THURSDAY, JUNE 21, 1900.

THE REMINISCENCES OF A VETERAN OF SCIENCE.

Erinnerungen aus meinem Leben. By A. Kölliker. Pp. x+399; with 7 plates, 10 text figures, and portrait of the author. (Leipzig: W. Engelmann, 1899.)

THE memoirs of the venerable Professor of Anatomy at Würzburg will interest a wide circle of readers in this country, whether amongst the older generation of scientific men, whose privilege it has been to know the author as a genial friend and colleague, or amongst the juniors in rank and years, to whom the name of Kölliker has been one which from their youth upwards they have learnt to respect as that of a great leader in scientific thought and discovery. Many of the latter class may, perhaps, learn from this book, for the first time, how much modern zoology owes to its author. So rapid has been the advance of biological science in the latter half of the nineteenth century, and so great is the interval, judged not by time, but by the progress of knowledge, which separates the science of to-day from that of fifty years ago, that there is always considerable danger of the merits of those who have grown grey in the ranks of science being overlooked or insufficiently realised by the younger generation. Students are taught at an early stage in their career facts or principles which seem so well established or even self-evident, in the light of current knowledge, that it is quite an awakening to find that the man who first enunciated them is still living in our midst. To give one instance, a student of zoology is taught, probably in the very first lecture he attends, the distinction between Protozoa and Metazoa based upon the essentially unicellular nature of the individual in the former sub-kingdom. If he reflects at all on the matter, a truth so obvious and so easily demonstrated will seem to him one which has been recognised by mankind perhaps from a remote antiquity. Yet it was Kölliker who first, in 1845, pointed out the existence of unicellular animals, and brought forward the Gregarines as instances, and who later, in conjunction with von Siebold, expressed the opinion that all the Infusoria, with the exception of such forms as the Rotifers, consisted of single cells. In a further work upon *Actinophrys* this conclusion was extended to the Rhizopods, and so a great generalisation was established, the truth of which is now never called in dispute.

Quite apart, however, from the great interest which these memoirs possess from the scientific point of view, their appearance at the present time is welcome for other reasons. At a period of strained political relations, when our country appears isolated in aims and sympathies from the rest of Europe, when international antipathies and prejudices seem in a fair way to spread from the official to the personal sphere, it is a refreshing change to read the narrative of one who was a frequent and a welcome visitor in our midst. To judge, at least, from the prevailing tone of this book, its author is no "Britenfresser." He refers constantly with warmth, we might say with affection, to the hospitality of his many friends in this country and to the pleasant times he spent in their homes, feelings which, we can be sure, were as warmly reciprocated by those about whom he writes.

The book is divided into two parts, the one personal, the other scientific. Part i. contains a general account of his life, with details of his many scientific and other journeys, and a brief account of his relations to various learned societies. Part ii. may be described as a *catalogue raisonnée* of his works, and is a marvellous record of many-sided scientific activity. His publications, amounting to nearly 250 memoirs, are arranged under the headings of histology, anatomy, physiology, embryology, evolution, comparative anatomy and zoology, and other miscellaneous items. Under each subdivision is given a historical account of his work, its main results, the ideas which guided him, and the conclusions which he upheld. Here much will be found of great value to the student—using the word in its widest sense—which cannot be dealt with adequately within the limits of a brief review. We turn, therefore, with greater interest to the personal narrative set forth in Part i.

Rudolf Albert Kölliker was born at Zürich on July 6, 1817. His boyhood and schooldays were passed in his native town, and he was intended at first for a business career, but, fortunately for science, this idea was given up, and he entered Zürich University, in 1836, as a medical student. At the University his attention was first given to botany, a subject in which he had as fellow-student his intimate friend, Carl Nägeli, and his first publication (1839) was a list of the phanerogams of Zürich. Besides other medical and scientific courses he attended the stimulating lectures of Oken on zoology and nature-philosophy. In 1839 he spent a semester at Bonn, and attended lectures on surgery and kindred subjects which were still delivered in Latin. He next went to Berlin for three semesters, from 1839 to 1841, a period which he describes as a turning-point in his life, since here he came under the influence of two great masters, whose courses he attended—namely, Johannes Müller and Jakob Henle. Of the former, he writes: "the comprehensive outlook by which he connected forms widely separated, and showed what they had in common, was especially stimulating and, for me, new." From Henle on the other hand, he received his first introduction to the cell-theory of Schwann, and his attention was directed to the structure of the animal body in a number of lectures and demonstrations which he describes with enthusiasm:—

"Now when the youngest medical student is acquainted with all this and much more from pictures of all kinds, and the facts concerning the minutest structure of the body are in every one's mouth even at school, it is not easy to realise the impression made upon the student at that time by the first sight of a drop of blood, a ciliated lining, a section of bone or a striped muscle fibre, and the impress of these experiences remains permanently in the memory."

Besides Müller and Henle, he attended many other eminent teachers at Berlin, including Ehrenberg and Remak. From the latter he received his first demonstrations of the embryology of the chick. In spite, however, of his ardent medical and scientific pursuits, he found time to attend lectures on ethics and Hegelian philosophy. It was a result doubtless of Henle's influence that his first

anatomical memoir was an investigation upon spermatozoa, published in 1841, with which he took his degree of philosophy at Zürich in 1841, and of medicine at Heidelberg in 1842. In the former year he passed his State examination, of which he records the following contretemps:—

"I, who had at my fingers' ends the finest ramifications of the cranial nerves, the structure of the auditory labyrinth, of the eye, the brain, and so forth, was unable to answer a question on the portal vein."

This is an experience which will assuredly come home to many, and while hence eliciting our sympathies, will at the same time afford no slight consolation to those who reflect on the subsequent achievements of the unfortunate examinee.

In 1841 Kölliker was appointed assistant to Henle, who had received the chair of anatomy at Zürich. In the following year he took a trip to Naples, where he made the acquaintance of Delle Chiaje, Costa and Krohn, and occupied himself with, amongst other things, his well-known studies on the development of Cephalopods. In 1843 he became docent at Zürich, and was prosector to Henle from 1842 until the latter's promotion to Heidelberg in 1844. Henle's chair was then divided into one of anatomy and one of physiology, and Kölliker received the latter; but in 1847 he accepted a call to Würzburg. His departure from Zürich, which was much regretted there, was largely caused by political intrigues in the faculty of the University.

At Würzburg he occupied, at first, the chair of comparative anatomy, but in 1849 he received that of anatomy, which he has now filled for more than fifty years, in a way that needs no praise. The names of many of the most eminent professors of anatomy in Germany, past or present, are to be found in the lists of his pupils or assistants, of whom it is only necessary to mention C. Gegenbaur, Fr. Leydig, R. Wiedersheim, H. Grenacher and Th. Eimer. In 1848 he was associated with von Siebold in founding the *Zeitschrift für wissenschaftliche Zoologie*, of which famous journal he is still one of the editors.

The accounts of his many journeys are compiled, for the most part, from letters written by him at the time to his relations or friends. There is much of interest to be found in them, especially in his visits to England. His first acquaintance with this country was made in 1845, and renewed on many subsequent occasions. In his letters he gives his impressions of England and English life. He quickly made for himself a large circle of intimate scientific friends, amongst whom he mentions, particularly in his earlier letters, the names of Todd, Bowman, Grant, Sharpey, Edward Forbes and Wharton Jones. His time in London seems to have been very well filled up, as he writes in one letter that in the last twelve days he had gone through nine dinners and two breakfasts, some of which do not seem to have been very entertaining. "I took part yesterday in a fearfully wearisome dinner, enough to kill one (etwas ganz totmachendes)," he writes; and further on he complains that "these everlasting dinners, lasting from 6 to 11 o'clock, have taken me *en grippe*, as the French say; but what can one do?" But in other cases he seems to have been happier. In London he is presented at Court, and finds that "the Queen is really pretty, and Prince Albert is also a handsome man." On the eve of his departure, he expresses himself almost as much at home in London, in spite of its size, as in Zürich, and considers it "very interesting, often pleasant, but for the most part fatiguing." He visited this country again in 1850 and 1857, on both of which occasions he spent some, or most, of the time in Scotland, where he became intimately acquainted with John Goodsir and Allen Thomson, and in London with Queckett. His letters from Scotland to C. Th. von Siebold contain some interesting remarks about English science and scientific men.

"The English doctors and physicians are, above all, practical men, and all that pertains to the theoretical side takes with them the second place. This is partly owing to the fact that the English are a people occupied chiefly with commerce, but only partly so; the chief cause of the phenomenon in question is the fact that science does not hold the place it deserves in popular estimation, nor is it supported by the Government in such a way that a man who devotes himself to it can be free from care."

This is the reason, he thinks, why so many men full of enthusiasm for science remain in practice, and finally lose themselves in it; while others regard theoretical studies merely as an advertisement to gain them more clients, since practice in England is golden, and procures for the practitioner a position which contrasts vividly with that of a professor.

"I know only three anatomists and physiologists in England," he adds, "who do not practise—namely, Owen, Sharpey and Grant, of whom Owen alone has a position at all equal to his merits."

In 1850 he also paid a short visit to Oxford, where he met Acland, Strickland and J. V. Carus, but found little that attracted him, and he returned, he tells us, to noisy but infinitely more stimulating London, well satisfied that he was not obliged to spend all his days in "this most peculiar of all university towns."

Space does not permit of reference to the many interesting personal reminiscences or amusing incidents which recur so frequently in this book, especially that detailed in two letters on p. 162, of which we lose nothing by its being to a large extent veiled in the obscurity of the English tongue. It can only be said that the book affords delightful reading, and gives pleasing glimpses of a warm-hearted and charming personality as well as of a great man of science. E. A. M.

DIFFERENTIAL EQUATIONS.

Theory of Differential Equations. By A. R. Forsyth, Sc.D., F.R.S. Part i. (1890). Pp. xiv + 340. Part ii. (1900). Pp. xii + 344, and x + 392. (Cambridge: At the University Press.)

ALTHOUGH these volumes contain more than a thousand pages, it would be premature to express an opinion upon the plan and proportions of Prof. Forsyth's work as a whole; so much of his vast subject still remains unrepresented. Thus the reader will find nothing, except incidentally, of the theory of partial differential equations; and, what is more remarkable, the subject of ordinary linear equations has been reserved for a future volume. However, the two parts which have

now been published are so far complete in themselves that it is possible to give some account of their contents, and to appreciate, to some extent, the author's method and point of view.

Part i. treats of exact equations and the problem of Pfaff. Of the two chapters on exact equations it is enough to say that they contain an excellent summary, with well-chosen examples, of the various methods which have been suggested; the most interesting part is that which deals with Mayer's very remarkable extension of Natani's procedure.

The rest of vol. i. is devoted to Pfaff's problem. A chapter on the history of the problem is followed by ten others, which give, in the order of their discovery for the most part, the principal results of Pfaff, Jacobi, Natani, Clebsch, Grassmann, Lie and Frobenius. This plan has its advantages, especially for those who wish to become familiar with the literature of the subject; and mathematical experts will duly appreciate the service which Prof. Forsyth has done them. But if we look at the result as a text-book for mathematical students, it is a question whether the course taken is the best one. A chapter which is an excellent guide to a reader who has before him the original book or memoir upon which it is based, may be simply puzzling to a student unfamiliar with the subject, and unable to refer to the primary sources. It is doubtful, for instance, if any one who has not mastered the *Ausdehnungslehre* will be able to appreciate the chapter on Grassmann's method; and in the same way, the chapters on tangential transformations and Lie's method will not, we fear, do much, in themselves, to arouse an interest in Lie's magnificent discoveries. It is unfortunate that Prof. Forsyth's exclusively analytical attitude has prevented him from utilising Lie's geometrical or quasi-geometrical conceptions. It is quite true that intuitional methods require to be controlled by strict analysis; but they often vivify a mathematical theory in a very instructive and fruitful way. Take, for instance, the question of the "integral equivalent" of the differential relation $Pdx+Qdy+Rdz=0$, where P, Q, R are functions of x, y, z. If we take x, y, z as ordinary Cartesian co-ordinates, this relation associates with any point $A(x, y, z)$ a flat pencil of elementary line-elements, concurrent at A, and lying in a definite plane $P(\xi-x)+Q(\eta-y)+R(\zeta-z)=0$. Thus we may take the "content" of the differential relation to be either a manifold of ∞^1 line-elements, or of ∞^3 plane-elements. If the given relation is an "exact equation" $d\phi=0$, the integral $\phi=c$ gives us a family of ∞^1 surfaces, each of which contains ∞^3 line-elements of the content and ∞^2 plane-elements of it. Moreover, every continuous curve made up of line-elements lies (in general) on one of the integral surfaces $\phi=c$, and the line and plane elements of the surfaces exhaust the corresponding elements of the content. These considerations justify us in saying that $\phi=c$, with c an arbitrary constant, is a complete integral equivalent of the differential relation. But in a case like $xdx+zdy-ydz=0$, we cannot construct an integral equivalent of this kind; and the question arises, what integral equivalent, if any, exists, and what will be the nature of its equivalence? To Prof. Forsyth, this is a purely analytical question; he simply inquires what functional relations connecting x, y, z are consistent with the given relation. Of the degree and nature of the equivalence to be expected he says very little; and the gist of what he does say is relegated to a note on p. 250. The geometrical theory at once suggests the possibility of constructing "integral curves" by linking line-elements of the content; a complete integral equivalent may be conceivably constructed by a system of ∞^3 integral curves together exhausting all the line-elements of the content, or again by ∞^2 integral curves, each with ∞^1 associated plane-elements of the content. As an example of the latter kind of integral equivalent, the system of lines

$$x=a, \quad y=bt, \quad z=t$$

where a, b are arbitrary constants, and t is a variable parameter, are integral curves derived from the content of $xdx+zdy-ydz=0$; and if with each point (a, bt, t) we associate the elementary flat-pencil which lies in the plane $a(x-a)+t(y-bz)=0$, we have a complete integral equivalent, all the elements of the content being taken into account. If we take the two analytical relations $x=a$, $y=bz$, involving arbitrary constants only, we get, it is true, a kind of integral equivalent; but this is not complete, in any sense analogous to the complete integral of an exact equation.

Part ii. deals with ordinary equations, not linear; and the point of view is almost entirely that of function-theory. The coefficients in the equation are analytical functions, in Weierstrass's sense; and the main problem is that of discussing the functional nature of the dependent variable or variables. The discussion is necessarily based upon the work of Cauchy, Briot and Bouquet, Weierstrass and Fuchs; the analysis is simple enough in essence, but the details, unfortunately, are unavoidably lengthy, and tend to be monotonous, owing to the necessity of considering different cases and establishing a set of typical forms. The results are so important that the student is bound to make himself familiar with them; but the judicious reader will do well to use his privilege of skipping. The fact is, that the demonstrations fall naturally into a very few types; and it is as profitless to study every one of them minutely as to attempt a detailed examination of every kind of singularity of an algebraic curve. There are, of course, many points in the analysis which cannot fail to arouse interest and admiration; for instance, the use of a dominant function in proving the existence-theorem, and the employment of a sort of extended Puiseux diagram in the applications.

Then, again, there are those surprisingly general and definite results which have been deduced, almost as corollaries, from this somewhat unattractive analytical theory. It must suffice to refer to Painlevé's theorem (ii. p. 211), that the points of indeterminateness of every integral of a single equation of a certain very general type are *fixed points* determined by the differential equation itself; and to the result established by Bruns (iii. p. 311 and following), that every algebraic integral of the differential equation of the problem of three (or more) bodies can be constructed algebraically from the long-known classical integrals. But the reader will find other results of almost equal interest due to Poincaré, Fuchs, Picard and others. The reaction of

the Weierstrassian function-theory upon other branches of analysis, and in particular upon the problems of celestial mechanics, is truly remarkable.

It is to be hoped that the publication of Prof. Forsyth's work will make English mathematicians better acquainted with current research on the subjects with which he deals. The value of his treatise for really competent readers is evident, and needs no commendation. But we may, perhaps, regret that he has not more definitely considered the interests of the rising generation. It is most important that new ideas and recent methods should be introduced to young men of ability while their minds are keen and susceptible; and their interest is seldom aroused in the first instance by a treatise which aims at being exhaustive. To take an example in point; few readers, we imagine, to whom the subject was new, would persevere in the study of Lie's great work on transformation-groups; yet what mathematical student could fail to be delighted with his lectures on differential equations with known infinitesimal transformations, as edited by Dr. Scheffers?

No doubt the task of writing an introductory, and thoroughly didactic, treatise on the modern aspects of this theory is very difficult; more so, very likely, than the one to which Prof. Forsyth has applied himself. The selection, combination and assimilation required would demand a great deal of care and judgment; a certain lightness of touch would also be desirable, and this is not easy to maintain after a course of reading in the extremely ponderous memoirs which are so often found in the literature of the subject. But a work of this kind might do more than the most conscientious handbook to encourage a living interest in the theory of differential equations. There is some appearance of a tendency to over-elaboration in English treatises presumably written for students; to authors as well as to lecturers may be commended the maxim "Above all, do not be dull." G. B. M.

OUR BOOK SHELF.

Origin and Character of the British People. By Nottidge Charles Macnamara. Pp. 242; 33 figures. (London: Smith, Elder and Co., 1900.)

MR. MACNAMARA seeks, in a small compass, to indicate the origin of the component parts of the British people, and to account for the differences of local moral character by proportionate inheritance from the original races, all of which are assumed to have their mental and moral peculiarities as fixed as their physical characters. He believes that the Iberians, as he prefers to call the Mediterranean or Afro-European race, formed the primary stock from which the existing inhabitants of Great Britain and the West of Europe are derived; and that they are the modified descendants of Palæolithic man. The tall fair Aryans originated in Western Asia.

The pioneer migration of the Aryans into Europe formed the Cro-Magnon race; then came the dolmen-builders, the South Mediterranean branch extending from the Amorites to the "fair Libyans"; the migrants into Central Europe mixed with the brachycephals and constituted the "Celts." A distinct northern migration formed the Teutonic Aryans.

The author also believes that dolmens and long barrows are everywhere the work of the Aryan race. The prehistoric tall brachycephals of Northern Europe were a branch of the Northern Mongolian or Turanian race. The short dark brachycephals of Central Europe brought the art of working in bronze from Asia, presumably from Burmah. The Formorians of Ireland were Iberians; in North-west Ireland are still to be found descendants of the Northern Mongoloid race; the Firbolgs were Celtic Aryans or dolmen-builders. The Southern Mongoloids arrived in the bronze age; these are the Tuatha de Danann. A second invasion of Aryan Celts, or Milesians, arrived in Ireland also during the bronze age. This abstract gives a fair idea of the scope and views of the author.

