THURSDAY, MARCH 31, 1910.

A FRENCH TREATISE ON PHYSICAL GEOGRAPHY.

Traité de Géographie physique: Climat, Hydrographie, Relief du Sol, Biogéographie. By Prof. Emmanuel de Martonne. Pp. viii+910, and maps. (Paris: Librairie Armand Colin.) Price 22 francs.

EVERY writer of text-books is faced by the difficulty that the science of which he treats inosculates with and is overlapped by other branches of science. One of his most important tasks, therefore, consists in the exercise of a wise judgment as to what should be properly included, and what excluded, in the treatise he is preparing.

It has sometimes been suggested that all science may be regarded as falling into the two divisions geography and astronomy, the former dealing with everything that relates to our own planet, the latter with matters concerning the outside universe. But however logical such a scheme of classification of the sciences may be regarded, it cannot be commended on the score of convenience. There is no branch of physical or natural science which is not a part of "earth-knowledge," but it would be clearly impossible in a single treatise to deal with the foundations and superstructures of physics, chemistry, geology, botany, zoology, and anthropology. A work on geography must take for granted a certain amount of preliminary knowledge of science, and be contented with showing their application to the explanation of the various phenomena exhibited on the surface of the globe.

In the preface to the work before us, its author suggests as natural divisions of physical geography the following:—Morphologie, l'hydrographie, le climat, la biogéographie, et la géographie humaine; and the bulky volume now issued deals only with the first four of these divisions. The author justly remarks that it is almost impossible for any man to have a complete personal knowledge of all these subjects, but that specialisation becomes necessary; he has therefore sought and obtained assistance from various colleagues and friends in dealing with different departments of the subject.

In the first division of the work, devoted to general notions on the subject, a clear account, occupying 25 pages, is given of the history and evolution of geological science, and in this part, as in all following divisions, a very useful and complete bibliography of the subject is supplied. The question of projection is fully treated, and, for the very numerous maps of the whole globe given throughout the work, the conventional system of Molweide (or Babinet) is adopted in preference to that of Mercator, thus avoiding the extreme polar distortions of the latter system.

The 160 pages devoted to meteorology, and constituting the second division of the work, contains an excellent summary of that branch of science. The chief meteorological instruments are described, and clear statements given on the temperature, the hygroscopic characters, and the movements of the atmosphere in different areas; and the bearings of these several factors in producing different types of climate are discussed with much skill.

The subject of hydrography has more than 100 pages devoted to it, and constitutes the third division of the book. A good *résumé* of the observations made in recent years in the deep oceans is given with abundant references, including those to the latest published works. This is followed by chapters on the movements of the oceanic water, on the lakes, and on the rivers of the globe.

The fourth part of the work, dealing with the forms of the great land masses of the globe, constitutes the largest division of the book, occupying no fewer than 340 pages. After a sketch of the methods employed in surveying and of the different ways of representing the results on maps, a list is given of the chief published topographical maps of different parts of the world. We notice here some singular omissions. The Ordnance maps of England and Wales and of Scotland, on the one-inch scale, are referred to, but there is no mention of the existence of maps on other scales, or of any of the Ordnance maps of Ireland! The maps of the trigonometrical survey of India are included, but no notice is taken of any British colony, although Algeria and Tunis receive full consideration. This is a matter which certainly calls for rectification in a future edition.

The forms of the land surfaces resulting from different kinds of erosion are dealt with somewhat fully on the lines rendered familiar by the writings of Prof. W. M. Davis. Under the title of palæogeography a chapter is devoted to the forms and dimensions of land-masses during former geological periods, and the somewhat problematical questions connected with the subject are dealt with in considerable detail. The map of "Gondwanaland" on p. 587, in which the great continent of Permo-Carboniferous times is made to include, not only India and a large part of Africa, but to extend over Australia and the western half of South America, will naturally excite criticism from those who believe in the permanance of ocean-basins; as will also the map of the world in Cenomanian times, in which, following de Lapparent, Haug, and Frech, the author represents a northern and a southern Atlantis, and, more doubtfully, a Pacific continent. The chapters on glacial and desert conditions, and the surface features resulting from them, are fully up to date, and contain much useful information of a kind not usually found in text-books.

In the 180 pages devoted to "biogeography" there is much useful information included, but opinions will differ as to how far much of this matter should legitimately form a part of a treatise on physical geography. Such subjects as commensalism in plants and animals, the fertilisation of plants, domestication and its influence, mutation and saltation—important as they undoubtedly are—seem scarcely to form a portion of *geographical* science, and if they are included it is difficult to understand why many similar questions are omitted.

Apart from this difficult question of the limits which the author should adopt for his subject, the work before us is a mine of information, and especial praise

must be given to the great wealth of useful illustrations it contains. These include 396 figures and maps in the text, 48 plates with very beautiful photographs of scenery, &c., and two folding coloured maps. J. W. J.

THE PREHISTORIC EVOLUTION OF ITALY. The Stone and Bronze Ages in Italy and Sicily. By T. Eric Peet. Pp. 528; maps and plates. (Oxford: Clarendon Press, 1909.) Price 16*s.* net.

THIS book gives a clear and exhaustive description of the results of the numerous excavations made by Italian archæologists and a critical discussion of the material obtained. The author succeeds in giving a remarkably complete record of the evolution of culture in Italy from the Palæolithic age down to the Iron age. In arriving at his conclusions he relies almost entirely on technological data, which, though of great value in determining the state of culture of the peoples with which he deals, are of much less value than the data of physical anthropology in solving racial problems. Large numbers of skeletons appear to have been discovered in the immense number of tombs that have been investigated by the Italian archæologists, but only in two or three cases does the author give us the measurements of these skeletons. As a result, many problems have to be left unsolved which with the assistance of physical data would apparently be easily soluble. For instance, a type of Neolithic pottery is found in a cave at Villafrati, in north Sicily, which differs from the Neolithic types found in other parts of the island, and has analogies with pottery found in certain neighbouring countries. The author is unable to decide whether this pottery was introduced by the immigration of a new race or by trade intercourse with foreign countries. He appears to have overlooked the important fact, mentioned by him in a footnote, that four skulls having an average index of 82·2 were found in the same cave as the new type of pottery. Knowing that the average index of the ancient Mediterranean race is 74–75, the physical anthropologist would have no hesitation in saying that the probability was immensely in favour of the new type of pottery being introduced into Sicily by the immigration of a new race.

The difference in the technique of the Neolithic implements and pottery in north and south Italy leads the author to the conclusion that the populations of these regions were two branches of the Mediterranean race who arrived in Italy by different routes. The southern branch almost certainly came by sea from Crete; about the route of the northern branch there is not the same certainty. Towards the end of the Neolithic period, pottery of the "dolmen" type appeared in south Italy, north Sicily, and Sardinia, and superseded the older types.

In the period coming after the Neolithic, which the author, following the Italian archæologists, calls the Eneolithic period, copper makes its appearance alongside of stone. The rock-hewn tomb is introduced in south Italy and Sicily, and a great advance takes place in the technique of stone implements. Several new types of pottery appear. One of these is distinctly Ægean, so there can be no doubt that there was trade intercourse in the Eneolithic period between Crete and south Italy and Sicily.

A remarkable type of pottery occurs in the early Eneolithic period in south-west Sicily in association with rock-hewn tombs. The ornamentation consists of rectilinear patterns painted in black on a ground of "white slip," with which the clay pot is coated. The distribution of this pottery is interesting; it is not found in Crete, but it has been found in Thessaly and in other parts of north Greece; fragments have also been found at Molfetta, in Apulia, south Italy. It looks, therefore, that there was a second route of trade or of migration from the east, across north Greece, the Adriatic, and south Italy to Sicily, which is quite distinct from the Ægean sea route along which the greater part of the trade of south Italy with the east, passed.

The author leans to the view that the great cultural changes of the Eneolithic period were not due to the immigration of a new race, but to foreign influence. Measurements of skulls found associated with the "painted white slip" ware might possibly change this opinion. The average cephalic index of four skulls found at Castelluccio with this ware was 77·9, which looks significantly higher than that of the Mediterranean race.

The Bronze age in Italy is treated topographically. A very painstaking and up-to-date description is given of the material found in the lake dwellings, in the Terremare, and in Bronze-age hut-settlements and caves of north Italy. Chapters are then devoted to the Bronze age in south Italy, and to the Bronze age in Sicily and Sardinia.

In a chapter on the racial problem, the author deals with the racial affinities and origins of the peoples who introduced bronze into Italy. There are two theories in the field, that of Brizio and that of Pigorini. The author favours the latter. According to Pigorini's theory, the hut villages and caverns of the Neolithic age in north Italy were inhabited by a dolichocephalic race (called usually *Ibero-Liguri*) who inhumed their dead. At the end of the Neolithic period a new race appeared in north Italy which cremated its dead. This race planted the first lake dwellings in Lombardy. In the full Bronze age another branch of the same race invaded the eastern district of north Italy, and planted the lake dwellings of the Veneto and the Terremare of Emilia. At the end of the Bronze age, part of the new people crossed the Apennines and entered Tuscany and Latium. This new people Pigorini calls the *Italici*. He considers that they were of the same race as the Swiss lake dwellers, and therefore probably brachycephalic. There is no direct evidence of this, as cremation was an invariable burial custom among the Italian like dwellers and the Terremare folk.

The volume is well printed, contains many excellent illustrations, and four valuable maps showing the distribution of sites in the Neolithic, Eneolithic, and Bronze ages. No student of the prehistory of man in Italy, or indeed in Europe, can dispense with read-

ing this volume. It is, we believe, the first treatise in English which has fully utilised the remarkable archæological discoveries of the last decade in Mediterranean countries, and the author is to be congratulated on the thoroughness and ability with which he has accomplished his task. J. G.

BOTANICAL PHOTOGRAPHS.

Vegetationsbilder. Seventh series. Parts iii. to viii. Part iii., Der nördliche Schwarzwald, by Otto Feucht; part iv., Vegetationsbilder aus Dalmatien, by L. Adamović; part v., Charakterpflanzen des abessinischen Hochlandes, by Felix Rosen; parts vi. and vii., Pflanzenformationen aus Ost-Bolivia, by Th. Herzog; part viii., Vegetationsbilder aus Dänisch-Westgrönland, by M. Rikli. Price 4 marks, each part containing 6 photographs. Edited by Prof. G. Karsten and Prof. H. Schenck. (Jena: Gustav Fischer, 1909–10.)

THIS unique botanical publication is being continually extended, so that a seventh series is now completed. The first double part of the volume, dealing with the colonisation of volcanic lands in Java and Sumatra, has been previously noticed. The third part is devoted to the vegetation of the northern area of the Black Forest, which is characterised by its coniferous trees and moorland. A typical bit of high moor shows bushes of *Pinus montana*, clumps of *Scirpus caespitosus* and tufts of *Juncus squarrosus*. On another plate the same pine is seen as a tall tree, contrasting with the adjacent Scots pine and spruce. The author has also been very successful with his representations of the two subalpines, *Andromeda polifolia* and *Athyrium alpestre*, and of the umbellifer, *Meum athamanticum*. Dr. L. Adamović has brought together a most attractive set of photographs from the sunny climate of Dalmatia. They illustrate a strip of shore and rocks of the littoral, sublittoral and montane regions. So carefully have the spots been chosen and the photographs taken that the author can point out most of the individual plants. Especially charming is the first plate, showing *Aster Tripolium* with species of Statice and *Inula crithmoides* on the shore, and the second picture of sublittoral rock where *Dianthus dalmaticus* and *Iris germanica*, with other plants, are easily recognised. Trees provide the chief feature of the views on the Abyssinian plateau. The rosaceous plant *Hagenia abyssinica*, which tardily assumes its arboreal shape, is very striking; the unripe fruits are esteemed by the natives as a valuable specific for internal complaints. A fine specimen of tree Euphorbia is depicted, which the author suggests may have developed an arboreal form when it passed from a dry to a moist climate. Even more singular is the tree Lobelia, formerly known as Rhynchopetalum. Illustrations are also given of a huge spreading Ficus and a tree Entada.

Dr. Th. Herzog has provided a fine double part relating to the remote territory of East Bolivia. Along the Paraguay, on savannah land subject to inundations, is the home of the wax palm, *Copernicia cerifera*, where it is associated with tall grasses, species of Paspalum and Andropogon. Another plate represents the growth of the palm *Acrocomia Totai*, on the sandstone highlands of Chiquitos. A "monte" or thicket formation occurs on parts of the plain of the Rio Grande, where thorny scrub and succulents predominate; the plates depict species of Cereus, a Trithrinax and the bromeliad *Aechmea polystachya*, which last is valuable to travellers, as it generally holds a store of water. Other palms selected for illustration are *Orbignya palmata* and *Mauritia vinifera*, typical of the savannahs, *Astrocaryum Chonta* and *Iriartea exorrhiza*, denizens of the rain forests; Iriartea produces remarkable thorny prop roots. The last two plates portray succulents, of which *Pilocereus celsianus* is the most striking, on account of its silvery crown of hairs.

The concluding part contains some typical aspects of vegetation in Danish West Greenland. In the southern area birches alone attain to the height of trees as seen in the first plate; the second indicates the importance of *Salix glauca*. A brilliant photograph of an Arctic meadow would be better appreciated if a key to the plants had been supplied. There is an effective photograph of cotton-grass growing by the edge of a lake, and another of clumps of *Glyceria distans* which attract attention on account of the peculiar lie of the stems.

MAGNETIC CHARTS.

Magnetische Kartographie in historisch-kritischer Darstellung. By G. Hellmann. Veröffentlichungen des Kg. Preuss. Meteorologischen Instituts, Abhandlungen, Bd. iii., Nr. 3. Pp. 61. (Berlin: Behrend and Co., 1909.) Price 6 marks.

DR. G. HELLMANN, as head of the Prussian Meteorological Institute, which controls the magnetic observatory at Potsdam, and as a lover and collector of antique magnetic literature, is conspicuously qualified for the work he has undertaken in the present volume. It aims at giving a complete list of all magnetic charts of any importance. All time prior to the year 1700 is regarded by Dr. Hellmann as preceding the era of charts, but he devotes a few pages to Columbus and other pioneers, whose work relates to the discovery that the magnetic needle is usually inclined to the geographical meridian.

Time since 1700 is divided into two periods. The first, extending until 1835, was heralded in by the famous chart of Halley; it is briefly discussed on pp. 10–11. The second period, extending from 1835 to the present day, saw the introduction of magnetic surveys on land.

The earliest work of this kind, according to our author, took place in England on the initiative of the British Association. On pp. 11–17 there is an enumeration of all the principal land surveys; while pp. 18–27 summarise the present state of our knowledge of the distribution of the magnetic elements. There is a useful list on p. 26 of the epochs of the principal surveys since 1891, with particulars as to the number and density of distribution of the stations. A number of propositions are laid down in pp. 28–29 as to the objects to be aimed at in magnetic surveys and other work preliminary to the construction of

charts. The author considers it most important that the exact observational work at sea commenced under the auspices of the Carnegie Institution should be extended as soon as possible to all seas. He advocates international cooperation to ensure continuity in the drawings of magnetic lines in frontier districts, and emphasises the importance of adequate determinations of secular change.

The terminology, units, &c., employed in the description of the charts are explained in pp. 30–31. The charts themselves are divided into those dealing with the whole or the greater part of the earth, those confined to the oceans, those dealing with the several continents, and, finally, those devoted to individual countries or districts. The information given usually includes the area, the epoch, the magnetic element or elements dealt with, the interval—in specified units—between the successive isogonal, isoclinal, or isomagnetic lines, the geographical scale of the map, also the locus and date of publication. The title in each case, when there is one, is given in the original language. There is a separate list on pp. 60–61 of charts based on theory.

The list of charts seems very complete. As evidence that it is up to date may be mentioned the fact that it includes the British and American world charts published respectively in 1906 and 1907, Commander Chetwynd's charts of the South Polar regions published in 1908, Dr. Schmidt's charts of North Germany, and Prof. Beattie's South African charts published in 1909. The volume is clearly printed in good-sized type, and should prove a valuable work of reference. C. CHREE.

ELECTRICAL BIOGRAPHY.

Makers of Electricity. By Brother Potamian and Prof. James J. Walsh. Pp. vi+404. (New York: Fordham University Press, 1909.)

THIS is not a work on central-station engineers, but a series of biographical sketches of the chief pioneers in the science of electricity in its historical development. Of these sketches there are twelve, as follows:—Peregrinus and Columbus; Norman and Gilbert; Franklin and some of his contemporaries; Galvani; Volta; Coulomb; Oersted; Ampère; Ohm; Faraday; Clerk Maxwell; Lord Kelvin. As the first three, together with those on Oersted and Lord Kelvin, are signed by Brother Potamian, it may be assumed that the rest are by his colleague, Dr. Walsh, who is the author of several others works, "Makers of Modern Science," "Catholic Churchmen in Science," "Makers of Modern Medicine," and "The Popes and Science," which appear to have a great vogue amongst Roman Catholic readers in the United States. Brother Potamian, better known to his English friends as Dr. O'Reilly, is one of those who has made the bibliographical history of electricity his own; and his masterly annotations of the catalogue of the Wheeler collection of electrical books (formerly the library of the late Mr. Latimer Clark) in the possession of the American Institute of Electrical Engineers show him to possess abundant qualifications for writing biographies of the pioneers. If the chapters on Peregrinus and Columbus, Norman and Gilbert, add nothing to previous knowledge, they are valuable in presenting very readable summaries of the results of recent antiquarian research into the achievements of these early investigators of magnetism. The account of Peregrinus is particularly good, and avoids errors too often attaching to accounts of his long-forgotten discoveries. The article on Gilbert is also replete with the details which have been unearthed in recent years, though by a slip on p. 49 he is said to have blamed Stevinus for certain "vain and absurd" views about the variation of the compass in southern regions of the earth. It was not Stevinus whom he blamed, but "certain unnamed Portuguese mariners." Gilbert's Copernican views are discussed fully, and criticised.

Franklin's work in electrical observation is treated at some length, as is natural in a work intended primarily for American readers; but all readers should be grateful for the very clear way in which Brother Potamian has laid out the historical position of Franklin with respect to those contemporaries of his—De Romas, d'Alibard, and Divisch—who have been alleged to have anticipated him with respect either to the kite experiment or the invention of the lightning rod. One amusing reminiscence is recorded in this chapter of the controversy which arose upon knobs *versus* points, and was referred to a committee of the Royal Society. In that committee the Hon. Henry Cavendish and Dr. Benjamin Wilson were opposing partisans. Sir John Pringle, the President of the Royal Society, supported Cavendish in favour of using points. But points had been advocated by Franklin, whom to support at that moment was "unpatriotic." His Majesty George III. accordingly ordered that the points of the lightning conductors at Kew Palace should be replaced by balls; whereupon Sir John Pringle, replying with dignity, "Sire, I cannot reverse the laws and operations of nature," resigned the presidency. This evoked the following witty epigram:—

> While you, great George, for knowledge hunt,
> And sharp conductors change to blunt,
> The nation's out of joint;
> Franklin a wiser course pursues,
> And all your thunder useless views
> By keeping to the point.

The chapters devoted to Galvani and to Volta call for little comment. That on Coulomb gives a better biography than is accessible in English elsewhere. Those on Oersted, Ampère and Ohm are each good in their way; but that on Ohm lacks proportion. One might think that the whole of mathematical physics began and ended with Ohm's "Law."

The lives of Faraday, Clerk Maxwell, and Lord Kelvin are compiled with a knowledge and sympathetic comprehension. The one phrase to which one must take exception in the account of Lord Kelvin is the suggestion—*apropos* of Lord Kelvin's saying at his jubilee that the most strenuous of his efforts for the advancement of science had ended in "failure"—that "because Dame Nature did not open to his

sesame, but persisted in her reticence, the philosopher grew pessimistic and disappointed." "Pessimistic" is the very last adjective to be applied to Lord Kelvin in his cheery and undaunted battling to the last with the deepest problem of mathematical physics. No trace of disappointment soured the serene close of his strenuous life.

There are eight portraits and a score of illustrative cuts in the work, which is well and clearly printed.

OUR BOOK SHELF.

Syllabus of the Lessons on Marine Biology for Fishermen, given at the Marine Laboratory, Piel, Barrow-in-Furness, by the Lancashire and Western Sea-Fisheries Joint Committee. Revised January, 1910. Pp. 35; 7 plates. (Liverpool: C. Tinling and Co., Ltd., 1910.)

THIS handbook, which has been prepared by Mr. James Johnstone, is written in a clear, direct style, and is illustrated by good text-figures and seven excellent plates. The author is to be especially congratulated on the skill with which he has, throughout the book, avoided the use of technical terms without sacrificing scientific accuracy. The desire to avoid the use of the word protoplasm has, however, led to the use of another term in an unusual sense; on p. 13 the author, dealing with Peridinians, writes:—"They, like the diatoms, are jelly-fish, and have shells . . . ." It would be better to avoid the use of the term jelly-fish, in such a connection, in view of its more generally accepted application to organisms of a higher class.

The book contains outlines of lessons on those branches of marine biology which are of special interest to fishermen—the general anatomy, physiology and development of the mussel, the structure of the cockle, the food of these molluscs; the structure of shrimps, crabs and lobsters, their growth, "casting" (ecdysis) and reproduction; the anatomy of the haddock or whiting, the fecundity of various fishes, especially of flat fishes, that of the flounder being studied in detail; the food in the sea, plankton; the different kinds of spawn found on the shore; the elementary chemistry of air and water, the temperature of the sea, &c. This list will serve to show the range of subjects comprised in this admirably planned course of scientific instruction. The book is certain to stimulate the interest, not only of those who attend the classes, but also of other fishermen, to whose notice it will be brought by their more fortunate fellow-workers who have passed through the classes and used the book.

The Sun a Habitable Body like the Earth. By Sree Benoybhushan Raha Dass. Pp. xiv+130. (Naldha: Published by the Author, 1909.) Price 5*s*., or 3 rupees.

