THURSDAY, AUGUST 30, 1894.

A THEORY OF THE GLACIAL DEPOSITS.

Papers and Notes on the Glacial Geology of Great Britain and Ireland. By the late Henry Carvill Lewis, M.A., F.G.S. (London: Longmans, Green, and Co., 1894.)

THEY are wrong who think that little is left in England for a geologist to discover or do. Not only are there gaps to be filled up, and doubtful points to be made certain, but even whole fields remain where if labourers have been at work they have as yet reaped little fruit. Especially may an Alexander, sighing for a fresh world, be invited to turn his attention to what are called the glacial deposits. In area they extend over the greater part of the British Isles; in variety they far exceed the Archæans; in difference of opinion about them they would also exceed Archæans, if such an excess be possible. They have difficulties peculiarly their own. It is well said by the editor of this volume that in glacial geology not merely the interpretation of facts is debated, but there is dispute as to what the facts are themselves. Geologists of repute go to the same section, see the same phenomena, and describe them in contradictory terms. Mr. Clement Reid surveys the Cromer cliffs, and figures chalk masses ploughed up by glaciers. Mr. Mellard Reade examines the same cliffs, and sketches chalk masses dropped down by ice-floes. The questions connected with these deposits have been raised on the hills of Nicaragua and the banks of the Amazon. As their range of space, so their range of time: glacial phenomena have been described from the Permian epoch, and the Carboniferous. They seem to claim all time and all space as their province.

To conquer such a world is needed an Alexander in truth. Such an one some friends hoped they saw risen in the student whose remains are now given to the world. Those who knew Carvill Lewis, who knew his ability, energy, enthusiasm, perseverance, with his equipment of knowledge, travel, and means, when they saw him devote all these to his study of glacial deposits, thought that now at last order would emerge out of chaos; that what Sedgwick and Murchison did for the Grauwacke he might do for the Drift. His early death destroyed these hopes, quenching a kindled light. We have, however, in this volume a not unworthy memorial; no mean contribution to science. It is a record of the ideas he had formed or was forming, in some respects more valuable than a completed treatise would have been. For here we discover his plans, ideas, observations; his opinions, formed, corrected, abandoned; together with an immense mass of materials, collected out of previous writers, abstracted, arranged, and criticised. Dr. Crosskey has performed his most difficult task of editing with extreme tact and judgment. "I venture," he says in his introduction, "to set aside the injunction laid upon me to 'criticise' as well as to arrange and edit." A high proof this of fitness for such a task; it makes of correspondingly high value the two or three criticisms which he does pronounce. Sad that we should be presented with a volume doubly posthumous; that science must mourn the loss of editor as well as of author. But science should be grateful for what she has gained. The gain is great. Here we have presented a theory of the glacial deposits which, whether the truth or no, is certainly clear, consistent, rational, and moderate in its demands. Probably it will not ultimately be accepted as complete; assuredly it will not at once convince every sceptic, or even create an orthodox belief; but it may do much to destroy some current absurdities, it does bring out clearly some neglected truths, and it should form a very convenient working hypothesis to direct our reflection and research.

The volume consists of introductions by Dr. Crosskey and Mrs. Lewis, five entire papers, a mass of extracts from note-books, some memoranda and brief essays, with two appendices. One of these might, perhaps, be spared. We are keen to know what Carvill Lewis thought, but not so much what another thinks he would have thought on sections which he did not see. The other appendix, "Field Notes from Switzerland," though introduced with an apology, is inseparably connected with the rest of the notes, an essential part of the book. If dates could have been added to the extracts from note-books, it would have helped a reader to perceive which of the writer's varying views was his latest.

Prof. Lewis concerned himself little with the causes of the glacial epoch, though one or two shrewd remarks will be found. He devoted his research and thought to the interpretation of the effects which that epoch produced, of what occurred during the period, of what its phenomena represent. His fundamental idea pictures many separate glaciers originating from separate centres of high ground, spreading from these centres till they meet, then still retaining their separate individualities in the motions of the continuous ice-cap into which they have joined. His guiding principles are that such separate individualities can be traced by the peculiarities of the stones transported; still more, that the furthest advance of such glaciers must be marked by a moraine, or by some visible boundary of like nature. The tracing of these boundaries he made an especial work, and he believed himself to have followed them across England, through Yorkshire wolds and Welsh mountains, from the Humber to the Bristol Channel. As a consequence of prime importance, he lays down that such advancing glaciers would frequently dam the courses of rivers, and that the lakes formed by the ponded-up waters would produce deposits of their own. Such deposits he continually recognises and describes. Especially he maintains that the Scandinavian ice met the British, and damming the waters of the Humber and the Wash, created an enormous lake, which drowned all England east of the Pennines and north of the Thames. This vast sheet of fresh water he regards as the manufactory and manufacturer of all those deposits in East Anglia and the Midlands which are commonly called by us glacial. And whatever difficulties may lie in the way of this hypothesis, it is certainly remarkable that the highest level of such deposits at Flamborough Head (according to Lamplugh), on the Lincolnshire Wolds (according to Jukes-Browne), in East Anglia (according to Survey Memoirs), together with the lowest level of passes across the central watershed (as I infer from a map of

Stanford's), should all deviate little from the 400-feet contour line.

The volume is full of minute observations and acute remarks. Readers will find many cherished beliefs rudely handled; perhaps may feel some of them shaken. What a heresy is his denial of the three-fold division of the Drift. In disbelief of interglacial periods he has had predecessors. Herr Penck will find the assertion that frequent and finely striated stones in a clay are an argument against that clay being ground-moraine. Neither contortions nor groovings are here invariably ascribed to a glacier; on the contrary, he explains most such when they occur as products of his lakes or his moraines. He has seen no evidence (in Switzerland) for glacier excavation (of lakes). He expresses opinions freely and forcibly: it is refreshing to read that "much rubbish has been written on the Cromer cliffs." The doctrine of a post-pliocene great marine submergence he believes "the most pernicious one ever propounded in geology." Amusing is his description of the "remarkable properties of this sea, wholly unlike any known sea. It made till and eroded till: it filled some regions with drift, while others it cleared utterly of all drift; its icebergs made striæ, while its waters washed them away." It is true that like language might be applied to the effects of glaciers, as described by some of their admirers. Probably it did not occur to him that with regard to them any expression of opinion was needed.

The author's own views offer points for an opponent's attack. While he cannot induce himself to believe in a thousand feet of submergence, it seems to him simple for Scotch ice to have climbed a thousand feet up a Welsh hill, and easy for it to have pushed portions of the sea-bottom to the top. He repeatedly distinguishes between clay formed under a glacier (till) and clay formed in a glacier lake (boulder-clay). But when he sees only till at Filey, and only boulder-clay in East Anglia, it is not easy to make out which of their points of difference are the critical ones. He makes several references to striæ as indicating direction of ice-motion. Yet his ultimate conclusion appears to be that the shape of the striæ depends only on the slope of the rock, and, except on level ground, gives no guide to the direction of motion. He frequently insists on the effects of great floods and débâcles which would result from his glacier-dam lakes, but he does not indicate the way in which these catastrophes would be brought about. "I believe," he says, "that the Scandinavian ice-sheet would temporarily dam up the Humber and form a great inland lake, which would pour over the country to the south in débâcles, making gravels. . . . ." The water would rise steadily to a level of overflow, but how would a débâcle be thereby produced? Such floods seem no necessary part of his theory; however, his belief in them is firm.

To decipher field notes intended only for the writer's own eye, must have been a most difficult task. It has been performed with remarkable success: of course, mistakes have not entirely been avoided, but probably each will be obvious to and easily corrected by any reader who is concerned with the case. In the illustrations on pages 322–4, some clays are marked "Permian." There is no Permian clay in that neighbourhood; the word should evidently be Pennine, a designation for a division of the Midland boulder-clay.

Prof. Carvill Lewis began his studies in Pennsylvania, and there obtained his conceptions of moraines as "high-tide marks" for glaciers. He came to the British Isles for explanations of phenomena which perplexed him in America. In Ireland he sought and thought he found a solution of Transatlantic problems. He extended his researches over England and Scotland, and visited the Alps to see existing glaciers. The ideal order of study would be to begin by learning all about ice, and then applying the acquired knowledge to these questions. But practically all, even Carvill Lewis, begin upon deposits said to be glacial, though all do not go on to examine actual ice; and very few can study its grandest manifestations. It is much to be wished that such a geologist as he could spend some summers and winters round Greenland and Hudson's Bay. If to this he could add an acquaintance with Antarctic ice, he would have an equipment of appropriate knowledge such as no one has yet brought to bear on the question. Yet even so there is, perhaps, no spot on the earth where we can now see a glacier advancing across unglaciated lands: a cause whose effect is freely invoked by various writers on this question. However, we must use as best we can such means as we possess. Two characteristics of Carvill Lewis seem especially worthy of our imitation, viz., his untiring assiduity—we are told that he traversed the country between Cork and Mallow six separate times; and his readiness to acknowledge mistake and correct it—he completely retracts more than one opinion at first freely expressed. If any critic had condemned this as "a complete change of front," he would probably have answered, "I am ready to front any way where I see a road to truth."

An estimate of the advance which this book will have made towards a full and true theory is only possible to an infallible critic. His idea, that there ought to be a definite mark of the furthest extension of a glacier, seems to me a correct one: if so, such marks should be sought for. His clear conception of the power and action of floating ice deserves to be studied and developed. His distinctions between the products beneath an ice-sheet (till), adjacent to an ice-sheet (moraine), beyond the ice-sheet, but in waters washing it (boulder clay), are real distinctions of the highest importance. Surely there must be criteria of difference, whether the author has arrived at them or not. Surely when such criteria are ascertained, we shall be very near the solution of one side of the glacial problem. Still would remain for study another side: What brought that problem into existence; what was really the cause of the Ice Age?

E. HILL.

UNIVERSITY EXTENSION.

Aspects of Modern Study. Pp. 187. (London: Macmillan and Co., 1894.)

THIS volume consists of addresses delivered by Lord Playfair, Sir James Paget, Prof. Max Müller, the Duke of Argyll, and Canon Browne, among others, to students of the London Society for the Extension of University Teaching, at annual meetings held at the

Mansion House since 1886. In most of the addresses, special aspects of study are considered, but those by Lord Playfair and Canon Browne deal with the Extension movement itself.

Men of science, as a rule, look askance at University Extension lectures. They know that there is no royal road to scientific knowledge, and believe that popular lectures of a "peep-show" kind have no place in a properly organised educational system. This is true to some extent. Popular lectures of any sort, whether delivered at the Royal Institution or in a village club, are of little use to the practical student of science. They are useful, however, in bringing people into touch with current opinions, and in creating an interest in scientific things.

The subject of Lord Playfair's address is the evolution of University Extension as a part of popular education. After people have heard lectures, they desire to found institutions in which instruction is regularly given. Out of the single and unconnected penny readings in the early part of this century grew the Mechanics' Institutes that, in the Midlands and the North, have helped on the cause of education. It was, of course, inevitable that the committees of these institutes should sometimes have had queer ideas as to the kind of programme which should be offered to the community. Lord Playfair says that one of the most prosperous of them asked him to give a single lecture on chemistry in 1846, and sent him the programme for the preceding year as an inducement to accept the invitation. It was as follows:—"Wit and Humour, with Comic Songs—Women Treated in a Novel Manner—Legerdemain and Spirit-rapping—The Devil (with illustrations)—The Heavenly Bodies and the Stellar System—Palestine and the Holy Land—Speeches by Eminent Friends of Education, interspersed with Music, to be followed by a Ball. Price to the whole 2s. 6d. Refreshments in an Anteroom." Even now, programmes of this motley character can be found at many of the large workmen's clubs in the East End, and though most educationists consider them to be "awful examples," the fact that the science lectures are usually very largely attended testifies to a desire for knowledge, which often leads to systematic study. The University Extension scheme has certainly done something to mould this demand for popular instruction. When interest has been awakened by a pioneer lecture, it becomes a comparatively easy matter to run a successful course of six or twelve lectures. And if such courses are linked together in proper sequence, it cannot be denied that advantage must accrue from them. For, to use a simile of Lord Playfair's, not only does the lecturer scatter information broadcast among his audience, trusting that some of it will fall on fertile soil, but, in the class after each Extension lecture, he acts as a tutor and is able to treat the students individually, giving each mind the attention conducive to the production of good results. The great difficulty, however, is with regard to practical work. Every man of science feels that, so far as serious study is concerned, lectures should take a secondary place in a scheme of instruction. Observations in the field, laboratory, or observatory, are absolutely necessary for a proper appreciation of the facts and phenomena of nature; and, until some provision is made for this kind of work, the science lectures will be considered little more than a form of recreation.

Sir James Paget's address is concerned with the study of science. He points out that a scientific mind should be educated in four ways, viz. (1) in the power of observing, (2) in accuracy, (3) in the difficulty of ascertaining truth, (4) in proceeding from the knowledge of what is proved to the thinking of what is probable. The subject of Prof. Max Müller's address is "Some Lessons of Antiquity," and that of the Duke of Argyll, "The Application of the Historical Method to Economic Science." The addresses are interesting from many points of view, and they help to define the *rôle* of courses of University Extension lectures in our educational system.

R. A. GREGORY.

SOME RECENT WORKS ON ELECTRICITY.

(1) *Electric Traction on Railways and Tramways.* By Anthony Reckenzann, C.E. (London: Biggs and Co.)

(2) *Portative Electricity.* By J. T. Niblett. (London: Biggs and Co.)

(3) *First Principles of Electrical Engineering.* By C. H. W. Biggs. New edition, partly rewritten and extended. (London: Biggs and Co.)

(4) *Electrical Distribution, its Theory and Practice.* Part i., by Martin Hamilton Kilgour. Part ii., by H. Swan and C. H. W. Biggs. (London: Biggs and Co.)

(5) *Town Councillors' Handbook to Electric Lighting.* By N. Scott Russell, M.Inst.C.E. (London: Biggs and Co.)

(1) THE present state of electric traction is precisely given, and the various methods and constructive details at present in use described. The best modern examples of traction are explained, with many excellent illustrations. In particular may be mentioned the proposed St. Louis and Chicago high-speed electric railway, designed to convey passengers 250 miles in two and a half hours. Much useful information has been collected from the various electrical journals and *Transactions*, and a handbook formed, which is sure to be of great service to practical men. We notice that the words "energy," "power," and "work" are used in the popular rather than in the exact scientific sense; but this circumstance detracts little from the value of the work.

(2) This little work is described as being "A Treatise on the Application, Methods of Construction, and the Management of Portable Secondary Batteries." It has been written mainly for the benefit of those who find this form of stored energy of service for economic, artistic, or scientific purposes. Part i. deals with applications to mining operations, domestic use, medical and other scientific purposes, the Army and Navy, carriage lighting, and traction and decoration. In a popular form we are presented with much information that will be very useful to anyone contemplating some of these special uses of electricity. Many of these are recent and novel, and not to be found in any other work with which we are acquainted.

Part ii. is occupied with the description and management of primary and secondary batteries and their

adjuncts. It is an excellent small book, suitably illustrated.

(3) This is described as an "attempt to provide an elementary book for those who are intending to enter the profession of electrical engineering." In a very entertaining and humorous preface the author at once enlists the sympathy of the ordinary reader in general, and of the reviewer in particular. After its perusal the latter feels prepared to find much that is novel in treatment and revolutionary in substance in the work itself, but he finds that his anticipations are only realised to a moderate degree. The so-called "Inductive Circuit" is easily recognised as an old friend under a new name. The equation of the condenser, usually written

Quantity = Capacity × Potential-Difference,

is given by the author in the form

Accumulation × Resistance = Electrical Pressure,

wherein he regards inductive resistance as bearing the same relation to capacity that electrical resistance does to electrical conductivity. The only advantage we can see in this notion is that it brings out clearly the fact that condenser capacities combine according to the same law as electrical conductivities. Again, the author imagines the "sapient critic" to laugh at his views of "loops" and "unlooping" in connection with the lines of force of a magnetic field, and puts a question to him which he evidently regards as a poser of the first water. He says: "Your teaching involves cutting here, there, and everywhere—first in this direction, then in that; but though you tell us what happens when you cut 'lines of force,' you say nothing of what happens when your conductor leaves those lines of force. You bring your conductor to be acted upon by lines of force, but although you also take your conductor from those lines of force, you recognise no reverse action. All your cry is 'Cut,' 'cut,' 'cut,' &c., &c."