The Geography of the Region about Devil's Lake and the Dalles of the Wisconsin. By Prof. R. D. Salisbury and Mr. W. W. Atwood. Pp. x+151. (Madison, Wisconsin: Geological and Natural History Survey, 1900.)

THIS is the first number of an "Educational Series" to be published by the Wisconsin Geological and Natural History Survey. The region to which attention is now particularly called is in the south-central part of Wisconsin, and it is of interest because it well illustrates many points in the geographical evolution of land-surfaces. It comprises an undulating plain chiefly of Potsdam Sandstone, with some areas of magnesian limestone, and with a northern and southern range of bold quartzite hills. The southern range rises from 500 to 800 feet above the surrounding land, or up to 1600 feet above sea-level, and in the bottom of a deep gap, which divides this range, lies Devil's Lake. This is a lake which, in glacial times, occupied an enclosure between the ice on the one hand and the quartzite ridge on the other: a gorge which originally was the work of a pre-Cambrian stream. The melting of the ice supplied abundant water, and the lake rose perhaps 90 feet above its present level. In this and in many other cases the irregular deposition of glacial drift gave rise to many depressions without outlets, in which surface-waters collected after the ice had disappeared. Few of these lakes now remain in the region, but Devil's Lake, which is more than a mile in length and half a mile wide, occupies an unfilled portion of an old river valley, isolated by great morainic dams from its surface-continuations on either hand. Streams originate beyond these dams. The "Dalles" are sandstone cliffs which form a gorge along the Wisconsin River for a length of about seven miles, and a depth of 50 to 100 feet. The effects of weathering by atmospheric agents, and of erosion by the river, are well exhibited, and the views remind us of the rock-scenery along the Eden near Corby Castle.

The volume, which, with its index, extends to 151 pages, is in reality an essay on the origin of scenery treated from a geological point of view. The authors deal with the pre-Cambrian history of the quartzite, from its origin in loose sand to its uplift and deformation; and they deal similarly with the other strata. They contribute also a fairly full account of the phenomena of the Glacial period, and of the work of rain and rivers. Numerous excellent photographic representations of the scenery are given, including views of various natural arches, tors, and needles.

Monistische Gottes- und Weltanschauung. Von J. Sack. Pp. viii + 278. (Leipzig: Engelmann, 1899.)

IN Herr Sack's view all particular existences are modes of one spirit-substance—God. He calls this doctrine monism, and not pantheism, because he thinks the latter not incompatible with polytheism. Be this as it may, the distinguishing mark of his thesis is that it works to an Hegelian doctrine of being along the lines of a naturalistic theory of becoming that might satisfy Mr.

Spencer. The result is a form of vitalism. The movement which is to be found in the inorganic world is not merely continuous with, but synonymous with life and consciousness. Matter is not only the revelation of spirit, but body and spirit are one and the same. His method, which consists simply in the assumption that human spirit is an *analogon* of the world-principle, will not bear this conclusion. And his superstructure is rather in the air.

In his view of evolution there is nothing novel. It is, of course, teleological. Its real dynamic, as opposed to its formal occasions, is the all-inclusive being as principle of organisation. The working of this is elucidated quite after the manner of Mr. Spencer, by what Herr Sack oddly calls "antinomies"—viz. the antithesis of individuality and community, and the like.

It is when he comes to deal with art, morals and religion that Herr Sack is most at home. These are man's adumbrations of the contents of the intellectual intuition of the universal spirit: Art, like ethics, is a social product. Ethics are treated in a manner on the whole definitely Spencerian, even to the condemnation of the social-democratic movement. In his discussion of religion, Herr Sack is opposed to Mr. Spencer, and, while owing a good deal to Prof. Max Müller, is original. Not in dreams with their presentment of the dead, not in natural phenomena like sunrise and sunset, not in anything so symbolic as totemism, does the matter of religion arise. They might confirm its sublimity; they are most of them too habitual and ordinary phenomena to create it. It is rather what suggests the invisible, the beyond, the infinite, that originates religious feeling—the horizon, the movement of the wind, the breath of life. Infinite space and infinite movement, and the *anima mundi*, are the elements of the religion of monism, and primitive religion was monistic. Cult degrades it into polytheism, and an interested priestcraft corrupts it; but monism has never been without a witness.

A world of spirits, in the spiritualist's sense, is of course incompatible with such a view. As is individual immortality. In truth, personality other than relative can belong only to the *Allwesen*, "in whom we live, and move and have our being."

In description, Herr Sack often shows a good deal of power. His views in the field of *Religionsforschung* doubtless express something of the truth, though not to the exclusion of other explanations. Indeed, the horizon, and the wind, and breathing are habitual too! Herr Sack's monistic formula, if true, must be established on other lines than his. Its only value here is that of any unverified vaticination that has brought peace to some of our fellow-men. H. W. B.

First Stage Hygiene. By Robert A. Lyster, B.Sc.Lond. Pp. viii + 199. (London: W. B. Clive, 1900.)

IN general character this book resembles those already available for students of elementary hygiene and public health. It is intended more particularly for students receiving lessons upon the lines of the syllabus of the Department of Science and Art, now the Board of Education, but it may also be used by other students. The order of treatment differs from that usually adopted, but it may be doubted whether in some cases the change is an improvement. A noteworthy point, however, is that, so far as possible, the physiological facts required to intelligently consider hygienic principles are dealt with as they are required, instead of being described in a separate section devoted to physiology. Another characteristic of the book is that simple experiments illustrating the points described are given at the ends of some of the chapters. There is still room for a book containing not only lecture experiments, but a good course of laboratory work to be done by individual students of hygiene.

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.*]

Measurements in Schools. Collateral Heredity.

I AM at present engaged on an investigation into the strength of collateral heredity, *i.e.* the degree of resemblance for a variety of mental and physical characters of pairs of brothers, pairs of sisters, and pairs of brothers and sisters. In this matter I cannot seek the aid of parents, for they are scarcely unbiased observers, but I have to appeal for aid to those who teach in schools, and have thus an independent and often extensive knowledge of their pupils' characters. This is very frequently combined with the scientific training and caution which renders the teacher's aid of special value. As it is necessary to obtain measurements and observations of both sexes, I have appealed to both men and women teachers, and as it is also needful to combine the sexes (in the brother-sister measurements) to those working in elementary schools, as well as in boys' public schools and in girls' high schools. The result of my appeal has been to bring me a great deal of most valuable aid. Several high schools have been dealt with, four of our chief public schools have been, or are being measured, and a considerable variety of private, elementary and other schools. But a single public school (even of 500 to 700 boys) will often have only ten to twenty pairs of brethren, not, perhaps, as many as in a village national school, and I am most desirous of getting further help. The determination of the strength of collateral heredity is a problem of great scientific importance, and it can only be achieved by co-operative action. I have found so many teachers in all classes of schools willing to give disinterested aid in the cause of science that I venture to make a further appeal through NATURE for more assistance. Besides observations of physical and mental characters, which can be recorded without measurement, my data papers ask for certain head-measurements, which can, following the printed instructions, be taken quite easily. I shall be most glad to send sample papers to any one willing to assist, and if, after considering these, they find themselves able to assist, say by filling in data papers for ten or more pairs of brothers or sisters, I will at once despatch a head-spanner, of which I have several at the present time, free. The head-spanner should not be retained (unless under special circumstances) for more than a few weeks. Where the school is a small one, one master has, as a rule, filled in the papers entirely; in larger schools, one of the science masters, or even the medical officer, has done the head-measurements, and the other data have been provided by house, form or consulting masters. In the ultimate publication of the statistics all aid will be duly acknowledged, but I make the appeal for help simply on the ground that the investigation of heredity is to-day one of the most important scientific problems, and that its exact quantitative determination is well within the reach of co-operative observation. KARL PEARSON.

University College, London.

The Perseid Meteoric Shower.

IN the years from 1893 to 1899 inclusive, about 120 determinations of the Perseid radiant were made. With the exception of three or four positions, the dates of the observations ranged from August 1 to 16, while the majority were for August 10 and 11 only.

It seems of little use to continue accumulating observations of the radiant point on and near the date of its maximum. What we essentially require are observations of the earlier stages of the shower during the last half of July, and as the present year offers a good prospect for obtaining them, I trust observers will make a special effort in this direction. The moon will reach her last quarter on July 19, and will prove a very slight hindrance to observation during the ensuing fortnight. When the sky is clear it should be watched all night, the paths of such meteors as are visible carefully recorded, and the results for each date kept separate, so that the place of the Perseid radiant may be traced in its diurnal motion of about 1° to the E.N.E. Some really good determinations of the radiant in July would be valuable, for very few have ever been made owing to the

comparative feebleness of the shower in this month. An observer, however, who extends his watch over a long period, if not over the whole of the night, will find little difficulty in mapping a sufficient number of Perseids to indicate a good radiant.

Bishopston, Bristol, June 10. W. F. DENNING.

Variations in Plants of the Herb Paris.

THE enclosed table, showing the variations in 200 plants of Herb Paris, picked this month in the woods near Wells, may be of interest to some of your readers, especially if looked at in connection with the memorandum written by Sir Edward Fry, which he is kind enough to allow me to send with it.

L. ELEANOR JEX-BLAKE.

HERB PARIS.

Plants	Leaves	Sepals	Petals	Stamens	Cells of Ovary	Styles
96 normal flowers	4	4	4	8	4	4
44 normal flowers	5	4	4	8	4	4
2 normal flowers	6	4	4	8	4	4
13	5	5	4	9	4	4
8	5	4	4	9	4	4
5	4	4	4	9	4	4
2	4	4	3	8	4	4
2	4	4	4	8	4	5
2	5	5	5	10	5	5
2	5	5	4	10	4	4
2	5	4	3	7	3	3
2	6	4	4	10	4	4
2	7	4	4	9	4	4
1	3	4	4	9	4	4
1	3	4	3	8	5	5, and one rudimentary
1	4	4	3	8	4	5
1	4	5	3	9	4	4
1	4	5	4	9	4	4
1	4	4	4	10, one double	4	4
1	4	4	4	8	4	3
1	5	5	3	8	4	4
1	5	4	3	8	4	5
1	5	4	4	8, one double	4	4
1	5	4	4	8	3	2, and one rudimentary
1	6	4	4	9	4	4
1	6	6	4	8	4	4
1	6	5	3	8	3	3
1	6	5	4	9	5	5
1	6	5	4	9	4	4
1	6	4	3	9	4	4
1	5½	4½	3	8	4	4
	two halves grew together					

[Miss Jex-Blake's table seems to me to show many points of interest.

The Herb Paris has long been known to be very variable in the number of its parts; this table quantifies (I use the word, though it used to make a friend of mine very angry) the variability of the plant. It shows that, taking the 96 plants as exhibiting the normal form, more than one-half, *i.e.* 104 out of 200, vary from the standard; that the most variable element is the circle of stem leaves; and that looking at the flowers alone, 142 plants out of 200 are normal, 58 only abnormal; that the 58 thus varying plants fall into no less than 28 groups; that not only do the plants vary as wholes, but that parts usually the same in number, or multiples of the same number, do not maintain this relation, *e.g.* that in 13 plants you get 5 sepals, 4 petals and 9 stamens, and so on.

The plant being thus given over to variability and belonging to the great group of monocotyledons, in which 3 and multiples of 3 are the dominant number for the parts of the flower, a systematist might expect that the variations of the Herb Paris would oscillate round 3, or a multiple of 3, as the standard form; but, in fact, they oscillate round 4 as the dominant number, the 96 normal plants having that number, or a multiple of that number, everywhere, and 44 plants having that number and multiple everywhere except in the leaves. Nature, therefore, disappoints our reasonable expectation.

It has, I believe, been suggested that the flower of Herb Paris is ideally of 6 and 12 parts, and that it has been reduced to 4 and 8 parts by atrophy and suppression of 2 and 4 parts respectively. If this were a true theory, you would expect to find here and there a reversion to the ancestral form; but the table shows that the number 6 occurs in the floral parts once, and once only, viz. in the sepals, and the number 12 never occurs in the stamens or elsewhere, so that the suggestion of suppressed parts becomes highly improbable.

The Herb Paris wanders from the ordinary type of monocotyledons, not only in the number of the floral parts, but in having ramifying veins of the leaves in the place of parallel veins; there are other monocotyledons which have this variation in the leaf from the standard. Do they, too, show any tendency to vary in the number of the floral parts? or to put it in other words, is there any correlation of the two variations? I have not looked into the subject, but it might prove worth consideration.—E. F.]

May 25.

Quaternion Methods applied to Dynamics.

I SHALL be obliged if any of your readers can give me the titles of any works on statics, or dynamics, or any physical science which are based on Quarternion methods and use nothing but Quaternion symbols.

The end chapters of P. G. Tait's "Quaternions" give examples; Kelland and Tait work out the theory of strains using Quaternion methods, but neither of these suffice for the purpose I have in view, namely, to put into the hands of a student a text-book on dynamics, &c., written in Quaternion language.

Jubbelpore, June 1. W. G. BARNETT.

PLANT HYBRIDS.

HORTICULTURISTS have recognised that as time goes on they must look more and more to hybridisation for "new plants." Biologists are already pointing out that, if anything can, breeding experiments will add to our knowledge of "the species." For both of these reasons the current volume[1] of the Royal Horticultural Society's *Journal* is of very particular interest, seeing that it is in fact the detailed report of the Conference on Hybridisation and Cross-breeding held last summer. The present writer has already summarised in these pages[2] the chief facts of importance brought out in the two days' proceedings; but several of the papers have been elaborated and illustrated, while many further contributions have been sent in and are now published. The latter in particular call for further comment.

Speaking generally of the report, it may be said that it is of very great value as a record of parentage, as a storehouse of many facts, and as putting forth several interesting theories. Furthermore, among the contributors are amateur and professional horticulturists, scientific workers pure and simple, as well as men who combine the interests of both, and this is a decided step in the right direction. It is not to be expected that the collection of papers forms a complete treatise to guide the practical or theoretical student; useful points are only to be found among cases at present not to be reconciled together and along with striking differences of opinion.

The very discrepancies are, however, to be welcomed, for from them can be learned the work to which attention should be most ungrudgingly given in the future; and by the publication of the "Hybrid Conference Report" the Royal Horticultural Society will earn the gratitude of a larger circle than ever. In the present account it will be

[1] *Journ. R.H.S.* vol. xxiv. (April 1900), pp. 1–348; 123 Figs.

[2] NATURE, vol. lx. (No. 1552, July 27, 1899), pp. 305–307.

best to touch upon individual papers rather than to attempt to discuss them together under special headings, as was done before.

One must not pass over without mention the list of some hundreds of hybrid plants exhibited at Chiswick on the first day of the Conference. In this are given the names of the parent species and of the raisers, as well as notes as to characteristics and habits, and points in which the hybrids most resemble their father or their mother. The generic headings are arranged alphabetically, while several plants and the pitchers of some *Nepenthes* are figured. A page is further devoted to the interesting series of mixed grafts which were also shown. In these the branches of both scion and stock retain their foliage, and in all cases the component plants belong to different genera. The title of "Hybrid Grafts," given to them in the report, does not seem to be a satisfactory one, being open as it is to misinterpretation or to confusion with "graft hybrids."

Dr. Masters' introductory address has already appeared in NATURE (vol. lx. p. 286). Among Mr. Bateson's contentions as to the origin of species, which have not been previously alluded to, is his statement that most professed botanists and zoologists are agreed that no natural species, whether animal or plant, has arisen by direct hybridisation. This may be mentioned, as another contributor to the report expresses the opposite opinion. Furthermore, Mr. Bateson's remarks as to the benefits that many horticulturists might confer upon the student of evolution, by recording even rough statistics, are very much to the point.

The genus Anthurium.—M. de la Devansaye says: (1) that in this genus, pollen to be of value must come from plants springing from a different batch of seeds from that giving rise to the ovule-bearing individuals; (2) that pollen from allied genera has a beneficial effect; (3) that variations may not be seen in the first or second generation of hybrids, and yet may appear in the third or fourth. Hence experiments should not be abandoned too soon.

Monstrosities.—Prof. Hugo de Vries' paper, read under the title of "Hybridisation as a means of Pangenetic Injection," now appears as "Hybridisation of Monstrosities." There is plenty in it, however, which does not refer to monstrous plants. Variation among hybrids of the first generation, as regards the colour of the flower, in a case considered by the professor, is put down by him as justifying the supposition that they simply inherited their variability from their mother. He lays down as a rule of horticultural practice the choosing of forms to hybridise, of which at least one is known to be very variable. The well-known multiformity of hybrids is stated to arise from this, but the fact—abundantly proved by the Conference—is also noted, that many hybrids can hardly be distinguished exteriorly from one or other of their parents, and therefore may be often mistaken for true species.

Hybridisation and its Failures.—Physiological affinity, says Prof. Henslow, it would seem, must be neglected altogether in purely systematic work. He gives many cases where plants that botanically are placed in separate genera or families, on the strength of a single character, will not breed together, and he contends that genera that can be crossed should not be united for this reason alone, for if interbreeding is to be the test, polymorphic forms of the same species would logically have to be separated. The many "failures" recorded by Prof. Henslow must not be all put down as definitely proved to be such, as in many cases adverse conditions, of which the experimenters were ignorant, may have prevailed.

One would be interested to know whether the professor gained much information from the answers to the question set by him at the Royal Horticultural Society's examination last year, which ran, "Give any instances of failures, and state your opinion as to their causes, in crossing distinct species."

1 2 3 4

FIG. 1.—True and false hybrids of *C. trus*

Official Work of the United States.—In the previous notice were mentioned the difficulties met with by Mr. Webber and Mr. Swingle, owing to the ovule of *Citrus* producing more than one embryo. In the accompanying illustration (Fig. 1), reproduced from the report by the courtesy of the Royal Horticultural Society, pots 1 and 4 each contain two seedlings of *Citrus trifoliata* type, arising from a single seed, and which show no effects of any cross. In the second pot are three young plants, again rising from a single seed, as determined after it had germinated. The seed was the result of a cross between *C. trifoliata*, ♂, and the Tangerine orange, ♀. One of the seedlings has trifoliate leaves of larger size than the typical *C. trifoliata*, and this is the true hybrid from the egg-cell proper, while the other plantlets with unifoliate leaves, and resembling the Tangerine, are from adventive embryos.

In No. 3, where the parents of the seed were the sweet orange, ♂, and *C. trifoliata*, ♀, two seedlings have grown both with trifoliate leaves, and that having these larger and more abundant may be put down as the hybrid. The

other, which is like the mother in every respect, is looked upon as the product of the nucellus. Mr. Webber's other remarks and illustrations apply to the hybridisation of cotton and maize.

