THURSDAY, MARCH 21, 1901.

CELTIC TRADITIONS AND ANTHROPOLOGY.

Celtic Folk-lore, Welsh and Manx. By John Rhys, M.A., D.Litt., Hon. LL.D. of the University of Edinburgh, Professor of Celtic, Principal of Jesus College, Oxford. 2 vols., paged consecutively. Pp. xlviii+718. (Oxford: Clarendon Press, 1901.) Price 21*s*.

PROF. RHYS has done well to republish, in these two handsome volumes, the collections of Celtic Folk-lore contributed by him to the pages of *Y Cymmrodor* and the *Transactions* of the Folk-lore Society. For not only are they thus rendered accessible to a larger number of readers, but he has enriched them with considerable additions, and a valuable commentary. Had he seen his way to recast the original articles, with a view to a more complete classification of their contents, it would have avoided some repetition, and would have set the relations of the various tales in a clearer light. But we must be grateful for the work in its present form. To recast the articles would have been a troublesome process, and perhaps no classification would have been entirely satisfactory. Moreover, we should certainly have missed in any such rearrangement much of the genial charm of the collections as they first came from his pen, derived from the personal narrative of the collector. To a large number of his readers this would have been a sacrifice they might not be willing to make, even for the sake of theoretical order. When, however, the severely virtuous student, who, intent only on what he is to learn, would have preferred to make this or any other sacrifice, has calmed his ruffled feelings and settled down to his task of learning, he will speedily realise how important a contribution to anthropology, and in particular to Celtic archæology, he has before him.

The chief intent which runs through the commentary is to determine so far as possible the race-elements that have gone to fashion the composite people of Wales, now so thoroughly welded together in historical memories and in political, religious and artistic aspirations. To this Prof. Rhys makes the whole of his collection subservient. Though he modestly disclaims the title of "folk-lorist," no living man has probably so wide a knowledge of the folk-lore of his native country, and certainly none has brought to its elucidation a scholarship so profound. His open-mindedness and candour are as remarkable as his scholarship. Consequently the present work is greatly in advance of his Hibbert Lectures as an exposition of the origin and real meaning of Celtic traditions. His theory, as summed up in the final chapter, is that in these traditions we have traces of at least two pre-Celtic races: first, a dwarf population inhabiting underground dwellings, and at a level of civilisation no higher than that of the present-day inhabitants of Central Australia; and secondly, the enigmatical people over whom Monkbarns and his guest fought with so much vigour, the Picts, "whose affinities appear to be Libyan, possibly Iberian." That a dwarf race was widely spread over this island cannot be questioned. Whether the beehive huts of Scotland and Ireland belonged to them is not quite so certain. In Roman times, and in the south of what is now England, they occupied ordinary wattle-and-daub huts. Prof. Rhys attributes wholly or partially to them birth-stories like those of Cuchulainn and Etain, of which the chief characteristics are virgin-birth and re-incarnation. He acutely points out that in the Cuchulainn story we have "two social systems face to face in Ulster," one of which recognised fatherhood, while the other did not. But alike the story-incidents and the corresponding superstitions are known practically all over the world. It is therefore impossible to fix the dwarf-race with responsibility for them. Besides, upon his own showing, the social organisation of the Picts was founded upon mother-right, and it is to the Picts that Scottish tradition assigns the mounds as dwellings.

In my opinion folk-lore seldom yields trustworthy evidence of race. What it does yield is evidence, often of the most decisive weight, of social states, of belief and practice. That the Welsh are descended from a people who were organised on the basis of mother-right, and believed in transformation, Prof. Rhys has rendered fairly certain from the traditions embodied in their literature, or found by himself in the mouths of the peasantry. Whence the organisation and belief in question were derived must be discovered, if at all, from evidence of another kind, that is to say, from philology and archæology. With the aid of his rare philological learning the author has illuminated many a dark place in the *Mabinogion* and in the folk-tales, though he has failed to solve the riddle which would, perhaps, tell us more of the origin of the fairies and of the descent of the Cymric people than any other incident in the stories, namely, the riddle of the non-Welsh names Penelope, Belene and others attributed to the fairy heroines of so many Welsh tales.

If, however, the folk-tales of the present day fail to yield sure evidence of race, some of those embodied in the *Mabinogion* do. But it is to be obtained rather in the names than in the incidents. It is common ground, for example, between Welsh and Irish Celticists, that there is a Goidelic element in the *Mabinogion*. The question is whether the stories were imported ready-made from Ireland, or grew on the soil of Wales and were adopted and adapted by the Cymric-speaking Celts from the Goidelic and Goidelised peoples they found in occupation of the country when they invaded it. The chapter on place-name stories (and in particular Prof. Rhys' analysis of the Hunting of the Twrch Trwyth) has gone far to settle this question. It must now be held, as the better opinion, that the *Mabinogion* stories which point most strongly to Irish influence, or indeed Irish origin, were taken over from the Goidelic substratum of the nation.

It would be easy to linger on many a delightful page of these fascinating volumes. Prof. Rhys always writes with humour. His gravest discourses are tempered with a smile. But, for all that, they are none the less grave in purpose. He has done more than any other man to rouse in his fellow-countrymen an intelligent interest in their history, language and literature. In conjunction with Mr. Brynmor Jones he has placed the study of Welsh history and institutions at last on something like a sound basis. So here he begins by laying down the maxim that—

"the history of no people can be said to have been written so long as its superstitions and beliefs in past times have not been studied; and those who think that the legends here recorded are childish and frivolous, may rest assured that they bear on questions which could not themselves be called either childish or frivolous."

Further on he returns to the subject:

"With regard to him," he says, "who looks at the collecting and the studying of folk-lore as trivial work and a waste of time, I should gather that he regards it so on account, first perhaps, of his forgetting the reality their superstitions were to those who believed in them; and secondly, on account of his ignorance of their meaning. As a reality to those who believed in them, the superstitions of our ancestors form an integral part of their history. However, I need not follow that topic further by trying to show how 'the proper study of mankind is man,' and how it is a mark of an uncultured people not to know or care about the history of the race. So the Roman historian, Tacitus, evidently thought; for, when complaining how little was known as to the original peopling of Britain, he adds the suggestive words *ut inter barbaros* 'as usual among barbarians.' Conversely, I take it for granted that no liberally educated man or woman of the present day requires to be instructed as to the value of the study of history in all its aspects, or to be told that folk-lore cannot be justly called trivial, seeing that it has to do with the history of the race—in a wider sense, I may say, with the history of the human mind and the record of its development."

There are many scientific men who need to lay to heart this protest.

A full index is given, and a most useful bibliographical list of references. E. SIDNEY HARTLAND.

ALKALOIDS.

Die Pflanzen-Alkaloide. By Jul. Wilh. Brühl, Professor in the University of Heidelberg, and Eduard Hjelt and Ossian Aschan, Professors in the University of Helsingfors. Pp. xxii + 586. (Brunswick: Friedrich Vieweg und Sohn, 1900.) Price Mk. 14.

THE progress that has been made in the rapidly developing fields of organic chemistry can be best estimated when recognised authorities, such as the authors of the present volume, furnish chemists with special monographs dealing with those groups of compounds in which the writers can lay claim to an expert knowledge. As a class the vegetable alkaloids, which are dealt with in this volume, are of exceptional interest, not only on account of their wide distribution as natural products, but also because of their remarkable physiological actions. It is interesting to note, in reading through this admirable summary of the existing state of knowledge in this branch of chemistry, what great strides have been made towards a more definite conception of the structure or "constitution" of the molecules of these compounds within the last few years. At the present time, the synthetical achievements in this field are not numerous. The first complete synthesis of an alkaloid was that of coniine by Ladenburg in 1886, followed soon after by the synthesis of trigonelline by Hantzsch and Jahns. The latter chemist succeeded in synthesising arecoline in 1891, and the synthesis of piperine from piperidine and piperic acid by Ladenburg and Scholtz in 1894 may be said to complete the list of total syntheses thus far accomplished. But several partial syntheses have to be recorded, viz. aconitine from aconine and methyl benzoate, cocaine from ecgonine and benzoic anhydride; and one step towards the synthesis of hydrastine was made in 1895 by Fritsch.

The effect of this more intimate knowledge of the chemical constitution of the alkaloids is evident in the classification adopted in the present work. It is, in fact, now possible to refer large numbers of these compounds to different groups, each group having a well-known organic base as its parent form. Every one of the four parent compounds, viz. pyrrolidine, pyridine, quinoline and isoquinoline, are, it may be of interest to point out, capable of being completely synthesised. A brief sketch of the mode of treatment will enable our readers to form an idea of the value of this monograph by Prof. Brühl and his colleagues.

The introductory chapter deals with the history, distribution, preparation and properties, modes of decomposition, synthesis, physiological action, detection and estimation, and other general considerations relating to the group as a whole. This is followed by the chapter on the alkaloids of the pyrrolidine group, which comprises the hygrines and cuskhygrine. The second chapter contains an account of the alkaloids of the pyridine group, the latter comprising twelve subdivisions trigonelline, the jaborandi alkaloids, areca alkaloids, conium alkaloids, piperine, chrysanthemine, nicotine, solanum bases such as atropine, hyoscyamine, tropacocaine, madragorine, &c.; the alkaloids of coca, the alkaloids of pomegranate root-bark, sparteine and cytisine. The third chapter comprises the quinoline group, and, although divided into only two subdivisions, is very rich in individual compounds, since it includes the very numerous cinchona alkaloids and those of the plants belonging to the genus *Strychnos*. In the fourth chapter, the authors treat of the alkaloids of the isoquinoline group, comprising more than twenty opium alkaloids, hydrastine and canadine, and the alkaloids of *Berberis* and *Corydalis*.

The four chapters, the contents of which have been briefly referred to, deal with those alkaloids which are susceptible of chemical classification by virtue of our knowledge of their constitution. Whether with the progress of chemical science any or all of these formulæ may not require modification—and many of them are confessedly but tentative—does not affect the main question as to the atomic complexes from which the various alkaloids are derivable, and the reference of a particular alkaloid to any one of the four groups may be looked upon as a definite allocation of the compound with reference to its parent complex, whether the latter is genetically connected with its derivative by actual laboratory processes or whether the connection has only been inferred by indirect methods. The remaining alkaloids, which are distributed through the sixteen subdivisions constituting the fifth and last chapter, are, however, classified botanically rather than chemically, since their chemical constitution is unknown and only empirical formulæ can at present be assigned. Thus we

have alkaloids from cryptogamic plants such as ergotinine, lycopodine and pillijanine, and then following these the alkaloids from twelve families of flowering plants, viz. Coniferæ and Gretaceæ, Liliaceæ, Apocynaceæ, Aristolochiaceæ, Buxaceæ, Lauraceæ, Papilionaceæ, Loganiaceæ, Papaveraceæ, Ranunculaceæ, Rubiaceæ and Rutaceæ. A number of odd alkaloids and a few glyco-alkaloids conclude the work. In some of the numerous alkaloids considered as of unknown constitution, a certain amount of knowledge may be said to have been acquired in the direction of structural formulation. To illustrate this point, consider, for example, colchicine from *Colchicum autumnale*, which is empirically written $C_{22}H_{25}NO_6$. It is known, chiefly through the researches of Zeisel, that this alkaloid is a methyl ester containing four methoxy-groups and one acetamino-group. Its formula thus becomes :—

$$C_{15}H_9(OCH_3)_3\begin{cases}COOCH_3\\NH\,.\,COCH_3\end{cases}$$

and it is obviously a derivative of a phenolic amino-acid. But the constitution of the hydrocarbon complex $C_{15}H_9$ is still unknown, and the placing of the compound among the alkaloids of unknown constitution is thus justified. It is of interest to note in passing, as an illustration of the richness of this field of plant chemistry, that in this fifth chapter alone more than one hundred alkaloids of unknown constitution, but which are nevertheless definite chemical "individuals," are treated of. It may be further mentioned that under the term glyco-alkaloids the authors comprise compounds such as achilleine, solanine, moschatine and vicine, which split up on hydrolysis into glucose and a base.

A work such as that which forms the subject of the present notice cannot be criticised as a literary production. It belongs to that class of books which, being of the nature of monographs, are absolutely indispensable to all who are interested in the progress of organic chemistry, whether as students, investigators, teachers, pharmacologists or manufacturers. It sums up and presents in a systematised form the achievements of research in this particular field, and as a special work it may be said to have no competitor since, as the authors point out in the preface, the standard works on this subject by Pictet (1891) and Guareschi (1896) are already behind the actual state of knowledge in this domain, the boundaries of which are being extended with such astonishing rapidity. In writings of this class, where chemical compounds are dealt with from the historical point of view as well as from the most recent standpoint, there is often a tendency to spin out the history in wearisome detail. No fault can be found on this score with the authors' treatment ; their general histories, as well as their histories of the individual alkaloids, are marvels of succinctness. We have long been in the habit of looking to continental writers for such monographs, and if our own specialists have hitherto failed in contributing such standard works to chemical literature, there is some compensating satisfaction in the present case, since the volume under notice is a special contribution to the German edition of an English work, viz. Roscoe and Schorlemmer's well-known "Treatise on Chemistry." R. MELDOLA.

SOUNDINGS IN THE NORTH ATLANTIC.

On the Results of a Deep-Sea Sounding Expedition in the North Atlantic during the Summer of 1899. By R. E. Peake, M.Inst.C.E. With Notes on the Temperature Observations and Depths, and a Description of the Deep-Sea Deposits in this Area. By Sir John Murray, K.C.B., F.R.S. Pp. 44. (London : John Murray, 1901.) Price 5*s*.

THIS little book, the latest of the "Extra Publications" of the Royal Geographical Society, ought effectually to attain at least one of its main objects, which is "to call attention to the assistance that Telegraph Cable Companies render towards improving our knowledge of the character and condition of the ocean's bed." The immense amount of valuable work done at sea every day by the commanders and officers of all kinds of ships deserves far more cordial recognition than it usually receives, especially in this country. The ordinary navigation of a ship involves daily observations of quite as great difficulty and complexity as any in the routine scientific work of a deep-sea expedition, and sailors not only have done, and do, much in the way of special observations of all kinds, but they are able and willing to do more. All they need is to be told what is wanted, and to be encouraged occasionally by satisfactory evidence that their labour is not thrown away. It may be hoped that the inauguration of the British Pilot Chart of the North Atlantic, and the publication of a paper like the present by the Royal Geographical Society, will lead to still fuller recognition of what must probably remain the only available methods of systematic and continuous investigation in ocean meteorology and oceanography.

The expedition here described was sent out to survey routes of cables which the Deutsch-Atlantisch Telegraphengesellschaft and the Commercial Cable Company had decided to lay ; the former between Germany, the Azores and New York, and the latter between Ireland, the Azores and Nova Scotia. The preliminary survey was undertaken on the advice of Messrs. Clarke, Forde and Taylor, engineers to the companies. Mr. Peake was responsible for the plan of the survey and the supervision of the operations, and the work was carried out by the Telegraph Construction and Maintenance Company's s.s. *Britannia*, Captain H. Woodcock. The *Britannia* left England on May 4, 1899, and returned on August 3, having made 477 soundings, from most of which samples of the bottom were obtained, and 150 observations of bottom temperature. A large number of current observations were also recorded. The route is described as follows :—A large number of soundings were first taken between Fayal and Flores, on the Azores bank ; next a line from south of Flores to New York ; then a line from Cape Canso, Nova Scotia, towards the north of Flores. Different parts of the Azores bank were then surveyed in detail, and a line run to the coast of Ireland ; and finally the ship returned to the Azores bank and sounded north-eastward to the mouth of the English Channel.

The results of the expedition are dealt with under four heads—depths, bottom temperatures, currents, and

nature of the bottom. A new map shows the distribution of deposits in the North Atlantic according to recent information, and an inset, based principally on the soundings of the *Britannia*, shows the outline of the Azores bank.

The lines of soundings fall naturally into three groups; those between the Azores and the British Islands, those between the Azores and North America, and those on the Azores bank. In each case new discoveries of interest have been made. On the first line a new depression, with soundings over 3000 fathoms, the "Peake deep," has been found; but the chief feature is the discovery of numbers of shoals rising steeply from over 2000 fathoms to within 1200 and 1400 fathoms of the surface, evidently the summits of submarine cones. The more southerly of the two lines between the Azores and North America revealed the important fact that the "tail" of the great Newfoundland bank extends much farther south than has hitherto been supposed. The *Britannia* has added largely to Thoulet's chart of the Azores bank, but the ground is so irregular that much sounding still remains to be done; the bank is described as being probably "a series of small hills, no doubt due to volcanic action."

The observations of bottom temperature, which were made with thermometers of Six's pattern, consist of two series of parallel lines, one double line between the Azores and the British Islands, and another between the Azores and America. It is pointed out that, on the whole, these observations give temperatures above the mean assumed in the *Challenger* report for this region of the ocean; but as that value is merely the average of the observations existing at the time, the volume of water at different temperatures not being taken into account, the difference may not be due to actual change. On the other hand, the *Britannia* observations show that in each of the double lines the temperatures are different; of the Azores-America line, the more northerly gave the higher readings at depths below 2000 fathoms; of the Azores-Europe line, the more southerly. It is suggested that these differences are due to actual change occurring between the dates of observation, and this view is supported by reference to the different temperatures observed in the south-west Pacific by H.M.S. *Egeria* in 1889 and H.M.S. *Penguin* in 1897. From the observations of H.M.S. *Jackal* in 1893, the writer showed that in the Færœ-Shetland Channel temperature was not constant at depths of at least 400 fathoms, and it was further shown that the variations were due to differences of level in the movements of water. The results of more recent work go to show that the active circulation of the eastern and western Atlantic consists chiefly of stream currents comparatively near the land, developed by the drift movements of the central areas and altogether separated by them. The currents on the eastern side are chiefly caused by the banking up of water from the west-wind drifts, and while most of this water escapes laterally to north and south, there is also a descending movement—hence the high temperatures in the depths. It is known that the horizontal streams are liable to great variations, partly seasonal, partly irregular, and the observations of the *Britannia* seem to prove that the vertical movements undergo corresponding changes. The variations of temperature may be regarded as directly due to movements of water, and therefore as seasonal in only a secondary sense, if at all.

The samples of deposits collected by the *Britannia*, numbering 432, are very fully described by Sir John Murray. The map shows two considerable alterations when compared with that of the *Challenger* report. First, the red clay area is extended northward from the deep water round Bermuda and passes directly into the blue mud south of Newfoundland. This abrupt transition to a terrigenous deposit is accounted for by the great distance to which continental detritus is carried by icebergs. Second, the pteropod ooze region round the Azores is restricted to a smaller area than before, although it is noted that the characters of this deposit are not well marked, and that it is difficult to classify some samples as pteropod or globigerina with certainty. Many samples from moderate depths near the Azores contain fewer pteropods than those obtained from deeper water farther north.

H. N. D.

OUR BOOK SHELF.

Modern Astronomy. Being some Account of the Astronomical Revolution of the last Quarter of a Century. By H. H. Turner, F.R.S. Pp. xvi+286. (Westminster: Archibald Constable and Co., Ltd., 1901.) Price 6*s.* net.

THE Savilian professor is so strongly impressed with the magnitude of the changes which have taken place in astronomical methods during the last quarter of a century that he does not hesitate to describe them as revolutionary. The task which he has set himself in this book is to give a brief review of the present situation, pointing out the nature of the changes rather than giving a complete account of them or of the discoveries to which they have led. The book can thus in no sense be regarded as a reference or text-book, but it may be remarked that elementary explanations have usually been introduced to make the matter generally intelligible.

Several quotations are given as an indication that about 1875 there was a feeling that novelties in astronomical methods or results were no longer to be expected. Such a feeling, if it existed, was certainly premature. New instruments of precision have been invented or erected; telescopes of increased size and novel construction have been made; photography has come to aid the astronomer in numberless ways; astrophysics has become an important branch of the subject, with almost boundless possibilities; and even in mathematical astronomy new methods of treating the lunar and planetary theories have been introduced.

This progress is treated under the four heads, "Modern Instruments," "Modern Methods," "Modern Results" and "Modern Mathematical Astronomy." Occasional overlapping and repetition is the natural outcome of this classification, but the book provides an interesting and fairly connected account of several departments of astronomical work. The treatment of astrophysics, however, leaves much to be desired. There is practically nothing in the book relating to the great advances in our knowledge of the sun as a result of recent eclipse work, and it is especially to be regretted that the evidences of stellar evolution are not more fully set forth. There are other indications of the author's unfamiliarity with the progress of astrophysics; on p. 239, for instance, he states that no supposition allied to that of a revolving companion will explain the variability of stars in clusters, whereas the collisions of revolving swarms of meteorites at periastron explain the light curves completely. For the sake of historical accuracy,

it should have been stated on p. 91 that the original idea of the spectroheliograph was due to Dr. Janssen, who first suggested it at the Exeter meeting of the British Association in 1869. Again, with reference to the first observation of the spectrum of a nebula, it is stated (p. 242) that "it was seen at a glance that the spectrum consisted of a few bright lines," though the observer at first attributed what he saw to some possible derangement of his instrument.

Looking forward, Prof. Turner believes that, among other changes, the transit circle will be gradually superseded by the almucantar for star observations, and by the heliometer for observations of the positions of planets, and in celestial photography he predicts a great future for the portrait lens.

The illustrations, some thirty in number, are of indifferent quality, and that of Eros, on p. 109, is almost unintelligible.

Chemistry an Exact Mechanical Philosophy. By Fred. G. Edwards, Inventor of Atomic Models. Pp. xii + 100. (London: J. and A. Churchill, 1900.)

"THE object of this work is to determine the exact shape of the atoms, to find their relative position in space, and to show that chemical force is purely a function of matter and motion." Further, "the shapes obtained for the different atoms is the subject-matter of a British patent (atomic models) dated 1897." Again, "the conclusions herein deduced (when accepted as true) will form a fitting climax to the discoveries of a century which has produced the atomic theory of Dalton, the theory of heat as a mode of motion, and the discoveries of the correlation of physical forces, and that force, like matter, is indestructible."

For the scientific reader there is little need to add any comments to these quotations. There is, however, always the possibility that an author may have a good idea but an unfortunate way of presenting it, and one does not forget that "the law of octaves" was received with something like ridicule. It is necessary to add, therefore, that a careful examination of the present work, made with every desire to find precious metal in it, has failed to reveal anything that seems likely to aid the advancement of science.

In dealing with the *exact shape* of atoms, the author starts with the assumption that the lightest known element, hydrogen, consists of two tetrahedra placed base to base, and that the atoms of the whole of the remaining elements may be similarly formed by tetrahedra built up symmetrically, every two tetrahedra representing one unit of atomic weight. It is practically impossible, without the models before one, to judge whether there is any outcome from this view of things that compensates in any degree for its arbitrariness and complexity. There can be little question, however, that as a whole the book and its doctrines will not command the serious attention of men of science whose leisure and patience are limited. A. S.

The Chemists' Pocket Manual. By R. K. Meade, B.S. Pp. vii + 204. (Easton, Pennsylvania: The Chemical Publishing Co., 1900.)

A LARGE amount of information of use to professional chemists is brought together in this pocket book. The tables include almost everything to which occasional reference has to be made in chemical laboratories; and with the formulæ, calculations, physical and analytical methods, should be of service not only to chemists, but also to assayers, metallurgists, manufacturers and students. Among the points worthy of special mention are the applications of graphic methods to conversion tables; and the descriptions of select methods of technical analysis.

LETTERS TO THE EDITOR.

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

The Use of the Method of Least Squares in Physics.

THE application of the method of least squares to physical measurements is described in several standard text-books—to wit, Kohlrausch's "Introduction to Physical Measurements" (third edition, 1894), Stewart and Gee's "Elementary Practical Physics" (1885), and others. In none of these is it pointed out that the method *as set forth* offers in certain cases a choice of results, and that the solution is practically unique only if a sufficient number of observations be taken. Nor is any indication given how the method is to be applied when none but a small number of observations is available. Since the method is intended for use only when a high degree of refinement is aimed at, these points are of practical importance.

As illustrating the necessity for examining the matter, we may take the example given by Kohlrausch on p. 13 of the book referred to above. The object is to determine the law connecting the length L and temperature θ of a standard metre bar from the following four observations:—

θ . . . . . = 20°, 40°, 50°, 60°

l (the excess over 1 metre) = ·22mm., ·65mm., ·90mm., 1·05mm.

