THURSDAY, AUGUST 22, 1901.

JAPANESE SPONGES.

Studies on the Hexactinellida. Contribution I. (Euplectellidæ). By Isao Iijima. Pp. 299; 14 plates. (Reprinted from the *Journal of the College of Science*, Imperial University, Tōkyō, Japan, vol. xv. 1901.)

THIS important memoir is the first instalment of a general monograph of the rich Hexactinellid fauna of the Japanese seas, upon the study of which the author has been engaged for the last seven years, with the result of increasing very largely the list of these interesting and beautiful sponges known to occur in that part of the world. Four species of *Euplectella*, three of *Regadrella* and one of *Walteria* are here described in great detail, and all but two of them are species described and named by the author himself, either in previous publications or in this memoir for the first time. The part of the work, however, which above all claims the attention of the zoologist who is not specially interested in this group of animals, or in the faunistic problems which attach to them, is the detailed account of the histology and organisation of *Euplectella marshalli* (pp. 116–200). The author has had at his disposal a very abundant material of this sponge, which he was able to preserve by various methods directly after capture. As the result of his careful studies upon this valuable material, the author describes in these Hexactinellids a type of structure which is radically different in two main points from that of all other sponges, and in both respects probably to be regarded as more primitive.

In the first place, he finds no trace of the intercellular matrix or mesoglœa of the connective tissue parenchyma, which in other sponges forms the chief mass of the sponge body. In the second place, perhaps in consequence of the absence of any such ground substance, there is no layer of flat epithelium to be found on any part of the sponge body, neither on the external surface nor in the canal system.

The dermal layer, in short, forms in these Hexactinellids a system of trabeculæ, composed of fused cells corresponding to the collencytes of other sponges, which here form a continuous protoplasmic syncytium with scattered nuclei. In this syncytium the spicules are laid down, but there is no secreted matrix apart from them and from the protoplasm of the syncytium, nor is there any flat epithelium covering the exposed surfaces. The trabeculæ anastomose and form a cobweb-like felt-work, through which the water filters both before and after traversing the flagellated chambers. At the external and internal surfaces of the body wall the trabeculæ are expanded to form film-like membranes perforated by numerous gaps or pores, the so-called dermal and gastral membranes. In the trabecular system are found other cellular elements, the archæocytes, with their modifications into nutritive and reproductive elements.

If the author's observations are confirmed, therefore, the Hexactinellids stand on a lower plane of evolution, at least as regards histological structure, than any other sponges, in that the dermal layer forms only one category of cell elements and is not differentiated into separate epithelial and connective tissue strata. This conclusion, it is hardly necessary to point out, is in direct antagonism to the view, still maintained by many authorities, according to which these two commonly found differentiations of the dermal layer are to be regarded as an "ectoderm" and a "mesoderm" respectively. In the author's words, the Hexactinellids "are a group of sponges which have undergone a far-reaching development and differentiation in the spicules, but have remained in a primitive condition so far as certain points in the soft parts are concerned."

The author has also made a number of important observations upon other points of microscopic structure. He brings forward the first observations yet made upon the formation of spicules in these sponges. He has also observed "archæocyte congeries" which he believes to give rise to free larvæ, thus reverting to, and supporting, the view of H. V. Wilson, that many sponge larvæ are really free-swimming gemmules, and are not egg-larvæ. But the account given of the collar cells and flagellated chambers merits special mention, as differing in some points, both important and unimportant, from Schulze's recently published description of the collar cells in another Hexactinellid, *Schaudinnia arctica*. Each collar cell has a flattened basal portion containing the nucleus and running out into ramifying processes, which anastomose with those of neighbouring cells to form the "reticular membrane" of Schulze. According to Iijima, all the meshes of the reticular membrane are open and serve as prosopyles or chamber pores, which are therefore practically equal in number to the collar cells themselves, "converting the epithelium into a veritable sieve membrane." The trabeculæ of the dermal layer attach themselves directly to the reticular membrane. The "polyprosopylar" condition here described contrasts sharply with what is seen in other sponges, and in the author's opinion it is correlated with the absence of mesoglœa. In sponges other than Hexactinellids, *i.e.* in Calcarea and Demospongiæ, the copious deposit of the ground substance round the bases of the collar cells necessarily blocks the free infiltration of the water between them, and causes a specialisation of the prosopyles; they become few in number and restricted in distribution, while between them the collar cells close up their ranks and extinguish the gaps in the wall. In Calcarea at least, it may be added, the prosopyles are further guarded, each by a special cell or porocyte of the dermal layer. These porocytes have not as yet, however, been demonstrated to occur in Demospongiæ, and their existence in Calcarea is, perhaps, a peculiarity of this group alone.

The histological facts brought forward by the author throw a flood of light upon the nature of the prosopyles or primitive pores of sponges, and if carried back in imagination to the primitive vase-like Olynthus form, which was probably the ancestor of all sponges, they permit of interesting speculations as to the probable structure of the body wall in such a form. The earliest type of sponge must be pictured as entirely without mesoglœa, and with a thin basket-like wall perforated by very numerous pores or interstices, corresponding to the intervals between the collar cells. The first advance towards strengthening this fragile structure would have

been the secretion of spicules, formed by cells, probably at first very few in number, of the dermal layer, which continually increased in numbers and in importance, not only for the better support and protection of the sponge body and in particular of the reproductive cells, but also, perhaps, for entangling and capturing the nutritive particles brought by the water current. Clearly, so delicate an organism could only maintain its existence in tranquil water. The ancestors of the Calcarea and Demospongiæ, by the development of a thick and often very tough mesoglœa and a highly differentiated dermal layer, attained to the degree of firmness necessary for life in the littoral zone. The Hexactinellids, with a more primitive type of histological structure, have retained also their ancient deep-sea habitat.

Enough has been said to show the important results of Prof. Iijima's researches. We may add that the plates accompanying the work are a credit, not only to the author, but also to Japanese lithography. We shall await further instalments with much interest. E. A. MINCHIN.

INSTRUCTION IN VILLAGE SCHOOLS.

Rural Readers. Book I. By Vincent T. Murché. Pp. 168. (London: Macmillan and Co., Ltd., 1901.)

The Teacher's Manual of Object Lessons for Rural Schools. Books I. and II. By the same author. Pp. 231 and 252.

THESE books have been written by the headmaster of the Boundary Lane Board School, Camberwell, to meet the requirements of teachers in rural schools as laid down in the suggestive circular recently issued by the Board of Education. Mr. Murché claims to be an old hand at rural education, and the books before us certainly bear out his claim. If properly used, teachers will find them most valuable guides in introducing nature study into elementary schools. Their value is so much dependent on their mode of use that the author's caution, as given in the preface, must be kept well in mind. He says,

"*These books are not intended to form a rigid cast-iron scheme of lessons*, to be blindly followed by every teacher into whose hands they may fall. They are rather to be considered as *a store-house from which the teacher may draw*, to suit his own special conditions; and further, the ample provision of subjects in each volume will enable him for years to construct scheme after scheme, all of them dealing with *just those subjects which will appeal to country children*."

A brief summary of the contents will enable our readers to form an idea of the ground covered. Book I. (Object Lessons) contains forty lessons, grouped under six headings; lessons from simple natural phenomena such as the air, the sky, the sun, clouds and rain, wind and weather, &c.; round about the farm; lessons on the seasons; animals kept on the farm; and some useful minerals. Book II. contains forty lessons, grouped under lessons from animals, domestic and wild; lessons from birds; lessons from plants, and a number of miscellaneous lessons. The "Reader," of which the first part only is at present before us, is arranged in dialogue form and is to be used in conjunction with the corresponding volume of object lessons. We have nothing but praise for Mr. Murché's little books. They are the best of the kind that have hitherto come under our notice, and should go a long way towards facilitating that kind of teaching which all those who have taken part in the modern revival in rural education have been so anxious to see introduced into village schools. The great danger attending the use of such books is of course the tendency shown by teachers to make a fetish of the printed page. It is so much easier to teach didactically and to pump information into pupils from printed books than it is to develop their individual powers of observation and reasoning that extreme advocates of the "heuristic" method might take exception to the present volumes, as calculated to play too much into the hands of the teacher and to leave too little to the pupils themselves. But this danger is not confined particularly to rural education; it lurks in the pages of teachers' manuals in every branch of science, and if the publication of such works has injured the cause of true education it is more frequently the teachers than the authors who are at fault.

With respect to rural education in particular, it must not be forgotten that it has lagged far behind the education in towns, and that now—largely owing to the work of the Agricultural Education Committee—it is in a state of transition. The practical difficulties in the way of rational teaching in village schools are familiar to all who have attempted to grapple with the problem. Not the least of these difficulties is the imperfect education of the teachers themselves. Some of the technical instruction committees, as in Essex, have done good work through their normal classes, but much remains to be done before a body of teachers thoroughly trained in the requirements and in full sympathy with the objects of rural education can be called into existence. There are teachers in many such schools who are anxious to meet the new conditions now made possible through the enlightened policy of the Board of Education if they are helped in the way that Mr. Murché has attempted to help them by showing what there is to teach and how to teach it. If conducted rationally and scientifically, these object lessons will certainly accomplish the purpose for which they are written.

There is one little side issue to which the writer of this notice is glad of the present opportunity of calling attention. Now that the education of country children is making a serious departure in the right direction, the time seems ripe for inculcating that respect for living nature which is generally absent in the average child. Boys and girls are naturally destructive animals. The teachers in rural schools can do more than any other class of people to restrain and direct this tendency. They have to deal with children at the most impressionable period of their lives, and they have it in their power to point out exactly why wanton destruction is to be deprecated. The collecting of the common forms of animal and vegetable life for the purposes of study, *i.e.* for educational purposes, might be encouraged *judiciously*, but the ruthless destruction that accompanies the ordinary country ramble should be severely censured. If hordes of village school children are to be taken out into the country without proper restraint, the "nature study" is apt to degenerate into a mere collecting raid with no

educational value and with serious consequences to our native fauna and flora. The teachers have it in their hands to impress upon their pupils that nothing is to be gained and everything to be lost by plucking every flower because it looks pretty, by raiding every nest because it is good sport, or by killing every insect that looks strange. If by proper tuition the child can be made to realise how infinitely more instructive and interesting is the living organism than the dead "specimen," a well-organised course of nature study should have as distinct a moral influence as it is intended to have an intellectual influence in moulding the character of the pupil. For this reason we should like to see in such works as those under consideration special and emphatic recommendations to teachers to repress all unscientific collecting. R. MELDOLA.

HEDDLE'S MINERALOGY.

The Mineralogy of Scotland. By the late M. Forster Heddle, M.D., F.R.S.E., Emeritus Professor of Chemistry, St. Andrews. Edited by J. G. Goodchild, H.M. Geological Survey, F.G.S. Two vols. Pp. 148 and 212. (Edinburgh: David Douglas, 1901.)

NO book is of more use to the practical mineralogist and collector than one which describes in a detailed manner the mineral localities of a country. Among the best examples are the lexicon of Zepharovich and Becke for Austria; that of Frenzel for Saxony; and, on a much more elaborate scale, the treatise by Lacroix on the mineralogy of France and her colonies, which is still in progress.

Greg and Lettsom's "Mineralogy of Great Britain and Ireland" (1858) is also a very useful book of reference, but scarcely adequate at the present date. Much of that work was actually due to Prof. Heddle; and it was known that he was for many years collecting materials for a "Mineralogy of Scotland"; no man possessed anything like his intimate knowledge of Scotch localities, so that a treatise of considerable importance and magnitude was expected from him.

After his death the unfinished manuscript was left to Mr. Alexander Thoms, who placed the work of completion in the competent hands of Mr. J. G. Goodchild. The present handsome volumes are the result, and it is evident that no trouble has been spared in their production. The book is a worthy monument of Prof. Heddle's lifelong labours, and will rank with the above-mentioned treatise of Lacroix.

Mr. Goodchild's task must have been a heavy one. There was a great mass of detail to be sifted; many of the localities have been difficult to identify, having been phonetically spelt by the author in his early journeys and not existing in the maps; further, it is not known to what specimens many of the figures relate, or what is the meaning of their symbols.

Prof. Heddle was an expert draughtsman, and there are no less than 103 plates, each containing about eight figures beautifully drawn and engraved. But many of these are taken from other sources, and their origin is doubtful. Confronted with the impossibility of making a trustworthy selection, the editor has thought it best to publish all the figures, though many of them have, perhaps, little direct bearing on the mineralogy of Scotland. These figures, and the numerous chemical analyses quoted throughout the book bear witness to Prof. Heddle's untiring industry.

In addition to these plates, a remarkable feature of the book is a number of beautiful and elaborate stereographic and gnomonic projections drawn by Mr. Wilbert Goodchild. The only book which has hitherto been provided with such complete stereographic projections is Des-Cloizeaux's "Manuel de Minéralogie," and even they are not so elaborate as those which adorn the present book. The gnomonic projections are quite a new feature, and will probably be found useful. The book is, further, provided with very complete tables and indices of mineral names, localities, pseudomorphs, &c.

A great part of such a book as this must necessarily consist of a mere list of localities; but, in addition, an account of the crystalline forms and of the physical and chemical properties is given for each mineral, and under some species will be found a good deal of interesting comment and historical information—conspicuous examples are gold, silver, galena and niccolite.

The reader's attention may be particularly directed to the description of agate and onyx, where he will find a very interesting and suggestive account of their probable mode of formation.

The most important part of the book is the description of the mineral localities; errors in the other portions are not of so much account, but it may be noted that it is not correct to call the form x of quartz a double three-sided pyramid, nor the face a the twin plane of pyrites.

The term gleit-face is a curiously hybrid expression for the glide-plane (*Gleitebene*) of calcite, and some of the terms used in the description of the varieties of agate, such as Jasp-agate, Oonachatæ, Hæmachatæ, Hæma-ovoid agate, can scarcely be regarded as satisfactory.

One failing inseparable from a posthumous work of this character may be noted; the reader, not knowing how much is generally established fact, and how much derived from incomplete or inadequate notes of the author, cannot feel equal confidence in all the statements. It is difficult, for example, to feel entire confidence in the occurrences of some obscure minerals, or in the identification of many of the crystal forms. It would have been well if Mr. Goodchild could have distinguished in some way those statements which he has been able to confirm from his personal knowledge and from his own extensive experience or from that of others. An appendix which contains some of his own observations is for this reason particularly valuable.

The book, as a whole, is remarkably free from the ornate style and the tinge of romance displayed by many of Prof. Heddle's published papers. It must long remain the standard treatise on the mineralogy of Scotland. It is satisfactory to know that the author's extensive collection of Scotch minerals is in the Museum of Science and Art at Edinburgh, and has been carefully arranged and made intelligible to the public by Mr. Goodchild, to whom the hearty thanks of all mineralogists are due for the labour and care which he has bestowed both upon the collection and upon the present treatise.

H. A. MIERS.

THE CIRCULATION OF THE ATMOSPHERE.

Mémoires originaux sur la Circulation générale de l'Atmosphere. Annotés et Commentés par Marcel Brillouin, Maître de Conférences à l'École Normale Supérieure. Pp. xx+163. (Paris: Georges Carré et C. Naud, 1900.)

THIS may be described as a French Student's note-book of foreign memoirs upon the general circulation of the atmosphere. It contains papers upon the subject, partly translated in full, partly in extract or analysis, by Halley, Hadley, Maury, Ferrel, James Thomson, W. von Siemens, Möller, Oberbeck and von Helmholtz, with a short introduction and some critical notes to the current text.

The book may be welcomed as calling attention to a subject which greatly needs attention in this country. But little has been done for it since James Thomson, in the Bakerian lecture of 1892, revived the ideas he had originally put forward at the meeting of the British Association at Dublin in 1857. In the United States Prof. Cleveland Abbé has collected and translated the principal memoirs, but the mathematical treatment of atmospheric circulation has been neglected in England.

Contrary to the general experience of scientific books in French, the work is rather dull. The introduction makes it clear that only foreign memoirs are included, and the work of MM. Tastes and Duclaux, as well as that of M. Teisserenc de Bort and of M. Brillouin himself, particularly "Vents contigus et nuages" (*Ann. du Bur. Centr. Mét.* 1898) is only incidentally referred to, but this does not altogether account for the impression. The subject itself is difficult; indeed, in its details it is far beyond the power of mathematics. No one can suppose that it is possible to deduce the actual motion of the air at this instant at every part of the globe from its primary causes, namely the insolation of one half the globe, the radiation from the other half, the force of gravity and the rotation of the earth; and yet that is what, in a generalised manner, most of the authors quoted set out to do. Of course, a conventional atmosphere has to be used and a conventional circulation therein accounted for; and, as a matter of fact, the assumptions and conventions that a writer makes in order to bring his powers of calculation to bear are more interesting than the details of elaborate mathematics on artificial hypotheses leading to results which, to put the matter bluntly, are only true in so far as they are not new.

Von Siemens' application of the principles of conservation of momentum and of energy strikes a livelier key, but it is only when von Helmholtz's papers are reached that the reader can feel that the analysis has really become an engine of research. The mode of treatment becomes quite different. The hydrodynamics and thermodynamics of real air are the starting point, and equatorial heating becomes a secondary consideration. As each section is developed, and the dynamical effect of the scale of the problem, the equilibrium shapes of atmospheric layers, the wave phenomena that can occur between layers of different density are unfolded, it becomes possible to be enthusiastic as to the service that mathematics can render to this subject.

Von Helmholtz himself gives no general system of atmospheric circulation, but M. Brillouin indicates the results in that direction that flow from his conclusions. He finds them in general agreement with Ferrel's distribution, and pays a tribute to Ferrel's achievement on that account.

The notes throughout are frank, appropriate and useful. It is to be feared that the book appeals to a limited class of readers, namely those who are at the same time meteorologists and mathematicians. The ordinary meteorologist will feel the want of a mathematical introduction, and the ordinary mathematician of a meteorological introduction. W. N. S.

OUR BOOK SHELF.

The Elements of the Differential and Integral Calculus. By J. W. A. Young, Assistant Professor of Mathematical Pedagogy in the University of Chicago, and C. E. Linebarger, Instructor in Chemistry and Physics in the Lake View High School, Chicago. Pp. xvii + 410. (London: Hirschfeld Bros., 1900.) Price 10*s.* 6*d.* net.

Differential and Integral Calculus with Applications for Colleges, Universities, and Technical Schools. By E. W. Nichols, Professor of Mathematics in the Virginia Military Institute. Pp. xi + 394. (Boston U.S.A.: D. C. Heath and Co., 1900.)

