubber gave a value for n of 18·4.—N. L. **Müller**: Remark on the communications of M. Pierre Achalme on the *rôle* of the interatomic electrons in catalysis and electrolysis. A claim for priority.—P. **Achalme**: Concerning the communication of M. N. L. Müller. A reply to the preceding paper.—Albert **Granger**: The methods of manufacture of earthenware obtained from the excavations at Suziane.—Camille **Matignon**: The function of the valency in the stability of binary metallic compounds.—Maurice **Nicloux**: The preparation of iodic acid for the estimation of carbon monoxide. The Stas method of preparing iodic acid by the reaction of fuming nitric acid and iodine is capable of giving much higher yields than those indicated by Stas, more than 90 per cent. of the iodine being converted into iodic acid if suitable precautions are adopted.—J. B. **Senderens**: The catalysis of the cyclanols in the wet way by means of sulphuric acid. The preparation of the cyclenes. The cyclanols lose water readily under the influence of diluted sulphuric acid, giving cyclenes. The reaction must be referred to a specific catalytic action of the sulphuric acid rather than to a direct dehydration.—Marcel **Delépine**: New classes of oxyluminescent substances.—E. **Carrière**: The acylic acid aldehydes. The acid aldehyde of succinic acid. Formyl-succinic ethyl ester, $(C_2H_5.CO_2).CH_2.CH(CHO)(CO_2C_2H_5)$, is readily hydrolysed by aqueous oxalic acid, the acid aldehyde, $OCH.CH_2.CH_2.CO_2H$, being formed. — Georges **Dupont**: The aci-nitro-derivative of tetramethylketofurane.—Henry **Hubert**: The gold-bearing strata in western Africa.—Ph. **Nogier**: Therapeutic methods based on increasing and decreasing the activity of the endocrinal glands by physical methods. The glandular secretions can be stimulated by using the electric current or reduced by using filtered X-rays or the γ radium rays.—A. **Conte**: *Encyrtus sericophilus* and its use in sericiculture.—A. **Pézard**: The determination of the secondary sexual characters in the Gallinaceæ.—Mieczyslaw **Oxner**: New experiments on the nature of the memory in *Coris julis*.—R. **Fosse**: The direct production of urea at the expense of albuminoids either by oxidation or hydrolysis. An account of the method of isolating the urea formed from albumin by the action of an aqueous solution of potassium permanganate.—H. **Labbé** and G. **Vitry**: Contribution to the study of non-dialysable substances in urine.—Louis **Gentil**: The origin of the folds of the Saharan Atlas.—Fernand **Meunier**: The Protoblattinæ and Mylacrinæ of the Commentry coal measures.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), parts i. and ii., for 1912, contain the following memoirs communicated to the society:—

July 1, 1911.—K. **Försterling**: Theoretical considerations on the propagation of light in absorbing active uniaxal crystals.

October 28, 1911.—C. **Runge**: The astronomical determination of position in ocean ships and aircraft.

December 9, 1911.—F. **Körber**: The two limiting volumes of a liquid at the absolute zero of temperature and under indefinitely high pressure.

December 23, 1911.—B. **Dürken**: Unilateral extirpation of the eye in young tadpoles.

December 23, 1911.—L. **Bieberbach**: Minkowski's reduction of the positive quadratic forms and the finite groups of linear integral substitutions.

January 13, 1912.—R. **Fricke**: Contributions to the transformation-theory of the automorphic functions (ii.).—G. **Révész**: Demonstration that in so-called musical pitch two independent properties of sound are distinguishable.

February 3, 1912.—E. **Riecke**: The molecular theory of the piezoelectricity of tourmalin.

BOOKS RECEIVED.

Das Tierreich. Edited by F. E. Schulze. 28 Lief. Hymenoptera. Apidæ I.—Megachilinæ. By Dr. H. Friese. Pp. xxvi+440. (Berlin: R. Friedländer & Sohn.) 32 marks.