The law deduced is

$$L = 999{\cdot}804 + 0{\cdot}0212\theta.$$

It is not, however, pointed out that the law would be different if the equation connecting x and y, in this case θ and l, were written to begin with in a slightly different form. On the contrary, the above solution is presented as if it were altogether beyond doubt.

In the working of the example as given by Kohlrausch, the equation is written

$$y - ax - b = 0;$$

but if it be written

$$cy - x - d = 0,$$

and exactly the same procedure as that adopted in evaluating a and b be followed in determining c and d, the law thence deduced from the observations becomes

$$L = 999{\cdot}800 + 0{\cdot}0213\theta.$$

It will be seen that the constants in these two laws differ by one in two hundred, or 0·5 per cent., as regards the significant figures; and that from the precisely similar way in which they are obtained, they are each equally entitled to recognition.

In fact, corresponding to the values for a and b usually given, viz.:—

$$a = \frac{\Sigma x \Sigma y - n\Sigma xy}{(\Sigma x)^2 - n\Sigma x^2}; \quad b = \frac{\Sigma x \Sigma xy - \Sigma x^2 \Sigma y}{(\Sigma x)^2 - n\Sigma x^2},$$

there are always another pair of values, giving the second form of the law, viz.:—

$$a' = \frac{(\Sigma y)^2 - n\Sigma y^2}{\Sigma x \Sigma y - n\Sigma xy}; \quad b' = -\frac{\Sigma y \Sigma xy - \Sigma y^2 \Sigma x}{\Sigma x \Sigma y - n\Sigma xy}.$$

The first pair of values corresponds to the supposition that the x measurements are guaranteed correct, and the experimental errors are all confined to the y measurements; and the second pair corresponds to the supposition that the y measurements are correct and the errors are all in the x measurements. The two lines

$$y = ax + b$$
$$y = a'x + b'$$

intersect at the centre of mass of the system of points obtained by plotting the observations.

The question naturally arises: How shall a relatively small number of observations, or a series of observations which are relatively discordant, be made to furnish the best mean result obtainable when no other observations are available?

In order to answer this question, we may recur to the remark above that differences in the result are obtained by writing the equation in different forms. The various forms of the equation correspond to the several directions in which the divergencies of

the plotted observations from the graph of the law are to be considered. For instance, when the equation is written

$$y_1 - ax_1 - b = \delta',$$

the divergence δ' is measured along the ordinate; but when it is written

$$cy_1 - x_1 - d = \delta'',$$

the divergence δ'' is measured in the direction of the abscissa. Now if the divergencies were measured at right angles to the graph, and the sum of the squares were made a minimum, the graph would be the principal axis of inertia of the system of points. This line passes through the intersection of the other pair of lines, and gives a smaller sum of squares than any other line. When the number of points is very great, all three lines become sensibly coincident.

We may conclude, then, that when the observations are numerous and fairly concordant, the method of least squares, applied in the manner commonly taught, will give a practically unique result. But if in any particular case there be any doubt on this point, by reason of the number of observations being small, or the discrepancies between the observations being very great, it would appear to be desirable to find both the lines corresponding to the values of a, b and a', b', given above, in order to test the question. In the event of the difference between the pairs of constants obtained not being negligeable, the proper line to be made use of, in preference to either of the two others found as above, would seem to be the principal axis of inertia.

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The Collection of Material for the Study of "Species."

STRANGELY enough, while the publication of "The Origin of Species" and the research which has been carried on since Darwin wrote his epoch-making work have completely revolutionised the morphologist's conception of what is a "species," nearly all the "systematic" work which is published even at the present day, especially in those branches of biological science where the amateur collector exerts most influence, is based upon the principles founded by Linnæus. These principles, while they were perfectly logical in pre-Darwinian days, are now, however, quite obsolete and out of harmony with the current state of biological knowledge. With a view to bringing scientific practice more into accord with scientific theory, a paper to which I listened at a recent meeting of the Linnæan Society suggested a reform in the present system of species nomenclature. Since, however, the great majority of those who describe "species" are unfortunately not in a position to realise how great indeed is the necessity of some such reform, it will probably not obtain immediate support from the systematists. The average "systematist" still holds the pre-Darwinian view of "species"; and, as the great bulk of the material at his disposal in public and private collections is of little value for the proper study of taxonomy, he quite fails to see how absolutely untenable his position really is. He does not realise how utterly impossible it is in certain groups to assign limits to the variability of "species," and it will never occur to him that two specimens superficially alike in all respects may quite possibly have been evolved along entirely different paths.

It is not my intention here to enter into a discussion as to whether a system of provisional names, such as is suggested by Mr. Bernard, might not be of distinct advantage in at least some branches of zoological inquiry; what I do wish to call attention to now is the necessity, if any decided advance is to be made in the study of taxonomy, for a sweeping change in the present system of collecting material, and in its representation in collections. The following remarks bear particularly upon the case of the mollusca, of which group I have personally most knowledge, but they are, of course, more or less applicable to other branches.

The taxonomist requires as a basis for his investigations to know as exactly as may be the range of variation which those forms in which he is interested experience at the different stations over which they occur. This knowledge is obviously most satisfactorily acquired by personal observation on the spot; but, as this is seldom practicable, the student is in general forced to rely upon material collected by others. Unless this material has been properly collected, the conclusions based upon it are likely to be erroneous; and most of the material available to the student of such groups as the Mollusca is eminently unsatisfactory. Apparently the aim of many conchologists is to represent (?) in their collections the greatest possible quantity of "species," each by a certain definite number—usually three—of "fine specimens." These may be as unlike the ordinary examples of the form as can be; and, whether they are localised or not is of little account, so long as they be fine. If a larger or more brilliantly coloured specimen is obtainable it replaces one of the mystic three.

Large Series necessary.—Little can be known about a species until large series have been examined; yet a collector or museum curator almost invariably prefers a "new species" to a specimen which might lead to a clearer understanding of others already in the collection. Again, in most museums two or three shells, for instance, are considered to amply represent a species. When one has only a few examples under examination it is a fairly simple matter to assign these to so-called species; but the task becomes very different when one comes to deal with a large series, particularly if the specimens are from different localities. In all groups the range of specific variability is very much greater than will be admitted by those who confine their attention solely to museum specimens: in the case of the marine Mollusca, it is often quite easy to select from a large gathering of a single species two or more series which will readily pass as distinct species if the intermediate forms are suppressed. In the past, many "species" have been thus formed; and, if rumour speaks truly, this has sometimes been done quite knowingly, the connecting forms having been carefully destroyed; though more generally it has arisen inadvertently through the study of insufficient material. Again, a museum series, in addition to demonstrating the range of variation of a form, should also illustrate its life-history; but only too frequently an immature individual is regarded by the collector as a "bad specimen" and thrown away as valueless.

Exact Localities.—The most important consideration in a collection is that every specimen shall be accurately localised, and the more minutely the exact locality has been recorded the more valuable will the specimen be for study. At the present day, perhaps, few collectors are satisfied with such records as "Australia" or "America," but such scarcely less vague ones as "S. Africa," "W. Indies," &c., are to be commonly met with; and specimens with inexact localities, or without any record at all, abound in our museums. One unsatisfactory feature about specimens purchased from dealers is that there is a temptation for the dealer to suppress the true origin of his specimens.

Those whose knowledge of species has been derived mainly from museum specimens seldom realise how greatly these species often vary in relation to their environment. Thus, in the case of the marine Mollusca, specimens obtained from the sandy portions of a shore will frequently differ perceptibly from others of the same species collected on the neighbouring rocks or mud. By keeping the series from different stations distinct, the collector will often be surprised at the considerable local variation which his specimens will manifest.

Fossil and Recent Forms.—The treatment of palæontology as a distinct science is one of the greatest obstacles in the way of a proper appreciation of the problems of taxonomy. In most museums, as in our own National collection, the fossil forms of a group are widely removed from their recent allies; and the not unnatural result is that writers on existing species of, say, the Mollusca, seldom make even the slightest reference to fossil members of the group. A true knowledge of the relationships of the living members of any group *can* only be attainable by the study of those forms which have preceded them in the process of evolution; and this research will be greatly simplified when recent and fossil forms can be examined side by side. The comparison of recent specimens with the closely related subfossil ones from the same locality and elsewhere is of most particular importance, but is as yet seldom possible.

The Condition of Specimens.—Among conchologists, and in this respect they are almost the only sinners, insufficient attention is generally paid to the condition of the specimens. The collector of shells too often prefers to gather up the miscellaneous débris of a "shell beach" rather than search for living examples, and unfortunately he is in the habit of founding "species" upon material so obtained. A very large percentage of Molluscan species has been based upon single, dead and unlocalised specimens: what wonder that so many of their names are absolutely worthless?

"*Faking*" *Specimens.*—Any interference with the natural

appearance of a specimen is to be most strongly deprecated, unless, indeed, this has been deliberately undertaken for the express purpose of demonstrating some particular structural feature; yet many collectors are in the habit of making their specimens "look pretty." The conchologist removes the periostracum from his shells, treats them with acid or oil, and conceals any imperfection by aid of a file; the entomologist is said to be not above patching a damaged insect with parts taken from another specimen (not necessarily of the same species); and corals are occasionally provided with artificial bases of plaster of Paris.

The practice in vogue in many museums of mounting small specimens upon tablets is an exceedingly bad one, since it greatly restricts any critical examination; moreover, the specimens are liable to be injured by the cement used.

Collecting a Representative Series of Specimens.—As has been pointed out, scientific research necessitates the examination of large series of specimens exactly representing the form as it occurs at the particular station where the specimens were collected. The field naturalist will most readily ensure that a series shall conform to this condition by collecting every specimen of the form in question which is observed during a certain period of work—five minutes, an hour, a month, according to its abundance and variability. And, in order that small local variations may be rendered evident, the area over which the series is collected must be a small one. If now the whole gathering thus obtained is kept *intact* and unmixed with specimens collected on other occasions or at different stations, it may safely be regarded as fairly representing the species as it occurred at that particular time and place; and it will form a satisfactory basis for comparison with similar series gathered elsewhere and at other seasons. It will probably be urged that this system of collecting is impracticable, as it will entail greater cabinet space. Granted that it may necessitate the provision of more storage room, but is not the usefulness of a collection the only excuse for its formation? And if more space is required it must be provided. However, this objection is not nearly so serious as might be imagined; it is by no means necessary or even desirable that enormous series of specimens should be displayed for exhibition in museum cases or cabinets; all that is required is that they should be stored in such a way as to be easily accessible when wanted for study. Thus in most cabinets much space is occupied by cotton-wool which could readily be filled with specimens without in the least adding to the bulk of the collection. In any case, whatever difficulties may be encountered they will have to be overcome, as only when large series of carefully localised specimens from numerous stations are gathered together in our museums and private collections will it be possible for any really scientific taxonomic work to be accomplished. Until this material is available it is useless to argue over rules of nomenclature and such like, as no satisfactory answer can yet be given to the fundamental question, "What is a species?" S. PACE.

Variations of Atmospheric Electricity.

I ENCLOSE a photograph of the tracings, recording the atmospheric electricity disturbances from January 4 to February 15 inclusive. The records are obtained in the following manner: Two antennæ are used, one vertical 20 metres in length, its lower extremity connected to coherer. The other, 47 metres long, consisting of an ascending vertical portion of 20 metres, also connected below with same pole of coherer, a horizontal portion of 7 metres, and a descending vertical portion of 20 metres, the whole being the shape of an inverted U, going up one side of house, across the top and down the other side. These two antennæ are carefully insulated. The other pole of coherer is connected to earth, in this case to the bottom of a deep well. The coherer closes the circuit of a relay, which in its turn closes the circuit of two electro-magnets, one of which draws up the style and so records a stroke on the revolving drum; the other sets a clockwork apparatus in movement which strikes coherer and so decoheres. The receiver is situated on a hill, overlooking the neighbouring country.

The disturbances seem at times to recur about the same time on successive days, or sometimes after an interval of a day or two. For instance, the first two on the 4th and the first two on the 9th seem to have some connection. Again, the second pair on the 9th seem identical with the first pair on the 10th.

Taking the central group on the 9th, 10th, 12th, 14th, it might be subdivided into two groups, commencing on the 9th with two in each group, reaching its maximum on the 10th, five and seven, and on the 12th reduced to one in each group, finally, on the 14th, only one remaining in the stronger group, that is the one with a maximum of seven.

On February 13 there was one disturbance, on February 14 two, the first of which was at identically the same time as the one of the previous day. It would be interesting to compare the records of several receivers and see how far-reaching these disturbances are, or whether they are purely local phenomena. For this purpose two more receiving stations are shortly to be fitted up in this department. During the period covered by these records there have been no visible or audible signs of thunderstorms, and on many occasions the sky was cloudless, barometer high, thermometer low—28° F. to 36° F.—during the last eight days of February, when there could have been no storms within several hundred miles. E. PELLEW.

Bellevue, Laroin, Pau, Basses Pyrénées, France.

The Selborne Yew-tree.

GILBERT WHITE, in his "Antiquities of Selborne," Chap. v. (Chandos Classics Edition) mentions a male yew growing in the churchyard. He believed it to be some centuries old and states its girth as 23 ft. This afternoon I have, with Mr. Lewis Eynon, remeasured the trunk and find it to be 25 ft. 6 in. The stem of this magnificent tree is squat and rather bulging, and as White mentions its girth as something extraordinary, it is to be presumed that his measurement was made at the point of maximum diameter—about four feet from the ground. This is the height at which our figure was obtained, and we used a steel tape taken right round without regarding irregularities of surface. The increase in girth will be seen to correspond to a radial growth of 4·7 in. in the 120 years or so since White's time. I know not whether recent measurements of this tree have been published, but the fact seems worthy of record.

F. SOUTHERDEN.

75 Barry Road, Dulwich, S.E. March 16.

INJURIOUS CONSTITUENTS IN POTABLE SPIRITS.

AN interesting communication is just to hand, by Sir Lauder Brunton and Dr. Tunnicliffe, upon "Certain apparently injurious constituents of potable spirits." Its appearance now is certainly opportune, since, whatever else we may be interested in, alcoholic beverages are certainly attracting a deal of public attention at the present time. It is further, if not a relief, certainly a change, to learn that something else in alcoholic drinks besides arsenic and selenium may be the cause of mischief, and their removal advantageous. Our mentation just now is rather apt to be over-arsenicated; moreover, from the point of the consumer, the impurities discussed by these workers certainly seem to have one important advantage over arsenic, in that they can be completely removed—that is, removed to the satisfaction of the chemist as well as to that of the pharmacologist.

The subject of whiskey, with which the above monograph is concerned almost entirely, has not received very much attention at the hands of chemists, pharmacologists or dietetic experts, since the publication, in 1891, of the report of the select Committee on British and Foreign Spirits. This Committee directed itself mainly to the question whether compulsory bonding, as practised in Canada, should be adopted in this country, and also whether any restrictions should be placed upon blending, as by, for instance, limiting the name whiskey to the product made from malt, or malt and grain, in a so-called pot-still. The result of the Committee, so far as legislation was concerned, was nil. In the course of the inquiry, however, many interesting pharmacological facts came out, and the present work must be looked upon as a continuation of what may be termed the pharmacology of whiskey. Readers who are interested in the subject are strongly recommended to consult the Blue Book, which contains a mass of most interesting and important information.

Certainly until the appearance of this report, and by many even to-day, fusel oil is regarded as par excellence the injurious constituent of whiskey. This substance, which is a mixture of varying proportions, according to the spirit, of butylic, propylic and amylic alcohols, has apparently been maligned, and is not, at any rate in the proportion in which it occurs in ordinary potable spirits, a source of much danger to the public health. The chief other impurities touched upon at this inquiry were furfural and aldehydes other than furfural. At that time very little was known concerning the action of furfural or the aldehydes, and it is especially in this connection that the monograph before us is of interest.

Although there can be no doubt that it is the ethyl alcohol that causes alcoholic intoxication, it appears that the actual way in which one gets drunk, or gets sober after being drunk, depends largely upon the quality of the liquor partaken of. One of the most important factors in determining the quality is the content of the beverage in question in aldehydes, including furfural, another its content in certain volatile bases.

The source of furfural in the manufacture of whiskey is a class of substances known as pentosans; these are derived from the cellulose of the grain husks, and under the influence of heat, in the presence of acids, are in the wash still converted into furfural. Furfural is present in all pot-still whiskeys, and also obviously to a less extent in those patent still whiskeys which are blended with the real pot-still products to give them the taste of whiskey. Any one can apparently demonstrate for himself quite simply the presence of furfural in whiskey. It is simply necessary to dilute the whiskey and to add to it a few drops of an aniline acetate solution; almost immediately the whiskey becomes rose-coloured and later deep rose, changing to light purple according to the quantity of furfural present.

In addition to furfural there are also present in whiskey other aldehydes. Speaking generally, these bodies are poisonous, or at least irritating; they are for the most part converted in the body into the corresponding acid, and thus tend to diminish the alkalinity of the blood. This individual point is not without interest in that, according to most physicians, any cause tending to render the blood less alkaline favours the occurrence of gouty deposits in the joints.

The experimental inquiry concerns itself more especially with the action of furfural upon animals and man. This substance, according to Sir Lauder Brunton and Dr. Tunnicliffe, gives rise to paralysis of the voluntary muscles, and later to clonic and tonic convulsions. An odd point about these symptoms is their transient nature; immediately after the injection of the drug the animal would fall down completely paralysed, its tongue and lips would become bluish and its breathing slow and convulsive, at other times irregular and rapid; convulsions would then appear, vomiting would occur, and then the animal would begin to recover, being at first dazed but becoming rapidly normal. Two human subjects who were bold enough to take this apparently active poison in the same dose got bad throbbing headache after it which lasted the rest of the day. This latter result brings us to what, from the practical standpoint, is the most interesting part of the research.

We believe it will be generally admitted that one of the commonest results of too free potations in the human subject is a bad throbbing headache, and it appears that the alcohol itself is only partly to blame for this disagreeable sequela. The aldehydes generally, and furfural particularly, play a very active part in the production of these headaches. This appears to be one reason why one is less liable to get a headache after old whiskey, for instance, than after new, or, speaking more correctly, relatively new. One of the effects of maturation upon whiskey is to diminish the amount of furfural and aldehydes which it contains. This effect of maturation can apparently be effected by another means, viz., by distillation of the fresh spirit or of the low wines with phenylhydrazine-sulphonate. By this means the authors were able to obtain an aldehyde-free whiskey, and to watch the effect of it upon animals, comparing it with that of the same spirit before distillation. Their results are certainly interesting. They found that recovery from profound alcoholic, or rather whiskey, poisoning was distinctly different in the two cases. In the case of the original spirit, the animal, during the transition stage from drunkenness to sobriety, was restless, wandering from one part of the laboratory to another, and seemed, generally speaking, remarkably uncomfortable. Even when the gross symptoms of alcoholic poisoning had passed off the animal did not behave normally for some time; it refused food offered to it, and showed marked signs of bad temper. These secondary symptoms were entirely absent in the case of the aldehyde free spirit. When the animal was sober it appeared perfectly normal, and if offered food took it apparently with relish.

These symptoms, which cannot fail to remind one of the so-called "Katzen-jammer" of the German student, are, oddly enough, most markedly relieved by precisely those substances which contain chemical groups capable of combining with and rendering innocuous these same aldehydes. The most general substance used in this connection is either ammonia itself or some compound containing amido (NH_2) groups. The action of all morning "pick-me-ups," from the student's red-herring to the viveur's effervescing citrate of caffeine, is apparently explainable upon this hypothesis, viz., that they neutralise the alhedyde constituents of the potable spirits.

THE ORIENTATION OF GREEK TEMPLES.

A PAPER, "Some Additional Notes on the Orientation of Greek Temples," an abstract of which was read before the Royal Society on February 14, gave an account of six Grecian temples of which the orientation had been examined or re-examined during the spring of 1900. The chief observations and results described in the paper may be stated as follows:—

(1) The grotto sacred to Apollo on Mt. Cynthus, in the isle of Delos, was interesting as being not improbably the very earliest existing structure of a religious character on Greek soil. The orientation seems, as usual, to have been connected with a zodiacal star, *a* Libræ, and the date of the formation of the grotto derived from this is about 1530 B.C. The original foundation of temples in Greece on some other sites are, indeed, more ancient than this; but it is presumed, and in a good many cases can be clearly established, that in those cases what can be now seen and measured is that which remains of reconstructions following the same lines as the earlier works. But this grotto at Delos, the sides of which are formed by the natural rock, and the roof and doorway only are artificial, is probably the very shrine alluded to by Virgil as already ancient at the time of the Trojan war (*Templa dei saxo venerabar structa vetusto*, Æn. iii. 84).

(2) At Delphi, where the clearance of the site by the French archæologists gave a better opportunity of examining the celebrated temple of Apollo, there is evidence of a change of orientation, one, evidently the more ancient, having the angle 231° 18′, the other 227° 8′. These are the angles of the axis when looking east, measured from the south point round by west. The site is very peculiar, being surrounded by mountains. The sun must have illuminated the sanctuary through an opening on the flank, as was the case at Bassæ, also dedicated to Apollo;

and there are only two dips between the mountains where the sunrise could have properly represented the early dawn. One of these has for amplitude $-7^\circ 42'$ E., the other $-23^\circ 16'$ E. The latter, taken with the earlier orientation, and the bright star ϵ Canis Majoris setting near the western axis, where the local horizon is favourable, suggests 950 B.C. as the date of the foundation. The sunrise at the $7^\circ 42'$ point, and the sufficiently bright star β Lupi, setting also near the western axis of the more recent temple, offers the date of 580 B.C., but this would have been the predecessor of the structure which now occupies the site. It is known that the temple must have been several times rebuilt, and many stones of a previous temple, or temples, are found in the existing foundations.

At Syracuse it was found necessary to reconsider the orientation date (given in a former paper published in 1897) of the temple which has been attributed to Diana, but which is now known from an inscription to have been dedicated to Apollo. Of this temple, both the style of the architecture and the shape of the letters of the inscription above mentioned show that the date 450 B.C. given in the paper referred to, the orientation having been derived from the axis, is too late; and that the alternative date, derived from the northern limit of the eastern opening, which in this case can be obtained with accuracy, should be taken instead. The date, so altered, becomes 700 B.C., which is thirty-four years subsequent to the Hellenic foundation of the city.

N.B.—In Greek temples the question whether the sunrise entered upon the line of the axis or on the northern limit of the eastern opening has generally to be taken into consideration and decided upon archæological grounds. This results, in the majority of cases, in favour of the axis; but in an important minority—notably at Athens—the other has to be chosen.

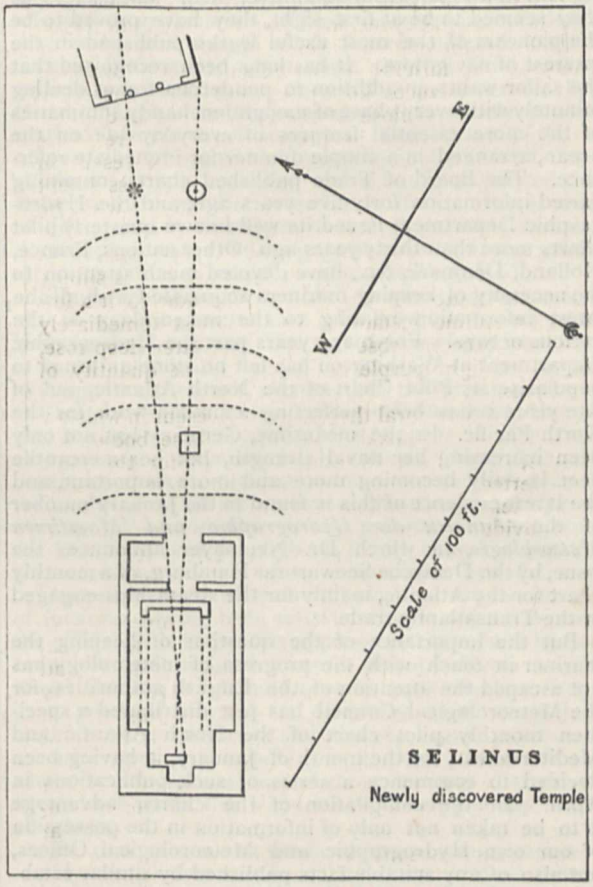
(3) In the paper an argument is drawn from the orientation of the foundations of a small temple lately discovered, adjoining the famous theatre at Taormina, that the theatre itself was that of the early and populous city of Naxos, which occupied the sea-coast at about 800 feet immediately below it; and not the work of the much later town of Taurominium, from which Taormina derives its name. Naxos was utterly destroyed by the Syracusans about 400 B.C.