This is of course veritable moonshine. Every electrician is aware that every line of force forms a closed loop, and that "cutting" necessarily involves looping or unlooping, as the case may be, and *vice versa*, whenever the conductor forms a closed circuit.

The first principles of the dynamo are clearly and accurately given, though a worse illustration than that of a gramme ring on p. 152 is not often to be seen. However, it is good to see a clear distinction between "energy" and the "rate of its production," all the more noticeable by reason of its rarity in recent electrical books.

Notwithstanding its eccentricity, the book will be useful to a certain class of student.

(4) Mr. Kilgour considers scientifically the design of systems of distribution which shall give maximum economy with satisfactory working results. This subject was initiated by the valuable papers of Lord Kelvin and of Profs. Ayrton and Perry. In 1881 the former considered the problem of finding the cross-sectional area of copper required for a conductor to transmit a given current in order that the total annual expenditure for the energy wasted in the conductor, and for interest, depreciation, and repairs on the conductor should be a minimum. This problem is now historical. It was on this occasion, the meeting of the British Association in the year mentioned, that Lord Kelvin first brought before engineers the fact that the relation between the size of the conductor and the current strength should be governed by economical considerations. As stated by Mr. Kilgour, six quantities are involved in an important manner, viz.:—V, the pressure in volts at end of feeder near to generators; v, the pressure in volts at end of feeder remote from generators; C, the current strength in ampères flowing through the feeder; P, the watts delivered to feeder; p, the watts delivered by feeder; and x, the cross-sectional area in square inches of the copper of feeder. These six quantities are obviously connected by three relations; we may further assume two other relations between them, and then a sixth relation deduced from economical considerations suffices to determine the whole of the six quantities. The two assumed relations may take the form of two of the quantities being given. This is what usually happens, and is always the case in the author's discussion. Of the fifteen possible cases Lord Kelvin investigated, that in which v and C are given; Prof. Ayrton, that in which V and C, and also that in which V and x are given; while Prof. Ayrton and Perry, in conjunction, before the Society of Telegraph Engineers and Electricians in 1886, considered V and p to be given quantities. The remaining eleven cases are completely examined by Mr. Kilgour, and in doing so, as well as by giving a clear exposition of the whole subject, he has rendered valuable service. To all those who are concerned with the design of systems of distribution, this part of the work will be found to be of high interest and usefulness. In Part ii. will be found a collection of descriptions of the systems which practical men have gradually evolved by knowledge and experience. The best mains and culverts, and also the means of maintaining them in a state of efficiency, in use in England and on the continent, are described in detail with a large number of excellent illustrations. The compilers have shown good judgment in the selections they have made from the many systems that have been adopted.

(5) This work is intended to afford to County Councillors and others similarly placed some information likely to be of use to them in dealing with questions of central station lighting. It is a small and unpretending work of some forty pages, and seems to have accomplished the object in view.

OUR BOOK SHELF.

The First Technical College. By A. Humboldt Sexton. Pp. 188. 1894. (London: Chapman and Hall.)

WHEN John Anderson became Professor of Natural Philosophy in the University of Glasgow, in 1786, he began to give instruction in science to persons engaged in industries. This was the beginning of technical education, and the future of the new line of study was to some extent provided for in Glasgow by its founder bequeathing the whole of his property "to the public for the good of mankind and the improvement of science in an institution to be denominated Anderson's University." The total value of the property, however, was only about £1000, and this, as Prof. Sexton remarks, was a small sum wherewith to start a new university which was to revolutionise the education of the country. But the gift formed a nucleus which attracted other benefactions,

and, after a short time, sufficient funds were raised to appoint a Professor of Natural Philosophy and Chemistry. Dr. Thomas Garnett was nominated for this post in May, 1796. Three years later Count Rumford founded the Royal Institution, and Garnett accepted the first professorship in it. He was succeéded at the Anderson's Institution by Dr. George Birkbeck, who afterwards assisted in founding the well-known Birkbeck Institution in London. Dr. Ure next occupied the chair, and when he retired it was decided to appoint two professors—one of Natural Philosophy and one of Chemistry. Among the men who occupied the former chair at different times were Dr. William Heron, Dr. John Taylor, Prof. Carey Foster, and Prof. A. S. Herschel. The chair of chemistry was successively filled by Thomas Graham, Dr. William Gregory, Dr. Penny, Dr. T. E. Thorpe, and Prof. Dittmar. About 1830 Graham established a public laboratory for experimental work in chemistry, the first of its kind in Great Britain, and among the students who worked in it were Dr. James Young, Lord Playfair, and Dr. Walter Crum. Into the various changes which the institution has undergone we do not propose to enter. Suffice it to say that Anderson's College, the Mechanics' Institute, and the Allan Glen's School were united in 1882 to form the Glasgow and West of Scotland Technical College. The Mechanics' Institution, or College of Science and Arts, mentioned in this connection, was founded in 1823 as the result of the secession of some members of the Anderson's Institution. Lord Kelvin and his brother, the late Prof. James Thomson, studied for some time at the former institution.

The present Technical College, and the institutions from which it was formed, has had many distinguished men among its teachers and students. Prof. Sexton's history of the whole organisation is not merely of local interest, but appeals to all interested in the growth of technical education. The illustrations in his book are numerous, but mostly very bad, and the descriptive text might have been far more brightly written.

Practical Work in General Physics. By W. G. Woollcombe, M.A., B.Sc. Pp. 83. (Oxford: Clarendon Press, 1894.)

INSTRUCTION in practical physics is steadily, though very slowly, gaining ground in our schools and colleges. The tardy recognition of the great importance of this kind of work is doubtless due to the fact that practical physics does not bear directly on industrial and commercial pursuits. But, for training the mind, there is no better means than a course of physical laboratory practice. The hand is exercised in delicacy of manipulation; the eye is led to perceive instead of seeing things vacantly; and the mind is trained to make scientific deductions from observed facts. Whether a boy is designed to be a politician or a preacher, whether it is intended that he should follow the law or be sacrificed to science, in fact, no matter what the calling or profession in which he has to work his way through life, by far the best mode of obtaining the accuracy of observation and deduction desirable in everyone, is through instruction in practical physics. It is because we believe this, that we welcome any indication of the extension of such knowledge. Mr. Woollcombe is the author of a little book on practical work in heat, which we were able to commend when it appeared. The present volume deserves the same praise that we gave the previous one. It begins with descriptions of such instruments as the linear vernier, sliding callipers, micrometer screw gauge, and balance, and passes on to the measurement of length, area, and volume. The experiments performed under these heads lead naturally to the determination of the densities of solids, liquids, and gases, and then to Boyle's Law, the barometer, and capillarity. This order is practically the same as that followed in "A First Course of Physical Laboratory Practice," by Prof. A. M. Worthington, F.R.S., published eight years ago. Indeed, Mr. Woollcombe's book reminds us of Prof. Worthington's in more than one respect; but a similarity of gradation and general treatment almost inevitably exists between books covering the same ground.

The author is among those who take every opportunity of correcting the sense in which the word *weight* is generally understood. An aphorism of his worth quoting is: "We can no more lock up forces in a box than Pandora could imprison Hope in a casket, so that it is incorrect to talk of a *box of weights*—the correct term being a *box of masses*." We hope that a time will come when books similar to the one under notice will be required in all our public schools and colleges.

Manual of Practical Logarithms. By W. N. Wilson, M.A. (London: Rivington, Percival, and Co., 1894.)

THE great importance of a sound knowledge of the use of logarithms, and the frequency of their application in the majority of sciences, is sufficient to account for the appearance of such books as that under review, entirely devoted to their exposition. The subject is treated to a small extent in many of the larger text-books on algebra and trigonometry, but their insertion there is more to acquaint the student with the principles than to give him a good working knowledge, which can only be obtained by constant solving of problems.

In the book which we have under notice, the author assumes that the reader has had such a smattering of the subject as above suggested, since he purposely omits the propositions and formulæ found in most of the text-books, and devotes his whole attention to the treatment of various methods of solving problems with their aid. The examples dealt with, illustrate those branches of arithmetic, algebra, plane trigonometry, and mensuration, and those that are worked out are given in the forms that the student himself is advised to adopt.

The author deviates here from the usual method of writing the characteristic before the mantissa, by placing it afterwards. His reason for doing so is that he thus avoids the necessity of using the old and clumsy notation, as he calls it, for denoting the combination of a negative characteristic with a positive mantissa. The method here adopted has, no doubt, its advantages, and might facilitate matters for beginners, who nearly always find this a difficult point to surmount.

The reader is supplied with plenty of examples to practise his ingenuity upon, many of them being selected from various examination papers for the Army, Navy Oxford, and Cambridge, &c.

In the absence of any external assistance, close attention to the methods of solution employed in the book should give the reader a good insight not only in the right way of handling and becoming familiar with tables, but in the art of successfully attacking problems by their aid.

W. J. L.

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, rejectea manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Towards the Efficiency of Sails, Windmills, Screw-Propellers, in Water and Air, and Aeroplanes.

THE discussion of this day week, on flying machines, in the British Association was not, for want of time, carried so far as to prove from the numerical results of observation put before the meeting by Mr. Maxim, that the resistance of the air against

a thin stiff plane caused to move at sixty miles an hour through it, in a direction inclined to the plane at a slope of about one in eight, was found to be about fifty-three times as great as the estimate given by the old "theoretical" (!) formula, and something like five or ten times that calculated from a formula written on the black-board by Lord Rayleigh, as from a previous communication to the British Association at its Glasgow meeting in 1876.

I had always felt that there was no validity, even for rough or probable estimates, in any of the "theoretical" investigations hitherto published: but how wildly they all fall short of the truth I did not know until I have had opportunity in the last few days, *procul negotiis*, to examine some of the observational results which Maxim gave us in the introduction to his paper. On the other hand, I have never doubted but that the true theory was to be found in what I was taught conversationally by William Froude twenty years ago, and which, though I do not know of its having been anywhere published hitherto, is clearly and tersely expressed in the following sentence which I quote from a type-written copy, kindly given me by Mr. Maxim, of his paper of last week:—

"The advantages arising from driving the aeroplanes on to new air, the inertia of which has not been disturbed, is clearly shown in these experiments."

Founding on this principle, I have at last, I believe, succeeded in calculating, with some approach to accuracy, the force required to keep a long, narrow, rectangular plane moving through the air with a given constant velocity, V, in a direction perpendicular to its length, l, and inclined at any small angle, i, to its breadth, a. In a paper, which I hope to be able to communicate to the *Philosophical Magazine* in time for publication in its next October number, I intend to give the investigation, including consideration of "skin-resistance" and proof that it is of comparatively small importance when i is not much less than 1/10, or 1/20, of a radian, and the "plane" is of some practicably smooth, real, solid material. In the meantime, here is the result, with skin-resistance neglected:—The resultant force (perpendicular, therefore, to the plane) is $2\pi V^2 \sin\theta \cos\theta\, la$; which is $\frac{4\pi \cos\theta}{\sin\theta}$ times (or for the case of $\sin\theta = 8$, one hundred times), the old miscalled "theoretical" result. KELVIN.

Eastern Telegraph Company's Cable Steamer
Electra; crossing the mouth of the Adriatic,
August 17.

Geological Maps of Baden.

IT may interest some of your readers likely to visit the Black Forest, that Herr Winter, of Heidelberg, has begun the issue of an official series of geological maps, each $19\frac{1}{2} \times 17\frac{1}{2}$ inches, with memoir. Two are already out, one east of Heidelberg, the other giving the Mooswald district, north-east of Gengenbach. The scale is 1 : 25000; *i.e.* 10 cm. to $2\frac{1}{2}$ km., or practically two and a half inches to the mile. Three sections are given on the sheet; the memoir has about 100 pages. The price for the map and memoir is only two marks; if the map is mounted, three marks. I had intended to comment on the contrast between this marvellous cheapness and our own Survey issues, as our inch ordnance cannot approach this for detail; for instance, the contour lines are given for every ten metres. But a paragraph read to-day in the New York *Nation* of August 9, in a letter signed "W. M. D." will speak for me:—". . . unfortunately the publications of the British Surveys are rarely found complete at home outside of the Governmental bureaus in Washington. Very few copies of the British geological reports and maps are presented to libraries in foreign countries, and the prices at which they are sold practically forbids their purchase. The maps are, moreover, coloured by hand, so every copy is expensive; while ours are lithographed, and 'additional copies' are of only nominal cost, perhaps three or four cents apiece. . . . The British practice almost seals up the costly results of the geological surveys. . . . It was a satisfaction to learn that this opinion, formed at home, was shared and emphatically expressed over here" (at Edinburgh).

The Baden State geology maps are also, of course, lithographed, and so are the equally cheap Imperial maps of all Germany, another series, now being published by Justus Perthes, and of which also the first two are just issued and cover the same region, South-west Germany. That the policy pays seems certain. Three other purchases, for instance, were the immediate result of my own, whereas my friends have always been content to *borrow* my English maps, when I could see my way to lend them. J. EDMUND CLARK.

York, August 21.

Variation of "Aurelia."

I SEE that you note (p. 413) the occurrence of an *Aurelia* with pentamerous symmetry. In an expedition of the Liverpool Biological Society to Hilbre Island, a few weeks ago, we found several such specimens, and remarked upon the frequency of the variation. I think the number was either four or five pentamerous forms out of twelve examined.

Port Erin, August 25. W. A. HERDMAN.

CREATURES OF OTHER DAYS.[1]

"CREATURES of Other Days" is a work of literature rather than science, and is yet so full of reference to scientific facts and discoveries that it appears like a work of learning. It narrates the history of extinct animals laboriously discovered, and in many cases still undergoing laborious interpretation by palæontologists, in language which is free from technicality. There is no reference to the anatomical structure of the skeleton which necessitates technical language. There is no critical digest of the facts enumerated, or of the nomenclature under which the fossils are described. No attempt is made to state the osteological characters which distinguish these fossils from each other. Materials which any author has supplied are accepted impartially, and the same animal type is illustrated by dissimilar restorations. Thus Mr. Hulke made a quadrupedal restoration of *Hypsilophodon Foxi*, an animal which once was termed a young *Iguanodon*, out of which Mr. Smit has restored a vigorous-looking lizard. If these interpretations are correct, it is improbable that the vertical bipedal restoration of *Anchisaurus*, given by Prof. Marsh, and restored by Mr. Smit, can also be satisfactory. Many of the original restorations endeavour to convey an idea to the unlearned of the skin and aspect of the living animals. And as these are based upon published figures, or restorations, the author has no doubt gone to the best material which was available, even when the result is unsatisfactory. Sir William Flower, in his preface, fairly states the claim of the restorations to consideration. He says: "In the restoration of the external appearance of extinct animals, known only by bones and teeth, there is much of imagination, much indeed of mere guess-work, and I should therefore be sorry to guarantee the accuracy of any of the representations of animals in this book, the majority of which were never seen in the flesh by the eyes of mortal man. I think, however, I may safely say that Mr. Hutchinson and his accomplished artist, Mr. Smit, have done their work carefully and conscientiously, and given us, in most cases, a fair idea of the appearance of the creatures they have endeavoured to depict according to the best evidence at present available." Sir William commends the figures because they give a better idea of the animals than most persons who only saw their fossil remains would be able to carry away. This unscientific attitude of the book is its chief merit. It is only when the author becomes an expositor of science that scientific men are likely to disagree with him. More care was needed in some of the restorations. The old red sandstone fishes, for example, are drawn without any regard to their relative sizes, those of the upper and lower beds swimming together as though they were of the same geological age, while at the bottom of the water are Trilobites, Brachiopods, and Cephalopods, which no one ever saw in the old red sandstone.