THIS is, typically, a book "published (and distributed) by the author," and perhaps the kindest statement to make about it is that it is an anachronism. Apparently the author attempts to explain all solar phenomena as electrical effects, and, as a prelude, describes the actions of, and discharges from, insulated conductors; but the language is so often obscure, and, where intelligible, is so devoid of connected reasoning, that no clear idea can be obtained as to the ultimate conclusions. Quotations from great authorities, including Herschel's conclusion as to the sun's habitability, give the volume itself an air of authority which is rudely dispelled on a closer acquaintance.

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 "Reindeer" from the Lorthet Grotto.

I HAVE just been consulting in *Science Progress* for July, 1909, the very interesting paper of Prof. Sollas on the Palæolithic races, and I venture to direct attention to the title of an illustration on p. 25. It is entitled "Reindeer and Salmon Incised on a Piece of Horn from Lorthet." This legend is taken from the original figure by the late M. Piette in *L'Anthropologie*, 1904, p. 160; but is the Cervus there engraved rightly ascribed to *tarandus*? Is it not *megaceros*? *Tarandus* has no brow tines like those delineated on this horn plaque. They are more or less palmated, while in *megaceros* they are differently directed, present a different section, and are bifid as are those figured in *Science Progress*. It may or may not be now or later of importance to ascribe correctly this particular drawing, but the determination of the species in prehistoric cave-engravings has an important bearing on the age and climate of the horizon from which they come.

May I venture, if Prof. Sollas will allow me, to refer also to p. 26 of the same important contribution, where occur the words ". . . Saiga antelope, the same animal as that which is sculptured in so masterly a manner on the spear-thrower mentioned on p. 20 (Fig. 3)." The animal sculptured—also after M. Piette's figure in *L'Anthropologie*—on the implement (from Mas d'Azil) referred to can hardly be a *Saiga*. The position and form of the nostrils and the uninflated nose-sac which the side-view reveals preclude this determination. The creature must be a goat or a chamois, or belong to a nearly related genus.

HENRY O. FORBES.

The Museums, Liverpool, March 20.

Centre of Gravity of Annual Rainfall.

THE ordinary method of exhibiting the annual distribution of rainfall for any station or country is a graph the ordinates of which represent the monthly rainfall. Though this pictorial method is both useful and interesting, it does not lend itself to the ready comparison of a number of such graphs for different places or for the same place in different years. By a similar graphic method we can exhibit the yearly rainfall totals for a number of years, but we cannot show differences of internal distribution for each year unless we are at the trouble to graph each month of each year separately.

Another method, which may be called the analytical method, I have been applying recently to the study of the rainfall of the province of Mysore, India, upon which I had to report officially from 1893 to 1908, and I have been much surprised at the results brought out by this method. The same method applied to the rainfall statistics of England, Scotland, and Ireland, as given by Dr. H. R. Mill in "British Rainfall" for 1908, shows also curious and interesting results.

The method consists in the application of the well-known formula for finding the position of the centre of gravity of a number of weights placed along a straight rod, viz. $X = \Sigma(wx) \div \Sigma(w)$. If we imagine the rainfall for the months of the year January, February, . . ., December to be weights placed along an axis at distances 1, 2 . . . 12 units from the Origin, or end of the axis (January 1), multiply each month's rainfall by its distance from the Origin, and divide the sum of the products by the total rainfall for the year, we get the position (or date) at which the year's rainfall might be supposed to have fallen all together to give the same effect as the separate monthly falls.

The Mysore Province, which has about the same area as Scotland without the Isles (28,000 square miles), is divided into eight *Districts*, which differ greatly in the amount of yearly rainfall, as well as in the monthly distribution. Each *District* is divided into a number of

parishes, called *Taluks*, and the rainfall is gauged at the chief-town of each Taluk. The mean of these is taken as the rainfall for each District. From the average monthly rainfall of each District for the past thirty-nine years I have found the C.G., also for the year 1908, and they are given for comparison :—

District.	No. of Taluks.	Average for 39 years.		1908.	
		Rainfall	C.G.	Rainfall.	C.G.
1. Bangalore ...	10	30·48	7·93	25·49	6·47
2. Mysore	13	27·53	7·74	24·24	6 64
3. Hassan	8	37·95	7·62	27·98	6·74
4. Chitaldrug...	9	21·10	7·51	14·03	6·93
5. Tumkur.....	10	25·90	8·01	15·76	7·00
6. Kolar... ...	11	27 89	8·14	16·00	7 07
7. Shimoga ...	9	66·60	7·34	67·31	7·14
8. Kadur... ...	7	73·00	7·40	63·74	7·06
Province...	77	36·79	7 68	29·94	6·91

The Shimoga and Kadur districts each include three stations where the rainfall is enormously greater than at the other stations; yet though the thirty-nine-years' average annual rainfall for six of the Shimoga Taluk stations is only 35·78 inches, and for the three stations of great rainfall it is 128·24 inches, I find that the mean position of the C.G. is 7·28 for these three stations, while for the whole nine stations it is 7·34. In the same Shimoga District there are, besides the nine Taluk stations, fourteen additional rain-gauge stations, among which are Agumbi, with a mean yearly rainfall of 333·17 inches, Aralagode, with mean of 237·79 inches, and Karur, with mean of 115·79 inches, and I find the C.G. for these is at 7·29, 7·21, and 7·13 respectively.

It is to be noted that the great deficiency of rainfall throughout Mysore Province as a whole for the year 1908 is indicated, not only by the diminished yearly totals, but by the displacements of the C.G. for each District and for the whole Province. This means, of course, that the deficiency was in the "latter rains"—or those for the north-east monsoon—but the important thing is that we have a simple numerical measure, by combining the displacement of the C.G. and the total rainfall defect, of the real rainfall deficiency for the year. Thus while the rainfall average for the whole Province was 18·6 per cent. less than the yearly normal, the deficiency of the *rain-moment*, as we may call it in the language of mechanics, was 26·8 per cent., which agrees better with the agricultural effect.

This has led me to examine Dr. H. R. Mill's "British Rainfall" for 1908, and the results of working out the C.G. for a large number of stations, and for the 1908 mean rainfall of England, Scotland, and Ireland, are interesting. The position of the C.G. for the monthly mean rainfall of 122 stations in England and Wales is 6·54, of 55 stations in Scotland 6·37, of 53 stations in Ireland 6·72, and of 230 stations in the whole British Isles 6·55. For Greenwich, with rainfall 23·78 inches, it is 6·48; for Borrowdale (Cumberland), with rainfall of 127·38 inches, it is 6·54; for Glenquoich (Inverness), with 107·40 inches, it is 6·21; for Kenmare (Co. Kerry), with 70·01 inches, it is 6·59.

From the Journal of the Scottish Meteorological Society for 1908 I find the following results :—

	Year's Rainfall.	C.G.
Means of the eight principal towns of Scotland	33·05	6·54
Means for all Scotland for 1908	37·55	6·48
Means for all Scotland for fifty years (1856–1905)	39·19	6·87
Means for 1908 of eighteen Lighthouses on the Scottish coast	30·74	6·68

It is remarkable that the rainfall should be so small at the Lighthouses, and that the law of rain-distribution throughout the year should agree with that for the land-stations. The smallest rainfall for 1908 was at the Isle of May Lighthouse, where it was only 18·33 inches, with C.G. at 6·90; and the heaviest rainfall was at Ardnamurchan Lighthouse, where it was 50·99 inches, with C.G. at 6·63.

This method is readily applicable to the graphic presentation for a series of years either of the C.G. or of the *rain-moment*. Thus I have worked out the results for Bangalore from 1867 to 1908, and find that while the average position of the C.G. is 7·81, the positions for 1875 and 1876, the successive droughts of which caused the great Mysore famine, were 6·82 and 6·72, and while the average *rain-moment* is 276, it was for those years only 151 and 117 respectively. I also find that for the two years 1907 and 1908 the C.G. for Bangalore was at 6·77 and 6·08 respectively, and that the rain-moments were 214 and 157; which agree with the fact that Mysore narrowly escaped another serious famine quite recently, and give a measure of the margin by which it escaped the disaster caused by the rain deficiency of 1875 and 1876.

It is evident that we might easily graph on the same sheet for a sequence of years (1) the total rainfall; (2) its yearly C.G.; and (3) its rain-moment or coefficient. This principle will also give the data for charts of the general distribution of rainfall in a country for any year or series of years. That each station and country has its rain-constant which can be expressed numerically seems to be more than a mere theoretical curiosity.

J. COOK.

30 Hermitage Gardens, Edinburgh.

Lycopodium Spores.

MISS EDITH A. STONEY states (NATURE, January 6, vol. lxxxii., p. 279) that with a large aperture microscope objective and oblique illumination, Lycopodium spores are seen to be coated with hair-like projections. We believe this appearance to be illusory. Owing to the transparency of the outermost layer of cells, the margin of the spore is quite invisible under certain conditions, giving to the radial cell walls the appearance of hair-like projections.

Photomicrographs of some of these spores reproduced in the *Physikalische Zeitschrift* of February 1, p. 78, show the effect in question in some parts of the field, and evidence the correctness of the explanation given.

JOHN ZELENY.
L. W. MCKEEHAN.

Dr. H. J. Hansen and the Copenhagen Museum of Zoology.

I BEG permission to acknowledge the receipt of the open letter sent me through your Journal of March 10, by the leading zoologists of Great Britain and Ireland, regarding my resignation from the Copenhagen Museum and my zoological investigations. I am deeply conscious of the great honour done me in sending me such an address, and I regret that I am unable to write to all personally; but for that reason I would request them through your columns to accept my most sincere and heartfelt thanks.

H. J. HANSEN.

5te Juni Plads No. 1, Kjóbenhavn, F., March 17.

Title of the Natural History Museum.

WHAT has history, in its present sense, to do with the subject? What have the Muses to do with it? Certainly Terpsichore is not included at any of the museums. The N.H.M.(B.M.) is not a museum, but a Natureum. Might not a ten-syllable name on the other side of the way be replaced by the Arteum? Then Bloomsbury might use the name Historeum. The address need not include London or England, as no other place uses these terms. For all scientific reference one word would be complete.

W. M. F. P.

The Meaning of Ionisation.

IN his lecture at the Royal Institution on March 11, Dr. Brereton Baker proposed the term electromerisation instead of ionisation when applied to gases. May I venture to suggest the word "electronisation" as more euphonious, and as indicating the essential difference in the process, viz. the freeing of electrons instead of ions?

W. DEANE BUTCHER.

Holyrood, Ealing, March 18.

NUMERALISED PROFILES FOR CLASSIFICATION AND RECOGNITION.

WHEN children or savages attempt to draw a human profile, the result is usually a rude figure that lays stress on five cardinal points. These are the notch between the brow and the nose, the tip of the nose, the notch between the nose and the upper lip, the parting of the lips, and the tip of the chin. Supposing these five points, B′, N′, U′, L′, and C′, to be located with fair precision, as will shortly be shown to be feasible, then Fig. 1 is directly deducible from them, together with the vertical and horizontal axes, C′B′, and C′X at right angles to C′B′. The position of the five cardinal points varies in different profiles much more than the probable error of measurement. So though Fig. 1 is a mere skeleton, which determines what may be called the set of the features, and corresponds to the primary triangulation of a country, other points are to be derived from it, and similarly utilised. Among these are the intersections with the outline by perpendiculars, drawn from the middle or other specified division of the lines. This skeleton serves as an excellent basis for the classification of profiles and for anthropological statistics.

Peculiarities of profile, as a racial or family characteristic, can be expressed numerically by an extension of this system in a way that promises to be serviceable for eugenic records. It was, in fact, largely with this object in view that I began the

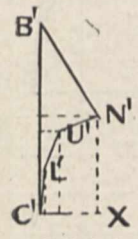


FIG. 1

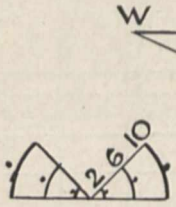


FIG. 2

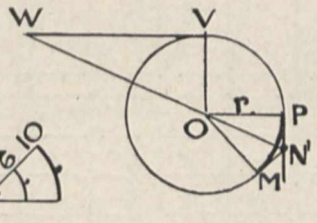


FIG. 3

inquiry. The replacement in all scientific work by numerical values, in the place of vague adjectives, is a gain of first-class importance. There is no way known to me, other than this, by which likenesses can be "lexiconised," that is, arranged as words in a dictionary. A needed portrait may by its means be discovered by a formula, as a spoken word is found in a dictionary, by the letters that express its sound. There are many simple purposes of newspaper interest to which this same method might be applied, but with more elaboration.

The practice of cataloguing profiles may perhaps become useful as a secondary means of identification when the number of persons who may require to be identified shall have become too large to be readily dealt with by finger-prints alone.

It will be shown (Fig. 5) that four telegraphic "words" are sufficient to convey a very fair profile likeness. The cost of sending an extra four words by telegram to any part of the British Isles being only twopence, and of a moderate amount over-seas, the practice of telegraphing profiles of persons of current interest, might become common. A refugee criminal could easily be outstripped by his portrait, sufficiently like to him to justify, in connection with corroborative evidence, his being placed for a while under police observation. The measures of profiles must, of course, be reduced to uniformity. Thus, by utilising two out of the five cardinal points to give direction and scale, the mean positions of the remaining three points may be determined for any given race or family, together with the frequency of deviations of any given amount from those mean positions, and such other deductions as can be reached by the modern methods of statistics.

The corrected values are here described by the same letters as the original ones, but without the dashes. The standard scale that is used is such that BC, the corrected value of B′C′, shall be always 50 units in length (see Fig. 5). The reduction is, of course, effected by multiplying each measure in the portrait by 50 divided by its B′C′. The number 50 is preferable to 100, which would probably first suggest itself, for a variety of practical reasons, into which I need not now enter. Two figures are assigned to each measure, so the values 0, 1, 2, ·.9, have to be written 00, 01, 02, .09. The measures are recorded to the nearest integer, there being no room for fractions, decimal or other. A millimetre is a convenient unit for purposes of drawing, more so than one-tenth of an inch; therefore, in reproducing the corrected measures, BC becomes 50 millimetres, and the other measures are altered in the same proportion.

A thick beard interferes with determining L′ and U′, but their positions can usually be inferred with a useful degree of precision in moderately bearded faces.

The accuracy with which the five cardinal points can be located differs considerably. The most exact determinations in an unbearded face are those of the points C′ and N′, and the direction of the line C′B′. U′ comes next in order of exactness, then B′, and, lastly, L′. The distance between a line joining C′N′ and a parallel line tangential to U′, can be fixed with precision but is not used here. C′ and N′ are each defined by the intersection of two tangents, as shown for N′ in Fig. 3.

It is well to examine these conditions more closely, as they bear on the treatment of curvatures generally. A knowledge of them permits rough and ready drawing, in which the principal matters are attended to, the less essential ones being more or less disregarded. One of the tangents is parallel to C′B′, which is treated as vertical; the other is inclined to the vertical at 45°. Consequently, the curve of N′ is contained in an obtuse angle of 180°−45°=135°. The tip of each prominence and the bottom of each hollow is represented by one or other of the three short circular arcs shown in Fig. 2, which are sufficiently numerous for the purposes to which they are here applied. The centres of all circles that touch both the vertical and the diagonal will necessarily lie in the line that bisects the obtuse angle between them; consequently, N′O forms an angle with the vertical that is equal to half 135°, or 67½°. The tangent of this angle is 2·4142; therefore the position of the line of centres may be found by laying off a point V in a vertical direction, at 10 units of length from O, and by drawing another line from V horizontally to W, at a distance from it equal to 24·14 of the same units as before. Then the line of centres passes through O and W. It is easily shown (Fig. 3) that the points of contact between the circle and the two tangents are exactly 45° of arc apart. The length of the chord of that angle is equal to about three-quarters of its radius. The shortness of the chord, when the radius is small, is well seen in Fig. 2, and must be borne in mind; it accounts for the scarcely noticeable differences in the curvatures, and consequently for the fewness of the standard arcs that are necessary. The arc of 45° is shown by a heavy line in Fig. 3, where the circle has a radius of 10 mm. There is often a colloquial confusion between the obliquity of the planes between which an edge lies and that of the sides of the edge itself. The former may be very acute, and the angle of the edge would be equally acute if the planes were prolonged until they met; but usually they do not meet, the edge itself being more or less rounded. The acutely inclined faces of a knife may have a blunted edge, that fails to cut the skin without much pressure, while a broken piece of glass, the fracture

of which is perpendicular to its face, but the edge of which is not blunted, only too readily makes a gash.

The arcs of 45° in Fig. 2 all refer to the cutting edge, so to speak. The direction of the lines within which the cutting edge is situated is determined by the adjacent cardinal points towards which they point.

Referring back to Fig. 3, OP=OM=r, the radius, ON=$r\times1{\cdot}082$, therefore the distance between N and the circle is only $r\times0{\cdot}82$, which for a radius=10 mm. is about three-quarters of 1 mm. This small value is diminished in proportion for lesser values of r (see Fig. 2), so for practical purposes N (and similarly C) may be considered to lie only just outside the convex circumference of the arc by which they are in each case represented.

The values of r which are used as standards for the lesser curvatures are 2 mm., 6 mm., and 10 mm. The drawings in Fig. 4 are not exactly on this scale, but the differences are unimportant. It is unnecessary to divide these small curves into concave and convex, as their condition in that respect is indicated by the part they play in the profile. Two other curvatures of the larger radii, 25 mm. and 30 mm., are used to express and to define the concavity or the convexity of the ridge of the nose.

It is well, at the risk of some repetition, to describe in a single paragraph the nomenclature of the five cardinal points in the original portrait. B′ is the point in the fronto-nasal notch at what is judged to be its deepest part; N′ is the tip of the nose, found in the way already described; U′ is the point of contact between the naso-labial notch and a tangent, drawn diagonally to it; L′ is a point half-way between the furthest positions at which the lips would touch one another if they were lightly closed; C′ is found by a similar method to that used for N′.

The portraits are described by numerical formulæ. Each formula consists of four groups of figures, five figures in each group. The shapes of the profile at and immediately adjacent to the cardinal points, and those of the intermediate links, are expressed by single numerals, as set forth in tabular form in Fig. 4. Not more than 0 to 9, or 10, varieties of shape are provided in each case. Thus, the radius of the standard curve that best fits the fronto-nasal notch, *b*, is expressed by its appropriate numeral, as shown in the first line of Fig. 4; also the inclination of the brow immediately above *b*, whether it slopes forwards, backwards, or is upright. The ridge of the nose *g* is counted as either sinuous, concave, or convex, in two or three different degrees, or else as straight. The letter *n* includes both the very tip of the nose and the outline underneath it, which leads towards the naso-labial notch. The letter *u* includes the naso-labial notch and the first portion of the upper lip. The lips require two statements, and therefore two separate figures; the former, *lp*, shows whether the lips are shut, parted in the portrait by 1 or 2 mm., or open by 3 mm. or more, and, again, whether they project evenly, are overhung or underhung. The latter notation, *ll*, expresses the sizes of the upper and lower lips respectively, whether they are small, medium, or large. The outline between the lower lip and the chin is always notched, and *k* describes the size and position of the notch, whether it be small, medium, or large, and whether it be high, medium, or low. The curve of the chin itself at C′ is not given.