The Structure of Certain Hybrids.—Dr. Wilson contents himself chiefly with the external structure of hybrid *Passiflora*, *Albuca*, *Ribes* and *Begonia*. His figures bring out very forcibly the intermediate nature of many hybrids. The grades between ideal "tuberous" and "non-tuberous" conditions in hybrid *Begonia* are remarkable, joints of the stem falling away in several instances. We reproduce his illustration (Fig. 2), a

FIG. 2.—Flowering shoot of *Ribes nigrum*, ♀, × *R. grossularia*, ♂, (nat. size).

flowering shoot of a hybrid between the gooseberry, ♂, and black currant, ♀, and his sections of the ovary walls of the young plant and its two parents (Figs. 3, 4, 5). Several experimenters have obtained the cross and fruit from it, but no seeds. It is interesting that no odour of the black currant is possessed by the leaves, and that the caterpillars of the gooseberry saw-fly attack them without hesitation.

Self-sterility.—It is well that the importance of determining whether a plant may not be self-sterile has been

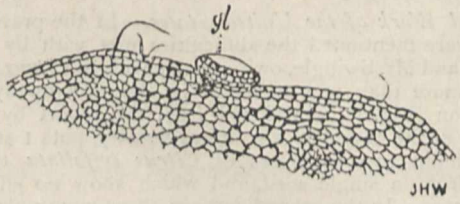

FIG. 3.—Transverse section of part of the ovarian wall of the black currant.

brought out by Dr. F. Ludwig. All the individuals of a species which is propagated vegetatively may, in a particular neighbourhood, be practically the same plant, and incapable of fertilising one another (compare the case of *Crocus sativus* on p. 276). Hence the importance in bringing pollen from physiologically independent individuals at a distance, mentioned in the discussion by the Rev. G. H. Engleheart with regard to daffodils, but not explained by him. Among a series of his opinions summarised conveniently by Dr. Ludwig is one with regard to the springing up of races within the same species, which may be self-sterile and self-fertile. Another is of a very practical nature, and deals with the advisability, when introducing a new species of plant into a garden, to obtain at least two examples of it of as different origin as possible, or to procure the seed of such.

Work at the Paris Natural History Museum, 1887–99.—M. L. Henry contributes a list of plants supposed to be hybrids, which he suggests might have their origin

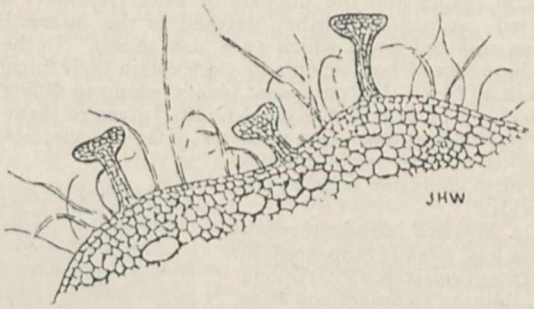

FIG. 4.—Transverse section of part of the ovarian wall of the hybrid.

proved by hybridisation experiments. He adds a record of his work during recent years, giving most details with regard to lilacs.

Graft Hybrids.—This account of the Bronvaux medlar, by M. E. Jouin, appeared originally in *Le Jardin* (January 20, 1899); and M. Daniel ("La Variation dans la Greffe," *An. Sci. Nat. Bot.* Series 8, vol. viii. (1898), pp. 1–226; pls. i.–x.) has figured and given some details in

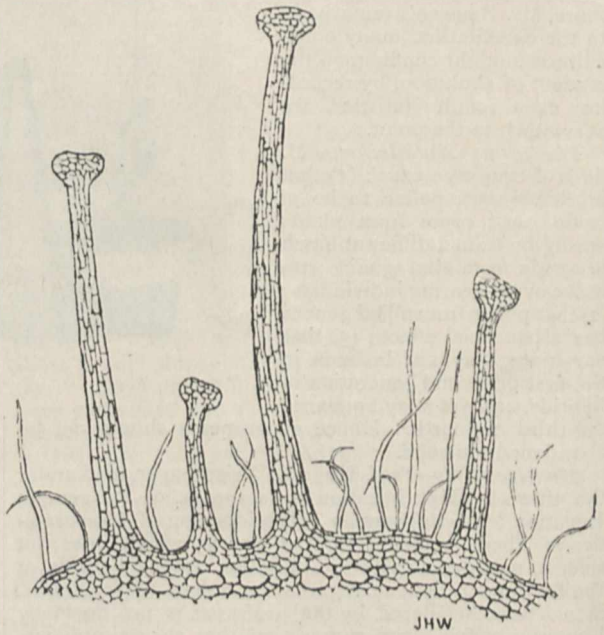

FIG. 5.—Transverse section of part of the ovarian wall of the gooseberry.

his recent paper of the remarkable branches pushed out by the whitethorn stock below the graft.

Branch No. 1 is intermediate between the whitethorn and medlar. It is, however, thorny, and bears corymbs of as many as twelve flowers, instead of solitary blossoms. The fruits are medlars, but small and much flattened.

Branch No. 2.—The young leaves resemble those of the whitethorn; the older, those of the medlar, being hardly, or not at all, lobed. The flowers are like those of

the former plant, and arranged in corymbs, but a trifle larger. The fruits are not medlars.

Branch No. 3.—The base is simply whitethorn, but the extremity is practically like Branch No. 2.

Similar cases are instanced by M. Jouin, who puts down the now celebrated *Cytisus adami* as having arisen in the way that the branches above described have done.

Drosera Hybrids.—This paper, by Prof. Macfarlane, has already appeared in the publications of the University of Pennsylvania; it deals with the structure of a batch of natural hybrids. It may be noted that several instances of what the author has called bi-sexual hybridity occur in the plants considered (p. 248); for instance, instead of finding structures intermediate between the elongated glandular hairs of *Drosera filiformis* and the sessile two-celled glands of *D. intermedia*, both appear on the calyx of the hybrid between them. This fact calls forth some interesting speculations of a cytological nature, which the Professor hopes to see verified. As showing the growing opinion in favour of graft hybrids being realities, it might be mentioned that *Cytisus adami* is referred to as such in the paper.

The Influence of each Parent.—From experiments with cereals and Bromeliaceæ, Dr. Wittmack concludes that "the mother has the more influence upon the habit; the father the more upon the inflorescence; at least, upon its colour." The contrary opinion of M. Duval is given, who also holds that to reduce the volume of the plant the larger must be fertilised by the small parent species. According to Mr. Tropp, the same holds good usually, but not always, with orchids.

Principles.—The laws given by Herr Max Leichtlin may be quoted in full:—

(1) The female parent gives to the offspring the form and shape of the flowers; also certain qualities.

(2) The male parent gives more or less of the colouring of the flowers, and if it be richer and blooms more freely than the female, this property is transferred to the offspring.

(3) Artificially produced offspring give larger flowers than either of their parents.

(4) The more distant the habitats of the species intended to hybridise, the more difficult is it for them to be fertilised with each other's pollen.

(5) The offspring becomes infertile and delicate if the form of the flowers of their parents is widely different in shape and outline.

Breeding Staple Food Plants.—In alluding to the cost in labour and money of developing hybrids when the immense number of plants that should be dealt with are used, Prof. Willett Hays points to the importance of selecting carefully the parental individuals. The best flower, he says, too, should be chosen from the best part of the plant.

An Improved Variety of Crocus Sativus.—It was not till after many experiments with examples from many places that the saffron could be got to produce seed, except very meagrely (compare the remarks already made on self-sterilising above). After a wild plant of *Crocus graecus* was obtained from the island of Syra, as much seed as was wanted was obtained. In the variety produced by M. Chappellier there is a proliferation of stigmas, sometimes thirty, and even bracts and sheaths have been converted into them.

Experiments with Dioscorea.—In an attempt to obtain a tuber which was short enough for one to dig up easily, a plant was obtained by M. Chappellier bearing both male and female flowers. This worker also contributes a note on *Mirabilis*.

Hybrid Lilacs.—M. E. Lemoine sends an account of how he proved the Varin lilac to be a hybrid between *Syringa persica laciniata* and *S. vulgaris*, a piece of work which M. Henry would also have succeeded in if his plants had not died before flowering.

Hybrid Clematis are dealt with by M. Morel and Mr. Jackman. M. Duval treats of *Anthurium scherzerianum*, of Bromeliads and of Gloxinias. This hybridist points out how important it is to know the pedigree of plants experimented with, and says that the male parent should be most carefully selected, as being the one whose influence greatly preponderates. Mr. Meehan and Mr. Smythe have written a few general notes. Mr. Weekes has a little to say about Chrysanthemums, while Mr. James Lye, when discussing the cross-fertilisation of the *Fuchsia*, states that he uses the tip of a squirrel's tail to transfer the pollen, and prefers muslin bags to those made of paper for enclosing the chosen blossoms.

Mr. Wilks, the secretary of the Royal Horticultural Society, must be complimented upon the successful production of the report. WILFRED MARK WEBB.

OUR NORTHERN BIRDS.[1]

MR. DIXON is a prolific writer, and confines himself almost entirely to one subject. Nevertheless he always succeeds in interesting his readers, and contrives to say something fresh even upon such a trite and thread-

FIG. 1.—Rough-legged Buzzard (From Dixon's "Among the Birds in Northern Shires.")

bare theme as British birds. In a former volume Mr. Dixon took as his subject "Bird-life in a Southern County"; and in the present work he dwells on the great difference between the bird-fauna of the more northern counties of England and Scotland from that of the south

[1] "Among the Birds in Northern Shires." By Charles Dixon. Pp. x + 303. (London and Glasgow: Blackie and Son, 1900.)

of England. Not only are many of the birds of the northern districts normally strangers to the south, either at one season of the year or at all times, but notable differences in their habits are observable. Species, for instance, that sing during winter in the south are silent at that season further north; while others that are permanent residents in the former area are migratory in the latter. And it is certain that from an ornithological point of view the northern counties are more interesting than the southern—and more especially the south-western counties.

In the treatment of his subject, Mr. Dixon has acted wisely in abandoning a systematic classification in favour of a grouping by means of "station," so that we have chapters on the birds of the upland streams, of the moors, the mountains, the heaths and marshes, the forests and copses, the farm and the garden, the river and pool, the sea and the beach, and the crag and sea-cliff. By this arrangement a much more discursive and "chatty" style of writing is permissible than would otherwise have been the case. The reader is accordingly spared a repetition of the descriptions of the various species of which we have already more than enough; and the author has also seen fit to abandon the use of technical names, and to content himself with the English titles of the birds mentioned.

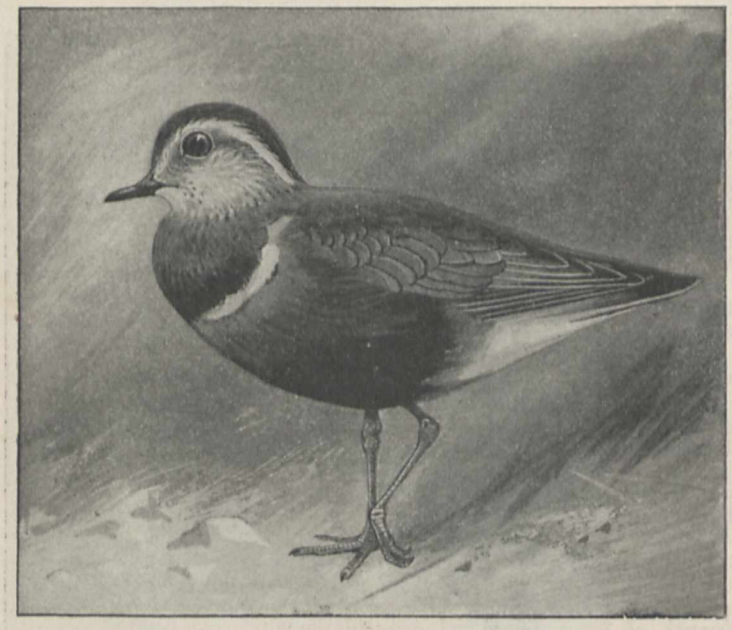

FIG. 2.—The Dotterell. (From Dixon's "Among the Birds in Northern Shires.")

Much of the attraction of the book is due to the exquisite portraits of birds in their haunts from the accomplished pencil of Mr. C. Whymper. Where all are good it is difficult to select examples for special commendation, but the black-cock crowing is one that strikes our own fancy, and the two cuts that we are enabled, by the courtesy of the publishers, to reproduce, will serve as good examples of the general style of illustration. If we mistake not, the figure of the raven is very like one that has appeared elsewhere.

In the chapter on the birds of the upland streams an excellent account is given of the habits of the water-ouzel or dipper; and here the author appears, for once, to have caught Prof. Newton "tripping." In his "Dictionary of Birds" the origin of the name "dipper" is attributed by the Cambridge ornithologist to the writer of the letter-press of Bewick's "British Birds," but Mr. Dixon points out that it occurs in a work published as far back as 1771, and a later issue of which was actually edited by the learned professor himself!

An especial feature of all the author's works is his own practical experience of birds in their native haunts; and all who have had bird-nesting adventures in their own early days will read with delight the description, on p. 136, of his ascent of a lofty oak to secure a clutch of buzzard's eggs, which were safely carried down. In making friends, during his youthful days, with both poachers and game-keepers, Mr. Dixon seems indeed to have had an almost unique experience, and one whereby his practical acquaintance with the ways of birds was largely augmented. He has many stories to tell of the wanton manner in which he has known keepers fire into the nests of brooding birds and otherwise inflict destruction on what they are pleased to denominate "vermin." In regard to these latter, he urges (p. 151) that our indigenous native game-birds would thrive all the better if hawks, crows, magpies, owls and the like were left unmolested. The pheasant, he thinks, however, might not fare so well; but, he adds in effect, perish the pheasant! This, however, we venture to suggest, is scarcely a practical way of looking at things. If pheasant-preserving were to be given up, our coverts would not be guarded at all, and many of the other birds would be ten times worse off than they are under the present régime.

Not the least interesting chapter in a very interesting book is the final one on bird migration in the northern counties, where, instead of a learned discussion on the theory of migration, we have an actual account of the manner in which the swarms of autumn and spring migrants reach and leave our coasts. Here the author remarks that the short-eared owl and the woodcock frequently reach the Wash together, making the passage from the Continent during the same night, although the one just skims the water while the other flies high in the air. And many other passages attests the author's close observation of the movements of birds. It is to be wished, however, that he would employ the familiar name hedge-sparrow in place of the pedantic hedge-accentor. The term sparrow, as Prof. Newton remarks, was probably originally applied to all our smaller birds; and it is surely an unwarrantable assumption on the part of ornithologists to traverse popular usage and attempt its restriction to the members of the restricted genus *Passer*.

R. L.

NOTES.

THE delegates to the third biennial conference in connection with the International Catalogue of Scientific Literature were entertained at dinner by the Royal Society as we went to press last week. In the course of the evening several interesting speeches were made in proposing and responding to toasts. Prof. Forsyth, in proposing "International Science," referred to the great empire of science, the possessions and achievements of which are intended for the welfare of all men. Prof. Darboux responded for France, Prof. Klein for Germany, and Prof. Weiss for Austria. The toast of "The Delegates to the Conference" was proposed by Sir John Gorst and responded to by Prof. Ciamician (Italy), Dr. Graf (Switzerland), and Dr. Brunchorst (Norway). Sir Michael Foster proposed the toast of "The Guests," which was responded to by Lord Strathcona; and the

health of "The President" was proposed by Dr. Schwalbe and acknowledged by Lord Lister. We have not yet received from the Royal Society the *procès verbal* of the meetings of the delegates, but it is understood that the support promised will warrant a commencement of the Catalogue at the time fixed.

THE third biennial Huxley lecture at the Charing Cross Hospital Medical School will be delivered by Lord Lister on Tuesday, October 2. The two former lecturers, in 1896 and 1898, were Sir Michael Foster and Prof. Virchow.

THE Society of Arts has awarded its Albert medal for the present year to Mr. Henry Wilde, F.R.S., "for the discovery and practical demonstration of the indefinite increase of the magnetic and electric forces from quantities indefinitely small." This principle is the one on which the invention of the dynamo machine is based, and is utilised in the construction of all modern dynamos.

AT the annual general meeting of the Royal Statistical Society, held on Tuesday, Lord Avebury was elected president for the ensuing session. It was announced that the subject of the essays for the Howard medal, which will be awarded in 1901, with 20*l.* as heretofore, is "The History and Statistics of Tropical Diseases, with especial reference to the Bubonic Plague." The essays should be sent in on or before June 19, 1901.

THE annual meeting of the Marine Biological Association will be held at the Royal Society on Wednesday next, June 27.

WE learn with regret that Mr. W. Percy Sladen, for years an honorary secretary of the Linnean Society, died at Florence on June 11.

THE death is announced of M. Boutan, one of the founders of the French Physical Society, and the author of an excellent "Traité de Physique" as well as other works.

PROF. EDMUND PERRIER has been appointed to succeed the late Prof. Milne-Edwards as director of the Paris Natural History Museum.

THE autumn meeting of the Iron and Steel Institute will be held at Paris under the auspices of the Société d'Encouragement pour l'Industrie Nationale, on Tuesday and Wednesday, September 18 and 19.

THE summer meeting of the Institution of Mechanical Engineers will be held in London on June 27 and 28. The programme includes an adjourned discussion on road locomotion (a short supplementary paper dealing with the recent trials will be submitted by Prof. H. S. Hele-Shaw, F.R.S.); recent locomotive practice in France, by M. Edouard Sauvage; polyphase electric traction, by Prof. C. A. Carus-Wilson; observations on an improved glass revealer, for studying condensation in steam-engine cylinders and rendering the effects visible, by Mr. Bryan Donkin.

AN interesting exhibition of objects illustrating the population, monuments, customs, and native industries of the Chawi and Kabyle tribes of Algeria will be on view in the rooms of the Anthropological Institute, 3 Hanover Square, W., until June 23, from 11 a.m. to 5 p.m. The objects were collected in the course of a recent journey in Algeria by Mr. D. MacIver, student of Egyptology at Worcester College, Oxford, and Mr. Anthony Wilkin, of King's College, Cambridge.

THE Advisory Committee appointed by the Board of Trade in connection with the business of the Intelligence Branch of the Commercial, Labour, and Statistical Departments of that office met on Thursday last, Sir Courtenay Boyle being in the chair. There were present, among others, Lord Avebury, Sir Frederick Abel, F.R.S., Prof. Wyndham R. Dunstan, F.R.S., and Mr. C. A. Harris, C.M.G.