(4) The most interesting example, however, is from another Sicilian temple lately unearthed at Selinus. Of this temple I found the orientation of the eastern axis to be $30^\circ 22'$ north amplitude, which at once suggests a solar temple arranged for the summer solstice, which for a level site and for the date in question should be $30^\circ 35'$. But the temple's site is near the bottom of a valley; and the sun would have to gain an altitude of rather more than two and a half degrees before it could shine into the temple, and then the amplitude required would be $28^\circ 17'$. Thus, apart from what may be derived from the plan of the temple itself, the orientation theory would seem to show to a disadvantage.

The plan of the temple, however, appears to give the solution of the difficulty. It will be seen on examination of the accompanying figure that about 130 feet distant from the sanctuary there was a portico, *i.e.* the propylæa of entrance to the temple enclosure. One of two dotted straight lines drawn from this portico, namely, that which proceeds from its S.W. corner, indicates the direction of the first beam of sunrise as it rose at the summer solstice over the local horizon, about the middle of the sixth century B.C.; but it will be seen that whilst it passes centrally through the doorway it falls obliquely and excentrically upon the western internal wall of the temple, the amplitude of this line being $+28^\circ 17'$ E.; but it will be also observed that it *does* fall centrally upon the western internal wall of a *naos* constructed within the flank walls of the temple. The square object which the line intersects before it reaches the temple is an altar, itself of no great height, and on lower ground, and which therefore interposed no obstruction to the solar rays reaching the sanctuary. The difference of level between the floor of the temple and that of the propylæa is about 18 feet. The warning star β Geminorum, which would have been heliacal—that is, just visible before extinction—about an hour before sunrise, and the direction of which is represented by the other straight dotted line, would have been well seen over the roof of the propylæa, the height of which, as known from architectural fragments, would not have exceeded 23 feet, and the star would have overtopped this by about 2°.

The explanation, by help of the plan, of the apparent misfit of the orientation is as follows:—

Presumably the angle upon which the lines of the



temple were set out was taken from data obtained on some platform which had a level horizon, and the building was considerably advanced before the actual solstice came round and showed the error that had been made.

To meet the difficulty, a *naos* was constructed within the flank walls, but hugging the northern one; so that the first beam of sunrise coming through the centre of the eastern aperture, at the local amplitude of $+28^\circ 17'$ E., might shine in centrally upon the statue of the deity; and for this a pedestal was provided a little northwards of the centre of the niche which had been previously formed for it. We may notice also that the south-west angle of the propylæa is so placed as to keep exactly clear of the point of sunrise. F. C. PENROSE.

PILOT CHARTS.

FROM the popular and astrological point of view, meteorology is as old as the oldest of the canonical writings; but as a scientific study it may truly be said to belong wholly to the great Victorian era of scientific development. It was only in the 'thirties of last century that Redfield and Reid—the former in America, the latter in the West Indies—set about the patient study of the vagaries of storms, and discovered that these meteors were, like everything else in Nature, subject to natural laws. By the middle of the nineteenth century the progress made by the early pioneers was such that Maury felt justified in utilising the results in the preparation of his pilot charts for mariners all the world over. Maury's charts were certainly not perfect; fifty years afterwards many would, no doubt, regard them as a confused mass of information which would weary the most persistent student in an endeavour to unravel them; but useless as they seemed to be at first sight, they have proved to be the pioneers of the most useful works published in the interest of navigators. It has long been recognised that the sailor wants, in addition to ponderous tomes dealing minutely with every phase of navigation, handy summaries of the more essential features of everyday life on the ocean, arranged in a simple manner for immediate reference. The Board of Trade published charts containing varied information forty-five years ago, and the Hydrographic Department issued its well-known quarterly pilot charts more than thirty years ago. Other nations, France, Holland, Denmark, &c., have devoted much attention to the necessity of keeping mariners acquainted with all the latest information relating to the meteorology of the various oceans. For many years past the Hydrographic Department at Washington has left no stone unturned to popularise its Pilot Chart of the North Atlantic, and of late years it has been perfecting a similar work for the North Pacific. In the meantime, Germany has not only been increasing her naval strength, but her mercantile fleet is daily becoming more and more important, and the latest evidence of this is found in the January number of the *Annalen der Hydrographie und Maritimen Meteorologie*, in which Dr. Neumayer announces the issue, by the Deutsche Seewarte at Hamburg, of a monthly chart for the Atlantic, mainly for the steamships engaged in the Transatlantic trade.

But the importance of the question of keeping the mariner in touch with the progress of meteorology has not escaped the attention of the English authorities, for the Meteorological Council has just distributed a specimen monthly pilot chart of the North Atlantic and Mediterranean for the month of January, it having been decided to commence a series of such publications in April. In the compilation of the charts, advantage is to be taken not only of information in the possession of our own Hydrographic and Meteorological Offices, but also of any suitable facts published by similar establishments in other countries. Just as we are certain that the atmospheric conditions during winter are different in various ways from those which obtain in summer, so we may conclude that between the extremes there are, on the average, more or less gradual changes in the controlling features, and, therefore, we must expect that every month in the year has its own individualities, which are not exactly in agreement with even those of neighbouring months. To be of real use to the navigator, then, information should, as far as possible, be sorted out into its principal monthly features, and this is to be the aim of the Marine Department of the Meteorological Office under Commander Hepworth, R.N.R., the superintendent. Each ocean area of 5° of latitude by 5° of longitude contains a wind-rose showing the prevailing winds, some of the less frequent winds, and the frequency of calms, a simple method being adopted to indicate the mean strength of the wind, whether light, moderate, or gale. The normal limits of the Trades; the sailing routes recommended to and from the Equator; the steamship routes to and from America; the mean paths followed by cyclonic areas; the region in which gales exceed 10 per cent. of the wind observations; the localities affected by fog; and the ice limits about Newfoundland are laid down. A feature of as great interest to the theoretical physicist as to the practical sailor will be the ocean currents for each separate month, based upon observations covering a period of sixty-five years. Until the Admiralty and Meteorological Office recently published a selection of the currents in representative months, the scientific world had to be content with studying the circulation of the waters from a chart representing the annual results only. There will now be an opportunity for a much closer study, as the monthly winds and currents are given together in the same sea-room, while the distribution of atmospheric pressure for the same month is given, with that of the air and of the sea temperature, in an inset chart, and all three subjects must be considered as inseparable when investigating ocean currents. Two other inset charts represent south-westerly and westerly types of weather over Western Europe. In addition to the foregoing pictorial method of displaying the facts, a considerable amount of valuable information is conveyed in descriptive letterpress on all available spaces, directing the navigator's attention to the dangers associated with making the Spanish coast, to the Harmattan winds of West Africa, the Northers of the Gulf of Mexico, the Mediterranean sirocco and other winds; to treacherous inshore currents; to the difficulties arising from the low-lying haze and the great refraction along the west coast of Africa; to the rollers breaking on the South American coast, from Trinidad to Guiana; and advice is given as to the best routes for crossing the Equator. An interesting article is devoted to Atlantic storm systems, showing how the mariner must combine his wind and barometer observations when he wants to ascertain the behaviour of the disturbance which may be affecting his ship, the problem being much more complicated than is generally supposed, and more particularly in this age of swift steamships, which may be travelling faster than a cyclone, so that the experiences on a liner travelling eastward through a storm would be largely different from those on another meeting it going westward. Everything depends upon the particular circumstances, and with the aid of these notes and an intelligent interpretation of them, officers should be able to have a much better knowledge of the cyclonic areas through which they so frequently have to steer. For many reasons, the new pilot charts deserve to have a long and successful career.

MALARIA AND ITS PREVENTION.

SINCE the work of Laveran (1880) proved malaria to be a fever caused by the invasion of the blood by minute animal organisms, steady progress has been made in the work of probing and elucidating the etiology and pathology of this dreadful scourge.

The extent of its ravages was—and, unfortunately, still is—appalling, and the recognition of this fact has impelled many eminent scientific men to direct their best efforts towards solving the problems which have been facing us for the last twenty years, and which were the natural offspring of Laveran's discoveries.

English, Italian and German workers have competed with each other in the race and shown unprecedented keenness and enthusiasm; of their work an immense bibliography remains as a monument to-day. In America, too, has been done some of the very best work.

At the present time, however, though our knowledge of the Hæmamœbidæ has so much increased and though their pathological significance is now more clearly defined, yet we cannot say certainly that all the species which invade man have been identified.

In England we group all malaria parasites under three heads :—

(1) *Haemamoeba malariae*, the parasite of Quartan fever.

(2) *Haemamoeba vivax*, that of Tertian fever.

(3) *Haemamoeba precox*, that of Quotidian or æstivo-autumnal fever.

But in Italy Grassi states positively that he has observed a fourth species, which he names *Haemamoeba immaculata*. This species is without pigment and has been accepted by Marchiafava and Bignami, but our knowledge of the facts is still somewhat limited. In West Africa the first expedition which went out to investigate malaria was inclined to divide *H. vivax* into two distinct species differing in the colour of their pigment, one with fine brown and the other with fine black granules. Furthermore, it has been suggested that *H. precox* may be also split into two or more distinct species.

On these points we must await the results of patient investigations now pending.

For many years after the inseparable association of the Hæmamœbidæ with malaria had been demonstrated, the means whereby they could enter the blood and attack the corpuscles was unknown. But at last the work of Ross in India (with which Manson must ever be associated) enabled us to see light. King (1841) had suspected that mosquitoes were a factor in malarial infection, as also had Laveran ; but Ross led us, by his researches in the life-history of *H. relicta* (the parasite of birds), from mere hypothesis to fact. Confirmation was soon forthcoming in Italy, a country where the prevention of malaria is of great economic importance ; and later expeditions were dispatched by the Liverpool School of Tropical Medicine, the Royal Society and the German Government to various malarial districts, to thresh out the whole question and to evolve, if possible, some practical method or methods of prophylaxis.

Valuable experiments, too, were made in the Roman Campagna last year by the London School of Tropical Medicine, which afforded valuable confirmation of the views advanced by previous expeditions. More recently, too, an expedition from Liverpool has returned after making a complete survey of the lower reaches of the Niger, with the result that previous observations have been confirmed and further additions to our knowledge made.

Now we know, with a certainty rarely attained in medical matters, that malaria, instead of being inhaled with the night air as a noxious miasm from marshy countries or ingested with water, as was at one time suggested, is caused by the direct injection of animal parasites into the blood by mosquitoes previously infected by some human being suffering from the fever.

Careful microscopic work has shown that the Hæmamœbidæ of human malaria are parasitic not only in man but also in certain mosquitoes.

The parasites have two phases in their cycle of development, and need a different host for the completion of each phase, that is to say, that like many other well-known parasitic organisms, they exhibit "alternation of generation," in which man is the "intermediary" and mosquito the "definitive" host.

But it has been proved that all mosquitoes are not hospitable to the hæmamœbidæ of malaria. One genus only—Anopheles—has so far been convicted, though Culex has been subjected to an equally searching cross-examination.

Although Anopheles, as compared with Culex, is a small genus with a comparatively limited distribution, yet all its species have not been proved hospitable.

In West Africa *A. Costalis* and *A. funestus*, in British Central Africa *A. funestus*, in the West Indies *A. Costalis* (?), in Italy *A. Maculipennis*, are the species chiefly concerned as agents of transmission.

With the information at present obtainable it must, therefore, not be too hastily concluded that the whole genus Anopheles is hospitable to the parasites, but I venture to say that it may now fairly be assumed, on the other hand, that no species of Culex ever conveys the human parasites, though this genus is chiefly concerned as definitive host of the avian hæmamœbidæ.

White men who have travelled in the tropics say, assuming what you teach about the parasitic nature of malaria and the part played by mosquitoes to be the truth, there remains the question as to where the mosquitoes originally became infected. This was for a time a mystery, but the recent work of Koch in Java and Stephens and Christophers in West Africa has afforded an explanation. These observers independently discovered that though adult natives suffered little or nothing from malaria, yet their children from earliest infancy exhibited great numbers of parasites in their blood, though, like their parents, they rarely showed marked symptoms of infection. The blood of 80 to 90 per cent. of native children in some districts has been shown to contain parasites, and it has been noticed that these varied in number inversely as the number of years of life ; that is to say, evidence of parasitic invasion decreased as the children grew to manhood, and gradually a condition of partial immunity was attained.

Similar instances of acquired immunity are occasionally seen among white men who have lived many years in malarious countries. The mechanism of this immunity is as yet unknown.

It appears, therefore, certain that the prime source of mosquito infection is the native children, who, though not indifferent to mosquito bites, appear to view their ravages with equanimity. It follows, then, that the proximity of native habitations is a constant menace to the health of white men provided that the necessary connecting link—Anopheles—is also present. In considering the best means of prophylaxis, it will be seen that important deductions have been drawn from these facts.

The prime cause of malaria being known, its method of invasion having been satisfactorily demonstrated and the official seal of scientific approval to these facts having been obtained in Lord Lister's recent address to the Royal Society, it remains now to apply our knowledge in a practical way, so as to evolve some method or methods of prophylaxis and thereby crown a piece of scientific work as far reaching in its power to benefit the whole human race as any of those brilliant discoveries which have made the Victorian age conspicuous above all others.

And that this is not the language of exaggeration is readily seen when one considers the enormous tale of deaths caused annually throughout the world by malaria, and when one realises how much the control and development of new territory are arrested by the constant invalidism of Government officials, medical officers and traders in tropical climates, where it is constantly necessary to employ two men to do the work of one.

This latter point will appeal specially to those who recognise that the British Empire is now world-wide and tending to still further extend its borders.

During the last two years various authorities on paludism abroad, and members of the various expeditions from England, have made suggestions and recommendations as to the prophylactic measures which should be taken in consequence of the recent additions to our knowledge.

Some have advocated wholesale destruction of

mosquitoes by surface drainage and by the treatment of their breeding puddles with substances fatal to their development; others have suggested the careful and more extensive use of mosquito-proof curtains and blinds, &c.; while one distinguished authority holds that the continuous administration of quinine is likely to give the best results.

This apparent difference of opinion has afforded an opportunity for unbelievers to scoff; but there exists, notwithstanding differences of opinion as to detail, an entire unanimity as to the principles on which we should work.

With our present knowledge we are not justified in saying that any one alone of the measures mentioned above is of preeminent value, for all are not applicable to the same district, nor is the application of one method alone likely to prove sufficient.

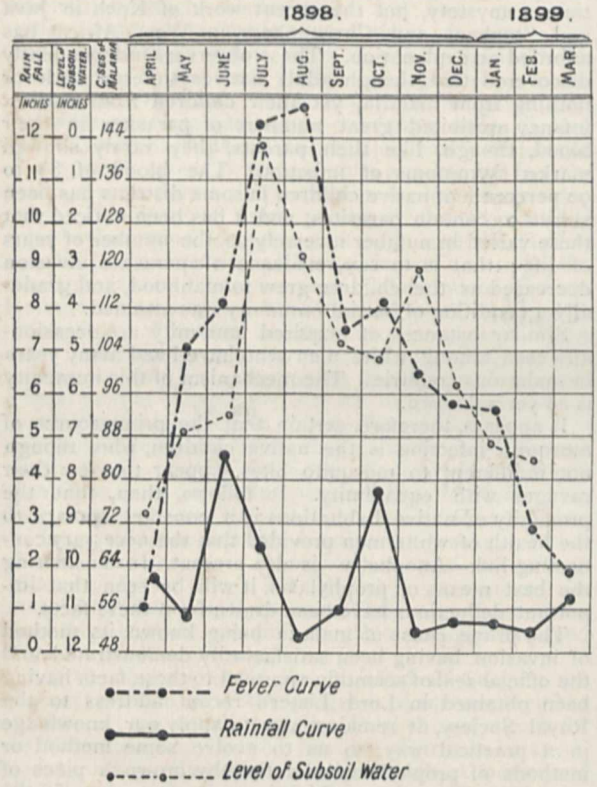


FIG. 1.—Chart showing relation of incidence of fever to rainfall and to level of subsoil water. (From figures supplied by Dr. Strachan, P.M.O. Lagos.)

It is in a due application of all these methods, in so far as each is practicable and suited to the district under consideration, that the truest salvation will be found.

In support of this view I would mention the conditions of rainfall and geological formation which obtain at Sierra Leone, Accra (Gold Coast) and Lagos (Fig. 1). In the first, surface drainage is possible and could not fail to somewhat reduce the ravages of malaria, but in the last-named colony any system of drainage is impossible; the town is built on a sandy island which has the general form of a saucer; here some other method must be considered. At Accra, on the other hand, the rainfall is so small and the soil so absorbent that there are no puddles or marshy lands which need draining. Here, again, some method other than drainage must be sought for.

Since the days of Empedocles of Agrigento (B.C. 500) the efficacy of surface drainage has been known and, where practicable, is doubtless one of the surest methods. But in districts unsuitable from any cause, the application of larvicidal substances (petroleum, tar, lime, &c.) has been suggested; but, so far as experiments go, the effect of such applications has proved too transient to be of much value. The essential point is to avoid being bitten by infected mosquitoes by night and also by day, for, notwithstanding statements to the contrary, I have repeatedly noticed Anopheles gorging themselves in full daylight, though no doubt their habits are chiefly nocturnal.

For this purpose the constant use of mosquito curtains of a proper kind is essential. Unfortunately, since familiarity breeds contempt, it is only too frequently that one finds in the tropics curtains of an utterly useless kind being used; either they are torn or the mesh is too large, or by their arrangement the free ingress of mosquitoes is possible.

They are best fixed on four posts at the four corners of the bed, and as the netting descends around the bed it should be tucked in under the mattress. The enclosed space should be of sufficient size to allow a certain freedom of movement during sleep, so that the danger of coming into contact with the netting is impossible.

More effectual, however, is the employment of wire gauze blinds to windows and doors, so that bedrooms and houses generally are kept entirely free from mosquitoes.

Celli recommends that windows should be protected by wire netting the meshes of which measure from 1 to 1·5 mm. square, and that all doors opening exteriorly should be protected by a cage of similar netting, so as to oppose two screens to the ingress of mosquitoes (see Fig. 2). He further suggests that to facilitate the capture of any stray mosquitoes all walls should be bare and painted white, and that trees should not be allowed to grow near dwellings, as they afford a retreat in which mosquitoes may hide. Experiments carried out in the Roman Campagna have proved that these and similar devices have been sufficient to protect from fever for considerable periods; but it is to be feared that unless unceasing vigilance be exercised all such precautions may prove ineffective, and one mistake may render them entirely abortive.

We need yet, however, further information as to the habits of mosquitoes. We do not yet know certainly how far they are able to travel, or at what height can they raise themselves from the earth. On these and many other points in the bionomics of Anopheles our information is very scanty. Giles' recent work on the Culicidæ has brought together practically all we know; but workers in many distant fields find that the habits of mosquitoes are liable to vary according as local conditions are suitable or the reverse; they are, it would seem, capable of a certain measure of adaptability to their environment.

All patients suffering from fever should be specially protected, for now we know that where malaria and Anopheles co-exist the fever is infectious; in consequence of the transmission power of the mosquitoes a fever patient is a source of danger to all his neighbours.

In the matter of clothing some precautions can be taken, such as the wearing of proper mosquito-proof boots and stockings. Mosquitoes are specially fond of the shades under a dining-table, where they may pursue their depredations unchecked.

The continuous use of quinine, though backed by such great names as Koch and Manson, is open to many objections, and is a method of prophylaxis unlikely, alone, to attain such great results as the former evidently expects.

Preeminent above all other methods of prevention stands *segregation*, advocated first by the first expedition to West Africa, and since supported so strongly by the researches of Koch and in the published work of the Royal Society Commission.

Native habitations have already been referred to as the source from which Anopheles obtains its parasites; native huts, ill-ventilated and overcrowded, are the hot-bed in which the Hæmamœbidæ luxuriate.

In tropical countries Europeans pitch their temporary camps, and often live permanently, within a few yards of such native hovels; given, then, a full supply of Anopheles and a swarm of native children, 80 per cent. of whom are infected with Hæmamœbidæ, it is not surprising, with our present knowledge, that an epidemic of malaria soon starts among the white men.

The pitching of camps near native villages, or living in close proximity to native huts, is flying in the face of all recent scientific research, and suicidal in its results. This cannot be too often nor too emphatically reiterated.

R. FIELDING-OULD.

THE NEW STAR IN PERSEUS.

THE HARVARD OBSERVATIONS.

PROF. PICKERING, the Director of the Harvard College Observatory, in a *Circular* No. 56, has detailed the observations of the new star made there soon after its discovery by Dr. Anderson. This *Circular* we print *in extenso*:—

The cable message announcing the discovery of a new star in the constellation Perseus, by the Rev. T. D. Anderson, was received at the Observatory early in the evening of February 22, 1901. Owing to clouds, the new star was only occasionally visible, and twice it was necessary to cover the instruments on account of falling snow. During the intervals, however, various observations were made, which have a value owing to their early date. Numerous comparisons by Miss Cannon, with α Aurigæ, magnitude 0·21, α Orionis, magnitude 0·92, and α Tauri, magnitude 1·06, showed that the magnitude of the star was about 0·9. Photometric comparisons, by Prof. Wendell with the 15-inch telescope, of the Nova with the star +43°·732, magnitude 7·25, at 14h. 0m. and at 17h. 25m., Greenwich Mean Time, gave the magnitudes 0·35 and 0·39 respectively.

Meanwhile, an examination was being made, by Mrs. Fleming, of the photographs of the region obtained here earlier in the month, with the various instruments. Although photographs are taken with the transit photometer throughout every clear night, yet owing to twilight they cannot be taken as early in the evening as this star culminates. Fortunately, for some weeks the work of the transit photometer, which only photographs objects near the meridian, has been supplemented by photographs with Cooke and Ross-Zeiss Anastigmat lenses. With these instruments an attempt is made to cover the entire sky, both east and west of the meridian, at short intervals. The completeness with which this has been done is shown by the fact that we have photographs of the region of the Nova with the Cooke lens on February 8, 18 and 19, and with the Ross-Zeiss lens on February 2, 6, 18 and 19. The photograph taken with the Cooke lens on February 19 had an exposure of 66m., beginning at 11h. 18m. Greenwich Mean Time. While this photograph showed not only the faintest stars contained in the Durchmusterung, but also stars as faint as the eleventh magnitude, no trace of the Nova was seen. This result was confirmed by the other plates mentioned above. A general examination of the large number of earlier plates of this region did not seem to be necessary. Plates taken with the 8-inch Bache telescope as early as November 6, November 8 and December 12, 1887, fail to show the Nova, although the spectra of stars as faint as the eighth magnitude are clearly visible on all, and those of the ninth magnitude on the plate taken on November 6. A photograph taken with the 24-inch Bruce telescope on October 18, 1894, with an exposure of 15m., shows no trace of this object, although stars as faint as the magnitude 12·5 are well seen.

On this same evening, February 22, eighteen photographs were taken with various instruments, under the direction of Mr. Edward S. King. They showed that, photographically, the Nova was 0·3 fainter than α Aurigæ. The general appearance of the photographic spectrum resembled that of the Orion type and was very unlike that of other new stars, in which the bright lines are the most conspicuous feature. This star had a strong continuous spectrum traversed by thirty-three dark lines. The approximate wave-lengths, as derived by Hartmann's formula from the measures of Hε, Hγ and Hβ, are given below. Each is followed by its relative intensity, and by the difference found by subtracting it from the wave-length of the corresponding line, if any, in the spectrum of β Orionis. As the lines having greater wave-length than 5000 have thus been determined by extrapolation, they may be subject to large systematic errors.

3894, 10, Hζ, −5; 3970, 20, Hε, 0; 4026, 3, 0; 4077, 2, −1; 4102, 30, Hδ, 0; 4126, 5, +2; 4151, 1, −4; 4266, 2, +1; 4341, 40, Hγ, 0; 4366, 1, +1; 4388, 2, 0; 4415, 1; 4435, 1, +3; 4470, 2, +2; 4481, 20, 0; 4510, 2, −2; 4530, 2; 4552, 2; 4572, 1; 4616, 1; 4643, 1; 4665, 3; 4714, 3, −1; 4862, 40, Hβ, 0; 4885, 2; 4922, 2, 0; 5325, 1; 5399, 1; 5431, 1; 5677, 2; 5695, 7; 5719, 5; and 5761, 1. On careful examination the lines 3970, 4102, 4341, 4481 and 4862 were seen to be bright on the edge of greater wave-length. The line 4665 was bright on the edge of shorter wave-length, or there was a bright line whose approximate wave-length was 4660. The line 4026 was not measured, but identified from its position.