I have called these profiles "numeralised" to express the fact that they are transformed into numerical formulæ. Twenty figures enter into each formula; they are arranged, as for telegraphy, in the way already described, into four groups of five figures in each group. A "figure," in telegraphic language, includes not only the ten numerals, 0 to 9, but the three symbols in addition, of a stop (.), a hyphen (-), and a short oblique line (/), such as is used in fractions. The arrangement in groups of five, or in "quintets," proved suitable to other similar work on which I was engaged, so it has been adopted throughout. In the four quintets, or, we may say, in the four *words* that compose a formula, the first three refer respectively to N, U and L, and in that order. The first two and the last two figures, in each of the first three quintets, give the position of the point in question in X and in Y to the nearest whole millimetre. The middle figure of the quintet is derived from Fig. 4 to describe the peculiarities of the profile at and immediately adjacent to that point. The fourth and last of the quintets is preceded by a dot (.), to show that it belongs to a separate category,

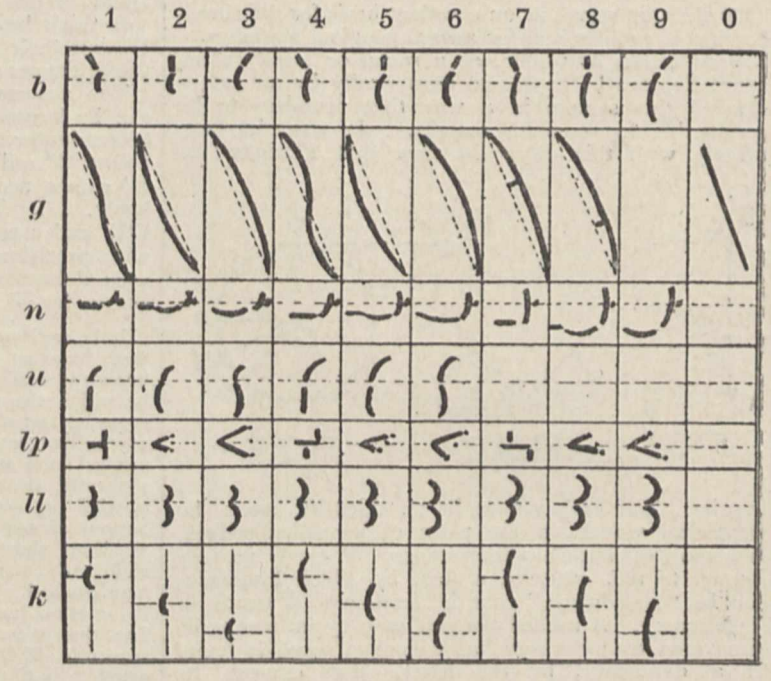


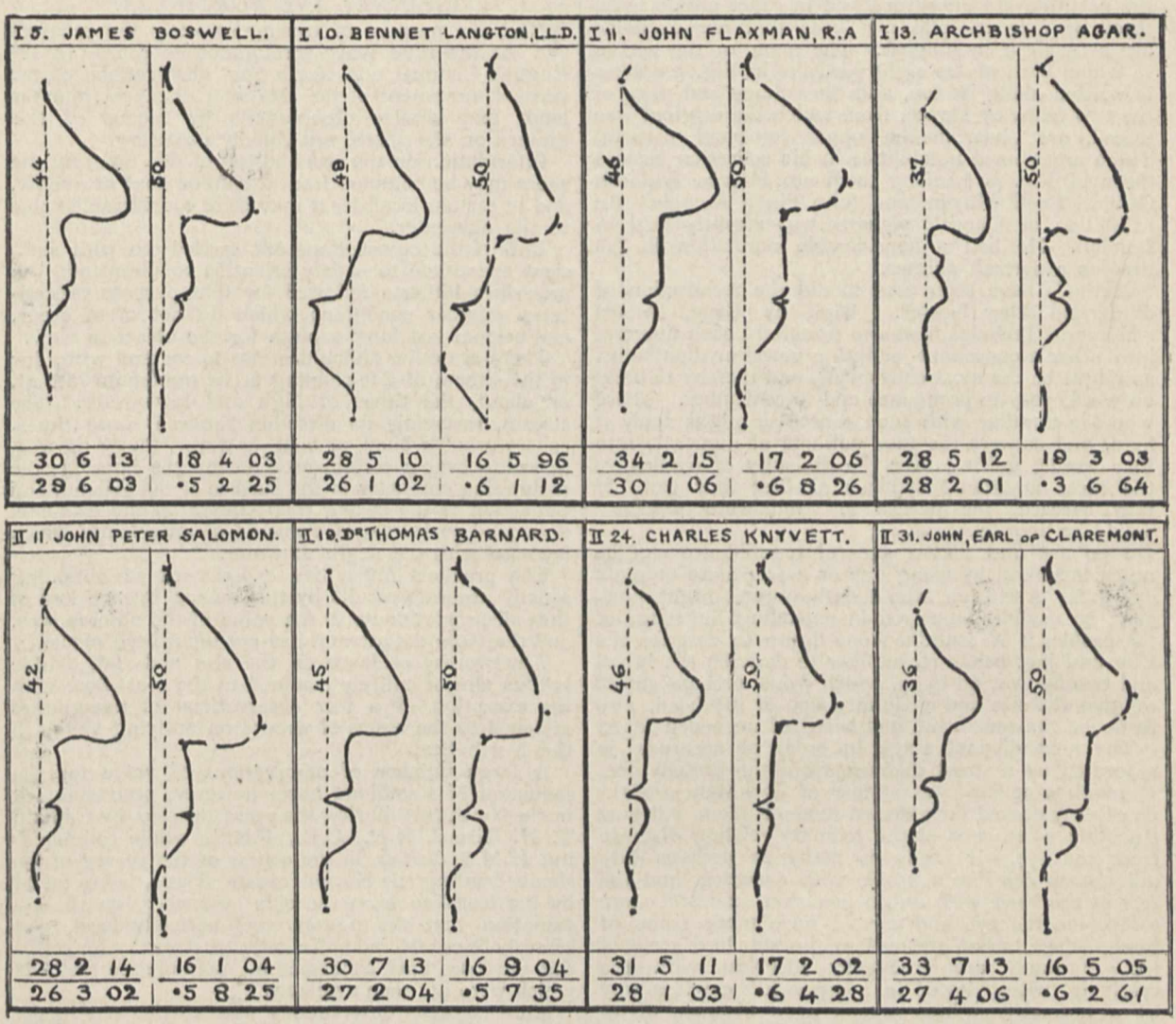
FIG. 4.

namely, to the peculiarities of *b*, *g*, *ll*, and *k*, as set forth in Fig. 4, and in that order. When proceeding to draw a figure from a formula, it is advisable for a beginner to use tracing paper. Then, after drawing an arbitrary line in any convenient place, of 50 millimetres in length, to serve for BC and, therefore, for the vertical axis, and another line CX, at right angles to CB at C, for the horizontal axis, to plot the positions of N, U, and L; then, laying the transparent paper upon Fig. 4, to trace, or copy on an enlarged or reduced form, according to the space available, the figures of *n*, *u*, and *lp*, very faintly. Next to do the same to *b*, *g*, *ll*, and *k*. Afterwards to harmonise the whole tentatively, with faint and brush-like strokes; lastly, with a free and firm hand to draw the outline through them. Tracing paper may otherwise be convenient, because when the original profile looks to the left, by the simple act of turning the traced outline it affords an almost equally clear profile, looking to the right.

When transforming the portrait into a formula, the reverse process has to be followed with little alteration. Before finally adopting any formula, the portrait should be reconstructed from it and the formula revised where necessary. It is easy after a little practice mentally to compose a formula so far as the seven small letters are concerned, from a brief inspection, either of the picture or of the living face; also to reproduce by copying by eye the symbols from Fig. 4 without caring to trace them. In short, the whole operation may be satisfactorily gone through by an

traits are by no means deficient in resemblance to their originals. I think they are considerably more like to them than the sketches, usually printed in the illustrated newspapers, are to the public characters whom they profess to represent. They are, to say the least, of considerable negative value, sufficing to eliminate at the rate of about nineteen out of every twenty individuals as *not* being the person referred to.

Any form of telegraphy suffices to transmit these four-word profiles. In other respects they are far inferior to those complete pictures now transmitted



30 6 13	18 4 03	28 5 10	16 5 96	34 2 15	17 2 06	28 5 12	19 3 03
29 6 03	·5 2 25	26 1 02	·6 1 12	30 1 06	·6 8 26	28 2 01	·3 6 64
28 2 14	16 1 04	30 7 13	16 9 04	31 5 11	17 2 02	33 7 13	16 5 05
26 3 02	·5 8 25	27 2 04	·5 7 35	28 1 03	·6 4 28	27 4 06	·6 2 61

FIG. 5.

Explanation of the first formula, namely, that of James Boswell; the others are to be read on the same principle. N_x, 30; N_y, 13. U_x, 28; U_y, 03. L_x, 18; L_y, 03. The small letters are, *n*, 6; *u*, 6; *lp*, 4. *b*, 5; *g*, 2; *ll*, 2; *k*, 5.

intelligent person in a rapid and off-hand way. This might become a popular game for the members of a party to practise their art upon one another, care being taken that the five cardinal points should be truly laid down, perhaps by tracing a shadow.

Eight couplets of very different features are given in Fig. 5, both for illustration and for the reader to practise upon. Each couplet contains the original portrait on the left, its formula along the bottom, and the reproduction from the formula (to the standard scale) on the right.

It will be seen from Fig. 5 that four-word portraits between certain offices, by means of costly and delicate apparatus, by a method at present not developed to its utmost.

It will be observed that in the second of the portraits, namely, that of Dr. Bennet Langton, the point L lies to the left of CY, and has therefore a negative value. This is −04, but is expressed here as 96, an artifice which practically transfers the horizontal measurement from CY to another vertical line drawn parallel to CY and 100 mm. to its left. No confusion need arise through this transformation, since it leads to very large values lying adjacent to

very small ones, and therefore showing that they belong to a different category. The *minus* values in Y are similarly treated. The process may also be extended beyond the eight squares of 0 to 100 mm. in their sides, that surround the primary one.

My experiments have been chiefly made upon the "Collection of Portraits by George Dance, R.A., Sketched from Life and Engraved in Imitation of the Original Drawings" (Longmans and Co., 1809). They were convenient to work with, being all drawn on scales differing little from that of the standard. All the portraits are unbearded and in exact profile, with three or four exceptions. Those that are available are sixty-eight in number. The name of the person to whom each of the eight portraits in Fig. 5 applies is written along its top, and the volume and page of the two folios by Dance, from which the original was traced, are given in the upper left-hand corners. There are several notabilities in his collection besides those in Fig. 5. Among them are Horace Walpole, General Paoli, Haydn, and John Philip Kemble. An exhibition of Dance's pictures was recently held in London. He had a considerable reputation in his time as a portrait painter.

Methods have been used to aid the recollection of dates and other figures. That by Gray, in his "Memoria Technica," was to transform each numeral into either a consonant or into a vowel or diphthong, as might be the most convenient, and thereby to build up words easy to pronounce and to remember. Those who are familiar with such a process might apply it here, and convert the four quintets of numerals into four words, getting over the difficulty of employing the three additional symbols as best they can. If they succeed, the phrase of "four-word profiles" would be literally exact.

I do not find that a general resemblance can be much increased by using one or a *few* more quintets or words. A fifth, or even a sixth, quintet might, however, be usefully employed in extending the range of the profile, if it contained one figure to describe the chin and just below it, another to describe the brow, and two figures, 00 to 99, which would perhaps suffice to give the size and general shape of the head, also to define the mustachio and beard of unshaven faces.

The next distinct stage in order of accuracy is separated by a great distance from the present one. It requires so large a number of dots that straight or slightly curved lines drawn through them will flow smoothly when seen at the ordinary reading distance from the eye. It needs as many as perhaps fifty quintets to describe a profile with exactness and the rest of the head with rough precision, and still more to include the eye and ear. I have made many of these, which, when reduced to the standard scale of BC=50 mm., are practically identical with the originals, when viewed in a somewhat careless way by a normally sighted person at a distance of 12 inches. A special use is made in this case of the middle figure of the quintet. Thus, the numeral 1 means that a half-unit is to be added to the first two figures; 2, that it is to be added to the last two; and 3, that it is to be added to both of them. This power of doubly minute description is often wanted in the outline that joins and includes the nose-tip and the two lips. Another use for the middle figure of the quintet is to tell that a dotted line should be drawn from the preceding point, to signify doubt of some kind. A hyphen (-) in the middle of the quintet means to begin; an oblique line (/) to end; and a point (.) means an isolated point. But I will not go further into this now; neither will I do more than hint at the way of dealing with portraits that are not in exact profile, by multiplying their horizontal measures into the secant of the angle through which the profiles are turned away from it.

Much more might be added on extensions of this method, especially as regards its facilities and limitations in conveying plans—ceremonial, strategic, and others—for newspaper use. But its general principles have been explained, and as this article is already too long I will end it abruptly here.

FRANCIS GALTON.

TIDAL OBSERVATIONS IN THE ENGLISH CHANNEL AND NORTH SEA.

FOR the purpose of tracing correctly the progress of the tidal wave throughout its course in the English Channel and North Sea, observations of the vertical movement of the tide at a distance from the land, and similar observations by means of tide gauges on the shore, are equally necessary.

Information on the rise and fall of tide far from the shore may be obtained from a ship or boat at anchor, and in certain localities it may be of considerable value to the navigator.

But, if the observations are carried out with sufficient exactitude to satisfy scientific requirements, the procedure hitherto followed for that purpose necessitates weather conditions which do not often occur, and seldom last long enough for the object in view.

There are other difficulties also to contend with, due to the stream of tide running at its maximum rate at, or about, the times of high and low water. The stream, reversing its direction between those times, causes a mark buoy, or boat, however, tautly moored, to swing over a certain area during the interval; the undulating character of the surface of the ground, and the action of the strong tidal stream on the lead-line, thus tend to introduce elements of uncertainty which increase with the depth of water.

The practical difficulties experienced in obtaining strictly accurate results by this means involve loss of time disproportionate to the value of the observations, and therefore the attempt has not often been made.

Trustworthy evidence on the rise and fall of tide is thus almost entirely confined to the coast-line, with the exception of a few observations of tide-gauges attached to the masts of wrecks on off-lying banks in the North Sea.

A large number of observations of value for the reduction of soundings have, however, been obtained in the North Sea during the years 1886–90 by Captain T. H. Tizard, R.N., C.B., F.R.S., while commanding H.M.S. *Triton* in the course of the survey of the shoals fronting the Norfolk coast. These, being taken by the lead-line from the ship at anchor, on the assumption that the bottom was perfectly level, can scarcely be considered sufficiently trustworthy for scientific purposes until confirmed by more precise methods which were not then available.

More rigorous observations were carried out in the North Sea by the late Captain W. Hewett, R.N., commanding H.M. surveying ship *Fairy* in 1838 and 1840, with the object of verifying the prediction of the late Dr. Whewell as to the existence of an area situated eastward of Orfordness and about midway between the coasts of England and Holland, where the rise and fall of tide was expected to vanish.

The method employed by Captain Hewett was to moor a boat head and stern as tautly as possible by means of lead-lines attached to anchors laid out in the direction of the tidal streams. A remarkable elevation in the form of a ridge on the bottom, with a depth of 18½ fathoms over it, having been previously detected, the boat was moored at slack water as nearly as possible directly over the ridge. Another boat dropping down with the tide, with lead kept just on and

off the bottom, the summit of the ridge was felt with the lead, and the depth over it registered every half-hour from 5.30 a.m. to 8 p.m., August 25, 1840.

The observations, being carried out with the utmost care under exceptionally favourable conditions of weather, gave an absolutely uniform depth throughout the day, showing conclusively that at that spot there was no rise and fall of tide. The position in which the observations were made was in lat. 52° 27′ 30″ N., long. 3° 11′ 30″ E., the moon's age being 27·6 days, and the maximum strength of the tidal stream 1·6 knots.

The particular spot for observation, as indicated by Dr. Whewell, was about 30 miles S.S.W. (true) from the above position, but circumstances did not permit of reaching it, and no observations have yet been made there.

On a former occasion, on July 5, 1838, the moon's age being 13·4 days, at a position about 20 miles S.S.E. (true) from Dr. Whewell's position, using precisely the same method and under conditions only slightly less favourable, Captain Hewett found a rise and fall of tide of 6½ feet.

The question of tidal observations in deep water having recently engaged attention at the Hydrographic Department of the Admiralty, an apparatus has been devised which obviates to a great extent the difficulties referred to above.

This apparatus, for use from a ship at anchor, is based on a principle similar to that of the pneumatic self-recording tide gauge now under trial by the Admiralty. It consists of india-rubber tubing having a bore of about ½ inch, supplied in a sufficient number of lengths joined together to allow one end open to the sea to be attached to a weight lowered to the bottom near the anchor. The inboard end of the tubing is attached to the upper part of a closed vertical cylinder 4 inches in diameter and about 6 feet high, on the top of which is fitted a small Bourdon gauge of ordinary pattern. The lower part of the vertical cylinder is in connection with an air-reservoir, and is also connected, by a separate pipe of small diameter, with a large Bourdon gauge of special construction.

The air-reservoir, charged by a powerful air pump, consists of four cylinders, each of which is similar in size and pattern to the vertical cylinder. The large Bourdon gauge is 12 inches in diameter, very delicately made, capable of indicating pressures up to 250 lb. on the square inch, and graduated on a reflecting surface to obviate the effect of parallax in reading off. It can be accurately read to within 1/10 lb.

The method of using the apparatus is as follows:—With the ship lying at anchor, and having sufficient cable veered, the india-rubber tubing should bear no strain. The 12-inch Bourdon gauge being shut off by a needle-valve controlling connection with the remainder of the apparatus, air is pumped into the air-reservoir, flowing from thence to the sea through the vertical cylinder and india-rubber tubing. Pumping is continued until the small Bourdon gauge ceases to rise, thereby showing that all the water is expelled from the tubing, and that the air is escaping freely from the submerged end, at each stroke of the pump. The valve at the junction of the india-rubber tubing and vertical cylinder, controlling connection with the sea, is then closed, and the air reservoir and vertical cylinder charged to a pressure considerably exceeding that of the head of water due to the depth. The compressed air being then admitted to the 12-inch Bourdon gauge by turning the needle-valve, the whole apparatus is again placed in direct communication with the sea by means of the valve for that purpose.

The air pressure as shown by the 12-inch Bourdon gauge will then steadily fall as the air escapes into the sea, and will continue to do so until the pressure in the apparatus exactly balances that due to the column of water represented by the depth over the submerged end of the india-rubber tubing. When the pointer of the 12-inch gauge ceases to fall and remains quite stationary, the gauge is read off.

As a column of sea water 1 foot high, with sectional area of 1 square inch, weighs 0·445 lb., it follows that the depth is obtained by the multiplication of that factor by the pressure in lbs. per square inch as indicated by the gauge. The variation in pressure, provided the weight at the submerged end of the india-rubber tubing has not moved its position, is therefore a measure of the rise and fall of tide.

Observations with this apparatus have been made successfully in depths of 35 fathoms, and the results, when compared with observations of an ordinary tide-gauge on the beach in the immediate vicinity, were found to agree very closely. For purposes of comparison, simultaneous observations were taken afloat and ashore at half-hourly intervals during several days. In fine weather an occasional difference of 2 or 3 inches might be noted, but it seldom exceeded one inch, or even less.

On one occasion when observations were being made during bad weather, force of wind 5 to 6, with the ship rolling and pitching considerably, difficulty was experienced in reading the gauge accurately; the differences observed were consequently somewhat larger, but in no case exceeded 8 inches. The Bourdon gauge used on that occasion has, however, since been vastly improved by the addition of the reflecting surface for the avoidance of parallax, besides other modifications tending towards greater accuracy and facility in reading off. The improved gauge may be expected to give results on which reliance may confidently be placed within a very small margin of error, even under unfavourable conditions.

The apparatus having been thus satisfactorily tested, the officer commanding H.M. surveying ship *Triton* was directed to make observations at certain positions in the English Channel, using the improved Bourdon gauge, with the view of verifying the co-tidal lines as drawn by the late Dr. Whewell from theoretical considerations.

The results given in the following table are very interesting, and show that the theoretical co-tidal lines require considerable modification. It may be hoped that with an apparatus available which enables accurate observations to be carried out without unnecessary loss of time, further information may eventually be obtained in many parts of the English Channel and North Sea.

A. M. F.

English Channel.—Tidal Observations by Capt. W. P. Dawson, R.N., H.M.S. "Triton," May, 1909.

Date 1909	Position	Depth Fathoms	Wind	Time of High Water h. m.	Time of preceding Moon's Transit h. m.	Lunitidal Interval h. m.	Time of Low Water h. m.	Range of Tide ft. in.	Max. Current knots	Bar. and Ther.	Time of H.W. at Dover h. m.
May 18	50 22 35 N. 0 35 40 E.	24	West 2·3	9 30 a.m.	10 33 p.m. May 17	10 57	4 30 p.m.	24 0	1·5	30·20 / 53	9 40 a.m.
May 19	50 9 30 N. 0 49 15 W.	27	Calm	10 30 a.m.	11 26 p.m. May 18	11 4	4 30 a.m.	13 9	2·6	30·40 / 55	10 30 a.m.
May 20	50 26 0 N. 1 8 0 W.	19	E. by S. 0–1	10 30 a.m.	0 21 a.m. May 20	10 9	4 15 a.m.	10 11	4 0	30·30 / 52	11 24 a.m.
May 21	50 24 10 N. 2 2 10 W.	23	Lt. air W.	8 50 p.m.	1 46 p.m. May 21	7 4	1 0 a.m. May 22	6 6	3·5	30·16 / 55	0 7 p.m.

All times are G.M. Time.

MODERN AËRONAUTICS.[1]

(1) WITHIN about three hundred pages Mr. Turner gives a popular account of the whole field of aërial navigation, including balloons, airships, and aëroplanes, in his survey. He first gives an account of the history and principles of each branch of the subject. In the chapter on the principles of ballooning the expansion of the gas in a balloon appears to be attributed mainly to the heating by the sun's rays, and only a sentence, by the way, refers to the expansion due to the diminished pressure at an increased height, which, of course, affects the gas in the balloon and the surrounding air equally, and also materially affects the vertical stability of the balloon's equilibrium in the air. The natural variation of the temperature of the air with altitude might also be with advantage discussed more fully. In treating of balloons of the non-rigid type, the action of the *ballonet* in preventing flabbiness might be made clearer. On p. 181, after exposing the fallacy of an airship tacking, Mr. Turner seems to say that aëroplanes are on a different footing. Of course, the speed of an aëroplane is relative to the air just as an airship's is, and an aëroplane and an airship capable of travelling at the same speed are under the same conditions as to the directions in which they can travel in a wind. The aëroplane can have the advantage only so far as its speed exceeds the airship's.

The second part of the book deals with various problems which have to be solved. Very interesting speculations are made about the aërial law of the future, and the landmarks, sign-posts, and alighting stations which will be provided for aviators. In chapters on military and naval aëronautics and strategy and aërial invasion, Mr. Turner discusses questions which interest everyone at present. A very clear account is given of the limitations which make some of the achievements that have been attributed to aërial craft impossible, and others improbable of execution, while at the same time full justice is done to the great services they can render within their limitations. Mr. Turner's discussion of these important matters can be recommended as sane and reasonable. Other chapters deal with the possibilities of exploration and long-distance travel in general by the air, and in a chapter headed "Work to be Done" attention is directed, among other things, to the need for increased stability in aëroplanes and for a trustworthy light motor.

While those who wish to construct aëroplanes will have to have recourse to fuller and more technical treatises, this book fills a want, and a second edition is already advertised.

In a couple of places characteristically English remarks are made at the expense of mathematicians and men of science in general. These are the more uncalled for in view of the very hazy notions which the book itself shows up, regarding stability and similar questions, that are capable of exact mathematical treatment, as well as experimental tests. The references to stability alone show a lack of exactness in the use of well-known mathematical and physical terms. Thus in the glossary at the end we have the following definitions:—

"*Equilibrium.*—In flying machines the term is used in the same sense as stability."

"Horizontal stability is the same as longitudinal"; while on p. 291 the author says (of dirigibles):—

"To maintain horizontal stability—that is, to enable the airship to move forward in a straight line without veering to one side or the other—fixed vertical planes at the rear of the frame are used. In addition, there is a fixed vertical plane surface at the rear of the gas-envelope."

The "useful tables" and "glossary" at the end are good features.