THE grant of 1000*l.* in aid of the work of the Marine Biological Association; the site of the National Physical Laboratory at Kew; and the grant to the British School at Athens, were brought before the House of Commons on Friday last, upon the vote to complete the sum of 50,724*l.* for scientific investigation. It was urged by Mr. Gibson Bowles that the grant to the Marine Biological Association should be largely increased; and by Lord Balcarres that the vote of 7000*l.* for building and equipping the National Physical Laboratory should not bind the Treasury to adhere to the site which has been proposed. Mr. Hanbury said it should be borne in mind that the grant of 1000*l.* to the Marine Biological Association was not the only grant made in connection with the fisheries of the United Kingdom. A grant was given to the Fishery Board of Scotland for the purpose of scientific investigation, and similar assistance was given to the Irish fisheries. Under present conditions there did not seem to be any urgent necessity to increase the grant. The Treasury had very little voice in the matter of the Physical Laboratory; it had acted on the recommendation of a committee of the Royal Society. It was absolutely necessary to find a site near Kew Observatory, and after looking at every possible site the committee strongly reported that no other site would answer the purpose so well as that which adjoined Kew Gardens. He agreed that nothing ought to be done which would interfere with the amenities of Kew Gardens, and this point had been considered in the selection of the site. The two buildings, one for the machinery and the other for carrying on the more delicate scientific operations, were to be placed in positions which would not mar the views from the gardens or injure their amenities. The voting of the 7000*l.* would in no way prejudice the consideration of the case against the proposed site.

REFERRING more particularly to the British School at Athens, Mr. Balfour said that the only ground for the alarm expressed was that the original grant was for five years, and that this term was drawing to a close. The question of Governmental subvention of scientific investigation was a very important subject, and there was no doubt that this country had, from a traditional policy, lagged greatly behind other nations in this respect. It never occurred to us to do what the Germans, the French, or the Americans did in making certain grants for investigations; and whether we were right or wrong he did not undertake to say. His own personal inclination was rather in the direction of Governmental aid in cases where they could not expect private aid to come forward; but at the same time he confessed that he often thought how strange it was in a very rich country like ours there were not found some people who, in a difficulty to find other and more profitable investments, did not attempt to earn glory for themselves by carrying on those investigations with the money that was required. He could only say that certainly the grant would not be discontinued without a generous consideration of the facts and interests involved.

A MEETING of the Röntgen Society was held on Thursday, June 7, at St. Bartholomew's Hospital, by the invitation of Dr. Lewis Jones. A large American Holtz machine has recently been presented to the hospital, and it was chiefly to allow the members to have an opportunity of seeing this machine at work in connection with X-ray tubes that Dr. Jones invited the Society to meet at the hospital. Large Holtz machines, though used considerably in America, are rarely seen in this country, where the Wimshurst pattern is more commonly employed. A dark room has been fitted up in the electrical department specially for X-ray work. The wires for bringing the current to the tubes are passed through a partition to the machine, which is on the other side. The observer and the patient are thus in no way disturbed by the movements of the

machine, or of the motor or other appliances connected with the working of the same. The light given by the tubes was perfectly steady, which is one of the advantages usually claimed for the influence machine over the coil, although this has been somewhat diminished since the advent of the Wehnelt and Caldwell electrolytic breaks.

MR. J. WIMSHURST, F.R.S., also read a short paper on his work in connection with the design and perfecting of the several forms of his influence machine, describing, among others, the large machine made for and presented to the Science and Art Department, with plates 84 inches in diameter; and another, with twenty-four plates 36 inches in diameter, shown at the Earl's Court Exhibition, and which is now, we believe, in the possession of Dr. J. Macintyre, of Glasgow.—Dr. Rémy, of Paris, showed a new localising apparatus. This consists of a vertical support moving in a socket fixed to the table. The tube is supported by a cross piece at the lower end, under the table, while the fluorescent screen is attached to the upper end, together with two pointers representing the paths of the rays, and held in supports moving in slots or grooves. Two observations are made and the pointers adjusted, after which the apparatus is turned round away from the table, and the pointers lowered until their points meet, thus indicating the depth of the hidden object below the surface. A bullet hidden in a loaf of bread was found in a minute or so by Dr. Rémy.

THE *Scientific American* contains an account of Count von Zeppelin's projected navigable balloon now under construction on Lake Constance. The balloon is to be 416 feet in length and 38 feet in diameter, divided into seventeen compartments, and supported on an aluminium framework. It is to carry two cars and motors, and to be propelled by screws placed in pairs at the side of the balloon and geared to the driving-shaft by two diagonal shafts. In the preliminary experiments for testing the efficiency of the motors, a launch was driven on the lake at from 6·8 to 9·2 miles an hour by aërial propellers. The fuel is benzene, and it is calculated that the balloon will carry sufficient fuel to perform a journey of over 179 miles.

THE cutting of the *sudd* on the Upper Nile and the consequent release of large volumes of stagnant water has, we learn from the *Times*, had an unanticipated influence on the condition of the river at Assuan. From reports received by Sir Benjamin Baker from the engineering staff it would appear that the absence of free oxygen in the water has caused wholesale destruction of the fish. Within a hundred yards of the resident engineer's office at least a million dead fish, ranging in size from minnows to six feet in length, are to be found. This result is consistent with London experience when it was usual to pour crude sewage into the stream. The filtered water, though clear and odourless, was drunk with impunity, but, having no free oxygen, eels plunged into it would struggle violently and finally die of suffocation, as has apparently been the case with the fish in the Nile in the special circumstances resulting from the long-deferred cutting of the *sudd* this year.

SOME notes on New Zealand volcanoes are contributed to the latest volume (1899) of *Transactions* and *Proceedings* of the New Zealand Institute, by Dr. B. Friedländer. A description of an eruption of Te Mari witnessed by him is of interest. The eruption began with an explosion, and masses of ash-bearing steam were ejected. There were at least four different light-phenomena:—(1) the reflection of incandescent matter upon the dark clouds; (2) a large number of red-hot boulders, which were shot high up and fell down in parabolic curves; (3) lightning, due to electricity produced by friction. The lightning appeared in masses of ash-bearing steam; and the ashes were coarse, the single grains being about the size of a pin's head. (4) Blue flames, and probably reddish flames. Some red flames were apparently distinct from the light due to illumination of steam, and the blue flames must have been real. Dr. Friedländer suggests, to account for the flames, that during the explosion there escaped combustible gases which at a certain height above the crater met the oxygen necessary for taking fire. He considers that vaporised sulphur would explain his observations better than hydrogen, the flames of which are less brilliant and less distinctly blue. Another paper of interest to students of vulcanology, in the volume referred to, is a detailed description of the volcanoes of the Pacific, by Mr. Coleman Phillips.

AN official report by Captain R. H. Elliot, upon his researches into the nature and action of snake-venom, is referred to in the *Madras Mail*. Captain Elliott confirms the fact that the mongoose is not immune in the fullest sense of the expression, seeing that it may succumb to a snake-bite, if sufficiently severe, like any other animal. His researches go to show, however, that the mongoose does enjoy a partial and comparative immunity from snake-poison—that is to say, a mongoose takes from ten to twenty-five times as much cobra venom to kill it as a rabbit does, and five to twelve times as much as a dog. M. Calmette gives a somewhat lower estimate than this; but he made only a few experiments, and it is noteworthy that the mongooses that he experimented with were obtained from Guadeloupe, where venomous snakes are unknown. The mongoose was introduced into Guadeloupe (and Barbadoes) some twenty-five years ago with a view to the destruction of rats. Captain Elliott thereupon remarks:—"We are thus led to the interesting conclusion that the introduction of the mongoose into a country in which venomous snakes are unknown has resulted, in so short a period as a quarter of a century, in a very appreciable reduction of the animal's resistance to snake-venom. This fact points strongly to the farther conclusion that the immunity is an acquired one, and inasmuch as the acquired characteristic has been so rapidly and easily diminished, it would appear likely that it must be maintained from generation to generation. Be it remembered that a quarter of a century probably means about fifty generations."

THE growing necessity of obtaining greater speed on railways has of late been freely discussed, and different designs have been put forward favouring very much the idea of a single-rail system resting on supports and its train suspended below. Hitherto all railways of this nature have been propelled by steam or electric motors, but *Fielden's Magazine* (June) describes and illustrates a still later application of this suspended car system, patented by Mr. H. S. Halford under the name of the Halford gradient railway. The remarkable feature about his system is the fact that no locomotive or electric motors are carried, as the train derives its motion by gravitation imparted by raising, as long as this is required, to a slight incline, the section of line upon which the train is running. The track of this railway, which is supported, is divided into sections, the extremities of which can be raised or lowered by hydraulic (or other) power, the operation being performed either automatically by the carriage in its transit or by the driver at will. It is stated that the cars ride smoothly going from one section to another, and also the change of incline is so small and gradual that the lifting of the track is almost unperceived. The Halford gradient railway has yet to see a more practical test, but the following advantages claimed make the devise feasible in many ways:—(1) In all other systems, the greater the load the less the speed; in this, the greater the load

the greater the speed. (2) There is no need to stop for coal or water. (3) Its natural tendency must be to increase in speed. A photograph of a working model and diagrams illustrate the article.

CONSIDERING the advances that have been made in the rate of travelling during the present century, it would be unsafe to say that a speed of 120 miles an hour is not attainable The evidence that was produced before a Committee of the House of Commons, in a Bill recently brought forward, was not, however, sufficient to satisfy the Committee that such a rate of speed can be attained with safety to the passengers. The scheme of the inventor, Mr. Behr, was for an electric railway to run between Liverpool and Manchester, and to perform the journey of 35 miles, including stoppages, in 17½ minutes, which would mean a speed of more than double that now attained by the best express trains. The carriages were to be suspended on a single rail resting on A-shaped iron tressels, with two side rails to keep the carriages in place. The idea of carriages being suspended from rails is not new, an electric railway on this principle, 8 miles long, having for some time been in use between Barmen and Elberfeld. The trolley rails there are double, and the speed attained is only 18½ miles an hour. In the Lartigue system, which has also been in use for some years, the carriages are suspended from a single rail, but no high speed is attempted. An experimental railway was constructed at Brussels on the Behr system, when a speed of 80 miles an hour was said to be attained. The sensation produced by the sudden pulling up of an ordinary express train is sufficiently uncomfortable, to say the least, to create considerable doubt as to the safety of stopping a train within any reasonable distance travelling at double this rate. Anyway, the Committee, in the interest of the public, declined to give their sanction to the scheme as presented to them ; and while admitting that the mono-rail system when properly matured might make an important development in railway traffic, yet as regards the method of applying the brake-power to trains running at such high speeds, they were not satisfied that the safety of the public was sufficiently provided for.

THE action which the vestry of the Parish of Hammersmith has taken to make known the nature of consumption, and the measures which should be adopted to prevent its spread, is altogether praiseworthy, and other public authorities should emulate it. At the request of the vestry, the medical officer of health, Mr. N. C. Collier, has prepared a report upon the causes and prevention of consumption,and it has been distributed in the form of a leaflet. It is pointed out that "there is now no doubt that consumption is caused by a minute living organism, the bacillus of tubercle, and that the presence in the body of the tubercle bacillus is most rarely inherited, but becomes introduced from without. What is inherited is the non-resistile condition of the vitality of certain cells in the body which are unable to destroy the tubercle bacillus, when it has become accidentally introduced into the system. To prevent consumption it is necessary, firstly, to avoid all those means by which the tubercle bacillus may be introduced into the body ; and, secondly, to avoid all those causes which enfeeble the vitality of the cells of the body, and so render them unable to destroy the tubercle bacillus should it become introduced." The hygienic principles to be borne in mind in order to prevent the spread of the disease are briefly summarised, and the information given cannot be too widely known to the public.

THE recent report of progress of the observatory at Colába (Bombay) shows the large amount of work accomplished during the year ending March 1900. In addition to the usual magnetic and meteorological instruments, one of Prof. Milne's horizontal pendulums has been in action for nearly two years. During the year covered by the report, twenty-seven earthquakes were registered, besides 1398 small and local movements. A second horizontal pendulum, designed and made locally, was erected last March. It is similar in principle to the other, but much more sensitive. The record is made mechanically by means of an ordinary crow quill and glycerine ink, writing on paper driven at the rate of five inches an hour, excellent open diagrams being thus obtained.

THE Deutsche Seewarte has recently issued its twenty-second volume of *Aus dem Archiv* for the year 1899, containing valuable discussions relating to the motions of air and sea. Among the most popular subjects we may mention a paper, by Dr. van Bebber, on a scientific basis of weather prediction for several days in advance. The same subject has been treated of by the author, in a preliminary way, in periodical publications, and has already been noticed in our columns. The question is one of great importance, and we therefore refer our readers to the present more elaborate discussion. An examination of the weather conditions of twenty years, as shown by the daily weather charts of the Deutsche Seewarte, has led the author to distinguish five principal types, under one of which the actual conditions may be classed, with a fair degree of probability that the behaviour of the weather (on the Continent) will conform in its general features to that of the type in question. The types all refer to the more persistent areas of high barometric pressure, in contradistinction to the more mobile areas of lower barometric pressure. The paper is accompanied by sixteen charts and diagrams printed in the text, and will repay careful study by those interested in weather prediction.

WE have received a double number of the *Journal* of the Scottish Meteorological Society, completing vol. xi. (3rd Series) of this useful publication. It contains the usual valuable meteorological returns from the Scottish lighthouses, and from a large number of stations belonging to the Society. These observations (which refer to the years 1897 and 1898) have been carefully examined ; and monthly means have been calculated and utilised in the preparation of the annual reports on the meteorology of Scotland. In addition to this routine work, the number contains several special discussions, *e.g.* the "Annual Rainfall of Scotland from 1800 to 1898." This is a comprehensive and laborious compilation, by Dr. Buchan, and will be of the greatest utility in any inquiry bearing upon the rainfall of this part of the United Kingdom. The tables are divided into two parts, showing (1) the annual amounts, and (2) the average rainfall for the whole period, the heaviest and least yearly amount, the height of the station, and other particulars. Among the other papers may be mentioned "Barometric and Thermometric Gradients, 1704–1898," showing the differences in the mean monthly and annual values of these elements at London and Edinburgh, by Mr. R. C. Mossman. We are glad to see that the important work of the Ben Nevis Observatories will be completed in the way desired by the directors, thanks to the magnificent donations of two of the members of the Society.

THE Wisconsin Geological Survey sends us the third number of an "Economic Series," a "Preliminary Report on the Copper-bearing Rocks of Douglas County, Wisconsin," by Dr. Ulysses S. Grant. The copper occurs mainly as the native metal, and most commonly in the upper amygdaloidal parts of the old lavas belonging to the Lower Keweenawan (pre-Cambrian) formation. It occurs also in small particles scattered through both igneous and stratified rocks, in minute seams and in veins. It was deposited in its present position by circulating waters. At times, at the surface the native copper is not discernible, and its presence may then be detected by the green and blue alteration products or stains, malachite or azurite. Areas where the rock is highly charged with epidote are of a yellow or yellowish-green colour, and it is

recommended that these be searched for particularly, as in them copper is likely to occur. The rocks of Douglas county are the same in nature, in origin and in age, as the copper-bearing rocks of Keweenaw Point, Lake Superior; but at present it has not been determined in Douglas county that any deposit of copper of sufficient richness is extensive enough to be of economic value. Some of the recent explorations are, however, very encouraging.

THE *Quarterly Journal* of the Geological Society for May is a bulky number, which contains the address of the ex-president, Mr. Whitaker, and fourteen papers dealing with a variety of subjects. Perhaps the most important of these are contributed by women, who, by the by, are not at present eligible to become Fellows of the Society. There can be no doubt, however, that the essay by Miss Gertrude Elles on the zonal classification of the Wenlock shales of the Welsh borderland, and that by Miss Ethel Wood on the Lower Ludlow formation and its graptolite-fauna, make very great advances on our previous knowledge. The papers bear evidence of long-continued and critical research on the Silurian strata and on the difficult subject of the zoological characters of the graptolites which characterise successive stages in the rocks.

THE volume of "Geological Literature," which since 1895 has been separately published by the Geological Society of London, reflects great credit on the compiler, Mr. W. Rupert Jones, and on the editor, Mr. Belinfante. In this work the titles are given of the books and of all the geological papers contained in periodicals which have been added to the Society's library during the year 1899. This list occupies over a hundred pages, while the subject-index brings the total to 176 pages. As a work of reference it is indispensable to all geologists.

THERE is now in the press, and will shortly be published by Messrs. Young, Liverpool, and Messrs. Porter, London, the report of the conjoint expedition to Sokotra and Abd el-Kuri, conducted in 1898–99 by the British Museum (represented by Mr. Ogilvie-Grant, of the Zoological Department) and the Liverpool Museums (represented by the director of museums to the Corporation, Dr. H. O. Forbes). The expense of its publication is borne by the Museums Committee of the Liverpool City Council, and the volume is edited by Dr. Forbes. It will be illustrated by between twenty-five and thirty plates, chiefly coloured, depicting the zoological and botanical discoveries of the expedition, the ethnography of the islands, &c. The introductory chapters by the editor give an account, fully illustrated by blocks, of the journey, of the geography of the islands and of their inhabitants. The scientific chapters are contributed by Lord Walsingham, F.R.S., Prof. I. B. Balfour, F.R.S., Mr. Boulenger, F.R.S., Dr. Forbes, Mr. Ogilvie-Grant, Mr. A. E. Smith, Colonel Godwin-Austen, F.R.S., Mr. De Winton, and other well-known naturalists.

THE last number of the *Zeitschrift für wissenschaftliche Zoologie* contains an elaborate paper, by Dr. E. Zander, on the male reproductive organs of the Hymenoptera. It is illustrated by a remarkably well-executed coloured plate.

A CORRESPONDENT of *Nature Notes* asks for some good reason why a lover of animals should not wear the stuffed head of a bird or other creature as an ornament. The query appears to us a pertinent one.

WE have received the Report of the South African Museum for 1899, in which the Trustees express themselves generally well satisfied with the progress of the institution. They record an addition to the edifice of a large block of new building to receive the art collections.

IN No. 3 of *Marine Investigations in S. Africa*, Mr. G. A. Boulenger describes an example of the rare unicorn-fish (*Lophotes cepedianus*) from the Cape of Good Hope, where it has not hitherto been definitely known to exist. The specimen was considerably over a yard in length. The unicorn-fish, which is an ally of the ribbon-fishes, takes its name from the peculiar filamentous process arising from the front of the elevated head.