THE first of these books is based upon the German treatise on the differential and integral calculus with special reference to chemistry which was published by Profs. Nernst and Schönflies five or six years ago. The chief alteration in the mode of presenting the subject is that the method of limits is used throughout in the treatise before us to the exclusion of the method of differentials which was early introduced and much employed in the German text-book. But the distinctive feature of the original work, viz. the continual use of illustrative examples from chemical and physical science, has been retained in the adaptation before us, and many additional examples of the like kind have been introduced.

The treatise in its present shape forms a very convenient and serviceable text-book for English and American students of chemistry desirous of obtaining an elementary acquaintance with the principles and methods of the calculus, for here they will find a very clear presentation of the fundamental ideas of the subject, and in particular will be furnished with abundant easy exercises and applications of the mathematical processes to subjects in which they are specially interested. The book is well designed to save the time and keep up the interest of such students. Thus the first chapter contains an introduction to analytic geometry, with numerous exercises on the graphing of curves, and the last chapter is a characteristic one on the differentiation and integration of functions found empirically.

Whilst so much has been done to smooth the path and provide for the wants of the class of students specially in view, it seems matter for regret that an additional chapter on the solution of easy linear differential equations has not been furnished.

We have in Prof. Nichols' work another elementary text-book specially designed as a first book on the calculus for students of physics and engineering. It is a clear and teachable work for beginners, and contains several easy applications to mechanics and electricity. The ordinary applications of the differential calculus to geometry are brought forward earlier than usual; thus we have a chapter on tangents, normals and asymptotes to plane curves before the chapters on successive differentiation, series, illusory forms and maxima and minima. Then, after a chapter on partial and total differentiation,

we have applications to curvature, envelopes, singular points and tracing of curves.

The second part of the book contains the fundamental methods of the integral calculus, including a slight treatment of double and triple integrals and their applications to surfaces and volumes.

There is also a short chapter on differential equations, giving the methods of dealing with some of the simpler forms, and the concluding chapter contains applications to such subjects as moments of inertia and the deflection of beams.

Compared with recent English treatises on the calculus for engineering and physical students, the work before us appears slight and superficial in its technical applications. But as an elementary text-book on pure mathematics it has decided merit, and is evidently the production of an experienced teacher.

Album de Aves Amazonicas. Organisado pelo Dr. Emilio A. Goeldi, Director do Museu Paraense. (Museu Paraense de Historia Natural e Ethnographia, 1900.)

THE illustrated supplement to Dr. Goeldi's "Aves do Brazil," of which the first part, consisting of twelve coloured plates designed by Señor Ernesto Lohse, has been issued, will when completed give a good general idea of the avifauna of those regions. The birds represented in the present fasciculus comprise the cormorants, grebes, gulls, terns, waders, plovers, herons, egrets, boatbill, storks, spoonbills, rails, geese, ducks, toucans and kingfishers, as well as those two curious forms, the hoactzin and the sun-bittern. In herons and their allies the country is very rich, and two plates illustrate ten species of toucan, both sexes in this, as well as in other cases, being figured when desirable. Several species are figured on most of the plates, and they number eighty in all. But one plate is entirely devoted to a beautiful illustration (produced from an instantaneous photograph taken in 1900) of a breeding-place of the scarlet ibis. The crowd of graceful scarlet birds, backed by the rich, deep greenery of the western tropics, must afford a sight worth going to South America to see. There are pleasing bits of tropical scenery in the background of the plates, which form quite pretty pictures. The work has been printed at Zürich, and although the designs are on a rather small scale, and too much must not be expected of colour printing, the illustrations of the birds strike us as being decidedly good, and we readily recognise at a glance several old South American acquaintances. The supplement will be most useful to any one travelling in the country who takes even a passing interest in natural history. The plates, like Dr. Goeldi's recently completed "Aves do Brazil," may be regarded as decidedly popular, and on that account will doubtless prove the more generally useful.

Qualitative Chemical Analysis, Organic and Inorganic. By F. Mollwo Perkin, Ph.D. Pp. viii+266. (London: Longmans, Green and Co., 1901.)

THIS book begins with a general account of dry reactions and reactions in solution, attention being paid both to the manipulative and the theoretical aspects. Then follows the usual account of metals in groups with their tests, and afterwards come the acids. The remaining third of the book is devoted to what is called organic analysis, and here appears the most distinctive feature, namely, a list of tests for a great variety of organic substances—acids, alcohols, sugars, nitrogenous bases, glucosides and alkaloids. The intention of the author, as declared in the preface, has been "to write a book in which theory and practice are more or less dovetailed." It is difficult to find any realisation of this in the large section devoted to organic substances, but the treatment of the inorganic section is more in accordance with the stated object. A. S.

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 Fire Walk Ceremony in Tahiti.

THE very remarkable description of the "Fire Walk" collected by Mr. Andrew Lang and others had aroused a curiosity in me to witness the original ceremony, which I have lately been able to gratify in a visit to Tahiti.

Among these notable accounts is one by Colonel Gudgeon, British Resident at Raratonga, describing the experiment by a man from Raiatea, and also a like account of the Fiji fire ceremony from Dr. T. M. Hocken, whose article is also quoted in Mr. Lang's paper on the "Fire Walk," in the *Proceedings* of the Society for Psychical Research, February, 1900. This extraordinary rite is also described by Mr. Fraser in the "Golden Bough," and by others.

I had heard that it was performed in Tahiti in 1897, and several persons there assured me of their having seen it, and one of them of his having walked through the fire himself under the guidance of the priest, Papa-Ita, who is said to be one of the last remnants of a certain order of the priesthood of Raiatea, and who had also performed the rite at the island of Hawaii some time in the present year, of which circumstantial newspaper accounts were given, agreeing in all essential particulars with those in the accounts already cited. According to these, a pit was dug in which large stones were heated *red hot* by a fire which had been burning many hours. The upper stones were pushed away just before the ceremony, so as to leave the lower stones to tread upon, and over these, "glowing red hot" (according to the newspaper accounts), Papa-Ita had walked with naked feet, exciting such enthusiasm that he was treated with great consideration by the whites, and by the natives as a God. I found it commonly believed in Tahiti that anyone who chose to walk after him, European or native, could do so in safety, secure in the magic which he exercises, if his instructions were exactly followed. Here in Tahiti, where he had "walked" four years before, it was generally believed among the natives, and even among the Europeans present who had seen the ceremony, that if anyone turned around to look back he immediately was burned, and I was told that all those who followed him through the fire were expected not to turn until they had reached the other side in safety, when he again entered the fire and led them back by the path by which he had come. I was further told by several who had tried it that the heat was not felt upon the feet, and that when shoes were worn the soles were not burned (for those who followed the priest's directions), but it was added by all that much heat was felt about the head.

Such absolutely extraordinary accounts of the performance had been given to me by respectable eyewitnesses and sharers in the trial, confirming those given in Hawaii, and, in the main, the cases cited by Mr. Lang, that I could not doubt that if all these were verified by my own observation, it would mean nothing less to me than a departure from the customary order of Nature, and something very well worth seeing indeed.

I was glad, therefore, to meet personally the priest, Papa-Ita. He is the finest looking native that I have seen; tall, dignified in bearing, with unusually intelligent features. I learned from him that he would perform the ceremony on Wednesday, July 17, the day before the sailing of our ship. I was ready to provide the cost of the fire, if he could not obtain it otherwise, but this proved to be unnecessary.

Papa-Ita himself spoke no English, and I conversed with him briefly through an interpreter. He said that he walked over the hot stones without danger by virtue of spells which he was able to utter and by the aid of a goddess (or devil as my interpreter had it), who was formerly a native of the islands. The spells, he said, were something which he could teach another. I was told by others that there was a still older priest in the Island of Raiatea, whose disciple he was, although he had pupils of his own, and that he could "send his spirit" to Raiatea to secure the permission of his senior priest if necessary.

In answer to my inquiry as to what preparations he was going to make for the rite in the two or three days before it, he said he was going to pass them in prayer.

The place selected for the ceremony fortunately was not far from the ship. I went there at noon and found that a large shallow pit or trench had been dug, about nine feet by twenty-one feet and about two feet deep. Lying near by was a pile containing some cords of rough wood and a pile of rounded water-worn stones, weighing, I should think, from forty to eighty pounds apiece. They were, perhaps, 200 in number, and all of porous basalt, a feature the importance of which will be seen later. The wood was placed in the trench, the fire was lighted and the stones heaped on it, as I was told, directly after I left, or at about twelve o'clock.

At 4.0 p.m. I went over again and found the preparations very nearly complete. The fire had been burning for nearly four hours. The outer stones touched the ground only at the edges of the pile, where they did not burn my hand, but as they approached the centre the stones were heaped up into a mound three or four layers deep, at which point the lowest layers seen between the upper ones were visibly red-hot. That these latter were nevertheless sending out considerable heat there could be no question, though the topmost stones were certainly not red-hot, while those at the bottom were visibly so and were occasionally splitting with loud reports, while the flames from the burned wood near the centre of the pile passed up in visible lambent tongues, both circumstances contributing to the effect upon the excited bystanders.

The upper stones, I repeat, even where the topmost were presently removed, did not show any glow to the eye, but were unquestionably very hot and certainly looked unsafe for naked feet. Native feet, however, are not like European ones, and Mr. Richardson, the chief engineer of the ship, mentioned that he had himself seen elsewhere natives standing unconcerned with naked feet on the cover of pipes conveying steam at about 300° F. where no European foot could even lightly rest for a minute. The stones then were hot. The crucial question was, *how* hot was the upper part of this upper layer on which the feet were to rest an instant in passing? I could think of no ready thermometric method that could give an absolutely trustworthy answer, but I could possibly determine on the spot the thermal equivalent of one of the hottest stones trodden on. (It was subsequently shown that the stone might be much cooler at one part than another.) Most obviously, even this was not an easy thing to do in the circumstances, but I decided to try to get at least a trustworthy approximation. By the aid of Chief Engineer Richardson, who attended with a stoker and one of the quartermasters, kindly detailed at my request by the ship's master, Captain Lawless, I prepared for the rough but conclusive experiment presently described.

It was now nearly forty minutes after four, when six acolytes (natives), wearing crowns of flowers, wreathed with garlands and bearing poles nearly fifteen feet long, ostensibly to be used as levers in toppling over the upper stones, appeared. They were supposed to need such long poles because of the distance at which they must stand on account of the heat radiated from the pile, but I had walked close beside it a moment before and satisfied myself that I could have manipulated the stones with a lever of one-third the length, with some discomfort, but with entire safety. Some of the uppermost stones only were turned over, leaving a superior layer, the long poles being needlessly thrust down between the stones to the bottom, where two of them caught fire at their extremities, adding very much to the impression that the exposed layer of stones was red hot, when in fact they were not, at least to the eye. These long poles and the way they were handled were, then, a part of the ingenious "staging" of the whole spectacle.

Now the most impressive part of the ceremony began. Papa-Ita, tall, dignified, flower-crowned and dressed with garlands of flowers, appeared with naked feet and with a large bush of "Ti" leaves in his hands, and, after going partly around the fire each way uttering what seemed to be commands to it, went back and beating the stones nearest him three times with the "Ti" leaves, advanced steadily, but with obviously hurried step, directly over the central ridge of the pile. Two disciples, similarly dressed, followed him, but they had not the courage to do so directly along the heated centre. They followed about half-way between the centre and the edge, where the stones were manifestly cooler, since I had satisfied myself that they could be touched lightly with the hand. Papa-Ita then turned and led the way back, this time with deliberate confidence, followed on his return by several new disciples, most of them not keeping exactly in the steps of the leader, but obviously seeking cooler places. A third and fourth time Papa-Ita crossed with a larger following, after which many Europeans present walked over the stones without reference to the priest's instructions. The natives were mostly in their bare feet. One wore stockings. No European attempted to walk in bare feet except in one case, that of a boy, who, I was told, found the stones too hot and immediately stepped back.

The *mise en scène* was certainly noteworthy. The site, near the great ocean breaking on the barrier reefs, the excited crowd, talking about the "red-hot" stones, the actual sight of the hierophant and his acolytes making the passage along the ridge where the occasional tongues of flame were seen at the centre, with all the attendant circumstances, made up a scene in no way lacking in interest. Still, the essential question as to the actual heat of these stones had not yet been answered, and after the fourth passage I secured Papa-Ita's permission to remove, from the middle of the pile, one stone which from its size and position every foot had rested upon in crossing, and which was undoubtedly at least as hot as any one of those trodden on. It was pulled out by my assistants with difficulty, as it proved to be larger than I had expected, it being of ovoid shape with the lower end in the hottest part of the fire. I had brought over the largest wooden bucket which the ship had, and which was half-filled with water, expecting that this would cover the stone, but it proved to be hardly enough. The stone caused the water to rise nearly to the top of the bucket, and it was thrown into such violent ebullition that a great deal of it boiled over and escaped weighing. The stone was an exceedingly bad conductor of heat, for it continued to boil the water for about twelve minutes, when, the ebullition being nearly over, it was removed to the ship and the amount of evaporated water measured.

Meanwhile others, as I have said, began to walk over the stones without any reference to the ceremony prescribed by Papa-Ita, and three or four persons, whom I personally knew on board the ship, did so in shoes, the soles of which were not burned at all. One of the gentlemen, however, who crossed over with unburned shoes, showed me that the ends of his trousers had been burnt by the flames which leaped up between the stones, and which at all times added so much to the impressiveness of the spectacle, and there was no doubt that any one who stumbled or got a foot caught between the hot stones might have been badly burned. United States Deputy-Consul Ducorran, who was present, remarked to me that he knew that Papa-Ita had failed on a neighbouring island, with stones of a marble-like quality, and he offered to test the heat of these basaltic ones by seeing how long he could remain on the hottest part of the pile, and he stood there, in my sight, from eight to ten seconds before he felt the heat through the thin soles of his shoes beginning to be unpleasantly warm.

A gentleman present asked Papa-Ita why he did not give an exhibit that would be convincing by placing his foot, even for a few seconds, between two of the red-hot stones which could be seen glowing at the bottom of the pile, to which Papa-Ita replied with dignity, "My fathers did not tell me to do it that way." I asked him if he would hold one of the smaller, upper hot stones in his hand. He promised to do so, but he did *not* do it.

The outer barriers were now removed and a crowd of natives pressed in. I, who was taking these notes on the spot, left, after assuring myself that the stones around the edge of the pit were comparatively cold, although the centre was no doubt very hot, and those below red hot. The real question is, I repeat, how hot were those trodden on? and the answer to this I was to try to obtain after measuring the amount of water boiled away.

On returning to the ship this was estimated from the water which was left in the bucket (after allowing for that spilled over) at about ten pounds. The stone, which it will be remembered was one of the hottest, if not the hottest, in the pile, was found to weigh sixty-five pounds, and to have evaporated this quantity of water. It was, as I have said, a volcanic stone, and on minuter examination proved to be a vesicular basalt, the most distinctive feature of which was its porosity and non-conductibility, for it was subsequently found that it could have been heated red hot at one end, while remaining comparatively cool at the top. I brought a piece of it to Washington with me and there determined its specific gravity to be 0·39, its specific heat 0·19 and its conductivity to be so extremely small that one end of a small fragment could be held in the hand while the other was heated indefinitely in the flame of a blow-pipe, almost like a stick of

sealing-wax. This partly defeated the aim of the experiment (to find the temperature of the upper part of the stone), since only the mean temperature was found. This *mean* temperature of the hottest stone of the upper layer, as deduced from the above data, was about 1200 degrees Fahrenheit, but the temperature of the surface must have been indefinitely lower. The temperature at which such a stone begins to show a dull red in daylight is, so far as I am aware, not exactly determined, but is approximately 1300 to 1400 degrees Fahrenheit.

To conclude, I could entertain no doubt that I had witnessed substantially the scenes described by the gentlemen cited, and I have reason to believe that I saw a very favourable specimen of a "Fire Walk."

It was a sight well worth seeing. It was a most clever and interesting piece of savage magic, but from the evidence I have just given I am obliged to say (almost regretfully) that it was not a miracle. S. P. LANGLEY.

Smithsonian Institution, Washington, D.C., August 7.

The Size of the Ice-grain in Glaciers.

IN referring to the size of the grain of the glacier in the chapter on chemistry and physics in the "Antarctic Manual," I have given 700 grammes as the maximum weight which I have observed. In August, 1895, I made an extended study of the structure of glacier ice, principally from the Aletsch Glacier. The fragments of this glacier, which float as icebergs in the Mergelin See, are exposed to the powerful weathering influence of the summer sun, and are comparatively easily dissected into their constituent grains. A number of blocks were so dissected in order to ascertain the weight and size of the largest grains. The following weights of single grains were determined :—700, 590, 450, 270, 255, 170, 155 and 100 grammes. It was observed that blocks of ice contained grains of all sizes, which fitted each other so exactly that, in the fresh unweathered block, the whole volume was filled with ice.

It was not then thought necessary to determine the weight of the smaller grains. On revisiting the Mergelin See in the latter part of July of this year, I dissected several blocks of ice more or less completely and weighed their constituent grains. In order to effect the dissection a powerful sun is requisite, and a powerful sun means a high atmospheric temperature, under the influence of which the small grains melt and disappear very quickly. All the grains in the block are melting at the same time, but the smaller the grain the greater is the ratio of its external surface to its mass. Therefore the weights of the large grains are reduced in a less degree than those of the small ones. Hence it is impossible to furnish an exact statistical account of any block of ice, but the figures in the following tables give a very fair idea of the structural composition of the ice examined. The analyses of blocks E and F are the most complete.

The first block, A, is from the lower end of the Glacier des Bossons in the Chamonix valley, and it was examined on July 17, 1901, which was one of the hottest days of that very hot week. The other blocks are all from the Aletsch Glacier, as they are found floating in the Mergelin See, the waters of which are retained at one end by the ice of that glacier. The Aletsch Glacier is the largest in Switzerland and it contains the largest ice-grains that I have met with. Different parts of the glacier, even in the immediate vicinity of the lake, are of different grain, and the fragments are easily distinguished as they float in the water. Thus block F is a block of large grained ice, while E is of comparatively small grained ice, though it is by no means of the smallest grain.

List of blocks dissected.

Block A.—Chamonix, July 17, 1901. From the end of the Glacier des Bossons.

Blocks B, C and D were taken from the Mergelin See on July 21, 1901, and exposed to the sun on a rock for some hours. B and C were then dissected, though not completely; that is, a certain comparatively small portion of each of them remained undissected. D was dissected only in so far as to enable a prominent and very large grain (570 grm.) to be removed and weighed. The remainder was left till the next day. Owing to the high temperature of the air both by night and by day, its size was very much reduced. It is called Block *d*, and it was dissected on July 22, 1901.