FIG. 2.—Hut with mosquito cage round door, which is itself mosquito proof (as suggested by Celli). Reproduced from a photograph lent by the Sanitary Institute.

On February 23 the clouds were so dense that few observations could be made. The star appeared to be brighter and bluer than α Aurigæ and to have the approximate magnitude 0·0. The spectrum was photographed faintly and showed no marked change except that the line K, which was absent on the previous evening, was present and nearly as intense as Hε.

On February 24 it became clear soon after noon, and at 1 o'clock the Nova was seen with the 6-inch Equatorial, and also with the 2-inch finder, in strong sunlight. In the evening the magnitude, according to visual comparisons, was 0·54, from measures with the 15-inch Equatorial, 0·59, and with the meridian photometer, in strong daylight, 0·28. Photographically it was 0·4 or 0·5 fainter than α Aurigæ. The spectrum showed a remarkable change. It was traversed by numerous bright and dark bands, and closely resembled that of Nova Aurigæ. The principal lines were dark with accompanying bright

lines of somewhat greater wave-length. The bright lines accompanying K and Hϵ were reversed, and traversed by narrow, well-defined dark lines. These last lines, and one of somewhat shorter wave-length than Hβ, are the only sharply defined lines in the spectrum, all of the others being broad and hazy, and difficult to measure with accuracy.

Clouds interfered with observations on February 25, but the Nova was evidently much fainter than on the previous evening. Its magnitude from visual comparisons was 1·4, from photometric measures, 1·07. The spectrum differed slightly from that on February 24. The lines Hδ, Hγ and Hβ were also reversed and replaced by one or more narrow dark lines.

On February 26 the magnitude from visual comparisons was 1·3, from photometric measures 1·49. The changes in the spectrum were slight.

Observations of the position of the Nova were made by Mr. J. A. Dunne, with the 8-inch meridian circle, on February 23, 24 and 25, with the result for 1900·0, R.A. 3h. 24m. 24s·02, Decl. + 43° 33′ 42″·4.

It therefore appears that on and before February 19, 1901, the star was invisible, or at least fainter than the eleventh magnitude. On February 21 its magnitude was 2·7, according to Mr. Anderson. On February 22 its magnitude was 0·5, perhaps becoming a little brighter on February 23, and then diminishing, so that on February 25 its magnitude was 1·1. Its spectrum on February 22 and 23 was of the Orion type, nearly continuous, traversed by narrow dark lines. During the next twenty-four hours an extraordinary change took place, so that on February 24 the spectrum resembled that of the other Novæ. It was traversed by bright and dark bands, and the principal dark lines had accompanying bright lines of slightly greater wave-length.

During the last fourteen years, and since the general application of photography to astronomy, eight new stars are known to have appeared—Nova Persei, in 1887; Nova Aurigæ, in 1891; Nova Normæ, in 1893; Nova Carinæ, in 1895; Nova Centauri, in 1895; Nova Sagittarii, in 1898; Nova Aquilæ, in 1899; and Nova Persei, in 1901. The second and last of these, which were much brighter than the others, were found visually by Dr. Anderson. All of the others were found by Mrs. Fleming, from an examination of the Draper Memorial Photographs. Nova Aquilæ was announced by telegraph, but has not been described in these circulars. Its position for 1900 is R.A. 19h. 15m.·3, Decl. − 0° 19′. It was not seen on plates taken on November 1, 1898, and earlier, although stars of the thirteenth magnitude appeared on some of them. On April 21, 1899, it was seventh magnitude. It appears on eighteen photographs taken during that summer, and on October 27, 1899, it was tenth magnitude. In July, 1900, when it was discovered, it was about twelfth magnitude. Seven bright lines—Hζ, Hϵ, Hδ, Hγ, 4693, Hβ and the nebular line 5007—were seen in the spectrum photographed on July 3, 1899. On September 7, 1899, Hγ and a somewhat fainter line, which is probably 4959, were the only bright lines visible. On October 27, 1899, Hγ and 5007 were alone visible and bright, so that the spectrum had then become that of a gaseous nebula.

EDWARD C. PICKERING.

NOTES.

AMONG other noteworthy remarks made by speakers at the jubilee dinner of the Royal School of Mines, on March 13, was one in which Sir George Kekewich, secretary of the Board of Education, acknowledged that science must occupy a place in any wise system of education. He said, "I should like to see the day when no education can be regarded as a liberal education which excludes a knowledge of science. In addition, I should like to see no one matriculating at any University in this kingdom who does not possess some knowledge of science. Indeed, I should like to see it recognised as part of the general education of every man who has any claims to possess a liberal education." The dinner was largely attended by past and present professors and students at the College. The chair was occupied by Sir George Gabriel Stokes, and toasts were proposed and acknowledged by the chairman, Sir Kenelm Digby, Prof. J. W. Judd, Sir William Roberts-Austen, Sir George Kekewich, Sir William Huggins, Prof. Le Neve Foster, Mr. Bennett Brough, Prof. W. A. Tilden, Prof. Milne, Mr. F. W. Rudler, Prof. Bauerman, Prof. J. Perry and Mr. Hugh McNeill, the secretary. The chairman described the gradual development of the School of Mines, and referred to the humble way in which it was established. "Even still," he remarked, "it bears indications of the tentative mode of proceeding to which I have already alluded, for Sir Norman Lockyer's elaborate work in astronomical spectroscopy, so far as taking observations on the heavenly bodies is concerned, is carried on in buildings of the nature of sheds." Sir William Roberts-Austen made mention of Stokes, Playfair, Hofmann, Huxley, Tyndall, Warington Smyth, and other brilliant men of science who had been connected with the College; and other speakers showed how professors and students have played important parts in various fields of scientific and industrial activity.

THE death is announced of M. Theodore Moutard, distinguished by his contributions to geometry.

M. A. NORMAND has been elected a correspondant of the Paris Academy of Sciences, in succession to the late General Alexis de Tillo.

THE ninth triennial conference of the German Meteorological Society will be held at Stuttgart on April 1, 2 and 3, the first half of Passion week, as Easter week, the usual time of the meeting, has been set apart for the Seismological Conference at Strassburg. Hail will form one of the principal subjects for discussion.

IT has been decided to hold the seventy-third meeting of the German Association of Naturalists and Physicians at Hamburg from September 22 to 28 next. In response to many representations there has been a rearrangement of the sections, which have hitherto numbered thirty-eight, but will in future be reduced to twenty-seven, and of these sixteen will be medical sections.

IT is reported that the grave of Hippocrates has just been discovered during excavations at Larissa, in Thessaly. A Royal Commission has been sent to the place by the Greek Government to take what measures may seem advisable.

THE *British Medical Journal* announces that Dr. C. W. Daniels has been appointed superintendent and medical tutor of the London School of Tropical Medicine, in succession to Dr. D. C. Rees. Dr. Daniels served on the Royal Society's Malaria Commission in 1898 for two years, and is now seconded for a further period whilst filling his present appointment at the London School of Tropical Medicine.

THE zoological lectures of the Zoological Society of London will be delivered in the Society's meeting room this year on Thursdays April 18, May 16, June 20 and July 18 at 4.30. The first lecture will be given by Prof. C. Stewart, F.R.S., conservator at the Royal College of Surgeons, and will relate to the various devices of nature for the protection and nourishment of young fishes. The lectures are free to Fellows of the Society.

THE latest number of the *Zeitschrift für wissenschaftliche Zoologie* (vol. lxix. part 2) contains three articles dealing with invertebrates. The first, by Herr J. Grofs, treats of the ovary of hemipterous insects; in the second, Herr C. Dawydoff treats of the process of regeneration among the brittle stars; while in the third, Herr O. Bütschli gives the results of his investigations into the nature of siliceous and calcareous sponge-spicules. In the latter it is shown that sponge-spicules, under the influence of heat, display minute cavities, which it is inferred exist under normal conditions, although too small to be detected. The

composition of both the organic and inorganic constituents of the calcareous spicules is worked out, the mineral matter being a double salt of $CaCO_3$ and K_2CO_3.

SERIOUS students of the science of meteorology will welcome Dr. J. Hann's "Lehrbuch der Meteorologie," the publication of which has just been commenced by the firm of Tauchnitz, Leipzig. The work will be completed in eight parts, and it is to be hoped that they will follow one another in quick succession. The first part contains a general introduction on the physics and chemistry of the atmosphere, and sections on radiation and daily and annual ranges of temperature. There are also charts showing the isotherms of the world in January, July, and of the year, and also representing the paths of hurricanes in the North Atlantic Ocean. The work will be reviewed when all the parts have been received.

WE have already referred on two or three occasions to the dispute between the authorities of Kew Observatory and the West London Tramways. The subject of the dispute—whether the currents leaking from the tramway rails would affect the readings of the magnetometers at Kew—was put to the test of experiment on Friday last, when the Board of Trade inspection of the electrical equipment of the Tramways was carried out by Mr. Trotter. For an hour or two the ordinary horse-car trams were replaced by electrically-driven cars, thirty of which were run on the line between Hammersmith and Kew. During this trial observations were made on the measuring instruments in the generating station by Mr. R. T. Glazebrook on behalf of Kew Observatory. It will be possible, by comparing the records thus obtained with the readings of the instruments at Kew during the time of the trial, to determine how far the leakage currents are likely to interfere with the value of the Kew records. Should an appreciable effect be observed, an arrangement will have to be made between Kew and the Tramways as to the amount of compensation to be paid by the latter for the cost of removing the instruments.

THE prospects of agricultural developments in South Africa were described by Prof. R. Wallace at a meeting of the Colonial Institute on March 12. After referring in detail to the crops produced in Cape Colony, the scanty herbage, the rearing of sheep and goats, the production of wool, ostrich-farming, the breeding of cattle, forest areas, and the products of Natal, he alluded to the Transvaal and the Orange River Colony. The south-eastern parts of the Transvaal, including New Scotland, he said, were specially suitable for sheep-breeding as well as for agriculture, the high central area for cattle and corn, the northern and lower elevations for coffee and sugar plantations and for tropical fruit culture. Good tobacco was largely grown in the Transvaal for export to other districts of South Africa. A great deal had been written about irrigation being the probable salvation of the country. Many small local ventures had been marvellously successful in transforming what was desert into gardens of Eden, and a good many promising irrigation schemes had been examined in various districts of Cape Colony, but most of them involved the expenditure of a large amount of capital and would require to be worked with much skill and care to make them pay. Without irrigation, the extent of South Africa that was capable of cultivation with satisfactory results was an infinitesimal fraction of the whole, and even that was subjected to periodical droughts which at times destroyed a whole season's crop; to destructive hailstorms, which were specially prevalent on the central plateau; and to fungoid parasitic pests on the common grain crops, which made the growth of European cereals practically impossible during the wet season of summer. It was highly probable that among the new disease-resisting breeds of cross-fertilised grains which had been produced at Newton-le-Willows by the brothers Garton, species of both oats and wheat might be found on experiment to overcome this difficulty; but still sufficient reasons remained why South Africa would never be a great agricultural country capable of exporting grain. With the development of the local irrigation schemes that were possible and better systems of management, it might more nearly produce the amount of food requisite for internal consumption.

THE *Newcastle Daily Journal* announces the death of Mr. Richard Howse, one of the old school of naturalists, who had been for half a century actively identified with the Natural History Society in Newcastle, and since the new museum was opened at Barras Bridge sixteen years ago he discharged the duties of curator. For a considerable period he acted as one of the secretaries to the Tyneside Naturalists' Field Club, and was also editor of its transactions. Mr. Howse was one of the first geologists to study the Permian rocks of the north-east coast, and he made a number of important observations of the carboniferous fossils of the north of England, many interesting specimens of which have been named after him. He was a prolific writer, and in addition to many papers which were published in the transactions of the local societies, he prepared an interesting "Guide to the Natural History Museum." He compiled other volumes dealing with the exhibits in the Barras Bridge Museum, amongst the number being a "Guide to the Collections of Local Fossils," and a "Catalogue of the Fishes of the Rivers and Coast of Northumberland and Durham." Prior to this publication, no systematic list of the fishes found on the coast and in the rivers of Northumberland and Durham had been issued. Mr. Howse also published an index catalogue of birds in the Hancock collection and a catalogue of Permian fossils, and was joint editor with Mr. J. W. Kirby of a "Synopsis of Geology of Northumberland and Durham."

A METHOD of distinguishing human blood from that of animals has been discovered independently by Dr. Uhlen-Luth, of Greifswald, and Drs. Wassermann and Schutze, of Berlin, and is described in the *Medical Press and Circular* of March 13. From this account of the investigations it appears that it is now possible to obtain a definite reaction from blood-stains, however old, which indicates with something approximating absolute certainty the source of the blood under examination. This result is based on the fact that the blood serum of animals which have been injected with the blood of an animal of a different species, when added to a dilution of blood from the latter, produces therein a well-marked precipitate. Thus, if a rabbit be injected with human blood, the serum of the rabbit blood, when added to a dilution of human blood, causes immediate turbidity, a phenomenon which is conspicuous by its absence when it is added to dilutions of any other kind of blood. The only element of uncertainty is that the blood of monkeys reacts, to some extent, in the same way as human blood; but apart from the fact that the medico legist is seldom likely to be called upon to differentiate between these two varieties, there is a notable difference in the length of time required for a dilution of monkey's blood to become cloudy as compared with that of man. Full details of the procedure will be found in our contemporary.

THE Meteorological Council have just published a series of charts illustrating the weather of the North Atlantic Ocean in the winter 1898–9. This period was marked by a succession of severe gales, and it will be remembered that public interest was especially aroused by the anxiety as the safety of the liners *Pavonia* and *Bulgaria*. The charts illustrate the state of the weather from December 18, 1898, to February 15, 1899, compiled from observations from the log-books of some 200 vessels,

and show that during the month of January and the first half of February the weather was exceedingly boisterous, and the period was also noteworthy by the great difference of temperature between the eastern and western shores of the Atlantic. For instance, between Fort Logan, in Montana (latitude 47° N.), with its terribly severe frost of −61° in the night of February 10, and Liège in Belgium (latitude 48° N.), with its temperature of 70°·5 on the afternoon of the 10th, there was a difference of 131°·5, while over extensive regions of America and western Europe there was a difference of more than 100°. This combination of circumstances seemed to indicate the occurrence of some peculiar atmospheric conditions of which the Meteorological Council considered a permanent record was desirable.

THE *Proceedings* of the American Academy of Arts and Sciences for January contain a description of an ingenious apparatus devised by Mr. F. A. Laws for recording alternating current waves. The system is a modification of the "point-to-point" or "contact" method; by a mechanical arrangement which automatically shifts the position of the contact brushes, the galvanometer deflection instead of being changed intermittently is made to alter gradually, thus slowly following the wave-form. The reflected spot of light is received on a moving photographic plate on which it imprints a record of the wave-form. The method only gives the average wave-form, but inasmuch as this is obtained in a few minutes, it is a considerable improvement on the older "point-to-point" systems. But now that oscillographs have been developed into thoroughly practical instruments by Blondel, Duddell and others, the "point-to-point" method must be regarded, we think, as having had its day.

SOME experiments on the heat evolved when powders are wetted are described by Signor Manfredo Bellati in a recent pamphlet (printed by Carlo Ferrari, of Venice, 1900). It has been suggested as an explanation of the phenomena that the heating is due to the compression produced in the stratum of liquid immediately surrounding the solid, and this explanation has been confirmed by the experiments of Jungk, according to which, when the water is below 4° C., cooling, instead of heating, takes place, such as would occur in water below the temperature of maximum density when subjected to an increase of pressure. This result has been negatived by the experiments of Meissner. The present writer points out, however, that since the effect of pressure is to lower the point of maximum density, it does not necessarily follow that cooling must always occur at temperatures below 4° C., and hence the above hypothesis is not necessarily inconsistent with Meissner's results. In Signor Bellati's experiments dry sand was found to become heated when wetted with water even at a temperature of 0° C. When the sand had been previously moistened, however, the author found that at 0° C. heating occurred when the sand contained more than 2·1 or less than 1·4 per cent. of water, but that with percentages between these limits cooling sometimes took place instead. The author describes some further experiments conducted with the object of testing Canton's and Martini's theory.

IN addition to other communications, the second part of the Bergens Museum *Aarbog* contains two papers, one by Mr. O. Nordgaard and the second by Mr. E. Jorgensen, dealing with the "plankton" of the North Sea, as well as one by Emily Arnesen, treating of the sponges of the Norwegian coasts. In the *fjords* of western Norway it is ascertained that the deep plankton fauna is of an Arctic character; copepods existing in the deep layers, where Atlantic conditions prevail, which attain their maximum development, both as regards size and number, in the Arctic Ocean. We have likewise received the *Aarsberetning* of the Bergen Museum, in which we notice an excellent reproduction of a photograph of a portion of the zoological gallery.

THE first fasciculus of an important work on the Hydroids, or Hydromedusæ, of the North American seas, now in course of publication by the Smithsonian Institution as *Special Bulletin* No. 4, has been received. The rich material for the history of this group of zoophytes accumulated in the U.S. National Museum, as one of the results obtained by numerous dredging expeditions of late years, has never hitherto been worked out, and the detailed investigation now being undertaken promises very important additions to our knowledge of the group. The present fasciculus, by Prof. C. C. Nutting, of Iowa University, deals with the Plumulariidæ, of which it is doubtful if more than fifty North American species were previously known. The result of the investigation is to show that, in place of Australia, the West Indian area is the richest in plumularian life of any region of the equal size in the world.

WE have received the *Sitzungsberichte* of the Royal Bohemian Society for 1900, which forms a thick volume containing, among other matter, nine articles on zoological and the same number on botanical subjects. Of the former perhaps the most interesting is one by Dr. A. Mrázek, describing the discovery of a small freshwater nemertine worm in a tank in one of the hothouses in the Botanical Garden at Prague. So little is at present known of the freshwater representatives of this group that every new fact is of importance; but since specimens have been found in regions so far apart as Nicaragua and Turkestan, there can be little doubt that some forms are indigenous to freshwater. The specimen described by Dr. Mrázek is identical with *Stichostoma* or *Tetrastemma*, *graecense*, of which the other known example was taken in a warm-water tank in the Botanical Garden at Gratz; the species is, therefore, probably introduced. The author adds some general remarks with regard to freshwater faunas.

THE issue of the *Revue Scientifique* (*Revue Rose*) of March 9 contains a long and interesting article by M. Louis-Adrien Levat on the destruction of birds, especially by means of traps and snares, which he declares to be illicit. After a brief survey of the persecution to which birds were exposed in ancient times, and reference to the fact that taking the hen sitting on her nest is expressly forbidden by the Mosaic code, the author goes on to say that during a single spring a few years ago no less than 1500 nests were taken in one French province. This represents a prospective loss of about 6000 birds, which might be expected to consume some 6,000,000 insects among them. He adds the significant observation that in the year 1860 one hundred cages filled with insectivorous birds of various kinds were exported from Baden to New South Wales; and that at the present day it would be almost impossible to send such another cargo, owing to the scarcity of these birds on the continent. And it is not alone the disappearance of bird-life and bird-song from the country districts that is to be deplored. The effects on agriculture, horticulture and the grape industry are simply disastrous. Some birds, it is computed, will consume 200,000 insects per season, and others as many as 600 per day. A single insect-eating species may be the means of saving 3200 grains of wheat and 1150 grapes daily! In Hérault alone the destruction of insectivorous birds is calculated to cost the department 100,000 hectolitres of wine annually. And in some districts of France the country is practically desolated by insect ravages owing to bird-slaughter. From the fact that in France so-called sportsmen are in the habit of shooting small birds, the situation is much worse than in England. Remedial measures are urgently needed, but the author says he is preaching to deaf ears.

THE Trinidad *Bulletin of Miscellaneous Information* states that a recent analysis made by Prof. Carmody, Government Analyst, confirms the previous work of Francis as to the presence of prussic acid in sweet cassava, the proportion found

varying from 0·005 to 0·019 per cent. The skin was found to yield from 0·014 to 0·042 per cent., while the inner part gave only 0·003 to 0·015 per cent. The interior part of bitter cassava yielded 0·013 to 0·037 per cent., while the skin and outer layer yielded from 0·012 to 0·035 per cent. Peeling sweet cassava before cooking is therefore a wise precaution. Prof. Carmody also suggests that the acid may in part be formed by fermentative change.

MR. C. THOM (*Trans.* Acad. Sci. St. Louis, ix. No. 8) gives an account of the details of fertilisation as observed in ferns belonging to the genera Aspidium and Adiantum. In describing the development of the spermatozoa he states that a blepharoplast is present in the cytoplasmic part, and that the nuclear portion really consists of a hollow tube, chiefly composed of chromatin, enclosing a core of a substance probably representing a transformation of nucleolar matter. When the sperm reaches the archegonium, the cytoplasmic envelope becomes more or less functionless, and the nuclear part wriggles to the egg by an autonomous movement. The cytoplasmic portion containing the blepharoplast either is thrown off before the egg is entered or it is detached and disintegrates in the egg cytoplasm. Hence the importance which has been ascribed to this body, as the result of a comparison with animal centrosomes would seem to have been exaggerated. The coiled nuclear part of the sperm enters the nucleus of the egg, in which it can be recognised for some time. Ultimately, however, the mixing of the egg and sperm nuclear constituents becomes so complete that finally no difference between the sexual elements can be detected.

THE report of the work of the Division of Forestry of the U.S. Department of Agriculture during the year 1900 has been issued. The year witnessed a conspicuously wider and more effective and intelligent interest in forest matters in the United States than any previous year. To give an idea of the extent of the work it may be mentioned that during the year applications were received for working plans for 48,078,449 acres, personal examinations on the ground were made of 2,103,670 acres, working plans were begun upon 1,325,000 acres; plans were completed for 179,000 acres, and 54,000 acres were put under management. In accordance with the request of the Secretary of the Interior, the preparation of a working plan for the Black Hills Forest Reserve was begun as the first step toward conservative lumbering on the national forest reserves. A unique and most promising study of the effect of forest cover on the flow of streams has been commenced in southern California upon the lands of the Arrowhead Reservoir Company, whose observations of precipitation, run-off, evaporation and temperature for eight years have been placed at the disposal of the Division of Forestry. A careful study of the subordinate watersheds, which differ completely among themselves in the character of their forest covering, has been undertaken, and strong hopes are entertained of valuable results from the comparison of the run-off from various types of cover. An investigation of the value of the widespread views regarding the effect of denudation upon the once forested lands bordering the Mediterranean Sea has been begun, and the conditions in Tunis, Algeria and Tripoli have been studied.

WE have received a reprint from the Twelfth Annual Report of the Missouri Botanic Garden, a monograph of the Crotons of the United States, by Mr. A. M. Ferguson. It includes about twenty-four species, and is illustrated by thirty-one plates.

A DAINTY and cheap edition—the price is only eighteenpence net—of Izaak Walton's "Complete Angler," has been published by Messrs. Gay and Bird. This matchless idyl of angling and its associations, first appeared in 1653, and the present volume is a reprint of the text of the fifth edition (1676), as revised by Sir John Hawkins. The book is just the kind of volume to slip into the coat pocket, to be read at quiet moments by contemplative naturalists, whether anglers or ramblers, who find pleasure in observing nature.

SEVERAL interesting articles upon scientific subjects appear in the March magazines which have come under our notice. The *Idler* contains an instructive description of the Jena glass works and of Prof. Abbe's researches. Mr. Walter Wellman describes some experiences of his Polar expedition of 1898–1899. A fine series of instantaneous photographs showing the forms assumed by water thrown out of a bucket is reproduced in *Pearson's Magazine*. Dr. Louis Robinson describes popularly how adaptation to environment may lead to the survival of such animals as the giraffe, camel and zebra; and a description is given of a trip in an immersible boat, the *Argonaut*. In *Scribner's Magazine* some of the geographical discoveries made between 1825 and 1900 are shown by comparative maps. *Good Words* contains articles on Mr. Edison, insect pests, and the building of the locomotive.