THE Annual Report of the Field Columbian Museum, containing an excellent portrait of its founder, Marshall Field, is likewise to hand. The museum appears to be making extremely rapid progress, its ethnological series having been very largely increased by the acquisition of the rich collection acquired by the Stanley McCormick Expedition among the Hopi Indians. An especial feature of the report is the introduction of a number of photographs of recent acquisitions. Among these, we may call attention to the portrait of a Hopi bride, and also to a plate of a group of the extraordinary gigantic spiral fossils known as "devil's corkscrew," or *Daemonelix*, which have lately excited so much interest.

THE Imperial Department of Agriculture for the West Indies has just issued a small pamphlet on the best means of destroying that troublesome insect, the "moth-borer" (*Diatraea saccharalis*), which inflicts so much damage, while in the caterpillar stage, on sugar-cane. It appears that a considerable number of the eggs of the moth-borer (which are laid in patches on the leaves of the sugar-cane) are attacked by parasites which prevent the development of the caterpillars, and in due course come forth as flies. These parasite-infested eggs are readily distinguished from healthy eggs by being black, instead of yellow or orange. It is recommended to destroy all the yellow and orange eggs that can be collected, but to leave the black ones, in order that they may breed flies to destroy other clutches of eggs. If this remedy were adopted as soon as the young cane commences to show, and continued as long as it is sufficiently small, the loss of the best shoots would be avoided. If, however, the caterpillars are allowed to hatch out and bury themselves in the cane, there is nothing for it but to cut out the "dead hearts," and this to a considerable depth. When cut out, they must forthwith be destroyed, or the caterpillar will either complete its development in them, or crawl out to other canes.

Bulletin No. 2 of the West of Scotland Agricultural College is a report by Prof. R. Patrick Wright on experiments on the manuring of rye-grass and clover-hay in 1899.

THE following are the most recent official botanical publications which have reached us from the United States:—The germination of seeds as affected by certain chemical fertilisers, by Mr. G. H. Hicks (U.S. Department of Agriculture, Division of Botany, *Bulletin* No. 24); Bread, and the principles of bread-making, by Helen W. Atwater (U.S. Department of Agriculture, *Farmer's Bulletin*, No. 112); Co-operative experiments with grasses and forage-plants, by Dr. P. Beveridge Kennedy (U.S. Department of Agriculture, Division of Agrostology, *Bulletin* No. 22).

UNDER the title of "Annuaire des Mathématiciens," Messrs. Georges Carré and C. Naud propose to publish a directory containing the names, addresses and academic rank of those interested in the study of mathematics.

MUCH information is given in a clear and concise form in Mr. A. A. C. Swinton's little book on "The Elementary Principles of Electric Lighting" (Crosby Lockwood), the fourth edition of which has just been published. The book only runs into sixty-four pages, but everything in it is to the point; and electrical artisans, as well as readers unfamiliar with

electrical phenomena and effects, will find its pages perfectly intelligible.

THE first part of Dr. Carl Chun's narrative of the cruise of the *Valdivia* and the scientific work accomplished, which has been published by the firm of Gustav Fischer, Jena, shows that the complete work, "Aus den Tiefen des Weltmeeres," will be a most interesting account of a successful expedition. The descriptive matter is untechnical in style, and liberally illustrated with excellent half-tone blocks and plates reproduced from photographs. The complete work will contain six chromolithographs, eight heliogravures, thirty-two full-page plates, and about 180 illustrations in the text. There will be twelve parts in all, two of which will be published every month, and the whole by November next. The work will be a *Challenger* narrative on a small scale, full of interest to all students of natural history and of physical geography in the most comprehensive sense of the term. We propose to review it in detail when all the parts have been received.

PROF. E. B. WILSON'S work on "The Cell in Development and Inheritance" (The Macmillan Company) contains a masterly treatment of the facts of cell-structure and division, and is favourably known to many biologists. It originally appeared in 1896, and has already been reviewed in NATURE (vol. lv. p. 530). Since then the aspect of many important questions with which it deals has been greatly changed, more particularly in case of those focused in the centrosome, and involving the phenomena of cell-division and fertilisation. This has necessitated a complete revision of the work, and there is scarcely a page of the second edition, which has just been published, that has not undergone alteration. More than a hundred pages of new matter have also been added. The most important results of modern cell-research, especially on the zoological side, are brought together in the volume, which will continue to be used as a convenient and clear synopsis of a vast amount of knowledge to which additions are constantly being made.

THE additions to the Zoological Society's Gardens during the past week include a Grivet Monkey (*Cercopithecus griseo-viridis*) from North-east Africa, presented by Mr. H. G. F. Stallard; a Campbell's Monkey (*Cercopithecus campbelli*) from West Africa, presented by Miss E. B. Hall; two Palm Squirrels (*Sciurus palmarum*) from India, presented by Mr. W. B. Bingham; two Common Squirrels (*Sciurus vulgaris*), British, presented respectively by Dr. J. L. Williams and Mr. G. S. Johnson; an Egyptian Jerboa (*Dipus aegyptius*) from North Africa, presented by Lady Preston; an Angola Seed-eater (*Serinus angolensis*) from Angola, presented by Miss Long; a Yellow-billed Sheathbill (*Chionis alba*), captured at sea, presented by Captain Bate; ten African Walking Fish (*Periophthalmus koelreuteri*) from West Africa, presented by Dr. H. O. Forbes; a Hocheur Monkey (*Cercopithecus nictitans*), a Moustache Monkey (*Cercopithecus cephus*), a Malbrouck Monkey (*Cercopithecus cynosurus*), an Angolan Vulture (*Gypohierax angolensis*) from West Africa, a Chacma Baboon (*Cynocephalus porcarius*, ♂) from South Africa, a Negro Tamarin (*Midas ursulus*) from Guiana, two Wandering Tree Ducks (*Dendrocygna arcuata*) from the East Indies, four Anderson's Tree Frogs (*Hyla andersoni*), four Changeable Tree Frogs (*Hyla versicolor*) from North America, deposited; an Orinoco Goose (*Chenalopex jubatus*), a Blue-fronted Amazon (*Chrysotis aestiva*, var.) from South America, a Little Guan (*Ortalida motmot*) from Guiana, a De Filippi's Meadow Starling (*Sturnella defilippi*) from Argentina, purchased; two Collared Fruit Bats (*Cynonycteris collaris*) from South Africa, received in exchange; three White Ibises (*Eudocimus albus*), six Glossy Ibises (*Plegadis falcinellus*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

FRENCH OBSERVATIONS OF THE TOTAL ECLIPSE OF THE SUN.—The *Comptes rendus* of the Paris Academy of Sciences for June 5 (vol. cxxx. pp. 1495–1529) contains the preliminary reports of several of the French astronomers who made observations of the recent total eclipse.

M. le Compte de la Baume-Pluvinel, observing at Elche, near the east coast of Spain, successfully carried out a very extensive programme. Nine photographs of the corona were obtained with objectives of 1·50 metres focal length; on these he says the coronal structure is almost identical with that he observed in 1889 at Salut. The planet Mercury is shown on all these plates, and will be useful for their accurate orientation. Three plates were obtained with a lens of 2·70 metres focal length, in conjunction with a cœlostat. For spectroscopic work three instruments were employed. A single prism spectrograph, with the slit in the line of the solar equator, showed the continuous spectrum of the corona extending to 12′ from the limb. Thirty-five bright lines were recorded, more intense on one side than the other. A second spectrograph had two objective prisms of spar and quartz; plates taken with this showed numerous chromospheric arcs, and a strong one due to the corona, this latter having no definite outer boundary. One interesting plate taken some seconds after totality still shows chromospheric arcs, and will furnish measures of the thickness of the chromospheric layers from the actual limb of the sun. An attempt to observe with a powerful six-prism spectroscope for special examination of the principal coronal radiation was rendered difficult by the feeble intensity of the image.

M. Ch. Trépied, director of the Algiers Observatory, also communicates a number of successful results. In addition to many accurate visual observations, twenty-eight photographs of the partial phases were made; six of the corona during totality, using an objective of 0·16 metre aperture and 1·03 metre focal length; the coronal extensions are recorded to 3·5 lunar diameters from the limb. Spectroscopic photographs were obtained with a Thollon prism spectrograph, an attempt being made to record the spectrum of the corona at diametrically opposite regions.

M. G. Meslin and party at Elche obtained eight photographs of the corona with a Henry lens of 16cm. aperture and 1 metre focus, and wide angle photographs of the region round the eclipsed sun for recording new objects. A photograph of the spectrum of the corona was obtained with a concave Rowland grating of 3 metres radius of curvature, used with a heliostat. The second order was photographed on plates 13 × 18cm., the spectrum extending from F to M; the images of the chromospheric radiations being portions of circles 16mm. in diameter.

THE TOTAL ECLIPSE OBSERVED AT SEA.—In an interesting letter written to the *Gibraltar Chronicle* of May 30, Colonel E. E. Markwick describes the appearance of the recent total eclipse as he and other fortunate passengers observed it from the Orient Steamship Company's R.M.S. *Austral*. The Company had considerately arranged that the vessel should be so navigated as to be near the central line of totality at the time of the eclipse, and, thanks to the skill of those in charge, this was accomplished with perfect success.

The position of the ship during totality was about Long. W., 9° 27′, Lat. N., 41° 3′, this being about 50 miles west of Oporto; the duration of the eclipse was about 1m. 31s. The Orient Company had provided an ample supply of glass plates, which, when smoked, permitted the passengers to view the progress of the partial phases, opera glasses being substituted during totality. During the eclipse the sky near the horizon was a lurid yellow, the clouds visible being reddish; the sea looked dark and sombre against the bright yellow of the sky. Close to the sun, however, the sky was quite blue; the darkness during totality was just sufficient to interfere with distinct vision.

The success of this enterprising project will probably induce many would-be observers in the future to adopt this exceedingly convenient and comfortable style of eclipse expedition; the departure from regular routine, though slight in itself, furnishing opportunity for really important scientific operations without disorganising any of the usual arrangements of the observers.

NEW VARIABLE STAR IN CEPHEUS.—Prof. W. Ceraski, of Moscow, announces in the *Astronomische Nachrichten* (No. 3644) that Mdme. Ceraski has found a new variable on examin-

ation of plates taken by M. Blajko. The star is not in the D.M., and has the following position :—

R.A. oh. 28m.
Decl. + 79° 33′ } 1855.

The brightness varies from between 8-9 to about 12 magnitude. It was increasing in October 1896, and decreasing in October 1897 ; it was almost at minimum during May 1898, April 1899, and at commencement of May 1900.

EPHEMERIS OF EROS.—Herr F. Ristenpart communicates a revised ephemeris of this planet to the *Astronomische Nachrichten* (Bd. 152, No. 3643), as follows :—

Ephemeris for 12h. Berlin Mean Time.

1900.	R.A.	Decl.
	h. m. s.	° ′ ″
June 21 ...	0 30 15·44 ...	+ 9 57 27·1
23 ...	33 42·19 ...	10 33 33·6
25 ...	37 8·20 ...	11 9 49·0
27 ...	40 33·44 ...	11 46 13·3
29 ...	43 57·91 ...	12 22 46·6
July 1 ...	47 21·57 ...	12 59 29·0
3 ...	50 44·44 ...	13 36 21·0
5 ...	0 54 6·51 ...	+14 13 22·3

HOWE'S PHOTOGRAPHIC OBSERVATION OF EROS.—Mr. A. C. D. Crommelin writes to point out an error in our note on the above, in which it was incorrectly stated that Prof. Howe's photographic observation of Eros was obtained during the solar eclipse of May 28. The photograph was taken before sunrise on the morning of the eclipse, some hours before totality. The error was introduced by the report of the observation being included in reports of the eclipse, and if uncorrected might lead to wrong estimates of the comparative brightness of the planet and of the darkness of the sky during totality.

A MODERN UNIVERSITY.

I.

THE granting of a Charter to the University of Birmingham, which has just become an accomplished fact, forms a fitting climax to an educational movement which may turn out to be one of the most momentous of the century. We have seen University Colleges called into existence in the great cities of the land by the perception of leading citizens that culture and scientific education of a high type must be brought to their doors and made accessible to all ; and we have seen the chairs of those colleges occupied by men who have devoted their spare time to the advancement of learning in various ways. All this has been of the greatest interest in the past and is full of hope for the future.

Side by side with these colleges there is now growing up in many cities a Technical School generally under Municipal Government, wherein artisans and hand workers generally may be trained in their craft, and in the main principles underlying it, in a more direct and satisfactory manner than by the old system of apprenticeship.

Such schools can no more turn out a finished artisan than the colleges can turn out a finished scholar. Much remains to be learned in later life and in the actual pursuit of trade or profession, but the early stages are overcome not only more rapidly, but far more thoroughly, by aid of direct instruction ; and in the more favourable cases a substratum of scientific knowledge is laid, and a grasp of principle attained, which must be of the utmost benefit hereafter, and could never have been obtained on the old plan. It is this scientific training in principles which is the really needful thing, when the public is educated enough to perceive it ; it is this which is of interest to the educationist, and not a mere instruction in handicraft : it is the making of men, and not the making of machines, which is of vital importance to the future of a country.

Without a training in principles a man remains ignorant and narrow, limited to the performance of the one thing which he has been trained to do, and incapable of turning his attention profitably to anything else ; inelastic and incapable of devising or of assimilating modifications and developments, which, as they come in, tend to leave him stranded and belated, waiting only for a period of slacker demand to throw him out of employment. And even if the artisan and the foreman are well educated, there remains his employer to be considered. If he is ignorant—too ignorant to turn his enterprise in the right direction when opportunity offers—his workers must suffer, and the whole nation suffers with them. But though Colleges and Technical Schools impart education on the one hand and instruction on the other ; though they enlarge and make more real the education available to the average citizen, they do not control and modify the educational ideal of the country. That ideal remains in many respects still essentially the same as it was at the beginning of the present century, before all this amazing inrush of new knowledge. The new knowledge has not yet been incorporated into education. The half-hearted effort made by schools to introduce what they term a "modern side" only serves to emphasise the blankness of the prospect. They say, and say truly, no doubt, that the new studies do not answer. They do not pay either for Government appointments or for the university. But a new university, able to set its own standards, select its own faculties, and set its seal on students of its own subjects, has far larger possibilities before it. It can control, and not only impart, edution. It may need an effort to rise to its privileges. The easiest plan is to follow the lead of others and establish degrees on the worn old lines, but that is not what we expect and hope from the new university of the Midlands. We hope to see it break away from mediæval traditions and realise the need there is for a new educational ideal.

The aim we have before us is an aim at actualities rather than at artificialities ; at real things rather than at conventions.

There is a stage of thoroughness at which a study of the conventionalities of grammar and orthography is able to convey real information about men and things—the advanced stage when it becomes the science of philology—but as usually learnt by ordinary persons it is little better than a conventional code and set of rules. If there was little in the world to learn about—as in the middle ages there was but little—it might be well to spend much time in acquiring precisely the gender of nouns and the terminations of irregular verbs in different foreign tongues ; not only for practical purposes but for mental training ; but amid the superfluity of real subjects of the present day, of all of which the ordinary person is densely ignorant, to immerse him for a long period in these barren studies is wasteful of his youth.

On the other hand, History is reality ; and some knowledge of history is necessary for every one. Art, again, and Literature and Music are, or may be, realities ; and the vast majority who have no power of creation should at least learn reverently to appreciate the great work of the greatest masters in all subjects, unless they are deaf and dumb and blind. The things really valuable to the human race should be made in some degree accessible to all, and this part of the work of education the Press and the Stage indirectly in some degree accomplish ; imperfectly, no doubt, but often more really than do the bodies which make the attempt in a more academic way.

Thus we would discriminate between the conventionalities of language and the realities of literature, just as we discriminate between the laws of colour and perspective, the technique of the painter on the one hand—and the great work of art itself, the expression of a thought or of an emotion, or of a beauty or of a fact. To the scholar, as to the painter, the two are inextricably interwoven ; technique is the material in which he works ; but the general human race, who have to do the work of the world, and who constitute the bulk of the nation, are neither scholarly nor artistic, and it is both wasteful and cruel to plunge them into technique, and disgust them with the—to them—dull and meaningless details, instead of educating them in the finished work possible only to masters of the craft.

The same sort of things do we say of science and of mathematics. Here, again, there is too great a tendency to educate youths in subtleties and artifices and minutiæ, as if they were going all to be accomplished mathematicians or men of science. The teacher is himself, perhaps, a mathematician, and so thinks that what was necessary for him is suitable for everybody. More usually, of course, the teacher knows very little about it, and feels only that he was himself taught that way, and that he must pass it on. Only a few stop to think what they are doing, and these are the educationists ; what they have to say is written at large, and there is no need to repeat it. Some of them are faddists, doubtless ; not all are wise ; but it is well at any rate to try and think a matter out ; and the speculative teaching even of a faddist is likely to be more stimulating than the tenth-hand droning of a conventional pedagogue. To indicate our meaning in terms of mathematics and science, as we have tried briefly to indicate it in the domain of more humanistic studies, we would say that a good deal of the teaching of Euclid

and algebra and trigonometry is conventional, and unsuitable to the average youth. If a youth is going to be a mathematician, it matters very little how he is taught these things, so long as they are put in his way. He can hardly have too much of them, he can look at them every way and they present no difficulty; but even the young mathematician might be saved the wearisome and long continued grind through the conventional books of Euclid, with the result that at the end he knows about as much geometry as a month of reasonable teaching would have given him. It is not mathematics at all that he is studying when he is doing Euclid in the usual way, it is a piece of old world literature, very admirable in its proper place, no doubt, and read through at a fair pace quite interesting. It is at any rate far more interesting than the military despatches with which so large another portion of his time is usually, at the same time, being burdened—a form of literature which is not of the slightest interest, and leaves no residue of real information in his mind, except that Gaul used to be divided into three parts; that Cæsar's army built an ingenious and highly technical bridge; that he had difficult times in conquering a people who are not our ancestors, but who happened to occupy the same plot of ground on the earth's surface as we do now.

The conventional part of algebra we refer to may be illustrated by G.C.M. and other rules which in actual work are never needed or employed even by mathematicians. Factors and Equations and Progressions are well enough,—all those parts that are really used or likely to be used hereafter, and all those parts which give a firmer grasp of principles.

Thus in arithmetic, familiarity with such a subject as scales of notation—with the principles, that is, of Arabian numeration—will be really educative and far more helpful than excessive repetition of a rule called "practice," and much dealing with commercial articles. A variety of problems from mensuration, mechanics and heat might be introduced into arithmetic, and the subject made more living than it is apt to be. Mensuration and practical trigonometry may be made truly educative subjects, and a quantity of arithmetical exercises may be founded upon things actually done in the workshop, the laboratory and the field, in the working out of which boys might readily be got to take a real interest.