Block E from the Mergelin See was collected and dissected on July 22, 1901.

Block F had suffered far-reaching sun weathering. It was not removed from the lake, but was dissected in the water on July 24, 1901.

The results are embodied in the two following tables. All the

TABLE I.

Weight, in grammes of single ice-grains.			
A	C	*d*	F
100	230	125	
110	210	70	590
90	200	65	550
85	150	60	460
80	130	30	360
80	75	25	325
75	60	25	250
75	60		240
60	50		240
40	50	400	190
40	50		180
35	25		155
30	25	E	150
30	25	120	150
30	25	115	140
25		105	130
		85	130
	1365	70	125
1045		60	120
		60	120
		50	120
		50	110
		50	110
B		45	100
315		35	100
220		35	90
150		30	90
90		30	80
75	D	30	75
60	570	30	60
50	225	30	60
50	95	25	45
40	75	25	45
25	75	25	45
20	50	20	30
1095	1090	1125	5765

TABLE II.

Number of grains weighed.	Aggregate weight of grains.	Average weight of one grain.	Number of grains weighed.	Aggregate weight of grains.	Average weight of one grain.
	A			*d*	
16	1045	65·3	7	400	57·1
10	110	11·0	10	30	3·0
4	25	6·25			
10	25	2·5	17	430	25·3
40	1205	30·1		E	
			22	1125	51·1
	B		10	150	15·0
11	1095	99·5	10	135	13·5
10	95	9·5	10	120	12·0
23	60	2·6	10	60	6·0
			10	50	5·0
44	1250	28·5	10	40	4·0
			10	20	2·0
	C		10	15	1·5
15	1365	91·0			
5	50	10·0	102	1715	16·8
10	25	2·5		F	
			34	5765	169·6
30	1440	48·0	10	190	19·0
			10	190	19·0
	D		10	140	14·0
6	1090	182·0	6	60	10·0
5	30	6·0	40	70	1·75
11	1120	102·0	110	6415	58·3

weights are given in grammes. They were determined on a Salter's spring balance which carried 500 grammes, and its scale was divided into intervals of 10 grammes each. Ice-grains which weighed more than 500 grammes were divided in two.

As has been already pointed out, the figures in the tables do not give an exact statistical account of the blocks of ice. The smallest grains have most frequently escaped being weighed, therefore the average size of the grain comes out higher than the truth. The figures in the tables give a general idea of the constitution or anatomy of a block of ice taken from the lower part of a large glacier. They are particularly interesting when we reflect that every grain, even the largest, has grown, according to the rigid laws of crystallomorphic development, from a single snow crystal which probably weighed no more than one or two centigrammes.

In the Mergelin See, glacier ice can be studied in a way that is possible in no other place. The fragments of the Aletsch Glacier which float in it are veritable icebergs, and behave in the same way as their relatives in the Arctic or Antarctic Ocean. In the middle of summer, however, they are exposed to a much more powerful sun than either the northern or the southern bergs. Consequently, the weathering and disintegration, as well as the melting, proceed at a much more rapid rate.

The action of the sun's rays on glacier ice is twofold; it disarticulates the ice into its constituent grains, and it splits the individual grain up into laminæ perpendicular to the principal axis of the crystal and bounded by the planes of fusion discovered and described by Tyndall. These planes are the distinguishing characteristic of the individual ice-grain.

Under the influence of radiant heat an ice-crystal begins to melt at the surfaces which separate these laminæ, and the process of disintegration and decay is directed by their plane. On the other hand, an ice-crystal, floating in water and losing heat, generates ice laminæ which are directed by the same planes, which form the continuation of the corresponding laminæ of the parent crystal. This was well observed at the end of August, 1895. Every night a thin skin of ice was formed at the shallow end of the lake, where the ice blocks are collected. As the grains in a block of glacier ice are distributed quite irregularly, the water line of a floating block necessarily cuts a great number of grains, all of which are oriented differently. The ice which was formed during the night along this line was oriented crystallographically by the grain with which it was in contact and from which it appeared to spring in continuation of its crystalline laminæ. This produces a remarkable pattern of lines on the surface of the lake ice contiguous to a block of glacier ice.

Tyndall has described and figured the minute features of the disintegration of the crystal under the absorption of radiant heat. Similar and complementary features are observed when ice is generated from an existing crystal under the dissipation of heat. To do justice to them, however, would require the services of a skilful, patient and resourceful artist.

The disarticulating and analysing action of the sun's rays is not accomplished without the selection and expenditure of energy. Accordingly we observe that one grain protects another. The disarticulation into separate grains, although very thorough near the surface of a glacier, does not penetrate far. A stroke or two with an ice axe reveals the fresh blue ice. The analysis of the individual grain into crystallographically oriented laminæ can be particularly well studied in the Mergelin See. It is only the grains that are exposed to the sky, and above water, that are so analysed; and prolonged exposure of this kind reduces a grain to the last stage of dilapidation. The grains beneath the surface, *whether of ice or water*, are almost completely unattacked.

The importance, or rather the necessity, of direct sky-light for the disarticulation of glacier ice into its constituent grains is very well seen in the artificial grottoes which are maintained at easily accessible parts of most popular glaciers. The thickness of the layer of completely disarticulated ice is so small that it is hardly noticed, and the whole grotto appears to be cut out of pure blue ice. If the observer, on penetrating for a few paces, turns round and looks outwards, he sees the surface of the ice-walls of the grotto etched with strange line-figures. These are most strongly marked near the opening, and they cease exactly at the spot where the last ray of direct sky-light strikes the ice. The lines so developed are formed by the intersection of the surface of the ice-wall of the cave with the separating surfaces of contiguous ice-grains. The photographic picture thus presented is one of very great interest.

It is only perfectly pure water, received directly as it flows from the still, that can be frozen into homogeneous glass-like ice. All natural ice proceeds from impure water.

In lake ice of moderate thickness the crystalline axis is perpendicular to the surface of the lake. Consequently, Tyndall's planes of fusion are parallel to this surface. When exposed to a powerful sun, and with an air temperature even much below 0° C., the ice weathers into horizontal laminæ separated by Tyndall's planes of fusion, and into vertical columns. The column in lake ice and the grain in glacier ice are homologous features. They express the form which the individual crystal takes in these different varieties of natural ice.

Were it not for the fact that a glacier is made up of distinct grains of ice, and that this substance has the property of melting and freezing at different temperatures, according to the composition of the water with which it comes in contact and to the pressure to which it is subjected, there is little doubt that a glacier would be as motionless as any other mass of crystalline rock.

I. Y. BUCHANAN.

August 6.

Problems of Geometry.

IN Klein's "Famous Problems of Elementary Geometry," geometrical proofs are given for solving the problems of "the duplication of the cube" and "the trisection of an angle" by means of the *cissoid* and the *conchoid* respectively. I find, however, that in "Chambers' Encyclopædia" it is stated, without proof, that the *cissoid* and the *conchoid* are capable of furnishing geometrical constructions for the solution of *both* problems. Can any of your readers furnish me with the necessary references, or supply a proof of the "trisection of an angle" by means of the *cissoid*, and of the "duplication of the cube" by means of the *conchoid*?

A. B. BASSET.

Fledborough Hall, Holyport, Berks, August 9.

Forecast and Fact.

IN NATURE of January 12, 1893 (p. 246), I represented as probable an early descent of the smoothed curve of rain days at Greenwich, there given, "and a commencing series of (on the average) drier summers than we have had lately."

The following table may now be compared with this:—

	Rf. Summer.	Relation to av. (6·81)
1893	5·40	−1·41
1894	8·33	+1·52
1895	5·74	−1·07
1896	5·07	−1·74
1897	5·52	−1·29
1898	3·95	−2·86
1899	2·85	−3·96
1900	6·26	−0·55

Per contra, there is the chastening reflection that a rule which held good (with one exception) since 1815 (see *Symons' Met. Mag.*, June 1898, p. 70), and which was quoted in your columns, has broken down on this occasion, viz. that in the group of five summers ending with a sunspot minimum, there are more wet summers than dry!

A. B. M.

Boomerangs.

IN relation to the interesting article on boomerangs in your issue of August 1, it may perhaps be of interest to some of your readers to know that Schiaparelli, in his famous book, "Entwurf einer astronomischen Theorie der Sternschnuppen," p. 13, speaks of "bumerangs." He says:—"Very likely the *cateja* described by Isidor of Seviglia was nothing but a sort of bumerang." "Est genus Gallici teli, ex materia quam maxime lenta, quæ jacta quidem non longe propter gravitatem evolat, sed quo pervenit, vi nimia perfringit: quod si ab artifice mittatur, rursus redit ad eum qui misit." Isidori Hispalensis, Origg, xviii.

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BATRACHIANS AND REPTILES IN THE CAMBRIDGE NATURAL HISTORY.[1]

IN the preface to this welcome volume the author reminds his readers of the words of Linnæus, "Amphibiologi omnium paucissimi sunt nullique veri." What progress has been accomplished by the "Amphibiologi"—herpetologists we now term them—in dealing with the "pessima tetraque animalia" during the 150 years which have elapsed since this statement of the great naturalist cannot be better realised than by a perusal of the excellent contribution supplied by Dr. Gadow for the eighth volume of the "Cambridge Natural History."

This work is not only of the highest interest in bringing together in a small compass and in a charming style the essence of a most voluminous literature; it derives special value from the authority of its writer as an anatomist and observer of the Batrachians and Reptiles both in their native haunts and in the vivarium.

Not content with giving us the benefit of his wide experience in the departments to which he has devoted so much study, Dr. Gadow has also suggested various reforms in the general classification, thus raising the work far above the usual standard of this kind of semi-popular treatises.

The following table will show the classification adopted, and which, on the whole, reflects so well the state of our present knowledge. The author explains in the preface that the principal groups are called subclasses in order to emphasise their taxonomic importance in comparison with the main groups of birds and mammals :—

	Subclass	Order	Suborder
Amphibia	Stegocephali	Lepospondyli	Branchiosauri, Aistopodes
		Temnospondyli, Stereospondyli	
	Lissamphibia	Apoda, Urodela	
		Anura	Aglossa, Phaneroglossa
Reptilia	Proreptilia		
	Prosauria	Microsauri	
		Prosauri	Protorosauri, Rhynchocephali
	Theromorpha	Pareiasauri, Theriodontia, Anomodontia, Placodontia	
	Chelonia	Atheca	
		Thecophora	Cryptodira, Pleurodira, Trionychoidea
	Dinosauria	Sauropoda, Theropoda, Orthopoda, Ceratopsia	Stegosauri, Ornithopodi
	Crocodilia	Pseudosuchia, Parasuchia, Eusuchia	
	Plesiosauria	Nothosauri, Plesiosauri	
	Ichthyosauria	Ichthyosauri	
	Pterosauria	Pterosauri	Pterodactyli, Pteranodontes
	Pythonomorpha	Dolichosauri, Mosasauri	
	Sauria	Lacertilia	Geckones, Lacertæ, Chamæleontes
		Ophidia	

The boldest attempt at innovation in taxonomy consists in the removal from the class Batrachia or Amphibia, as generally understood, to that of Reptilia, not only of the Microsauria, but of a number of other members of Cope's Stegocephalia. But this change is not one that is likely to commend itself. We all know how, in the light of recent palæontological discovery, most of the supposed distinctive features of the two classes in question have faded away, as instanced by Prof. Seeley's proposal to unite the Stegocephalia with the Reptiles, and Prof. Credner's establishment of the group Eotetrapoda for the reception of the earlier Batrachians and Reptiles. However, one thing appears certain to me: the Stegocephalia, as defined by Cope, form one compact group, distinguished from both Batrachians proper and Reptiles by the presence of additional dermal bones in the skull—the occipital (dermo-occipital) and the so-called "epiotic," which I regard as the homologue of the post-temporal of Fishes—and, further, in all cases where the pectoral arch is known, by their conforming to the type of the Crossopterygian and early Ganoid Fishes in the possession of the element termed cleithrum by Gegenbaur (clavicle of ordinary Teleosts) in addition to the clavicle proper. These highly important features, connecting the Crossopterygians with the Stegocephalians, are relegated to the background by Dr. Gadow, who prefers to establish the turning-point where to part the Reptilian phylum from the Batrachian upon the constitution of the elements of the vertebral column, Batrachians being defined as *acentrous*, *pseudocentrous* or *notocentrous*, that is to say, in which the author's "dorsal arcualia" are reduced or absent, Reptiles as *gastrocentrous*, the centra of the vertebræ being formed by pairs of "interventralia," while the "basiventralia" (intercentra of Cope) are reduced, persisting either as wedgebones or as intervertebral pads, or absent. This is the application of the views set forth by the author in his well-known paper published in the *Philosophical Transactions* for 1896; but it must be admitted that, so far as the Stegocephalia are concerned, the ideal distinction between interdorsalia and interventralia cannot be practically applied, owing to the types which connect *Eryops*, now proposed to be placed with the Reptiles together with the Embolomeri and Microsauria, and *Archegosaurus*, associated with the Labyrinthodonts. Whatever measure of truth Dr. Gadow's theory of the evolution of the vertebral column may contain, it is very doubtful whether any students of the fossil remains will be able to agree with him in regarding the composition of the tripartite vertebræ of these genera as due to "superficial resemblance." "After all," the author adds (p. 285), "we feel certain that Reptiles have arisen from Stegocephalous Amphibia, and it is in the Lower Permian, exactly where the debatable creatures lived side by side with the Stegocephali, undoubtedly likewise temnospondylous, that the change from Amphibia into Reptiles seems to have taken place."

It is highly probable that the Stegocephalians will be found to have been derived from the Crossopterygians and to lead, on the one hand, to the Batrachians through the Branchiosauria, and, on the other hand, to the Reptiles through the Microsauria. Perhaps the best means of getting over the difficulty with which we are confronted would be to raise the Stegocephalians to the rank of a class, which is quite capable of exact definition. But there is certainly no sufficient justification at present for the proposal to unite *Eryops* and the *Embolomeri* (*Proreptilia* of Gadow) with the Reptiles rather than with the Batrachians.

I would add that if Dr. Gadow thus repudiates the classification of Cope, it is contrary to the rules of nomenclature to make use in the sense he does of the name *Stegocephali*.

On the other hand, I hail with satisfaction the

[1] Amphibia and Reptiles. By Hans Gadow. "The Cambridge Natural History." Vol. viii. Pp. xiii + 668; 181 woodcuts. (London: Macmillan and Co., Ltd.) Price 17*s.* net.

systematic position given to the Apoda or Cæcilians (which name should not have been spelt Cœcilians).

In the division of the Anura or Ecaudata an attempt is made at reducing the number of families, but it is

FIG. 1.—Australian tree-frog (*Hyla caerulea*).

difficult to see what is to be gained by this reduction in a manner for which the author himself pleads guilty of inconsistency; a reproach which would apply likewise to some changes in the classification of the Lacertilia.

In accordance with what I believe to be the duty of a reviewer, however more disposed he may feel to praise than to criticise, a certain prominence should be given to the pointing out of small errors, such as necessarily creep in all books of some extent, in order to prevent their propagation, especially in the case of a work which is certain to enjoy a wide circulation. I have, therefore, here noted a few which I have come across.

P. 11. The number of caudal vertebræ varies much in our species of newts. It might mislead the student in search of additional characters by which to distinguish *Triton palmatus* from *T. taeniatus* to read that the latter has about a dozen vertebræ more than the former.

P. 30. *Pelobates* cannot be described as a "very aquatic" genus. On the same page, *Amphodus* should have been mentioned as the best example of a frog with toothed parasphenoid.

P. 45. There is no difference in the nature of the external gills of *Protopterus* and *Lepidosiren*.

P. 95. On the map showing the distribution of the Urodela, the range of these Batrachians should be extended to Ireland, Southern Norway, Syria, Northern Persia and Peru. The habitat of *Plethodon platensis*, mentioned on p. 94, is not marked on the map.

P. 153. The tympanum is often very distinct in *Discoglossus*.

P. 161. The map does not show the eastern extension in Europe and to South-western Asia of the *Pelobatidæ*, nor is it correct as to the distribution of the *Pelobatidae* and *Discoglossidae* in Eastern Asia and North America (cf. pp. 153, 162, 164, 165).

P. 167. The common toad occurs in Norway as far as 65° lat., as correctly stated on p. 177; but this is not shown on the map.

P. 189. The pupil is horizontal in *Diaglena* (as the name implies) and *Pternohyla*.

P. 198. The curious *Hyla goeldii* is from the Serra dos Orgãos, not from Pará.

P. 288. "Deeply amphicœlous vertebræ" is not true of all "Prosauria" (cf. *Hyperodapedon* and *Sauranodon*, the latter with procœlous vertebræ).

P. 332 (map). Testudinidæ, Cinosternidæ and Chelydridæ occur in Ecuador.

P. 499. The shell of the egg of *Lacerta viridis* and *L. agilis* is not hard like Geckos', but parchment-like, as described on p. 555, whilst that of *L. vivipara* is a mere membrane.

P. 500. The Scincidæ are represented by several species in New Zealand.

P. 501. Chameleons exist on the Seychelles (*Chamaeleon sechellensis*) and Mauritius.

P. 514. The Pygopodidæ cannot be described as leading a usually subterranean life, any more than our common slow-worm.

P. 529. The map showing the distribution of Anguidæ and Iguanidæ is not quite correct, since the former are represented in South-eastern China (*Ophisaurus harti*) and the latter extend to the South-eastern United States (*Anolis*, *Sceloporus*, *Phrynosoma*), as stated in the text.

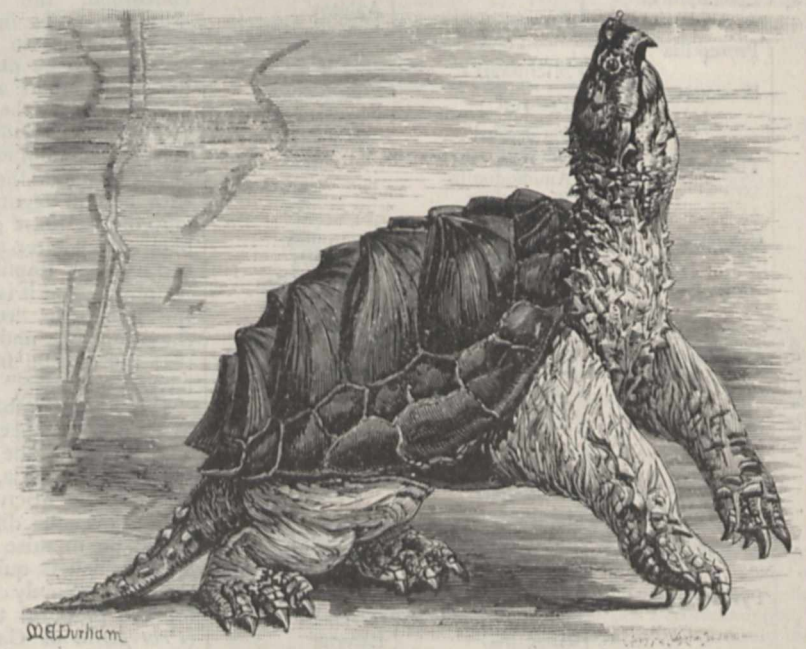

FIG. 2.—"Alligator turtle" (*Macroclemmys temminaki*).