THE current number of the *Berichte* contains a paper by W. Ipatieff upon the action of a high temperature upon alcohols. Since the researches of Berthelot upon the substances produced when various substances are passed through red-hot tubes, very little work has been done in this direction. It is now found that in the case of alcohols the reaction is a much simpler one than would be expected, the corresponding aldehyde being the chief product. In many cases the yields are so good that it forms an advantageous method for the preparation of certain aldehydes. The hot tube may be of glass or iron, preferably the latter, the temperature giving the best yields being about 700°. Methyl alcohol treated in this way gave 25 per cent. of the theoretical quantity of formaldehyde, isobutyl alcohol about 40 per cent. and isoamyl alcohol 30 to 40 per cent. of the corresponding aldehydes.

OWING to the fact that the values obtained for the atomic weights of iodine and tellurium are inconsistent with their relative positions in Mendeléeff's table, numerous determinations of the atomic weight of the latter element have been made in recent years, the results obtained varying between 127·5 (Staudenmayer) and 128 (Wills), all being above that of iodine (126·8) instead of below it as required by the periodic law. As is pointed out, however, by Herr O. Steiner in the current number of the *Berichte*, all these determinations of the atomic weight of tellurium are based upon the analysis of inorganic preparations, the methods of purification adopted giving no complete guarantee that small quantities of substances of similar properties but different atomic weights may not be present. The fact that tellurium forms a stable and well-defined diphenyltelluride, $Te(C_6H_5)_2$, distilling without decomposition in a vacuum, was therefore utilised for a fresh determination. Although these preliminary results have not the high degree of precision necessary for the complete resolution of the problem, Herr Steiner points out that the accuracy obtainable by an ordinary combustion is sufficient to fix the atomic weight of tellurium to within 0·5, and several results obtained by combustion of the carefully fractionated product gave a mean value of 126·4, a figure much lower than those mentioned above and agreeing with the prediction of the periodic table. As a confirmation of the method, a similar set of experiments upon diphenylselenide gave the values 78·8 and 79·3, the number usually adopted being 79·1. The results of more exact determinations carried out upon material purified by this method will be awaited with interest.

THE additions to the Zoological Society's Gardens during the past week include a Dingo (*Canis dingo*) from Australia,

presented by Mr. W. R. Temple; a Pinche Monkey (*Midas aedipus*) from Colombia, presented by Lady Moor; a West African Python (*Python sebae-natalensis*) from Natal, presented by Mr. Alex. Buchanan; a Spotted Ichneumon (*Herpestes auropunctatus*), four Hamilton's Terrapins (*Damonia hamiltoni*), seven Bungoma River Turtles (*Emyda granosa*), eight Roofed Terrapins (*Kachuga tectum*) from India, a Common Boa (*Boa constrictor*) from South America, deposited; a Maguari Stork (*Dissura maguari*) from South America, four Gouldian Grass Finches (*Poëphila gouldiae*) from Australia, purchased.

OUR ASTRONOMICAL COLUMN.

NOVA PERSEI.—Prof. H. C. Vogel describes, in the *Astronomische Nachrichten* (Bd. 154, No. 3693), the results of measures of photographs of the spectrum of Nova Persei, taken with the 80 cm. refractor and spectrograph of small dispersion. The spectra extend from λ 3740 to λ 5800. Wave-lengths have been determined by comparisons with the spectrum of β Orionis (Rigel). Tables of the wave-lengths of the deduced lines are given, the origins being traced to hydrogen, calcium, magnesium and silicon. The displacements of the lines is shown to indicate a velocity of some 700 kilometres per second relative to the earth; an exception to this occurs in the case of the two calcium lines at H and K, which are indicated as giving velocities of approach of only 45 kilometres per second.

VARIABILITY OF EROS.—At the Lyons Observatory MM. Guillaume, Le Cadet and Luizet have recently obtained a series of estimations of the variations in the brightness of Eros, observing with an equatorial coudé of 0·32 metre aperture and a Brunner equatorial, 0·16 metre aperture. A diagram of the light curve is given. This is similar to that of β Lyræ, but the secondary minimum is almost equal to the principal one. The determinations gave

	h. m.
Principal minimum to secondary minimum	= 2 51
Secondary ,, principal ,,	= 2 24
Principal maximum to secondary maximum	= 2 50

Details of estimates on seven nights during February are given (*Comptes rendus*, cxxxii. pp. 530–531).

In the same issue M. Luizet gives the elements for computing future minima as follows:—

	h. m.	h. m.
1901 Feb. 20. ...	7 57	+5 16·15 E.
20. ...	10 48	

The eccentricity of the orbit of the system would thus be about 0·0569, which is nearly equal to that of the moon's orbit (0·0549).

In the current issue of the *Comptes rendus*, M. L. Montangerand describes the photographic investigations which have been made with the astrographic refractor at the Toulouse Observatory. It is interesting to note that the measures so obtained agree very well with visual determinations. The planet was allowed to trail over the plate, and the points of equal brightness marked off at intervals. The period thus found is given as 2h. 38m. (2h. ·63) (*Comptes rendus*, cxxxii. pp. 616–618).

In close agreement with this result is the determination of Prof. Deichmüller at Bonn, who gives 2h. ·61 as the period of variation. This observer gives also, for the two evenings of February 21 and 22, a series of estimations of magnitude at intervals of ten minutes from 5·0 to 10·0 p.m. (*Astronomische Nachrichten*, Bd. 154, No. 3693).

NEW VARIABLE, 2 1901 (CYGNI).—Dr. T. D. Anderson announces, in the *Astronomische Nachrichten* (Bd. 154, No. 3692), the discovery of a new variable star. Its position is

	h. m.	
R.A. =	19 12·2	(1855·0).
Decl. =	+ 49° 55′	

And the variations recorded are

1900 Dec. 26 ...	9·5
1901 Jan. 12 ...	9·8
Feb. 16 ...	10·4

OBSERVATIONS OF CIRCUMPOLAR VARIABLE STARS.—Vol. xxxvii. part 1 of the *Annals* of the Harvard College Observatory contains the results and discussion of the observations of 17 circumpolar variables made at the institution during the period 1889–1899. The estimates of magnitude were made by Argelander's method, but differ from similar observations of other workers in two respects—first, the stars have been observed throughout the whole period of their variation of light; and second, all the observations have been reduced to a uniform photometric scale, that of the meridian photometer. This latter peculiarity is of great importance, as by its means the stars can not only be systematically compared *inter se*, but collateral comparisons made with stars of constant brightness in any part of the sky. Both the 15 inch and 6-inch equatorials have been employed in the work.

Three of the stars, T Persei, S Persei and R Ursæ Minoris appear to be irregularly variable. With the exception of these, mean light curves have been deduced for the variables, and tables are given showing the phases obtained by this means. An examination of the curves shows that the principal maximum is in several cases preceded, and in a few cases followed, by a more or less marked *secondary* maximum.

Treating these variables as a class, it is noted that the

mean of all the periods ...	= 363·4 days
mean magnitude at maximum	= 7·81
,, ,, ,, minimum	= 12·64
So that the range is therefore	= 4·83 magnitudes.

Drawings are given of the mean light curves of 14 of the variables, and 16 small charts showing their positions with respect to the surrounding stars.

EROS AND THE SOLAR PARALLAX.

FEW projects involving long continued observation and laborious calculations have received a more ready assent or commanded a wider co-operation than that which has for its aim the determination of the solar parallax from observations of the planet Eros. This readiness to adopt a general programme was materially assisted by the meeting of the International Astrophotographic Congress at Paris, in July 1900, whereby the directors of many of the best equipped observatories were able to rapidly mature their plans and to complete the necessary organisation. The representatives of some twenty observatories gave in their adhesion to the proposal, which contemplates the collection of measures, either photographic, micrometrical or heliometric, and the necessary meridian observation of a large number of comparison stars. The general scheme follows the well-known lines of utilising observations made at considerable hour angles east and west of the meridian at any one observatory, of combining the observations made in the north and south hemispheres, and adds the somewhat novel feature of making available simultaneous observations of the planet at stations in America and Europe, a suggestion which, among other advantages, has the effect of eliminating errors arising from an imperfect knowledge of the planet's motion.

Under date, Paris, January 31, M. Loewy gives an interim report of the progress of the observations up to the end of the year 1900. M. Loewy and those responsible for the inception of the scheme are to be congratulated on the energy exhibited and the hopeful results obtained. The report states that, notwithstanding the bad weather that has generally prevailed in the northern regions of our hemisphere, not one day has passed in which the planet has not been observed by one or other of the several methods adopted. The number of coincidences of observation between the three contributing American observatories and those in Europe is shown by the following figures:—

Number of Coincidences up to December 31, 1900.

	Madison.	Washington.	Williams Bay (Yerkes).	Total.
Micrometric ...	40 ...	49 ...	106 ...	195
Photographic ...	15 ...	30 ...	66 ...	111

The English observatories of Oxford and Cambridge (Greenwich is not reported) are in the least favourable position, since the arc of the Great Circle intercepted between them and the average American station is only about 55°; but seeing that the parallax of the sun can be determined quite independently of the motion of the planet, and that the stars of comparison will be the same in the two cases, a very small error can be anticipated under the least favourable conditions. Considerable attention has been given to the amount of this error, and one

can only hope that the favourable presage will be realised. The probable limit of error is based upon a preliminary inquiry due to M. Hermann Struve, of Königsberg, who has found that the probable error of a single complete micrometrical measurement is ±0″·077, and such an error would introduce no greater uncertainty into the parallax than 0″·03, a most satisfactory result for one night's determination. Such a favourable result, however, implies (1) that we are in possession of the accurate diurnal motion of the planet; (2) that no error exists in the relative position of the stars of comparison, and (3) that every source of systematic error has been eliminated. It is not unimportant to observe in this connection that the motion of the planet itself in one second of time can amount to, and even exceed, 0″·03 in the arc of a great circle, no inconsiderable fraction of the total error found by M. Struve. The actual epoch of exposure, with a rapidly moving shutter, would probably be known to much less than a second of time, but the proper moment to assign to the formation of the image seems to be open to more doubt. A question of very similar import has been discussed at Paris by M. Henry, and has been reported upon. This has reference to the formation of the trace of the planet on the sensitised film, when the equatorial is driven to sidereal time by means of a star. M. Henry photographed a region of the sky with an exposure of three minutes, in which an acceleration and retardation of three seconds was alternately given to the driving clock. Two other exposures were made on the same plate in the reversed order, and the differences of right ascension of the centres of the traces were measured. The mean of the differences of the measured distance with clock accelerating was compared with the mean of the distances clock retarding, in groups according to magnitude, with the following result :—

Number of stars.	Mean magnitude.	Mean diff. of distance.	Prob. error of the mean.	Prob. error of a distance.
		″	″	″
13	9·3	+0·10	±0·02	±0·06
20	11·3	−0·03	±0·02	±0·09
25	12+	−0·02	±0·03	±0·13

The large probable error in the third group is quite sufficiently explained by the faintness of the stars and the shortness of the exposure, but we seem to be in presence of errors of quite the same order of magnitude as those found by M. Struve. Certainly one of the most interesting of the results that will proceed from this elaborate programme will be the relative certainty and freedom from systematic errors of the various methods of observing.

This memoir or report also contains, besides an ephemeris of the planet supplied by M. Millosevich and a table of star constants applicable to the stars used in the discussion of the photographic plates, a memoir by Mr. Comstock on the computation of refraction in the direction of the diurnal motion of the planet. Other points which have been discussed are crowded out of the present number, but enough is given to assure us that the International Committee forms a centre of activity calculated to attract the energy and the enterprise of all the co-operating astronomers. But it is impossible to anticipate, as the result of so much labour, anything more than an academic interest. Based upon the constants employed in the reduction and an assumed figure of the earth, the resulting parallax will represent the best value procurable from an isolated inquiry; but in view of the solemn acceptance of the value 8″·80 for the solar parallax at the Paris Congress in 1896, it seems extremely improbable that the various national ephemerides will make any alteration in a value which has been so recently introduced.

FORTHCOMING BOOKS OF SCIENCE.

Mr. Edward Arnold announces :—"The Physiological Action of Drugs, an Introduction to Practical Pharmacology," by Dr. M. S. Pembrey and Dr. C. D. F. Phillips; "The Morphology of the Brain: an Introduction to the Study of the Comparative Anatomy of the Brain in the Vertebrata," by G. Elliott Smith; "A Text-book of Biology," by G. P. Mudge; "Applied Embryology and Morphology," by Dr. A. Keith; "Anthropology and its Practical Value," by E. W. Brabrook; "A School Botany: being an Introductory Text-book on the Study of Flowering Plants," by David Houston, illustrated; "Wood: a Manual of the Natural History and Industrial Applications of the Timbers of Commerce," by Prof. G. S. Boulger; "A Hand-book on Fermentation and the Fermentation Industries," by Charles G. Matthews; "The Dressing of Minerals," by Prof. Henry Louis; "Traverse Tables for Surveyors and Engineers," by Prof. Henry Louis and G. W. Caunt; "Physical Calculus," by Rev. P. E. Bateman.

The announcements of Messrs. Baillière, Tindall and Cox include :—"Cerebral Science: Studies in Comparative Psychology," by Dr. Wallace Wood, illustrated; "Gold and Diamonds: South African Facts and Inferences," with coloured maps and thirteen plates, by W. H. Penning; "Suggested Standards of Purity for Foods and Drugs," by C. G. Moor, Cecil H. Cribb, and Martin Priest.

Mr. B. T. Batsford promises :—"Sanitary Engineering," by Colonel E. C. S. Moore, illustrated; and a new edition of "New Tables for the Complete Solution of Ganguillet and Kutter's Formula," by Colonel E. C. S. Moore.

Messrs. A. and C. Black will publish :—"Encyclopædia Biblica," edited by Rev. Prof. Cheyne and Dr. J. Sutherland Black, vol. iii.; "Geography of South America," by L. W. Lyde; "World Pictures and Problems, an Elementary Pictorial Geography," by Joan B. Reynolds, illustrated; "New Descriptive Geography of Africa," edited by Dr. A. J. Herbertson and F. D. Herbertson; "Introduction to the Study of Physics," by A. F. Walden and J. J. Manley, vol. i., General Physical Measurements, illustrated; "A Treatise on Elementary Statics," by W. J. Dobbs.

The announcements of the Cambridge University Press include :—"Scientific Papers," by John William Strutt, Baron Rayleigh, F.R.S., vol. iii.; "Papers on Mechanical and Physical Subjects," by Prof. Osborne Reynolds, F.R.S., reprinted from various transactions and journals, vol. ii.; "Scientific Papers," by the late Dr. John Hopkinson, F.R.S., in 2 vols.; "A Treatise on Determinants," by R. F. Scott, a new edition by G. B. Mathews, F.R.S.; "A Treatise on Spherical Astronomy," by Prof. Sir Robert S. Ball, F.R.S.; "Zoological Results based on Material from New Britain, New Guinea, Loyalty Islands and Elsewhere, Collected during the Years 1895, 1896 and 1897," by Dr. Arthur Willey. Part v. An account of the Entozoa, by A. E. Shipley, with 3 plates; of the Nemertina, by R. C. Punnett, with 5 plates; the development of the Robber Crab (*Birgus*), by L. A. Borradaile, with 8 figures in the text; new genera and species of Entomostraca, by the Rev. T. R. R. Stebbing, F.R.S., with 5 or 6 plates; anatomy of *Neohelia porcellana* (Moseley), by Edith M. Pratt, with 2 plates. The entire work will be completed with the publication of part vi., which will be issued during 1901, and will contain Dr. Willey's monograph on *Nautilus* and other articles, including an account of the Ascidians, by Prof. W. A. Herdman, F.R.S.; "Reports of the Anthropological Expedition to Torres Straits by the Members of the Expedition," edited by Prof. A. C. Haddon, F.R.S., vol. ii., Physiology and Psychology; "Fauna Hawaiiensis, or the Zoology of the Sandwich Islands," being results of the explorations instituted by the Joint Committee appointed by the Royal Society of London for Promoting Natural Knowledge and the British Association for the Advancement of Science, and carried on with the assistance of those bodies and of the trustees of the Bernice Pauahi Bishop Museum, edited by Dr. David Sharp, F.R.S., Secretary of the Committee; "Zoology," by Prof. E. W. MacBride and A. E. Shipley; "Lectures on Great Physiologists," by Prof. Sir Michael Foster, Sec. R.S.; "Fossil Plants, a Manual for Students of Botany and Geology," by A. C. Seward, F.R.S., vol. ii.; "The Soluble Ferments and Fermentation," by Prof. J. Reynolds Green, F.R.S., new edition; "British Grasses," by Prof. H. Marshall Ward, F.R.S.; "Electricity and Magnetism," by R. T. Glazebrook, F.R.S.; "The Teacher's Manual of School Hygiene," by Dr. E. W. Hope and Edgar Browne; "An Introduction to Logic," by W. E. Johnson; "Euclid, Books I.–III., with Simple Exercises," by R. T. Wright; "An Introduction to Physiography," by W. N. Shaw, F.R.S.; "A Brief History of Geographical Discovery since 1400," by Dr. F. H. H. Guillemard; "A New Primer of Mechanics," by Prof. L. R. Wilberforce; "A New Primer of Physics," by the same author.

Messrs. Cassell and Co., Ltd., give notice of :—A cheap monthly re-issue of the Century Science Series, edited by Sir Henry Roscoe, F.R.S.; "The Herschels and Modern Astronomy," by Agnes M. Clerke; "Pasteur," by Prof. Percy Frankland, F.R.S., and Mrs. Percy Frankland; "James Clerk Maxwell and Modern Physics," by R. T. Glazebrook, F.R.S.;

"Humphry Davy, Poet and Philosopher," by Dr. T. E. Thorpe, F.R.S.; "Major Rennell, F.R.S., and the Rise of Modern English Geography," by Sir Clements R. Markham, F.R.S.; "Justus Von Liebig: His Life and Work," by W. A. Shenstone, F.R.S.; "Charles Lyell and Modern Geology," by Prof. T. G. Bonney, F.R.S.; "John Dalton and the Rise of Modern Chemistry," by Sir Henry E. Roscoe, F.R.S.; "A Practical Method of Teaching Geography" (England and Wales, part ii.), by J. H. Overton; "Pictorial Practical Fruit Growing," a concise manual giving instructions for the management of every important fruit in cultivation, by W. P. Wright, illustrated; and re-issues of "Familiar Wild Birds," by W. Swaysland, illustrated, and "Cassell's Natural History," illustrated.

Messrs. J. and A. Churchill's list includes:—"A Treatise on Physics," by Prof. A. Gray, F.R.S., in three parts, illustrated, part i., Dynamics and Properties of Matter; "Gynæcological Pathology," by Dr. Charles Hubert Roberts, illustrated; "Diseases of the Thyroid Gland, and their Surgical Treatment," by Dr. James Berry, illustrated; "Handbook of Clinical Medicine for Practitioners and Students," giving an account of the diagnosis, prognosis and treatment of disease, by Dr. Thomas D. Savill, illustrated; and a new edition of "Carpenter's Microscope and its Revelations," edited by Rev. Dr. W. H. Dallinger, F.R.S., illustrated.

In the announcements of the Clarendon Press we observe:—"Micro-Anatomy," by G. Mann; "A Text-Book of Arithmetic," by R. Hargreaves; "Geometrical Exercises," by Prof. A. Larmor; "The Works of George Berkeley," edited by A. C. Fraser, 4 vols.; "The Ethics of Spinoza," by H. H. Joachim.

Messrs. Dent and Co. announce:—"Bird Watching," by E. Selous, illustrated.

Mr. Gustav Fischer (Jena) announces:—"Studien über die Narkose," by Dr. Overton; "Weiteres über Malaria. Immunität und Latenzperiode," by Dr. A. Plehn, illustrated; "Die Parasiten im Krebs und Sarkom," by Dr. Max Schüller, illustrated; "Das Gesetz der Güterconcentration in der individualistischen Rechts- und Wirtschaftsordnung," Erster Halbband: Das Gesetz der Güterconcentration und seine Bedeutung für die Wirtschaftspolitik, by Dr. J. Worms; and a new edition of "Die moderne Weltanschauung und der Mensch," by Dr. B. Vetter.

The announcements of Messrs. C. Griffin and Co., Ltd., include:—"The Construction and Maintenance of Vessels Built of Steel," by Thomas Walton, illustrated; "The Metallurgy of Steel," by F. W. Harbord, illustrated; "Hints on Steam Engine Design and Construction," by Charles Hurst, illustrated; "A Text-Book of Physics," by Profs. J. H. Poynting, F.R.S., and J. J. Thomson, F.R.S.:—"Properties of Matter," illustrated; "Tables and Data for the Use of Analysts, Chemical Manufacturers, and Scientific Chemists," by Prof. J. Castell Evans; "A Dictionary of Dyestuffs: A Compendium of Dyes, Mordants, and other substances employed in Dyeing, Calico-Printing, and Bleaching," by C. Rawson, W. M. Gardner, and Dr. W. F. Laycock; "A Dictionary of Textile Fibres," by William J. Hannan, illustrated; "Sanitary Engineering: A Practical Manual of Town Drainage and Sewage and Refuse Disposal," by Francis Wood, illustrated.

Messrs. J. Hall and Co. give notice of:—"Army Science Papers, being papers in chemistry, physics, physiography and geology, set in the Woolwich, Sandhurst and Militia Literary Examinations, 1890-1896"; "Army Mathematical Papers, being papers in arithmetic, algebra, Euclid, trigonometry and mensuration, set in the Sandhurst and Militia Literary Examinations (Class I.), 1890-1896," with answers by T. A. E. Sanderson.

Mr. W. Heinemann announces:—"A Universal History of Mankind," edited by Dr. Helmolt, vol. i. Introductory Prehistory—America and the Pacific Ocean; "Britain and the North Atlantic," by H. J. Mackinder.

Messrs. Hy. Holt and Co. (New York) will publish "The Anatomy of the Cat," by Profs. Reighard and Jenning, illustrated.

Messrs. Isbister and Co., Ltd., will issue:—"Nature and the Child," by C. B. Scott, illustrated; "Differential and Integral Calculus," with applications, by Prof. E. W. Nichols; "Experimental Chemistry," by Dr. Lyman C. Newell, Teacher's Supplement; Heath's Mathematical Monographs, issued under the general editorship of Prof. Webster Wells: (1-4) "Famous Geometrical Theorems and Problems and their History," by W. W. Rupert; (5) "On Teaching Geometry," by Florence Milner.

Messrs. Jarrold and Sons announce:—"Letters and Notes on the Natural History of Norfolk, more especially on the Birds and Fishes," from the MSS. of Sir Thomas Browne, M.D. (1605-1682), in the Sloane Collection in the Library of the British Museum, with notes by Thomas Southwell.

Messrs. Crosby Lockwood and Son promise:—"The Engineer's Year-book of Formulæ, Rules, Tables, Data and Memoranda in Civil, Mechanical, Electrical, Marine and Mine Engineering," by H. R. Kempe, illustrated; and new editions of "The Art of Soap-making: a Practical Handbook of the Manufacture of Hard and Soft Soaps, Toilet Soaps," by Alexander Watt, illustrated; "Pumps and Pumping, a Handbook for Pump Users, being Notes on Selection, Construction and Management," by M. Powis Bale; "Gas-Engine Handbook, a Manual of Useful Information for the Designer and the Engineer," by E. W. Roberts; "The Construction of Roads and Streets," by the late Henry Law and D. K. Clark.

Messrs. Longmans and Co.'s list includes:—"My Autobiography," by Prof. F. MaxMüller; "Researches on Cellulose, 1895-1900," by Cross and Bevan; "Human Personality, and its Survival of Bodily Death," by Frederic W. H. Myers, two vols.; "Dissertations on Leading Philosophical Topics: being Articles Reprinted from *Mind*," by Dr. Alexander Bain; "A Practical Treatise on Mine Surveying," by Arnold Lupton, illustrated; "Pianoforte Tone Production," by Prof. T. Matthay; "Twentieth Century Inventions: a Forecast," by George Sutherland.