(2) Mr. Samuelson's pamphlet, a continuation of a previous publication of the author's, begins with a description and drawings of a model flying machine on the principle of "rowing" flight, and concludes

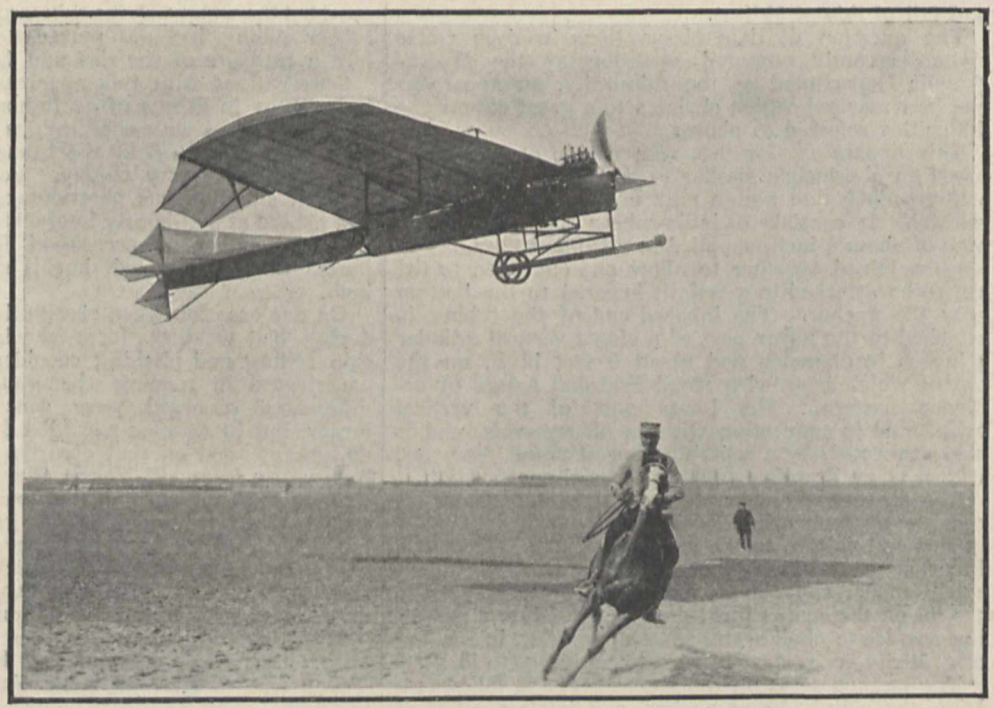


FIG. 1.—Scouts: old and new. From "Aërial Navigation of To-day."

[1] (1) "Aërial Navigation of To-day. A Popular Account of the Evolution of Aëronautics." By C. C. Turner. Pp. 327. (London: Seeley and Co., Ltd., 1910.) Price 5s. net.

(2) "Flight Velocity." By Arnold Samuelson. (English edition of "Fluggeschwindigkeit.") Pp. 56; 5 plates. (Hamburg: Boysen and Masch; London: E. and F. N. Spon, Ltd., 1906.)

(3) "The Conquest of the Air, or the Advent of Aërial Navigation." By Prof. A. Lawrence Rotch. Pp. x+192; 36 illustrations. (New York: Moffat, Yard and Co., 1909.)

(4) "Aërodynamik: eine Gesamtwerk über das Fliegen." Von F. W. Lanchester; übersetzt von C. und A. Runge. Erster Band. Pp. xiv+360. (Leipzig and Berlin: B. G. Teubner, 1909.) Price 12 marks.

with a proposal to form a company to construct a full-sized machine from the author's plans. The principles on which the author relies are not those generally accepted. He maintains that the centre of pressure for a plane does not vary with its inclination to the line of flight, that the normal pressure is independent of the inclination, and that flapping wings can be constructed so as to be mechanically more efficient than a screw propeller. To establish these principles he seems to rely on rough experiments with kites and small gliders. The accuracy of the observations and the deductions made from them both seem open to question. Plotting v against t, the graph of

$$v = \frac{1}{\frac{n}{M}t + \frac{1}{v_a}}$$

is said to be a straight line, because v and t only appear in the first power. The author maintains that his observations prove Langley's to be inaccurate, and attempts to explain away the discrepancy between his principles and Langley's experiments in a way which is not convincing.

(3) The preface to Mr. Lawrence Rotch's book is dated April, 1909, and when we think of the number of flights performed since then it will be evident that no writer could possibly bring out a book containing the most up-to-date records in aviation. The author has, on the other hand, brought into prominence several aspects of aërial navigation which are apt to be forgotten in these days, when the breaking of records by 'planes (not to mention other breakages of a regrettable character) is the all-absorbing topic. For example, in chapter i., the ocean of air, we have an account of the results of meteorological observations in which the author has played a most important part. It is illustrated by diagrams showing the greatest altitudes reached by mountains, balloons, and *ballons sondes*, also variations of temperature and wind velocity with the altitude, and it well shows up the efficiency of kites and *ballons sondes* in exploring regions of the atmosphere to which man can never hope to penetrate. In the second chapter—the history of aërostation—the author reproduces the letters of Benjamin Franklin to Sir Joseph Banks, P.R.S., describing the first balloon ascents made in France. The following extract from one of these letters is worth reading at the present day :—

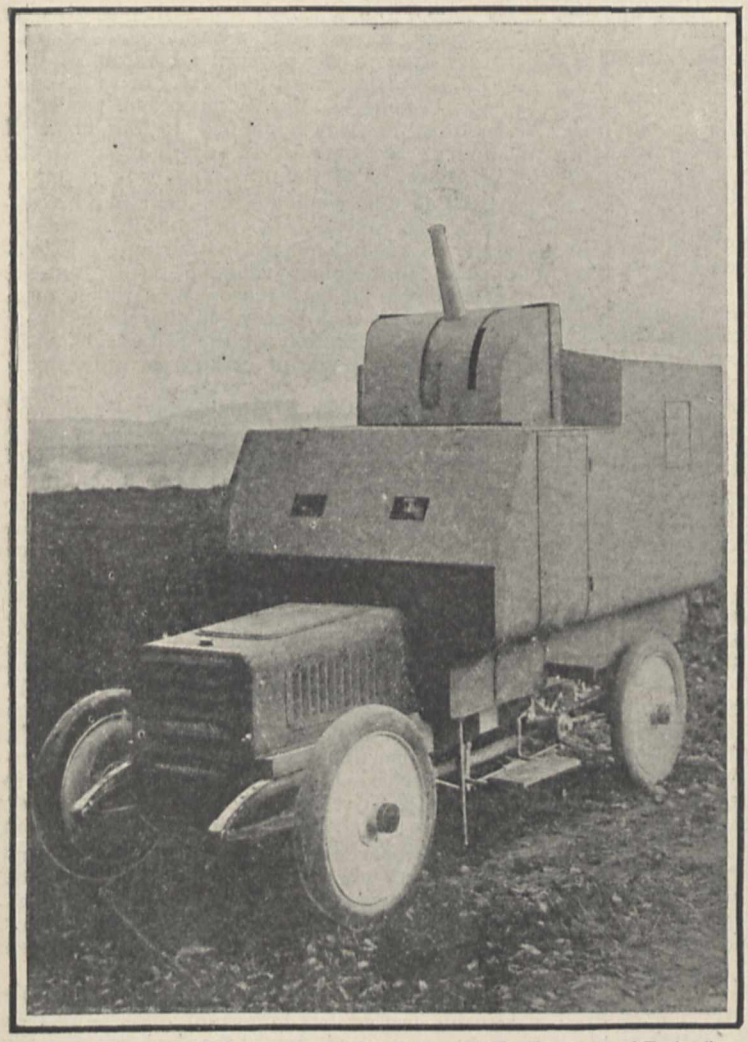


FIG. 2.—Armoured Defence against Airships. From "Aërial Navigation of To-day."

"I am sorry this Experiment is totally neglected in England, where mechanical Genius is so strong. I wish I could see the same Emulation between the two nations as I see between the two Parties here. Your Philosophy seems to be too bashful. In this country we are not so much afraid of being laught at. If we do a foolish thing we are the first to laugh at it ourselves, and are almost as much pleased with a *Bon Mot* or *Chanson*, that ridicules well the Disappointment of a Project, as we might have been with its Success. It does not seem to me a good reason to decline prosecuting a new Experiment which apparently increases the power of Man over Matter, till we can see to what Use that Power may be applied. When we have learnt to manage it, we may hope some time or other to find Uses for it, as men have done for Magnetism and Electricity, of which the first Experiments were mere Matters of Amusement."

How true this all sounds to-day! *In England there does not, we believe, exist at the present time a single prize for any scientific investigation bearing on aërial navigation.* Had such a prize existed the theory of longitudinal and lateral stability could have been disposed of years ago, and aëroplanes could have been built with a clear understanding of their stability or lack of it. It should surely have been worth while also for those who spend such large sums on construction of dirigibles to take some steps to obtain a theory of their stability, but this has not been done. There are several other problems, including one or two in discontinuous motion, awaiting solution; and it is not the mathematician alone who is handicapped by the persistent refusal of English people to provide any adequate recognition of *original work*.

We should be greatly surprised if members of the engineering profession would not be glad to make use of a similar encouragement to carry out experiments of rather a more scientific character than would

be otherwise compatible with their business requirements. As it is, there appears to be no such inducement in England for anyone to initiate, undertake, and publish original work, whether on stability, stream lines, propellers, motors, or strength of materials. Indeed, there are very strong inducements for having such work undone, unwritten, and unpublished.[1]

The next two chapters deal, respectively, with the dirigible balloon and the flying machine. In the former we have an illustrated historic description, tracing the gradual progress that has been made in dirigibles since the first idea of one was suggested by Franklin in 1784; while in the latter the evolution of the power-driven machine from the mere glider is briefly but sufficiently well discussed. "The Future of Aërial Navigation" is a subject on which anyone with an imaginative mind can write something which people will read with eagerness, and this being the case, we think that Mr. Rotch has been wise in only devoting twenty pages to it, in preserving the historic order, and in giving numerous references to what has been written. The book is, of course, much smaller and less compendious than Mr. Turner's.

(4) That such English people as are able, in spite of their national disabilities, to undertake *original work* find their efforts appreciated in Germany is well shown by the publication, by the Teubner Press, of a translation of part i. of Mr. Lanchester's book within a comparatively short time of its appearance in England. The English preface is dated October, 1907, the German preface, by Prof. C. Runge, August, 1909, none too long for the work of the translators and printer. We cannot do better now than quote from Prof. C. Runge's German preface in the following terms:—

"The present book contains so many important original ideas and investigations for the development of free flight that German engineers and men of science will be grateful to the publishers for having provided a translation of it.

The author has in some places altered the text, and in others the text has been altered by the translators in consultation with the author, so that the translation may be regarded as a revised edition. A complete retrospect of existing literature was, however, not attempted; this would have altered the character of the whole book and necessitated completely re-writing it, which was not contemplated by the translator.

For men of science the principal charm of the book lies in the ideas on fluid resistance, and the expression of these by exact mathematical formulæ should be the next problem of hydrodynamics."

Does not the last sentence confirm what has been stated above as to the need of prizes for which mathematicians as well as physicists and engineers are eligible?

G. H. BRYAN.
E. H. HARPER.

PROF. K. J. ÅNGSTRÖM.

BY the death of Prof. Knut Johan Ångström, physical science has lost a conscientious and capable worker, in a field which requires long and continuous experience before success can be achieved. For this reason his departure will be felt more severely than that of many men, who perhaps have gained a greater reputation, but have been fortunate enough to interest others in the line of research they have been pursuing.

Knut Ångström bore an honoured name. Those who still remember the early days of spectrum analysis know how much that science owed to the pioneer work of his father, Anders Johan Ångström, whose map of the solar spectrum remained until Rowland's time the standard to which all wave-lengths were referred.

The son was born on January 12, 1857, and received his school and university education at Upsala, where he spent almost his entire life. He was appointed assistant in the physical laboratory of that university in 1882, graduated as Doctor of Philosophy in 1885, and became lecturer in physics in the same year. In 1895 he was appointed to the chair of physics, and at the time of his death occupied the position of pro-rector of the university.

So far back as 1889 we find Knut Ångström investigating absorption phenomena in the infra-red by means of the spectro-bolometer, and during the following two years he obtained valuable results on the absorption spectrum of carbonic oxide, carbonic acid, and marsh gas. He also discovered the similarity in the characteristic absorption of the same substances (ether, benzene, bisulphide of carbon) in their liquid and gaseous states.

We owe to him, further, a valuable investigation on the infra-red absorption of aqueous vapour, carbonic acid and ozone. All these gases are constituents of our atmosphere, and the effect of the two latter on the temperature of the earth may be considerable, not so much because they absorb a certain portion of the solar radiation, but chiefly on account of their much greater comparative influence in preventing the heat radiated from the earth from being dissipated into space. An interesting and instructing controversy took place in connection with the effect of carbonic acid. Arrhenius in 1896 had given a very ingenious explanation of the Glacial period by assuming that the quantity of carbonic acid in the atmosphere had increased since that time. If it be assumed that the absorption is proportional to the total quantity present, it can indeed be shown that a small variation in quantity would exercise a very considerable effect on the temperature; but, as pointed out by Knut Ångström, the proportionality between absorption and quantity only holds when the quantities are sufficiently small, and he showed that the quantity of carbonic acid in the atmosphere must be reduced to about 20 per cent. of its present value before an appreciable effect in the total absorption can take place.

In the course of the further discussion of the subject Ångström carried out important observations on the effect of pressure, and showed that by increasing the pressure, but diminishing the thickness of the layer so that the total quantity of absorbing material remains constant, a marked increase of absorption is noticed at the higher pressure. It follows that in order to find by optical means the quantity of carbonic acid in our atmosphere, it is not sufficient to determine the amount of gas necessary in our atmosphere, it is not sufficient to produce the same absorption as shown by the atmosphere, but account must be taken of the conditions of pressure. Observations on the absorption of ozone also led to the interesting result that there must be considerable quantities of that gas in the upper regions of the atmosphere.

Knut Ångström's name has become more particularly associated with recent researches in the measurement of solar radiation. He constructed an instrument, the essential portions of which consist

[1] Mr. Alexander has offered a prize of 1000*l.* to the Aërial League for the best and most trustworthy motor of 20 h.p. capable of running unattended for twenty-four hours. While fully appreciating the importance and value of such prizes, it should be pointed out that the worker who attempts to penetrate more deeply into the *thermodynamics* or *general theory* of the internal combustion engine, with the view of paving the way for future improvements, has no prospect of reward, whereas the successful competitor for such a prize *may* have other prospects of a return for his exertions in the form of patents.

of two strips of platinum blackened at the front surface and carrying a thermo-junction at the back. One of these is exposed to the radiation to be measured, while an electric current passes through the other. This electric current is regulated until the two thermo-junctions are at the same temperature. The intensity of the current necessary for this purpose gives a measure of the radiation after certain corrections have been applied. The use of the instrument is simple and convenient, and found so much favour with observers well qualified to judge that the International Union of Solar Research recommended it as a standard for measurement of solar radiation.

Since then the instrument has shown itself liable to certain systematic errors which render further experimental investigations necessary. Its intrinsic merit is, however, so great that it is pretty certain that it will re-establish its reputation, but it is much to be regretted that Prof. Ångström's experimental skill is no longer available for the purpose. When the International Union of Solar Research made its recommendation, it was well aware that for a complete determination of the solar constant it is necessary to divide the spectrum into portions sufficiently homogeneous to allow the application of Lambert's law, but such complete determinations need only be carried out in one or two places. Abbot is doing excellent work, and if this be repeated at another station, say in India, the ground will be pretty well covered. In addition to these standards, we require, however, some instrument which is easily transported, and serves to record the radiations received at different times and in different localities. Ångström's pyrheliometer promises to serve that purpose admirably, as soon as more ready means have been found to standardise it easily from time to time, or to obtain a more permanent absorbing surface of the platinum strips. The coloured glasses which Ångström recently used to absorb parts of the spectrum chiefly affecting the absorption of aqueous vapour or carbonic acid will probably increase considerably the utility of the instrument.

It remains to notice an important contribution of Ångström's in the field of radio-activity. He measured, by means of a Bunsen ice calorimeter, the heat set free in a given time by radium salts, and found it to be constant and independent of the substance in which the radium is placed.

Ångström's charming personality endeared him to all with whom he came into contact, and we condole with Swedish science and the University of Upsala in the loss they have sustained. ARTHUR SCHUSTER.

NOTES.

WE notice with great regret the announcement of the death of Prof. Alexander Agassiz, on Monday, at seventy-four years of age.

SIR JAMES DEWAR, F.R.S., has recently received two foreign diplomas, namely, that of Doctor, *honoris causa*, of the University of Brussels, and that of honorary member of the American Chemical Society.

THE Oceanographical Museum at Monaco, established by the Prince of Monaco, was opened on Tuesday by the Prince in the presence of representatives of European Governments and scientific societies. An article upon the museum and the opening ceremony will appear in a later issue of NATURE.

THE third International Physiotherapeutic Congress was opened by President Fallières on Tuesday at the School of Medicine, Paris. A large number of members of the French Government and of the Diplomatic Corps in Paris, including the British and American Ambassadors, were present at the ceremony.

THE council of the South African Association for the Advancement of Science at a recent meeting resolved by a unanimous vote to offer the presidency of the forthcoming meeting in Cape Town to Dr. T. Muir, C.M.G., F.R.S., and he has accepted the invitation to occupy that office. The actual date of the meeting has not yet been fixed.

LORD KINNAIRD will preside at the dinner to Sir John Murray on Tuesday next, April 5, in connection with the *Michael Sars* expedition for the exploration of North Atlantic waters. The dinner will be held at the Criterion Restaurant, and tickets may be obtained from the honorary secretary of the Atlantic Union, 13A Cockspur Street, S.W.

AT a meeting of the National Geographic Society at Washington on March 26, President Taft presented the gold medal of the society to Sir Ernest Shackleton, and in doing so he remarked:—"It is evidence of the society's high appreciation of the marvellous work you have done in the cause of science, of the endurance, courage and intelligence you have shown in the pursuit of a definite object." On March 28 the explorer was presented with the Cullum gold medal of the American Geographical Society, New York.

ON March 23 the Mayor of Doncaster, Councillor Halmshaw, formally opened a municipal museum at Doncaster, for which purpose some of the rooms in a fine mansion, known as Beechfield, have been set apart. These are devoted to specimens illustrating local geology, archæology, and natural history. Mr. T. Sheppard, of Hull, who a short time ago was asked by the Doncaster Corporation to report on the lines the museum should take, was called upon by the Mayor to give an address. In this he dwelt more particularly upon the educational advantages of museums, and the necessity of provincial museums being of local interest. Subsequently the visitors were conducted round the collections, which reflected great credit upon the curator, Dr. Corbett.

ON Tuesday next, April 5, Dr. A. Harden will begin a course of three lectures at the Royal Institution on "The Modern Development of the Problem of Alcoholic Fermentation"; on Thursday, April 7, Dr. T. G. Longstaff will give the first of three lectures on "The Himalayan Region"; and on Saturday, April 9, Mr. W. W. Starmer will commence a course of three lectures on "Bells, Carillons and Chimes" (with musical illustrations). The Friday evening discourse on April 8 will be delivered by Prof. Percival Lowell, on "Lowell Observatory Photographs of the Planets"; on April 15 by Prof. W. J. Pope, on "The Chemical Significance of Crystal Structure"; and on April 22 by Mr. T. Thorne Baker, on "The Telegraphy of Photographs, Wireless and by Wire."

AFTER a number of slight earthquake shocks, an active eruption of Mount Etna commenced on March 23. Signor Ricco, the director of the observatory there, reported in a telegram from Nicolosi, a suburb of Belpasso, that the lava was advancing on March 24 in a stream more than 1500 feet wide, at a rate of upwards of 60 feet an hour. On March 25 he reported that the violence of the eruption had increased notably during the night, and that quantities of scoriæ were being thrown up, accompanied

by great explosions and rumbling. Five new craters on the south declivity of the mountain, in the same place as those of former eruptions, have been reported. Though on this day the lava stream was larger, it was descending more slowly. The *Times* Rome correspondent reported that on March 27 the activity of the eruption had diminished considerably, and that the lava streams had ceased to flow. The lava appears on this occasion to have flowed farther than in the eruption of 1892. There was renewed activity in the craters on March 28, and a fresh descent of lava, though in more moderate quantities. As yet there is no real anxiety for the safety of Nicolosi or Borello.

THE Reale Istituto Lombardo has awarded the following prizes:—the mathematical prize for an essay on theory of transformation groups is awarded to Prof. Ugo Amaldi, of Modena, for his essay on the determination of all the infinite continuous groups of analytic point transformations in three-dimensional space; the Cagnola prize, relating to miasma and contagion, is awarded to Prof. Aldo Castellani, of the hospital for tropical diseases at Colombo (Ceylon). From the Brambilla foundation for industrial prizes, awards have been made to Elia Bianchi, for his system of constructing dwelling houses formed of hollow concrete blocks, and to Renaldo Rossi, for whole-meal and anti-diabetes bread. The Fossati prize is awarded to Prof. Giuseppe Sterzi, of Padua, for his two published volumes on the central nervous system of vertebrates.

PROF. J. W. H. TRAIL, F.R.S., recently offered to the council of the Linnean Society a sum of money for the purpose of encouraging the study of protoplasm by means of an award to be made periodically. This generous offer has been gratefully accepted, and a special medal has been struck in bronze for presentation with the award, bearing on the obverse a portrait of Linnæus and on the reverse the words "Trail Award" and the name of the recipient in a wreath. It is proposed to make an award about once in every five years for original work bearing directly or indirectly upon the "physical basis of life," and, in accordance with the wishes of the donor, a wide interpretation will be given to the scope of the investigations. The first recipient of the award will be Prof. E. A. Minchin, professor of protozoology in the University of London, whose researches on sponges and protozoa have done so much to advance our knowledge of protoplasmic structures, and who is also the translator of Prof. Bütschli's well-known work on protoplasm.

THE February Bulletin of the Société d'Encouragement pour l'Industrie nationale contains the president's address delivered by M. Bertin at the general meeting in January last, and particulars concerning the award of prizes and medals on the same occasion. We notice that a grand gold medal was awarded to Sir Robert Hadfield, F.R.S. M. L. Baclé, representing the association's committee of chemical arts, points out that Sir Robert Hadfield has at least thirty-one memoirs to his credit extending over the period 1888 to 1909, and that these have been presented to various learned societies in England and America. Among the numerous other awards, we notice that the Lavoisier medal was awarded to M. le Comte de Chardonnet, for the creation of a new industry—that of artificial silks—and that the first award of the recently established Michel Perret medal for scientific workers, who by their researches have contributed to the progress of industrial chemistry, was made to MM. Gall and de Montlaur, for their electrochemical work.