P. 558. The Faraglione Rock near Capri is not blackish.

P. 565. The Amphisbænidæ are represented on the map as occurring all over Africa; but none are known from north of 12° lat. N. except the Mediterranean forms confined to the Atlas and the territory between it and the sea.

P. 644. The range of the *Crotalinae* extends to Celebes (*Lachesis wagleri*).

In matters of nomenclature, some inconsistency is displayed in the termination of the names of orders and suborders, and the use of the term "Sauria" for a group embracing lizards and snakes is unjustifiable.

The illustrations are for the greater part original, and many are actually taken from living specimens. So great a training is required to depict properly the attitudes of any class of animals, and especially the often mysterious-looking creatures which form the subject of the book under review, that only artists who have made a speciality of it can be expected to furnish nearly faultless work, which even then may be spoilt to a certain extent, so far as technical details are concerned, through the intervention of the engraver if, as in the present case, his services have also to be enlisted. It will, therefore, not be unnatural if an expert may find fault with a few of the illustrations in this book. For instance, Fig. 23 represents a difference between the heads of the male and female crested newt which does not really exist; Fig. 31 shows *Bombinator igneus* with the eyes much too far apart, Fig. 91 a *Trionyx* with azygous frontal bone, and Fig. 103 a ventral view of the hand of *Ptychozoon* with the inner finger longer than the outer, which is just the reverse of nature. But all the figures are marked by a freshness which makes up for any shortcomings, and many may be pronounced as exceptionally good.

In concluding the review I would express the opinion that by this handsome volume a very important addition to science has been made; that the beautiful illustrations, together with the clear and charming accounts of the life-histories which it contains, will do much to popularise the study of a rather neglected section of zoology; and that lovers of Reptiles, of which there are more than one generally thinks, will feel that the new knowledge imparted to them emanates from one who is thoroughly in sympathy with their enthusiasm. G. A. BOULENGER.

THE FORTHCOMING MEETING OF THE BRITISH ASSOCIATION.

IN the two articles which have already appeared (May 23 and July 18) upon the meeting of the British Association, to be held at Glasgow on September 11–18, the general arrangements made for the scientific and social pleasures of the members have been described. It is now possible to give an epitome of the programme of the meeting and a forecast of the work of the sections. The sections do not meet on September 11 and September 19, but on all intervening days.

Epitome of Programme.

Wednesday, September 11.—President's address in St. Andrew's Hall.

Thursday, September 12.—Conference of delegates of corresponding societies; inauguration of new anatomical buildings at the University, and the opening of the museum in connection therewith; reception and conversazione in the City Chambers, by invitation of the Lord Provost and Corporation of Glasgow.

Friday, September 13.—Garden party at Overtoun, Dumbartonshire, by invitation of the Lord and Lady Overtoun; lecture in St. Andrew's Hall, by Prof. W. Ramsay, F.R.S., subject: inert constituents of the atmosphere; smoking concert in Berkeley Hall of St. Andrew's Halls.

Saturday, September 14.—Excursions; lecture to artisans in St. Andrew's Halls, by Mr. H. J. Mackinder, subject: the movements of men by land and sea.

Sunday, September 15.—Official sermon in the Cathedral, by the Rev. Pearson M'Adam Muir.

Monday, September 16.—Garden party in the Botanic Gardens and Queen Margaret College, Glasgow, by invitation of the Lord Blythswood, president of the Glasgow Philosophical Society, and Lady Blythswood; lecture in St. Andrew's Hall, by Mr. Francis Darwin, F.R.S., subject: movements of plants.

Tuesday, September 17.—Special visits to public works; conference of delegates of corresponding societies; conversazione in the Exhibition Buildings, by invitation of the president, the chairman and the executive council of the Glasgow International Exhibition Association, 1901.

Wednesday, September 18.—Concluding general meeting; excursion to Paisley and luncheon in the Town Hall, by invitation of Sir Thomas Glen Coats, Bart.; reception and conversazione in the galleries of the Royal Scottish Society of Painters in Water Colours, 153, Sauchiehall Street, by invitation of the president (Sir Francis Powell, P.R.W.S.) and the council; "at home" in the Art Club, by invitation of the president (Mr. J. E. Christie) and the committee of the Glasgow Art Club; reception and conversazione in the Glasgow School of Art, by invitation of the chairman (Mr. James Fleming) and the governors; reception and conversazione in the galleries of the Royal Glasgow Institute of the Fine Arts, by invitation of the president (Sir John Stirling-Maxwell, Bart., M.P.) and the council of the Institute; annual inspection and dinner of the Clyde Navigation Trustees, to which a selected number (probably thirty) of members of the British Association will be invited; dinner by the Faculty of Physicians and Surgeons to a selected number of the medical members of the British Association.

By kind permission of the owners, a large number of shipbuilding yards, public works, &c., in Glasgow and district will be available to the inspection of members during the meeting. Details as to days and times are given in a special handbook and guide that is being prepared by the local committee.

In addition to the information given in NATURE of July 18 with regard to the sectional meetings, the following provisional programmes of sections have been received.

The president's address to Section B (Chemistry) will be on the position of British chemistry at the dawn of the twentieth century. In this address Prof. Percy Frankland, F.R.S., will direct attention to the factors which have been instrumental in promoting the growing activity in original investigation during the past twenty years. He will also point out the disadvantages at the present time incidental to university education, and will indicate some of the more important reforms which are required in the immediate future. Other papers which have been arranged for this Section are, bridged rings, by Prof. Perkin; the present position of electrochemical industries in this country and abroad, by Dr. Shields; the chemical exhibits at the Glasgow Exhibition, by Dr. Lewkowitsch; and ocean salt deposits, by Dr. E. F. Armstrong. The last paper may possibly be read at a joint meeting of Sections B and C. Prof. Letts will read papers on the chemical changes which occur during the contact of sewage with "bacteria beds," and on the assimilation of ammonia by the seaweed *Ulva latissima*.

In addition to Mr. J. Horne's presidential address, on recent advances in Scottish geology, to Section C (Geology), the following papers, among others, will be

read :—On the volcanic episodes in the geological history of Arran, by Mr. William Gunn; (1) relation of the Old Red Sandstone of north-west Ireland to the Metamorphic rocks, (2) relation of the Silurian and Ordovician rocks of north-west Ireland to the Metamorphic series, by Messrs. A. McHenry and J. R. Kilroe ; on a new method in the investigation of fossil remains, Prof. J. W. Sollas ; (1) phosphatic nodules, &c., in Upper Carboniferous Limestone of west Yorkshire, (2) a silicified plant seam beneath the Millstone Grit of Swarth Fell, by Mr. John Rhodes ; plants and Coleoptera of Pleistocene age from Wolvercote, Oxfordshire, by Mr. A. M. Bell ; origin of gravel-flats of Surrey and Berkshire, by Mr. H. W. Monckton ; (1) the distribution of fishes in the Carboniferous rocks of Scotland, (2) the fish fauna of the Old Red Sandstone of Scotland, by Dr. Traquair, F.R.S. ; the Cambrian fossils of the north-west Highlands, by Mr. B. N. Peach, F.R.S. ; fossil plants from Berwickshire, by Mr. R. Kidston ; sequence of Tertiary igneous rocks of Skye, by Mr. A. Harker ; the Scottish ores of copper and their geological relations, by Mr. J. G. Goodchild ; recent observations among the volcanic rocks of Mull, by Sir Archibald Geikie ; on Eastern Highland schists, by Mr. G. Barrow ; on rock specimens from Perim, by Miss C. A. Raisin.

The address of the president of Section D (Zoology) (Prof. J. Cossar Ewart, F.R.S.), on the experimental study of variation, will be given on Thursday, September 12. The preliminary list of papers to be read shows that from a zoological point of view the Glasgow meeting will be one of exceptional interest ; while the proximity of the Firth of Clyde and the establishment of the marine biological station at Millport will provide attractions of a special character for the marine biologist. The committee have invited lectures from Major Ronald Ross, F.R.S., on tropical parasitology, giving the results of his most recent investigations ; and from Dr. J. E. S. Moore, on the problem of Lake Tanganyika. Both gentlemen have consented, subject, in the former case, to Major Ross's expected return from Africa in time. In addition to the above, Prof. J. Arthur Thomson will read a paper on germinal selection in its relation to inheritance ; Mr. E. J. Bles, on a method of recording local fauna ; Mr. L. A. Borradaile, on the land crabs of Minikoi ; Mr. J. S. Budgett, on the youngest known larva of *Polypterus* ; Mr. J. Graham Kerr, on the origin of vertebrate limbs ; Mr. J. Y. Simpson, on variation in relation to binary fission in Protozoa ; and Dr. T. H. Bryce, on heterotypical division in the maturation of sexual cells. These titles indicate the main outlines of the zoological programme, but the committee have not yet finally closed their list. A joint discussion with Sections C and E on limnology is provisionally arranged for Monday, September 16.

In Section E (Geography) the president's address will be delivered on Thursday, September 12, at 10.30 a.m., and will deal specially with the study of geography, as distinct from the teaching of that subject, in this country. Amongst the papers which it is hoped will be communicated to the Section during the meeting are :—Mr. G. G. Chisholm, geographical conditions affecting British trade ; Mr. E. G. Ravenstein, Martin Behaim and his globe of 1492 ; Dr. A. J. Herbertson, a morphological map of Europe ; Dr. R. Bell (Geological Survey of Canada), Northern Ontario ; Dr. Moreno, on the Argentine Republic ; Mr. W. N. Shaw, on weather maps ; Mr. H. N. Dickson, on mean temperature and glacial periods ; Dr. R. Logan Jack, on travels in Western China ; Mr. Yule Oldham, on the Bedford level experiments. Captain Lemaire will give an account of his recent expedition. Special attention will be directed to the geography of Scotland, and it is hoped that Sir A. Geikie will read a paper on some questions relating to this subject ; Mr. G. F. Scott Elliott has promised a paper on the effects of vegetation in the valley and plains of the Clyde ; Dr. Marion Newbigin, on the proposed survey of the Forth valley, undertaken by the Scottish Natural History Society ; and Mr. W. G. Smith, on the methods of the Botanical Survey of Scotland inaugurated by his brother, the late Mr. R. A. Smith. Papers will probably be read on the British and German Antarctic expeditions, and Mr. W. S. Bruce has promised a paper on the methods and plans of the Scottish Antarctic Expedition. It is hoped that a joint discussion may be arranged with other sections on the objects and methods of limnology. Sir Thomas Holdich will present the report of the committee on surveys of British Protectorates, and the reports of committees on the climate of Tropical Africa and on surveys of the Phlegræan Fields will also be read.

In Section G (Engineering), the provisional programme includes the following papers :—Address of the president, Colonel R. E. Crompton, on (*a*) modern development of passenger and goods traffic, as affecting carriage on railways, tramways and ordinary roads ; (*b*) standardisation and interchangeability ; (*c*) the National Physical Laboratory. Paper by Mr. D. H. Morton on the mechanical exhibits in the Glasgow Exhibition ; report of the committee on resistance of road vehicles to traction ; the carriage of goods over electric trolley systems, Mr. A. H. Gibbings ; railway rolling stock, present and future, Mr. M. N. Macdonald ; the Panama Canal, M. Bunau Varilla ; tunnelling through quicksands, M. A. Gobert ; the protection of public buildings from lightning, Mr. Killingworth Hedges ; the Diesel engine, Herr Rudolf Diesel ; aluminium, Prof. E. Wilson ; aluminium as a fuel, Sir W. C. Roberts-Austen, K.C.B., F.R.S. ; report of the committee on the small screw gauge ; recent developments of chain driving, Mr. C. R. Garrard ; the critical point in rolled steel joists, Mr. E. T. Edwards ; machinery for engraving, Mr. Mark Barr ; measurement of the hardness of materials by indentation by a steel sphere, Mr. T. A. Hearson.

Prof. D. J. Cunnningham, F.R.S., the president of Section H (Anthropology), will take as the subject of his address the human brain, and the part which it has played in the evolution of man ; and papers on physical anthropology are likely to be more prominent this year than on some previous occasions. Special attention will be directed to recent work by Dr. Brown and Mr. Gray on the physical characteristics of the people of Ireland and Scotland respectively ; Mr. Douglas, Superintendent of Police at Glasgow, promises an account of the anthropometric method of identification as practised locally ; and other papers on Egyptian and Papuan anthropology are expected from Drs. Rivers and Myers. Two papers have been received on the natives of the Malay Peninsula, by Mr. Skeat, and Messrs. Annandale and Robinson. Dr. Sturge has a paper on the chronology of the Stone Age of man, and Mr. Arthur Evans will supplement the report of the Cretan Exploration Committee by an account of the Neolithic settlement which underlies the great Mycenæan palace of Knossos. Mr. Hogarth also promises an account of this year's campaign in eastern Crete. The report of the Canadian Ethnographic Survey promises, as before, a variety of subjects for discussion ; and it is hoped that special arrangements may be made for the description and examination of the ethnographic and archæological sections of the Glasgow Exhibition ; though at present the culture and archæology of the neighbourhood remain quite unrepresented in the programme.

The president of Section I. (Prof. J. G. McKendrick, F.R.S.) will open the work of the section with an introductory address. The feature of the transactions will, however, be a discussion on the subject of phonetics. This is to be introduced by a demonstration from the president of the different methods employed in researches into this subject, after which it is expected that Dr.

Lloyd (Liverpool), Dr. Pipping (Helsingfors), Dr. Boeke (Alkmaar) and others will take part in the discussion.

Communications are also promised from Dr. A. A. Gray (Glasgow), on the cochlea; from Dr. Kennedy (Glasgow), on the repair of nerves; from Dr. Edridge Green, on the classification of the colour blind; from Dr. R. Hutchison, on the chemistry of bone marrow. Other contributions are also promised from workers who have not as yet sent in titles. It is not anticipated, however, that the amount of work will be as great as usual, owing to the fact that many British physiologists are attending the International Congress to be held in Turin a week later than the Glasgow meeting.

A discussion on the teaching of botany will be opened in Section K by Mr. Wager and Prof. Bower from the point of view of school and university teaching respectively. Prof. Miall, Prof. Marshall Ward, Dr. Scott, Prof. Scott-Elliott and others are expected to take part in the discussion. On Friday afternoon, September 13, Prof. Reynolds Green will deliver a semi-popular lecture on flesh-eating plants. The following papers have been promised:—Prof. Bayley Balfour (president), morphological notes; Prof. Marshall Ward, the Bromes and their brown rusts; Mr. Wager, on the cytology of the Cyanophyceæ; Prof. Bower, on an *Ophioglossum* collected by Mr. Ridley; Dr. Lang, on the prothalli of *Helminthostachys*, *Ophioglossum pendulum* and *Psilotum*; on certain large prothalli of *Lycopodium cernuum*; on the mode of occurrence of the prothalli of *L. Selago* at Clova. Mr. Yapp, on two Malayan 'myrmecophilous' ferns; Miss Ford, on the anatomy of *Ceratopteris*; Mr. Brebner, on the anatomy of *Danaea* and other Marattiaceæ; Mr. Seward and Miss Ford, on the structure of *Todea*, and on the geological history of the Osmundaceæ; Dr. Scott, on a primitive type of structure in *Calamites*; Prof. F. W. Oliver, on the structure of certain Palæozoic seeds; Mr. Seward, Jurassic floras; the structure and origin of jet; Mr. Arber, a collection of fossil plants from New South Wales; Dr. F. F. Blackman and Miss Matthaei, autosurgery in leaves; on respiration; Miss Clark, effect of altered conditions of growth upon *Lemna* roots; Mr. Tansley, the vegetation of Mount Ophir; Mr. Yapp, some botanical photographs from the Malay Peninsula; Miss Clark, abnormal secondary thickening in *Kendrickia Walkeri*; Mr. Worsdell, the structure and morphology of the flowers of *Cephalotaxus*; the morphology of the ovule; Mr. Tagg, museum work; Mr. Borthwick, increment of wood; Mr. Gwynne-Vaughan, the vascular anatomy of the Cyatheaceæ; on the nature of the stele of *Equisetum*; Mr. Boodle, remarks on the stele and foliar bundles of ferns.

The new section of Educational Science will be opened on the morning of September 12 with an address by the president, Sir John Gorst. In the afternoon there will be papers and discussions on the organisation of education in Scotland and particularly in Glasgow. On September 13, papers on the science of education will be read by Prof. Armstrong, F.R.S., Prof. Miall, F.R.S., Prof. Withers and others. On Monday, September 16, a discussion on the teaching of mathematics will be introduced by Prof. Perry, F.R.S. On September 17 the subject of discussion will be the influence of universities and examining bodies on the education given in secondary schools, introduced by the Bishop of Hereford and Mr. H. W. Eve

The committee of the Marine Biological Association of the West of Scotland invite members of the Association who are interested in marine biology to work at or visit the Marine Station, Millport, N.B., any time during September 1901, and to join any of the open collecting excursions of the steam yacht *Mermaid* during that month. The intention should be communicated to the Curator, Marine Station, Millport, N.B.

THE INTERNATIONAL ZOOLOGICAL CONGRESS.

THE fifth International Congress, the proceedings of which have just terminated in Berlin, has, notwithstanding the depression caused by the recent death of the Empress Frederick, been a brilliant and important reunion, whether judged by the number and status of the zoologists present or by the interest of its work.

The meetings were held in the Reichstagsgebäude, corresponding to our Houses of Parliament, a fact which in itself testifies to the esteem in which science is held in Germany.