Messrs. Macmillan and Co.'s science list comprises:—"The Cambridge Natural History," vol. viii., Amphibia and Reptiles, by Dr. H. Gadow, F.R.S.; "The Scientific Memoirs of Thomas Henry Huxley," edited by Prof. Sir M. Foster, K.C.B., F.R.S., and Prof. E. Ray Lankester, F.R.S., in 4 vols., vol. iii.; "Diseases in Plants," by Prof. H. Marshall Ward, F.R.S.; "The Problem of Conduct, a Study in the Phenomenology of Ethics," by A. E. Taylor; Macmillan's "A Manual of Medicine," edited by Dr. W. H. Allchin, vol. iii.; and new editions of "The Scenery of Scotland viewed in connection with its Physical Geology," by Sir Archibald Geikie, F.R.S., illustrated; "The Methods of Ethics," by the late Prof. Henry Sidgwick, with portrait; "Introduction to Physical Chemistry," by Prof. James Walker; "Flowers and Ferns in their Haunts," by M. O. Wright, illustrated; "Dictionary of Philosophy and Psychology," 3 vols., edited by Prof. J. M. Baldwin; "The Limits of Evolution," by Prof. G. H. Howison; "School Hygiene," by Dr. E. R. Shaw; "The New Basis of Geography," by J. W. Redway; "Ethics, Descriptive and Explanatory," by Prof. S. E. Mezes; "Cyclopedia of American Horticulture," edited by Prof. L. H. Bailey, vol. iii., illustrated; "The Principles of Stock-Breeding," by Prof. W. H. Brewer; "Farm Poultry," by Prof. G. C. Watson, illustrated; "The Principles of Feeding Animals," by W. H. Jordan; "A Laboratory Manual in Physics," by Drs. Crew and Tatnall; "Elementary Electricity and Magnetism," by Profs. D. C. and J. P. Jackson; "Plane and Solid Geometry," by Prof. A. Schultze and F. L. Sevenoak; "Elementary Geometry," by Prof. T. F. Holgate; "The Röntgen Rays in Medicine and Surgery," by Dr. F. H. Williams, illustrated; "Surgical Technique," by Drs. von Esmarch and Kowalzig (translated), illustrated.

Messrs. Methuen and Co. give notice of:—"The Natural History of Selborne," by Gilbert White, edited by Prof. L. C. Miall, F.R.S., and W. Warde Fowler; "Diseases of the Heart," by Dr. E. H. Colbeck, illustrated.

Mr. John Murray's list includes:—"The Native Races of South Africa: their Economic and Social Condition," by the South African Native Races Committee, with maps; "The Life of Gilbert White, of Selborne, based on letters, journals, and other documents in the possession of the family, and not hitherto published," by his Great Grand-Nephew, Rashleigh Holt-White, 2 vols., illustrated; "The Natural History of Religion, based on the Gifford Lectures delivered in Aberdeen in 1889-90 and 1890-91," by Prof. Edward Burnett Tylor, F.R.S., illustrated; "The Book of Ser Marco Polo, the Venetian," translated and edited by the late Colonel Sir Henry Yule, revised throughout in the light of modern discoveries, with a memoir of Colonel Yule," by Prof. Henri Cordier, 2 vols., illustrated; "Heredity," by Prof. J. Arthur Thomson,

illustrated; "The Dawn of Modern Geography, a history of exploration and geographical science from the opening of the Tenth to the middle of the Thirteenth Century, A.D., 900–1250," by C. Raymond Beazley, illustrated; "Dangerous Trades, the historical, social and legal aspects of industrial occupations as affecting public health," by a number of experts, edited by Dr. T. Oliver, illustrated; "The Gypsies of Spain, their Manners, Customs, Religion and Language," by A. Wallis Mills, illustrated.

Mr. J. C. Nimmo promises:—A new edition of "A Handbook of British Birds, showing the distribution of the Resident and Migratory Species in the British Islands, with an Index to the Records of the Rarer Visitants," by J. E. Harting, illustrated.

Mr. David Nutt calls attention to translations of:—"The Realms of the Dead in Ancient Egypt," by Prof. Alfred Wiedemann; "The Tell-el-Amarna Tablets," by Dr. C. Niebuhr; "The Babylonian and Hebrew Genesis," by Prof. H. Zimmern; "The Babylonian Conception of Heaven and Hell," by Dr. Alfred Jeremias; "The Political Development of Babylonia and Assyria," by Prof. H. Winckler.

Messrs. Kegan Paul and Co., Ltd., announce:—"The Origin of Thought," by Rev. D. Nickerson; "Arsenic," by Prof. J. A. Wanklyn.

Messrs. G. P. Putnam's Sons' announcements include:—"The Method of Evolution," a review of the present attitude of science toward the question of the laws and forces which have brought about the origin of species, by H. W. Conn, illustrated; "Care of the Consumptive," a consideration of the scientific use of natural therapeutic agencies in the prevention and cure of consumption, together with a chapter on Colorado as a resort for invalids, by Dr. Charles Fox Gardiner; and a new edition of "Thinking, Feeling, Doing," by E. W. Scripture, illustrated.

In the announcements of Messrs. Lovell Reeve & Co., Ltd., we notice:—"Flora Capensis," the continuation edited by Sir W. T. Thiselton-Dyer, F.R.S., vol. vi., part 1; "Flora of Tropical Africa," the continuation edited by Sir W. T. Thiselton-Dyer, F.R.S., vol. viii., part 1; "Monograph of Membracidæ," by George Bowdler Buckton, F.R.S.; "The Hepaticæ of the British Isles," by W. H. Pearson, parts 1 to 17; "The Lepidoptera of the British Islands," by Charles G. Barrett, part 79; "Lepidoptera Indica," by F. Moore, part 49; "Teracolus, a Monograph of the Genus," by E. M. Bowdler Sharpe, part 9.

Messrs. Walter Scott, Ltd., announce:—"The Mediterranean Race," by Prof. Sergi; and new editions of "Hypnotism," by Dr. A. Moll; "The Criminal," by H. Ellis; "The Evolution of Sex," by Profs. P. Geddes and J. A. Thomson; and "The Psychology of Religion," by Prof. Starbuck.

In the list of Messrs. Smith, Elder and Co., we see:—"Surgical Experiences in South Africa, 1899–1900, being mainly a Clinical Study of the Effects of Injuries produced by Bullets of Small Calibre," by George Henry Makins, illustrated.

The S. P. C. K.'s list includes:—"British and Garden Poisonous Plants," by Rev. Prof. Henslow.

Messrs. Swan Sonnenschein and Co., Ltd., announce:—"The Romance of the Heavens," by Prof. A. W. Bickerton, illustrated; "Phenomenology of the Spirit," by G. W. F. Hegel, translated by J. B. Baillie; "The Elements of Embryology, Man and Mammals," by Dr. O. Hertwig, translated and edited by Dr. E. L. Mark and H. W. Rand; "The Specious Present: a Metaphysical Treatise," by Alfred Hodder; "Student's Text Book of Zoology," by Adam Sedgwick, F.R.S., vol. ii., illustrated; "The Wonderful Century Reader," by Dr. Alfred Russel Wallace, F.R.S., illustrated; "Biological Types in the Vegetable Kingdom," by Wilfred Mark Webb; "Ethics," by Prof. W. Wundt, vol. iii.:—The Principles of Morality and the Sphere of their Validity, translated and edited by Prof. E. B. Titchener; "Physiological Psychology," by Prof. W. Wundt, translated from the fourth German edition by Prof. E. B. Titchener. 2 vols; "Aristotle's Psychology," translated and edited, &c., by Prof. W. A. Hammond; "History of Contemporary Philosophy," by Dr. Max Heinze, translated by Prof. W. Hammond; "The Life of the Sea Shore," by M. Newbiggin, illustrated; "Text-Book of Palæontology for Zoological Students," by T. T. Groom, illustrated; "Mammalia," by Rev. H. A. Macpherson; "Birds' Eggs and Nests," by W. C. J. R. Butterfield, and a new edition of "Evolution and its bearing on Religions," by A. J. Dadson.

The Science announcements of the University Tutorial Press are:—"First Stage Practical Plane and Solid Geometry"; "First Stage Machine Construction and Drawing"; "First Stage Building Construction," by Bryssom Cunningham; "Mathematics, First Stage," Edited by Dr. Wm. Briggs; "First Stage Physiology"; "Section One Physiography"; "Key to Mechanics of Solids, First Stage," by F. Rosenberg; "Advanced Hygiene," by A. E. Ikin and R. A. Lyster; "The Tutorial Algebra," part i., Elementary Course, by Rupert Deakin; "The Tutorial Arithmetic," by W. P. Workman; "Deductions in Euclid," by T. W. Edmondson.

Mr. T. Fisher Unwin announces:—"In Tibet and Chinese Turkestan," by Captain H. H. P. Deasy, illustrated; "By Rock and Pool," by Louis Becke.

Mr. P. Wellby gives notice of:—A new edition of "Psychic Philosophy as the Foundation of a Religion of Natural Law," by V. C. Desertis.

Messrs. Whittaker's list is as follows:—"Electric Traction," by J. H. Rider; "Electric Lighting and Power Distribution," by W. Perren Maycock, vol. ii.; "Galvanic Batteries," by S. R. Bottone; "Telephone System of the British Post Office," by T. E. Herbert.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The subject for the Sedgwick Prize, 1903, is "The Petrology of some Group of British Sedimentary Rocks."

A John Lucas Walker Studentship in Pathology, of the value of £200 a year for three years, will shortly be filled up. Candidates, who need not be members of the University, are to apply to Prof. Woodhead, Pathological Laboratory, by April 16.

Mr. A. W. Hill and Mr. C. E. Inglis have been elected to fellowships at King's College. Mr. Hill took first classes in the Natural Sciences Tripos, 1897-98; Mr. Inglis was 22nd Wrangler, 1897, and first class Mechanical Sciences Tripos, 1898.

DR. KOHN, of University College, Liverpool, has been elected Principal of the new Sir John Cass Technical Institute, Aldgate.

THE Senate of the University of Aberdeen have decided to confer the honorary degree of LL.D. upon Prof. Virchow, of Berlin, Major Alfred W. Alcock, Superintendent of the Indian Museum, Calcutta, and Professor of Zoology in the Medical College of that city, and Dr. Angus Fraser, of Aberdeen.

THE celebration of the ninth jubilee of the University of Glasgow will begin on June 12, and will occupy three or four days. The details of the programme have not yet been arranged, but we understand that the celebration will probably include a religious service in the Cathedral, public reception of delegates and addresses from Universities and learned societies, a graduation ceremony, conversazione in the Bute Hall, banquet in the City Chambers, garden party in the Botanic Gardens, and a smoking concert. If the weather is fine there will also be an excursion down the Clyde by steamer.

SCIENTIFIC SERIALS.

American Journal of Science, March.—Circular magnetisation and magnetic permeability, by John Trowbridge and E. P. Adams. The experiments of Klemenčič upon the intensity of magnetisation produced by an oscillatory current in an iron wire, showed that for a frequency of 9×10^7 oscillations per second the permeability of iron to oscillatory currents is a constant. In the present paper the oscillation frequencies are much lower, ranging from 600 to 3000, and in this case the permeability is not a constant, but depends upon the strength of the magnetic field; that is, the iron behaves towards oscillatory currents in much the same manner as it does towards steady currents.—Notes on the geology of parts of the Seminole, Greek, Cherokee, and Osage nations, by C. N. Gould. A line of coal beds extends north and south near Bartlesville, Skiatook, Dawson, Tulsa, Okmulgee, and Henryville. There is no reason to doubt that gas and oil will eventually be found near these coal beds.—Names for the formations of the Ohio coal measures, by C. S. Prossner.—A new American species of Amphicyon, by J. L. Wortman.

A description of a palatal portion of a skull from the Loup Fork Miocene deposits of Nebraska, named *Amphicyon americanus*, which is undoubtedly to be referred to the European genus. All the Amphicyons of the American Tertiary hitherto described belong to genera quite different and distinct from the typical genus *Amphicyon* of Europe.—Studies in the Cyperaceæ, by T. Holm. *Carices* (*Vigneae*) *astrostachyae*.—A just intonation piano, by S. A. Hageman. A description of a piano mechanism for giving just intonation as opposed to equal temperament.—Very on atmospheric radiation, by W. Hallock.

Annalen der Physik, February.—The electromagnetic rotation experiment and unipolar induction, by E. Hagenbach. Lecher has described some results which have led him to regard the usual text-book explanations of many rotation experiments as fallacious. The experimental results here given are in complete accordance with the values calculated from the Biot-Savart laws, and, in fact, the fundamental experiment of Lecher furnishes an additional proof of their accuracy.—On the law of radiation of black substances, by F. Paschen. A comparison of the theories of Planck and Wein with experiment.—A new determination of the dispersion of fluorspar in the ultra-red, by F. Paschen.—The determination of the selective capacity for reflection of a plane mirror, by F. Paschen.—On the behaviour of liquid dielectrics on the passage of an electric current, by E. v. Schweidler. The results obtained show that the analogy between the behaviour of ionised gases and liquid dielectrics is not an accidental one, but is based upon the phenomena of discharge.—On the testing of the magnetic properties of steel, by I. Klemenčič.—Determination of the frequency of an alternating current, by R. Wachsmuth. The method described, which is very convenient for vibrations between 1 and 100 per second, ceases to be of service when the number rises above 150.—On the temperature in Geissler's tubes, by K. Kerkhof. The temperature in the capillary tube of a Geissler tube was measured by means of the change of resistance of a fine platinum wire. The results were not in agreement with Wiedemann's law, that the temperature is inversely proportional to the section of the tube.—Magnetic images, by H. Jaeger.—The experimental determination of the capillary constants of condensed gases, by L. Grunmach. The method used is based upon the production of capillary waves by the prongs of a tuning fork and the application of a formula developed by Lord Kelvin. It had been found previously to yield satisfactory results with ordinary liquids and molten metals, and has worked well with liquefied gases. Results are given for sulphur dioxide, ammonia, Pictet's liquid and chlorine. The application of the formula of Ramsay and Shields to these observations proves that there is no association of the molecules in liquid ammonia and sulphur dioxide. In the case of chlorine there appears to be a certain amount of association.—The motion of an electrified particle in an electrostatic field, by E. Riecke.—On stratification in a stream of electrified particles, by E. Riecke.—On the ionisation of electrified gases and the unipolar discharge in glowing bodies, by J. Stark.—On the thermoelectrical behaviour of some oxides and metallic sulphides, by E. van Aubel. The results do not confirm the researches of Abt on the same subject.—On the molecular heat of compound bodies and the Neumann-Joule-Kopp law, by E. van Aubel.—On the theory of radiation. A reply to the criticism of Planck, by W. Wien.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 28.—"On the Structure and Affinities of Fossil Plants from the Palæozoic Rocks. IV. The Seed-like Fructification of *Lepidocarpon*, a Genus of Lycopodiaceous Cones from the Carboniferous Formation." By D. H. Scott, M.A., Ph.D., F.R.S., Hon. Keeper of the Jodrell Laboratory, Royal Gardens, Kew.

A short account of the new genus *Lepidocarpon* has been given in a note communicated to the Royal Society last August[1]; the present paper contains a full, illustrated description of the fossils in question, together with a discussion of their morphology and affinities.

The strobilus of *Lipidocarpon Lomaxi*, the Coal-measure species, is, in its earlier condition, in all respects that of a *Lepidostrobus*, of the type of *L. Oldhamius*.

[1] "Note on the Occurrence of a Seed-like Fructification in certain alæozoic Lycopods," *Roy. Soc. Proc.*, vol. lxvii. p. 306.

In each megasporangium, however, a single megaspore or embryo sac alone came to perfection, filling almost the whole sporangial cavity, but accompanied by the remains of its abortive sister-cells. An integument ultimately grew up from the sporophyll, completely enclosing the megasporangium, and leaving only a narrow slit-like opening, or micropyle, along the top. As shown in specially favourable specimens, both of *Lepidocarpon Lomaxi* and of *L. Wildianum*, the more ancient Burntisland form, the functional megaspore became filled by a large-celled prothallus, resembling that of the recent *Isoëtes* or *Selaginella*. The whole body, consisting of the sporophyll, bearing the integumented megasporangium and its contents, became detached from the strobilus, and in this isolated condition is identical with the "seed" described by Williamson under the name of *Cardiocarpon anomalum*, which, however, proves to be totally distinct from the Cordaitean seed so named by Carruthers.

The seed-like organs of *Lepidocarpon* are regarded by the author as presenting close analogies with true seeds, but as differing too widely from the seeds of any known Spermophyta to afford any proof of affinity. The case appears rather to be one of parallel or convergent development, and not to indicate any genetic connection between the Lycopods and the Gymnosperms, or other Phanerogams.

"On the Theory of Consistence of Logical Class-frequencies and its Geometrical Representation." By G. Udny Yule, formerly Assistant Professor of Applied Mathematics in University College, London. Communicated by Prof. K. Pearson, F.R.S.

Geological Society, February 20.—J. J. H. Teall, F.R.S., president, in the chair.—Prof. J. B. Harrison, alluding to a series of views of parts of the interior of British Guiana, which he laid on the table, remarked that the photographs had been taken by his colleague, Mr. H. I. Perkins, Acting Commissioner of Mines in British Guiana, during their recent geological investigations into the structure of the goldfields of that colony. The views well illustrate the general characteristics of the densely wooded country in which the gold-bearing areas occur, and give some idea of the difficulties which affect the work of the mining prospector and of the field-geologist in that colony. Several of the photographs illustrate rapids, cataracts and falls which so frequently occur along the courses of some of the vast rivers of that part of South America, and show the differing forms of weathering of various igneous rocks and of horizontally-bedded sandstones and conglomerates in the tropics. With reference to a few rock-specimens exhibited, Prof. Harrison stated that they were of diamond-drill cores from the Omai Creek claims on the Essequibo River, and that they fairly represented the principal auriferous rocks of that district. Omai Creek is a small stream flowing into the Essequibo at about 130 miles above its mouth, and the country through which it flows is usually diabase (dolerite) and its decomposition-products. From a part of the bed of one of the tributaries of this stream (Gilt Creek), about 500 feet in length by 50 in breadth, some 60,000 ounces of gold and some hundreds of small diamonds have been recovered by the somewhat crude methods of working hitherto in use.—Prof. Edward Hull made a communication, illustrated by lantern slides, on the submerged valley opposite the mouth of the River Congo. The position of this submerged valley has been ascertained by Mr. Edward Stallybrass and Prof. Hull by contouring the floor of the ocean with the aid of the soundings recorded on the Admiralty charts. The sides of the valley are steep and precipitous and clearly defined, the width varying from two to ten miles, and the length across the continental platform being about 122 miles. It is continuous with the valley of the Congo, and its slope is uninterruptedly downward in the direction of the abyssal floor. The steepness of the sides indicates that they are formed of very solid rocks. Several other submerged valleys off the coast of Western Europe were described for comparison. In most cases the landward end of the submerged river-channel is filled with silt, &c., for some distance from the mouth of the actual river; but farther out its course becomes quite distinct towards its embouchure at the edge of the continental platform. Among the valleys specified were those off the mouth of the Tagus and the Lima, the Adour and the Loire, and those in the English and Irish Channels. The following communication was read:—The geological succession of the beds below the Millstone Grit series of Pendle Hill and their equivalents in certain other parts of England, by Dr. Wheelton Hind and J. Allen Howe. Part i. of this paper

consists of a detailed account of the ground. By various sections the extent of the deposit is shown, and it is demonstrated that the deposit occupies a basin, of which the Pendle district occupies the maximum area of deposit, for the sequence thins out rapidly north-west and south. But although the beds thin out, a calcareous series with a typical zonal fauna is always present. Beds containing this fauna are traced from County Dublin, the Isle of Man, Bolland, Craven, the Calder and Mersey valleys, to Derbyshire and North Staffordshire. It is shown that this series, for which the term Pendleside Series is proposed, occupies a basin about the size of the area indicated above, and that the beds are lithologically distinct from the Yoredale Beds of Wensleydale, and contain a different fauna. Part ii. discusses the question in detail, from a palæontological point of view. The migration of certain families of fossils from the north to the south, brought about by a slow change of environment, is shown by tables, and lines called "isodiectic lines" are drawn to represent this distribution. It is shown that the Nuculidæ are found in the lowest Carboniferous beds in Scotland, but come in at successively higher horizons as the beds range southward. These facts and comparative thicknesses are the basis of an argument as to the local distribution of land and water in Carboniferous times; and it is shown that the peculiar change in type which Carboniferous rocks undergo in passing from north to south is due entirely to physiographical conditions, and not to any theoretical assumption of contemporaneous faulting. It is shown, moreover, that the Craven Faults *per se* have had nothing to do with this change of type. The correlation of the limestone-knolls of Craven with the Pendleside Limestone is demonstrated to be no longer tenable.

Zoological Society, March 5.—Dr. W. T. Blanford, F.R.S., vice-president, in the chair.—Mr. Sclater exhibited, on behalf of Captain Stanley Flower, photographs of a young female giraffe, a young male white oryx (*Oryx leucoryx*), and a male ostrich, with the vocal sac extended, which had been taken from examples living in the Zoological Garden at Ghizeh, Egypt.—There were exhibited, on behalf of Dr. Einar Lönnberg, two photographs of a skull of the musk-ox from East Greenland.—Dr. Smith Woodward read a paper on some remains of extinct reptiles obtained from Patagonia by the La Plata Museum. They included the skull and other remains of a remarkably armoured Chelonian, *Miolania*, which had previously been discovered only in superficial deposits in Queensland and in Lord Howe's Island, off the Australian coast. The genus was now proved to be Pleurodiran. There was also a considerable portion of the skeleton of a large extinct snake, apparently of the primitive genus of the South American family Ilysiidæ. Along with these remains were found the well-preserved jaws of a large carnivorous Dinosaur, allied to *Megalosaurus*. Either the dinosaurian reptiles must have survived to a later period in South America than elsewhere, or geologists must have been mistaken as to the age of the formation in which the other reptiles and extinct mammals occurred. The discovery of *Miolania* in South America seemed to favour the theory of a former Antarctic continent; but it should be remembered that in late Secondary and early Tertiary times the Pleurodiran Chelonians were almost cosmopolitan. Future discovery might thus perhaps explain the occurrence of *Miolania* in South America and Australia, in the same manner as the occurrence of *Ceratodus* in these two regions was already explained.—Mr. R. I. Pocock read a paper containing descriptions of six new species of trap-door spiders from China. One of these, *Haloproctus ricketti*, was remarkable as constituting a new genus of a specialised group of Ctenizidæ, hitherto known only from the Sonoran area of North America. Another, *Latouchia fossoria*, also a new genus, was a more typical Ctenizoid.—Mr. R. H. Burne read a paper on the innervation of the supraorbital canal in the sea-cat (*Chimaera monstrosa*).—Mr. F. E. Beddard, F.R.S., read descriptions of certain new or little-known earthworms belonging to the genera Polytoreutus and Typhœus. Mr. Beddard also described the clitellum and spermatophores in the annelid *Alma stuhlmanni*.

EDINBURGH.

Royal Society, February 18.—Prof. Geikie in the chair.—Dr. Peddie communicated a paper by the late Mr. Shand and himself on the thermoelectric position of solid mercury. The thermoelectric line was found to be nearly parallel to that of iron and to meet the line of copper very near the temperature of −50° C.—Mr. Thomas Heath read a paper on observations of the Edinburgh rock thermometers, in which the observations both of the old and the new sets were fully discussed. There was some doubt about the corrections to be applied to the new set; but treating them in the same way as the old set which had been installed by Prof. Forbes in 1837, but had been broken in 1876 by a madman, Mr. Heath found that the results were fairly consistent. There was evidence of change of conductivity with depth, and the values of the conductivity deduced by him from the harmonic analysis were somewhat smaller than the values deduced by Forbes and Everett from the older observations. The new thermometers, however, had been steadily sinking in position since they had been installed in 1879.