Das Tierreich. Edited by F. E. Schulze. 30 Lief. Hymenoptera. Ichneumonidea—Evaniidæ. By Prof. J. J. Kieffer. Pp. xix+431. (Berlin: R. Friedländer & Sohn.) 31 marks.

Icones Plantarum Formosanarum. Fasc. i. By B. Hayata. Pp. iv+265+xl plates. (Taihoku: Bureau of Productive Industry, Government of Formosa.)

Tables Annuelles de Constantes et Données numériques de Chimie, de Physique et de Technologie. Vol. i., 1910. Pp. xxxix+727. (Paris: Gauthier-Villars; London: J. and A. Churchill.) Cloth, 24*s*. net; paper, 21*s*. 6*d*. net.

The Statesman's Year Book, 1912. Edited by Dr. J. Scott Keltie. Pp. lxxxiii+9 plates+pp. 1428. (London: Macmillan and Co., Ltd.) 10*s*. 6*d*. net.

The Teaching of Physics for Purposes of General Education. By Prof. C. R. Mann. Pp. xxv+304. (London: Macmillan and Co., Ltd.) 5*s*. 6*d*. net.

The Nervous System. By Dr. J. D. Lickley. Pp. xii+130. (London: Longmans and Co.) 6*s*. net.

Koninklijk Nederlandsch Meteorologisch Instituut. No. 104. Tabellen. Pp. vi+200; Kaarten. Plates 1–25. (Utrecht: Kemink & Zoon; Amsterdam: Seyffardt's Boekhandel.) 6.50 florins.

Observations made at the Royal Magnetical and Meteorological Observatory at Batavia. Vol. xxxi., 1908. Pp. xlviii+173+4 plates. (Batavia: Government Printing Office.)

Practical Geometry for Schools. By S. A. Switzer. Pp. viii+161. (London: Methuen and Co., Ltd.) 2*s*.

Qualitative Organic Analysis. By F. B. Thole. Pp. xi+68. (London: Methuen and Co., Ltd.) 1*s*. 6*d*.

An Introduction to Quantitative Analysis. By Dr. S. J. M. Auld. Pp. xi+215. (London: Methuen and Co., Ltd.) 5*s*.

The Flight of Birds. By F. W. Headley. Pp. x+163+xvi plates in text. (London: Witherby and Co.) 5*s*. net.

Physiologisches Praktikum für Mediziner. By Prof. Max Verworn. Zweite Auflage. Pp. xii+262. (Jena: G. Fischer.) 6 marks.

Bleaching and Dyeing of Vegetable Fibrous Materials. By J. Hübner. Pp. xxiii+434. (London: Constable and Co., Ltd.) 14*s*. net.

Foods: their Origin, Composition, and Manufacture. By Dr. W. Tibbles. Pp. viii+950. (London: Baillière, Tindall and Cox.) 18*s*. net.

Practical Exercises in Physiological Optics. By Dr. G. J. Burch. Pp. 164 (Oxford: Clarendon Press.) 4*s*. net.

Aus Indiens Dschungeln. By O. Kauffmann. Band i., pp. v+192+plates in text. Band ii., pp. 193–352+plates in text. (Leipzig: Klinkhardt and Biermann.) 20 marks.

Das Pflanzenreich. Edited by A. Engler. 53 Heft, iv., 129. Pp. 640. 54 Heft, iv., 277 and 277*a*. Pp. 207+1–6. (Leipzig: W. Engelmann.) 32 marks and 10.80 marks respectively.

Rubber. By E. A. Browne. Pp. viii+88+plates in text. (London: A. and C. Black.) 1*s*. 6*d*. net.

How to Use the Microscope. By Rev. C. A. Hall. Pp. viii+88+20 plates in text. (London: A. and C. Black.) 1*s*. 6*d*. net.

Deutsche Südpolar-Expedition, 1901–1903. Edited by E. von Drygalski. II. Band, Geographie und Geologie. Heft vii. Pp. viii+617–662, and Taf. xxxiv. and xxxv. (Berlin: G. Reimer.) 7.50 marks.