On the evening of Sunday, August 11, an informal gathering was held at which the delegates and members were able to meet and greet each other, to renew old acquaintances and form new ones. The business of the Congress began on Monday, August 12, in the large hall of the Reichstag, when Prof. Möbius assumed the presidential chair and, after declaring the proceedings open, made a touching reference to the sorrow which had fallen upon the Royal Family, and proposed that telegrams of condolence should be sent to the Emperor and to the Crown Prince, who had graciously consented to act as patron of the assembly. Replies to these messages were subsequently received and read.

The Congress was then welcomed by His Excellency Herr Rothe, Under Secretary of State, in the absence of the Chancellor, by Burgomaster Kirschner and by Prof. Harnack, the Rector of the University. Prof. Perrier expressed the acknowledgments of the foreign delegates, and after some formal business, Prof. Grassi, of Rome, delivered a lecture on "The Malaria Problem from the Zoological Point of View," in which he gave an account of the diseases caused by insect-stings and dwelt upon the importance of their study for the progress of hygiene.

It is usual with us to terminate the proceedings of a congress with a picnic, but the committee charged with the arrangements of the present meeting seem to have thought that the proceedings would be smoother if social intercourse preceded debate, and with this view organised an excursion to the Havel See.

On the Tuesday no forenoon sittings were held, in consequence of the Royal funeral; but at midday a general meeting was held, at which, among other business, it was announced that the prize offered by the Emperor Nicholas II. had been awarded to Dr. Oudemans, of Amsterdam, for his memoir "On the Influence of Light on the Development of Colours in the Lepidoptera."

Dr. Sclater having taken the chair, lectures were delivered on "The Theories of Fertilisation," by Prof. Yves Delage (Paris), who referred to the importance of studying the phenomena, not merely morphologically, but also physiologically; and on "The Psychic Faculties of Ants and other Insects," by Prof. Forel (Morges), in which he sought to show an identity between the senses of insects and our own and to demonstrate their possession of memory, association of sensory impressions and power of drawing conclusions from experience.

A general meeting was also held on Thursday afternoon, August 15, when addresses were given by Prof. E. B. Poulton (Oxford) on "Mimicry," by Prof. Patten (Hanover, U.S.A.) on "The Origin of Vertebrates," Prof. v. Zograf (Moscow) on "Hydrobiological Investigations and Institutes in Russia," M. A. Pizon (Paris) on "The Observation of Budding in Tunicates," Mr. C. G. Schillings (Düren) on "East African Mammals," and Mr. O. Neumann on "Results of a Journey from the Red Sea to the White Nile," all illustrated by the lantern.

At other times the Congress separated into seven sections—viz. General Zoology, Experimental Zoology, Vertebrata (Biology, Classification), Vertebrata (Anatomy,

Embryology), Invertebrata, Arthropoda and Nomenclature. These were presided over on successive days by different zoologists of eminence, and such numerous communications were made to each that it is impossible to give an account of these, or even a list of their titles.

The concluding meeting took place on Friday morning, when a large amount of business was transacted. The report of the Nomenclature Commission, which was adopted, included a recommendation that specific and generic names should be amended only when a printer's error or a mistake in orthography could be proved, and that in all cases the first name given to an animal, whether to the whole animal or to a part, to an adult or a larva, should stand, and also a proposal for introducing uniformity into the arrangement of figures on plates and the designation of their parts by explanatory letters. Resolutions were also passed in favour of the preservation of non-injurious animals and the formation of a section for zoogeography; it was, further, decided to hold the next congress in Bern, under the presidency of Prof. Studer. Addresses were given by Prof. Bütschli (Heidelberg) on "Vitalism and Mechanism," and by Prof. Branco (Berlin) on "Fossil Men," and after the usual complimentary resolutions the Congress was adjourned.

Such were in brief the formal proceedings, but, as is always the case, these were by no means the most important results. More far-reaching in their influence on the life and work of zoologists are the informal discussions and friendly conversations which take place in the intervals, on such occasions as the reception by the City of Berlin at the Rathhaus, by the Zoological Society in its magnificent garden and in other more modest convivial gatherings.

The whole meeting was admirably organised, with German thoroughness and attention to detail. It only remains to be added that an appendix to the Berlin meeting took place in Hamburg, where the members were received at the Rathhaus by the Senate of the City, by the directors of the Hamburg-American Line on board the ss. *Graf Waldersee* and by the Zoological Society in their garden. A trip to Heligoland terminated the whole proceedings, which must have left a vivid and pleasant impression on the mind of every one present.

CHARLES A. SCHOTT.

MR. CHARLES A. SCHOTT, whose death we regret to record, was renowned throughout the world of physical science on account of his numerous memoirs on terrestrial magnetism. The work accomplished by him during a long and active career was both extensive and influential, and its value has long been recognised by physicists in both hemispheres.

From an appreciative account of Mr. Schott's work, which appeared in *Terrestrial Magnetism* two years ago, we learn that he was born at Mannheim, Baden, Germany, August 7, 1826. After passing through the public school and partly through the Lyceum of his native town, he entered the Polytechnic School at Karlsruhe, where, after a six-year course, he graduated as civil engineer in 1847. In December of that year he entered the service of the United States Coast Survey, and in due time became a citizen of the United States. At first he was engaged in office and nautical duties, but he was assigned to the position of Chief of the Computing Division of the Survey in 1855. Mr. Schott continued in charge of this until the end of 1899, and he then undertook the discussion of the arc measurements in the United States resulting from the extension triangulation already executed by the different organisations engaged in survey work. A summary of some of the results of this work was given in NATURE of February 21 (vol. lxiii. p. 408).

Mr. Schott's numerous contributions to the annual reports of the Coast Survey since 1854 relating to hydrography, geodesy, practical astronomy, and especially to terrestrial magnestism, are well known. He also published through the medium of the Smithsonian Institution, between the years 1858 and 1881, a number of memoirs bearing on meteorology and on subjects relating to Arctic explorations. He was a member of the Government parties sent to Springfield, Illinois, to observe the solar eclipse of August 1869, and to Catania, Sicily, to observe that of December 1870. As delegate from the United States Coast and Geodetic Survey, he attended the International Conference on Terrestrial Magnetism, held at Bristol in 1898 in connection with the meeting of the British Association. In the same year he received the Henry Wilde prize of 4000 francs from the Paris Academy of Sciences for his numerous contributions to terrestrial magnetism. This was the first award of the prize; and the President of the United States in making the presentation alluded to the catholicity of scientific work and the recognition of distinguished merit implied in the fact that Mr. Schott—an American—should be awarded by French men of science a prize founded by an Englishman. It is encouraging to know that Mr. Schott's zeal and industry for the advancement of natural knowledge met with recognition in the world of science.

NOTES.

A COMMITTEE has been appointed by the President of the Board of Trade to inquire and report as to the best means by which the State or local authorities can assist scientific research as applied to problems affecting the fisheries of Great Britain and Ireland. The members of the committee are as follows:—The Right Hon. Sir Herbert Maxwell, Bart., M.P., Mr. Walter E. Archer, Mr. Donald Crawford, Rev. William Spotswood Green, Prof. William Abbott Herdman, F.R.S., the Hon. Thomas H. W. Pelham, Mr. Stephen E. Spring-Rice, C.B., and Prof. J. Arthur Thomson.

IT has been decided to erect in Leoben, Austria, a statue of Peter Ritter von Tunner, who died on June 8, 1897, to commemorate his great services to the metallurgy of iron. An influential committee has been formed, with Mr. Ignaz Prandstetter as president, Prof. J. G. von Ehrenwerth as vice-president and Prof. Carl Fritz as honorary secretary, to collect subscriptions. At a recent meeting of the council of the Iron and Steel Institute the matter was considered. As a contribution to the memorial could not be voted from the funds of the Institute, the members of council present decided to contribute two guineas each, and Mr. Bennett H. Brough, the secretary, now informs us that he has forwarded to the committee in Leoben contributions of that amount from twenty-six members.

A REUTER message records that the *Lucania*, which left Liverpool on August 10 for New York, was spoken by wireless telegraphy at Nantucket Lightship shortly after 6 p.m. on August 16. The following message, signed by Captain McKay, was among those received on the lightship from the *Lucania*, and then transmitted forty miles to Siasconset, on Nantucket Island:—"All well on board. We are 287 miles from Sandy Hook, with clear weather, and expect to reach New York on Saturday. Please inform Cunard Agents." On reaching port the officers of the *Lucania* reported that the messages from Nantucket were undecipherable aboard ship.

WE learn from the *Athenaeum* that Dr. Trootz, the Belgian Minister of the Interior, who is also Minister of Education, has proposed in the Chamber the foundation of a *Belgica* prize for the promotion of oceanic researches by Belgians, and that the

prize shall be allotted at the discretion of the scientific class of the Academy. The sum of 41,000 francs, which will constitute the nucleus of the projected prize, has been obtained by the sale of the *Belgica*, the ship of the Belgian South Polar Expedition, to the Norwegian Government. Lieut. Gerlache, who was the leader of the expedition, suggests, on the other hand, that the capital of 41,000 francs should be put out to interest until the fund amounts to 100,000 francs, and that the interest should then be expended upon grants to Belgian oceanic explorers, and also upon a *Belgica* medal, to be bestowed upon polar explorers of all nations. It is reported that the Minister is now inclined to support Lieut. Gerlache's two suggestions.

A STRIKING example of the improvements which have been made in the mechanical arrangements for the loading of coal from railway trucks into vessels has recently been afforded by a new hydraulic coal hoist which has been erected at the Penarth dock. A steamer arrived in the dock at 8.10 in the morning. After taking in sufficient coal for her boilers she proceeded to load her cargo at 9.15, which was completed at 11.50, the steamer entering and leaving the dock on the same tide. The quantity of coal placed in the vessel was 2333 tons, in two and a half hours, or at the rate of about fifteen tons a minute.

THE next meeting of the International Navigation Congress is to take place at Dusseldorf from June 29 to July 6, 1902. The subjects that will be specially considered are (1) as regards inland navigation; lifts; lifts on inland waterways; the transport of coal. Communications are invited on the construction of reservoir dams; improvements in the mechanical propulsion of vessels; utilisation of water-power at weirs for electric propulsion. (2) Ocean navigation; construction of iron and wooden gates for locks; the use of sea-going lighters; construction and management of graving docks and repairing slips; construction and cost of dredging machinery.

A PROJECT is now under consideration by the municipality of Vienna for disposing of the sewage of the city, which at present is discharged into the Danube. The scheme consists in the application of a method developed by Herr Noebel, of Posen, for the utilisation of the liquid part of the sewage for the double purpose of irrigation and manure. It is intended to convey the sewage in pipes to an extensive plain of poor land which suffers from a lack of water, due to inadequate rainfall, over which it is not to be carried in trenches, as is done in this country, but the surface of the land is to be irrigated by sprinkling the sewage water over it. It is contended that by this system the land will not be over-saturated, as it frequently is on the sewage farms at Berlin and Paris. The system is stated to have been already in use at Posen, with satisfactory results.

PROF. FREDERICK STARR, who for several years has closely studied the physical types of the tribes of southern Mexico, has, says *Science*, just brought his work to a close. Three kinds of work were done—measurement, photography and modelling. In each tribe one hundred men and twenty-five women were measured, fourteen measurements being taken of each individual. Photographic portraits were taken of typical subjects, a front view and a straight profile being made of each. Busts in plaster were made of those who appeared most perfectly to present the racial type, the moulds being made directly upon the subject. During the four seasons over which his work has extended, Prof. Starr has visited twenty-three tribes. While the physical types of the natives formed the chief subject of study, many views were also taken of the scenery, villages, houses, groups of Indians, native industries, &c. The material results of the investigation include measurements from 2850 persons, 1200 or more negatives, varying in size from 8 × 10 inches to 4 × 5, 100 busts in plaster and a large collection of objects—dress, weapons, implements and products—illustrating the ethnography of the region. Several months will be necessary for putting all this material into shape for exhibition and publication.

THE Deutsche Seewarte has published, as an appendix to the August number of the *Annalen der Hydrographie*, a useful collection of storm tables for the Atlantic Ocean. For some years the Seewarte has been collecting and publishing notices of storms, giving, in a very concise form, the time, position and duration, the reading and motion of the barometer (rising or falling) and the various changes of the wind (backing or veering). The results have been arranged in tabular form, in twenty-two districts, according to months and seasons, and grouped under four principal points of the compass. The chief object of the tables is to show at a glance if, on the occurrence of bad weather (when the wind force has reached a fresh gale), there is a prospect of it becoming worse, what the probable further behaviour of the storm will be. The explanatory text contains useful remarks respecting the general distribution and characteristics of storms in different seasons and in various localities of the Atlantic.

AN important publication, just issued by the Department of Revenue and Agriculture of the Government of India, brings together the agricultural statistics of British India and of the Native States, so far as they can be procured, for the five years 1895-6 to 1899-1900. The first thirty pages are explanatory. The bulk of the volume consists of tables of figures, giving the areas of cultivated and uncultivated land; the areas under each crop (the irrigated and not irrigated separately mentioned); the average yield of the principal crops; the number of farm animals, ploughs and carts; the statistics of land revenue assessment, and of transfers of land, for each separate district in the empire. The information will be of the greatest value to those who have the task of developing the resources of the country. The general summary of the acreage described for the year 1899-1900 is as follows:—

	British India, Acres.	Six Native States, Acres.
Total area surveyed	544,858,070	45,952,429
Under forest	65,843,924	3,087,209
Unculturable	135,506,014	11,374,311
Culturable waste	106,404,704	9,765,998
Fallow land	57,163,761	5,452,596
Sown with crops	180,151,093	10,385,927
Irrigated	31,544,056	1,357,463

THE Report on the Observatory Department of the National Physical Laboratory for the year 1900 has been published in the *Proceedings* of the Royal Society. The magnetographs have been in constant operation throughout the year, but the curves have been quite free from any large fluctuations. The mean westerly declination for the entire year was 16° 52′·7. The automatic and tabulated records of the various meteorological instruments have been transmitted, as usual, to the Meteorologica Office, to be dealt with in its publications, and special cloud observations have been made each month in connection with the international scheme of balloon ascents. Seismological observations have been regularly made; two noticeable disturbances occurred during the year, on January 20 and October 29. A detailed list of the movements of the seismograph will be published in the Report of the British Association for the present year. As regards experimental work, the observation of distant objects during mist and fog and researches upon atmospheric electricity, referred to in previous reports, have been regularly continued. The list of the various instruments tested is a very long one; we therefore select only a few of the principal cases in which a considerable increase has occurred:—Aneroids and marine barometers (number tested in year 1900), 336 (increase 69); compasses, 963 (increase 559); rain gauges, 1345 (increase

784); clinical thermometers, 20,476 (increase 4456); total number of instruments tested, 27,569 (increase 5518). The principal addition to the staff during the year has been the appointment of Dr. J. A. Harker as an assistant in the Laboratory. Among the different appendices may be mentioned one showing the mean values of the magnetic elements at observatories the publications of which are received.

THE first number has reached us of the "University of Missouri Studies," a publication which it is proposed to issue as irregular intervals as often as work of the required standard it offered by members of that University. The present number consists of "Contributions to a Psychological Theory of Music," by Dr. Max. Meyer, professor of experimental psychology.

PROF. ANGELO ANDRES, writing in the Lombardy *Rendiconti*, discusses the choice of a base line in the so-called "rational" measurement of animals according to which the various dimensions are expressed in terms of one measurement, generally representing the length of the animal. As a result of the considerations brought forward by the author, the distances which best satisfy the requirements in the selection of the base fall, in the case of vertebrate animals, into six groups, according to the particular class of animals considered.

A STUDY of the nummulites of southern Italy has been made by Dr. Giuseppina Gentile, chiefly from observations of specimens in the geological museum of the University of Naples. The examples which the authoress describes, belonging to twelve species and five varieties, come from the Middle and Upper Eocene formations, the former being represented by a prevalence of the forms *N. laevigata, N. lucasana and N. perforata* and the latter strata being characterised similarly by a prevalence of *N. Tchihatcheffi* and *N. Guettardii*. The paper is to appear in the *Atti* of the Naples Academy.

WITH the object of conducting researches in limnology in Italy similar to those instituted in Switzerland by Forel, the Reale Istituto Lombardo appointed in 1896 a committee to investigate the variations of temperature in the lake of Como, and a preliminary report appears in the *Rendiconti* of the Academy, xxxiv. 11. The western limb of the lake is particularly suitable for such observations, on account both of the regularity of its basin and, more especially, on account of the absence of any fluvial current of importance. The vertical distribution of temperature is in conformity with the measurements obtained by Burguières and Forel. In connection with the annual variations, the most remarkable feature (observed in two consecutive years) was the irregular undulation of the curves at depths of twenty and thirty metres, and in particular the appreciable cooling which at these depths occurs in the hottest months. Observations have also been made on the variations of long period, and on the horizontal distribution of temperature across various sections of the lake.

THE *Journal* of the Royal Microscopical Society for August contains the full report of the paper to which we have already alluded, by Mr. J. W. Gordon, on the Abbe diffraction theory, very fully illustrated by a large number of diagrams. The main point of Mr. Gordon's contention is that the diffraction effects seen in the use of Zeiss's *Diffractions Platte* are produced by the diaphragm itself. He maintains that the diffraction theory has virtually been abandoned by Prof. Abbe himself. In the discussion which followed, in which Prof. S. P. Thompson and Mr. Julius Rheinberg took part, and which is also reported in full, the prevalent view appeared to be that while Mr. Gordon had successfully exposed the incorrectness of some of the statements of Naegeli and Schwendener and of other exponents of the theory, he had not succeeded in showing that these errors were the necessary consequences of the theory.

M. BLONDEL concludes his paper on oscillographs and their use in the current number of the *Revue générale des Sciences* with an account of his work on the alternate current arc. The paper contains a number of very interesting oscillograph curves —the first to be published of those taken by Mr. Blondel's double oscillograph—showing the variation of current and potential difference with an alternate current arc between carbons or between carbon and metal. The general characteristics of these curves are now fairly well known, either through the previous papers by M. Blondel or through the exhaustive series of waveforms in Mr. Duddell's paper in the *Journal* of the Institution of Electrical Engineers (vol. xxviii. p. 1). Greater interest attaches, therefore, to the curves showing the effect of an alternating current superimposed on a direct current arc. The form of these curves throws important light on the much-discussed "negative resistance" of the arc. The curves published by M. Blondel lead him to the conclusion that the value of dV/dA is very small, positive for cored and negative for solid carbons. This ratio, the negative value of which, found by Messrs. Frith and Rodgers, gave rise to the controversy alluded to above, is defined by M. Blondel as "the coefficient of stability," which seems to us a very convenient term.