March 4.—Sir Arthur Mitchell in the chair.—Prof. Letts and Mr. J. Hawthorne communicated a paper on the seaweed *Ulva Latissima* and its relation to the pollution of sea water by sewage, in which they had investigated with care the manner of fermentation under various conditions. One of the most remarkable facts about this seaweed is the high proportion of nitrogen, distinctly in excess of what is met in other similar plants, in this respect resembling an animal rather than a plant. *Ulva Latissima* is found in great quantity in certain parts of Belfast Lough and Dublin Bay, where the water is strongly polluted by sewage. In similar situations in Stranford Bay, where there was comparatively little sewage, the weed was rarely met with.—Mr. Aitken, in some further notes on the dynamics of cyclones and anticyclones, discussed the relation between storm tracks and the regions of maximum temperature and maximum humidity. Four facts were mentioned as supporting the theory that cyclones were convectionally driven, namely: (1) the circulation in cyclones is principally towards the centre, (2) the velocity increases towards the centre at all levels, (3) storm tracks form and follow with the season change of the areas over which the supply of hot moist air is most plentiful, (4) the greater violence of winds in cyclones than in anticyclones points to some source of energy in cyclonic areas.—Prof. Copeland, the Astronomer Royal for Scotland, gave an account of the observations of the new star in Perseus, discovered by Dr. Anderson. Since the first night of observation the character of the spectrum of the star had changed greatly, being now a faint continuous spectrum crossed with broad, bright lines, flanked on the more refrangible side with dark absorption bands. No evidence of polarisation could be detected in the bright lines. The star was now on the wane, and would probably gradually diminish in brightness until it ceased to be visible to the naked eye. In the after discussion Dr. Knott pointed out how the distribution of the bright and dark bands fell in with the view that the phenomenon was due to a collision taking place mainly in the line of sight, the later stages requiring the relative displacement towards us of gaseous products, cooling by their expansion.

MANCHESTER.

Literary and Philosophical Society, March 5.—Prof. Horace Lamb, F.R.S., president, in the chair.—Mr. C. E. Stromeyer referred to the results of a study of tidal waves which he had published in NATURE in 1895, and which indicated that in the majority of cases of which records were available the tidal waves appeared to proceed from the Faraday Reef. Particulars of the tidal wave which recently struck the *Teutonic* are not yet to hand for comparison with former records.—Mr. W. E. Hoyle read a paper entitled "On the genera Octopus, Eledone and Histiopsis," in which he dealt with the nomenclature of these genera.

PARIS.

Academy of Sciences, March 11.—M. Fouqué in the chair.—Utilisation of the points of Collins for the determination of a quadrilateral, by M. Hatt.—On the complete synthesis of acetylpropylene and the terpenic hydrocarbons, by M. Berthelot. Propylene and acetylene, mixed in equal volumes, are heated together to about 500° C. The hydrocarbon C_5H_8 is formed, together with methane.—Remarks on my last communication relating to the telegraphic and telephonic lines established on the snow of Mont Blanc, by M. J. Janssen.—On the waves of the second order, with respect to the velocities which may be presented by a viscous fluid, by M. P. Duhem.—Maltosuria in certain diabetics, by MM. R. Lépine and Boulud. The difference between the rotatory power and the copper-reducing power in the case of certain urines from diabetic patients can be explained by the assumption that maltose is present as well as

glucose.—Remarks by M. Edmond Perrier, on the scientific expeditions of the *Travailleur* and *Talisman*.—M. A. Normand was elected a correspondant for the Section of Geography and Navigation in the place of M. Alexis de Tillo.—Remarks by M. Darboux on the death of M. Th. Moutard.—On the variability of the planet *Eros*, from negatives taken at the Observatory of Toulouse, by M. L. Montangerand (see p. 502).—Note concerning the preceding observations of M. Montangerand, by M. Baillaud.—Complementary details on the new star in Perseus, by M. H. Deslandres. The results of the spectroscopic study of the new star do not confirm the hypothesis tentatively put forward in a previous note. It appears to be necessary to assume the existence of at least two stars, one of which is perhaps a nebula, and which is approaching the other with an enormous velocity.—Observations on the sun made at the Observatory of Lyons with the Brunner 16 cm. equatorial during the fourth quarter of 1900, by M. J. Guillaume. The results are summarised in three tables, giving the number of spots, their distribution in latitude, and the distribution of the faculæ in latitude.—On a certain category of transcendental functions, by M. Edmond Maillet.—On the regular quaternary groups of a finite order, by M. Léon Autonne.—On an electrophone giving very loud sounds and on the causes which produce it, by M. Th. Tommasina.—On the reduction of sulphomolybdic acid by alcohol, by M. E. Péchard. Molybdic acid, dissolved in sulphuric acid and gradually reduced by alcohol, gives a blue crystalline deposit of complicated composition, approximately $5NH_3MoO_2SO_3.7MoO_3+8H_2O$.—A new glycol, 1-4 butane-diol, or tetramethyleneglycol, and its diacetin, by M. J. Hamonet. The diacetin is prepared by the action of silver acetate upon the di-iodobutane, and the glycol is obtained from this by heating with dilute lime-water.—The action of zinc powder upon the saturated fatty acids, by M. A. Hébert. Stearic acid, heated with zinc dust, gives a complicated mixture of olefines, the bromides of which were examined.—The action of mercuric oxide upon some organic compounds, by MM. A. Lumière, L. Lumière and F. Perrin.—On a new preparation of terpinol, by M. P. Genvresse. Pinene, dissolved in alcohol, is treated with nitrous acid, distilled with steam and the product purified by fractional distillation in a vacuum.—New characters of the short electrical stimulus transmitted by the nerve, by M. Aug. Charpentier.—Contribution to the psycho-physiological study of the vital acts in the total absence of the brain in an infant, by MM. N. Vaschide and Cl. Vurpas. The infant, which survived thirty-nine hours, showed a notable lowering of temperature and remarkably slow breathing of the type described by Cheyne and Stokes. The case demonstrated the *rôle* of the cerebral hemispheres in circulation, respiration and the temperature regulation.—New observations on *Bathyomus*, enormous isopods met with at great depths, by M. E. L. Bouvier.—On the sensibility of the higher plants to very small doses of toxic substances, by M. Henri Coupin. The higher plants, like the fungi, are so sensitive to the toxic action of certain metals, notably silver, mercury, copper and cadmium, that they give evidence of their presence in quantities too small to appreciate by chemical analysis.—Anatomical researches on the ripening of the shoots of the vine, by M. Kövessi. The branches ripen better as the cellular thickness of their walls increases and as their cells contain more starch.—On a fossil insect found in the Trias of Lorraine, by M. P. Fliche.—On the periods of the southern aurora, by M. Henryk Arctowski.—Note relating to a litholo-gical and bathymetric atlas of the coasts of France, by M. J. Thoulet.

DIARY OF SOCIETIES.

THURSDAY, MARCH 21.

ROYAL SOCIETY, at 4.30.—Studies in Visual Sensation (Croonian Lecture): Prof. C. Lloyd Morgan, F.R.S.

LINNEAN SOCIETY, at 8.—On the Intestinal Tract of Birds, and the Valuation and Nomenclature of Zoological Characters: P. Chalmers Mitchell.

CHEMICAL SOCIETY, at 8.—Researches on Morphine, Part II: S. B. Schryver and F. H. Lees.—The Constitution of Pilocarpine, Part II.: H. A. D. Jowett.—Note on the Latent Heats of Evaporation of Liquids: Holland Crompton.—(1) Action of Dry Silver Oxide and Ethyl Iodide on Benzoylacetic Ester, Desoxybenzoin, and Benzyl Cyanide; (2) Alkylation of Acylarylamines: G. D. Lander.

CAMERA CLUB, at 8.15.—Yorkshire Caves and Waterfalls: T. C. Hepworth.

FRIDAY, MARCH 22.

ROYAL INSTITUTION, at 9.—Some Recent Work on Diffusion: Dr. Horace Brown, F.R.S.

PHYSICAL SOCIETY (University College, Gower Street), at 5.—On the Expansion of Silica: Prof. Callendar, F.R.S.—The Spectroscopic Apparatus at University College: Dr. E. C. C. Baly.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Hunslet Railway and Bridge over the River Aire: O. L. McDermott.

SATURDAY, MARCH 23.

ROYAL INSTITUTION, at 3.—Sound and Vibrations: Lord Rayleigh, F.R.S.

MONDAY, MARCH 25.

SOCIETY OF ARTS, at 8.—Electric Railways: Major P. Cardew.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Journeys in the Linyanti Region, South Africa: Percy C. Reid.—Exploration and Survey in the Sobat Region: Major H. H. Austin, R.E.

INSTITUTE OF ACTUARIES, at 5.30.—On the Rates of Mortality in New South Wales and Victoria, and the Construction of a Mortality Table from a single Census and the Deaths in the Years adjacent thereto: E. McMahon Moors and W. R. Day.

CAMERA CLUB, at 8.15.—Colour Photography by the Sanger-Shepherd Process: A. Pringle.

TUESDAY, MARCH 26.

ROYAL INSTITUTION, at 3.—The Cell as the Unit of Life: Dr. A. Macfadyen.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Paper to be further discussed*: The Æsthetic Treatment of Bridge Structures: J. Husband.—*Paper to be read, time permitting*: The Burrator Works for the Water-supply of Plymouth: E. Sandeman.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—Some Improvements in Optical Projection: J. H. Agar Baugh.

WEDNESDAY, MARCH 27.

SOCIETY OF ARTS, at 8.—Clocks, Carillons and Bells: A. A. Johnston.

THURSDAY, MARCH 28.

ROYAL SOCIETY, at 4.30.—*Probable papers*: The Growth of Magnetism in Iron under Alternating Magnetic Force: Prof. E. Wilson.—On the Electrical Conductivity of Air and Salt Vapours: Dr. H. A. Wilson.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Electrical Transmission of Power in Coal Mines: H. W. Ravenshaw.—Portable Electric Lamps: S. F. Walker.

CHEMICAL SOCIETY, at 3.—Annual General Meeting.

FRIDAY, MARCH 29.

ROYAL INSTITUTION, at 9.

SATURDAY, MARCH 30.

ROYAL INSTITUTION, at 3.—Sound and Vibrations: Lord Rayleigh, F.R.S.

CONTENTS.

SUPPLEMENT TO "NATURE."

DARWINISM AND STATECRAFT.

National Life from the Standpoint of Science. An Address delivered at Newcastle, November 19, 1900, by Karl Pearson, F.R.S. Pp. 62. (London: A. and C. Black, 1901.)

THE main purpose of this address is one which all thinking men, who desire the good of their fellow men, must respect, and many will heartily approve. Prof. Pearson presses upon his readers the importance to a nation of the possession by its constituent individuals of good strong brains as well as of good strong muscles, and of a well-directed training of those brains. He points out that the laws of heredity are as true for mankind as for farm stock or pigeons, yet that the result of modern civilisation is to remove or suspend the natural selection by which, in the case of non-social organisms, those individuals with inferior qualities would be prevented from obtaining success in the struggle for existence, and so hindered from largely contributing to the reproduction of the race. He points out that, on the contrary, accumulated wealth enables its inheritors to produce and rear large families without regard to the qualities of the inheritor, and that what seems to be a still more dangerous condition arises from the reckless and abundant breeding of the hopelessly poor and unsuccessful members of the community. The class which has the greatest mental endowment and is serving the nation best in all directions, marries late and produces few children. Deliberate selection in breeding and the restriction of the increase of worthless stock would, if such discrimination were within our limits of knowledge, produce definite results in mankind as it does in animals. But, in common with many other thinkers who have examined this question, Prof. Pearson does not see the way to any control of the reproductive function in civilised communities, though he does not seem to doubt, as I should do, that mankind would conduct these breeding operations with real success were the control to be tolerated. Where custom has introduced a system of restricting the size of families, as in France, Prof. Pearson tells us that unforeseen results follow, as, for instance, the relatively excessive increase of some section or racial division of the community which refuses to adopt the custom of producing only two children. The population of France, it is said, is becoming more and more largely composed of Breton stock in consequence of the production of large families by that race, whilst the rest of the population deliberately restricts itself. Prof. Pearson does not urge any attempt on the part of the community to interfere with the individual in this matter. It is, indeed, a matter which requires far deeper study than Prof. Pearson or any one else has yet given to it before conclusions worthy of the name of science, and so well founded as to justify practical measures, can be formulated.

On the other hand, in advocating a really wise and carefully considered *training* of such brains as the mixed stock of the community presents for manipulation, Prof. Pearson is on less doubtful ground. He justly points out that not only in our warfare in South Africa, but in commerce and manufacture, we stand in need of trained "scouts," men who have learnt to keep their eyes open and apply common sense, men *trained to observe and reason*. Our educational system fails to train the youth of the country in this way; it does not even aim at it or consider it. Training in what is called "natural science" or in scientific method is utterly neglected. As I have shown elsewhere, Oxford sets the example of neglect, and, naturally enough, that example is followed by each successively lower grade of school throughout the Empire. Prof. Pearson rightly insists that it is not mere knowledge of scientific results and formulæ which is needed, but the training which a proper study of a branch of science can give. The British parent foolishly and mistakenly says, "I want my son to learn what will be useful to him in his profession in life." Prof. Pearson has heard it over and over again in his capacity as a teacher, and I can, with a similar range of experience, fully confirm him. Never, says Prof. Pearson, does the British parent say, as he ought to say, "I want my son to know how to observe and how to think." The result of this almost universal misapprehension of the value and purpose of education is that where, after prolonged resistance, science has been forced into colleges and schools, it is perverted and degraded by the commercial purveyors of so-called education; it is represented by scraps of information supposed to be useful in engineering, brewing or medicine. Meanwhile the claim is openly made on behalf of the "humanities" (classical literature, philosophy and history) that they alone can give the training of the mind which is desirable over and above mere technical information.

It cannot, I think, be denied that this false issue has been raised by the advocates of the present antiquated course of study through which the average youth of England is slowly and fruitlessly dragged at Oxford and the great schools of the country. Partly through ignorance, partly through interest, here as in other great mechanisms which affect the welfare and the destiny of the British nation, a traditional, ill-considered procedure and a fruitless expenditure of power and opportunity are obstinately maintained and ruthlessly defended by those who find the present arrangements profitable to themselves and their class. With persistence, which is the index of either profound ignorance or overweening conceit, science is declared to be what it is not, namely, professional or technical information, and then it is asserted that science is useless as "training," and that "training" can be given by the traditional classical studies alone. The value of real education in science, namely, its training of men to observe and to reason, does not, of course, belong to the travesty of science, which is all that the educational ring of schoolmasters and college tutors have allowed to grow up in the system which they control. Prof. Pearson has my sympathy in his endeavour to persuade our fellow-countrymen that training in science is a necessary and vital factor in national prosperity, and that it is almost totally unprovided for in this country.

But I greatly fear that this is a case in which it is useless to address the democracy. It is waste of words to harangue the deaf; it is foolish to appeal to the eyes

of the blind. Germany did not acquire its admirable educational system by popular demand—nor does England owe such institutions as the College of Chemistry, the School of Mines, the Royal College of Science and the national art schools and schools of design to political agitators. Still less did the professional class of educationists help in either case—on the contrary, they bitterly and fiercely opposed these new developments. They are due in Germany to the Kings of Prussia ; in England to the late Prince Albert. The only chance, it seems to me, which this country has for a change in the methods and aims of its education, and of its administration, which largely depends on the education of its administrators, is in the absolute conviction on the part of a great statesman, or, I say it with the deepest respect, of the King himself, that such change is of vital importance and is the one step necessary for the future welfare of the British nation. The crowd cannot guide itself, cannot help itself in its blind impotence. Here is the opportunity, the duty, of the greatest in the land.

Prof. Pearson's address was delivered at a time when the nation was suffering from the stress of war in South Africa. He has endeavoured to avail himself of the temporary awakening of the English people from their self-satisfied toleration of incompetence in order to press home the national need for the better training of its brains and the utilisation of the brains when trained. That is well-timed and legitimate. But when Prof. Pearson goes on to assert that the struggle between great civilised nations for territory, for trade-routes and for supremacy in manufactures—by warfare or by starvation —is the necessary condition, the moving power of human progress, he goes, I think, altogether beyond the conclusions which are warranted by our knowledge and beyond the indications which strictly follow from the application to this problem of the conclusions of biological science. He says :

"This dependence of progress on the survival of the fitter race, terribly black as it may seem to some of you, gives the struggle for existence its redeeming features ; it is the fiery crucible out of which comes the finer metal. You may hope for a time when the sword shall be turned into the plough-share. . . . But, believe me, when that day comes mankind will no longer progress ; . . . man will stagnate. . . ."

I do not hesitate to state, with a full sense of the gravity of the issue, that Prof. Pearson has no warrant in our present knowledge of the laws of development of animal societies or of human communities for this statement. This is certainly not a conclusion which can be for a moment pressed on popular acceptance as coming from the standpoint of science. It seems rather to originate in a hasty attempt to generalise from certain preliminary results of biology to conclusions in regard to an enormous unexplored field of human phenomena. I admit that the struggle between communities of human beings has resulted in the suppression of the more violent instincts of the individual and has led to the development, as an element of communal strength, of that quality which we know as human sympathy, to the elaboration of social instincts, of civic virtues, of pity and of principles of conduct. The list is Prof. Pearson's. But it has yet to be shown that there is any strict analogy between the struggle for existence of the countless individuals in each generation of a non-social species and the competition of great nations or great races of mankind. In the former case an immense number of variations is continually presented, and a remorseless destruction of all but the selected few. In the latter there is no great variation among the competitors on a given area and there is no destruction and consequent removal from reproductive perpetuation of the less successful community. The highly specialised communities of social insects might perhaps be fittingly dealt with in such prophecies as Prof. Pearson applies to mankind. It is, on the other hand, necessary to remember that the communities of human beings are far less individualised than are those of the insects referred to. One ant colony may utterly destroy another ; one community of bees or wasps may exterminate its neighbour. But in the struggles of human communities in these later days the conquerors absorb and do not annihilate their competitors in those cases where there is any similarity of race. In these later days the struggle is for the supremacy of a special form of political organisation, and not for the extinction or the survival of a breed. Moreover, the new and strangely significant factor of oral and written tradition is operative in civilised communities, so that a race, though dead or merged in other races, yet continues to speak in the works of its greatest men.

Further, it seems to be beyond doubt that that progress of humanity, which consists in the production of those splendid individuals who have blessed their race by great discoveries in science and by great creations in art, is not in any way promoted, but is, on the contrary, hindered by the diversion of the energies and resources of the community to warfare and aggressive struggle. Just as the race of the jungle-cock cannot develop a nine-foot tail-feather when fighting its fellows as a struggling breed, but when removed from the restricting influences of natural selection bursts out in the Japanese poultry yards into such magnificent "sports," so humanity can only develop that "sport" which we call genius when it has reached social conditions of security and freedom from the demands of international warfare. Those nine-foot sports of the human brain which we know as Shakespeare, Newton, Raphael and Mozart were most certainly not traceable to the struggles of their native communities with other communities for territory, trade-routes or commerce. Rather, it would seem, were they and others like them only possible as the outcome of conditions when defence and offence were occupying but little of the strength and thought of their own and neighbouring nationalities. And there is this to be noticed by those who, like Prof. Pearson, would apply particular conclusions of biological science, without discrimination or reserve, to human society—viz. that whereas the corporeal "sports" of animal stock can only affect subsequent generations by the physical process of reproduction, the sports of the human mind—and, indeed, all individual minds and characters which rise above the herd—have, in consequence of the perfection of our records, an enduring influence upon vast numbers in the later generations, not only of one, but of all civilised communities.

I, for one, do not despair of humanity ; I see no reason to suppose that what might be called "progress"

is impossible in the absence of bloodshed and international hostility. There is much ambiguity in the word "progress." A movement or change in human society which by some thinkers would be called "progress," would by others be called "retrogression," whilst others would deny the very existence of a change and see stagnation in place of either. Prof. Pearson, like other prophets of things to come, uses terms of conveniently vague significance. He should tell us more clearly what he means by "human progress" before he asks us to accept it as the end which justifies human warfare.

E. Ray Lankester.

Prof. Karl Pearson has for some years devoted his mathematical knowledge to a more exact co-ordination of observations on heredity. It cannot be said that in this address he uses any results of his study which were previously unknown to us through the observations of breeders of animals and the facts recorded by Mr. Galton. Prof. Pearson affirms that the "earlier interpreters of evolution" obscured it, and much of his address is devoted to pointing out that the association of individuals in a tribe made the development of human love and sympathy a necessity.

Now surely Huxley was the very earliest interpreter of evolution, and there was no part of the doctrine to which he devoted more attention than this very subject—evolution and ethics. But it is good that facts, however well known they may be to readers of Nature, should be set forth strongly in an address which has a chance of coming before other readers.

The essential part of the address shows that a nation must be untiring and unresting in its efforts to increase its "brain" power; to increase its proportion of people of better brains and physique, if it is to hold its own against other nations. It is certain that we readers of Nature are all in agreement with the author, and we are all in sympathy with him in his effort to rouse our sleeping nation, and to make it feel that the struggle for existence is not merely among neighbouring individuals, nor tribes, nor cities, nor counties, but among nations. We may go further, and say that every man of sense in the kingdom is fully alive to the fact that this struggle for existence is going on, and we only differ as to the best method of increasing the strength of our own people. There are many other things to be thought of, many things which Prof. Pearson's mere Aryan science cannot take into account. A nation, like a man or a field, needs occasional intervals of lying fallow. After national existence is secure, there is something important in the development of international friendship and affection. As care for the tribe preceded care for the nation, so care for the nation may only precede care for a federation of the nations. The struggle between some nations in Europe may be so bitter as to make them unfit for combination against a fitter Sclavonic and Asiatic federation. But these considerations must give place when our own nation is in such great danger as it is at the present time. Huxley and many others spoke of this danger and pointed out the remedy long ago, when the danger was remote; now it is coming swiftly upon us, and we can only repeat the same warnings and give the same advice in shriller and more vehement tones.

To show how we are continually saying the same things in regard to education, I would direct attention to "The Education of our Industrial Classes," an address delivered in 1883 by Sir Norman Lockyer, (Macmillan and Co.). At p. 16 I find the following words:—

"It is half a century since the Germans found out the importance of the new studies from a national point of view. We are now finding it out for ourselves, and finding it out not a moment too soon; and I need hardly tell you that the transformation which is going on is acknowledged to be one of the highest national importance. It is no longer an abstract question of a method of education; it is a question of the life or death of many of our national industries, for, in the struggle for existence, how can a man who wins his bread by the application of natural laws to some branch of industry, if he be ignorant of those laws, compete with the man who is acquainted with them? If for man we read nation, you see our present position."

The author, although he fears that our economic and social conditions are hardly ripe for such a movement, seems to favour Mr. Galton's notion that there ought to be social action towards an endeavour to prevent the inferior stock of people among us from breeding at will; making the all-important question of parentage a matter not of family, but of national importance. He points out that France is becoming a land of Bretons because the Bretons alone have large families, and that the feckless, improvident and brainless people in England among the very poor and the very rich have the largest families, whereas the provident people

"have been marrying late, have been having small families, have been increasing their individual comfort, and all this is at the expense of the nation's future."

This is why we are defeated commercially by Germans. He points out that a mere multiplication of centres of technical instruction will do no good against the American and German, as it is only where brains already exist that training is of use. He points out that nurture and education may immensely aid the social machine, but they must be repeated generation by generation; they will not in themselves reduce the tendency to the production of bad stock. He believes the Kaffir and Negro and Red Indian so low that they must be destroyed; that for a good stock of people to live alongside a bad stock, or to keep them as slaves, or to intermarry with them, is only to prepare a cataclysmal solution for the future.

It would, we think, be easy to prove, from the condition of mongrel races and from the history of the fall and rise of nations, that these statements are not the teachings of science; but let us suppose for a moment that he is right about England. During the French revolution a speaker declared, day after day, with vehemence, that the simple remedy for all French evils was "to kill all the scoundrels and traitors." Prof Pearson's remedy for all evils is to diminish the proportion of bad stock; but who are the people of England of bad stock? He himself confesses that they may be among the very rich as well as among the very poor; we are inclined to think that he would find much the same proportion among the middle class people, or Philistines, who "have been increasing their individual comfort."

He is specially wrong when he says that education will not improve the stock. On the contrary, we think that

it is by education alone, the education of the whole people, that such improvement can take place. Educated young people will so select partners that the stock will rapidly improve, and the improved stock will ask for better education still. What governor, however scientific, can so direct the choice of millions of different people as they themselves can if properly educated? for each case needs not only special scientific study, but something very much outside what we usually call science.

Whatever the stock, the author thinks—as we do—that it is only by education in scientific schools that, in a particular generation, a particular nation is made able to compete with other nations either in the arts of war or of peace.