[1] By Rev. H. N. Hutchinson, B.A., F.G.S., author of "Extinct Monsters." With numerous illustrations by J. Smit and others. (London: Chapman and Hall, Limited, 1894.)

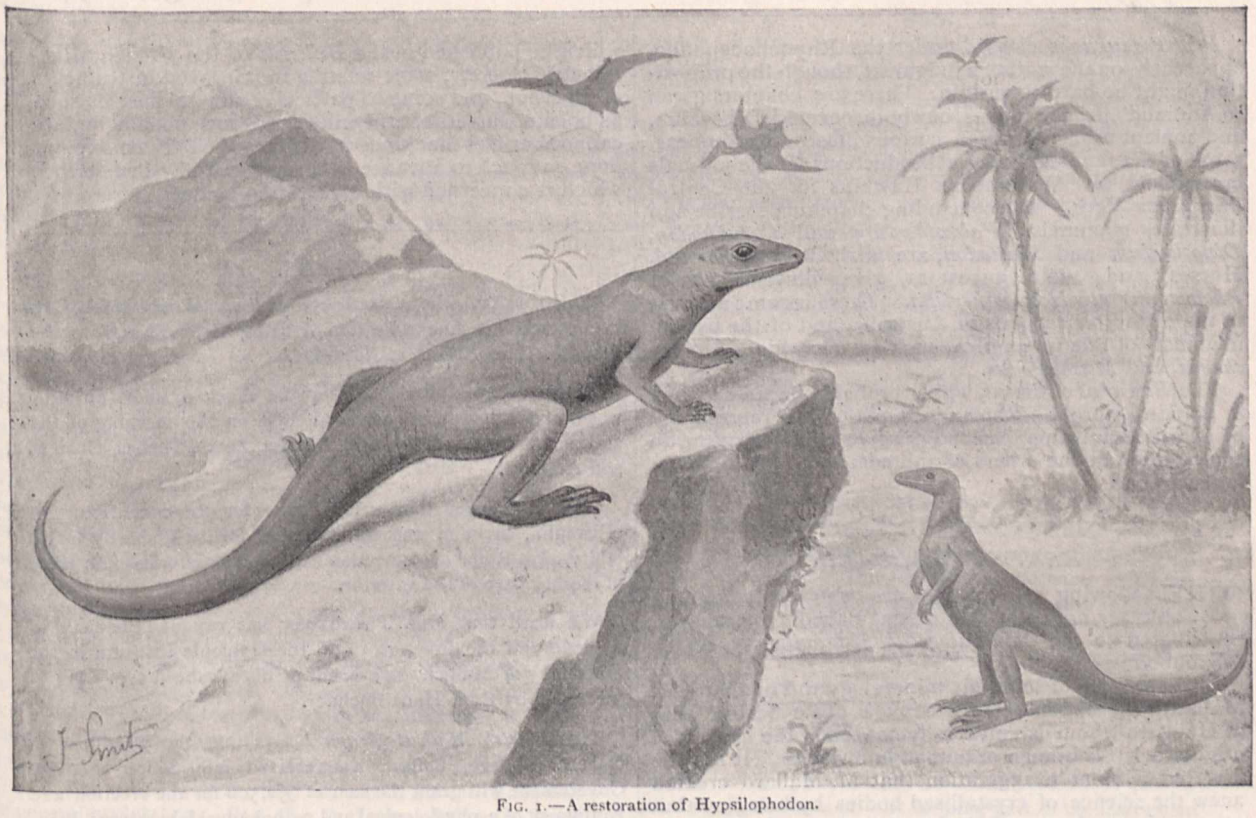
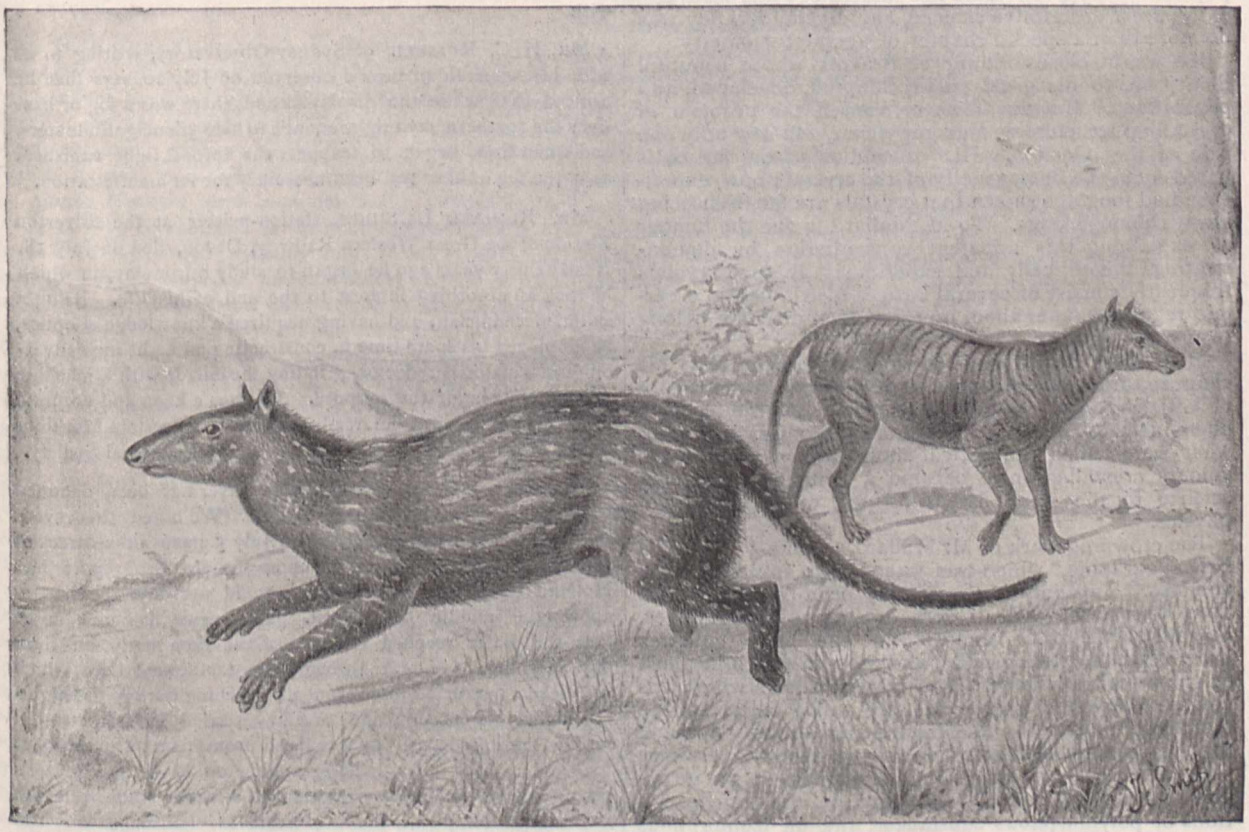


FIG. 1.—A restoration of Hypsilophodon.



(Phenacodus). (Hyracotherium).

FIG. 2.—Ancestors of the Horse. Eocene Period

Proterosaurus is classed under the Rhynchocephalia, apparently on the author's judgment, though the proposition might be hard to sustain. There are chapters given to Anomodonts, Crocodiles, newly-discovered Dinosaurs, and ancient birds; in which curious illustrations appear, some of the funniest being reproductions of the animals created by Mr. Waterhouse Hawkins for the Central Park, New York. The concluding chapters describe and illustrate mammals. *Palæotherium* and *Coryphodon*, *Dinotherium* and *Mastodon*, are fairly well illustrated. Horses and their ancestors give illustrations of *Phenacodus* and *Hyracotherium*. There is some account of the extinct marsupials of Australia, and of the extinct mammals of South America, such as *Toxodon*, *Macrauchenia*, and *Machærodus*.

The *Bos urus* of Cæsar, which probably became extinct in Britain before the Roman occupation, is represented by a spirited drawing. Appendices give a table of strata, an enumeration of the orders of animals, and a list of books for reference. H. G. S.

ERNEST MALLARD.

THE following paragraphs are extracted from an obituary notice of this distinguished mineralogist, contributed to the *Mineralogical Magazine* by M. G. Wyrouboff:—

In the history of scientific mineralogy the name of M. Mallard will undoubtedly occupy a place beside that of Haüy, to whom is universally conceded the honour of originating this branch of human knowledge. It may be asserted without exaggeration that M. Mallard created anew the science of crystallised bodies by bringing that science into close and intimate union with general physics. Only a few years ago mineralogy was regarded as a purely descriptive science, and crystallography was no more than a special chapter of abstract geometry.

He was a close follower of Bravais, whose beautiful theory he, to his great credit, adopted, developed, and popularised. Bravais, however, viewed the problem of crystalline structure as a geometrician, and saw only one side of the question. His conception of the lattice is based upon the homogeneity of the crystal; now, experience had long ago shown that crystals are far from being always homogeneous. To M. Mallard is due the honour of explaining this apparent contradiction by demonstrating, theoretically and experimentally, that crystals frequently consist of several lattices distributed in a certain regular manner about an axis which does not belong to any one of them.

M. Mallard did more than this, and hereon rests his claim to imperishable fame: he deduced from the theory of lattices and of reticular assemblages all the physical phenomena observed in crystallised bodies, including what were called the optical anomalies. Owing to his labours crystallography became a completely rational science to the same extent as any other branch of physics.

The crowning work of M. Mallard was his "Traité de Cristallographie," which was intended to comprise three volumes. Two only of these have been published; the third was to have dealt with crystalline assemblages, polymorphism and isomorphism, the most complex problems in crystallography, and those in which his most original work was done. The materials from which this volume was to be constructed are to be found in the memoirs published by M. Mallard since 1879. Some of these are real masterpieces, and have become classical; such are the papers on optical anomalies, on the quasi-cubic form of all crystallised bodies, on the transformations of polymorphous substances, and on isomorphous mixtures.

When we add to these the many detailed researches which he published in the *Bulletin* of the French Mineralogical Society, some relating to improved instruments of precision, and some to particular mineral species such as boleite, lussatite, tridymite, and melanophlogite, we cannot but feel that since the time of Haüy no one has done so much to advance that section of physical science which is concerned with crystallised bodies.

NOTES.

M. COTTEAU, whose death we announced last week, has bequeathed his fine collection of living Echinoderms to the Paris Muséum d'Histoire Naturelle.

REUTER reports that an earthquake shock of short duration was felt at Athens at a quarter to eight on the morning of the 26th inst., and also at Corinth, Vastizza, Zante, Thebes, Chalcis, and Atalanti.

IT is announced that a laboratory for the manufacture of tuberculin, mallein, anthrax, vaccine, &c., will shortly be established in Rome in connection with the laboratories of Hygiene of the Ministry of the Interior.

WE learn that Prof. Pettenkofer has resigned the chair of hygiene and the directorship of the Hygienic Institute in the University of Munich, on account of his advanced age. He is succeeded by Prof. Hans Buchner.

THE *British Medical Journal* says that the President of Queen's College, Belfast, has received information that the Government will grant the sum of £2,500 for the erection and equipment of a physiological and pathological laboratory. Plans are being prepared, and the buildings will be at once proceeded with.

MR. H. C. RUSSELL, of Sydney Observatory, writing to us with reference to an aurora observed on July 20, says that he noticed that while the display lasted there was a fog or haze over the southern sky bright enough to hide 5th magnitude stars, and when these began to reappear the auroral light vanished, as if the fog or haze had been necessary for its manifestation.

MR. RICHARD LANGDON, station-master at the Silverton Station of the Great Western Railway, Devon, died on July 18. Nearly thirty years ago he began to study astronomy, in which he took an absorbing interest to the end of his life. Being a skilful mechanician, and having acquired a knowledge of optics, he employed his spare time in constructing an eight-inch silver-on-glass equatorial reflector, grinding the mirror with a machine which he made for the purpose. He was a keen and accurate observer, and in 1872 he read a paper "On certain Markings on the Planet Venus" before the Royal Astronomical Society.

FOR just a year the Birahi Ganga River has been dammed back by the great landslip at Gohna. We noted this event shortly after its occurrence, and on July 5 gave an abstract of Mr. T. H. Holland's report upon it. In this report Mr. Holland estimated that the lake would overflow the barrier about the middle of August. The news has now come that the water reached the top of the dam early on Sunday morning, and cut through the temporary dam which had been constructed to prevent its escaping during the night. Combined percolation and overflow caused the water to fall rapidly, until its length was reduced from five miles to about two and a half miles. Telegraphing on Monday, Reuter's correspondent at Simla says that the water thus released has swept away all the Government buildings on the banks of the river. At Hardwar a torrent of water 6ft. in depth rushed through the town, but there was no

loss of life, owing to the precautions taken. All the buildings, however, between Gohna and Hurdwar have been destroyed. The lake formed by the landslip is now empty. Though considerable damage has been done to property by the escape of the water, no loss of human life is reported. The Indian Government is to be commended for the ample precautions taken to avert disaster at the time of overflow, and for the scientific manner in which the formation of the lake has been investigated.

THE journey to Greenland, modestly referred to by Prof. G. F. Wright in our correspondence columns on July 12, promises to lead to results of scientific value. We understand that the excursion was organised by Dr. Frederick A. Cook, anthropologist of Peary's first expedition, and consists of fifty persons, of whom a good part are students of science. Among the scientific members are Prof. W. H. Brewer, of Yale College, Prof. B. C. Jillson, of Pittsburg, Pa., who with Prof. G. F. Wright and his son, of Oberlin, Ohio, and a party of six, will disembark in Umenak Fiord about latitude 71°, to study the border of the ice-sheet, the neighbouring glacial deposits, the glaciers entering the fiord, the Tertiary deposits of the vicinity, and make a collection of the plants and animals. Prof. L. L. Dyche, at the head of the department of zoology and taxidermy at the State University of Kansas, is the official naturalist of the expedition. He will make a point of collecting birds and mammals. With him are Mr. S. P. Orth and Mr. B. F. Stanton (both of Oberlin), as assistant naturalists, to make general collections. Mr. E. A. McIlhenney, of Louisiana, accompanies the expedition as an ornithologist. Prof. C. E. Hite, of Philadelphia, with three assistants, goes to Labrador for general exploration. Prof. E. P. Lyon, of Chicago, goes for the general study of biology. The expedition expects to return about September 20.

PROF. H. B. DIXON'S report on the explosion that occurred at the Albion Colliery, near Pontypridd, South Wales, at the end of last June, has been published as a Parliamentary paper. Although it was not possible to examine all the workings, the evidence obtained justifies the opinion that the explosion throughout its main extent was purely a dust explosion. Prof. Dixon thinks it would have been practically impossible for fire-damp to have accumulated in the main intake air-roads, or to have been introduced suddenly into them in sufficient quantity to feed an explosion throughout the extent of road actually traversed by the flame. On the other hand, sufficient dust was found lying in a dry and fine state along the main roads to feed the flame throughout the parts penetrated by the explosion. As to the origin of the explosion, the belief is expressed that a dynamite shot raised a cloud of inflammable particles and set them on fire. If precautions were taken always to water the dust near the spot where a cartridge is going to be fired, such explosions as that at the Albion Colliery would be less frequent.