A REPORT by Prof. T. E. Thorpe, C.B., F.R.S., on the work of the Government Laboratory upon the subject of the use of lead compounds in pottery, has been published as a Parliamentary paper. It may be remembered that a detailed report upon the use of lead compounds in the production of pottery glazes and colours was prepared by Profs. Thorpe and Oliver in 1899, and the conclusions were described in these columns (vol. lx. p. 18). Since the publication of that report a large number of further experiments have been made upon lead fritts and upon glazes containing their lead in the form of lead fritt, and a second paper was issued a short time ago. The present paper embodies chemical evidence which Prof. Thorpe has to offer in connection with the special Rules drawn up for potteries as to the use of fritted lead and its degree of insolubility. Fritted lead is a silicate or borosilicate of lead formed when "raw" lead, that is, red lead, white lead or litharge is fused or fluxed with a part or the whole of the silica, or of the silica and the other materials used for the glaze. Potters agree that fritted lead can be substituted for raw lead in every section of pottery manufacture, and it was thought by the Department Committee (1893) on lead poisoning that this would mitigate the evil, then very prevalent. But there are different kinds of fritted lead depending upon the proportions of the materials taken. Some lead fritts appear to be little less soluble in dilute acids than raw lead, and therefore have just as injurious an effect when they find their way into the system of the potter and are dissolved by the gastric juice. Other fritts are nearly insoluble and therefore innocuous. It is to ensure the use of such insoluble, or slightly soluble, fritts that the efforts of the Home Office are now directed. Practical difficulties have, however, arisen as to the standard and tests of solubility, and Prof. Thorpe's report deals chiefly with the objections which have been raised to the proposed Rule on scientific grounds.

DR. R. W. SHUFELDT, in the *American Naturalist*, discusses the osteology and systematic position of the auks and puffins. After reviewing the various arrangements proposed by other writers, the author considers that these birds should form a suborder (= order of most ornithologists), the Alcæ, which is connected, on the one hand, with the plover group through the gulls and their allies, and on the other, through the petrels, with the penguins, loons, grebes and their extinct toothed ally, Hesperornis. In reality, this arrangement is not very different from the one proposed years ago by Dr. Sclater, who placed

the auks and loons in a single order (Pygopodes), flanked on the one side by the petrels and on the other by the penguins.

THE July issue of the *American Naturalist* opens with a continuation of Mr. W. H. Wheeler's account of the compound and mixed nests of American ants, the present section dealing with the instances of "social symbiosis." No less than eight different types of this association are recorded, for each of which a special term is adopted. Plesiobiosis, for instance, indicates the cases where ants of two (rarely more) species, which are generally inimical to each other, excavate their galleries in close contact. Xenobiosis, on the other hand, refers to the so-called guest-ants, which maintain independent households among their hosts, with whom they may be on terms of toleration, or even friendship; while Dulosis is applied to cases where one species of ant is kept in slavery by another. The paper teems with interest to students of ant-life.

THE important series of descriptive catalogues recording the collections made by the Royal Indian Marine Survey ship *Investigator* has been enriched by the appearance of "A Descriptive Catalogue of the Indian Deep Sea Crustacea Decapoda Macrura and Anomala." In his preface the author, Major A. Alcock, states that although most of the new species obtained during the dredging cruises of the vessel under his direction have been described in earlier publications, the present volume must not be regarded as a mere reprint of such reports. It contains definitions of the larger groups under which the species are arranged and also valuable tables of distribution, as well as a considerable amount of material prepared by the author as the basis of a larger work on Indian crustaceans. Out of a total of 117 species of Macrura (lobsters, crayfish, shrimps, &c.) obtained during the various cruises, sixty-nine are believed to be peculiar to Indian waters. Most were obtained in less depths—mostly much less—than 1000 fathoms; and out of eleven dredged from deeper water, only five appear to be truly abyssal, several of the others being taken in the net during its ascent. The Anomala present a greater percentage of deep-sea forms, eight out of fifty-two being abyssal types.

DESPITE an unfortunate falling-off in the income, the Report of the Manchester Museum for 1900–1 tells of continued progress of that institution. Owing to the generous presentation of his collection by Mr. P. Schill, which is especially rich in Eastern Holarctic forms, the Manchester series of Lepidoptera now occupies a foremost position among provincial cabinets. The director has also to report the presentation by Mr. R. D. Darbishire of a shell of *Pleurotomaria adansoniana* from Barbados; and the purchase of duplicate shells from the Layard collection has been a most satisfactory investment, the sale of superfluous specimens having repaid the entire cost, while more than 2000 examples have been added to the Museum series. The herbarium has also been largely increased. Neither has the exhibition series been neglected, the director calling especial attention to the display of the various groups of worms, as well as to the dissections and drawings illustrating the anatomy of molluscs.

WE have much pleasure in congratulating the Field Naturalists' Club of Victoria on its "coming of age," an event which was duly celebrated in Melbourne on June 25. In calling attention to the present condition of the Club, the committee were able to report, in spite of increased expenditure, a slight improvement in the finances and also an increase in the roll of members. During the year the Club has called attention to the destruction of various species of "wattle" (*Acacia*), and also to the spread of the water-hyacinth and iris—it is hoped with good results. Among other papers, the July issue of the *Victorian Naturalist* contains one describing the curious incrustations formed on roots in the littoral sand-dunes of certain districts. The theory that these are formed by the action of vegetable acids on the lime contained in the sand is confirmed. By the decay of the contained root and the percolation of calcareous matter these incrustations may become solid throughout.

THE occurrence of chrysoberyl in the gneiss of Manhattan Island, New York City, is recorded in a pamphlet published by Mr. W. G. Levison (New York, 1901).

AN article in the *Pioneer Mail* of July 5, 1901, deals with the important question of artesian wells for India, and it is urged that the Imperial Government should undertake a series of borings. Mr. Griesbach, the Director of the Geological Survey of India, has suggested that a search for artesian water might be made in the flat country enclosed by Mahi Kantha on one side and Kathiawar on the other in Gujerat proper. If successful the wells would be useful in the northern division of Bombay.

A PRELIMINARY report on the Cape Nome gold region on the south-western coast of Alaska has been prepared for the United States Geological Survey (1900) by Mr. F. C. Schrader and Mr. A. H. Brooks. In this region the bed-rock consists of altered limestones, mica schists and gneisses, and above it are various gravels forming beaches and terraces, which occur in the gulches (creeks) and valleys and also over the tundra. It is remarked that the gulch and beach placers are extraordinarily rich in gold, and the metal is also known to occur in the bars of the larger rivers and in the tundra. No bed-rock mining has been done, but as the gravels and gold are largely of local origin, workable veins may eventually be found. The authors observe that the staking of new claims "is probably nearly a thing of the past, yet those having capital to invest will undoubtedly find plenty of claims for sale." They add, "it would be very wise for all inexperienced newcomers to save money for the return passage."

A NEW scientific journal, the *Allgemeine Naturforscher-Zeitung*, will be published in Berlin early in October. The prospectus states that the journal will be "die erste naturwissenschaftliche Zeitung der Welt."

A SECOND edition of the second report of the United States Board on Geographic Names has been received, and with the exception of a few minor corrections it is the same as the original edition of May, 1900. The general policy of the Board has been to adopt the name which is in common local use at present, but local usage has been neglected in some cases in order to effect reforms in nomenclature. Among these departures approved by the Board are the following:—the avoidance, so far as practicable, of the possessive form of names; the omission of the final "h" in the termination "burgh"; the abbreviation of "borough" to "boro"; the spelling of the word "centre" as "center"; discontinuance of the use of hyphens in connecting parts of names; the simplification of names consisting of more than one word by their combination into one word; the avoidance of the use of diacritic characters; the omission of the words "city" and "town" as parts of names. Evidently these principles have their limitations, and the Board recognises the practical impossibility of inducing English people to speak of Germany as Deutschland, Turin as Torino, or The Hague as 's Gravenhage. It is suggested, however, that the adoption of the home name "is a reform to which we may look forward and work toward, and which may be attained in the future." Each name must evidently be considered separately, and the Board exists to do this and to decide what name shall be adopted. The present report contains all decisions rendered by the Board from its creation to April, 1900.

THE additions to the Zoological Society's Gardens during the past week include a Patas Monkey (*Cercopithecus patas*) from West Africa, presented by Mr. U. R. Noble; two Bonnet Monkeys (*Macacus sinicus*) from India, presented respectively by Mrs. Noble and Miss Weil; two Ring-tailed Coatis (*Nasua rufa*) from South America, presented respectively by Mr. Charles North and Mr. E. F. Johnston; two White-tailed Gnus (*Connochaetes gnu*) from South Africa, presented by Mr. C. D. Rudd; an Osprey (*Pandion haliaetus*) captured at sea, presented by Commander H. Strong; a Toco Toucan (*Ramphastos toco*) from Guiana, a Red-billed Toucan (*Ramphastos erythrorhynchus*) from Cayenne, a Hutchin's Goose (*Bernicla hutchinsi*) from Arctic America, presented by H.E. Sir W. J. Sendall, G.C.M.G.; two Infernal Snakes (*Boodon infernalis*), six Rufescent Snakes (*Leptodira hotambaeia*), six Rhomb-marked Snakes (*Trimerorhinus rhombeatus*), five Crossed Snakes (*Psammophis crucifer*), two Rough-keeled Snakes (*Dasypeltis scabra*) from South Africa, presented by Mr. A. W. Guthrie; a Horned Lizard (*Phrynosoma cornutum*) from Texas, presented by Miss Wilson; an Eyed Lizard (*Lacerta ocellata*), a Tessellated Snake (*Tropidonotus tessellatus*), South European, presented by the Rev. F. J. Jervis-Smith, F.R.S.; a Brindled Gnu (*Connochaetes taurina*) from East Africa, purchased.

OUR ASTRONOMICAL COLUMN.

NOVA PERSEI.—A telegram from Kiel announces that photographs of Nova Persei, taken on August 19 and 20 by MM. Flammarion and Antoniadi, show a nebulous aureola having a definite sharp outline.

PERIOD OF MIRA CETI.—Prof. A. A. Nijland finds from a series of thirty-nine observations of this long-period variable during the interval July 17 to September 11, 1900, that the maximum occurred last year on August 3. As will be seen from the table below, this brings the period back to the short value of 1897. (*Astronomische Nachrichten*, Bd. 156, No. 3733.)

Observed maximum.	Predicted (Chandler III.).	Magnitude.	Period.
1897 Jan. 11	1896 Dec. 12	3·70	
			319 days
1897 Nov. 26	1897 Nov. 9	3·24	
			312
1898 Oct. 4	1898 Oct. 6	2·91	
			350
1899 Sept. 19	1899 Sept. 3	3·75	
			318
1900 Aug. 3	1900 Aug. 1	3·35	

THE CAPE OBSERVATORY.—The annual report to the Admiralty has recently been issued by Sir David Gill, and summarises the work done at the institution during the year 1900.

The new transit observatory is now satisfactorily erected. It is of sheet steel, having triple sides, thus forming a double series of ventilating shafts, arranged so as to carry off all heated air by convection and deliver it by funnels 13 feet distant from the observing shutter; this latter is 6 feet wide, formed by the two halves of the building sliding apart.

The upper part of the structure is semicylindrical, its axis coinciding with that of the transit circle. It is hoped that this symmetry between building and instrument will eliminate abnormal refractions. The double-chambered walls have made it possible to attain practical equality between the external and internal temperatures.

Transit Circle.—Much of the transit circle work has consisted of a thorough investigation of the influence of "star magnitude" on the observers' personal equations. The results are given in detail, and indicate that, while there is considerable range in magnitude personality for different observers, every observer records the time of transit of a faint star later than that of a bright one, and also, as a rule, this personality is greater "per magnitude" for faint than for bright stars. Another somewhat unexpected fact brought out by the investigation is that the difference of personality remains nearly the same for stars of very different declination.

Heliometer.—Regular observations of all oppositions of major planets have been continued—of these fifty-three related to Jupiter, forty to Saturn, forty-four to Uranus and sixty-six to Neptune. Observations were also made of the conjunction of Jupiter and β Scorpii, and of the distances of the cusps of the partially eclipsed sun on November 22, 1900.

McClean Equatorial.—The 24-inch photographic objective has been refigured and forwarded to the Cape from Dublin. The 18-inch visual telescope has been employed in the observation of double stars, thirty-one previously unrecorded pairs being found, nine of which are naked-eye stars.

In consequence of the absorption of the three heavy flint prisms belonging to the "line of sight," spectrograph they have been replaced by four of lighter glass giving the same total deviation. Mr. McClean, who is providing these, has also generously given an order to Messrs. Zeiss for a second objective prism of 24 inches aperture and 10° refracting angle.

Physical Laboratory.—Investigations have been in progress by Mr. Lunt dealing with the spectra of oxygen, silicon, aluminium, boron and sulphur, and provision is being made for a further study of the spectra of various gases.

Astrographic Charts and Catalogue.—One hundred and three triple image chart plates have been passed, bringing up the total to 362. For the revision catalogue, 172 plates have been taken. During the year, 124 catalogue plates, containing 71,655 stars, have been completely measured in both coordinates in reversed positions of plate.

South African Survey.—This has been pushed rapidly forward in Rhodesia, the party reaching latitude 16° 30′ S., and they expected to reach the Zambesi by the end of July. The operations for the Anglo-German Boundary Survey are also in steady progress. It is hoped that arrangements will soon be possible for the extension of the survey through the international territories north of Rhodesia, thus bringing the long-wished-for African arc of meridian nearer to practical realisation.

OBSERVATION OF COMET *a* (1901).—Mr. J. Cresswell, writing from a mining camp near the centre of Borneo, sends a drawing of this comet, which was visible there on May 7–12. He says:—"It was very bright, and had two tails which on May 10 were 29½° apart and on May 12 35° apart. The lower tail was less bright than the upper. I looked for it during the solar eclipse, but did not see it." Further observations were prevented by cloud.

THE AUGUST METEORS OF 1901.

THE weather was tolerably clear near the time of the maximum and enabled the shower to be pretty well observed. On August 10, 11 and 12, or on one or two of those nights, a considerable number of meteors were recorded at various places where the clearness of the sky permitted observation. The maximum appears to have occurred rather later than usual, for the greatest number of meteors displayed themselves on Tuesday morning, August 13, but the state of the sky did not allow the progress of the display to be fully observed during its rise, culmination and fall.

The first marked indication of the Perseids as a definite shower became apparent on July 21, when the writer at Bristol recorded five swift streak-leaving meteors from a radiant at 23°+52°, but two of them were imperfectly seen and their directions could be only roughly noted, so that the resulting radiant was not very satisfactory, though there could be no doubt of its actual existence either at or very near to the position assigned.

Between July 21 and August 10 the development of the shower could not be fully traced, owing to moonlight or cloudy weather. On August 10 the display was moderately rich. There was no special activity on the part of the Perseids, but the minor showers of the period were in prominent evidence and provided meteors as fast as the observer found it convenient to record them. Between about 9h. 30m. and 15h. the total number of meteors seen by the writer at Bristol was 102, but nearly half of the time mentioned was consumed in registering paths. While the observer's attention was, in this manner, diverted from the sky, a large number of meteors must have eluded notice; of the 102 seen 55 were Perseids.

On August 11 the sky was clear until after midnight, and

between 9h. 30m. and 12h. 30m., 72 meteors were noticed, of which 49 were Perseids. As compared with the previous night the Perseids had increased, while the other meteors exhibited a marked decrease. Clouds prevented further observation at 12h. 30m.

On August 12 the sky was overcast, but between 14h. and 14h. 30m. there was a break along the east and south-east horizon, through which a few of the stars could be seen. Meteors were numerous, and it was considered that with a clear sky the display would have been unusually fine.

A few cloudy nights intervened, but on August 15 and 16 observations were secured during clear intervals. The Perseid shower was still actively in play, and supplied about one-third of the aggregate number of meteors visible. On August 18 the sky was watched between 9h. 30m. and 14h. 15m., but meteors, generally, were extremely rare. The Perseid shower furnished eight paths, so that the display was still well defined. On August 19, observations were made between 9h. 30m. and 15h., and 40 meteors were seen, of which 3 only were Perseids, so that the stream had become nearly exhausted. The radiant point was determined from several well-observed paths on each night, and its easterly position as compared with its place on August 10 and 11 was strikingly evident. Between July 21 and August 18, its R.A. differed to the extent of 32°, as the following figures will prove :—

		° °		
July 21	...	23+52	...	5 meteors
Aug. 10	...	44+58	...	55 ,,
11	...	45+58	...	49 ,,
15	...	51+58	...	6 ,,
16	...	53+58	...	5 ,,
18	...	55+59	...	8 ,,

The Perseids furnished some brilliant specimens, but there was only one fireball seen by the writer. This appeared at 11h. 2m. on August 11, and lit up the south-eastern sky with a lightning-like flash. It was seen also at Birmingham and Yeovil, and its height is given in the table. The largest meteors recorded at Bristol were as below :—

					From			To		
		h.	m.		° °			° °		
Aug. 10	...	12	47	♃	331½+6½	..		324½− 6½	...	swift stk.
	...	13	0	♃	33 −4	...		32 −12	...	v. swift stk.
	...	13	17½	>♃	333 +60	...		302 +45½	...	v. swift stk.
	...	13	33	1	62 +22½	...		66 +11¼	...	v. v. slow.
Aug. 11	...	11	2	2×♀	353½+ 7	...		343 −14	...	v. swift stk.
	...	11	34	♃	43 +79	...		232 +73	...	sw. b. stk.
	...	11	56	♀	120 +74	...		160 +65	...	sw. stk.
*	12 ...	14	4	♃	* 46 − 5	...		46 −15	...	sw. stk.
	19 ...	14	5	♃	322 +48½	...		338½+41	...	v. slow train.

Four meteors seen on August 10 were also recorded by Prof. A. S. Herschel at Slough, and their real paths have been determined. Their heights, &c., are included in the following table, in which are also given the results for the fireball of August 11, which left a streak for about a minute amongst the stars of Aquarius. It must have been a magnificent object from the English Channel :—

				Height at first	Height at end	Path	Velocity per sec.	Radiant
	h.	m.	mags.	miles.	miles.	miles.	miles.	° °
Aug. 10 ...	10	41	3−2	91	72	20	24	278+67
	12	0	1	76	51	36	50	44+58½
	12	16	2−1	69	50	27	39	42+57
	12	19	3−2	72	60	33	25	149+60
Aug. 11 ...	11	2	2×♀	95	56	64	...	45+58

The latter object began over the channel at a point about 25 miles W. of Dieppe, and ended a little W. of Havre on the French coast. It would be interesting to hear further descriptions of it from the channel and from the north region of France.