Unfortunately, he leaves us in great doubt as to what he means by a scientific school. Over and over again he attacks the technical schools, which in this country are getting to be so numerous and which are improving in their methods every year. We feel sure that he cannot have studied this matter. He seems to think that the numerous great technical schools merely teach trade tricks and trade skill and trade formulæ. There are technical schools attached to all the great colleges and universities. There are the technical colleges of the City and Guilds of London Institute. He will find that in all these, students are instructed through experiment, through their own observation and through mathematical deduction, in those scientific principles which underlie their future profession. The wail of the teacher in such classes is always that his pupils have been so badly taught at school that they cannot observe, they cannot think for themselves, they cannot reason, they cannot even express themselves on paper; what they have learnt as mathematics is in no sense a part of their mental machinery and cannot be used in reasoning. The author says that for sixteen years he has himself been helping to train engineers, and he describes how he endeavours to make his students observe and think for themselves. And does not every teacher of mathematics or applied mathematics to engineers at all the other technical schools in the country try to do the same? Has he any kind of proof that they do not? It is quite true that at some colleges the teacher may have been badly selected, selected merely because he took a good place in the mathematical tripos, a man with no liking or aptitude for teaching; but we beg to assure Prof. Pearson that such men are the exception, and not the rule, at the technical schools with which we are acquainted. Unfortunately, at all these colleges the teachers find many, or indeed most, of their pupils unprepared for the higher, more complex work which some years hence will, we hope, really be taken up by all students in these schools and colleges. And so it is that many engineering students, like Prof. Pearson's pupils, after they leave college "adapt themselves to an environment more or less different from that of the existing profession." If these young engineers had been brought up from early youth to observe and think for themselves, there would be no need to teach them the most elementary principles of "scouting" at the ages of eighteen to twenty, when, in truth, they ought to have already entered the practice of their profession. True it is that for these ignorant young men the very simplest scientific apparatus may serve; but there are some students who have already been trained to scout, who come prepared to be taught under our contemptible "brand-new system of technical instruction," and it is for them that we have our ridiculously unnecessary "physicist with palatial laboratory and elaborate and costly implements" and that there exists "the biologist with his 80*l.* microscopes and specimens drawn from the four quarters of the globe." Surely Prof. Pearson must see that the education which we all know to be so necessary for the development of the faculties ought to be begun in early youth, that there is at present no genuine education in English public schools, and that without physical science such an education cannot be given.

It is not alone the teacher in a technical college who complains of the absence of education in the public schools. Whether they apply themselves to commerce or manufactures, whether they enter one profession or another, whether they try to become diplomatists or statesmen, our boys are found to have had no education. In days when all Europe was at war and we were safe in our island, our grandfathers gathered to themselves all the good things of the world, and now we are living on their legacy. And we are blind to the fact that the lean and hungry nations, covetous, cautious and disciplined, are almost quarrelling already over us, their prey. If there are enough honest and thinking men in England this day they will speak to England loud enough to stir her out of her apathy; or if not, and if England cannot be so stirred, let her descend to her natural position; let the stranger come in and divide her property; even the property of those men who are selfishly silent. Our cry is for education and only that; true education for everybody, from the highest to the lowest, is a national necessity more important than any weapon of war or any political machinery for the repression of bad stock, because education will give us all these things and much more. JOHN PERRY.

THE DISCOVERER OF LAKE NGAMI.

William Cotton Oswell, Hunter and Explorer. By his son, W. E. Oswell. Two volumes. (London: W. Heinemann, 1900.)

SO far as the general public are concerned, the interest in the career of the late Mr. Oswell may be said to begin and end with the period (from 1844 to 1852) during which he made his five expeditions to Africa, at a time when by far the greater portion of that continent was still a *terra incognita*. But this period of the life of the great explorer and hunter occupies only a comparatively small portion of the two volumes before us, the bulk of which is taken up by an account of the parentage and early years of Oswell, and with letters to his family and friends. However interesting these may be to his immediate relations, we venture to submit that they appeal but slightly to the general public; and, in our opinion, the author would have been much better advised had he condensed his narrative into the space of a single volume of the bulk of one of the two under notice.

Apart from this, the author has discharged a task of considerable difficulty and delicacy (for it is never an easy matter for a son to write the biography of his father) in a highly creditable and satisfactory manner.

Until the appearance in 1894 of his chapters on hunting in Africa (written, after much persuasion, at the instance of Sir Samuel Baker) in the "Big Game" volume of the *Badminton Library*, the world knew practically nothing of Oswell's South African explorations and experiences, except what can be gleaned from Livingstone's "Missionary Travels."[1] The information given in the present volumes, though far less full than could be desired, tells the story of his adventures in considerably more detail than is the case in the articles referred to, and its publication is therefore a distinct gain to our knowledge of the early days of African exploration.

Oswell's persistent refusal to take any share in the honours attaching to the discovery of Lake Ngami, and his self-abnegation in permitting nothing from his own pen to forestall the appearance of Livingstone's volume, are now matters of history, and are alluded to in some detail in the introduction by Mr. Francis Galton to the work under review. But there can be no hesitation in admitting that as Oswell originated the idea and fitted out the expedition at his own cost, the honour and glory of the discovery should by rights have been his and his alone. Indeed, this is practically admitted by Livingstone himself. And here it may be said that we are not for a moment casting the slightest reflection on the great missionary explorer. The account of the discovery of Lake Ngami had to be written and published, and as Oswell refused to undertake the task it was the bounden duty of Livingstone to do so. The destruction of his own journals by Oswell, in case they should be published before the appearance of Livingstone's work, is, however, a matter which must always remain one for serious regret.

In this connection, it may not be out of place to mention that there is a discrepancy between the accounts of Livingstone and Oswell as to the precise date on which the great lake was discovered. Livingstone[2] states that "it was on the 1st of August [1849] that we reached the north-east [or lower] end of the Ngami." Oswell, on the other hand, as quoted on p. 201 of the first volume of the work under review, says that

"We started on the 16th of July, and after twelve days' march arrived at the half tribe of the Bamanguato, who call themselves Batouani. We outspanned nearly abreast of the town at the lower end of the Lake."

This would make the date of its discovery July 28. It is, of course, a matter of slight moment, but it would be interesting to find whether original manuscripts throw any light on the reason of the discrepancy.

It is to the African adventures of Oswell that our remaining space will be restricted. Several of his encounters with, and escapes from, wild animals mentioned in the present work have been already narrated in the *Badminton Library*, from which the illustrations have been reproduced. These latter were drawn by Joseph Wolf under the personal supervision of Oswell himself, and may be taken to be as truthful representations of the actual scenes as could be obtained without the aid of photography. It must, however, be confessed that, either from the wearing of the blocks or from the fault of the printer, the reproductions are by no means equal to the original plates. This inequality will be manifest if the plate facing p. 16 of vol. ii. of the work before us be compared with its prototype facing p. 128 of vol. i. on "Big Game Shooting" in the *Badminton Library*.

Like Cornwallis Harris and his own companion, Frank Vardon, Oswell was in the service of the Hon. East India Company, although in a civilian instead of a military capacity, and it was ill-health in India that led him to recruit his energies in the Cape. Both on his first expedition with Murray, and on his second with Vardon in 1844 and 1845, Oswell, to quote his own words,

"penetrated far beyond the utmost limits of previous geographical knowledge, exploring, hunting, revelling with them in shooting such as no men ever had before or will ever have again, the first Europeans and the first guns among the myriads of animals."

His acquaintance with Livingstone commenced in 1845 and continued till the death of the latter. On his return to Africa in 1848 from a short sojourn in India, the great expedition to Lake Ngami was organised and brought to a successful conclusion, his companions being Livingstone and Murray. The triumph of the march was the crossing of the Kalahari desert, for when the Zouga—the effluent of Ngami—was reached, the difficulties were over, and patience and perseverance were alone necessary. The fourth expedition, undertaken alone, was mainly occupied in shooting on previous routes; but in the fifth, which was undertaken with Livingstone, the course of the Zambesi and its tributaries was mapped for the first time, and the myth that the former discharged at Delagoa Bay disposed of for ever.

Although, unfortunately, neither of the quartet was a naturalist in the true sense of the term, their expeditions largely extended our knowledge of South African animals. During the third expedition, those beautiful antelopes the lichi (*Cobus leche*) and puku (*C. vardoni*) were discovered; and it seems that Livingstone or Oswell were really the discoverers of the nakong, or situtunga antelope, or, at all events, of the Chobi representative of the same, although the animal was named from specimens brought home at a much later date by Speke. A rhinoceros was also named after Oswell by Gray, being regarded as distinct from *Rhinoceros simus* on account of the forward direction of the front horn, which is always worn at the tip by being pushed along the ground. Later writers, and even Oswell himself, have, however, denied the distinctness of this form. But Oswell's notes tell us that the quebaaba—as this animal is always called by the natives—was never found below the southern tropic. If it had been the sole white rhinoceros north of the tropic, it would have undoubtedly been entitled to rank as a local race. And even as matters now stand its true affinities are worth the attention of naturalists.

Another piece of information afforded us by Oswell's notes is the fact that elephants from different localities in South Africa present certain points of difference. He says, for instance (vol. i. p. 205), that on the Zouga "the elephants are a distinct variety from the Limpopo ones; much lower and smaller in body (10 feet is a large bull), but with capital tusks." This also is worthy the best attention of zoologists, although it is to be feared that it is now late to differentiate local races of the species, if such

[1] In the popular edition of that work, published in 1861, Oswell's name is not even mentioned in the index, although it occurs on certain of the plates.

[2] *Op. cit.* p. 46.

really existed.[1] It is to be regretted that before making the statement (vol. i. p. 219) that a pair of gemsbok horns obtained by Oswell, which measure 44 inches, are the longest but one on record the author did not consult some recent works on horn-measurements. Had he done so, he would have found that these dimensions are exceeded by five examples, the "record" length being 47½ inches.

Of the profusion of great game in Central South Africa in Oswell's time, and of its subsequent extermination, the story has been told so often that its recapitulation here would be superfluous. Whether Oswell and his successors were altogether free from blame in regard to indiscriminate slaughter is a question which it is not our province to answer on this occasion. He himself wrote, somewhat pathetically, in after years as follows: "I am sorry now for all the fine old beasts I have killed, but I was young then, there was excitement in the work; I had large numbers of men to feed; and if these are not sound excuses for slaughter, the regret is lessened by the knowledge that every animal I shot, save three elephants, was eaten by man, and so put to a good use."

That Oswell was a gallant and noble-hearted gentleman, as well as a true sportsman, will, we think, be the verdict of all who read a very attractive, albeit in certain respects a somewhat saddening, book. R. L.

THE WORKS OF C. F. GAUSS.

Carl Friedrich Gauss Werke. Achter Band. Pp. 458. (Leipzig: Teubner, 1900.)

THE contents of this volume consist mainly of reviews, correspondence and a series of posthumous fragments relating to various branches of pure mathematics. It not unfrequently happens that a mathematician's unfinished essays, only brought to light after his death, are even more stimulating than the finished works which he published during his life. This is especially true of Gauss. As he says himself in one of his letters, he aimed at the utmost perfection of form; he worked, as it were, in marble, and did not give his masterpieces to the world until they had been elaborated to the highest degree of symmetry and polish. The result is that, when we study the productions of his genius, we feel a kind of awed admiration which is not entirely free from a sense of chill; his stately synthesis compels our assent, but does not always attract our sympathy, and rarely suggests the idea of even the humblest emulation. Gauss's own countryman, Jacobi, in his lectures on the theory of numbers, refers with a touch of bitterness to the frozen austerity of Gauss's demonstrations.

Much, then, as we may deplore the fact that Gauss's official duties, as well as his fastidious habit of composition, prevented him from working out the details of so many of his great ideas, there is a certain consolation in being able to see, in the notes which have been preserved, some traces of the inception of his far-reaching discoveries. There is no need now to emphasise the extraordinary way in which he anticipated many of the most important results obtained by other men. We can understand the suspicion and incredulity with which his claims were regarded by some of his contemporaries; but no one can doubt the extent and independence of his researches in the theories of elliptic functions, of modular functions, and of non-Euclidean geometry, not to mention other things. It must have been very trying to him to see so much of his work forestalled, so far as priority of publication was concerned; and on the whole it may be said that he betrayed less disappointment than might have been expected. It is true that in this volume there are letters of a rather controversial kind, in which he emphatically claims priority in the discovery of the method of least squares; but he refers appreciatively to Legendre's work on cometary orbits, adding pathetically,

"Es scheint mein Schicksal zu sein, fast in allen meinen theoretischen Arbeiten mit Legendre zu concurriren."

And in writing to Bolyai (a friend, it is true) about the non-Euclidean geometry, after saying that his many engagements prevent him from thinking of the subject for the present, he continues:

"Es soll mich herzlich herzlich freuen, wenn Du mir zuvorkommst, und es Dir gelingt alle Hindernisse zu übersteigen. Ich würde dann mit der innigsten Freude alles thun, um Dein Verdienst gelten zu machen und ins Licht zu stellen, so viel in meinen Kräften steht."

The letters and notes on the foundations of geometry form one of the most interesting sections of this volume. It is clear that before the end of 1799 Gauss had critically examined the theory of parallels, and begun to doubt its necessary truth: he says that he could prove the whole of geometry if it could be shown that a rectilinear triangle is possible, the area of which exceeds that of any given surface; but that, far from assuming this as an axiom, he thinks it may be possible that, however great the sides of the triangle are taken, the area is less than a certain fixed quantity. He returned to the subject from time to time during many years. It appears from a letter of Gauss to Gerling, dated March 16, 1819, that he had then obtained some of the principal results in that species of geometry in which the sum of the angles of a rectilinear triangle is less than two right angles, for he gives the formula

$$\text{"Limes areæ trianguli plani} = \frac{\pi CC}{\{\log \text{hyp}\,(1+\sqrt{2})\}^2}\text{"}$$

where C is a certain constant determined by the space under consideration. Gauss refers again to this constant in a letter of November 8, 1824, and speaks of it as "a definite (an sich bestimmte) linear magnitude existing in space, although unknown to us." This is not very clear, and the context does not enlighten us, in spite of its criticism of the philosophers. The fact is that Gauss nowhere (apparently) in these fragments expresses himself with perfect clearness about this constant. He had arrived at the notion of an upper limit to the area of a triangle; but he never suggests the possibility of an upper limit to the distance between two points, and, in fact, assumes that there is none. Moreover, he dismisses without sufficient consideration the question of how such a thing as an *absolute* distance is conceivable, and ignores the fundamental difficulties which beset the application of number to measurement. It is very remarkable that so

[1] Since the review was written Dr. Matschie, of Berlin, has proposed to split up the African elephant into several so-called species.

consummate an analyst failed to realise completely that no strict mathematical theory of the metrical properties of space is possible until the elements of space have been brought into correspondence with a definite arithmetical manifold. One such manifold is the field of analytical points (x, y, z) used in ordinary algebraic geometry. Its metrical properties admit of analytical definition, and are capable of exact determination. They apply to "real" space in so far as they belong to a system suggested by intuitions of sense, and therefore necessarily associated with intuitional experience. But no intuition can give a complete theory of space; and the question whether "real" space is Euclidean or non-Euclidean is one that, from the nature of the case, cannot possibly be answered, and it may even be doubted whether it has any meaning at all.

Some of Gauss's remarks on the metaphysics of space are extremely interesting, even though they may not, to every one, carry complete conviction. Thus, he says, "Der Unterschied zwischen Rechts und Links lässt sich nicht definiren, sondern nur vorzeigen," and proceeds to assert that the distinction can only be indicated by one intellect to another by means of a material object. He then says, in conclusion, that he finds in this a striking refutation of Kant's notion that space is *merely* the form of our outer intuition ("Der Raum sei *bloss* die Form unserer äussern Anschauung"). It is difficult not to see in this both vagueness of reasoning and a misapprehension of Kant. If "right" and "left" are terms used to indicate a distinction apprehended by sense, Gauss's statement is so obvious as not to be worth making; but when they are applied to relations of position in a mathematical space they *do* admit of definition, not absolutely, but as correlative terms. And even from the first point of view there is nothing in the fact to which Gauss calls attention which is inconsistent with Kant's assertion that space is a form, or scheme, in terms of which we interpret (or into which we fit) certain related groups of our sensuous impressions. This pre-Kantian attitude of Gauss is illustrated by other allusions to the "reality" of space. But it should be noticed that he expressly says that since a geometry of more than three dimensions can be considered *in abstracto* without contradiction, even though we have no corresponding intuitions, it is possible that such a geometry is accessible to beings of a higher order. He hopes, too, that in another life he may be able to see more into the essential nature of geometry.

The rest of the volume must be dismissed with a very few words. From the notes on elliptic transcendents it is clear that Gauss not only inverted the general elliptic integral, but expressed the result as the quotient of two integral functions: that his work on the arithmetico-geometric mean led him to the group of linear transformations of the period which leaves the modulus κ^2 unaltered; and that he represented this group geometrically, actually drawing a figure for the fundamental triangle and a few of its derivatives. A letter to Bessel, dated December 18, 1811, shows him to be in possession of the principles of complex integration. There is a considerable series of notes on the analytical theory of surfaces, most of which was incorporated in the famous memoir; applications of complex numbers to geometry, and especially to transformations of space, on which there are two short but very suggestive notes; a fragment on knots, with a very convenient notation, and a complete table of different knots with less than six crossings; and finally, there are notes on the barycentric calculus, with a formula $B - C = ai$, curiously like Grassmann's notation in the *Ausdehnungslehre*. These seem to be the most important items; several, which are of less interest, have not been mentioned. G. B. M.

CHINESE AFFAIRS.

China: Her History, Diplomacy and Commerce from the Earliest Times to the Present Day. By E. H. Parker. Pp. xx+332. (London: Murray, 1901.) 8*s*. net.

CHINA is an inexhaustible subject, and though we have lately had books in abundance on modern affairs and the present crisis, there is still room for such a work as Mr. Parker's "China." It aims at a great deal more than an account of current politics, and supplies a whole army of facts and statistics on the history, trade and government of the Empire. The chapters on the history will be found valuable. They are full of information, and will well bear a careful study. But the later portion of the work, beginning with the introduction of foreign trade, will probably be found the more generally interesting part. Mr. Parker opens this section with the life and trade at Canton, where British merchants were "cabined, cribbed, confined" in what was known as the "Factory."

"The merchants," he tells us, "passed a confined, ceremonious and reserved existence, entirely in the hands of their *Fiadors* and *Compradores*, on the one hand, and of the Chinese Cohong on the other. No wives were allowed, and even burials had to take place at Whanpoa, twelve miles down the river. It was only in 1828 that the British superintendent first succeeded in getting his wife up. British trade was, of course, the largest of all; lead (for packing tea) and woollens were the chief imports (no specie, no cotton fabrics) from England, opium from India, and the usual 'Straits' produce picked up from the Dutch colonies visited by our ships *en route*. Tea and silk were the main exports then as now. The British tea consumption in 1795 was 14,000,000 lbs. a year, more than one-half of which total was smuggled by foreign ships from Canton operating in the English Channel."

Since those days a complete change has come over our trade. India and Ceylon have competed so successfully with China in the production of tea that, whereas in 1880 2,100,000 cwt. of the leaf were exported from China, only 1,631,000 cwt. left the country in 1899. But while this export has thus diminished, certain new imports have been greedily accepted by the people. Kerosene oil is one of these. Before 1880 little was heard of it in China, while in 1890 more than a hundred million gallons were imported. On this and other articles of trade, Mr. Parker writes:-

"Mules may be seen by the thousand in distant Bhamo carrying kerosene oil through the passes into Yunnan; peasants may be met every evening in arcadian Hainan carrying home a neat pound bag of beautiful white flour, together with a farthing's worth of periwinkles their ancestors have always brought home of an evening as a relish for their rice. An immense trade is done in old English horse-shoes, which are considered the best iron in the world for making small

household articles, such as brackets, hooks and bolts. I have seen steamer after steamer disgorge this paying and useful ballast at Shanghai. Another revelation is the commercial capacity of the Bombay yarn . . . of which Japan also, who now sends her own yarn and piece goods to China, for some years imported annually one million sterling's worth. The trade in arms and ammunition has enormously expanded, chiefly in the hands of the Germans, who are now receiving an unpleasant reminder that this particular activity is apt to cut both ways."

Mr. Parker speaks, and speaks justly, of the honesty of the Chinese merchants, and has something to say for the honesty of the people generally. But, like the sale of arms, his argument on this subject cuts both ways. He assures us that he never lost anything of value while in China. This may perhaps be accounted for by the facts that he always kept his safe locked, and that he possessed no jewellery but that which he habitually wore on his person He incidentally mentions also that on one occasion he asked his "boy" how it was that so many of his forks had a stain. To which his "boy" replied that it had been done by

"various coolies or underservants, each of whom in succession invariably tested the electro on his own account, merely as a businesslike act."

On another occasion, when he wished to lock up the same electro box, he (the "boy") said :—

"Not at all ; if you lock it up, some one will mistake the contents for silver, and carry the whole box away or break it open ; whereas, if you leave it open, each thief will be able to ascertain for himself that it is not worth stealing."

The only time, he tells us, that he suffered any depredation was when a thief, at an inn, carried him and his bed to a convenient spot, and extracted a valuable fur coat from beneath him, without disturbing his slumbers. Altogether his chapter on the national characteristics of Chinamen is amusing reading, and all the more so since, quite unconsciously, he assumes throughout his remarks on the subject the attitude of the "Devil's Advocate."

ANTHROPOLOGY IN ITS SCIENTIFIC AND EDUCATIONAL ASPECTS.

Anthropologie als Wissenschaft und Lehrfach. By Dr. Rudolf Martin. Pp. 30. (Jena : Fischer, 1901.)

THE inaugural lecture delivered by Dr. Martin on the occasion of his appointment to the newly founded chair of anthropology in the University of Zürich may be described as a survey of the present state of anthropological science, together with some most opportune suggestions regarding anthropology as an instrument of education. After a few remarks on the gradual process by which anthropology has acquired a position of independence among other sciences, the author turns to the range of subjects now studied under the title of anthropology, and, in the first place, draws a strong line of distinction between the physical and the psychical aspects of that science. With the former are placed the sciences of physiology and pathology, while the latter division is taken as applying, in the first instance, not so much to the psychology of the individual as to that of various groups of humanity judged by their culture and social status. With the latter, the psychical, division there must be ranked the studies of archæology and of prehistoric anthropology. The distinction of the classifications of mankind based on the two great divisions of anthropology respectively is strongly insisted upon, and the methods of anthropologists call for some words of warning in this connection. The aims laid before future workers by Dr. Martin are, so far as regards the methods to be employed, a rational, systematic and uniform use of numerical data ; at the same time, we are reminded of instances that have occurred in past years of misapprehension of the true significance of the results of such methods, and are warned of the necessity of exercising the greatest care in judging similar results in the future. With particular reference to the classification of human races on physical grounds, the necessity of employing, not a single character, but a combination of features as the criterion of differences is dwelt upon at some length, and the urgent need for immediate action in the case of primitive races now fast dying out is also clearly expressed. The first part of the essay concludes with suggestions as to the lines of investigations to be pursued in the case of mixed races, and with a firm insistence on the importance of an intimate knowledge of the anatomy of the mammals of the order Primates, to those who work at the physical side of anthropology.

Dr. Martin then proceeds to discuss the place of anthropology in University teaching, and while considering that it must be studied in connection with what we may call unapplied sciences (his precise expression is "the mathematical and scientific section of the Philosophical Faculty," for which we have no exact equivalent in English universities), he is well aware of the advantages conferred upon those working at the physical side of anthropology by a knowledge of the elements of medical science, and, above all, of human anatomy as studied in the dissecting room. A place is therefore claimed for anthropology in the education of every professional man, but more particularly for those who teach in the higher schools, for medical men, and last, but not least, for those who hold administrative or other posts in colonial possessions. The application of anthropological methods to the identification of criminals is also mentioned. Finally, there are pointed out the claims of anthropology to figure as part of a liberal education, independently of any professional application of its results, and we are reminded of the deep significance of the attempt to realise, in its fullest sense, "man's place in nature."

The foregoing notes will, it is hoped, convey an idea of the scope and purport of Dr. Martin's lecture. It may be mentioned that Dr. Martin, besides being the author of important contributions to anthropology both in the laboratory and in the field, is deeply versed in philosophical studies. His opinions on the methods and aims of anthropology will be received with all the greater consideration by those who are interested in the future of that science. In a single lecture it was manifestly impossible to do more than indicate the chief points ; and we think that Dr. Martin has not overlooked any of great importance. From this point of view we think that the essay constitutes a valuable survey of the subject, and that it appears very opportunely at the commencement of the twentieth century. W L. H. D.