THE twenty-third meeting of the French Association for the Advancement of Science was held at Caen, from August 9 to 15, under the presidency of M. Mascart. In his opening address, the president paid homage to the many men of light and leading who were born and nurtured in the little province of Normandy, in which the meeting was held. Pierre Varignon, the celebrated geometer, was born at Caen in 1654. The two chemists, Rouelle and Vauquelin, and the intrepid traveller Dumont-Durville, were born in the same neighbourhood. Other names associated with the province are the great astronomer Laplace; Elie de Beaumont, one of the founders of French geology; Augustin Fresnel, whose work in physical optics has become classical; and that intellectual giant, Le Verrier. The second section of M. Mascart's address was devoted to brief descriptions of some of the institutions designed for scientific study in the United States. Praise was especially given to the generous donors whose lavish benefactions had helped on the cause of science in America. If M. Mascart had followed the traditions attached to a president's office, he would have given his audience his reflections upon the progress accomplished in the branch of knowledge to which he has paid most attention, that is, meteorology. This, however, he did not do, but passed in review some points in the history of electricity. The meeting was not favoured with fine weather, nevertheless the number of members was about the same as in previous years. The total receipts amounted to 91,182 francs, of which, however, only 55,551 francs came from annual subscriptions. The sum of 15,624 francs was disbursed in grants for scientific research. The Association will meet next year at Bordeaux, and in 1896 the place of meeting will be Tunis.

THE *London Gazette* for Friday last contains the following new denominations of standards for electrical measurement, adopted by the Privy Council on the previous day: (1) *Standard of Electrical Resistance.* The standard of electrical resistance, denominated one ohm, being the resistance between the copper terminals of the instrument marked "Board of Trade Ohm Standard Verified 1894" to the passage of an unvarying electrical current, when the coil of insulated wire forming part of the aforesaid instrument, and connected to the aforesaid terminals, is in all parts at a temperature of 15°·4 C. (2) *Standard of Electrical Current.* A standard of electrical current, denominated one ampere, being the current which is passing in and through the coils of wire forming part of the instrument marked "Board of Trade Ampere Standard Verified 1894," when, on reversing the current in the fixed coils, the change in the forces acting upon the suspended coil in its sighted position, is exactly balanced by the force exerted by gravity in Westminster upon the iridio-platinum weight, marked A, and forming part of the said instrument. (3) *Standard of Electrical Pressure.* A standard of electrical pressure, denominated one volt, being one-hundredth part of the pressure which, when applied between the terminals forming part of the instrument marked "Board of Trade Volt Standard Verified 1894," causes that rotation of the suspended portion of the instrument which is exactly measured by the coincidence of the sighting wire with the image of the fiducial mark A, before and after application of the pressure, and with that of the fiducial mark B during the application of the pressure, these images being produced by the suspended mirror, and observed by means of the eye-piece. In the use of the above standards the limits of accuracy attainable are as follows:—For the ohm, within one-hundredth part of one per cent.; for the ampere, within one-tenth part of one per cent.; for the volt, within one-tenth part of one per cent. The coils and instruments referred to are deposited at the Board of Trade Standardising Laboratory, 8 Richmond-terrace, Whitehall, London.

THE Department of Science and Art has issued the following list of candidates successful in this year's competition for the Whitworth Scholarships and Exhibitions. Scholarships of the value of £125 per annum (tenable for three years)—John Ball, 22, engineer, Derby; James H. Smith, 23, student, Manchester; Harry Verney, 24, fitter, Bristol; Charles F. Smith, 21, mechanical engineer, Bristol. Exhibitions of the value of £50 (tenable for one year)—Frank Fisher, 19, engineer, Brighton; William M. Thornton, 24, student, Liverpool; John W. Hinchley, 23, student, Lincoln; William D. Young, 23, engineer, Westfield (N.B.); Alexander L. Mellanby, 22, engineer, West Hartlepool; William T. F. Trunchion, 22, fitter, Bedford; Henry Deanesly, 25, draughtsman, Wincanton;

William T. Swinger, 19, engineer apprentice, Plumstead, Kent; Arthur W. Ashton, 21, fitter, Plumstead, Kent; Arthur E. Mascall, 18, engineer, Woolwich; William Rosbotham, 25, student Belfast; Joseph J. Kirwin, 20, engine fitter apprentice, Devonport; Charlie W. Cairns, 21, apprentice engineer, Newcastle-on-Tyne; John W. Button, 23, fitter, Oldham; Sydney Eraut, 22, mechanical engineer, London; Charles E. Pickles, 18, student, Bradford; Richard G. Allen, 21, fitter apprentice, Southsea; Alexander Craig, 22, engineer, Crewe; Thomas S. Usherwood, 20, engineer apprentice, London; Walter Eraut, 19, mechanical engineer apprentice, London; Lewis E. Limming, 21, shipwright apprentice, Southsea; Sidney E. Lamb, 20, fitter apprentice, Devonport; Francis J. Russell, 20, fitter apprentice, Portsmouth; Edgar R. Sutcliffe, 19, draughtsman, Leeds; George F. Hambly, 20, engineer apprentice, London; William Gore, 23, engineer, King's Lynn; Thomas S. Cockrill, 25, marine engineer, London; William H. James, 21, engineering student, Cardiff; Harry J. Peachey, 18, engineer apprentice, Stratford (London); James N. Boot, 25, engineer, London.

DURING a severe hailstorm at Vicksburg, in May last, a remarkably large hailstone was found to have a solid nucleus, consisting of a piece of alabaster from one-half to three-quarters of an inch. During the same storm at Bovina, eight miles east of Vicksburg, a gopher turtle, six by eight inches, and entirely encased in ice, fell with the hail. Commenting upon this, in the *Monthly Weather Review*, Prof. Cleveland Abbe says that apparently some special local whirls or gusts carried the enclosed objects from the earth's surface up to the cloud region, where they were encased by successive layers of snow and ice, until they fell as hailstones. He points out that the fact that hailstones, as well as drops of water and flakes of snow, often contain nuclei that must have been carried up from the earth's surface, is entirely in accord with the general principle that ascending currents precede the formation of cloud and rain, and that solid nuclei are needed to initiate the ordinary precipitation of moisture.

DR. HERGESELL has sent us the results of the meteorological observations made in Alsace and Lorraine during the year 1892, containing hourly values for Strassburg, and monthly and yearly summaries at various other stations. The results obtained from two anemometers at the central station are very interesting; one of the instruments is erected at about 170 feet, and the other at about 470 feet above the ground. The wind velocity at the higher level has a daily range corresponding exactly with that of mountain stations, the minimum occurring in the morning, and the maximum during the night. The results show that the indications of an anemometer fixed more than 150 feet above the ground are much more comparable than those at a lower level, where the indications are affected by local conditions. We look forward to the promised publication in the next volume of a chart showing the distribution of rainfall for a long series of years.

WE have received from M. E. Durand-Gréville two pamphlets entitled "Les grains et les orages," in which the author has endeavoured to show the connection between certain squalls, which accompany large barometric depressions, and thunderstorms. It is generally admitted that important thunderstorms occur at the same time on different points of an isochronous line moving towards east-north-east. Before the storm there is a gradual fall of the barometer, a rapid rise during the storm, and a sudden change in the direction of wind. But opinions differ considerably as to the conditions under which the thunderstorms occur. The author has investigated certain special cases, and has endeavoured, with some success, to co-ordinate the various views. He shows that several of them, while contradictory, at least in appearance, are capable of reconciliation, and are founded upon facts, which have been diversely interpreted. The papers are accompanied by several explanatory diagrams showing the line taken by the squalls, and the various forms of the isobaric curves which accompany them.

IN an interesting report issued by the United States Department of Agriculture, Mr. Alexander McAdie gives an account of the statistics concerning the position, &c., of buildings struck by lightning, and also of the best methods to be employed to protect buildings, &c., from being damaged by lightning. One interesting point which is very prominently brought out by the statistics is the decreased liability to accident from lightning strokes in thickly populated districts. In fact, it may be said that, in general, the risk in the country is five times as great as in a city. The report concludes with a number of rules which ought to be observed with reference to lightning, from which we may select the following:—If the conductor, at any part of its path, goes near water or gas mains, it is best to connect them to it. Independent grounds are better than connection to water or gas-pipes. Clusters of points or groups of two or three along the ridge of the roof are recommended. The top of the rod should be plated, or in some way protected from rust, and chain or linked conductors are of little or no use. Finally, if you should be in the vicinity of a person who has just been struck by lightning, no matter if the person struck appears to be dead, go to work at once and try to restore consciousness. There are many cases on record proving the wisdom of this course, and there is reason for believing that lightning often brings about suspended animation rather than somatic death. Try to stimulate the respiration and circulation, and do not cease in the effort to restore animation for less than an hour's time.

AT a recent meeting of the Vienna Academy of Science, Herr Bruno Piesch gave an account of his recent work on the change in the electrical resistance of aqueous solutions, and of the electric polarisation with change of pressure. The author has examined a large number of liquids, both acids and salt solutions. The apparatus was so arranged that the resistance and polarisation would be simultaneously measured. The high pressures used were obtained by means of a Cailletet's compression apparatus, and experiments were carried on up to a pressure of 600 atmospheres. The vessel in which the liquid to be experimented upon was placed was enclosed in the iron receptacle of the pump, being insulated by means of an ebonite plug. The following results have been obtained:—A change in pressure is always accompanied by a change in the electrical resistance, the resistance decreasing with increase of pressure. No definite connection is observable between the amount of the pressure change and the concentrate of the solution, but in the case of most of the substances investigated the change was greater in the case of very dilute solutions than in more concentrated ones. The magnitude of the change in resistance with change in pressure is very small, as is also the case with the change in the polarisation. In most cases an increase of the polarisation with increase of pressure was observed, but the irregularities were in this case greater than those observed in the resistance measurements. In conclusion the author examined a solution of ammonium nitrate in alcohol, when he obtained changes in the same sense as in the case of aqueous solutions.

AT the same meeting, Herr J. Liznar read a paper on the 26-day period of the earth's magnetism. In a previous communication the author had compared the diurnal variation a stations in middle and high latitudes. In the present paper the magnitude of the 26-day period variation for declination and inclination at the stations of Pulowsk and Jan Mayen are compared,

and it is shown that the amplitude of the variation at the northern station is four times as great as at the southern. The author also considers that the small variations which constitute the 26-day period variation are not due to a direct magnetic action of the sun, but that they must have their origin in some secondary action of the same.

IN cases where it is desired to investigate a ray of light reflected perpendicularly from a surface, it is usual to employ a transparent plate of glass which transmits the incident ray before it falls upon the surface, and partially reflects it aside on its return. Such an arrangement, best known in Gauss's eye-piece, may be called a Gauss's plate. The best position of such a plate is, as pointed out by Herr B. Walter in the current number of *Wiedemann's Annalen*, not the commonly accepted one of 45°, but another depending upon the refractive index of the material of the plate, and upon whether the light is polarised and in what manner. From theoretical considerations, he concludes that for light polarised either in or at right angles to the plane of incidence the greatest possible intensity of the reflected light is 15 per cent. of the original intensity, whatever may be the refractive index. If the light is polarised in the plane of incidence, the plate must be placed at a lesser angle to the ray the smaller the index of refraction. For light polarised at right angles to this plane the reverse holds good. But for refractive indices about 1·4 this angle reaches the common value of 7° 46′ 16″. The best position for ordinary light may be determined by regarding it as composed of the two species of polarised light. For crown glass the inclination should be $10\frac{1}{2}°$, at which position the intensity of the reflected light is 2·84 times that obtained with the usual inclination of 45°.

A NEW automatic sounding instrument has lately been brought into use by Captain G. Rung, the director of the Copenhagen Meteorological Institute, under the name of the universal bathometer. Unlike the instruments hitherto constructed, which register the depth attained by the compression undergone by a column of air, Captain Rung's bathometer, as described in *Hansa*, measures the density of a small volume of the compressed air cut off at the bottom of the sea. This density is directly proportional to the depth attained, and is measured by allowing the compressed air to expand until it is under atmospheric pressure only. Its volume will then be proportional to the density it had reached during compression. The whole apparatus is very neat and compact. A metallic tube contains two other tubes side by side, both communicating with a small chamber at the top. A valve shuts off the communication with the one or the other of the tubes, accordingly as the sounder is being lowered or raised. When the bathometer is being let down, water enters the "air tube" from the bottom, and compresses the air in the tube and in the small chamber. The whole is enclosed in another heavy tube, in which it can slide a little up and down. When the bathometer touches the bottom, the inner tube slides down, thereby turning the valve so as to close the communication with the air tube and open to the "measuring tube." At the same time, a couple of spring catches prevent the inner tube sliding up again. The bathometer is then drawn up to the surface, and the reading on the measuring tube at once indicates the depth. This tube is made of glass, and is graduated in fathoms or other units of length at equal intervals. This constitutes the chief advantage of this over previous types. In instruments measuring the depth by the volume of the compressed air the graduations had to be at smaller and smaller intervals as the depth increased, since the amount of compression decreases at high pressures. Captain Rung's instrument, on the other hand, can be graduated directly up to any limit of depth which it is likely to attain.

MR. W. J. MOENKHAUS has lately studied a species of American freshwater Percidæ—*Etheostoma caprodes*, Rafinesque—with a view to ascertain the extent of its variation, the relation of its variation to its geographical distribution, the extent of variation in each locality, and the variation with age. He gives an account of his investigation in the *American Naturalist* for August, and from it we learn, among other points, that the difference between specimens from the same locality is very slight. The greatest variation was found to be in the colour-patterns of the fish, but the most complicated colour-pattern can be connected with the simplest by means of intermediate stages. These variations, however, could not be connected with the latitudes inhabited by the different varieties. Slight variations were found in proportions and number of fin rays.

THE Plankton Expedition has yielded some very interesting results with regard to the bacteriology of the ocean, which are now published by Dr. B. Fischer in "Die Bakterien des Meeres nach den Untersuchungen der Plankton-Expedition." Except at very great depths, germs capable of germination were found everywhere. The number in the Canary, Florida, and Labrador currents was larger than in the south equatorial, north equatorial, and Guinea currents. None could be detected with certainty in the bed of the ocean; but bacteria abound at a depth of 400 m., and are certainly present at depths between 800 m. and 1100 m. The prevailing form of microbe is the spiral; but bacterium forms are also frequent; micrococci are rare. Forms more or less resembling the cholera-vibrio, both in their form and in their mode of motion, were very common. Most marine bacteria are aerobic, but some appear to be also facultatively anaerobic. Not a few form pigments, and a large number are luminous in the dark; the phosphorescent forms were most commonly met with on the surface of living fish. A number of new species are described.

SOME interesting points await settlement in the natural history of the mollusk *Gundlachia*, whose shell presents such puzzling and anomalous features. In a recently published paper on the Australasian forms (*Proc. Linn. Soc. N.S.W.* viii. 1893), Mr. Charles Hedley briefly reviews our knowledge of the genus and its distribution, and gives descriptions and figures of *G. petterdi* and *G. beddomei*. In the case of the former species, he describes a series of young shells showing the method by which the primary *Ancylus*-like shell is transformed into the curious double shell of the adult. Stimpson's suggestion that the septum which partially closes the aperture of the primary shell should be compared physiologically with the epiphragm of the Helices—as a protection during hibernation—well deserves some attempt at verification; as also does the unproved impression that under particular conditions the shell of *Gundlachia* never attains its normally double form, but remains simple and patelliform throughout life.

THE July number of *Modern Medicine and Bacteriological Review* contains an article entitled "The Value of Prof. Koch's Discovery," in which it is mentioned that the State of New York has recently passed a law authorising the use of tuberculin as a means of determining the presence or non-presence of the tuberculous process in cows. It is pointed out that though Koch's tuberculin has not fulfilled the expectations raised for it as a curative agent, as a means of diagnosis it may be of great service. Two or three drops of tuberculin injected beneath the skin of a cow will, if the animal is tuberculous, give rise within a few hours to an elevation of temperature of several degrees, whilst this characteristic reaction is absent in the case of animals free from this disease. Amongst the bacteriological notes is one on soap as a germicide, from which it appears that the so-called antiseptic soaps containing

salicylic acid or carbolic acid, yield no better results than ordinary toilet soap, the latter destroying the cholera bacillus in from ten to fifteen minutes when applied in the proportion of 2·5 parts of soap to 1000 parts of water. The same journal contains an account of an electric-light bath, consisting of a small cabinet large enough to permit of one person sitting comfortably, the walls of which are completely covered with mirror-glass. From forty to fifty electric lights are so distributed that every part of the body of the "bather" is almost equally exposed to the light. Dr. Gebbardt, who communicates the article, reserves his opinion as to the curative merits of this novel bath, but mentions that the intense light, contrary to his anticipations, did not produce an unpleasant or exciting effect, but exercised a calming influence upon him. Like the ordinary vapour bath, the electric light bath is followed by the application of cold water.