Reports are coming in from various observers, and show that the display was quite up to, if it did not exceed, the average. Mr. D. E. Packer, writing from Birmingham, says :—"On Saturday night, August 10, several hundreds of meteors were observed here in a four-hours' watch, commencing at 10 p.m. On Sunday, August 11, during the same period of time the number nearly reached a thousand. At 11 p.m. a magnificent fireball burst over the southern part of the sky, lighting up the heavens with a full moon radiance and leaving a brilliant streak of light which persisted for some little time." A correspondent of the *Nottingham Daily Guardian* says :—"On August 10 we had a splendid display of the meteors. The night proved to be the brightest and clearest I ever remember to have seen, and at about 10 o'clock meteors in great numbers were to be seen flitting across the heavens from north-east to south-west. On Sunday night, August 11, the display was repeated with even greater brilliance and frequency and with more variation, the sky being again very clear."

These descriptions may possibly convey a somewhat exaggerated idea of the character of the shower this year, but they sufficiently prove that the event was a conspicuous one and well worth the attention given to it.

As observed at Bristol the radiant point was pretty definite, for an area of about 3 degrees would include very nearly all the tracks directed from it on August 10 and 11. With reference to the minor showers, there were a considerable number visible, though they were very feeble. A few degrees south of the head of Draco and at the point 269° + 47°, there was a radiant of bright-trained, slow-moving meteors, while east of ζ Persei at 63°+30° there was a radiant of very swift streak-leaving meteors. There were other well defined showers from 290°+53°, 312°+13° and 333°+72°. W. F. DENNING.

Mr. W. E. Rolston sends the following account of observations made by him :—

"I commenced my observations at Birmingham at 10.45 p.m. on the night of August 11 and continued them till 12.48 a.m. on the morning of August 12, when a bank of clouds rising from the N.E. stopped further observations. For this period, of 2 hours 3 minutes, I counted 143 meteors, which appeared to have their origin in the region of Perseus, and 17 others having various origins. During this time a very clear sky obtained, rendering short and faint trails easily visible. All the observations were visual, and, as I happened to have exhausted my stock of plates, I was unable to attempt the securing of "trail" photographs. Several of the Perseids were remarkable either for their brightness, or else for the length of time their trails were visible after the nucleus had either disappeared below my horizon—of surrounding houses—or had died away. Observations on these, including the times of their appearance, are given in the appended table.

"From the 143 observations made, I deduced that the radiant point of these meteors is situated about the point whose co-ordinates are :—Decl. 58° N., R.A. 2h. 35m.

G.M.T. of appearance.		Remarks.
h.	m.	
11	7	Remarkable for a very bright nucleus, and a vivid trail which remained visible *for* 53–55 *seconds;* first appeared in the region of κ Andromedæ (alt. about 60°), and travelled between Aquila and Delphinus to about alt. 25°, when it disappeared behind a housetop. The trail had a bluish-white and shimmering appearance.
11	14	Appeared in region of δ Cassiopiæ ; was very bright, and trail lasted for 7 seconds.
11	35	Appeared in region of δ Cygni and travelled through Lyra, leaving a bright trail which lasted for 9 seconds.
11	53	Appeared in region of α Persei and travelled towards Aries ; was very short, but very bright ; evidently the greater component of its motion was in the line of sight.
11	55	Appeared in region of 33 Cygni and travelled S.W. through Lyra ; very bright, and left a bright trail which lasted about 8 seconds.
12	5	Very bright and short ; left bright trail which was, as nearly as I could judge, exactly parallel to a line joining β and γ Arietis, and near to them.
12	10	Very bright, leaving a good trail from Cassiopeia, half way between β Pegasi and ε Cygni.
12	15	A very bright meteor which "occulted" α Andromedæ and then travelled in the direction of the group 59, 57 and 55 Pegasi.

"In addition to the above, I remarked one of the extra 17—not a Perseid—which at 11.27 appeared at about the middle of The Great Square and travelled right through the zenith, disappearing near Corona and leaving behind it a remarkable red shimmering trail which lasted for 4 or 5 seconds.

"The above times given for the duration of trails were obtained by counting seconds from judgment, not by a watch. The observations were made whilst lying on my back, so that nearly the whole of the sky above the available horizon was observed."

SAND WAVES IN TIDAL CURRENTS.[1]

THE sand waves dealt with in this paper are not the well-known "current mark," or ripple mark of rivers, but the larger sort, first scientifically described by Prof. Osborne Reynolds. These larger sand waves are the normal production of a swift current when adequately supplied with sand. The supposed condition of "uniform drift" (the current picking up as much sand as it drops, and therefore neither silting nor scouring) is really so unstable that, when the current becomes sufficiently swift to hold sand in eddying suspension, it passes almost suddenly into wave motion, uniform drift being replaced by alternate silt and scour, giving ridges and furrows of sand which travel down stream. The material of the ridges is constantly being picked up by the current from the weather slopes, and deposited upon the lee slopes. Some explanation of the process was given in NATURE (vol. lxiii. p. 623, April 25) in the abstract of another paper by the author;[2] this is further elaborated in the paper now before us, which contains also details of the observations and measurements carried out during the year 1900, which have not hitherto been published.

The amplitude of the tidal sand waves is obviously limited by the depth of water, and it follows that as the tide ebbs off sand-banks, it tends to obliterate the ridges, leaving the banks with the smoothed surface which is familiar. Sometimes pools are left below the general level of the smoothed surface (Fig. 1). These have a steep and a gentle side, the former the lee slope of one ridge, the latter the weather slope of the next ridge. They are, in fact, homologous with the pits, called Fuljes, in sandy deserts.

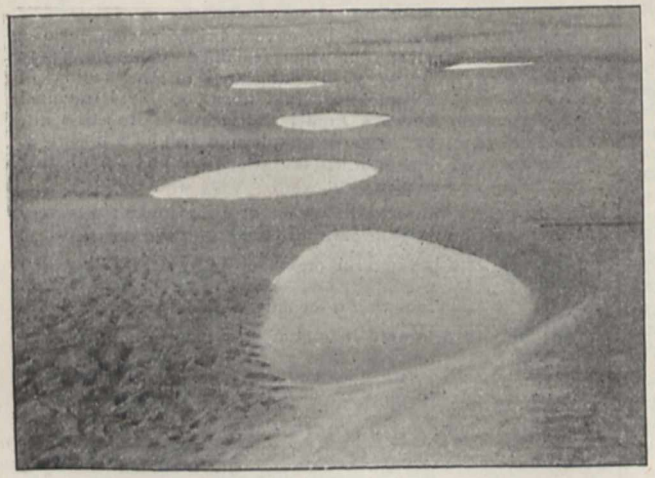

FIG. 1.—A chain of pools, Annat Sand, Montrose.

Where the conditions are such that the tide covers and leaves the banks gently, though running strongly when the water is deep upon them, the banks dry out with their wave surface almost perfectly preserved. The required conditions were found by the author in the tidal basins with narrow entrances at Barmouth and Aberdovey, North Wales, at Findhorn and Montrose, N.B., and at the Dun Sands, on the Severn (Fig. 2), which are protected from the tide until well submerged by a rocky shoal, which juts out from the left bank of the river.

The observed wave-length or distance from ridge to ridge varied from 3 feet 6 inches to 54 feet. The smallest of these measurements was unusual. From 12 to 24 feet wave-lengths were common. The steepest ridges had a wave-length 13·39 times as great as their height. In the model estuaries of Prof. Osborne Reynolds the wave-length was twelve times the amplitude.

FIG. 2.—Interpenetrating ridges on the Dun Sands.

Fig. 3 shows the orderly march of the ridges upon a portion of a sand-bank in the estuary of the Dovey, which the author pegged out for purposes of measurement with stakes driven into the sand to a depth of about 3 feet. There were five transverse rows of stakes 15 feet from row to row, and in each transverse row the distance from stake to stake was 20 feet. This permitted the exact measurement of the position of five wave-fronts along four sections. String stretched from stake to stake at the two sides of the plot served as datum lines and enabled amplitude and mean-sand-level to be taken with tolerable accuracy along two sections. Measurements were made once a day when the sands were dry. From June 2 to 5, 1900, the tides were diminishing after springs, and the average amplitude of the ridges diminished from 6″·34 to 3″·71 with no perceptible change of mean sand-level. The average wave-length in the same time only diminished from 14′ 3″·7 to 13′ 6″·6, and the regularity of the wave-lengths improved, thus :—

				Per cent. of mean L.
On June	1,	av. diff.	of successive Ls.	= 13·4
,,	2	,,	,,	= 11·4
,,	3	,,	,,	= 10·7
,,	4	,,	,,	= 4·4
,,	5	,,	,,	= 6·6

On June 5 the tidal current appeared to have fallen below some critical velocity, and suddenly to have lost control of the wave system. This is shown by the following table of the average advance of the ridges, which was :—

From June 1	to June 2	...	38″·07
,, ,, 2	,, ,, 3	...	29″·75
,, ,, 3	,, ,, 4	...	30″·57
,, ,, 4	,, ,, 5	...	1″·4

During neap tides the sands of the plot were almost smooth, and such undulations as could be seen on the surface were irregular and ill-defined. During the subsequent increase of tides, however, the plot emerged one day all covered with sharply defined ridges, which grew daily in height, and also (by elimination of some of the ridges) in length. On June 15 the average amplitude was 9″·71, with an average wave-length of 11′ 9″. The increase of wave-length appears to take place by the obliteration of certain ridges which find themselves unfavourably placed owing to the too great growth of the ridge on

[1] Abstract of a paper by Dr. Vaughan Cornish, read before the Royal Geographical Society, June 10, and published in the *Geographical Journal*, August 1901.

[2] "On the Formation of Wave-surfaces in Sand," *Scottish Geographical Magazine*, vol. xvii., January 1901.

the weather side. Thus the increase of amplitude is a steady process, whereas the increase of the wave-length (if determined by measurement along one or two sections of a few ridges) takes place *per saltum*, or, as Dalton might have said, in "multiple proportion."

It is pointed out that the tidal sand ridges, by their size, orientation, and lateral extension, afford an admirable means of mapping the tidal currents in those estuaries in which circumstances secure their preservation on the sand-banks visible above low-water mark.

Between the date of the writing and the publication of this paper the author observed in Canada the formation of long trains of waves of snow, by a process similar to that which creates these sand waves. They are distinct altogether from the ripples of drifted granular snow, which were also observed.

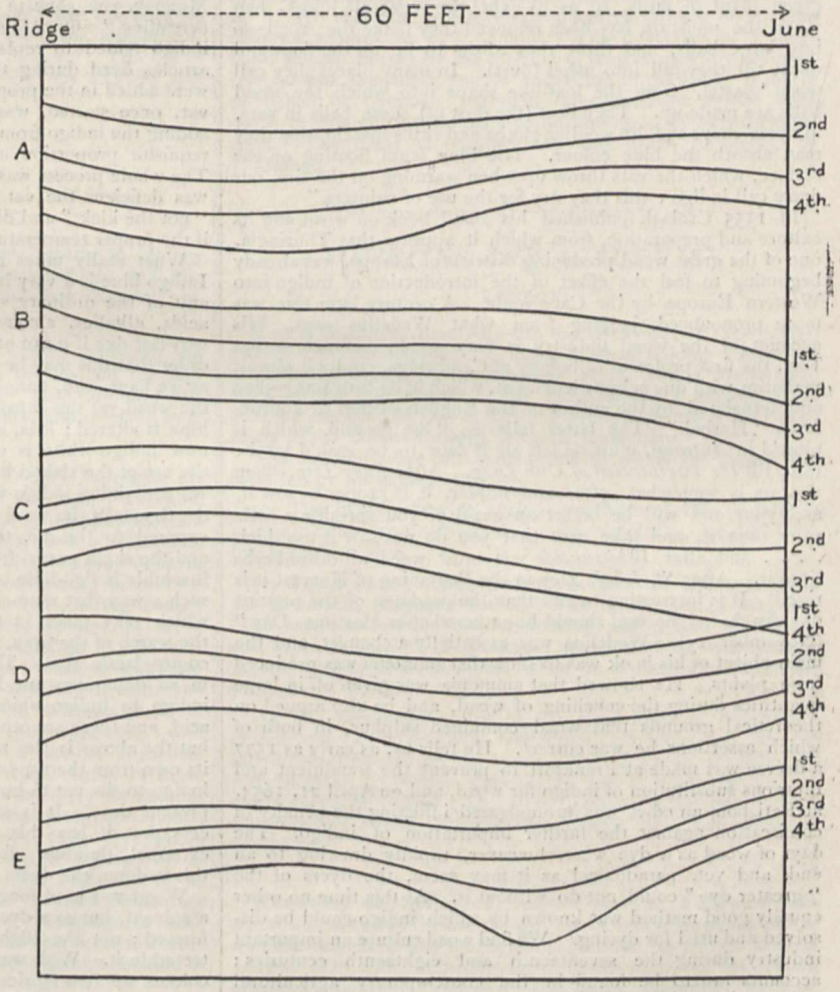

FIG. 3.—Plan of five sand ridges showing positions on four succeeding days, Dovey Estuary. Scale, 1 inch = 16 feet.

WOAD AS A BLUE DYE.[1]

MR. E. CORDER[2] has so thoroughly gone into the matter of East Anglian woad culture and preparation that the present remarks must be regarded as quite supplemental to his paper, having been, in fact, inspired by it. Frequent visits have been made to the Parson Drove Woad Mill, and a long series of experiments conducted before the blue colour, the indigo in fact, in this woad could be demonstrated. Curiously enough, the subject has engaged the attention of Prof. Beyerinck, of Delft, and by his help the presence of indigo was easily shown in the fresh plant from Parson Drove. The blue colour of woad is indigo—the same substance chemically as that obtained from *Indigofera tinctoria* and *Polygonum tinctoria*. There is this great difference however: in the last named plants it exists in a form which is easily extractable, whereas in woad it exists in a condition which is the very reverse.

In 1855, Dr. E. Schunck, in an exhaustive paper on the chemistry of woad, drew attention to the fact that indigo did not exist as ready formed indigo-white in this plant. He showed that the glucoside indican was the form from which indigo-white was produced by oxidation. In 1877, M. Alvarez attributed the formation of indigo to the action of bacteria, but in 1898 Bréaudat demonstrated that microbic life was not necessary.

Marchlewski and Radcliffe consider indican consists of sugar and a very unstable substance called indoxyl. Prof. M. W. Beyerinck holds the view that the indigo producing plants may be divided into two groups, in one of which this substance exists as indican (*Indigofera tinctoria* and *Polygonum tinctoria*), while in the other (of which woad, *Isatis tinctoria*, is the type) it exists as indoxyl. More recently, however, Beyerinck has come to the conclusion that even indoxyl does not exist ready formed in woad, but that it exists as a "loose compound" isatan, which by an enzyme isatase also present in woad is easily decomposed into indoxyl.

Be this as it may, it is not difficult to extract indigo blue from fresh woad leaves by the process given by Beyerinck. This consists in packing fresh woad leaves into a stoppered bottle and filling the bottle entirely with boiling water, inserting the stopper so that no air-bubble is left between it and the top of the water; after a few hours the infusion will be found of a pale yellow colour, having, when cold, a green fluorescence. If an alkali be added to this infusion and air blown through it, indigo blue is precipitated on the further addition of an acid. Woollen articles dipped into this alkalised infusion become, on exposure to the atmosphere, a pale azure blue. This change, however, takes place far more rapidly if they be dipped into acidulated water. The indigo thus obtained is, however, very apt to contain impurities; notably, to pass into a condition known as indigo-brown, in which an insoluble black-brown substance is formed which is useless to the dyer and cannot be reconverted into indigo blue. During the unsettled state of Europe towards the end of the eighteenth and beginning of the nineteenth century, numerous attempts were made to manufacture indigo directly from woad; prizes were offered by various Governments for the attainment of this object in order that the use of foreign indigo might be obviated, as it could only be obtained with difficulty. None of these processes were ever practically successful. Many of them were entirely theoretical. Some sought to obtain indigo by macerating fresh woad leaves in cold water, others in warm water, others by infusing them in boiling water and subsequently washing with cold.

To demonstrate the presence of indigo in the woad leaf, the process of Dr. Hans Molisch is the best. This consists in keeping the fresh leaves in a wide-mouth stoppered bottle, filled with gaseous ammonia for twenty-four hours, and then dissolving out the chlorophyll by immersing the leaves for a like period in absolute alcohol. Sections show that the indigo is confined to those tissues which contain chlorophyll, and that the hairs,

[1] Abridged from a paper by Dr. C. B. Plowright, in the *Transactions* f the Norfolk and Norwich Naturalists' Society, vol. vii. 1900-1901.

[2] Corder, E. *Trans.* Norfolk and Norwich Nat. Soc., 1890, vol. v. p. 144.

cuticular cells (excepting the guard cells of the stomata) and fibro-vascular bundles are free from it. When the chlorophyll has been thus extracted, the leaves have a blue colour of greater or less depth according to the amount of indigo they contain.

Although the extraction of indigo is so difficult and unsatisfactory a process, yet woad has been used as a blue dye from remote antiquity. Pliny refers to it as having been used to stain chalk blue for the adulteration of indigo, which was then a pigment of great rarity, as it had to be imported by the "overland route" from India.

The first printed reference to woad as a blue dye occurs in Ruellius ("De Natura Stirpium," 1536), who remarks in words of which the following is a translation:—"They crush the green plant in mills, so as to expel the vegetable juices, then when the moisture has been removed they make the woad up into large balls, and these they allow to lie on the floor and decay till they fall into ashes (dust). In many places they call woad 'pastel,' from the loaf-like shape into which the woad balls are made up. They heat (the dust of) these balls in vats, in dyers' shops and dip woollen cloths and skins therein, that they may absorb the blue colour. The blue scum floating on the surface, which the vats throw up when warming on the fire, our dyers call indigo; this they dry for the use of painters."