But all these are school subjects. What have they to do with a university? They have a great deal to do with it in reality, for it is one of the functions and the privileges of a university indirectly to control, or rather influence, the schools. The influence is quite natural and unavoidable anyhow, but on the side of exhibitions and scholarships it becomes obvious and direct.

The schools must train largely for the universities, and the universities must train largely for life.

Now it is just in this training for life that the universities have proved deficient. The only life they have contemplated has been that of the politician and the lawyer on the one hand, and the scholar and recluse on the other. The kind of training needed or supposed to be needed by the past generation of statesmen has been supplied—with results not wholly and completely satisfactory; the kind of training needed for the highly specialised scholar has likewise and will always be supplied. The ancient universities are the natural homes of this kind of learning, and no modern institutions can hope or should attempt to compete with them. The aroma of centuries is a unique growth, and should be carefully fostered and reverenced by a busy and pushing generation.

It would be a calamity if anything were done to destroy the peace and old world quiet of mediæval institutions, founded on monastic traditions and full of attraction for the few who are called to be learned. That Oxford should specialise in archæology and ancient philosophy is most appropriate; that it should regard with jealous eyes the learning of the present century, and hesitate about letting its old bottles be endangered by the inclusion of new wine, is natural and may be wise. We would urge its custodians jealously to preserve the old learning, and leave experiments in new developments to younger and less fragile growths. We would treat the old universities like old buildings, relics of the past, to be most carefully preserved, and supplying something in the life of the nation which no amount of energy or reforming spirit is competent to supply.

If this old world atmosphere disappears it is an irreparable loss. Let its custodians be jealous and conservative; if they see no way of engrafting the new learning on the old stock, without ruining it, then it were far better that the new learning should be planted in fresh soil.

Such soil is furnished by natural circumstance at the intersection of great trade routes, at the market places of the world. Here the average man is at his strongest and busiest, here he is most actively in touch with life on this planet, and is serving his day and generation with an energy which is unmistakable. The motives, doubtless, are mixed, and the results are mixed, there is little Utopian about them; yet there is real self-sacrifice for a far-off good instinctively felt. Ugly surroundings are put up with, as a concomitant apparently necessary, and as at any rate temporarily unavoidable; and life is lived hard for an end not often clearly grasped, yet powerfully felt to the uttermost parts of the Empire. It is on such strenuous home industry, of director, of manager, of foreman, of artisan and of salesmen that our empire is established; and if there is one thing that we are more powerfully realising at present than another it is that our empire must be consolidated, that fresh guiding force must be available, not mere energy—of that there is plenty—but more directing force, more intelligent guidance, more discrimination, more breadth of view—in a word, more real education.

The present war will wake the people of these islands out of their comfortable lethargy. They will see that to hold our position in the modern world we require improved training, not only in rifle shooting and artillery practice, but in every department of activity. Other nations are leaping to the front and spending public money lavishly to get their people better educated, better fitted for seizing new ideas and applying them; it will never do for us to lag behind.

A few scholars, a few men of science, a few men of genius in various branches, these will not save a nation. They extend its fame, they adorn it, they stimulate it, and they reward it; but the backbone of a nation is the average man, the average man of affairs, the man who does the business of the world. If he breaks down or is crippled, the ornamental head cannot be supported. He may be a professional man or a merchant, or he may be a manufacturer or a tradesman, but whatever he is, he must not rest on his oars and be content with the tradition of the past. We are entering a new century, many traditions of the past are out of date, and the vital thing for the nation to realise, if it is to maintain its hard won supremacy, is that antique methods of education will no longer serve. They have had their day; they need not yet cease to be, but they must be supplemented by others. The modern university must take care of the average man. Plenty of long-established universities will look after the high honours men, and in every department highly specialised training is already available; our artisans are as skilled, each in his narrow groove, as it is possible for man to be—marvels of mechanical skill they are; but where is the breadth of view, the elasticity, the power to modify, to invent, to reform, to seize new conditions, to adapt one's self to the growing and changing needs of the world? A foreign order comes to an engineering works of the present day with its sizes expressed in decimals. Before the order can be given out it has to be interpreted into the clumsy sixteenths and thirty-seconds and sixty-fourths of an inch, which alone the workman understands.

Nor is this portentous ignorance limited to workmen. Directly the domain of science is touched, your ordinary school-trained average man is stranded—he is ignorant even of the scientific alphabet—scientific principles are a sealed book to him: the divorce between science and practice, except in the case of a few leading firms who have already wakened up like their continental confrères, appears to be complete.

The modern university must aim for a long time not at depth so much as at breadth. Depth for the few, breadth for the many. It must seek to turn out all-round men, and not specialists only.

Its graduates should not one of them be illiterate, not one of them ignorant of the fundamental principles of science. Trained scientific men they cannot be, in any numbers—the idea would be absurd—but they should have sufficient education to understand a scientific question and know where to go for the answer. They should have lived for a time—even a short time—in the atmosphere of science, and thereafter it will never be quite strange to them.

The scientific training need not be given solely in an academic manner, aloof from all questions of practical interest.

Some people are best trained in this manner, but other persons with a vivid practical interest or experience in application to life and work are best trained in close touch with practical conditions. Medical training is the best example ; that is thoroughly done. We would have other training arranged on the same practical lines. The modern university will seek, so far as it can, to allow for differences of aptitude, or, it may be, differences of preliminary training. It will not seek to force every undergraduate at first through an arts course, and then through a science course, and then through a technical course. It may be well to do this with professional men, but not with all. Every graduate should pass through these three stages before he can be turned out a useful and educated citizen, fit intellectually to take his share in the work of the world ; but he need not in every case of necessity take them in this logical order.

To force a boy through a course of language or history or literature, at a period when for some reason he is not attracted by it, is doing him but little good. It may, indeed, do him harm, by breeding disgust for subjects which at a later stage he might realise were necessary, and, when properly taught, enthralling. It is love of culture, and not hatred of it, that should be implanted. The so-called "preliminary in arts" course should be taken compulsorily at some stage of a graduate's complete career, but not necessarily at the beginning. A student who has been immersed for a term in purely technical studies will, if he is good for anything, turn to such human subjects with relief ; and it is not fair to turn him out in the world without some worthy human interest and solace. The university has failed in one of its functions if it permits him to depart trained in nothing but unhuman technology.

But then, on the other hand, the arts man, the lawyer, the merchant, the man of business, and still more the teacher—how much better would they not be for a tinge of scientific training. Their ignorance does not come home to all of them, but to many it does ; and probably in middle life they strive, by attending popular lectures and miscellaneous semi-scientific entertainments, to obtain a growth by a top-dressing of superficial information never really assimilated, seldom adequately understood. A manuring of science placed low down when young would have rendered the surface soil fertile, and this later growth easy, just as the youthful smattering of letters renders moderately easy and interesting the subsequent reading of history, or, in some cases, even the learning of a new language ; but to the wholly untrained person these things are, and remain, hopelessly difficult.

A broad training all round can only result in what specialists would call a smattering—what we should prefer to call a leaven ; but so long as it is not confined to a learning of trivial details, but represents a grasp of some of the fundamental principles of a subject, it is all that most men ever have, or can have, in any branch but their own, however highly educated they may be. It takes a very exceptional man to be really learned, or to be able to say anything really worth hearing, off his own subject. There are men who make a large portion of knowledge their province, but the majority of men cannot and should not aim at this. They should know one thing well, and in all else they should not be entirely ignorant.

This absence of entire ignorance is a far more valuable commodity than is usually supposed. It enables the man of affairs to consult specialists with advantage. Special knowledge is always available, if one knows how and where to look for it ; but the man of complete ignorance is at the mercy of every charlatan ; he puts his money into the wildest scheme, on the one hand, and on the other he fails to realise possibilities of sound application lying all about him. His enterprise and power may be great, but the blight of ignorance makes him useless ; and it is just this blight which is endangering our continued industrial and commercial supremacy among the nations of the world.

We look to the new type of university now about to be created to remedy this state of things. If Birmingham succeeds in its high emprise, other great cities will follow suit. The experiment is one that is of interest to the whole British Empire, indeed to the whole Anglo-Saxon race.

In another article we may perhaps enter more into detail concerning some of the features of the scheme ; but it is at present in such extreme infancy that its features are barely recognisable. It does not follow that what is immediately to the front is in reality the most important or the most characteristic.

(*To be continued.*)

THE STEADYING OF SHIPS.[1]

THE evolution of the modern flat-bottomed merchant vessel, with its midship section of approximately rectangular form, from its old pointed-bottomed prototype, with deep central keel, has been a necessary result of commercial competition. The naval architect is called on to increase the carrying capacity of his vessels to the utmost extent, and a limitation is imposed on their draught of water by the limited depth of harbours, docks, rivers and, last but not least, ship canals. The old central keel has had to disappear in order that the extra foot or two of displacement might be utilised for the carriage of cargo, and a substitute has had to be found for it by the attachment of "bilge-keels" or side keels projecting from the ship at the only places where they could be placed without taking up valuable space—namely, at the two rounded off corners of the rectangular section.

The efficiency of bilge-keels in modifying the rolling oscillation of ships seems to have been for some time a debated point among naval architects, and the experimental fact that the extinction of oscillation produced by these keels may in some instances be many times—possibly as much as ten times—that which would be inferred from determinations of the resistance of a paddle oscillating in water certainly appears at a first glance paradoxical. On reading Mr. Luke's paper in the *Transactions* of the Scotch Shipbuilders, and subsequently Sir William White's account of his experiments on the *Revenge*, it occurred to me that the properties of discontinuous fluid motion, so long a favourite study among mathematicians, might be put to a useful purpose in explaining the high resistances to rolling observed with the use of bilge-keels. So far from these resistances being in contradiction with the principles of hydrodynamics, they appeared to be to a large extent in conformity with our theory of free stream-lines, and this view has been borne out by subsequent calculations, certainly to a far greater degree than I at first anticipated.

According to hydrodynamical theory, if a solid body is set moving through or rotating in an unlimited mass of perfect fluid previously at rest, the motion will continue indefinitely, provided that the body has no sharp edges or corners projecting into the fluid, and that the velocity does not exceed certain limits. The motion involves no continuous expenditure of energy, and if the solid is brought to rest, the fluid will come to rest, and the energy which was expended in starting the motion will be recovered. If, however, the body has any sharp projecting edges, the fluid is unable to flow continuously round these, and discontinuous motion is set up, a mass of dead water being dragged along behind the projecting edges, and this dead water being separated from the moving fluid by a "surface of discontinuity" in crossing which the velocity changes abruptly. In this case the fluid motion is not destroyed when the solid is brought to rest, and energy is absorbed by the fluid. The theory of discontinuous motion is the basis of the well-known calculations of the resistance experienced by a plane lamina moving through a liquid, originally due to Kirchhoff, and subsequently developed by Lord Rayleigh, Love, Michell and others.

The case of a ship floating in water rocking from side to side differs from these ideal cases in the properties (1) that waves are produced on the surface, (2) that water is not a *perfect* fluid ; so that energy is being continuously absorbed by wave-formation, and by the viscosity of the water. If the ship has no sharp keels projecting into the water, these are the only causes which retard the rolling of the ship, but as soon as keels are attached discontinuous motions are set up, which involve a further absorption of the energy of rolling, and the oscillations subside much more rapidly. If we imagine the ideal case of a ship floating in a perfect liquid, the surface of which is coated with a perfectly rigid sheet of ice entirely preventing any waves from forming, but just allowing free play for the ship to roll, the oscillation would continue indefinitely, provided the ship had no sharp projecting keels. If, however, bilge-keels were attached, the oscillations would gradually die down, the energy of rolling being absorbed by the production of discontinuous motions, and being transformed into kinetic energy of the liquid.

The object of this investigation is to show that the efficiency of bilge-keels in modifying the rolling of ships may be greatly increased by the action of the sides of the ship itself, and is so increased in a ship of section approaching to a rectangular form, provided that the bilge-keels are attached at the protruding

[1] Abstract of a paper read before the Institution of Naval Architects.

corners of the section. This increased efficiency is due to two causes :—

(1) The rocking of the ship produces currents in the water, which flow round the corners in the opposite direction to that in which the ship is rolling, thereby increasing the pressure on the bilge-keels.

(2) The discontinuous motion past the bilge-keels alters the distribution of pressure against the sides of the ship, and the differences of pressure thus produced have a moment always tending to retard the rolling motion.

The effect of stream-line motions.—Consider a cylinder of section, such as represented in Fig. 1, rotating in fluid about

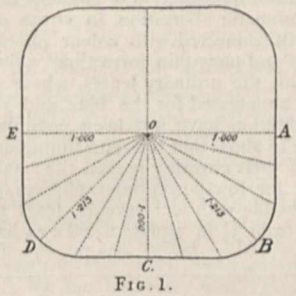

FIG. 1.

an axis through its centre O. It is known that the fluid displaced by the motion of the cylinder will flow past its protruding corners B, D in the opposite directions to that in which the cylinder is moving ; while at the points A, C, E the fluid will be moving in the same direction as the cylinder. Hence if a small lamina representing a bilge-keel be placed at B or D, it will encounter a current of liquid flowing in the opposite direction to that in which it is moving, and the pressure on the lamina will be correspondingly increased.

I made several calculations to form some estimate of the increases produced by these counter-currents on the resistance experienced by a suitably placed bilge-keel, assuming the resistance to vary as the square of the relative velocity. Taking certain sections more or less approximating to the form of a square with rounded corners, in a section where the greatest radius O B exceeded the least radius O A by 13 per cent., the resistance was increased, owing to this cause, by about 36 per cent. ; while in the section actually represented in Fig. 1, O B exceeded O A by 21 per cent., and the resistance on a lamina at B came out 67 per cent. greater than it would be if the lamina had only to encounter the relative velocity of the fluid due to its own motion.

In these cases the fluid was supposed to be indefinitely extended. To estimate the influence of surface-conditions *without*

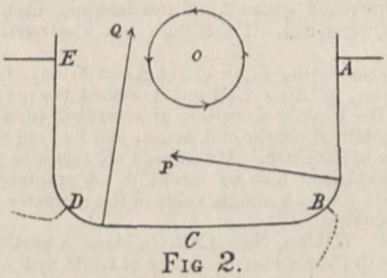

FIG 2.

taking account of waves, I next considered the case of a cylinder partially immersed in a liquid bounded by a rigid horizontal plane, the cylinder itself rocking about an axis in the plane of the surface. The form chosen for the section of the submerged portion was roughly suggested by a diagram of the ship *Revenge*, and the counter-currents past the protruding corners were found to be sufficient to more than double the resistance on a suitably placed bilge-keel.

The effect of pressure-variations against the sides of the ship.—The resistance on a lamina moving in fluid is due to the pressure being greater on the front than on the back of the lamina, this difference of pressure being the result of the discontinuous character of the fluid motion. When the lamina is attached to a ship as a bilge-keel, this difference of pressure also extends along the sides of the ship, the pressure in front of the bilge-keel being greater than behind it. Whether the pressure in front is increased or the pressure behind is decreased, or both of these effects take place simultaneously, is unimportant, for we may on each of these hypotheses represent the effect by an excess of pressure on the portions in front of the bilge-keels as compared with the portions behind.

Now let Fig. 2 represent a diagrammatic section of a ship approaching to a rectangular section, with bilge-keels at its protruding corners, B, D. Then if the ship be rolling about its centre of gravity, O, in the direction of the circular arrow, the greater pressures in front of the bilge-keels will be distributed over the segments A B and C D, and, as indicated by the arrows P and Q, their moments about O will be in the direction opposed to rotation. When the ship rolls in the opposite direction, the greater pressures will be on the segments B C and D E, and their moments will again tend to retard the rolling. In this way the pressures on the sides of the ship will materially assist the bilge-keels in steadying the ship.

To test the extent to which the pressure on the sides of the ship is likely to be modified by the presence of the bilge-keel, I examined the case of a fluid flowing along a plane, A B, with an edge, B C, projecting at right angles to it (Fig. 3). If from B there be measured off on B A a length = ·927 B C approximately, the thrust on this portion of B A is equal to the thrust on B C, and the average pressure on this portion is therefore a little greater than the average pressure on B C. If, again, we measure off on B A a length = 2·042 B C, the thrust on this portion is equal to twice that on B C. Speaking in general terms, we may say that the

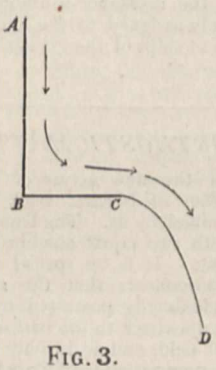

FIG. 3.

pressure is greater along B A than along B C, and that it does not fall off rapidly along the arm B A. If the arm B A, instead of being straight, bends away from B C like the curved side of a ship, we should expect the pressure on it to be even greater than in the case considered. These considerations led me to consider the results of supposing the bilge-keels to produce on the segments in front of them (A B and C D of Fig. 2) uniform increases of pressure equal in intensity to the average pressures on the keels themselves. Applying this hypothesis to a ship, the details of which were kindly furnished me by Dr. Elgar, I found that the total retarding moment came out to be about 3·9 times the retarding moment on the bilge-keels alone. This result, taken in conjunction with the previous result that the currents past the sides of the ship may double the pressure on the bilge-keel, shows that there is nothing paradoxical in the supposition that bilge-keels may have eight times the efficiency in extinguishing oscillations that would be inferred from experiments made with a simple paddle moving freely in fluid.

We learn from Sir William White that in the case of the *Sultan* the agreement between Mr. Froude's estimate of the resistance to rolling, based on the coefficient of resistance of a lamina, and the experimental facts was very close indeed. But the midship section of the *Sultan* was very much more nearly circular than that of the other ships experimented on. For a circular section there would be no counter-currents producing increased resistance, nor would the changes of pressure against the sides of the ship possess any retarding moment.

There are many further points connected with the investigation which want of space prevents us from discussing here. One such point is the fact that the rolling motion is not steady, but

oscillatory, and, therefore, account must be taken of the pressures involved in producing changes of motion, in consequence of which the pressures differ from those which would exist at any instant if the motion were steady. These pressures, which I have called the "$d\phi/dt$ pressures," after the term which produces them in the hydrodynamical equation, are completely modified in their action when continuous motion is replaced by discontinuous motion, but their effect can only be discussed from general principles. Other points are the effect of the ship's forward motion in increasing the steadying action, and the influence of bilge-keels in modifying pitching and in improving the steering of ships; the two last effects are further simple consequences of the properties of discontinuous motion.