THE New Zealand Survey Department is undertaking, in conjunction with the Marine Department, an inquiry into the tides of New Zealand. Hitherto the tide-tables for New Zealand in the New Zealand "Nautical Almanac" have been supplied by the U.S. Coast and Geodetic Survey, there having been no facilities in New Zealand for the necessary work. We learn from the *New Zealand Times* that the New Zealand Government has been invited by the Secretary of State for the Colonies to supply particulars as to the tides for insertion in the British Admiralty manuals for the use of the Navy and mercantile marine. It is hoped that the results from New Zealand, Australia, and other parts of the Pacific will lead to the thorough investigation of the tides of the Pacific Ocean, of which the available information is at present meagre. The latest scientific apparatus is being obtained from England, and the work has been placed in charge of Mr. C. E. Adams, secretary of the New Zealand Surveyors' Board, and is to be carried on actively at once.

IN the year 1891 Prof. Flinders Petrie found a curious mummy in a plundered tomb (supposed—though there is no positive proof—to have been that of a certain Ranefer or Ranofir) in the neighbourhood of the Medum Pyramid of King Snefru (*circa* 2900 B.C.). The fact that this was the oldest known mummy was duly recognised at the time, not only by its discoverer, but also by Prof. Maspero (see "The Dawn of Civilisation," p. 362), and with due care it was transported to England and lodged in the Museum of the Royal College of Surgeons. The significance of this mummy was not fully realised at the time, because it was generally supposed that the practice of embalming was as old as the history of Egypt, and many museums contained so-called "mummies" almost, if not quite, as ancient; and the importance attached to it seemed to diminish during the following decade, when some archæologists began describing earlier, even pre-dynastic, "mummies" (see "Guide to the First and Second Egyptian Rooms," British Museum). When, however, it was discovered (see *Cairo Scientific Journal*, May, 1908, p. 205) that there were no genuine mummies in the Cairo Museum (or in the British Museum) earlier than the time of the New Empire (*circa* 1580 B.C.), and that the bodies embalmed in the times of the tenth dynasty (*circa* 2200 B.C.) and twelfth dynasty (*circa* 2000 B.C.), found in 1907 by Mr. Quibell and Messrs. Lythgoe and Mace, respectively, were so fragile that they could not be moved without becoming reduced to mere bones and powder, the importance of the Medum mummy was more than rehabilitated, as was pointed out in NATURE in 1908 (vol. lxxviii., p. 342). The age of a mummy such as this was always open to question, seeing that it was found in a plundered tomb; but the important researches carried on by Dr. George A. Reisner at the Giza Pyramids during the last few years have now supplied the data which, when applied to the curious distinctive features of the Medum mummy, fix its age definitely at the period of the fifth dynasty (*circa* 2700 B.C.). Thus the specimen in the Royal College of Surgeons is of the utmost importance to the student of the history of embalming in Egypt, for it is more than 1100 years older than any *actual* mummy exhibited in any other museum, and 500 years older than any other mummy ever found.

MR. C. PEABODY has reprinted from the Putnam anniversary volume a valuable paper on certain quests and doles. He deals first with the rite of Hogmanay practised throughout western Europe, from the Isle of Man to France, in the period extending from late Advent to January. He connects it with a pre-Christian solstitial ceremony prevailing throughout northern and western

Europe. The English Waits fall into the same class. The French Dimanche des Brandons is connected by its fire rites with the ancient Pagan ceremonies at the vernal equinox. The paper is remarkable for a very elaborate collection of references to English and Continental folk-lore.

INFANTILISM and idiocy, and gigantism and idiocy, are the subjects of two papers by Dr. A. Marie in the *Bulletins et Mémoires de la Soc. Anth. de Paris* (5th Sér.), x., pp. 101, 113. He gives a classification of the various forms of dwarfing (nanism and infantilism). He believes that the nanism of the degenerate is nothing else than the permanence of an infantile stage through which all normal persons pass. One may consider the unprofitable age (*l'âge ingrat*) of transition between infancy and the final sprouting of growth at puberty as a kind of transitory normal acromegaly. Gigantism is only the acromegaly of infancy, the unprofitable age prolonged. Giants as well as dwarfs occur in families of degenerates.

THE Touareg, who have been exhibited at Paris, have been investigated by Dr. Atgier (*Bull. et Mém. de la Soc. Anth. de Paris*, 5th Sér., p. 222). The individuals studied were extremely limited in number, and necessarily belonged to the servile classes, as the upper-class Touareg would be too proud to exhibit themselves; consequently they represent a mixed group. On this slender foundation the following results have been arrived at. Excluding the Semitic element (Arabs, Jews, &c.) and the negro element (which is evident in those investigated), one finds the same ethnic groups as those which have peopled Europe—Indo-Europeans or Aryas—that is to say, blonds, brown brachycephals, and brown dolichocephals. Thus the expression "Berber" does not denote a race or variety of the human race, but a conventional term simply signifying those peoples of North Africa who are neither Semitic nor Negroid. According to Dr. Atgier, North Africa, like Europe, has Iberian, Celtic, Basque, and Kymric types, to which the term Aryas of Africa may be applied.

WE have received from the publishers (Bowes and Bowes, Cambridge) a copy of a lecture recently delivered by Mr. W. C. D. Whetham, F.R.S., in Trinity College, entitled "Eugenics and Unemployment." From his book on "The Family and the Nation," the lecturer cites evidence "that, with a few exceptions, the successful families in all classes are voluntarily restricting the number of their children, that their birth-rate has halved since 1876, and that the average number of children to the fertile marriage is now about three. About four children to the fertile marriage is the least number that will maintain a population unchanged. . . . But the population of the country as a whole is still expanding. Hence it follows that the unsuccessful families must still be multiplying rapidly. . . . We . . . are breeding fastest from our less efficient or definitely diseased strains." Having reached this conclusion, the lecturer begs his audience to dismiss any preconceptions and prejudices they may have as to pauperism and unemployment, and to look with him at the facts. He shows a curve based on the annual percentage of the unemployed members of trade unions, but points out that it "is roughly coincident with the cycles of good and bad trade," and "bears very little relation to the curve of general pauperism" or to "the total amount of distress in the country." He shows next how the curve based on the average number of paupers relieved per 1000 of the English and Welsh population has been declining "with natural fluctuations" from 1851 onwards. Since 1900 "there has been a slight increase, so slight that it is difficult to be sure that it is more than a temporary fluctuation on a curve which shows yearly changes." Despite this warning, Mr. Whetham subsequently suggests that "our failure to go on diminishing pauperism of late years may be due to a slight lowering of the average character and efficiency value of our population," arising from an artificial reduction of birth-rate among "the thrifty, the prudent and the far-seeing, quite as much as by the selfish and pleasure-loving."

EVIDENCE is steadily accumulating to show that most of the forest mammals formerly supposed to be restricted to the west coast of Africa extend eastwards into Uganda. The latest instance of this is afforded by the lemuroid pottos, of which Mr. O. Thomas described an East African species of the genus Perodicticus at a recent meeting of the Zoological Society. Sir H. H. Johnston had long since announced the existence of a Uganda potto, but no specimen was forthcoming.

IN No. 4 of the first volume of the *Queensland Naturalist* Mr. G. F. Bennett relates some of his early experiences in hunting and observing monotremes. On one occasion, after digging out the burrow for a distance of about 20 feet, he came upon a nest containing two young duck-bills, probably about a month old, each rolled up into a ball with the tail lying flat on the beak. In other instances the tail covered the head, and the beak rested on the stomach. All young ones of about a month old are plump with a greyish, bare skin.

AT the close of an article on the courtship of spiders, contributed by Prof. T. H. Montgomery, jun., to the March number of the *American Naturalist*, it is argued that Dr. Wallace's theory that the generally less conspicuous colour of female birds (as compared with their partners) is due to their need for greater protection will hold good also in the case of the Arachnida. "For the males do not develop their ornamentation until maturity, and they have much less need of protection than the females because they live usually not much longer than a few weeks after maturing, and take no part in the care of the young. The males have fulfilled their main function after impregnating the females, and they are of no use to the species thereafter. But the females live at least several months after maturing, in some cases several years, and they have the whole charge of the eggs and young."

THE March number of *Naturen* opens with an obituary, illustrated by a portrait, of Hans Christian Printz, Norway's oldest *savant*, who was born on April 13, 1817, and died, from an attack of influenza, on January 15 of this year in the ninety-third year of his age. On completing his education, Prof. Printz devoted much of his time to botany, and in 1864 made an important collecting tour; but about 1870 his attention was largely directed to meteorology, to which science he devoted much of his time in subsequent years. In addition to this, he was an enthusiastic egg-collector, and at one time possessed between 4000 and 5000 specimens, mainly, it would appear, Scandinavian, among which his greatest treasure was an egg of *Garrulus infaustus*. About 1871 this collection was acquired by the Bergen Museum.

THE nature and arrangement of the bony armour of the dinosaur Stegosaurus are discussed by Dr. R. S. Lull in the March issue of the *American Journal of Science*. In the specimen restored by Marsh a number of small ossicles were found adhering to the under surface of the lower jaw, and these, in the opinion of Dr. Lull, not only formed a gular shield, but also extended over a considerable part

of the body, as it is unreasonable to suppose that any portion of the skin of an armoured reptile would be unprotected. As regards the great vertical dorsal plates and caudal spines, the former of which Marsh regarded as forming a single series, it is practically certain that all were arranged in a double row. The vertical plates are considered to be nothing more than an ultra-development of the longitudinal vertical ridge on the horizontal scute of a crocodile or an unspecialised dinosaur like Ancylosaurus. Throughout the back the ribs are T-shaped in section in order to bear the weight of the plates. In the neck the latter are borne on short and notched transverse processes, but in the back these processes become longer and stouter, while in the sacral and anterior caudal region the bases of the plates are approximated and supported on the summits of the tall and expanded neural spines. On the other hand, the terminal third of the tail apparently formed a flexible aggressive weapon, in which the laterally divergent spines were inserted in the muscles between the neural spine and the centrum. Although the caudal spines of the English Kimeridgian Omosaurus or Dacentrus are structurally identical with those of one of the American species of Stegosaurus, in the lack of evidence as to the presence of vertical plates in the former the author is indisposed to admit the generic identity of the Old World and American types.

Dipterocarpus tuberculatus, known locally as the In tree, one of the most important members of the family Dipterocarpaceæ which bulks largely in the Burmese forests, forms the subject of a Forest Pamphlet (No. 13) compiled by Mr. R. S. Troup, and published by the Government of India. As a rule, it is a dominant tree, and an idea of its characteristic gregariousness may be obtained from computations, which estimate fifteen to twenty good-sized trees per acre. Fine specimens attain a height of 90 feet, with a clean bole of 60 feet and a girth of 10 feet. The wood is resinous and heavy, requiring bamboos if it has to be rafted; it is in considerable demand, as it works well, but is not durable if exposed.

A RECENT paper by Prof. G. Klebs, published in the *Sitzungsberichte der Heidelberger Akademie der Wissenschaften* (part v., 1909), and obtainable as a separate brochure, describes the modifications produced in flowers of Sempervivum when exposed to special cultural conditions, and incidentally contains some pertinent opinions on the subjects of variation in plants and inherited characters. The species, *S. acuminatum*, chosen for experiment is a recognised natural species. Plants were grown in rich soil and kept at a high temperature. The first inflorescences were cut off when quite young, and dormant inflorescences showing abnormalities were developed, from which self-fertilised seed was collected. Plants raised from the seed were grown, and increased vegetatively for three years. On flowering, the terminal inflorescences were removed as before, and the later flowers produced abnormalities, some new, others similar to those obtained before. These abnormal characters the author recognises as pathological modifications, yet regards their origin as intermediate between fluctuating variations and mutations.

MR. T. PETCH is responsible for three recent Circulars (vol. iv., Nos. 21–3) dealing with fungus diseases, issued from the Royal Botanic Gardens, Ceylon. A bark disease on Hevea and tea that appears during the south-west monsoon is attributed to *Corticium javanicum*. A more insidious disease of Hevea, known as "die-back," is started by a Gloeosporium which paves the way for the destructive parasite, assigned to the genus Lasiodiplodia. The third pamphlet discusses very fully the stem-bleeding disease of the cocoa-nut caused by *Thielaviopsis aceticus*, a known parasite on sugar-cane in Java. The author communicates a number of details regarding the structure of the cocoa-nut palm. He distinguishes two types of tree, the one with a uniform columnar base, the other with a swollen base, and suggests that the latter, which is the less desirable, has been selected unconsciously by planters.

ACCORDING to the *Agricultural Journal of the Cape of Good Hope*, a certain amount of work on the hybridisation of wheat is being done in Cape Colony. At present less than half the wheat required for consumption is grown, the rest being imported; steps are therefore being taken to increase the area under crop. One of the chief difficulties about wheat-growing in the colony, and particularly in the western provinces, is the vast amount of destruction caused by rust; indeed, this was at one time so serious that farmers almost despaired of making wheat-growing a success. The importation of certain varieties more or less resistant to rust rather relieved matters, but none has yet been found fully to meet the local requirements. A cross between Gluyas and Darling promises to give useful results; Gluyas is resistant to rust but possesses very weak straw; Darling, on the other hand, possesses exceptionally strong straw. A hybrid, Union, has been picked out possessing strong straw and also resistant to rust. Another promising cross is between Gluyas and Du Toits, probably the finest milling wheat in the colony.

IN the *Sitzungsberichte* of the Vienna Academy of Sciences (Bd. cxviii., Heft vii.) P. Vujević discusses at some length the results of five years' temperature observations (1902–6) made at Belgrade. The readings were taken from freely exposed mercury thermometers, with cylindrical bulbs, at the earth's surface and at 0·4, 1·0, and 2·0 m. above it. The results are of special interest in view of the plea for such observations recently put forward in this country. The excess of the mean temperature from hourly readings of the freely exposed thermometer at 2 m. above the mean temperature in the screen at the same height is −0·1° C. in January, +0·6° in July. The mean difference is greatest (+2·0° C.) at 1 p.m. and least (−1·0° C.) at 8 p.m., in both cases in July. The occurrence of the minimum difference immediately after sunset is attributed to the retention of warm air in the screen. It is probably also due in part to the heat capacity of the screen itself. The point is of importance in connection with the analysis of the daily variation of temperature. Comparisons showed that the freely exposed thermometers gave higher readings at all levels on clear days, and lower readings on a cloudy day, than the aspirated thermometer of the Assmann instrument. The disturbance of the natural condition by the artificial aspiration would have some influence on these results. The observations from the freely exposed instruments are compared with one another without any attempt at correction. Throughout the year the temperature at the earth's surface is lower by night and higher near mid-day than that in the air. The extreme differences between the hourly means for surface and air are approximately +1·5°, −0·5° C. in January, +9·1°, −1·6° C. in April, and +15·2°, −1·0° C. in July. Deposition of dew diminishes the value of the negative difference, while clear weather increases both the positive and negative differences. The temperature on the exposed earth's surface was found to be considerably below that of the neighbouring upper surface of snow. It is assumed that the results are inter-comparable because the thermometers are similar, an assumption which is not justified unless the ventilation is the same for each; this

is probably not the case. No attempt is made to find the effect of varying natural ventilation.

MR. HERMANN GEWECKE sends us a dissertation on the influence of changes of internal structure on the physical properties of copper, electrical conductivity and density being the properties chiefly considered. In this pamphlet of ninety-three pages the author discusses at length the experimental results and theoretical conclusions of previous workers in the same field, and also describes his own measurements of electrical conductivity and determinations of density carried out on a series of copper wires drawn under known conditions. His results show that the effects of wire-drawing depend upon two actions, which occur simultaneously, but to a different relative extent when the circumstances of the drawing process are altered. These two actions are longitudinal extension and lateral compression, and their effects on conductivity and density are opposite in character. The net result is that, as wires become more severely hard-drawn, their density first increases and then decreases again, while the electrical conductivity is reduced—in some cases to an extent exceeding 1·5 per cent. Mr. Gewecke has also studied the annealing process in these wires, but although a temperature of 210° C. is found to mark the beginning of rapid annealing, this temperature is found to vary with the duration of heating. This supports the view of Turner and Levy that the change in the copper is rather of the nature of a continuous re-arrangement of structure than a transformation from one allotropic phase into another, as suggested by Dr. Beilby.

WE have before us a draft report of the science standing committee of the Concrete Institute relative to a proposed standard algebraical notation for formulæ and calculations employed with reference to reinforced concrete. It would appear that this was considered last September at Copenhagen by a committee of the International Commission on Reinforced Concrete (established by the International Association for Testing Materials), which approved of a three-alphabet system, the three alphabets employed to be Roman capital letters, Roman small letters, and Greek smalls. The principle of the initial letter is also adopted in the report, though this cannot be made a basis for agreement with Continental nations; it is held, no doubt rightly, that the use of a self-explanatory notation is in this matter more important than international uniformity. The use of Latin smalls for linear dimensions, intensities of forces, &c., and constants, Latin capitals for areas and volumes, and total forces, Greek smalls for angles and constants, is recommended. The notation can be extended by the use of subscript letters; thus B_c may be used for "bending moment at the centre of a beam." The scheme is not put forward as part of a comprehensive system; indeed, it is pointed out that letters fail if any attempt is made at a comprehensive system for engineering formulæ alone, not to speak of physics generally. It is, however, clearly desirable that some general plan should be agreed upon, by engineers at least, before an attempt is made to work out a detailed notation for each branch of engineering work. It may be that the only plan possible is the adoption of some general principles, and those suggested are sufficiently in accord with existing usage. Possibly the Engineering Standards Committee may be able to look into the matter.

A PAPER on compounding and superheating in Horwich locomotives was read at the Institution of Mechanical Engineers on March 7 by Mr. George Hughes, the chief mechanical engineer of the Lancashire and Yorkshire Railway. A number of comparative tests have been made by the author on compound and simple engines, leading to the conclusion that the compound engine is more economical and efficient than the simple. The compound engine developed a comparatively greater pull on the draw-bar for the same indicated horse-power. The Aintree to Accrington trials show an economy of 23 per cent., and the Goole to Smithy Bridge tests an economy of 22·5 per cent., in favour of the compound, based on the steam consumption per indicated horse-power. On the basis of total steam consumption per hour, the savings in these trials are 39·7 and 33·3 per cent. respectively. In fuel consumption the savings by the compound per indicated horse-power per hour are 16 per cent. and 8·3 per cent. respectively. As the horse-powers developed by the compound are less than for the simple engine, the total fuel savings are 36 per cent. and 23·7 per cent. respectively. Using Schmidt's system of superheating on a six-wheeled coupled goods engine, comparative trials show an economy in coal of 12·93 per cent. per ton-mile for the superheater. Tests on five passenger engines having Schmidt's superheaters, extending over some months, show a coal saving of 21·4 and 21·9 per cent. per ton-mile, computed from the drivers' and guards' returns. Mr. Hughes is to be congratulated on his success in dealing with very difficult problems when applied to locomotives.

AN improved form of mouth blow-pipe is submitted for inspection by Messrs. W. and J. George, Ltd., Great Charles Street, Birmingham. It is a burner and air-tube combined, connecting directly with the gas supply by means of rubber tubing, and dispensing with a Bunsen burner. A metal collar at the mouth-piece end keeps the latter clean by preventing it from coming into contact with the bench when laid down. A similar collar at the burner end keeps the flame from scorching the wood. If desired, the instrument can be clamped to a retort stand for use at any convenient height or angle, and it serves instead of a foot blow-pipe for many small operations, such as flame, charcoal, and "bead" tests, and light glass-blowing. The article is neatly and strongly constructed, and for convenience of renewal the several parts are made to a standard size.

THE January number of the *Bulletin de la Société d'Encouragement pour l'Industrie nationale* contains two reports by A. Moreau on two forms of road-tarring apparatus, due to MM. J. Lassailly and J. Vinsonneau respectively. The tar has to be extracted from the barrels, warmed to a temperature sufficient to reduce its viscosity and remove water, and applied to the road as uniformly and as rapidly as possible. In the first apparatus of M. J. Lassailly all these operations are carried out by steam, and require a minimum of skilled control. The Vinsonneau apparatus warms the tar to 80° C. by a thermosiphon heated by a petrol burner, and distributes it by means of compressed air. The cost of superficial tarring by either process is from 8 to 10 centimes per square metre treated.

A SECOND revised edition of the valuable little book on "Butter-making on the Farm," by Mr. C. W. Walker-Tisdale and Mr. T. R. Robinson, has just been issued by the publisher, Mr. J. North, Office of the *Dairy World and British Dairy Farmer*. The original work was favourably reviewed in NATURE of February 12, 1903, and the revised edition should secure for it many new readers. The subject-matter has been brought up-to-date by revision and additions. The price of the book remains 1*s*. net.

ERRATUM.—March 24, p. 104, col. 1, line 36, for "9 grams" read "6 grams."

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN APRIL:—

April 1. 8h. 29m. Minimum of Algol (β Persei).
11. Venus, apparent diameter 28·3″.
16. 16h. 0m. Saturn in conjunction with the Sun.
20–21. Epoch of April meteoric shower (Lyrids).
21. 10h. 10m. Minimum of Algol (β Persei).
23. 4h. 0m. Venus at greatest elongation (46° 13′ W.).
25. 5h. 10m. to 7h. 31m. Transit of Jupiter's Satellite III. (Ganymede).
30. Mercury visible as an evening star situated amongst the Pleiades.

THE SPECTRUM OF COMET 1910*a*.—In addition to the objective-prism spectra, already mentioned in these columns, MM. Deslandres and Idrac secured some spectra of comet 1910*a* with a slit-spectroscope of great light-gathering power, which they describe in No. 11 of the *Comptes rendus*.

The series of bands usually ascribed to hydrocarbons and cyanogen, respectively, are fully represented in these spectra, with the exception of the band at λ 460. The hydrocarbon bands of the comet's spectrum exhibit different intensities to the similar bands photographed in the laboratory, with the carbon arc or the Bunsen flame as the light-source, the most refrangible of the blue bands being the most intense. An "unknown" band at λ 402·1 is similar to one which M. Deslandres found in the spectrum of Morehouse's comet, which Prof. Fowler has since traced to some carbon compound at very low pressures, but other "unknown" bands seen in the earlier spectra are not shown in that of comet 1910*a*.