PART V., completing the fifth volume of the *Transactions*, has been issued by the Norfolk and Norwich Naturalists' Society, which fully maintains the interesting character of its publications. The first paper consists of the annual "Presidential Address," in which the President (Mr. Thomas Southwell) avails himself of the twenty-fifth anniversary of the formation of the Society to give a slight sketch of its history and the work it has accomplished; and we cannot but congratulate the members on the excellent results it has to show, the five thick volumes forming not only an epitome of the natural history of the county for the past twenty-five years, with excellent lists of the fauna and flora, but numerous biographical sketches are given, often with portraits, of the men whose labours in the past have proved so valuable to their successors. The address then gives some very interesting information as to the physical features of the county in times past, as well as of its natural productions. The establishment of a branch of the Society at Great Yarmouth called for a second "address," which is devoted to an account of the local naturalists, collectors, and gunners, for which, ever since the latter part of the last century, that favoured locality has always been celebrated, as well as to the enumeration of the many ornithological rarities which have there been obtained. Prof. Newton contributes a very interesting account of the great flood in South-West Norfolk in 1852–53, which resulted in the temporary return to the fens in that district of birds, such as the black tern and black-headed gull, which had long ceased to frequent the locality. The occurrence of the bearded seal on the Norfolk Coast, for the first time in Great Britain, is announced. Mr. Stacy-Watson has a very useful paper on the varieties and distribution of the herring. There are also papers on the local occurrence of fungi and flint implements, with lists of Norfolk earthworms, ichneumons, mammalia, fishes, birds, hemispheræ, and flowering plants. Of the twenty papers in the number before us there are only two which have not a strictly local bearing.

THE last number of the *Izvestia* of the Russian Geographical Society contains two papers which are sure to be welcome to geographers. The first, by G. I. Tanfilieff, is on the tundras of North-East Russia, on the shores of the Arctic Ocean, between the rivers Mezen and Pechora. Middendorff's descriptions of the tundras of northern East Siberia are classical for the subject. So are also Beketoff's "Flora of Arkhangelsk" and his additions to the Russian translation of Griesebach's work. But so much has lately been written about the tundras and the features they have in common with the steppes, that the necessity of new researches in this direction was very much felt. M. Tanfilieff fully confirms this view, and shows the further likeness which exists between the black-earth, the clay, and the sandy steppes on the one side, and the peat-bog, the clay, and the sandy tundras on the other. And he gives, moreover, a very vivid description of the inner processes of the life of the tundra, and enters into very interesting considerations relative to the extension of the ever-frozen soil, and the limits put by it to the northward spreading of forests. The southern limits of the former, and the northern limits of the forest region, are identical, and wherever there are in the tundra islands of ground which does not freeze, groves of fir-trees appear upon them; while even in the forest tracts the appearance of peat-bog islands, which remain frozen to a great depth, is always followed by a disappearance of the trees. The rivers act as drainage channels, which prevent water from percolating the soil, and therefore prevent it from freezing; this is why their courses are always followed by trees, which penetrate into the treeless tundras along the watercourses. The author's remarks on the Samoyedes and the reindeer are also very valuable. He fully confirms the excellent reputation of these children of the tundra, who, in consequence of the extremely slow growth of the reindeer lichen (*Cladonia rangifera*) are deprived of their pasture grounds, and reduced to complete ruin, by the Zyryanes and the Russians, who bring their herds of over 2000 head of reindeer into the Samoyede domains.

THE other paper, also of great interest, is by V. M. Obrucheff, on the orography of the Nang Shan. The Russian geologist has crossed this system of mountains both in the west of Lake Kuku-nor, at the western end of these highlands, and in the east of the lake; and, with the information previously gathered by Przewalsky and Potanin, he was enabled to draw a scheme map of the whole system, appended to the *Izvestia*. It appears that the highlands of Nang Shan consist of a series of parallel ridges running west-north-west to east-south-east, both in the north and in the south of Kuku-nor. The first chain is the Lung-thu-shan, in the north-east of the towns Su-choi and Han-chou. Then comes the Richthoffen ridge, continued in the east by the Momo-shan; then comes Humboldt's ridge, which is supposed by the author to have its continuation in the Maling-shan, while Ritter's ridge is continued east-south-eastwards by the Tsing-shi-ling. However, some doubt still prevails as to these last two points, on account of a want of exploration in the middle part of the highlands. The chain which rises just on the southern coast of Lake Kuku-nor (South Kuku-nor chain of Przewalsky) is continued towards west-north-west by a ridge, to which M. Obrucheff gives the name of Mushketoff's ridge, while the last chain of the group is named Semenoff's ridge. This classification brings some order, which was most desirable, into this grand group of mountains. Their geological history and later dislocations are also discussed in the same paper.

A RECENTLY published *Bulletin* of the U.S. Fish Commission (vol. xi., 1891) contains the results of a search for a fish-hatching station in the Gulf States. The character of the biological station which the United States Government desired to establish is indicated in the following extract from the instructions to Prof. Evermann: "To unite in one station the facilities for fish-cultural work with the salt-water species, for the pond culture of fresh-water species, for the investigation and development of methods for the propagation and rearing of the oyster, and for the investigation of the marine life of this coast. This means, of course, a laboratory of marine biological research, not large or expensive, but thoroughly equipped in all respects for its work." The explorations led to the conclusion that no point on the coast examined offered entirely satisfactory conditions for the establishment of a combined fresh and salt water station, though a site near Galveston presented some advantages. In addition to the reports prepared by Prof. Evermann, the volume referred to above contains reports n matters connected with his investigations. Such, for instance, is

a statistical report on the fisheries of the Gulf States, by Mr. J. W. Collins and Dr. H. M. Smith; a report on a collection of fishes from the Albemarle region of North Carolina, by the latter author; a paper on the spawning habits of the shad, by Mr. S. G. Worth; a report on the aquatic invertebrate fauna of the Yellowstone National Park, and of the Flathead region of Montana, by Prof. S. A. Forbes; and a report on the fisheries of the South Atlantic States. Finally, the volume contains a description, by Mr. Bashford Dean, of the methods of oyster-culture in Italy, Spain and Portugal, Germany, Holland, Belgium, and England. Oyster-culture, as practised in France, had previously been reported upon in connection with the U.S. Fish Commission. This article, like most of the others, is excellently illustrated. They all help to disclose the possibilities of fish industries in the United States, and indicate how "the harvest of the sea" may be increased in value.

WE have received a ponderous volume (vol. vi.) of the transactions of the Reale Accademia delle Scienze Fisiche e Mathematiche, Naples. The volume contains nineteen fine plates and eighteen papers, most of which refer to natural science subjects.

MR. ROWLAND WARD, the well-known taxidermist, has published the seventh edition of his "Sportsman's Handbook," containing information on the "practical collecting, preserving, and artistic setting-up of trophies and specimens, to which is added a synoptical guide to the hunting grounds of the world."

THE second volume of Priestley's "Experiments and Observations on Different Kinds of Air"—that is to say, the one in which he first gave an account of the discovery of oxygen in 1775—is reproduced in the seventh number of the handy "Alembic Club Reprints," published by Mr. W. F. Clay, Edinburgh. The next volume in this series will contain Scheele's work in connection with the discovery of oxygen.

THE Robert Boyle lecture, delivered by Lord Kelvin before the Oxford University Junior Scientific Club, in May last, on "The Molecular Tactics of a Crystal," has been published by the Clarendon Press. No student of crystallography should neglect to read the lecture, for in it the geometry of crystalline structure is dealt with in the simplest manner. The substance of the lecture is contained in a paper read by Lord Kelvin before the Royal Society on January 18, and reprinted in these columns on March 8.

MESSRS. GEORGE PHILIP AND SON have lately published a book, of fifty pages, entitled "Knowledge through the Eye," by Mr. A. P. Wire and Mr. G. Day. The authors explain how to use the optical lantern in illustrating lectures in science and other branches of knowledge, and describe a new method of preparing lantern slides without the use of a camera. A drawing of the required illustration is first made. A piece of specially prepared transparent paper (sold by Messrs. Philip) is then placed over it, and the drawing is transferred by tracing. A lantern slide is obtained by making a contact exposure in the ordinary manner, using the picture on the transparent paper as a negative. This method, however, has very little to commend it. Line drawings are easily made upon a plate of smoked or varnished glass, or upon glass having a thin film of collodion upon it; and as the illustrations have to be drawn in any case, it is just as well to do the work directly as to make a lantern slide of a tracing made from a drawing in the way described by the authors.

THE additions to the Zoological Society's Gardens during the past week include a Hairy Armadillo (*Dasypus villosus*) from South America, presented by Mr. George Simpson; a —— Bamboo Rat (*Rhizomys*, sp. inc.) from India, presented by Mr. Angus M. Kinloch; a Himalayan Monaul (*Lophophorus impeyanus*) from the Himalayas, presented by Captain H. R. H. Helpman; two Sharp-nosed Crocodiles (*Crocodilus acutus*) from Jamaica, presented by Dr. Poole; two Common Chameleons (*Chamæleon vulgaris*) from North Africa, presented by Mr. E. Palmer; two Smooth Snakes (*Coronella lævis*) from Hampshire, presented by Mr. E. Penton; two Common Vipers (*Vipera berus*), British, presented by Mr. Hugh Bromley; a Sykes's Monkey (*Cercopithecus albigularis*) from East Africa; two Heloderms (*Helodermæ suspectum*) from Arizona, deposited; three Blood-breasted Pigeons (*Phlogœnas cruentata*) from the Philippine Islands, purchased; a Yak (*Pœphagus grunniens*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

SOLAR ECLIPSE PHOTOGRAPHY.—Mr. Albert Taylor recently read a paper before the Royal Dublin Society, on the selection of suitable instruments for photographing the solar corona during total solar eclipses. The photographs obtained by other observers and himself during the total eclipse of April 1893, have indicated the best methods, both photographic and instrumental, to be adopted for the next observable total solar eclipse, on August 8, 1896. One of the most disputed points in eclipse photography, says Mr. Taylor, refers to the proper exposure required to obtain the faint extensions of the corona without fogging the plate by the sunlight. Two opposite opinions are held as to the best method of photographing these diaphanous coronal extensions. Short exposures and slight photographic action are believed by some observers to give the best results, but others hold that long exposures and great photographic action are necessary to attain the desired end. An examination of the photographs obtained during the eclipse of April 1893, shows that the latter view must be abandoned; and that nothing is to be gained by using photographic actions exceeding 15 or 16. Photographic action is determined by the formula $100\ \frac{a^2}{f^2}\ t.\ s.$, where a is the aperture of the instrument employed, f the focal length, t the time of exposure, and s the sensitiveness of the plate. For obtaining photographs showing the detailed structure of the inner and middle coronæ, short exposures and a long-focus object-glass are recommended. The opinion is expressed that, with a twelve-inch object-glass of between forty and sixty feet focus, one hundred seconds' exposure would give nearly all the corona that is within reach of the photographic method of attack in the present state of photography. It is believed that with an instrument having a focal length equal to ten times the aperture, all the external corona would be obtained in about fifteen or sixteen seconds.

OBSERVATIONS OF SATURN AND URANUS.—Since the beginning of this year Prof. E. E. Barnard has used the 36-inch of the Lick Observatory in some observations of Saturn and Uranus (*Astronomy and Astro-Physics*, August). Measurements of the former planet were undertaken with a view of determining whether the ball was situated in the exact centre of the rings. Between the end of the ring and the limb on the following side of Saturn the angular distance was 11″·287, while similar measures on the preceding side gave 11″·167. The difference is less than one second of arc, and it may very well be due to some peculiarity in the measures. It is certainly not sufficient as yet to suggest that the planet is not exactly at the centre of its rings. Prof. Barnard has also made a series of measures of the polar and equatorial diameters of Uranus, and a series of measures of the position angles of the equator. From these it appears that "the equator of the planet coincides with the planes of the orbits of the satellites, thus verifying the supposition that Uranus rotates on an axis deviating but little from the plane of its orbit."

BIOLOGY AT THE BRITISH ASSOCIATION.

SECTION D, in spite of the loss of Physiology, had so many papers that it was necessary to meet on most days under the two departments of Zoology and Botany. A noteworthy feature was the large number of papers by distinguished foreigners, and the theoretical nature of a large proportion of the communications.

On Thursday, in addition to the Presidential Address (NATURE, p. 371), the following reports of Committees were taken :—

(1) The Naples Zoological Station. This contains an interesting letter from Dr. Dohrn on the future maintenance and administration of the station, statistics as to the work of the station during the past year, and an account by Mr. J. E. S. Moore of his investigations on the reduction division in cartilaginous fishes. He finds that the spermatogenesis stops short at a point corresponding to the formation of the first ovicyte in ovigenesis, and also that the archoplasmic vesicle of the Elasmobranch spermatid has an intranuclear origin, while in the mammalia it is of purely cytoplasmic construction.

(2) The Plymouth Biological Laboratory. This report contains a preliminary notice of Dr. Hickson's investigation of the anatomy and development of *Alcyonium*, and of Mr. Allen's researches on the later stages in the development of Decapod Crustacea. Mr. Allen's work has been chiefly on the cells and fibres of the central nervous system.

(3) The Zoology of the Sandwich Islands. Mr. Perkins has continued his explorations since the last report, and the Committee now propose that he should return to this country and give assistance in working out the extensive collections formed.

(4) The Zoology and Botany of the West Indies. Since last year ten reports have been published, on the insects and plants, chiefly from St. Vincent. The Committee have still to deal with the Coleoptera, and propose to explore Margarita.

(5) Index Generum et Specierum Animalium. The MS. consists now of 180,000 slips, representing 90,000 genera and species.

In the Zoological Department, Prof. Hubrecht (Utrecht) read a paper on the didermic blastocyte in mammalia, in which he showed the distinctness of the trophoblast cells from the embryonic cells of the blastoderm. Mr. W. Garstang, in a paper on the ancestry of the Chordata, gave reasons for his conclusion that the Echinoderms, Enteropneusta, and Chordata trace back their descent to a common pelagic ancestor which had many striking points of resemblance to the Holothurian larva "Auricularia."

Mr. W. E. Collinge read papers on the structure of the integument in *Polyodon*, in which he showed that the occurrence of scale-plates was very similar to those found in the embryos of *Lepidosteus*, &c., and indicated a relationship to the Palæoniscidæ of the coal measures; and on the vertebræ of *Amphisile*, in which the unique character of the vertebral column of this fish was described and the views of previous writers criticised.

In the Botanical Department, Prof. Johnstone showed Algæ which deposit calcareous matter in their tissues, and so probably are better able to resist the attacks of animals. He also exhibited Algæ which are able to dissolve calcareous matter and bore minute holes in the shells of Mollusca. In a second communication he discussed the genus *Pogotrichum*. Prof. Phillips described the great variety found in the development of the cystocarps of *Polysiphonia nigrescens* and other species. Mr. A. Church exhibited collections of Algæ.

On Friday a joint meeting of zoologists and botanists was held to discuss a few important papers dealing with protoplasm, the cell, and allied matters.

Prof. E. Van Beneden led off with a paper on the relations of protoplasm, in which he gave an account of his observations on the phenomena seen in the division of cells. He regards the nucleus as being not an independent organ in the cell, but as closely connected with the ordinary protoplasm. Some discussion followed, and, on the whole, the opinions expressed were highly favourable to Van Beneden's view.