Atlas Photographique des Nuages. By Dr. J. Loisel. Pp. 8+10 plates. (Paris: G. Thomas.) 18 francs.

Les Merveilles du Monde Sidéral. By M. G. Raymond. Fasc. i. Pp. 96. (Paris: G. Thomas.) 4 francs.

Geologische Rundschau. Band iii., Heft 2. (Leipzig: W. Engelmann.)

The Structure of the Atmosphere in Clear Weather: a Study of Soundings with Pilot Balloons. By C. J. P. Cave. Pp. xii+144. (Cambridge University Press.) 10*s*. 6*d*. net.

The Effects of Errors in Surveying. By H. Briggs. Pp. xi+179. (London: C. Griffin and Co., Ltd.) 5*s*. net.

Modern Destructor Practice. By W. F. Goodrich. Pp. xvi+278. (London: C. Griffin and Co., Ltd.) 15*s*. net.

Introduction to Analytical Mechanics. By Profs. A. Ziwet and P. Field. Pp. ix+378. (London: Macmillan and Co., Ltd.) 7*s*. net.

A School Algebra. By H. S. Hall. Parts ii. and iii., with Answers. Pp. x+301–550+xxxix–lix. (London: Macmillan and Co., Ltd.) 2*s*. 6*d*.

The Flora of Bristol. By J. W. White. Pp. viii+722. (Bristol: J. Wright and Sons, Ltd.; London: Simpkin, Marshall and Co., Ltd.) 13*s*. 6*d*.

The Development of the Incandescent Electric Lamp. By G. B. Barham. Pp. viii+198. (London: Scott, Greenwood and Son.) 5*s*. net.

DIARY OF SOCIETIES.

THURSDAY, MAY 9.

ROYAL SOCIETY, at 4.30.—On the Variation with Temperature of the Rate of a Chemical Change, with an Appendix by Prof. W. Esson, F.R.S: A. Vernon Harcourt, F.R.S.—Some Phenomena of Sunspots, and of Terrestrial Magnetism: Dr. C. Chree, F.R.S.—On the Ultimate Lines and the Quantities of the Elements producing the Lines in Spectra of the Oxyhydrogen Flame and Spark: Sir W. N. Hartley, F.R.S., and H. W. Moss.—The Transformations of the Active Deposit of Thorium: E. Marsden and C. G Darwin.—On the β Particles Reflected by Sheets of Matter of Different Thicknesses: W. Wilson.

ROYAL INSTITUTION, at 3.—Recent Explorations in the Canadian Rocky Mountains: Prof. J. Norman Collie, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 7.30.—The Behaviour of D.C. Watt-hour Meters, more especially for Traction Loads: S. W. Melsom and H. Eastland.—Electric Meters on Variable Loads: Prof. D. Robertson.

FRIDAY, MAY 10.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Radiant Points of Shooting Stars: 1899–1911: W. F. Denning.—Publication of Heliocentric Places of Planets: Nautical Almanac Office.—The Solar Eclipse of 1912, April 16–17: Rev. W Sidgreaves and Rev. A. J. Cortie; G. J. Newbegin; Rev. C. D. P. Davies.—Spectroscopic Observations during the Eclipse of 1912, April 16–17: A. Fowler.—Measures of Southern Binary Stars in 1911: J. Tebbutt.—Stellar Photometry by Focal Displacement: Maxwell Hall.—Preliminary Observations of Spiral Nebulæ in Polarised Light: J. H. Reynolds.—On the Motions and Distances of Certain Stars of Types B8 and B9: H. C. Plummer.—*Probable Papers:* The Effect of Magnetism on the Rates of Chronometers and Watches: S. Chapman and T. Lewis.—Positions of the Sun's Axis as Determined from Photographs, 1874–1911, Measured at the Royal Observatory, Greenwich: F. W. Dyson and E. W. Maunder.—Constitution of the Solar Corona. II.: J. W. Nicholson.—Observations of the Partial Solar Eclipse of 1912, April 16–17, at the Radcliffe Observatory, Oxford: A. A. Rambaut.—Note on the Appearance of the Corona of 1912, April 17: J. H. Worthington.—Prof. Lowell will be present, and give an account of the Spectroscopic Discovery of the Rotation of Uranus at the Lowell Observatory.