HALLEY'S COMET IN JAPANESE RECORDS.—Some exceedingly interesting extracts from Japanese records, probably referring to early observations of Halley's comet, are communicated to No. 420 of the *Observatory* (March, p. 129) by Mr. K. Hirayama, of the Tokyo Observatory. They include accounts of comets which appeared in the years A.D. 684, 837, 912, 989, 1066, 1145, and 1222, and generally give some details as to the direction and appearance of the object. The details for the apparition of 1145 are especially full, the observer remarking on the peculiarity that the comet itself should remain bright after the disappearance of its tail; this he explains, four days later, as possibly due to the presence of the moon when the observation was made. The time of perihelion—as calculated by Messrs. Cowell and Crommelin—agrees with the time at which the comet was observed in the year A.D. 912.

METEORIC ASTRONOMY.—Anyone interested in the observations of meteors, and those amateurs who, without the benefit of elaborate equipment, are seeking a field where observations may become both interesting and useful, should read Mr. Denning's article, on the progress of meteoric astronomy, in the current number of *Science Progress* (No. 15, p. 444). The writer therein gives a brief outline of the ideas concerning, and the observations of, meteors, and summarises the chief events in meteoric phenomena since 1798.

The Lyrids, Perseids, and Leonids are especially described, and the association between comets and meteors is concisely discussed. Mr. Denning also mentions that some showers persist, more or less actively, for months, and instances are not wanting where radiants continued in active play all the year round, the apparent position of the radiant remaining practically constant. He also makes it obvious that the study of meteoric phenomena needs recruits; the field is a large one, the observations are comparatively simple, and the results important. So far, photography has played but a small part, and there is ample scope for useful work by those possessing suitable cameras and a fair amount of persistent patience.

STARS WITH VARIABLE RADIAL VELOCITIES.—A number of observations of stars which have been found to exhibit variable radial velocities are published by Messrs. Campbell, Albrecht, and Wright in No. 173 of the Lick Observatory Bulletins. Among the twenty northern stars discussed may be noted κ Persei, α Ursæ Majoris, ρ Leonis, ο. ν, τ and ε Draconis, η Lyræ, σ Cygni, θ Cephei, and ζ Capricorni. Six southern stars, observed by the Chile observers, have also shown a variation of velocity in the line of sight; they are δ Canis Majoris, β Crucis, η Centauri, α *I* upi, γ Apodis, and ν Scorpii.

In the same bulletin Dr. Curtis announces that the definitive reductions of the spectrograms of κ Centauri confirm the variation of that star's radial velocity. Dr. Campbell notes that thirteen years' observations of Procyon show that the radial velocities do not appear to have varied appreciably in a manner to accord with a period of forty years, more or less; they seem to harmonise with Dr. Auwers's conclusion that the orbit plane of the system is approximately tangent to the celestial sphere. There is, however, a suggestion of a secondary variation of the radial velocity, of very small amplitude and a period of about seven years, for the confirmation of which further observations are necessary.

The minimum of the radial velocity of the binary system in the triple system of Polaris is shown, by the Lick observations, to have been passed, and the velocity of the centre of mass of that system appears to be increasing rapidly. Therefore velocity observations of the bright component of the Polaris system during the next few months promise to have unusual weight in the determination of the period of the third member of the system around the centre of mass of the whole system.

PRECAUTIONS NECESSARY IN PHOTOGRAPHIC PHOTOMETRY.—Under this title Mr. Parkhurst publishes a paper in the *Astrophysical Journal* (vol. xxxi., No. 1, p. 15) which contains a number of hints useful to all workers in astronomical photography.

During the work on photographic photometry, which has been carried on for a number of years at the Yerkes Observatory, it was found that the measures were affected by a number of errors introduced by differences in the method of development, by lack of uniformity in the photographic film, and by many other causes. These errors have now been fully investigated, and the results of the investigations are given in the present paper, illustrated by numerous curves. As an example of the results, it may be noted that at one point of the "developer curves" the density given by "pyro" introduces a difference equal to 0·3 mag. from that given by rodinal, whilst in the case of hydroquinone the resulting difference in magnitude amounts to 0·9. The necessity for rigidly controlling the time of development, the temperature of the developer, and other variables is just as forcibly shown by other curves.

OBSERVATIONS OF SATELLITES.—No. 172 of the Lick Observatory Bulletin contains the measures, made by Prof. Aitken during the years 1906–9, of the satellites of Mars, Saturn, and Uranus. In the case of Mars the positions of the satellites are referred to the planet's limb, but for Uranus and Saturn each satellite is referred to another satellite, except in the case of Titania. The positions given in the tables are uncorrected, except for differential refraction.

Photographs of Jupiter's eighth satellite were obtained at Greenwich on January 19 and February 11, and the resulting positions, showing fair agreement with the ephemeris, are published in No. 4393 of the *Astronomische Nachrichten*.

RESEARCHES ON ALLOYS.[1]

THE report referred to below was presented to a meeting of the Institution of Mechanical Engineers on January 21. The report itself is a memoir of some 175 pages and sixteen plates, and embodies the results of researches carried out during a period of two and a half years at the National Physical Laboratory. These researches constitute a continuation of the previous work of Messrs. Carpenter and Edwards on the alloys of copper and aluminium as recorded in the eighth report to the Alloys Research Committee. Owing to the magnitude of the task which would have been involved in undertaking a complete study of a ternary system of alloys, the authors at the outset decided to limit their investigations to those regions of the system

[1] Ninth Report to the Alloys Research Committee of the Institution of Mechanical Engineers, by Dr. Walter Rosenhain and Mr. F. C. A. H. Lantsberry, on "The Properties of Some Alloys of Copper, Aluminium and Manganese."

where results of practical interest were to be anticipated. As regards the heavy alloys, consisting principally of copper, important results were to be sought only in alloys containing more than 85 per cent. of copper, while at the aluminium end of the series only alloys containing more than 95 per cent. of aluminium could be expected to yield results of practical value. The study of the constitution of the alloys has, however, been pushed beyond these limits in order to render the data obtained over the "useful" range more intelligible.

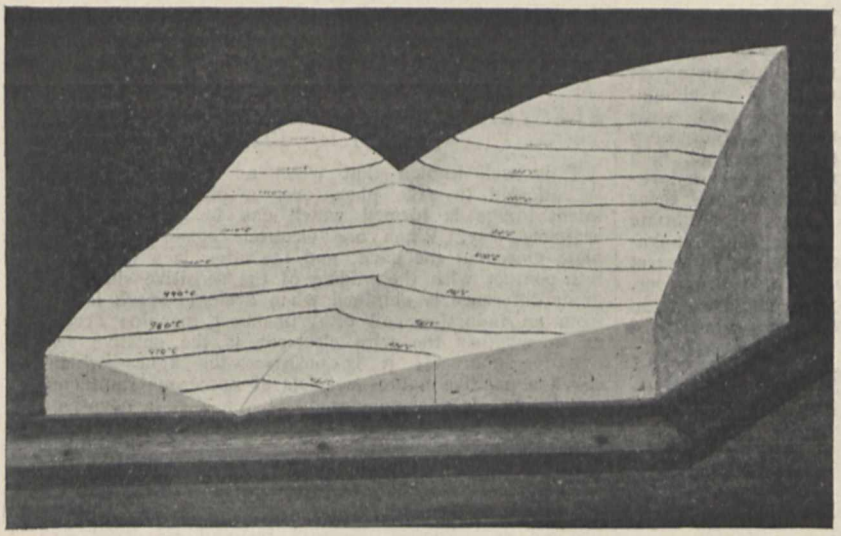


FIG. 1.—Model of the liquidus surface of ternary alloys of copper with aluminum and manganese.

The report therefore includes a model of the "liquidus surface" of the ternary system over a range of alloys containing less than 11 per cent. of aluminium and less than 10 per cent. of manganese. This model is constructed on the well-known principle of trilinear coordinates, in which the range of compositions of ternary alloys is represented by an equilateral triangle; the liquidus surface is constructed by erecting a vertical ordinate representing the temperature of initial freezing, on the points representing the alloys examined. A photograph of the model, upon which contour lines representing each 10° C. have been drawn, is reproduced in Fig. 1. The well-marked minimum of the copper-aluminium series, occurring at a concentration of about 8½ per cent. aluminium, is continued into the ternary system in the form of a valley in the liquidus surface, and microscopic examination has shown that alloys to the right of this valley (*i.e.* nearer the copper side) are homogeneous, while those to the left are duplex. A comparison of the model with the mechanical properties of the alloys further indicates that in the ternary alloys, just as in the binary copper-aluminium series, the presence of the second phase to the left of the minimum renders the alloys stiffer, stronger, and less ductile.

Throughout the range covered by this model (which represents the data obtained from more than 100 different alloys) no new phase resulting from the presence of manganese can be detected. This result is of special interest, because some of the alloys included in this group, viz. those lying towards the left-hand corner of the model, are distinctly magnetic, their permeability increasing towards the extreme left-hand corner of the figure. If, therefore, the magnetic properties of these alloys (which approach the type of some of the well-known Heussler alloys) are due to the existence of a magnetic metallic compound, this compound must be soluble in either or both the phases found in these alloys.

A photomicrograph typical of the structure of alloys in this region is reproduced from Fig. 75 of the report (Fig. 2), representing the structure of an alloy containing 8·56 per cent. of aluminium, 4·77 per cent. of manganese, and 86·67 per cent. of copper in the sand-cast condition. The effects of heat-treatment on the microstructure of these alloys are very marked. Thus Fig. 122 of the report (Fig. 3) shows the structure of another alloy of this type after annealing at 900° C., both these photographs being taken at the same magnification (150 diameters). Quenching the same alloy from 900° C. produces a totally different structure, reproduced from Fig. 129 of the report (Fig. 4), and this change renders the alloy hard and brittle.

As regards alloys at the light end of the series, the introduction of manganese is found to give rise to the formation of a definite compound, Al_3Mn, which tends to render the alloys hard and brittle. If present in large proportions, this compound appears to undergo a more or less gradual change, which leads to the spontaneous disintegration of the alloys containing it; an ingot consisting of 65 per cent. aluminium and 35 per cent. manganese is a hard, metallic mass when first cooled, but falls to a fine crystalline powder in the course of six or eight hours, and this process appears to be independent of oxidation.

FIG. 2.—Micro-structure of alloy as cast in sand.

FIG. 3.—Micro-structure of alloy after long annealing at 900° C.

In the "useful" light alloys of the ternary system, however, such disintegration does not occur.

The mechanical properties found in the best of the alloys of the ternary system are remarkable. The authors suggest that alloys of copper with aluminium alone are generally contaminated with a certain proportion of alumina, formed when the aluminium is added to molten copper containing more or less oxygen; by the previous addition of manganese, which acts as a reducing agent, the formation of this alumina is inhibited and the properties of the resulting alloys are improved. It has been found that a small percentage of manganese renders the alloys more ductile without reducing their ultimate strength, while larger proportions of manganese increase the strength but lessen the ductility of the alloys. Sand-castings giving an ultimate strength of 36 tons per sq. inch with an elongation of 22·5 per cent. on 2 inches have been obtained, while in the form of rolled bars the best of the heavy ternary alloys reach an ultimate strength of 43 tons per sq. inch with 22 per cent. elongation. Perhaps the most remarkable result, however, is that obtained with one of these alloys in the hard-drawn condition, where an ultimate strength of 52 tons per sq. inch with 10 per cent. elongation has been obtained. This is probably the strongest alloy known, containing more than 80 per cent. of copper. The remarkable properties of this alloy led Dr. Rosenhain to take up the challenge recently thrown out by Sir Gerard

FIG. 4.—Micro-structure of alloy after quenching from 900° C.

Muntz in his presidential address to the Institute of Metals, to the effect that modern scientific attainments in metallurgy had not yet enabled us to produce a bronze cutting tool. By further cold-working one of these hard-drawn alloys under a powerful testing machine, a material was produced from which a chisel was ground, and with this it was found possible to incise hard stone or—with a different form of cutting edge—to cut wood so easily and cleanly that a lead-pencil could readily be sharpened with it.

A result of considerable importance has been obtained by means of abrasion tests on certain of these alloys; the test applied was one of simple wear against hardened steel rollers, the loss of weight being determined. It was found that the best of these alloys possess a very great resistance to abrasion of this kind far surpassing even the harder varieties of steel. This property, together with their very great strength and the fact that they can be machined and finished very readily, should render them of special value for the construction of scientific instruments, particularly for those parts where much mechanical wear has to be met. These alloys also possess a very great power of resisting corrosion, both by fresh- and sea-water, while tests made upon them at temperatures up to 500° C. indicate that they retain their strength up to 300° C.; these results suggest the possibility of their employment for the blades of steam-turbines working with superheated steam.

As regards the light alloys, containing more than 95 per cent. aluminium, the properties of the ternary alloys are not markedly superior to those of the aluminium-copper alloys, except, perhaps, that in the form of chill-castings a higher tensile strength has been obtained. The presence of manganese, however, appears to protect these alloys from corrosion to a marked extent, the specimens of these alloys exposed to sea-water, for instance, becoming coated with a black patina consisting largely of oxide of manganese. Specimens of some of these alloys have retained their original brightness after more than two years' exposure in the laboratory cupboards, thus indicating a decided superiority over pure aluminium, which has hitherto been regarded as decidedly superior to its alloys in regard to corrosion.

ELECTRICAL DISCHARGES OVER PHOTOGRAPHIC PLATES.

IT is well known that when an electric discharge is allowed to take place over a photographic plate a latent image is formed which can be developed in the ordinary way. When one electrode consists of a metal plate placed at the back, and the other is a wire brought into contact with the middle of the sensitive side, a very great difference is obtained when a single spark is passed from an induction coil or Wimshurst machine according as to whether the wire electrode is the positive or the negative one. If it is positive, the figure—which is called a positive figure—consists of numerous ramifications suggesting meandering streams, while if it is negative the main lines in the figure change their directions very abruptly, and are terminated by expansions suggesting fans or palm-leaves. In each case the discharge may or may not pass to the edge of the plate; if it does, the corresponding line is very broad, with a finer, well-defined, intenser line passing midway through it. Such figures were obtained first by Mr. J. Brown, of Belfast, and have since been repeated by many experimentalists. Experiments made by Prof. J. A. McClelland and Mr. Campbell Swinton seem to render certain that the latent image is due to the luminosity of the discharge, and not to a direct electrical action.

I have recently made experiments with the object of extending our knowledge with respect to the formation of these figures, and the results have been communicated to the Röntgen Society, appearing in the society's journal for January.

My first idea was that if the paths of the discharge represent moving electricity they would be seriously modified in a perpendicular magnetic field. However, the greater part of the figure is apparently quite unchanged in such a field; the only evidence of change is in the trunk discharges that flow over the edge of the plate. These become still broader, the fine pilot spark, however, remaining apparently unshifted, and forming a sharp boundary to the trunk discharge along one edge. The direction of lateral shift is that corresponding to a wire carrying a current from the positive to the negative electrode.

A blast of air produces the same kind of effect. Indeed, if several radiating trunk discharges occur on the same plate, the effect in a perpendicular magnetic field is much the same as if a cyclonic blast of air had circulated over the surface of the plate.

The fine tracery lines in the fan-shaped expansions which terminate the lines of discharge in the case of a negative spark are very similar to the paths of the separate portions of an exploded projectile. Such paths are easily plotted by superposing a radial component of velocity, following any assumed law, upon the initial translatory velocity of the unexploded projectile. Owing to this similarity it is suggested that these tracery lines represent the actual paths of single ions or of simple groups of ions in the electrical field.

When the discharge takes place in a partial vacuum very considerable changes occur. In particular, as the exhaustion proceeds a new phenomenon appears, which reaches its most marked stage at about 17 cm. pressure. This is somewhat difficult to describe, and is shown in Fig. 1.

The wire terminal touched the plate nearly at its centre. Besides the trunk discharge ascending the plate are seen

two discharges in the shape of narrow triangles the bases of which are close to a *dark space* separating the glow surrounding them from a central rosette. The pointed ends are close to a *second dark space*, and are terminated by tuft discharges. These appearances show only imperfectly in the reproduction, but are exceedingly definite on the original negatives. The remarkable feature is the very sharp and well-defined edges which these triangles possess. It is suggested that there may be a connection

FIG. 1.—Discharge at a pressure of about 17 cm.

between these and the phenomena of *electrostriction*, but so far no definite theory has been formulated. In very many cases there is visible a *dark continuation* of these squirts on the side of their bases, which suggests that the effects seen represent a part only of the electrical effects taking place. The shape of the squirts suggests that in one region they experience a pressure from the disturbance which creates the luminous glow through which they stretch, and that this pressure is replaced by a tension as soon as the second dark space is passed. The luminous

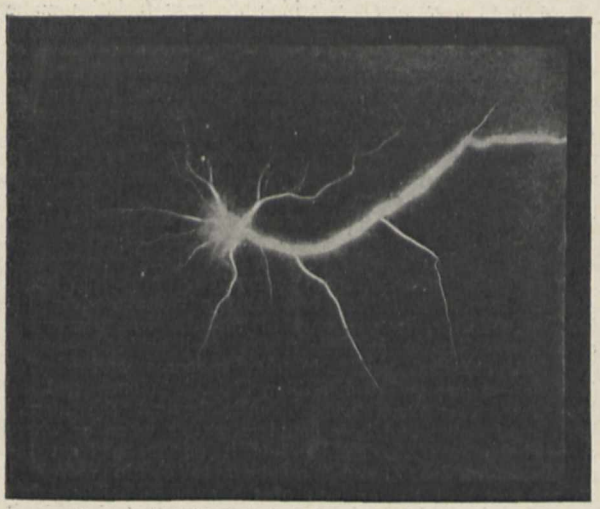


FIG. 2.—Negative figure in coal-gas at ordinary pressure.

glow bordered by the two dark spaces suggests a single stria as seen in a vacuum tube; the phenomena of ionisation in the two cases may be similar.

When the gas in which the plate is immersed is changed the effects obtained change also. Each gas produces a negative figure characteristic of itself. *The triangular squirts above referred to are given by air alone.* The negative figure in coal-gas at ordinary pressure is shown in Fig. 2. The figure in nitrogen is also very singular. It is noteworthy that the positive figures in various gases present very few differences from each other.

When a small metallic triangle placed on the sensitive film forms the electrode, some striking differences are obtained according as it is made the positive or the negative terminal. When it is positive the ramifications start in the main from the corners (Fig. 3); on the other hand

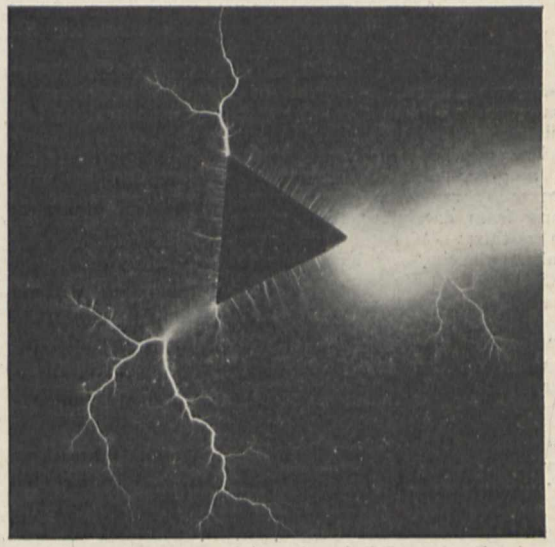


FIG. 3.—Positive ramifications from corners of triangular electrode.

when it is negative a preference is shown to leave at right angles to the edges (Fig. 4).

Throughout these descriptions it has been assumed that the discharges *leave* the electrode. It must be admitted that at present there is no proof that the streamers do not represent currents that advance *toward* the electrodes.

For some further details, as well as for numerous other

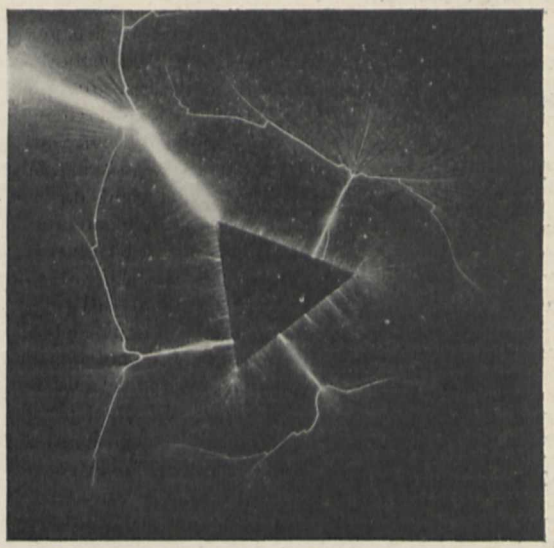


FIG. 4.—Negative streamers exhibiting a preference to leave the triangle at right angles to edges.

reproductions, reference must be made to the paper in the Journal of the Röntgen Society from which the figures illustrating this article have been selected. Perhaps it should be added that these are photographic positives from the original photographic negatives.

ALFRED W. PORTER.

FORESTRY.[1]

THE present half-yearly issue of the Transactions of the Royal Scottish Arboricultural Society contains a considerable number of useful and interesting articles on forestry and woodcraft generally. An article entitled "The Duty of the State as Regards Afforestation" shows, in a striking summary of the opinions expressed on the subject by landowners, foresters, and men of science, that all are agreed that the State should encourage extended afforestation. The article indicates very clearly what the State can and should do with this object in view.

In "Afforestation and Local Taxation" Sir Kenneth Mackenzie, Bart., president of the society, shows the disastrous results to the local taxpayer which might follow indiscriminate afforestation in large, continuous blocks on land compulsorily purchased by the State. The State could do a great deal to encourage afforestation by private owners by removing the burdens which at present deter many from extending their plantations. In the words of the author:—"There is a premium offered at present against planting—as long as an owner occupies his land with sheep he only pays rates on three-eighths of its valuation. If he fences and plants it, he has to pay rates on the full value appearing in the Valuation Roll."