Prof. Strasburger followed next, on the periodic variation in the number of chromosomes. He thinks that the reduction in the number of chromosomes in sexual generation has a phylogenetic interpretation, and is a recurrence to the primitive number of chromosomes possessed when the organism was asexual only. He considered that many cases of asexual plants were to be regarded as due to the loss of sexuality.

The third paper was Prof. Ray Lankester's, on chlorophyll in animals. He gave an account of its occurrence in severalt groups of the Invertebrata, and pointed out that in these casesi starch is produced as in plants, and that the animal does not become green if kept in the dark. He referred to the view that all such cases were to be explained by the presence of unicellular parasitic algæ, but pointed out that these arguments would apply as well to the presence of chlorophyll in plants, and he urged that the same interpretation should be given to the facts in the case of animals as in plants.

In the Zoological Department, Prof. E. Van Beneden read a paper on the origin and morphological signification of the notochord. He described the formation of the notochord and mesoblast in some bats from the external layer (apparently epiblast). He proposed that the two embryonic layers should be called blastophore and lecithophore. He also instituted a comparison with the young *Amphioxus* and *Cerianthus* (where the axis corresponds to the long axis of the vertebrate body), and pointed out how their essential similarity bore out the conclusions as to the origin of the Chordata reached by Sedgwick fifteen years ago.

Prof. Struthers gave a paper on the carpus of the Greenland right whale compared with that of finner whales. He showed that the arrangement of the cartilages in the wrist has no functional significance (the carpus merely functioning as a whole), and can only be explained by descent with modification from the less rudimentary condition seen in other mammals. He showed that the pisiform is actually the most important element, and the only one which has a distinct function.

Miss Kirkaldy gave a critical account of the various species of *Amphioxus*. She described in all eight species, referable to three genera (*Branchiostoma*, *Heteropleuron*, and *Asymmetron*), one of which, *Heteropleuron Singalense*, she considered to be new to science.

In the Botanical Department, Miss Benson described her investigations on the fertilisation of the Chalazogamic Amentiferæ, and showed that the pollen tube passes through the chalaza in *Corylus*, *Carpinus*, *Betula*, and *Alnus*. Miss Pertz had a paper on the hygroscopic dispersal of fruits in certain Labiatæ, in which she showed that there are cases where the capsule opens when moist; and Dr. J. Clark gave an account of his investigations on the hybridisation of orchids.

On Saturday, in the Zoological Department, after the reports (1) on the migrations of birds as observed at lighthouses (the digest of which has at length been completed by Mr. Eagle Clark), and (2) on the legislative protection of wild birds' eggs (in which the recent Bill was explained and criticised by Prof. Newton, Canon Tristram, and others), the following papers on the occurrence, distribution, &c., of marine animals were taken :—

On a tow-net for opening and closing under water, by Mr. W. E. Hoyle. Mr. Hoyle described his electrical tow-net, and explained that he was now waiting for an opportunity of getting into water of over 100 fathoms depth in a steamer fitted with electric power.

On temperature as a factor in the distribution of marine animals, by Dr. O. Maas (Munich). Dr. Maas considers that the great ocean currents are of primary importance in limiting the distribution of free-swimming forms, different species being found to north and south of them. He attributes greater importance to temperature than to pressure. He points out that the existence of eurythermal and stenothermal animals must be borne in mind, and that in drawing conclusions as to distribution all animals are not equally important.

On the marine zoology of the Irish Sea, by Prof. W. A. Herdman. The object in this investigation has been not merely to collect animals, but to investigate the condition of the sea-bottom in the various parts of the area, and correlate, if possible, the fauna with the environment. This report of the year's work gives (1) details of the dredging expeditions, (2) additions to the fauna—these include four new species of *Ecteinosoma*, one of *Bradya*, one of *Pseudocyclopia*, one new Amphipod, *Nannonyx spinimanus*, and one Bopyrian, *Pleurocrypta nexa*—and (3), finally, a discussion of the submarine deposits met with, their nature, distribution, origin, and influence upon the fauna. The importance of the nature of the bottom to the animals living on it is specially emphasised.

Prof. M'Intosh gave an account of the recent marine fish-hatching operations of the Scottish Fishery Board at Dunbar. He described the ponds and buildings, their mechanism and he movements of the hatching-boxes, and gave statistics showng how remarkably successful the first season's operations had been.

In the Botanical Department papers were read by Prof. L.

Kny on the correlation between root and shoot, and an exhibition of diagrams; and by Prof. Pfeffer on the sensitiveness of the root-tip.

On Monday forenoon a series of papers dealing with various points in the theory of evolution was taken before the Zoological Department. After the report of the Committee on Telegony, Prof. D'Arcy Thompson read a paper on some difficulties of Darwinism. He doubts the efficacy of the struggle for existence in the case of humming-birds, &c., and in these cases he regards the profusion of forms, colours, and other modifications as due merely to laws of growth, and thinks that growth may be more exuberant in the absence of struggle and hardship. In other cases which are usually interpreted as the result of natural selection, Prof. Thompson gave another explanation, *e.g.* he considers the form of the Guillemot's egg is merely the natural result of the pressure caused by a relatively large egg passing down a narrow muscular passage.

Then Prof. C. V. Riley followed, on social insects and evolution. He gave a summary of what is known of the habits and economies of bees, wasps, ants, and termites, especially as to the development of the young. He considered that the varied structures and habits of neuters are perfectly explicable upon the general principles which have governed the modification of organisms, amongst which he believes natural selection plays an important but limited part. He showed that the differences between the queen and the neuter resulted entirely from the treatment of the larva, and was at the control of the colony. In ants also the differences between the different individuals is again the result of food and nurture. He believed with Darwin that the variations in social insects have been guided by natural selection amongst colonies; but that this remarkable and somewhat unexpected social selection among individuals, as exemplified in these insects, simplified the origin of neuters. Competition had been between colonies rather than individuals. The author finally pointed out that just as in man among mammals, the higher intellectual development and social organisation is found correlated with the longest period of dependent infancy.

Prof. Haycraft read a paper on the *rôle* of sex in evolution, in which he argued that variation is a quality of protoplasm, and that it has and can acquire this quality in varying degree and apart from sexual conjugation; also that sexual conjugation tends to limit or diminish variations, and that this is the *rôle* of sex in evolution; to sex therefore we owe our fairly well-defined generic and specific groups.

Dr. F. A. Dixey, in a paper on the relation of mimetic characters to the original form, gave some interesting examples of mimicry amongst butterflies, and showed how a very perfect scheme of mimicry may be established by gradual changes from a very small initial resemblance.

Prof. Osborn treated of certain principles of progressively adaptive variations observed in fossil series. He appealed for a systematic analysis and investigation of variation, and for a suspension of judgment in regard to the factors of evolution. Recent works show a lack of analysis, since all adult variations are classed together without regard to the two following lines of cleavage; first, as to adaptation, whether progressive, retrogressive, or neutral; second, as to time of origin in the individual, whether palæogenic or neogenic. Neogenic variations which point to the future may be conveniently divided into (*a*) gonagenic; (*b*) gamogenic; (*c*) embryogenic; and (*d*) somatogenic according to lines suggested by the work of Kölliker, Weismann, Roux, and others. All previous inductions as to variation have failed to recognise that the adult may exhibit variations which have their immediate causes in all these periods, although all alike spring from the potentiality of the germ. A distinct consideration rises whether, besides the "minute variations" of Darwin and the "saltatory variations" of Bateson, there may not be variations so slight as only to be measurable by the comparison between two individuals separated by a long genetic series. Evidence for variation of this kind is seen in the contrast between the evolution of the premolars and of the molars in the eocene horse series. The limitation of variation to certain lines is seen in a comparison between the horse and rhinoceros molars of the miocene. The general conclusion drawn from these facts is that the pure selection principle is contradicted by them, and there is some unknown principle of teleological mechanics yet to be discovered.

In the discussion which followed, Prof. Poulton criticised Osborn's classification of variations, and argued in favour of the action of natural selection in picking out the minute characters which distinguish individuals and in building them up into varieties. The discussion was continued by Profs. Mivart, Lankester, Seeley, Hartog, and others.

In a paper on the wing of *Archæopteryx* viewed in the light of that of some modern birds, Mr. W. P. Pycraft showed that in the development of the primary wing-feathers, as well as in the general form of the manus, in the nestling of certain gallinaceous birds there was evidence that they had descended from a strictly arboreal form in which the manus of the nestling was armed with claws to assist it in climbing the trees in which it was reared, just as is the case in the young of *Opisthocomus cristatus* to-day. He showed that there is reason to believe that the claws of *Archæopteryx* were of prime importance only during the nestling period of life. A model of a restoration of the wing of *Archæopteryx* was exhibited, in which it was demonstrated that the remiges rested upon the third digit, the bases abutting against that of the second digit, the top of which was free. It was, however, suggested that this digit supported the semiplume-like feathers seen in the fossil which possibly functioned as coverts.

In the Botanical Department:—On the origin of the sexual organs of the Pteridophytes, by Prof. Douglas H. Campbell. Notwithstanding the radical differences, especially in the Archegonium, between the Bryophytes and the Pteridophytes, a comparison of the structure and development of the sexual organs of the higher Hepatics with those of the Eusporangiate Pteridophytes shows points of resemblance enough to warrant the hypothesis that here is to be sought the connection between the Bryophytes and the Pteridophytes. Notes upon the germination of the spores of the Ophioglosseæ, by Prof. Douglas H. Campbell. The author succeeded in germinating two species, *Ophioglossum pendulum* and *Botrychium virginicum*. In both the first division of the spore occurs before any chlorophyll is formed. On sterilisation and a theory of the strobilus, by Prof. F. O. Bower. The following are some of the leading points in Prof. Bower's theory:—The spore-bearing parts of the sporophyte are to be regarded as primary in the evolutionary history and in function. The homosporous vascular cryptogams attained the climax of numerical spore-production. As a consequence of increased spore-production arose sterilisation of sporogenous tissue in form of septa partitioning off loculi, and subsequently the formation of synangia, and separation of the sporangia. The sporogonial head is the correlative of the strobilus or flower, the latter has eruptions of the surface to form sporophylls upon which sporangia are borne. The evolutionary history of the sporophylls shows progress from small and simple to large and complex forms. Foliage leaves may have been derived from sterilisation of sporophylls. The following are the remaining papers brought before the Botanical Department:—Miss N. Layard, a method of taking casts of the interior of flowers; Prof. E. Zacharias, the function of the nucleus; Prof. Errera, exhibition of diagrams; Mr. G. Murray, on *Pachytheca;* Dr. Scott, the structure of fossil plants in its bearing on modern botanical questions; Prof. Marshall Ward, a Thames bacillus; Prof. Green, influence of light on diastase; and Mr. Seward, a contribution to the geological history of Cycads.

The following are the remaining papers and exhibitions brought before the Zoological Section; most of them were taken on Tuesday:—

Dr. W. B. Benham expounded a new classification of the Polychæta, which gave rise to some discussion. Prof. Jeffrey Bell exhibited lantern slides of some magnificent colonies of reef-building corals lately acquired by the British Museum.

Dr. W. B. Benham, on the blood of *Magelona*. It differs from that of any other Chætopod hitherto examined. Instead of a red (hæmoglobin) liquid plasma in which float either a few nucleated colourless corpuscles or free nuclei, the blood-vessels of *Magelona* are completely filled with very small spherical globules of a madder pink colour, in an extremely small amount of colourless plasma. These coloured globules are *not* cells. There are free nuclei scattered amongst them, but the coloured globules are not nucleated. The colour is due to a pigment similar to hæmerythrin occurring in some Sipunculids. The globules exhibit a very marked tendency to run together like oil-drops and fuse. This viscid mass seems to be intermediate between the absolutely liquid coloured plasma of chætopods and the red corpuscles of mammals which float in a small amount of colourless plasma. Further, these globules in

Magelona probably originate within cells, from which they are released.

Prof. G. Gilson (Louvain), on the nephridial ducts of *Owenia*.

The Rev. T. R. R. Stebbing, on zoological publication, &c., suggested that the leading biological societies should arrange the work of publishing between them, so as to avoid the overlapping which now takes place. He proposed that for every country there should be a single authorised journal to receive the names of new genera and species with brief descriptions, all claims to priority being dependent on the date of this record.

Mr. J. T. Cunningham, on the significance of diagnostic characters in the Pleuronectidæ, discussed the evolution of the characters which distinguish flat-fishes into sub-families, genera, and species. He considers that the specific and many of the generic characters are not known to be adaptational, and are more probably due to generative isolation and divergent variation. His general conclusion is that animal variation is to be regarded as the resultant of two opposing influences, one internal and one external to the organism. The one is the internal tendency to definite divergent variations which have no direct relation to the struggle for existence, the other is the direct influence of adaptation, whether due to the selection of individuals or to the direct modification of individuals.

Mr. Goodrich described some of the methods adopted recently in displaying specimens in the zoological part of the Oxford University Museum. Dr. F. A. Dixey, on the plantar surface in infants, showed that his investigations on the skin of the foot in very young infants who had never walked, do not lend any support to the view that acquired characters can be transmitted by heredity.

Mr. W. E. Collinge, in a paper on the relations of the cranial nerves to the sensory canal system, showed that the canals are innervated in the Elasmobranchs chiefly by the facial nerve, in the Ganoids by the trigeminal and facial, and in the Teleostei chiefly by the trigeminal. Dr. H. B. Pollard exhibited, with remarks, models of the cranial skeletons of some rare South American and African siluroid fishes, made after the method of Born, with the addition that they were electroplated in order to give them sufficient firmness. Attention was drawn chiefly to the barbules round the mouth. These were maintained to be the homologues of the oral tentacles of *Myxine* and the cirri of *Amphioxus*, and a new theory of the origin of the head in Vertebrata, termed the cirrhostomial theory, was based on these homologies. The author contrasted this theory with the old vertebral theory of Goethe and Oken, and the subsequent theories of Gegenbaur, Balfour, v. Wijhe, and others.

GEOGRAPHY AT THE BRITISH ASSOCIATION.

AT the Oxford meeting the popularity of the Geographical Section showed no abatement. Crowded meetings were the rule, even when papers of a severely scientific character were being read. This may be explained to some extent by the favourable situation of the section-room in close proximity to the reception-room; but perhaps the general use of lantern illustrations had more to do with it. By means of effective lantern diagrams the audience was able to follow with interest and pleasure, papers on detailed oceanography and climatology. The characteristic of the meeting may be given as the general high level of the papers offered, and the interesting discussions to which they frequently gave rise.