In 1555 Crolach published his small book on woad and its culture and preparation, from which it appears that Thuringia, one of the great woad producing districts of Europe, was already beginning to feel the effect of the introduction of indigo into Western Europe by the Cape route. A century later this was more pronounced, judging from what Wedelius says. His account of the woad industry is very good; so much so that Ray, the first professor of botany at Cambridge, copies it almost verbatim with due acknowledgment, which in its turn was copied and translated by the author of the English edition of Tournefort's "Herbal." The latter tells us, "the ground, which is plow'd in *Autumn*, must be left all *Winter* to be soak'd by the rain, till *the Purification of Our Lady*. After *Lady Day*, when the air is somewhat softer and milder, it is proper to sow it, and your end will be better answer'd if you sprinkle a little snow over it, and take care that you do not sow it too thick . . . . and after *Whitsuntide* you must weed all other herbs from it. After *St. John's Day* in the Beginning of Harvest it is ripe." It is interesting to add that the wadmen of the present day say that, "no wad should be gathered after Martimas Day" (November 15). Wedelius was essentially a chemist, and the main object of his book was to show that ammonia was produced from plants. He showed that ammonia was given off in large quantities during the couching of woad, and he also argued on theoretical grounds that woad contained sulphur, in both of which assertions he was correct. He tells us, as early as 1577 a decree was made at Frankfort to prevent the fraudulent and injurious substitution of indigo for woad, and on April 21, 1654, at Ratisbon, an edict was promulgated inflicting the penalty of confiscation against the further importation of indigo. The days of woad as a dye were, however, rapidly drawing to an end, and yet, paradoxical as it may seem, the dyers of the "greater dye" could not do without it. At this time no other equally good method was known by which indigo could be dissolved and used for dyeing. We find woad culture an important industry during the seventeenth and eighteenth centuries; accounts are to be found in the contemporary agricultural writers—Ellis, Trowell, Miller and Young. It was mostly carried on by itinerant "wadmen," who, with their families, travelled from place to place, growing the woad on newly broken up pasture land for which very high rents were paid. These gangs built their huts and wad mills with the sods from off the land, and were brought up to the industry from their childhood. They seldom stayed more than two or three seasons in the same spot, moving to a fresh location as soon as the soil became exhausted. Abroad Schreber's monograph, published in 1752, gives a very complete account, not only of the culture, but of the history of the subject, as well as copious extracts from the more important writers on the subject, with copies of the various proclamations, edicts, &c. In the appendix to this volume a German translation is given from Hellot's chapter on dyeing wool with indigo and woad. This book (Hellot's) was subsequently translated into English, anonymously. Under the "greater dye" or dyeing "colours in grain," it gives the *modus operandi* of working a woad or pastel vat, which was the best then known way of dyeing with indigo. The directions are sufficiently quaint; for instance, the writer begins by saying, "Your copper cauldron should be placed as near as possible to the vat and then filled with pond water: if the water be not sufficiently putrid you put in a handful of hay. When the copper is full the fire should be lighted under it at three o'clock in the morning." Then again, for every ball of pastel you throw in a full measure of *ware* (slaked lime), and sundry mysterious stirrings and coverings are enjoined, until the vat has "come to." When the indigo is put into it, there follow more stirrings and additions of ware, until the vat is ready for the "overture," or first piece of stuff to be dyed. "Towards the latter end of the week you dye the light blues, and on Saturday night, in order to preserve it 'till Monday, you *garnish* with a little more ware than on the day preceding." On Monday morning the vat was reheated, fresh indigo added to replace that which had been taken out by articles dyed during the preceding week, while bran and lime were added in the proper proportions. In point of fact a woad vat, once started, was kept going for many weeks or months, adding the indigo from time to time as required, as well as the requisite proportion of bran (sharps) and slaked lime (ware). The whole process was an exceedingly delicate one; if the lime was deficient the vat became putrid, if used too freely the vat "got the kick" and did not work at all; this was also the case if the proper temperature was not maintained.

What really takes place in a woad vat is concisely this:—Indigo blue is a very insoluble substance; it will not dissolve in any of the ordinary solvents, such as hot or cold water, dilute acids, alkalies, alcohol, ether, chloroform, &c. Hence it is a very fast dye if it can only be made to attach itself to a fabric. In order that this may be done, it is necessary to dissolve it; but, as we have seen, none of the ordinary solvents will do this. In the woad vat the chemical composition of the insoluble indigo-blue is altered; it is, as chemists say, reduced to indigo-white; now indigo-white is soluble in weak alkaline solution, hence the use of the slaked lime. If a skein of wool be dipped into a vat containing indigo-white in this state, the solution soaks into the tissues of the wool fibres; when the wool is taken out and exposed to the air, the oxygen unites with the reduced indigo and the skein passes from a greenish-yellow to a deep blue, the insoluble indigo-blue being thus formed and the fabric dyed in such a way that no mordant is required. The chemical changes which take place in the woad vat when once started are, that the starch of the bran is converted into grape sugar, which becomes lactic acid. The lactic acid becomes butyric acid, and in so doing nascent hydrogen is liberated, which reduces the indigo to indigo-white. Indigo is soluble in strong sulphuric acid, and there are other processes by which it can be reduced; but the above is the rationale of the woad vat, which has held its own from the time when the mediæval dyers added a little indigo to the vat to improve the colour of the blue down to this present time. It is an expensive, awkward and difficult process, but it has this one advantage—the colour produced is extremely durable. In actual practice a little madder is added; this is done, the dyers say, "to kill the green" in the indigo.

Woad was used long before indigo came into Europe, not as a solvent, but as a dye *per se*. Woad contains no indigo ready formed; not the slightest trace of any blue colour can be detected in it. With water it forms a dark brown mixture, which colours woollen fabrics olive-green. In order to dye with woad, all that is necessary is to pour boiling water on the woad and keep it in a well-covered vessel for fifteen or twenty hours at a temperature of about 110° to 140° F., not going above 150° or letting it fall below 100°. In about thirteen to fourteen hours bubbles of gas begin to rise; a very small quantity of slaked lime should now be added, and in a few hours woollen articles allowed to remain in it for an hour or two change from yellow to blue as they are taken out and exposed to the air. When the vat is in full working order the liquid is of an olive-brown colour, on the surface of which darker veins appear which change their position, slowly moving, appearing and disappearing spontaneously. The froth which at this time gathers on the surface of the vat is blue from the indigo precipitated by contact with the atmosphere. This constitutes the *caeruleum spumam* Ruellius speaks of as being dried and sold to the painters. It was also the "flowers of the woad" which the dyers of Coventry were accused of skimming off the woad vats in which they dyed their customers' goods and added to those vats in which they

dyed their own. It is interesting to notice that, if a skein of wool be suspended in a small experimental vat in good working order, it is the upper part of the skein nearest the surface which takes the deepest colour, and next to it, as one would have imagined, the lower part nearest the sediment at the bottom. This blue scum was the probable source, not only of the woad blue which Pliny speaks of as being used in his time to stain chalk with for the adulteration of indigo, but also of the "ancient Briton" pigment, of which we hear so much and know so little. Cæsar and Pomponious Mela speak of our ancestors staining their bodies blue; it is difficult to understand how they could dye their skin blue, but it is easy to see how they could have smeared themselves with woad-blue mixed with oil or grease. Herodian, however, throws a little more light on the subject when he tells us that "they mark their bodies with various figures of all kinds of animals, which is the reason they wear no clothes, for fear of hiding these figures." The use of indigo for tattooing is still common among our soldiers and sailors.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR. J. T. JENKINS has been appointed lecturer in biology and geology at the Hartley College, Southampton, and Mr. J. D. Coates assistant lecturer in physics and electrical engineering.

MISS ELEANOR ORMEROD, the well-known authority on agricultural entomology, lately deceased, bequeathed the sum of 5000*l.* to the University of Edinburgh. Miss Ormerod was an examiner in entomology for the University, and received from them last year the degree of LL.D.

THE councils of English Counties and County Boroughs expend upon scholarships a large amount of the money available for technical education. A report upon the scholarship schemes adopted by local authorities appears in the *Record* of Technical and Secondary Education, and it shows what is being done to provide continuous and systematic courses of training for promising students. It appears from this report that, taking County and County Borough Councils together, there are now 93 out of 110 such local authorities who provide scholarships in one form or another. The total number and value of the scholarships and exhibitions in force (*i.e.* those awarded and those continued and renewed from previous years) under the schemes of 90 of those 93 authorities during the year 1899–1900 were 19,971 and 156,793*l.* respectively. The scholarships are tenable at institutions of various ranks, and the number and value of those awarded annually in each class are as follows:—(1) At evening classes, 6766 (7862*l.*); (2) at technical and science and art schools, 3426 (17,064*l.*); (3) at secondary schools, 5593 (77,349*l.*); (4) at higher institutions and Universities, 679 (27,097*l.*); (5) at agricultural and horticultural schools, &c., 532 (9866*l.*); (6) at domestic science schools, &c., 1349 (12,199*l.*); (7) for elementary teachers, 1626 (5356*l.*). A comparison of these figures with similar returns obtained five years ago shows that a considerable increase has taken place in the number of scholarships tenable at permanent technical schools.

SCIENTIFIC SERIAL.

American Journal of Science, August.—Experiments on high electrical resistances, by O. N. Rood. The units of resistance employed were prepared by painting peroxide of manganese on strips of blue cobalt glass, then drying and immersing in a rosin wax bath at 150° C. It was found that the surface conduction of units prepared in this way in ordinary weather was practically zero. The aluminium leaf electrometer used in the measurements is also described. It was found possible to build up a set of high resistances with values from 32,000 to 14,000,000 megohms.—Mineralogical notes, by A. J. Moses. A description of mercuric iodide from New South Wales, some new forms on Bergen Hill pectolite and on atacamite crystals from Chili, realgar crystals from Snohomish County, Washington, vesuvianite from New Mexico, chrysoberyl from New York City, and a pyroxene crystal from the copper mines of Ducktown, Tenn.—On the motion of compressible fluids, by J. W. Davis.—The action of sodium thiosulphate on solutions of metallic salts at high temperatures and pressures, by J. T. Norton, jun. Solutions of various salts which are incompletely precipitated by sodium thiosulphate at the ordinary temperature were heated under pressure in sealed tubes at 120°–140° C. In many cases the reaction became complete, the whole of the metal being precipitated as sulphide or hydroxide. In a few cases the reaction was indeterminate.—Secondary undulations shown by recording tide gauges, by A. W. Duff.—Mathematical notes to rival theories of cosmogony, by O. Fisher.—Studies of Eocene Mammalia in the Marsh collection, Peabody Museum, by J. K. Wortman.—The electromagnetic effects of moving charged spheres, by E. P. Adams. The deflection of a magnetic needle caused by the rotation of two electrically charged spheres was measured, and in opposition to the views recently published by Cremieu, the deflections observed agreed with those calculated theoretically within the limits of experimental error.—The nadir of temperature and allied problems, by J. Dewar.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 20.—On the Behaviour of Oxy-hæmoglobin, Carbonic-oxide-hæmoglobin, Methæmoglobin and certain of their Derivatives, in the Magnetic Field, with a Preliminary Note on the Electrolysis of the Hæmoglobin Compounds, by Arthur Gamgee, M.D., F.R.S., Emeritus Professor of Physiology in the Owens College, Victoria University.

The following are the conclusions to which the author has been led by his experiments:—

(1) The blood-colouring matter, oxy-hæmoglobin, as well as carbonic-oxide hæmoglobin and methæmoglobin, are decidedly diamagnetic bodies.

(2) The iron-containing derivatives hæmatin and acethæmin are powerfully magnetic bodies. The differences in magnetic behaviour between the blood-colouring matter and acethæmin and hæmatin point to the profound transformation which occurs in the hæmoglobin molecule when it is decomposed in the presence of oxygen.

(3) The preliminary study of the electrolysis of oxy-hæmoglobin and CO-hæmoglobin renders it probable that, in the blood-colouring matter, the iron-containing group, on which its physiological properties depend, is (or is contained in) an electro-negative radical; according to analogy, the iron in such a compound would possess diamagnetic and not magnetic properties.

PARIS.

Academy of Sciences, August 12.—M. Fouqué in the chair.—A criterion for the recognition of singular points of the uniform branch of any monogenous function, by M. G. Mittag-Leffler.—On the infinitely small deformation of an elastic ellipsoid submitted to known forces on its boundaries, by MM. Eugène and François Cosserat.—Verification of the relation which exists between the characteristic angle of deformation of metals and the coefficient of restitution of their elasticity, by M. G. Gravaris.—On the colour of the ions, by M. G. Vaillant. The theory of ions applied to the coloration of solutions leads to the following consequences: in completely dissociated solutions containing only one coloured ion, the coloration is independent of the nature of the other ion; if the ionisation is incomplete, the coloration should vary with the concentration and nature of the non-coloured ion; and, finally, the coloration of a solution of any concentration ought to be related to its degree of dissociation by a formula with two moduli, and two only. All these conclusions were confirmed experimentally by a study of solutions of the permanganates of potassium, barium and zinc.—On the value of the molecular heats at the boiling point, by M. de Forcrand.—The action of benzoyl chloride upon trioxymethylene in presence of zinc chloride, by M. Marcel-Descudé.—A method for the prevention of hail, by

M. G. M. Stanoïéwitch. The use of a small captive balloon fitted with a deep-toned electrically-driven bell or siren is suggested as a means of breaking up hail clouds.

NEW SOUTH WALES.

Royal Society, June 5.—Mr. G. H. Knibbs in the chair.—On a new rock allied to nepheline phonolite, from Kosciusko, New South Wales, by F. B. Guthrie, Prof. David, F.R.S., and W. G. Woolnough. The Kosciusko rock is characterised by its large proportion of nepheline which dominates all the other minerals. The nepheline occurs in micro-porphyritic idiomorphic crystals. The soda-augite ægirine is also abundant, and there is a small amount of glassy material in the base through which are scattered delicate acicular crystals and microlites of felspar. A few small amygdules may be noticed, not sharply marked off from the surrounding rock; they consist of a shell formed chiefly of analcime enclosing secondary calcite. The specific gravity of the rock varies from 2·43–2·5. The rock differs conspicuously from typical phonolites in the following respects:—(1) low silica percentage; (2) entire absence of phenocrysts of sanidine. It is a felspathoid rock, and although its silica percentage allies it with the basalts, its mineral constitution, chemical composition and low specific gravity link it with the phonolites. So far as the authors are aware, it is unlike any rock that has hitherto been described from any part of the world.—Preliminary notes on the intermediary host of *Filaria immitis*, Leidy, by Mr. Thos. L. Bancroft. *Filaria immitis*, a worm-parasite of the dog, common throughout the world, but more especially in the warmer parts, of from five to ten inches in length, the males being the smaller, is found generally in the right ventricle of the heart and in the pulmonary artery. The so-called embryos, 1/90 in. × 1/3500 in., are produced in great numbers; the late Dr. Spencer Cobbold taught that an intermediary host was necessary to transmit the parasite from one dog to another. Among others, Grassi, Sonsino and J. Bancroft endeavoured to discover this intermediary host. The dog-flea (*Pulex serraticeps*), the various dog lice, and ticks were examined, but with negative results. The author for thirteen years past had endeavoured to find the intermediary host, examining *Pulex serraticeps;* the common horse-fly, *Stomoxys sp.?; Culex vigilax*, Skuse—a day-flying mosquito; the intestinal worm parasite of the dog—the *Anchylostoma* or *Dochmius trigonocephalus*. The possibility of metamorphosis being essential seemed doubtful, the embryo might, it was thought, go through a cold stage for several days in the body of an insect and then develop, after introduction into the body of the dog. A puppy, who ate 110 *Stomoxys* flies gorged with filariated blood, in one month showed after a series of experiments, extending over nearly a year, that such an hypothesis was untenable; and moreover, that the time taken by the young filaria to arrive at sexual maturity was not less than seven months nor more than twelve. After discussing Grassi's discovery of the intermediary host of *Filaria immitis*, viz. the *Anopheles maculipennis*, Meigen, syn. *A. claviger*, Fab., and the statements of a paper by Grassi and Noè on "the propagation of the filariæ of the blood exclusively by means of the puncture of peculiar mosquitoes," the author states we are now able to give an exact account of the life-history of both *Filaria nocturna* and *F. immitis*. The sexually mature worms in man or dog produce embryos, which swim in the blood: the mosquito on biting abstracts some of the embryos, these develop in the mosquito's body, and in about three weeks are capable of entering their final or definite hosts, passing into the puncture made by the mosquito in the skin; they then advance to sexual maturity in the course of about a year. The position in the mosquito's body during the metamorphosis of the embryos distinguishes *F. nocturna* from *F. immitis*, the former being in the thoracic muscles, the latter in the malpighian tubes, at their maximum development; the latter are distinguished as being shorter and thicker. It has been learnt that mosquitoes live for long periods, and not merely a few days as was formerly supposed, and that during their life they bite frequently. In Europe, *Anopheles maculipennis* plays the *rôle* of host for the malarial parasite, for *F. immitis* and it is believed also for *F. nocturna;* in Australia the house-mosquito, *Culex skusii*, Giles, is host for both *F. nocturna* and *F. immitis*, and probably also for the malarial parasite.

Linnean Society, June 26.—Mr. J. H. Maiden, president, in the chair.—On the occurrence of diatoms and radiolaria in the Rolling Downs Formation (Lower Cretaceous) of Queensland, by Prof. David, F.R.S., W. S. Dun and W. H. Rands.—Notes on an aboriginal grave in the Darling River District, N.S.W., by Graham Officer. Certain objects of aboriginal manufacture found over a large area of the western division of New South Wales have hitherto been somewhat of a puzzle to anthropologists, and precise information about them is very difficult to obtain. The objects in question are of two types, one of which has already received consideration from Mr. W. R. Harper in the Society's *Proceedings* for 1898 (p. 420). A second type is described in the present paper, some examples of which were found on an aboriginal grave arranged in a circle about three feet in diameter. The author concludes that the objects of both types had a phallic significance; also that those of the first type were used to mark the graves of men, while those of the second type were placed on the graves of women, possibly also of youths who had not attained their tribal majority.—The "shot-hole" fungi of stone-fruit trees in Australia, by D. McAlpine. The shot-hole effects produced in stone-fruit trees are shown to be due to an effort on the part of the tree to get rid of a parasite or other irritating agent, and the formation of a callus bounding the spot is a special property of the living tissue. At least twenty fungi are known at present to be the cause of "shot-hole," and of these one-half are found in Australia.—Australian Psyllidæ, part ii., by W. W. Froggatt. Twenty-four species referable to three subfamilies are described as new.—On the "onvar" of Malekula, New Hebrides, by Walter R. Harper. The "onvar" or thumb-guard of the Malekulan archer was first mentioned by Captain Cook, and a decorated form of it—probably part of the insignia of a chief—was described by Forster. The more common form is a circular piece of hard though light wood about 3 cm. in thickness, 12 cm. outside diameter at the base, bevelled off to an outside diameter of 7 cm. at the top and pierced by a hole large enough to admit the hand of the wearer, the average diameter of the opening in five specimens being 6·5 cm.

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