We have seen that the action of bilge-keels in steadying a ship is largely modified by the actions of the sides of the ship, and is much augmented when the keels are placed in a suitable position; and it is interesting to notice how the exigencies of trade, while they have necessitated the removal of keels from the middle line of the ship to the sides, have brought about such a change in the form of the section as to render the new position by far the most effective. In the old pointed-bottomed ship, the central keel was the best, as it not only intercepted the currents flowing round the bottom in each swing from side to side, but also produced a difference of pressure on the two sides whose moment was always opposed to rolling. In the modern flat-bottomed ship of rectangular section a central keel would be unfavourably placed for this purpose, as not only would the water tend to flow in the same direction as that in which the ship is rolling, producing a diminished pressure on the keel, but the differences of pressure on the sides of the ships would have a moment tending to diminish the resistance to rolling. The favourable position now commonly assigned to the bilge-keel is calculated to render its addition to ships of the greatest value in increasing their steadiness.

G. H. BRYAN.

THE "ORTHOSTIGMAT" LENS.

A SPECIMEN of the new series of lenses issued under the joint auspices of Messrs. Beck and Steinheil, has been tested and examined by us. The lens is of the rectilinear symmetrical type with two equal combinations, each consisting of three elements. It is by special construction of the surfaces of these components that the remarkable qualities claimed for, and undoubtedly possessed by, the new lens are attained. The great drawback to the best of the old type lenses was the curvature of field, and it is only in recent years that the discovery of the new varieties of glass has made it possible to correct this, and at the same time perfect the corrections for spherical aberration and astigmatism. The result of the process is that each component of the lens is made up of a positive meniscus, with a double convex lens cemented on one side of it and a double concave one on the other. The centre positive lens will consequently have a lower power than the two outer ones.

When it is understood that each of the twelve surfaces involved in the complete lens is worked with such accuracy that an error of 1/40,000th of an inch is inadmissible, the increased price, compared with the old types of lenses, is amply accounted for in the superior product obtained.

We have tested the lens, which is of about $4\frac{3}{4}$ inches solar focus, and are quite satisfied that it fulfils to a high degree of perfection the claims made for it by the makers. Although the lens is listed for ¼ plate, the circle of good definition is much larger, and with a stop of $f/16$ excellent definition was obtained over the whole of a ½ plate. The lens at its greatest rapidity works at $f/6{\cdot}3$, and at this aperture the definition appears very perfect over an area $4\frac{1}{4}$ inches square. The makers call attention to the special attempts they have made to eliminate astigmatism, and it is not until an oblique pencil falls considerably beyond the listed angle that any distortion shows itself. To make this clearer, let the image of the sun, moon, a star, or any distant object, be focussed at the centre of the plate, and then the camera so tilted that the image falls gradually away to the extreme corner. The slightest distortion can be at once recognised in this manner. With the lens in question no distortion was evident until the image was received at an angle of about 30 degrees from the axis, and for another 10 degrees further the resulting astigmatism, although present, was much less than is present closer to the axis in a rectilinear of the ordinary type. So that for an angle of view of over 60° the new lens is practically non-astigmatic at the large aperture $f/6{\cdot}3$. This will recommend it especially for all process and copying work, where critical definition and speed are primary necessities. A word should be said concerning the focussing with these new lenses. This adjustment must be critical, as an almost imperceptible displacement of the plate will suffice to throw it out of the focal plane sufficiently to destroy the definition, and so create false impressions of the capabilities of the optical system. For all such work, therefore, only perfectly rigid apparatus is permissible.

Another important qualification of the lens is its comparative freedom from chromatic aberration, in virtue of which it will be useful for work connected with colour photography, obviating the laborious and uncertain corrections which are necessary in such work with the ordinary lenses, whose chromatic aberrations are only suppressed for the blue and yellow. Critical tests of this correction have not been possible, but sufficient have been made to show that the outstanding error is small.

On account of their covering power, the smaller sizes will be found excellent for low-power microphotography. The new lenses are obtainable with foci varying from $3\frac{1}{2}$ in. to $23\frac{1}{2}$ in., covering plates from $3\frac{1}{4}$ in. square to 28×24 inches.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Romanes Lecture will be delivered by Dr. James A. H. Murray on Friday, June 22, upon "The Evolution of English Lexicography."

Sir William Thiselton-Dyer, F.R.S., has been made a permanent elector to the Sherardian Professorship of Botany, in succession to the late Prof. Bartholomew Price.

The Statute instituting Diplomas in Geography has been approved by Convocation, and is to remain in force until October, 1904.

The extensive bequest to the University under Mr. Fortnum's will has made an enlargement of the Ashmolean Museum necessary. The cost is estimated at 1500*l.*, and towards this sum Brasenose College has offered a contribution of 500*l.*

At Merton College there will be an election to a fellowship on October 6, after an examination in Animal Physiology and Animal Morphology. Candidates are requested to inform the Warden by September 10 of their choice between these two subjects, and to submit, if they wish, original papers or memoirs.

At a meeting of the Oxford University Junior Scientific Club, held on Wednesday, June 6, Sir John Burdon Sanderson, F.R.S., gave an account of the method he has been lately employing for producing tetanus in muscle, by means of telephone currents produced by musical sounds, showing how the results bear on the vexed question of the inherent rhythmicality of muscle and nerve-cell. The lecture was illustrated by experiments.

At a meeting of the above club held on Friday, June 15, Mr. T. C. Porter, of Eton College, described the growth of the shadow of the Peak of Teneriffe, as witnessed from the summit of the mountain at sunrise and sunset, and its gradual eclipse by the shadow of the earth. He showed photographs taken at the time, and explained how by means of an ordinary watch and pair of opera glasses a rough value of the diameter of the earth might be deduced.

Mr. A. F. Walden, New College, made a preliminary communication to the club on the theory of labile hydrogen atoms.

CAMBRIDGE.—The researches of Mr. J. C. McLennan on electrical conductivity in gases traversed by kathode rays, and of Mr. R. L. Wills, of St. John's College, on the magnetic properties of iron as influenced by temperature and the presence of other elements, have been approved by the Degree Committee as qualifying for the B.A. degree.

In the Natural Sciences Tripos, which is now the largest of the Honour Examinations, forty men and three women are placed in the first class of Part I. In Part II. fourteen men and no women obtain first-class honours.

At St. John's College the following awards in natural science were made on June 18. Foundation Scholars continued or elected: Lewton-Brain, May, Adams, Ticehurst, Fletcher, Browning, Wakely, Gregory, Williams, Harding, Hepworth,

Pascoe, King, Macalister, Mitchell. Exhibitioners: Crocker, Denham, Simpson, Balls. Hockin Prizeman (for electricity): Browning. Engineering Scholar: Paton.

THE attention of teachers and others engaged in schools is directed to the appeal made by Prof. Karl Pearson in our correspondence columns. Observations of the physical and mental characters of children are required, and measurements of the head, in order to provide material for an investigation of heredity upon which Prof. Pearson is engaged. There should be no difficulty in obtaining the co-operation of masters and mistresses in schools in this work, for the observations and measurements can be made with very little trouble, and they are of as much interest from an educational point of view as they are to biological science.

SCIENTIFIC SERIAL.

Bulletin of the American Mathematical Society, May.—The number opens with four papers read before the Society at the dates annexed: On the geometry of the circle, by Dr. V. Snyder (December 28, 1899); isomorphism between certain systems of single linear groups, by Prof. L. E. Dickson (February 24); the Hessian of the cubic surface ii., by Dr. J. I. Hutchinson (February 24); and note on the group of isomorphisms, by Dr. G. A. Miller (February 24). These papers are short and, in the main, continuations of work previously published by the authors.—Prof. F. S. Woods contributes an interesting sketch of a German translation, by F. Engel, of two articles by Lobachevsky, with the titles "Ueber die Anfangsgründe der Geometrie" and "Neue Anfangsgründe der Geometrie mit einer Vollständigen theorie der Parallellinien." The reviewer's conclusion is that, "while it is remarkable that the solution of a two-thousand-year-old problem should be given almost simultaneously by three men, it should be remembered that these three were not the only mathematicians who had worked upon the problem. More than one had missed the solution by a hair's breadth only; Lobachevsky, Bolyai and Gauss succeeded in finding it."—Other notices are Vogt's "Algebraic solutions of equations," by J. Pierpont; the elements of the differential and integral calculus, based on the work by Nernst and Schönflies (translated by W. A. Young and C. E. Linebarger), by L. E. Dickson; and E. Pascal's "Die Variationsrechnung," by J. K. Whittemore.—University and general mathematical information come into the "Notes" and "New Publications."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 5.—"The Kinetic Theory of Planetary Atmospheres." By Prof. G. H. Bryan, F.R.S.

The application of the kinetic theory to the atmospheres of planets dates from the paper of Waterston, who gave an investigation based on the then only possible assumption of equal velocities for all molecules, an assumption since known as Clausius' law. Of later papers reference is due in especial to Dr. Johnstone Stoney's memoir "Of Atmospheres on Planets and Satellites" (*Trans.* R Dublin Soc.), in which the test of permanence of a gas in the atmosphere of a planet is made to depend on the ratio of its velocity of mean square to that relative velocity which would enable a suitably projected body to escape from the planet's attraction. If it be admitted, as Dr. Stoney assumes, that helium cannot exist in our atmosphere, it follows that vapour of water cannot exist on Mars.

The author's object has been to investigate the logical conclusions obtained by applying the Boltzmann-Maxwell distribution to the atmospheres of planets. In 1893 calculations were made, having special reference to the absence of atmosphere from the moon, but these took no account of axial rotation. When this cause is taken into account, the distribution of co-ordinates and *relative* velocities of the molecules is found to be the same as if the planet were at rest, and "centrifugal force" applied to the system. The surfaces of equal density are of the forms originally investigated by Edward Roche, of Montpellier, and they cease to be closed surfaces when passing to the outside of the point on the equatorial plane where centrifugal force just balances the planet's attraction. Calling the surface through this point the "critical surface," the density of molecular distribution over this surface must be very small to ensure permanence. The ratio of the density at the planet's surface to the density at the critical surface has been called the "critical density ratio," and the author calculates its logarithm for particular gases at different temperatures on the various planets. The use of this logarithm has the advantage that the calculation can at once be extended to any gas at any temperature.

The high value obtained in the case of helium, considered in reference to the earth, appears to afford abundant proof that if helium existed in our atmosphere it would possess a very high degree of permanence at ordinary temperatures. To test this point further, a calculation is made of the total rate at which molecules would flow across the critical surface, this rate being regarded as a superior limit to the rate at which the planet would lose its atmosphere, since it takes no account of molecules which describe free paths beyond the limit and fall back again. To further exhibit the results in a tangible form, the rate of flow is estimated by the number of years in which the total amount of gas escaping across the critical surface would be equal to the amount of the gas in a layer covering the surface of the planet to the depth of 1 cm. This measure is independent of the actual quantity of the gas under consideration existing in the atmosphere, since, if this quantity be increased, the rate of flow across the critical surface and the amount of gas present in the surface layer 1 cm. thick will be increased in the same proportion.

If a gas of molecular weight 2, such as helium, be supposed to exist in the earth's atmosphere, the loss in question would occupy $3{\cdot}5 \times 10^{36}$ years at -73° C., 3×10^{19} years at 27°, $8{\cdot}4 \times 10^{10}$ years at 127° C., 6×10^{5} years at 227° C., and 222 years at 327° C.

If we halve the absolute temperatures, we have the conditions applicable to hydrogen, the losses in question therefore taking place in $8{\cdot}4 \times 10^{10}$ years at -73° C., 6×10^{5} years at -23° C., and 222 years at 27° C.

For water vapour on Mars, the corresponding results are $1{\cdot}2 \times 10^{33}$ years at -73°, $1{\cdot}9 \times 10^{16}$ years at 27°, $2{\cdot}4 \times 10^{9}$ years at 127°, $4{\cdot}3 \times 10^{5}$ years at 227°, and 106 years at 327°.

These figures indicate that helium cannot practically escape from our atmosphere at existing temperatures, nor can vapour of water escape from the atmosphere of Mars. A leakage may, and undoubtedly does, take place, which may appear considerable when estimated by the number of actual molecules escaping, but it is wholly inappreciable relative to the mass of gas left behind.

At a future time it is proposed to examine the corresponding results, based on the hypothesis that the atmosphere of a planet is distributed according to the adiabatic instead of the isothermal law.

"On the Weight of Hydrogen desiccated by Liquid Air." By Lord Rayleigh, F.R.S.

In recent experiments by myself and by others upon the density of hydrogen, the gas has always been dried by means of phosphoric anhydride; and a doubt may remain whether, on one hand, the removal of aqueous vapour is sufficiently complete, and on the other, whether some new impurity may not be introduced. I thought that it would be interesting to weigh hydrogen dried in an entirely different manner, and this I have recently been able to effect with the aid of liquid air, acting as a cooling agent, supplied by the kindness of Prof. Dewar from the Royal Institution. The operations of filling and weighing were carried out in the country as hitherto. I ought, perhaps, to explain that the object was not so much to make a new determination of the highest possible accuracy, as to test whether any serious error could be involved in the use of phosphoric anhydride, such as might explain the departure of the ratio of densities of oxygen and hydrogen from that of 16 : 1. I may say at once that the result was negative.

Each supply consisted of about six litres of the liquid, contained in two large vacuum-jacketed vessels of Prof. Dewar's design, and it sufficed for two fillings with hydrogen at an interval of two days. The intermediate day was devoted to a weighing of the globe *empty*. There were four fillings in all, but one proved to be abortive owing to a discrepancy in the weights when the globe was empty, before and after the filling. The gas was exposed to the action of the liquid air during its passage in a slow stream of about half a litre per hour through a tube of thin glass.

I have said that the result was negative. In point of fact the actual weights found were $\frac{1}{10}$ to $\frac{2}{10}$ milligrams *heavier* than in the case of hydrogen dried by phosphoric anhydride. But I

doubt whether the small excess is of any significance. It seems improbable that it could have been due to residual vapour, and it is perhaps not outside the error of experiment, considering that the apparatus was not in the best condition.

May 31.—"Palæolithic Man in Africa." By Sir John Evans, K.C.B., F.R.S.

In April 1896, just four years ago, I ventured to call the attention of the Society (*Roy. Soc. Proc.*, vol. lx. p. 19) to some palæolithic implements found in Somaliland by Mr. H. W. Seton-Karr. In doing so, I pointed out the absolute identity in form of these implements with those from the valley of the Somme and numerous other pleistocene deposits in North-western Europe and elsewhere; and I cited others from the high land adjoining the valley of the Nile, and from other places in Northern and Southern Africa. I was at the same time careful to point out that though there could be no doubt as to this identity in form, no fossil mammalian or other remains had been found with these African implements. I did not, however, hesitate in claiming them as palæolithic.

Since the publication of my short note, an extensive collection of stone implements formed in Egypt by Mr. H. W. Seton-Karr has been acquired by the Mayer Museum at Liverpool. I have not had an opportunity of examining the specimens, but a detailed account[1] of them, with numerous illustrations, has been published by the Director of the Liverpool Museums, Dr. H. O. Forbes. The majority of the implements are of Neolithic Age or even of more recent date, and with the account of these I need not here concern myself; but the author is at considerable pains to dispute my view that the instruments of palæolithic forms belong to the Palæolithic Period. As he says, Mr. Seton-Karr's statement that he sometimes found spear-heads "on the ground surrounded by a mass of flakes and chips as though the people had dropped their work and fled," is very suggestive and important. He adds, however, that "one such occurrence is almost sufficient in itself, I venture to think, to disprove the high antiquity claimed by Sir John Evans for these implements."

Were it certain that the so-called spear-heads were really of palæolithic form, and had the flakes and chips been fitted on to them so as to reconstitute the original blocks of flint, as has been done in the case of undoubted palæolithic specimens by Mr. Spurrell and Mr. Worthington Smith, the question would still remain to be discussed as to the condition of the localities in relation to subaërial denudation.

It is, however, hardly necessary to discuss these points, as some recent discoveries made in Algeria will, I venture to think, go a long way towards settling the question. I propose, therefore, very briefly to state their nature. About sixty miles to the south-west of the town of Oran, and about ten miles to the north of Tlemcen, on the plateau of Remchi, about a mile to the south of the River Isser, lies a small lake known as Lac Karâr. It occupies a depression in lacustrine limestone of comparatively recent geological date, superimposed on beds of Lower Miocene Age. The level of the water, which is some 15° C. warmer than that of the ordinary springs of the district, and appears to be derived from some deep-seated source, seems to be about 600 feet higher than that of the River Isser. The lake originally filled a much larger part of the depression than it does now, and from its old bed a considerable amount of material has of late years been extracted for the Service des Ponts et Chaussées. This material consists of sand and gravel rich in iron pyrites, in the midst of which lie, pell-mell, bones of animals and stone implements fashioned by the hand of man.

These have for some years been diligently collected by M. Louis Gentil, a geologist, and form the subject of a memoir that has just appeared in *l'Anthropologie* (Tome xi.), by my friend M. Marcellin Boule, of the Galerie de Paléontologie at the Jardin des Plantes, Paris. Some 200 specimens of implements have been submitted to him, of various sizes, and all or nearly all of well-known palæolithic forms, including several with a broad chisel-like end, of which examples have been found in the laterite of Madras and the gravels of Madrid. They are for the most part formed of an eocene quartzite, though some smaller specimens of the type known as that of "le Moustier" are formed of flint. The *facies* of these latter is not so distinctly palæolithic as that of the former, of which some, through the kindness of M. Marcellin Boule, are exhibited.

The most important part of the discovery is that which relates to the mammalian remains found with the implements. These are of elephant, rhinoceros, horse, hippopotamus, pig, ox, sheep, and certain cervidæ. I will not detain the Society with the details given in M. Boule's memoir, but I may call attention to the fact that the elephant is not the African elephant, but one more nearly related to the quaternary or even pliocene elephants of Europe, to which the designation Atlanticus has been given. Some teeth seem closely allied to those of *E. meridionalis* and even *E. armeniacus*. Having regard to the whole fauna, M. Boule arrives at the conclusion that it is identical with that of the fossiliferous deposits of Algeria, which from their topographical or stratigraphical characteristics have been assigned to the Quaternary or Pleistocene Period. He also cites other instances in Algeria, such as Ternifine and a station near Aboukir, in which palæolithic implements have been found associated with the remains of a similar pleistocene fauna.

Altogether, these recent discoveries in Northern Africa tend immensely to strengthen my position with regard to the truly palæolithic character of the implements found in other parts of that vast continent, and I am tempted to bring for comparison some few specimens from South Africa. One of these, found by Mr. J. C. Rickard at the junction of the Reit and Modder twenty years ago, is almost indistinguishable from those of the Lac Karâr, as is also one from the valley of the Embabaan in Swaziland. But the most remarkable is an implement of typically palæolithic character found in 1873 under 9 feet of stratified beds at Processfontein, Victoria West, by Mr. E. J. Dunn.[1] May the day be not long distant when researches for the implements of palæolithic man may again be carried on, and trenches be dug in South Africa for peaceful instead of warlike purposes.