The President, in his address, dealt with oceanography in its widest sense, and was followed by a number of papers of similar character, though narrower scope. Unfortunately, it was found impossible for papers on similar subjects to be taken in all cases on the same day, as the convenience of the authors frequently made it necessary to alter the provisional arrangements which had been made. Mr. H. N. Dickson gave an account of the share he had taken on board H.M.S. *Jackal* in the international oceanographical observations initiated by Prof. Petterson, of Stockholm. The general conclusions arrived at were as follows:—

While the Atlantic current flowing over the Wyville-Thomson ridge attains its maximum velocity in winter, its speed is maintained during summer by the greater warmth of the upper layers of water in the Atlantic, and consequent higher level of the surface of that ocean compared with the Norwegian Sea. Passing over the ridge, the Atlantic current is cooled by mixture with the cold water of the Norwegian sea lying at the bottom of the Faeröe-Shetland Channel, and loses its horizontal motion. The warmer the Atlantic current the more rapidly does this mixture take place. Hence in a hot, windless summer a mass of Atlantic water, extending to a great depth, tends to collect on the northern and north-western edge of the North Sea bank. At all seasons Atlantic water is drawn from the Faeröe-Shetland Channel and forced into the North Sea by the tides between Orkney and Shetland. The tidal streams run north-west and south-west, and an eddy is formed to the north-west of the Orkneys, into which North Sea water is drawn, and perhaps also water from below. As the season advances the surface water of the North Sea becomes warmer, the upper layers probably receive smaller supplies of fresh water, but they become specifically lighter than the under layers, which they protect from the warming influences of the atmosphere. The upper layers becoming ultimately warmer than the Atlantic current, the surface of the North Sea becomes higher, and the surface water spreads outwards into the Faeröe-Shetland Channel, checking the surface supply of Atlantic water. Meanwhile, the mass of Atlantic water, collecting at the edge of the North Sea Bank, seeks entrance into the North Sea. Mixing with the cold bottom water already there, it increases its salinity, but reduces its specific gravity by warming it, and, at a certain stage of mixture, the temperatures and salinities of the two waters combine to form a ridge or axis of maximum specific gravity. This axis, which probably runs north-east from Shetland in the end of May or in June, turns slowly toward a north to south direction, and moves eastward. As it retreats, Atlantic water is gradually admitted round the north end of the Shetlands, passes down the east side of the groups, joins the tidal stream at the south end, and, guided by the axis of heavy water, is distributed along the east coast of Scotland, probably during July and August. Later in the summer, as the axis retreats still further, the Atlantic water is probably distributed more towards the eastward, perhaps until the latter part of September, when the diminishing supply from the Faeröe Channel, and the increasing outflow from the eastern side of the North Sea, bring about a gradual return to the conditions with which we started. Obviously the controlling conditions are complex, but it appears that the greater the winter cold and the spring supply of ice-cold water from the continent, the more slowly will Atlantic water penetrate into the North Sea below the surface; and the warmer the summer, the more will the surface supply be checked. At the same time, the warmer the summer the larger the quantity of Atlantic water seeking admission, and the greater its thermal power to drive back the axis of maximum weight.

M. A. Delebecque, of Thonon, sent an account of his methods of surveying and constructing bathymetrical maps of the French lakes, a series of which was exhibited. The geographical conditions of the English lakes were described by Dr. H. R. Mill, and in the discussion which ensued, Prof. Guido Cora, of Turin, took a leading part. Mr. J. Y. Buchanan, F.R.S., sent an account of the researches being carried out by the Prince of Monaco and himself on board the Prince's yacht *Princesse Alice*, in the Mediterranean and North Atlantic, which received considerable attention. He found that even at a distance of 600 miles south-west of the Strait of Gibraltar the salt water from the Mediterranean occupied the lower half of the whole depth, the upper half alone being occupied by Atlantic water. Numerous observations were made in the narrowest part of the Straits, with the effect of defining the manner in which the surface current of Atlantic water entering the Mediterranean is related to the deeper current of dense water escaping to the ocean.

Dr. John Murray gave a discourse on the geographical and bathymetrical distribution of organisms in the ocean, focussing all our knowledge of the distribution of marine life, and concluding with the belief that the existing distribution is a result of the gradual restriction of a universal fauna which flourished in a climate of world-wide warmth, possibly due to the larger size of the sun. This paper gave rise to an animated discussion. Although not formally organised, this was practically a joint discussion between Sections D and E, the participants in the discussion comprising Dr. Gunther, Mr. P. L. Sclater, Dr. O. Maas, Canon Norman, Dr. H. O. Forbes, and Mr. Garstang.

Papers dealing with new exploration were unusually numerous.

Mr. Osbert H. Howarth gave a magnificent series of new views of the Cordillera of North America, in illustration of a paper on the Sierra Madre of Mexico, from which he had just returned. Mr. D. G. Hogarth summarised the result of his recent journey in the valley of the Euphrates. The river was found to be so difficult of passage as to form a natural frontier of the most effective kind. Very fine remains of Roman bridges, aqueducts, and forts were found and photographed. Mr. Weld Blundell, just returned from an even more adventurous journey in the Libyan Desert, gave a paper full of interest describing his observations and photographs. Dr. A. Markoff gave a comprehensive general description of Russian Armenia. Travel papers of minor importance, but no less popular on that account, were read by Mr. W. H. Cozens-Hardy on Montenegro, and by Miss Baildon on a visit to New Guinea.

An animated discussion was also called forth in connection with a valuable paper by Mr. Somers Clarke, on the geography of Lower Nubia. He vividly described the scenery and present economic state of the site of the proposed great Nile reservoir. He said that the Wadi Kenus, the abode of the Beni Kensi tribe, is nearly coincident with the projected Nile reservoir, and if the proposed scheme is carried out the population to be displaced numbers about 30,000, inhabiting a cultivated area of some 10,000 acres. Population in the Ptolemaic times must have been greater, as there are tracks about Korti and Dakkeh, once under cultivation, now abandoned. In the Dodeka-Schoenus there is a number of temples and remains of antiquity, a further proof of considerable population; and the district is protected by a line of forts, some of very high antiquity, others of later date. The existence of Egyptian civilisation side by side with the ruder customs of the natives, is especially to be observed in the method of burial. The present inhabitants on the course of the Nile valley from Assuan to Wadi Halfa exhibit very slight variations in modes of dress, particularly among the women. Men go to Cairo, women stop in the villages, so that the men adopt the ordinary dress of fellahin in Egypt. The manner of building houses from lumps of earth, crude brick, with flat wooden or vaulted brick roofs, constructed in the same way as those used by the ancient Egyptians, was noticed. Reed shelters are also in use. Not only the unique antiquities but the present people, with all life, animal and vegetable alike, are affected by the projected reservoir. In view of the contemplated destruction it is of the utmost importance to make an exhaustive scientific investigation of the valley before it is submerged.

Mr. Norman Lockyer, in commencing the discussion on this paper, said that if the dam were constructed it might after all, if preceded by an exact scientific survey, prove to be a blessing in disguise even to Egyptologists, and that the advancement of science and the advancement of Egypt might proceed hand in hand.

Papers of more technical interest were contributed by several authors. Mr. A. Montefiore sent a detailed account of the equipments of the Jackson-Harmsworth Arctic expedition; Mr. John Thomson gave an account of the methods of photography best adapted for the use of travellers; and Mr. B. V. Darbishire showed a new method of representing the surface configuration of the British Islands. Mr. G. G. Chisholm initiated a valuable discussion on the spelling of geographical names, the purpose of which was to show that the indispensable preliminary requirement, with a view to the end stated, is to have an adequate scheme of orthography, making up for the deficiency of such signs by clear rules to be followed with respect to the sounds for which signs are lacking. To leave it to the individual judgment to decide what is the nearest sound represented in the scheme to one for which no express provision is made, is bound to lead to confusion. The inadequacy of the latest version of the Royal Geographical Society's scheme from this point of view was pointed out, and suggestions of remedies made. The addition of some subordinate rules likely to promote the efficiency with which the scheme is carried out was recommended. Attention was drawn to special difficulties in connection with Russian and Greek names, and reasons given for entertaining the hope that, with the aid of Oriental scholars, special rules might usefully be framed with regard to the spelling of Chinese and Indo-Chinese names. Finally, it was urged that, once an adequate scheme clearly expounded is adopted, it would be of great importance to make special arrangements to secure the co-operation of all contributors to the *Geographical Journal* and other geographical periodicals, of publishers and authors, and, above all, of the newspaper press towards getting the scheme carried out.

Mr. H. Yule Oldham attracted much attention to his statement of evidence, from a MS. map at Milan, of date 1448, of the discovery of Brazil before that date. In the long discussion which followed, the evidence was criticised by several speakers who were reluctant to accept it without more ample proof.

Colonel Feilden read a brilliant paper on current polar exploration, in which he explained the position of the various expeditions now in the field, and expressed a strong opinion as to the folly of inexperienced travellers adventuring themselves lightly into regions so fraught with danger.

Mr. E. G. Ravenstein presented a discussion of the climatology of tropical Africa, resulting from the observations collected by the Committee on African Climate appointed some years ago. The results present the first satisfactory generalisations on the tropical climates of Africa, but its scope cannot be conveniently summarised. Mr. Theodore Bent gave an admirably illustrated account of his recent visit to the Hadramut in Southern Arabia. The proceedings of the Section were assisted by several eminent foreign geographers, amongst whom Prof. Vambery, of Budapest, and Prof. Guido Cora, of Turin, took a leading place.

MECHANICS AT THE BRITISH ASSOCIATION.

THE sittings of Section G, at the recent meeting of the British Association at Oxford, were held in the Common Hall of Keble College, which afforded more than ample accommodation for the purpose.

We have already printed the presidential address of this Section. Prof. Kennedy, who some time ago resigned his chair, was one of the pioneers of the modern movement towards technical education in mechanical engineering, and it was natural, therefore, that he should largely deal with the training of engineering students in his address.

There was a very long list of papers down for discussion at the meeting. The first sitting was held, according to custom, on the Thursday, and the Section met on the Friday, Saturday, Monday, and Tuesday following, that is to say, from August 9 until August 14. With so long a list of papers to deal with, we can do no more in the space at our command than simply refer to some of them by name, and we therefore give the following, which is a complete list of the papers read:—

Thursday.—(1) Some reminiscences of steam locomotion on common roads, by Sir F. J. Bramwell, F.R.S.; (2) bore-hole wells for town-water supply, by H. Davey.

Friday.—(1) Joint meeting with Section A:—(*a*) On integrators, harmonic analysers and integraphs, and their application to physical and engineering problems, by Prof. O. Henrici, F.R.S.; (*b*) note on the behaviour of a rotating cylinder in a steady current, by Arnulph Mallock; (*c*) on the resistance experienced by solids moving through fluids, by Lord Kelvin, P.R.S.; (*d*) discussion on flight, in which Lord Rayleigh, Mr. Langley, Mr. Maxim, and others took part; (2) the strength and plastic extensibility of iron and steel, by Prof. T. Claxton Fidler; (3) tunnel construction by means of shield and compressed air, with special reference to the tunnel under the Thames at Blackwall, by M. Fitzmaurice.

Saturday.—(1) On methods that have been adopted for measuring pressures in the bores of guns, by Sir Andrew Noble, K.C.B., F.R.S.; (2) the most economical temperature for steam-engine cylinders, by B. Donkin.

Monday.—(1) Signalling through space, by W. H. Preece, F.R.S.; (2) some advantages of alternate currents, by Prof. S. P. Thompson, F.R.S.; (3) continuous current distribution of electricity at high voltage, being a description of the lighting of the city of Oxford, by T. Parker; (4) a special chronograph, by H. Lea; (5) a direct-reading platinum pyrometer, by G. M. Clark.

Tuesday.—(1) Report of committee on dryness of steam, by Prof. W. C. Unwin, F.R.S.; (2) the temperature entropy diagram, by H. F. Burstall; (3) the hunting of governed engines, by J. Swinburne; (4) engineering laboratory instruments and their calibration, by Prof. D. S. Capper; (5) lighthouse apparatus and lighthouse administration in 1894, by J. Kenward; (6) on spring spokes for bicycles, by Prof. J. D. Everett, F.R.S.

Sir Frederick Bramwell's paper was one of considerable interest, the veteran engineer described the experience of his youth when he was a protégé of Hancock, who was then running a steam carriage for ordinary purposes of carrying passengers on the public roads. Sir Frederick stated how he used to travel from work to his home when an apprentice, Hancock generally giving him a lift on his return journey with the steam carriage. Under the existing state of the law steam locomotion of this nature is, of course, an impossibility, the restrictions which have been put on this method of transportation being absolutely prohibitive. These restrictions were brought about in consequence of the introduction of traction engines, as we now see them on our country roads. The pace of steam-propelled vehicles is limited to three miles an hour, and it is necessary that a man should walk in front of the engine with a red flag; naturally such regulations make the carriage of passengers out of the question.

This is much to be regretted, for steam carriages, as has lately been proved by continental experience, can be made both safer and more expeditious than those drawn by horses. They are more under control, being easily stopped and turned, and they are naturally far cheaper.

To return, however, to Sir Frederick Bramwell's paper, the details of the early road steam carriages possess considerable interest at the present time, as pipe boilers were used in nearly all of them, and now that the water-tube boiler is coming to the front so rapidly, it is interesting to see what was done by the pioneers of steam engineering. Many inventors whose brains are active in this field would do well to study the earlier records, for old types are now being reinvented at an expenditure of much useless brain work and anxiety.

The second day of meeting of Section G (Friday, August 10) was a very busy one, a joint sitting having been arranged with Section A. Four subjects were down for discussion, as stated in the above list of papers.

Prof. Henrici's contribution was one of great interest, as also was Mr. Mallock's note on the behaviour of the rotating cylinder. Lord Kelvin also gave a valuable lecture on the resistance of solids moving through fluids.

Public interest, however, was chiefly centred in the paper read by Mr. Maxim, in which he described his flying machine. To hear this part of the transactions a large number of members flocked into the hall, many of them being ladies. Some of the members present did not appear to take much interest in the more abstruse subjects dealt with by the previous lecturers, and their want of attention made it a little difficult to follow the first three speakers.

Two papers, relating purely to Section G, were taken on this day; the first was Prof. Fidler's monograph on the extensibility of iron and steel, a valuable contribution which, however, was read to a very thin audience.

The author pointed out that the stress-strain diagram of ductile material as autographically drawn does not indicate any definite relation between tensile stress and plastic strain. The unit stress varies in different parts of the bar; the elongation measure by the diagram being that of the whole bar. The author's experiments indicated that the plastic extensibility under any given stress is nearly the same in all segments of the bar's length, even when the ultimate elongation varies. Volumetric measurements of the successive segments indicate that there is no sensible telescopic shear, and justify the general application of the assumption of unchanging volume. It might at first sight be supposed that a bar of uniform plastic extensibility ought to draw out uniformly over its whole length, but beyond a certain critical point a uniform extension is almost impossible. In order to illustrate these points in a bar of mild steel a diagram had been prepared. The law of plastic extension is determined by the curve, fixed mathematically the curves of the plastic limit, and it fixed also the breaking weight per square inch of original area. In regard to the possibilities of deformation in a bar of nearly uniform extensibility, as the plastic limit is approached the slightest irregularity in section or in extensibility tends to precipitate the formation of a contracted region, and beyond that limit the further extension of the bar and the further contraction of area will be confined to the same region. For stresses below the plastic limit the probabilities of deformation might be examined by considering the relative time rates of extension at two elements which may have been unequally stretched, and at first the tendency is theoretically in favour of preserving the cylindrical form of the bar. But beyond the plastic limit these conditions are reversed, and the tendencies are all in favour of precipitating the most rapid contraction of area at the point where any contraction already exists. Referring to the yield-point, sudden elongation takes place at different stresses in the different segments, while in any one short element it seems to be instantaneous. If the yield is arrested midway and the bar examined, it may be found that the elongation has been completed in some segments and not commenced in others.

In the discussion which followed, Profs. Unwin, Ewing, and Hele-Shaw and Sir Benjamin Baker took part. Prof. Hele-Shaw pointed out that certain bronzes, unlike steel, would contract in several places at once.

Mr. Fitzmaurice's paper on the Blackwall Tunnel gave an interesting description of that important work, now being carried out under Mr. Binnie, for the London County Council.

Two papers only were read on Saturday of the meeting. The first an extremely interesting contribution by Sir Andrew Noble, of Elswick. The author referred to the early experiments of Count Rumford to ascertain the pressures in the bores of guns, and pointed out the errors into which that investigator was led. He referred to the researches of Robins, Cavalli, Rodman, and those of the Prussian Artillery Committee of 1854. He also gave details of experiments made by himself, from which it would appear that with projectiles of increasing weight very different results are obtained, in regard to pressure, with modern slow-burning powders than with the older fine grain powders.

Mr. Bryan Donkin's paper was also one of considerable interest, and gave details of an extensive series of experiments made by the author. He pointed out that in most cases cylinder walls of engines are much colder than the steam, and often one-half the weight of steam is condensed during admission. The details of this will be published later, and at greater length, in the Proceedings of the Institution of Mechanical Engineers. It may be said generally, that throughout the experiments an increase of economy with hotter walls was always verified.

On Monday the proceedings were largely devoted, according to custom, to electrical engineering.