"The Sitka Spruce as a Tree for Hill Planting and General Afforestation" (with plate), by Mr. Crozier, Durris, is the most important article which has yet appeared regarding the sylvicultural characters and capabilities of this important conifer.

"Vegetable Remains from the Site of the Roman Military Station at Newstead, Melrose," is an article which will appeal to historians and antiquarians. Samples of deposits from the pits and trenches of the Roman station were examined by Mr. H. F. Tagg, of the Royal Botanic Garden, Edinburgh. The numerous twigs and branches examined belonged to some seven different species of trees which have always been considered indigenous. There was no evidence to show the presence in Britain, at the period of the Roman occupation of this station, of species of exceptional interest.

Mr. W. Mackenzie, Forester, Novar, contributes an article entitled "Underplanted Larch Plantations at Novar." The sylvicultural methods adopted to combat the ravages of the larch canker fungus are clearly and succinctly described.

"Continental Notes—Germany," by Mr. B. Ribbentrop, with figures, gives a review of the recent sylvicultural developments in that country, while Mr. A. G. Hobart-Hampden deals in a similar manner with French sylviculture.

The society's excursion to the forests of Bavaria, which took place last August, is interestingly described by Sir Andrew N. Agnew, Bart. In "Notes and Queries" are included many topics of great value to sylviculturists, and the "Reviews and Notices of Books" will bring them in touch with the recent literature on the subject.

WORK OF A LOCAL SCIENTIFIC SOCIETY.

THE value of the work accomplished by local scientific societies is, perhaps, not always given adequate recognition. On what may be described as the educational side, such societies create and foster interest in the world of nature; and out of this comes the desire to investigate parts of the field of science. A report, programme, and presidential address received recently from the North London Natural History Society provide evidence of the well-directed activity and progressive spirit which should be characteristic of a society that desires to extend a knowledge of science and promote its progress. The society is particularly to be congratulated upon its research committees, which are concerned, among other matters, with the flora, lepidoptera, and birds of the local district. This district covers an area within twenty miles of St. Paul's, and is subdivided into twelve sections for recording.

As instances of the valuable work which these committees accomplish, we mention a few points in the annual report for 1908—that for 1909 not yet being available. It appears that the adventitious flora of the district is spreading widely, while, as might be expected, the native flora is diminishing. Twenty species were recorded for the first time in 1908, making the total of 684 species for the district. Six of these were aliens, and eight were new records for the outlying salt marshes of West Thurrock. Six additions were made to the list of Lepidoptera, bringing the total up to 542. The ornithological research committee, which was inaugurated in 1908, records 110 different species of birds, of which seventy-nine were then known to nest within the district. Two members of the biological research committee, Messrs. L. B. Prout and A. Bacot, have carried out a research on inheritance in *Acidalia virgularia*, and a paper on the results of their investigation was communicated to the Royal Society in February of last year.

It is clear, therefore, that the members are actively engaged in the extension and advancement of scientific knowledge. We congratulate the society upon the keenness and energy of its members and committees, both of which are worthy of emulation by other local scientific societies. The society has just taken rooms in Salisbury House, Finsbury Circus, for its meeting-place, library, and collections. The annual subscription is only five shillings a year, being kept purposely low in order to place the advantages offered within the reach of everyone. It is to be hoped many new and faithful observers will thus be brought within the scientific field through the instrumentality of the society. Subjoined is the main part of the presidential address delivered before the society on January 11 by Mr. Louis B. Prout.

Let us have done with the days of a nearly stationary membership of about seventy, and an average attendance of perhaps a score or less; let us individually use every endeavour to attract to our society all the nature-lovers with whom we come into contact, whether they aspire to be called "naturalists" or not; let us remember that no one who lives within reach of London at all can now plead the *inaccessibility* of our meeting rooms as an excuse for holding aloof, and that, although our local researches will continue to justify our title of the "North London Natural History Society," yet there is nothing whatever to prevent our drawing upon South London just as extensively as upon North London for our membership. It is proverbial that nothing succeeds like success, and if only the next few months witness anything like the accession of new members which the new facilities make feasible, the future of our society should be well assured.

I have directed attention more than once to the love of *facts* which has characterised the early career of most of those naturalists who have become the most famous for their *theories*. The pioneers of evolution—Darwin, Wallace, and Bates—were all careful and accurate recorders at a time when most "mere collectors," at least in entomology, no more thought of labelling every specimen with locality and other details of information than the philatelist of labelling every stamp with the date of purchase and the name of the dealer from whom it was obtained. The two hobbies were very nearly on a par. The collecting was, without reservation, an end in itself, and if the entomologist had any advantage over his brother collector, it was only in that he was developing a somewhat more æsthetic taste, and probably—unless he, too, collected solely in auction-rooms and similar localities—a somewhat healthier body. Science and all branches of research were equally beyond the mental horizon of both; and how could it matter when or where a specimen was obtained, unless it might be from the mercenary motive of knowing how to obtain more? I do not say that the outlook of the average collector has radically changed; I do not even say that I wish it radically to change. I have no patience with the lordly being who speaks and writes disparagingly, or even contemptuously, of the "mere collector," and forgets that he only theorises because it amuses him to do so, just as the other only collects with like intent; but I think most have now been educated up to that point where they know that there *is* value in facts, and I believe that the majority of these are willing to "take themselves seriously" to the extent of observing and recording those facts; and if there are any listening to me who have *not*

[1] Transactions of the Royal Scottish Arboricultural Society, vol. xxiii., part i. (January, 1910).

yet realised these things, I would urge them from henceforth to bear their part in this movement, which may result in issues more far-reaching than any of us can at the moment conceive. Let me repeat that it is not necessary for every nature-lover, nor for every collector, to become a man of science; yet everyone may become in some measure a contributor to science.

When do the facts observed, or believed to have been observed, become *data*? Not when they are thrown away loosely into the chambers of memory, to be brought out again for use a few years later, clogged with the dust of time, or metamorphosed by long yet unsuspected contact with some subtle subconsciousness with which they ought to have had no affinity. No; the memory, however excellent, is not a safe repository for facts which are to be used as data; as soon as possible they ought to be reduced to writing. For it is impossible to overestimate the importance of absolute accuracy as a basis for all scientific generalisations.

I have often been impressed with the thought of the dependence of the greatest statisticians on the humblest recorders. Most of us have had questions addressed to us by Prof. Karl Pearson on simple questions of family statistics; and the entomologists have been asked to furnish to the Evolution Committee of the Royal Society certain data regarding percentages of black and of white moths among their favourites. These are but random examples which occur to me of what is constantly going on in the world of to-day; and yet on the faithfulness of the replies to such questions may well hang the entire development of the infant science of eugenics, the whole welfare, and perhaps ultimately the very continuance, of the human race. Fortunately, I believe—and one may hold this belief without a very over-exalted estimate of the average integrity of mankind—the danger of wilful perversion of facts which are to be used as data is extremely small. No doubt there are romancers here and there, and a de Rougemont or a Dr. Cook may set back the clock for a moment or two on occasions; but men such as these have generally some motive of self-interest behind their romancing, and I do not think there is any large army of hoaxers for hoaxing's sake.

Although, however, there is very little to fear from wilful deceivers of their fellows, there is very much to fear from unconscious self-deceivers. It is true that we have little to depend upon, whether in nature-study or in scientific research, but the evidence of our senses; but it is equally true that we must not allow ourselves to be deluded by our senses. I have on other occasions urged that the cardinal virtue of a naturalist is fidelity to his own observations, but he must make very sure that they *are* observations, and not imaginings. It is a perfectly well-known fact that even careful and experienced men of science have sometimes been led astray by certain psychological processes, and have seen things which it has afterwards been proved to demonstration were not, and could not have been, present for them to see.

The subtle enemy which all observers and recorders have to fight is, I believe, named by psychologists "suggestion," or, more particularly, "auto-suggestion." All of us know, and yet few of us give the knowledge its due weight in dealing with the analysis of our observations, that whatever is present as a mental background is ever liable to colour the newly arriving impressions from without. If something which we see falls in naturally with our expectations, that is, if its incidence on the mind causes no sense of jarring, we assume that it is correctly observed, and make no attempt at verification; if, on the other hand, it conflicts with our expectation—in other words, with past experiences or general habits of thought—we are sceptical, and demand a repetition of the observation before acknowledging that our senses have not deceived us. Now is there not really a great deal to be said in favour of a diametrically opposite course? Should we not be more suspicious of the expected when it is observed, and more trustful of the unexpected? I need scarcely add that I do not mean this to be the universal principle of life; we should have more than enough to do if, every time we entered our homes, we made it a duty to investigate whether the familiar faces and objects with which we met—and had been expecting to meet—might not in reality be the phantasms of our own brain! I am referring solely to phenomena which are under observation or investigation for furnishing scientific data; it is in these that we are too apt to accept the expected, perhaps also too apt to discredit the abnormal.

A plain and evident observation, made under no preconceived notion that it was about to be observed, may, in a normal state of health, be noted down as a fact, and thenceforth relied upon. If a member of our ornithological or Lepidoptera committee observes a bird or a moth with which he is well acquainted, he is entitled to make and to use the "record," which should be given full credence. Of course, there may be an error—infallibility is not an over-common attribute of man—and it is always satisfactory if two or three can make the observation simultaneously, or in such a way as to confirm one another, or if, as with our botanical committee, a specimen can be obtained as a voucher; but no good purpose is served by constant suspicion of data of this kind unless the recorder has proved himself untrustworthy. On the other hand, the observer himself should be the first to desire every possible verification, especially in cases of intricacy or difficulty of observation, such as in most microscopic work, or where he has any reason to suspect that "the wish is father to the thought." In all such cases a fact should not be considered as established until it has been verified two or three times, and under the most favourable conditions obtainable.

The most difficult questions of all have been left until last, and I really do not feel competent to give either an adequate answer. What facts or data are worth recording? And what steps should the recorder take to place them at the disposal of the specialist who could use them? In regard to the first question, I would say that, ideally, almost everything is worth recording; but, practically, life is too short, nature too long. While we are staying to record something commonplace, or already well known, we may be missing valuable opportunities of turning our attention to something more important. A retentive memory should be cultivated, so that we may know, to some extent, what has already been established by ourselves or others; and we shall then find that the most casual passing attention will suffice to accumulate any supplementary testimony that may be needed. For the rest, I think we ought to work upon the principle that a few things thoroughly observed and confirmed will form from us a worthier contribution to the sum total of science than a hundred half-observed and half-guessed at. As to the second question, To what use should the recorder put his data? I touched upon this in my former address, but there are great difficulties in the way of the application of sound methods, and the ideal arrangements are as yet far off. A society like ours ought to have a research committee in every possible field of nature-study, besides one or two committees for coordination of work along different lines—organisation, biology, topographical knowledge, bibliography—besides a sort of clearing-house for miscellaneous information; then (and not until then, I fear) it will be possible for observers rightly to place their data, and though much will be handed in which leads no further, there will also be much solid material for the rearing of the noblest edifices in the future of natural-history research.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Hebdomadal council has appointed Prof. Poulton, F.R.S., Dr. Dixey, fellow of Wadham College, and Dr. Malcolm Burr, New College, as representatives of the University at the International Congress of Entomology to be held at Brussels in August next.

WE learn from *Science* that Columbia University has received an anonymous gift of 70,000*l*. for the erection of a building for the faculty of philosophy. The University has also received anonymously 3000*l*. for work in agricultural education. From the same source we gather that a zoological laboratory is to be erected at the University of Pennsylvania, at a cost of about 50,000*l*. In making the announcement recently, Provost Harrison stated that it would be "the most complete biological laboratory yet

erected." By the will of Mrs. Mary A. Richardson, Tufts College is to receive 8000*l.* for fellowships.

By the will of the late Prof. Hilary Bauerman, the sum of 500*l.* is left to the Memorial Fund of the Iron and Steel Institute. The residue of his property (about 15,000*l.*) is left, subject to a life interest, upon trust to be applied by his trustees in the encouragement of the study of mineralogical science at the Royal School of Mines, by means of lectures on subjects of prominent or educational interest at the time, but which are not included in the ordinary list of subjects taught, and for making grants to enable students to make special investigations or to enable them to travel for the better pursuance of their studies.

In addition to the regular courses of instruction given by Profs. Sedgwick and MacBride and by Mr. Dobell at the Royal College of Science, a series of special courses on important departments of zoology are being delivered by lecturers, each as specialist in his particular branch. A course on heredity and variation, by Mr. A. D. Darbishire, has just been completed, and two other courses of great interest will commence shortly. One of these courses will be delivered by Dr. E. J. Allen, director of the Plymouth Marine Biological Station, and will treat of marine biology, with special reference to its bearing on fishery problems as well as on oceanic science. The question of the feasibility of the artificial rearing of marine animals of economic importance will also be dealt with. An opportunity will thus be afforded to the student of obtaining in a condensed form the results of a lifetime devoted to this form of research. The lectures will be delivered on Tuesdays, Wednesdays, and Fridays at 2 p.m., commencing April 19, and will be accompanied by practical work, for the benefit of which salt-water aquaria have been installed in the Royal College of Science, and are now in successful operation; at the conclusion of the course in London the practical part of the course will be continued at the Marine Laboratory, Plymouth, during July, for those desirous of prosecuting the study further. Another of these courses, treating of organs of embryonic and fœtal nutrition, is in charge of Mr. Richard Assheton, and will be held on Tuesdays and Thursdays at 5 p.m., beginning on Tuesday, April 19. This course will deal with the comparative anatomy and physiology of the placenta in a comprehensive way, taking into consideration all cases of trophic connection between mother and offspring throughout the Vertebrata, and tracing thus the fully developed placenta of the highest forms from its first beginning. An account of the œstrus cycle will also be given, and the question of the influence of the internal secretions of the generative organs on the organism will also be dealt with. The course will be accompanied by demonstrations and practical work. Such a course has never before been given in London, and it should enable a medical student to grasp the meaning and physiology of the placenta in a way unattainable to those who have only had acquaintance with the human type of the organ.

In an address at the recent annual banquet of the American Chemical Society, Dr. R. C. Maclaurin, president of the Massachusetts Institute of Technology, referred to the necessity for keeping industry in the closest possible touch with science. In the course of his remarks, he said:—"The awful example, the standing warning in this respect, is the case of England. There a few years ago was celebrated the fiftieth anniversary of an English chemist's epoch-making discovery of mauve, and yet the jubilee in honour of this man of science was the occasion of the funeral oration of the colour industry in his own country. This deplorable result was brought about entirely by two things that are closely related:—first, the failure to keep industry in close touch with science, and, second, the impatience of the manufacturer and his narrowness as a self-styled 'practical' man. The practical Englishman is too apt to be impatient of the slow processes of research. He wants to be compensated in hard cash, and at once. The German, on the other hand, has learned to be no less practical, but he has retained the traditions of a race of idealists plodding patiently and surely to success. But the field of *industrial* chemistry is not the only one in which the times are critical and exciting. That is equally true of the pure science itself. I hope my own predilection for physics does not mislead me into thinking that the most conspicuous development of chemistry during the past quarter of a century has been on the physical side; but, in any case, there can be no question that the artificial boundaries between physics and chemistry are being rapidly removed, and, of course, it is well to have it frequently brought home to us that all such boundaries are purely artificial. One point suggested by recent experiences is that we should pay more serious attention than we usually do to the logic of science, and have as clear ideas as possible as to what we are really aiming at, as to what we can reasonably expect to do and not to do. It seems unfortunate that men of science are still so much scared by the bogey of metaphysics. What we have to be afraid of is not metaphysics, but bad metaphysics, and it is difficult to accept the simple faith of many a man of science that his metaphysics is to be preferred to any other brand merely because it is either unconscious or naïve. A little quiet thought and study should at least have the good effect of enabling us to preserve our calm when things seem to be tumbling down. We should realise, perhaps, that a science like chemistry is, above all else, a work of art, and that concepts like atoms, energy, and the like are not much more than pigments with which we paint our pictures. The next generation may find new pigments or mix the old ones differently."

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, March 9—Prof. W. W. Watts, F.R.S., president, in the chair.—E. E. L. **Dixon** and A. **Vaughan**: The Carboniferous succession in Gower (Glamorganshire). The succession in three districts in Gower is described. With the description of the lithological sequence are notes on some breccia-like limestones, on "lagoon-phases," and the origin of radiolarian cherts. From the faunal sequence it is concluded that many zones are characterised by the same assemblages as in the Bristol area. The lithological sequence shows (1) that over the area the depth of the Carboniferous sea underwent a cycle of change during Lower Avonian time, the initial deepening being followed by shallowing up to the top of the lower part, C_1, of the Syringothyris zone, deposited almost at sea-level; (2) that a cycle marked the ensuing period up to the top of the Seminula zone; (3) that a cycle took place in the Dibunophyllum zone, the latter reaching the surface; and (4) that a fourth cycle characterised the Posidonomya zone. A comparison of the sequences and thicknesses in the districts shows that the axis on which the movement during the first cycle hinged was different in direction from the axis during the second cycle. The bearing of these movements on the question of the delimitation of the divisions of the Avonian is then discussed. It is suggested that the base of the upper part, C_2, of the Syringothyris zone should form the base of the Upper Avonian. The base of C_2 in at least two localities is connected, faunally, with the zones below, whereas the fauna of the main mass of C_2 passes into S_1 without appreciable change other than the introduction of Lithostrotion. Probably the break between the Lower and the Upper Avonian should be taken at a level within C rather than at the base of the Seminula zone.

Physical Society, March 11.—Prof. H. L. Callendar, F.R.S., president, in the chair.—Dr. W. H. **Eccles**: Coherers. A method of investigating detectors is developed with special reference to the relations between the energy given to the detector in the form of electrical vibrations and the energy delivered by the detector, as direct current, to the circuit of the indicating instrument. The author puts forward the hypothesis that the properties of an oxide coherer may arise solely from the temperature variations caused in the minute mass of oxide at the contact by the electrical oscillations and by the applied E.M.F. He examines the hypothesis mathematically, and shows that most of the phenomena recorded above can in this way be

accounted for as perfectly as the present state of the measurements permits.—G. C. **Simpson**: Earth-air electric currents. The paper describes a method for recording automatically the electrical current which passes from the earth into the air during periods of fine weather. A large plate (17 metres²) was placed in the open as near to the ground as was consistent with efficient insulation; this was then connected to an insulated vessel, from which water issued through an orifice surrounded by an earth-connected cylinder. The water as it dropped from the insulated vessel carried away, by the well-known "collector" action, all the charge which the exposed plate received, and the latter remained at zero potential. The charged water drops were collected in a vessel connected to a self-registering electrometer, which was earth-connected for an instant at the end of every two minutes. The paper describes the sources of error and the method of determining the value of the earth-air current and of the conductivity of the air from the records of the electrometer.—Dr. B. D. **Steele**: An automatic Toepler pump designed to collect the gas from the apparatus being exhausted.

Zoological Society, March 15.—Mr. E. T. Newton, F.R.S., in the chair.—T. **Goodey**: A contribution to the skeletal anatomy of the fish *Chlamydoselachus anguineus*, Gar. The author dealt with the anatomy of the axial and appendicular skeleton, paying particular attention to the structure of the notochord. He stated that the notochord in this fish had generally been regarded as unconstricted except at the extreme anterior extremity, but that he had ascertained the presence of well-developed, calcified cyclospondylic centra at the anterior end of the column, and of calcified cyclospondylic centra of two sizes in the main caudal region.—W. R. **Ogilvie-Grant**: Additional notes on the birds of Hainan. The notes were based on a small collection of Hainan birds recently forwarded to the Zoological Society by Mr. Robert Douglas, of Shanghai, and, at the suggestion of Dr. Chalmers Mitchell, F.R.S., presented to the Natural History Museum. The collection contained several species of great interest, and two were described as new, namely, *Tephrodornis hainanus* and *Pitta douglasi*. Among the rarities, attention was directed to the remarkable magpie (*Temnurus niger*), with its curious truncate tail-feathers, the beautiful green jay (*Cissa katsumatae*), recently described by the Hon. Walter Rothschild, and a bulbul (*Pycnonotus sinensis*), not hitherto recorded from the island.—Dr. Einar **Lönnberg**: The variation of the sea-elephants.

Royal Meteorological Society, March 16.—Mr. H. Mellish, president, in the chair.—Captain H. G. **Lyons**: Climatic influences in Egypt and the Sudan. From early times the ancient Greeks recognised the marked difference between the climate of the Mediterranean and that of Africa, and Aristotle indicated correctly the rains of Ethiopia as the cause of the annual flood of the Nile. Travellers have supplemented our knowledge from time to time, but only within the last ten years has a network of meteorological stations given precision to our views and furnished a basis for further investigations. The comparatively low relief of the country, which lies as a vast land area in low latitudes, combined with the effect of the north-easterly trade winds which sweep over it, produce the hot and dry conditions which are so characteristic of north-eastern Africa. Modified somewhat in the north by the warm waters of the Mediterranean, and in the south by the rains of the monsoon in summer, the highest temperatures and most arid conditions are reached between Wadi Halfa and Dongola, where northerly winds, clear skies, and a great range of temperature prevail throughout the year. The important rains are those falling in Uganda, the southern plains of the Sudan, and on the tableland of Abyssinia, since they not only provide the whole supply of the Nile and its tributaries, but largely control their regimen. Fed by the south-easterly air currents blowing in from the Indian Ocean, these monsoon rains supply the equatorial lakes and the tributaries of the Nile; but it is the Abyssinian tableland, with its heavy summer rainfall, which is most effective, since it furnishes the whole of the Nile flood and enables the Nile to maintain itself through 1500 miles of desert. As the sole source of the flood, the variation of these rains directly determines the abundance or deficiency of Egypt's supply, so that this climatic problem is of immense importance. Hardly less important in these days of intensive cultivation of cotton is the study of the winter storms which occasionally break in the Sudan and Abyssinia, raising the level of the rivers and increasing the supply of the Nile appreciably at a time when the normal supply is inadequate. The climate of the region not only influences the water supply, but the great range of temperature rapidly disintegrates the rocks, and the wind removes the finer portion of the material. In this way the deserts are being constantly modified, and vast ranges of sand dunes are piled up. The distribution of vegetation is very markedly influenced both by the moisture and by the physical character of the country.