ROYAL INSTITUTION, at 9.—The Gaumont Speaking Kinematograph Films: Prof. W. Stirling.

MALACOLOGICAL SOCIETY, at 8.—A Synopsis of the Recent and Tertiary Fresh-water Mollusca of the Californian Province: Harold Hannibal.—On *Dosinia lucinalis*, Lam., and its Synonyms: A. J. Jukes-Browne, F.R.S.—New Generic Names and New Species of Marine Mollusca: T. Iredale.

PHYSICAL SOCIETY, at 8.—A Method of Measuring Small Inductances: S. Butterworth.—The Conversion of Starch into Dextrin by X-Rays: H. A. Colwell and Dr. S. Russ.—Demonstration of Apparatus for showing the Generation of Electricity by Carbon at High Temperatures: Dr. J. A. Harker and Dr. G. W. C. Kaye.—Calibration of Wave-meters for Radio-telegraphy: Prof. G. W. O. Howe.

INSTITUTE OF METALS, at 8.30.—The Inner Structure of Simple Metals: Sir J. A. Ewing, K.C.B., F.R.S.

MONDAY, MAY 13.

ROYAL SOCIETY OF ARTS, at 8.—Heavy Oil Engines: Captain H. R. Sankey, R.E.

TUESDAY, MAY 14.

ROYAL INSTITUTION, at 3.—The Study of Genetics: Prof. W. Bateson, F.R.S.

WEDNESDAY, MAY 15.

GEOLOGICAL SOCIETY, at 8.

ROYAL METEOROLOGICAL SOCIETY, at 4.30.

ROYAL SOCIETY OF ARTS, at 8.—The Manufacture of Nitrates from the Atmosphere: E. K. Scott.

ROYAL MICROSCOPICAL SOCIETY, at 8.—British Enchytræids. IV. The Genus Henlia: Rev. Hilderic Friend.

THURSDAY, MAY 16.

ROYAL SOCIETY, at 4.30.—*Probable Papers:* (1) The General Theory of Colloidal Solutions; (2) The Tension of Composite Fluid Surfaces and the Mechanical Stability of Films of Fluid; (3) On the Formation of a Heat-reversible Gel: W. B. Hardy, F.R.S.—(1) Studies on Enzyme Action. XVI. The Enzymes of Emulsin. II. Prunase, the correlate of Prunasin; (2) Studies on Enzyme Action. XVII. Enzymes of the Emulsin Type. II. The Distribution of β-enzymes in Plants: Prof. H. E. Armstrong, F.R.S., E. F. Armstrong, and E. Horton.—Studies on Enzyme Action. XVIII. Enzymes of the Emulsin Type. III. Linase and other Enzymes in Linaceæ: Prof. H. E. Armstrong, F.R.S., and J. V. Eyre.—Reflex Rhythm Induced by Concurrent Excitation and Inhibition: Dr. Alexander Forbes.—The Factors in Rhythmic Activity of the Nervous System: T. Graham Brown.

ROYAL INSTITUTION, at 3.—Ice Formation in Canada. I. The Physical Aspect: Prof. H. T. Barnes, F.R.S.

INSTITUTION OF MINING AND METALLURGY, at 8.

INSTITUTION OF ELECTRICAL ENGINEERS, at 7.45.—Annual General Meeting.—At 8.30.—Condensers in Series with Metal Filament Lamps: A. W. Ashton.

ROYAL SOCIETY OF ARTS, at 4.30.—Indian Railways: Neville Priestley.

FRIDAY, MAY 17.

ROYAL INSTITUTION, at 9.—High Frequency Currents: W. Duddell, F.R.S.

CONTENTS.