Anthropological Institute, June 5.—Mr. C. H. Read, President, in the chair.—Dr. J. G. Garson explained in detail the metric system of identification of criminals which is in use in this country. This system, which is a modification of the Bertillon system employed in France, consists in measuring as accurately as possible certain dimensions of the individual, and classifying them, according as they prove severally large, medium or small, in such a way that the search for any single set of measurements at the central office is curtailed to the utmost. Finger prints are used, as an additional proof of identity, on the back of the card which carries the record of the measurements. The paper was illustrated by diagrams and examples of the measurements and of the instruments which are employed; and was followed by a discussion.

June 12.—Mr. C. H. Read, President, in the chair.—The secretary exhibited, on behalf of Mr. H. Swainson Cowper, a primitive figurine from Adalia in Asia Minor, which presented analogies with the "owl-faced idols" found on the site of Troy by Dr. Schliemann.—Mr. B. H. Pain read a paper on Eskimo craniology, in which he stated that from observations on a number of living Eskimo, lately in London, he had been enabled to extend the comparisons instituted by Virchow between the dimensions of the head and those of the skull in this race. Reference was incidentally made in the paper to the collection of Eskimo crania at Cambridge (of which a descriptive note was published in the *Journal* of the Anthropological Institute, 1895), as well as to the large collection of crania of Greenlanders in the Anatomical Museum at Copenhagen. The paper was fully discussed by M. J. Deniker, Dr. Garson, Mr. Duckworth and Mr. Shrubsall.—Mr. W. L. H. Duckworth read a paper on the skeletal characters of the Mori-ori of the Chatham Islands. The result of his observation and measurement of ten skulls and two complete skeletons of Mori-ori (from the Chatham Islands) is a general corroboration of the earlier results of Turner (*Challenger* Report) and Scott (*Transactions* of the New Zealand Institute) as to the characters of the skeletons of these Pacific Islanders. Special notice was directed to the frequency of occurrence of osteo-arthritis, as evidenced by the condition of the sacrum, innominate bones and femora especially, and to the rare form of occipito-atlantic articulation in one of the specimens. The paper was followed by a discussion.—Mr. J. Gray gave a summary of the anthropometric survey conducted by Mr. James Tocher and himself in East Aberdeenshire, and exhibited diagrams showing the relative frequency and the local

[1] *Bull. Liverp. Mus.*, II., Nos. 3 and 4 (Jan. 20); NATURE, vol. lxi. April 19, p. 597.

[1] See also a paper by M. E. T. Hamy in the *Bulletin du Muséum d'Histoire Naturelle*, 1899, No. 6, p. 270.

distribution of various types of complexion, &c.—A paper, by Mr. D. MacIver, on recent anthropometrical work in Egypt, was taken as read.

EDINBURGH.

Royal Society, June 4.—Prof. M'Kendrick, Vice-President, in the chair.—Dr. R. Stewart McDougall read a paper on the biology of certain species of *Pissodes* and *Scolytus*. *Pissodes* is a genus of Coleopterous insects very harmful to pine trees in Great Britain, the eggs being laid under the bark, and the grubs tunnelling in the Cambial layer. In working out the life-history of *P. notatus*, a pest on young pines, and of *P. pini*, which attacks chiefly grown trees, the author found that imagos could be obtained from March to November, and that breeding might take place from April to September inclusive. A remarkable feature was the long life of adult beetles of both sexes, with repeated copulation. Specimens of *P. notatus* had lived 22, 24 and 37 months, hibernating twice in the first two cases and three times in the last case. Marked adults kept in confinement, but otherwise in natural conditions, began hibernation in November, and appeared above ground again in the following March. *Scolytus multistriatus* attacks the elm—almost invariably dead or decaying trunks or branches. Attempts to develop the eggs in living trees had failed. The beetles are late swarmers, appearing chiefly in July. The generation is an annual one.—Sir John Murray read a paper on the physical, chemical, and biological conditions of the Black Sea. Certain peculiar features were pointed out, notably the presence of a cold layer at a depth of 50 fathoms, the deeper waters being warmer; the lack of vertical circulation, and the consequent stagnation of the deep waters, which can find no outlet through the comparatively shallow straits; the presence of sulphuretted hydrogen and the absence of oxygen in these depths; the absence of animal life there; and the deposit of carbonate of lime on the bottom. This carbonate of lime was not of organic origin, but was formed by chemical action, the sulphuretted hydrogen being one of the products. The special interest of the inquiry arose from the fact that in several of these particulars the Black Sea conditions differed fundamentally from conditions that obtained in oceans and other ocean-connected seas.

Mathematical Society, June 8.—Mr. R. F. Muirhead, President, in the chair.—The following papers were read:—(1) A general proof of the addition theorems in trigonometry; (2) a slight extension of Euler's theorem on homogeneous functions, by W. Edward Philip; note on proofs by projection in trigonometry and co-ordinate geometry, by Prof. Gibson.

PARIS.

Academy of Sciences, June 11.—M. Maurice Lévy in the chair.—Reduction of certain problems of heating or cooling by radiation to the more simple case of heating or cooling of the same bodies by contact; heating of a wall of indefinite thickness, by M. J. Boussinesq.—On the radiation of uranium, by M. Henri Becquerel. The rays from uranium are deviable in a magnetic field, although on account of the comparatively feeble action of the uranium radiations, the time of exposure of the photographic plates has to be very long. Uranium salts treated with barium salts and a sulphate have their radioactivity reduced. The author has not been able to obtain an inactive uranium salt.—Researches on the pressures of saturated mercury vapour, by MM. L. Cailletet, Colardeau and Rivière. An experimental study of the vapour pressure of mercury from its boiling point up to about 880°. At the point where the pressure is about 160 atmospheres, the experiments were stopped by the iron tubes allowing the mercury to pass through them, thus rendering the study of the critical phenomena of mercury impossible. The pressures were read on a metallic manometer which had been directly calibrated against a mercury column, and the temperatures on a thermo-couple.—On the β-phenyl and β-benzyl-α-alkoxy-α-cyanoacrylic acids, by MM. A. Haller and G. Blanc. Starting with phenylacetylcyanacetic and benzylacetylcyanacetic esters, the silver salts are prepared and these treated with alkyl iodide. The esters so obtained are isomeric with the benzoylcyanacetic esters, and are clearly derivatives of crotonic acid.—Note on an earthquake in Mexico on December 19, 1899, by the French Consul in Mexico.—On a photograph obtained at the Observatory of Algiers during the total eclipse of the sun of May 28, by M. Ch. Trépied.—On the polarisation of the corona of the sun observed at Elche, by M. P. Joubin. The experiments of Prazmowski and Ranyard were confirmed. Further observations with a Bravois bi-plate showed that for all points of the sun's limb between the equator, and about 15° to 20° from the north solar pole, there was no elliptical polarisation. Above this, the colours of the two plates could be clearly distinguished.—The method of Neumann and the problem of Dirichlet.—On the class of primitive continuous finite groups of transformations of Lie, by M. Edmond Maillet.—On the logarithms of the algebraical numbers, by M. Carl Störmer.—On the angular points of solubility curves, by M. H. Le Chatelier.—On the electrical distribution in a Hertz resonator in activity, by M. Albert Turpain.—Permanent modifications in metallic wires and variation of their electrical resistance, by M. H. Chevallier.—On the kathode rays, by M. P. Villard. A study of the heating effect produced upon the kathode. The usual metal electrodes can be replaced by ordinary lamp filaments, the kathode in this case being rapidly raised to a white heat. The fall of potential necessary for the production of light by a filament in this way is much greater than when the carbon is heated by the ordinary Joule effect.—The campylograph, a curve-tracing machine, by M. Marc Dechevrens. A new method of producing Lissajous figures. Instead of being confined to compounding two rectangular motions only, the instrument can combine three simultaneous movements, two rectilinear and oscillatory, the third uniform and circular. Seventeen illustrations of the results obtainable accompany the paper.—Heat of solution of hydrogen peroxide. Thermal value of the hydroxyl group: influence of carbon and hydrogen, by M. de Forcrand.—On the direct production by the wet method of mercuric and mercurous iodides in the crystalline state, by M. F. Bodroux. Mercuric iodide can be crystallised in octahedra from boiling concentrated hydrochloric acid or from a solution of potassium iodide. A better method is to leave mercuric acetate in contact with methyl iodide. The substitution of mercurous nitrate for mercuric acetate yields large crystals of mercurous iodide.—On the impossibility of the primary formation of potassium chlorate obtained electrolytically, by M. André Brochet. The electrolysis was carried out in presence of large amounts of oxide of cobalt. Since hypochlorites are destroyed by this oxide, whilst chlorates are unaffected, only chlorate which has been formed by primary interaction of the ions will be found. Since no chlorate is produced under these conditions, it follows that in the electrolysis of alkaline chlorides, contrary to the hypotheses of Œttel, Haber and Grinberg, Forster, Torre and Müller, the formation of chlorate is never due to a primary action, but is always due to the intermediate formation of hypochlorites, even in a strongly alkaline medium.—On the decomposition of metallic chlorides, by M. Œchsner de Coninck.—Addition of hydrogen to acetylene in presence of reduced iron or cobalt, by MM. Paul Sabatier and J. B. Senderens. At 180° reduced iron causes the interaction of hydrogen and acetylene, ethane, ethylene, benzene and higher unsaturated hydrocarbons being produced. Cobalt under similar conditions gives a much larger yield of ethane compared with that previously noticed for nickel.—On a product of decomposition of a diiodhydrin of glycerol, by MM. E. Charon and C. Paix-Séailles. The substance formed by the elimination of hydriodic acid from the iodhydrin, $CH_2I.CHI.CH_2OH$, is β-iodopropionaldehyde, most probably the polymer $(CH_2I.CH_2.CHO)_3$.—Action of acetylene upon cuprous chloride dissolved in a solution of potassium chloride, by M. Chavastelon.—On acidimetry and alkalimetry in volumetric analysis, by M. A. Astruc.—Fixation of clay in suspension in water by porous bodies, by M. J. Thoulet. Analysis of marine deposits consisting largely of shells, showed great variations in the amount of clay present, and it appeared possible that this clay might have been abstracted from the water after the death of the animal by mechanical means. Experiments with powdered pumice stone and with wood charcoal confirmed this view.—Preliminary note on the decapod crustacea collected during the Belgian Antarctic expedition, by M. H. Coutière.—The embryos of mummy wheat and barley, by M. Edmond Gain. A microscopical examination showed that in spite of their external appearance of good preservation, the mummy cereals do not possess a cellular organisation compatible with germination.—The ratio of nitrogen to chlorides in the contents of the stomach during digestion, by MM. J. Winter and Falloise.

ST. LOUIS.

Academy of Science, May 23.—A paper by Dr. Adolf Alt, entitled "Original contributions concerning the glandular structures appertaining to the human eye and its appendages," was presented by title.—Dr. M. A. Goldstein read a paper on the physiology of voice production, in which he discussed three essential factors in the production of voice—the motor force, the organ of sound, and the resonators.—Prof. F. E. Nipher read a short communication on the zero photographic plate, to which reference was made at the meeting of May 7 (see pp. 62, 159). The zero plate is one upon which a photographic image has been made, but which will develop no image in a bath placed in light of given candle power, at a distance of one metre from the source. For example, if the developing bath is twenty centimetres from a sixteen candle lamp, a Cramer isochromatic plate, such as is called "instantaneous," held for ninety seconds at a distance of one metre from the lamp, will be a zero plate. With an opaque stencil over the plate when placed in a printing frame during the exposure, there will develop a positive of holes through the stencil, if the exposure is longer, and a negative if the exposure is shorter. If a fresh plate is exposed in our camera with full opening to a brilliantly lighted street scene for one minute, it will develop as a positive in that same bath. This time can be somewhat reduced, but the least time needed has not yet been determined. It is evident that part of this minute is used in producing a zero plate. It is furthermore clear that different parts of the plate will arrive at the zero condition at different times. The exposure may be arrested at a time when the strongly lighted white background of a sign-board will develop white as a positive, and when the black letters will also show white as a negative. It has been found that when a plate is uniformly exposed over its whole surface to the extent that nothing would have developed had it been covered by a stencil, this plate may then be placed in a camera and exposed in the ordinary way, and a perfect positive will develop in the bath to which it has been adapted. This preliminary spoiling of the plate for developing a negative is a very advantageous preparation for taking a positive. It shortens the time of exposure, and ensures that a positive shall be obtained over all parts of the plate. It is not yet known how short the camera exposure may be made, but the present indications are that they will be as short as those now made in the taking of negative pictures. It is currently believed by photographers that in a positive plate the object has "printed its picture" upon the plate. This appears to be a misconception of the process. It is true that in an exposure of long duration an image shows on the plate before it is placed in the bath. But this image is blackest where the light has acted most. It is a negative. This picture disappears in the developing bath when illuminated. The plate becomes perfectly clean. The positive picture then develops exactly as a negative would under ordinary conditions.—Mr. J. B. S. Norton presented some notes on the flora of the south-western United States

DIARY OF SOCIETIES.

THURSDAY, JUNE 21.

ROYAL SOCIETY, at 4.30.—On the Effects of Changes of Temperature on the Elasticities and Internal Viscosity of Metal Wires: Prof. A. Gray, F.R.S., V. J. Blyth, and J. S. Dunlop.—On the Connection between the Electrical Properties and the Chemical Composition of Different Kinds of Glass, Part II.: Prof. A. Gray, F.R.S., and Prof. J. J. Dobbie.—On the Change of Resistance in Iron produced by Magnetisation: Prof. A. Gray, F.R.S., and Prof. E. T. Jones.—Underground Temperature at Oxford in the Year 1899, as determined by Five Platinum Resistance Thermometers: Dr. A. A. Rambaut, F.R.S.—On the Kinetic Accumulation of Stress, illustrated by the Theory of Impulsive Torsion: Prof. K. Pearson, F.R.S.—Lines of Induction in a Magnetic Field: Prof. Hele-Shaw, F.R.S., and A. Hay.—On the Spectroscopic Examination of Colour produced by Simultaneous Contrast: G. J. Burch, F.R.S.—An Experimental Investigation into the Flow of Marble: Dr. F. D. Adams and Dr. J. T. Nicolson.—A Criticism of the Young-Helmholtz Theory of Colour Perception: Dr. F. W. Edridge-Green.—And other Papers.

LINNEAN SOCIETY, at 8.—On some Scandinavian Crustacea: Dr. A. G. Ohlin.—The Subterranean Amphipoda of the British Islands: Chas. Chilton.—On certain Glands of Australian Earthworms: Miss Sweet.—Notes on Najas: Dr. A. B. Rendle.

ZOOLOGICAL SOCIETY, at 4.30.—The Gigantic Sloths of Patagonia: Prof. E. Ray Lankester, F.R.S.

ANATOMICAL SOCIETY (Owens College, Manchester), at 10.30.—Lantern Demonstration on the Comparative Anatomy and Histology of the True Cæcal Apex—the Appendix Vermiformis: Dr. R. J. Berry.—Lantern Demonstration of some Surface Markings of the Calvaria, and their Significance: Prof. Dixon.—Lantern Demonstration of Microphotographs of the Maturation Stages in the Ovum of Echinus: Dr. T. H. Bryce.—Some Points in the Anatomy of the Digestive System: Prof. Birmingham.—(*a*) Two Cases of Absent Vermiform Appendix; (*b*) A Specimen showing Direct Continuity between the Long External Lateral Ligament of the Knee-joint and the Peroneus Longus Muscle; (*c*) A Supernumerary Bone in the Carpus connected with the Trapezium: Prof. Fawcett.—A Note on the Genital Apparatus of the Jerboa: Dr. Armour.

CHEMICAL SOCIETY, at 8.—Ballot for the Election of Fellows.—Notes on the Chemistry of Chlorophyll: Dr. L. Marchlewski and C. A. Schunck.—Researches on Morphine, I.: Dr. S. B. Schryver and F. H. Lees.—A New Series of Pentamethylene Derivatives, I.: Prof. W. H. Perkin, jun., F.R.S., Dr. J. F. Thorpe, and C. W. Walker.—Experiments on the Synthesis of Camphoric Acid. III. The Action of Sodium and Methyl Iodide on Ethyl-dimethyl-butanetricarboxylate: Prof. W. H. Perkin, jun., F.R.S., and Dr. J. F. Thorpe.—On the Oxime of Mesoxamide and some Allied Compounds: Miss M. A. Whiteley.—The Oxyphenoxy- and Phenyleneoxy-acetic Acids: W. Carter and Dr. W. T. Lawrence.—(1) The Condensation of Ethyl α-Bromo-isobutyrate with Ethyl Malonates and Ethyl Cyanacetates: α-Methyl-α'-isobutylglutaric Acid; (2) Methylisoamylsuccinic Acid, II.: Dr. W. T. Lawrence.

FRIDAY, JUNE 22.

PHYSICAL SOCIETY, at 5.—Notes on Gas Thermometry: Dr. P. Chappuis.—A Comparison of Impure Platinum Thermometers: H. M. Tory.—On the Law of Cailletet and Mathias and the Critical Density: Prof. J. Young, F.R.S.

ANATOMICAL SOCIETY (Owens College, Manchester), at 10.30.—Note on the Configuration of the Heart in a Man and some other Mammalian Groups: Dr. C. J. Patten.—On the Arrangement of the Pelvic Fasciæ and their Relationship to the Levator Ani: Dr. Peter Thompson.—(*a*) A Preliminary Note on the Development of the Sternum; (*b*) Specimens of Diaphragmatic Hernia and of a Left Inferior Vena Cava: Prof. Paterson.—Preparations and Lantern Slides illustrating: (*a*) The Anatomy of the Subclavian and Axillary Arteries; (*b*) The Position and Relations of the Eustachian Tubes: (*c*) Stereoscopic Views of Anatomical Preparations: Dr. Arthur Robinson.—A Series of Microscopical Preparations illustrating the Development of the Posterior End of the Aorta: Prof. Young and Dr. Arthur Robinson.—Demonstration of a Series of Preparations of the Posterior End of the Adult Aorta: Prof. Young.

MONDAY, JUNE 25.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Results of the Sir George Newnes Antarctic Expedition: C. E. Borchgrevink.

TUESDAY, JUNE 26.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—The Selection of Lenses with regard to Photographic Perspective: J. H. Agar Baugh.—How to ascertain the Conjugates of a Lens without Calculation: Rev. F. C. Lambert.

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