Linnean Society, March 17.—Dr. D. H. Scott, F.R.S., president, in the chair.—E. P. **Stebbing**: The life-history of *Chermes himalayensis* on the spruce (*Picea Morinda*) and silver fir (*Abies Webbiana*) of the N.W. Himalaya. The life-histories of the European species of Chermes, *C. abietis* and *C. viridis*, have been studied by Blochmann and L. Dreyfus in Germany, Cholodkovsky in Russia, and more recently by E. R. Burdon, of Cambridge. It is now well known that *C. viridis* has alternating series of generations upon the spruce and larch. The discovery that a species of Chermes formed galls on the spruce in the Himalaya was first reported by A. Smythies, of the Indian Foreign Service, in 1892. These were considered by the late Mr. Buckton to be *Chermes abietis*. Investigations commenced by the author in May, 1901, and carried on intermittently up to July, 1909, have led to the discovery that this Chermes, although an undescribed species, has a life-history somewhat similar to the European species of the genus, having series of agamic generations alternating between the spruce and silver fir (which grow together in mixture in the western Himalaya), with a sexual generation occurring but once a year, in the autumn, on the spruce. The paper shows that the Himalayan insect passes through similar generations to its European congeners, to which the names Fundatrices, Alatæ, Colonici, Sexuparæ, and Sexuales have already been given by European investigators. The periods at which these generations are to be found upon the trees in the Himalaya differ considerably, however, from the European ones, and are apparently chiefly governed by the appearance of the monsoon early in July in this region.—R. S. **Bagnall**: A contribution towards our knowledge of the neotropical Thysanoptera.

Institution of Mining and Metallurgy, March 17.—Mr. Edgar Taylor, president, in the chair.—W. A. **MacLeod**: The surface condenser in mining power plant. The author conducted a number of tests on the winding engines of a mine with which he was connected, the results of which were embodied in this paper, together with a vast amount of other information concerning the relative consumptions and efficiencies of condensing and non-condensing engines. He found that the employment of condensers was distinctly beneficial in both respects, even under the intermittent conditions attaching to most mining power plants, and the results of his investigations have enabled him to determine with some exactness the leading features to be emphasised in the laying down of a condensing plant suitable for work of a more or less intermittent nature, as in the case of winding engines.

CAMBRIDGE.

Philosophical Society, February 21.—Prof. Seward, vice-president, in the chair.—Prof. **Punnett**: Mimicry in Ceylon Rhopalocera, with some notes on the enemies of butterflies.—A. R. **Brown**: The Andaman Islands. Some of the features of the physical anthropology and the social life of the aborigines of the Andaman Islands were briefly described. The extremely primitive characteristics of the Andamanese are to be attributed to their long isolation from all other races and peoples, and the stability of population.—T. G. **Edwards**: The procession and pupation of the

larva of *Cnethocampa pinivora*. The processionary habits of the larva of this moth—which is abundant in the pine woods of the neighbourhood of Bordeaux—were first studied by Réaumur in 1736, and again by Fabre in the latter half of the last century. Both these writers describe the life-history and habits of the insect in considerable detail. The present paper, which is a summary of observations made during a fortnight spent at Arcachon, is an attempt to supplement these accounts by supplying information on certain points which still remain obscure. The procession is one of single file, the whole moving along a silken thread which is commenced by the leader and added to by all the larvæ in succession. The author found that though any larva could function as leader, yet the leader was capable of taking a real initiative in cases, such as the selection of a path, burrowing for pupation, &c., the satellites following him whether influenced by the same stimuli or not. The "circulating mass" is a formation which the larvæ frequently adopt when on the march. It consists in an assemblage of larvæ moving among each other, the mass, as a whole, remaining stationary. A "circulating mass" is always formed before the larvæ burrow for pupation. The leader appears to start the process of formation by assuming a zig-zag mode of progression, which is followed by the satellites. Though the order is completely broken up within the mass, yet it was found in every case observed that the leader of the procession which was re-formed from it was identical with that of the original procession. This was ascertained by marking the larvæ by means of fine sand or flour scattered over the dorsal papillæ. Pupation occurs beneath the ground, and is complete about nineteen days after burrowing. The burrowing is a collective process, in which all the larvæ within a circulating mass take part.—Prof. W. **Burnside**: Double sixes.—H. **Bateman**: The solution of a system of differential equations occurring in the theory of radio-active transformations.—Dr. **Young**: The change of order of integration in an improper repeated integral.—R. T. **Beatty**: The production of kathode particles by homogeneous Röntgen radiations. The kathode particles produced when these radiations pass through a thin silver leaf are absorbed by air, so that their coefficient of absorption is a linear function of the coefficient of absorption in aluminium of the exciting radiations. The total energy of the kathode particles set free in the leaf is proportional to the absorption by the leaf of the radiations. The range of these particles in hydrogen relative to that in air increases with the speed of the particles from 5 to 8. The total ionisation produced by any bundle of these kathode particles when totally absorbed in hydrogen is the same when air replaces hydrogen.—Sir J. J. **Thomson**: The scattering of rapidly moving electrified particles by matter, and its application to the determination of the number of corpuscles in the atoms of the various elements. An expression for the scattering of a pencil of rapidly moving electrified particles is found by the following method. First calculate the average deflection of the direction of motion of an electrified particle when passing through an atom which is assumed to consist of a large number of corpuscles placed in a sphere of uniform positive electrification; the expectation of any angular deflection after a large number of particles have passed through a large number of atoms can then be found by the theory of probability. In this way it is shown that the average angular deflection when a pencil of rapidly moving particles passes through a thin plate of thickness t is

$$\frac{e^2}{mv^2}\sqrt{\pi.N.\left(64N_0+\frac{\pi^2}{16}N_0^2\right)t},$$

where v is the velocity of the particle, e the charge, and m the mass of the particle, N the number of atoms in unit volume of the plate, and N_0 the number of corpuscles in each atom in the plate; hence if we measure the scattering of such a pencil we can determine the value of N_0.

MANCHESTER.

Literary and Philosophical Society, February 22.—Mr. Francis Jones, president, in the chair.—A. **Brothers**: Halley's comet as seen in 1835, compared with Donati's in 1858. Good drawings or sketches of Halley's comet seem to be rare. Sir John Herschel saw the comet at the Cape of Good Hope, and from his sketches it was not very conspicuous. Struve in 1835 gives a sketch which shows it to have been bright, probably when it was near the sun, but as a brilliant object it must have been very inferior to several which were seen during the nineteenth century. The author has a distinct recollection of seeing the comet in 1835. The object certainly was not so bright as Struve shows it to have been, and still greatly inferior to Donati's comet. It is generally spoken of now as likely to appear as a brilliant object, but the author points out that there is little evidence for the assertion.—Dr. H. F. **Coward**: The inflammability of gas-mixtures. Hydrogen and oxygen mixtures were shown to be capable of inflammation at a much lower pressure than had been imagined previously if the igniting spark were produced in the most suitable manner. Minima for sparks of various nature with electrodes of various kinds were given.

March 8.—Mr. Francis Jones, president, in the chair.—D. M. S. **Watson**: Upper Liassic Reptilia, part ii., the Sauropterygia of the Whitby Museum. The chief Plesiosaur in the Whitby Museum is the type-specimen of *Plesiosaurus propinquus*, Blake. This is re-described in the present paper. It is a member of the large-headed group of Plesiosaurs, but differs considerably from other Liassic species, such as "*Thaumatosaurus*" *megacephalus* (Stutchbury) and *Rhomaleosaurus cramptoni* (Baily and Carte). It may possibly be necessary to found a new genus for the species. The other remains consist of small groups of vertebræ, one set of which, containing fifteen cervicals of *Sthenarosaurus dawkinsi* (Watson), may be Owen's type-specimen of *Plesiosaurus coelospondylus*.—Sir W. H. **Bailey**: Mr. Myring's recent discoveries of prehistoric pottery in Peru. Mr. Hewitt Myring, a mineralogist and mine owner, visited the Chincuna Valley in Peru, and explored some sand ridges with the view of finding something in the Inca graves. The valley, however, had been used as a cemetery, not by the Incas, but by the Chimus, who preceded them in the occupation of the country, and the work of exploration brought to light several hundred pieces of pottery of great variety and interest. The pieces are well preserved, owing to the absence of rain and the consequent dryness of the soil. This pottery, some of which recalls that of China, India, and Egypt, shows great care, skill, and art, especially in the modelling of the human face, and is remarkable in that no two pieces are alike, a fact which demonstrates, the author thinks, the intellectual liberty and original genius of these early craftsmen. The age of the pottery is not known, and may be several thousand years. About one-third of the pieces discovered have been secured for the British Museum, and it is hoped that shortly some portion of the collection may find a permanent home in Manchester.

EDINBURGH.

Royal Society, February 7.—Dr. J. Burgess, vice-president, in the chair.—Prof. Cossar **Ewart**: The short-tailed domestic sheep.—Principal **Laurie**: Electromotive force of cells with a single salt and two solvents. The paper gave some preliminary results with cells in which potassium iodide was the salt and water and alcohol the solvents, as, for example, the relation of the electromotive force to the strengths of the solutions, the variation with temperature, and the connected thermal properties, &c. In co-ordinating the curious results obtained, the author brought forward some suggestive views as to the distribution of molecular energy in the two solutions.—Prof. F. G. **Baily**: A stereoscopic optical illusion. When two objects are nearly in the line of vision, so that when one is clearly focussed the other appears as two images, one on each side of it, this clearly focussed object appears to be, under certain conditions, distinctly nearer to the observer than it really is. The phenomenon was noticed accidentally, and a careful study showed that it occurred only for a certain range of distances. It was evidently a physiological effect.—Drs. E. P. **Cathcart**, J. **Gray**, and A. **Black**: A new form of respitory respiratory calorimeter for physiological purposes. The temperature of the entering and issuing air was measured by platinum thermometers or thermoelectric junctions, the whole being under perfect automatic control,

so that the exact amount of heat generated within the calorimeter could be estimated.—Dr. T. **Muir**: The theory of persymmetric determinants in the historic order of development up to 1860, and the theory of bigradients in the historical order of development up to 1860.

February 21.—Dr. Traquair, F.R.S., vice-president, in the chair.—J. **Murray**: Scientific work of the British Antarctic Expedition of 1907–9. Moraines were traced on the sides of Mount Erebus to a height of 1100 feet. At the same time, there are abundant evidences of recent elevation of the land to the extent of several hundred feet, so that it cannot be said that glaciers ever stood so high as the moraines now stand. The tabular Antarctic icebergs appear to consist of compressed snow, not ice. They float very high, the depth of the substance below water being just about equal to the height above. By the fortunate re-discovery of a depôt laid down by Captain Scott on known bearings six years previously, the average rate of travel of the Great Ice Barrier at its western edge was found to be, on the average, about 500 yards per annum. The accumulation of drift on the Barrier surface was measured at the same place, and averaged just above 1 foot per annum of compressed snow. With these somewhat rough data as basis, it was estimated that the snow cliff, which to a height of 200 feet forms the face of the stratum at sea-level, must have originated some fifty miles to the south some 200 years ago. Yet under this long-continued weight of accumulated snow the material is not transformed into ice. The original glacier ice depressed beneath the accumulating snow seems to have been corroded away below sea-level, as the whole barrier moved outwards from the land valleys. Some important conclusions may be expected to result from a study of the rocks collected, especially if the discovery of coal and fossil wood should lead to the determination of their geological horizon. Of the optical phenomena observed, one of the most interesting was the projection, as long tapering dark bars through the air, of the shadows of mountain peaks. Under certain conditions the observer saw the shadow of Erebus cast on to Mount Lister, appearing as a circular arc reaching a height of 30° or more above the horizon. The observer was looking transversely to the direction of the shadow. Aurora displays were very frequent. They seemed to be dominated by the mass of Ross Island, and frequently circled Mount Erebus. The chief fact of biological interest was the abundant development of microscopic fauna and flora in the shallow lakes. The microfauna survives from year to year frozen in the ice without suffering injury. The lakes attain a temperature as high as 60° F. in summer, and in winter may go down to −40°. In some deeper lakes, which do not thaw in ordinary summers, many live animals were found at the bottom under 15 feet of ice. These must have been frozen for years. It was shown by experiments that they can endure being heated when in the dry condition almost to the boiling point and cooled to −108° F., a range of 300°. As regards the vital phenomena exhibited, there was a striking contrast between the fresh-water animals and those living in the sea not many yards away. These perform all their vital functions several degrees below the freezing point of fresh water, and are killed if the temperature either rises or falls one or two degrees. The rotifer fauna of the Antarctic lakes, which alone has been fully worked up, is very limited in numbers, and presents distinct peculiarities. Of the sixteen species recognised, five are at present unknown elsewhere, and many of the others differ from the usual types. These facts point to long isolation and difficulty of access to the region.

DUBLIN.

Royal Irish Academy, February 28.—Dr. F. A. Tarleton, president, in the chair.—J. J. **Simpson**: A revision of the Juncellid group of the Gorgonellidæ. According to the author, the Juncellid group of the family of flexible corals (Gorgonellidæ) comprises the genera Juncella, Ellisella, Scirpearia, Scirpearella, Ctenocella, and Nicella. Having had special facilities for studying these forms in the living condition when taking part in some of the cruises of the Indian Government steamer *Investigator*, the author has been able to add a good deal to the knowledge of their mode of life, structure, and distribution of which in some cases our information was very deficient. He directs special attention to the great taxonomic importance of the canal system and the character and variety in type of the minute spicules. A full description of the family Gorgonellidæ and its genera, with new diagnoses, conclude this contribution to our knowledge of the flexible corals.—J. **Adams** and G. H. **Pethybridge**: A census catalogue of Irish fungi. This paper contains an historical account of the previous work which has been done on the Irish fungi and Myxomycetes from the first published records in 1726 up to the present day, together with a complete bibliography of the subject. It also contains a complete list of all the fungi hitherto recorded as occurring in Ireland, together with a few hitherto unrecorded species. The arrangement follows that adopted in Engler and Prantl's "Pflanzenfamilien" in the main, and the distribution of each species in the four main provinces and in twelve sub-provinces is indicated. The total number of species, including Myxomycetes, recorded is 1464, which probably represents far from the actual number of species occurring in Ireland, seeing that the province of Connaught is at present almost virgin ground so far as these plants are concerned.—J. **Adams**: A list of synonyms of Irish algæ, with some additional records and observations. The greater part of the paper consists of a list of the names under which Irish species of algæ were originally published, and of the modern names of the species to which they are considered to be equivalent either in whole or in part. Some additional records have been brought together, numbering rather more than a hundred species. There is a revised census of species, a list of errata occurring in the "Synopsis of Irish Algæ" published in 1908, and some additional bibliographical records.

PARIS.

Academy of Sciences, March 21.—M. Émile Picard in the chair.—M. **Metchnikoff**: Experiments in typhoid fever. Hitherto it has been impossible to make satisfactory experiments with this disease on animals owing to the invariable fatality, but by making the attempt of inoculating a chimpanzee with typhoid matter from infected excreta, many interesting observations have been obtained, which are described.—J. **Guillaume**: Observations made on the sun at the Lyons Observatory during 1909.—A. **Chatelet**: A transformation of continuous arithmetic fractions.—A. **Cotton** and H. **Mouton**: The magnetic and electric bi-refractivity of aromatic liquids and the theory of molecular orientation.—Ch. **Maurain**: Variation with temperature of the magnetic properties of iron in a weak magnetic field.—M. **Robin**: The phenomenon of the extinction of sound in iron.—Jean **Meunier**: The laws of combustion.—J. **Ville** and W. **Mestrezat**: The hydrofluoric hydrolysis of cellulose.—L. **Blaringhem**: An unstable variety of Nigella, *Nigella damascena cristata*, obtained after a mutilation.—L. **Moreau** and E. **Vinet**: The use of lead arsenate in vine culture. Among other observations, it was definitely shown that the lead arsenate did not make its appearance subsequently in the wine.—Maurice **Holderer**: The filtration of diastases.—M. **Doyon**: The normal secretion in the liver of a substance preventing coagulation of the blood.—Jean **Giaja**: The isolation of a biose sugar derived from amygdalin.—MM. **Lagriffone** and **Roger**: Malta fever in France.—L. **Lindet**: The raising of flour in baking.—Ph. **Glangeaud**: The architecture of the central part of the Monts du Forez.—Marcellin **Boule**: Some vertebral fossils from the district south of Tunis.—M. **Nouailhac-Pioch** and Edmond **Maillet**: The rise of the Seine in January-February, 1910.—B. **Galitzine**: The determination of the epicentre of an earth tremor, from the data provided by one seismic station.

CALCUTTA.

Asiatic Society of Bengal, March 2.—I. H. **Burkill**: Notes on the pollination of flowers in India, note No. 7. A few observations made in the Central Provinces and Berar. The notes were made in the Central Provinces and Berar, chiefly in the Melghat. In the Melghat at the end of the rains, flower-visiting

insects are rare. *Megachile albifrons* was observed to be a regular visitor to cotton-flowers in north-eastern Buldana. As cotton has been asserted to be self-pollinated constantly in western India, and as some of the agricultural departments have been endeavouring to improve the plant on the assumption that races ought consequently to continue pure though grown by the side of other races, the observation has interest in directing attention to the necessity of relying on artificial pollination in breeding experiments. *Apis dorsata* was observed to work in the dawn and dusk on the flowers of *Dalbergia Sissoo* at Nagpur.—I. H. **Burkill**: Note on the spreading of *Croton sparsiflorus*, Morung, along the Assam-Bengal Railway. This introduced plant has reached Lumding and Gauhati by means of the Assam-Bengal Railway, along which it is to be found in several places between them and Chittagong. Chittagong is the port whereby, doubtless, it entered India.

GÖTTINGEN.

Royal Society of Sciences.—The *Nachrichten* (physico-mathematical section), part iv. for 1909, contains the following memoirs communicated to the society:—

July 3.—G. **Angenheister**: Cloud observations in Samoa.

November 20.—Rudolf H. **Weber**: Asymmetric and symmetric tensors.—The late K. **Zoeppritz** and L. **Geiger**: Seismic waves, iii., calculation of path and velocity of precursive waves; Poisson's constant in the interior of the earth.

December 4.—Researches from the Göttingen University chemical laboratory, xxii. Remarks on the terpinene question.

The "Business Communications," part ii. for 1909, include the text of the address presented to the University of Cambridge at the Darwin centenary, and a discourse by G. **Berthold** on organisation, morphogenesis, and metamorphosis in plants.

DIARY OF SOCIETIES.

FRIDAY, APRIL 1.

GEOLOGISTS' ASSOCIATION, at 8.—An Account of the District to be Visited at Whitsuntide (the Isle of Purbeck and Bournemouth): H. W. Monckton and F. Hovenden.

MONDAY, APRIL 4.

SOCIETY OF ENGINEERS, at 7.30.—Moulmein Waterworks: P. G. Scott.

ARISTOTELIAN SOCIETY, at 8.—Bergson's Theory of Instinct: H. Wildon Carr.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The India Rubber Industry: Dr. P. Schidrowitz.

VICTORIA INSTITUTE, at 4.30.—Darwinism and Malthus: Rev. J. White.

TUESDAY, APRIL 5.

ROYAL INSTITUTION, at 3.—The Modern Development of the Problem of Alcoholic Fermentation: Dr. A. Harden, F.R.S.

ZOOLOGICAL SOCIETY, at 8.30.—On the Alimentary Tract of Certain Birds, and on the Mesenteric Relations of the Intestinal Loops: F. E. Beddard, F.R.S.—The Caudal Fin of the Teleostomi: R. H. Whitehouse.—Some Notes on Tasmanian Frogs: T. M. S. English.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The New Clyde Bridge of the Caledonian Railway at Glasgow: D. A. Matheson.—The Queen Alexandra Bridge over the River Wear, Sunderland: F. C. Buscarlet and A. Hunter.

FARADAY SOCIETY, at 8.—The Nature of the Action of Dyeing: W. P. Dreaper.—The Electrical Theory of Dyeing: Prof. W. W. Haldane Gee and W. Harrison.

WEDNESDAY, APRIL 6.

SOCIETY OF PUBLIC ANALYSTS, at 8.—A Note on the Composition of the Milk yielded from Cows on a Pasture manured with Potash and Phosphates: J. Golding and S. G. Paine.—Note on the Influence of Solvents on the Drying of Linseed Oil: W. E. F. Powney.—An Improved Method for the Estimation of Titanium: A. Gemmell.—Extraneous Mineral Matter in Rice: F. W. Richardson.

ENTOMOLOGICAL SOCIETY, at 8.—On the Behaviour of Coleoptera during Floods: N. H. Joy.

THURSDAY, APRIL 7.

ROYAL INSTITUTION, at 3.—The Himalayan Region: Dr. Tom G. Longstaff.

LINNEAN SOCIETY, at 8.—Elm-seedlings showing Mendelian Results: A. Henry.—On the Foraminifera and Ostracoda from Soundings, chiefly deep-water, collected round Funafuti by H.M.S. *Penguin*: F. Chapman.

RÖNTGEN SOCIETY, at 8.15.—Some methods of using the Alternating Current Mains for Röntgen Ray Work: Dr. G. B. Batten.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Progress of Electric Braking on the Glasgow Corporation Tramways: A. Gerrard.

FRIDAY, APRIL 8.

ROYAL INSTITUTION, at 9.—Lowell Observatory: Photographs of the Planets: Prof. Percival Lowell.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Reconstruction and Extension of Egremont Ferry Pier: G. H. Hodgson and H. M. Gell.

PHYSICAL SOCIETY, at 8.—An Experimental Demonstration of the Loading of Artificial Telephone Cables: B. S. Cohen.—Further Tests of Brittle Materials: W. A. Scoble.

ROYAL ASTRONOMICAL SOCIETY, at 5.

SATURDAY, APRIL 9.

ROYAL INSTITUTION, at 3.—Bells, Carillons and Chimes: W. W. Starmer.

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