Mr. Preece's paper, on signalling through space, was of a very popular nature, and attracted a large audience. He described the operations which took place at Kilbrannan Sound. It is satisfactory to know that the Post Office authorities are introducing metallic returns wherever possible for telephone circuits.

Prof. Sylvanus Thompson's paper was in praise of alternate currents. The author expressing his opinion that the alternate current system would entirely supersede continuous currents for lighting and power distribution purposes. The continuous current being superior for electrolytic purposes alone. Mr. Preece supported the paper, whilst Prof. Kennedy and Mr. T. Parker took entirely different views.

Mr. Parker's paper was an excellent description of the electric lighting in the city of Oxford. Mr. Lea described a special form of chronograph he had had made to his own designs. Mr. Clark's paper was also one of value, and should be studied in the original by those interested in the measurement of high temperatures.

Tuesday's proceedings commenced with the reading of the Report of Prof. Unwin, of the Committee on the Dryness of Steam. This is a long and valuable report, but as it will appear in full in the Transactions of the Association, it is not necessary we should deal with it on the present occasion.

Mr. Burstall, in his paper, and by aid of a model which he exhibited, has given a new means of illustrating the temperature entropy diagram. This model will doubtless be seen on future occasions. Considerable ingenuity has been shown in its construction. Mr. Swinburne's paper was one of practical interest to engineers, whilst Prof. Capper's contribution on the calibration of laboratory instruments will prove of value, and is worthy of passing notice. The author stated that the reliance to be placed upon observations made with measuring instruments evidently depends upon the accuracy with which those instruments record. Neglect of this fundamental truth often leads to inaccurate and erroneous deductions from experiments which are themselves of the highest scientific value; not infrequently the whole value of observations may be destroyed by insufficient care in the calibration of the instruments used. The subject is therefore one of some importance. The author described the chief sources of error in some of the most common engineering

investigations, and their probable value, and pointed out some of the possible methods of correction where such exist. For example, in engine trials there are many possible sources of error. Most of these may be reduced in percentage value by continuing the trial for a sufficient period. But this is not the case with errors which may occur in the indicators, gauges, or spring balances used in the determination of power. In these, unless properly calibrated before trial, very serious errors may be introduced, amounting in some cases to 5 or 6 per cent. of the total power indicated. It is therefore, he said, absurd, even if proper precautions have been taken, to rely upon horse-power measurements to two places of decimals. With regard to tension and compression experiments with standard 10-inch bars, calibration of the testing machine is extremely difficult, and can in general only be carried out over a small portion of the range of the experiments. Deductions have therefore to be made from the less to the greater, with the result that small errors in the calibration will tend to be magnified. Vertical testing machines have fewer sources of error, and can be calibrated with more certainty, than horizontal machines. Extensometers are, however, much more easily applied to a horizontal bar than a vertical, and variable jockey weights, which are requisite if the same accuracy is to be maintained at low loads as at high, are also more readily adapted to horizontal machines. Extensometers can be made and calibrated well up to the accuracy of the testing machine. With standard bars and a measuring instrument true to the ten-thousandth of an inch, the modulus can be relied upon to the second significant figure. It is doubtful if more can be obtained without very special construction and calibration of the testing machine. The difficulty in bending experiments, again, lies in the accurate application of load. Unless the beams are very short or of unmanageable cross-sections, the load measurement must be very delicate if readings approaching the accuracy of those in tension are to be obtained. It is possible that some of the discrepancies in published beam experiments may be due to this cause. The paper dealt briefly with other cases where calibration is specially needed.

Mr. Kenward's paper was of value, both from an historical and a practical point of view. It was illustrated by a number of drawings and photographs.

ANTHROPOLOGY AT THE BRITISH ASSOCIATION.

THURSDAY, August 9.—Dr. E. B. Tylor read a paper on the distribution of mythical beliefs as evidence in the history of culture. The author showed that the wide distribution of several mythical beliefs, such as the idea of souls being weighed in a spiritual balance, and that of the Bridge of the Dead, gave evidence of connecting links between the great religions of the world. The theory that the pre-Columbian culture of America took shape under Asiatic influence was supported by evidence of a similar nature. Thus, in the religion of ancient Mexico four great scenes in the journey of the soul in the land of spirits are depicted in a group in the Aztec picture-writing known as the Vatican Codex: first, the crossing of the river of death; second, the passage of the soul between two mountains that clash together; third, the soul climbing up a mountain set with sharp obsidian knives; fourth, the dangers resulting from these knives being carried about by the wind. There is a close resemblance between these Mexican pictures and certain scenes from the Buddhist purgatory depicted on Japanese temple scrolls. Here are seen, first, souls wading across the river of death; second, souls passing between two huge iron mountains, which are pushed together by demons; third, souls climbing the mountain of knives, whose sharp blades cut their hands and feet; fourth, knife-blades flying through the air. Dr. Tylor also referred to Humboldt's argument from the calendars and mythic catastrophes in Mexico and Asia, and to the correspondence in Bronze-Age work and in games in both regions, and expressed the opinion that the evidence was sufficient to justify anthropologists in considering that ancient American culture was due to a great extent to Asiatic influence.

Dr. Beddoe read a paper on complexional differences between the Irish with indigenous and exotic surnames. The author showed that dark hair and light eyes are much more prevalent among the former class of Irishmen than among the latter.

The following reports were also read:—Report of the Anthropometric Laboratory Committee, report of the Ethnographical Survey Committee, report of the Anthropometry in Schools' Committee.

Friday, August 10.—The greater part of the day was devoted to a joint discussion with the Geological Section on the plateau flint implements of North Kent. The discussion was opened by Prof. T. Rupert Jones, in a paper in which he expressed general concurrence with the views of Prof. Prestwich as to the genuineness and antiquity of the implements found in the plateau gravels. He argued that the gravel in which the flints were found must have been of pre-Glacial Age. Mr. Whitaker could not admit that there was any good evidence to connect the men who worked the flints with pre-Glacial or even with glacial times, as there were no deposits of undoubted Glacial Age in or near the district. Mr. Montgomerie Bell stated his reasons for believing that the collections of flints from the plateau gravels were of human handiwork. He said that all the evidence pointed to the working of a race of men with strongly-developed body but weakly-developed mind, and this was exactly the conclusion we should expect. Sir John Evans said that the evidence as to the Palæolithic Age in Suffolk being locally post-Glacial was irrefragable, and that the principal outcome of the recent discoveries was, to his mind, the fact that the existence of palæolithic man could be carried further back in time than the valley gravels, inasmuch as his implements are now found in gravels on plateaus at far higher levels. General Pitt-Rivers contended that a single bulb of percussion was not in itself sufficient to prove human workmanship. The bulb of percussion shows the direction in which the blow was given, but any hard knock would produce it, and it was necessary that two or three blows at least should have been given in some definite direction in order to prove design on the part of the fabricator. Dr. H. Hicks, Prof. Boyd Dawkins, Sir Henry Howorth, and Lieut.-Colonel Godwin Austen also took part in the discussion. Mr. H. Stopes read a paper on the evolution of stone implements, and the following reports were presented:—Report of the Prehistoric and Ancient Remains in Glamorganshire Committee, report of the Elbolton Cave Exploration Committee, report of the Explorations at Oldbury Hill Committee.

Saturday, August 11.—Mr. Arthur Evans read a paper on the discovery of a new hieroglyphic system, and pre-Phœnician script in Crete. During the exploration of the ancient sites of Central and Eastern Crete, the author had succeeded in bringing to light a series of stones presenting pictographic symbols of a hieroglyphic nature, and was now able to put together over seventy symbols belonging to an independent hieroglyphic system. More than this, he had discovered partly on stones of similar form, partly engraved on prehistoric vases and other materials, a series of linear characters, a certain proportion of which seemed to grow out of the pictorial forms. As in the case of the Egyptian and Hittite symbols, the Cretan hieroglyphics fell into certain distinct classes, such as parts of the human body, arms and implements, animal and vegetable forms, objects relating to maritime life, astronomical and geometrical symbols. Some of them belonged to that interesting class of pictographs which is rooted in primitive gesture language. The symbols occurred in groups, and there were traces of a boustrophedon arrangement in the several lines. The comparisons instituted showed some interesting affinities to Hittite forms. The linear and more alphabetic series of symbols fitted on to certain signs engraved on the walls of what was apparently a Mycenean palace at Knôsos, and again to two groups of signs on vase handles from Mycenæ. It was thus possible to construct a Mycenean script of some twenty-four characters, each probably having a syllabic value. The author gave reasons for believing that the Philistines, who, according to unanimous Hebrew tradition, came from the Mediterranean islands, and who were actually called Krethi in the Bible, in fact represented this old indigenous Cretan stock, and that they had here the relics and the writing of "the Philistines at home."

Mr. Arthur Evans exhibited a number of prehistoric objects collected during his journey and explorations in Central and Eastern Crete.

Mr. H. Balfour, in a paper on the evolution of the bow as a musical instrument, gave the aboriginal races of Africa and India the credit of providing us with the prototype of many of our best string instruments.

Miss Weld read a paper on the possibility of a common language between man and beast, in the course of which she mentioned that she had herself reduced a large and savage dog to a state of the most abject terror by imitating some of the deeper tones of his growl.

The Rev. G. Hartwell Jones read a paper on the relation between the body and mind, as expressed in early languages, customs, and myths. The conclusions at which the author arrived were that (1) the primitive condition of the pioneers of civilisation was no higher than that of modern savages; (2) the parallels presented by words and ideas in countries widely separated from one another cannot be satisfactorily explained by mere coincidence; and (3) the civilisation of Western Europe viewed as a whole began in contact with the East.

The following papers were also read:—Prof. A. Macalister, on the heredity of acquired characters; Prof. Arthur Thomson, notes on skin, hair and pigment; Dr. Louis Robinson, the anthropological significance of ticklishness; H. Ling Roth, on the presence of Negritoes in Borneo; Prof. B. Windle, on mythical pygmy races; report of the Mental and Physical Condition of Children Committee.

Monday, August 13.—A paper by Prof. J. Kollmann, on pygmies in Europe, was read. Near Schaffhausen, in Switzerland, a prehistoric settlement has been discovered, in which the remains of two races were found interred side by side. The average stature of one of these races was that of Frenchmen of the present day, but the average height of the other race was only 1424 mm., and they must be looked upon as pygmies of the Neolithic period in Europe. There have recently been discovered some living pygmies in Sicily and Sardinia, and in the author's opinion these small types must be regarded, not as diminutive examples of normal races, but as a distinct variety of mankind which occurs in several types dispersed over the globe; and he believes that they have been the precursors of the larger types of man.

The present state of prehistoric studies in Belgium was described in a paper by Count Goblet d'Alviella. The manufacture of flint implements appeared to have been an important industry, extending all over Belgium, and there have been recent discoveries of megalithic monuments, the existence of which was till lately denied.

General Pitt-Rivers described the explorations of British camps and a long barrow near Rushmore. The skeletons of upwards of twenty-five persons found in and around the barrow give evidence of a people of small stature with long, narrow skulls. They belonged to the polished stone age.

The following communications were also received:—Dr. E. B. Tylor, on some stone implements of Australian type from Tasmania; H. Ling Roth, on Tasmanian stone implements; Dr. Émile Cartailhac, on the art and industry of the Troglodytes of Bruniquel, France; Dr. Émile Cartailhac, on a new ivory statuette of a woman in the reindeer period; Dr. Émile Cartailhac, on the close of the stone period on the borders of the Mediterranean; Prof. Max Lohest, observations relative to the antiquity of man in Belgium; General Pitt-Rivers, on a new craniometer; Dr. J. G. Garson, on the long barrow skeletons from near Rushmore; Dr. R. Munro, notes on ancient bone skates; Prof. A. C. Haddon, exhibition of lantern slides illustrating the people of Western Ireland and their mode of life; report of the Glastonbury Exploration Committee.

Tuesday, August 14.—Mr. Theodore Bent read a paper on the natives of the Hadramut. This valley was formerly the great centre from which frankincense and myrrh were exported to Europe by caravan routes across the desert, and the modern inhabitants of this district are quite distinct from the Bedouins of northern Arabia; they have many curious customs and a religion of their own, and are in all probability an aboriginal race.

Mr. J. Gray contributed a paper on the distribution of the Picts in Britain as indicated by place-names. The evidence of place-names shows that probably the whole country from the north of Britain to the south of Gaul was at one time or another occupied by the same race. The pre-Pictish inhabitants were Iberians, and prevailed mostly in Ireland, South Wales, Cumberland, and South Scotland.

The following communications were also received:—Mrs. H. Stopes, on three neolithic settlements in Kent; Lionel Decle, on the native tribes of Africa between the Zambezi and Uganda; Prof. Max Kovalevsky, on the Lex Barbarorum of the Daghestan; J. D. C. Schmeltz, on snails and mussels in the housekeeping of the Indoneses; Basil H. Thomson, on the ancient religion of Fiji; B. P. Kehlpannala, on ceremonies observed by the Kandyans in paddy cultivation.

Wednesday, August 15.—Prof. L. Manouvrier described the brain of a young Fuegian, and pointed out that the external morphology of this brain showed little or no distinction from that of a European.

The Rev. Lorimer Fison read a paper on the classificatory system of relationship. The Fuegian system of relationship divide the sexes in any one generation into groups of non-marriageable persons and other groups of marriageable persons, and it was shown that precisely the same groups appeared as the result of the division of the community into two exogamous intermarrying divisions such as are found in Australia. The inference was that wherever the classificatory terms appeared these divisions had existed in the past.

Mr. J. Graham Kerr read a paper on the Tobas of South America. These Indians are nomadic in their habits, and live entirely on the products of the chase. They believe in the existence of numerous minor evil spirits who cause diseases, accidents, and other misfortunes, but the author had not discovered that they had any notion of a supreme deity.

Mr. Alfred P. Maudslay read some notes on native buildings at Chichen Itsa, Yucatan, and the customs of the Maya Indians. The author gave an account of some excavations of a burial mound in the Vera Paz of Guatemala, and the discovery of small jars containing the bones of little fingers, probably deposited by mourners. The earliest notices of the great Maya ruins at Chichen Itsa were discussed, and extracts were given from a document recently discovered in Seville, in which are described the ceremonies performed by the Mayas at the time of the Spanish conquest.

The other communications received were:—Prof. L. Manouvrier, on a method of valuation of proportional dimensions in the description of the brain; H. Bellyse Baildon, notes on some of the natives of British New Guinea; Miss A. W. Buckland, on the philosophy of holes; report of the North-western Tribes of Canada Committee.

SCIENTIFIC SERIALS.

American Journal of Science, August.—On certain astronomical conditions favourable to glaciation, by G. F. Becker. The elements of the earth's orbit undergo slow variations, some of which affect climate. These are the time of perihelion, which affects the length of the two great seasons; the eccentricity of the earth's orbit, and the obliquity of the ecliptic. The winter of the period of maximum eccentricity in the rigorous hemisphere would be intensely cold as compared with that of the period of zero eccentricity, but the difference would be most marked in the tropics. The summer would be intensely hot, and also wet. On the whole, the period would be most unfavourable to glaciation; the snowfall being the smallest, and the warm rainfall the largest that can occur with the present obliquity. A difference of 1° 9′, however, in the obliquity would make the area to the north of the Tropic of Capricorn 1,800,000 square miles greater than it is to-day, this area being rather more than the combined areas of the Mediterranean and the Gulf of Mexico. The area of evaporation supplying precipitation to the northern latitudes would thus be increased, and the conditions would be favourable to glaciation. Thus a glacial age would be due to the combination of a low eccentricity and a high obliquity, more than to any other set of circumstances pertaining to the earth's orbit. The epochs of such combinations should be deducible from astronomical data.—Development of the lungs of spiders, by Orville L. Simmons. The connection between Limulus and the Arachnida can only be established by a study of the development of the lungs and tracheæ of spiders. The lungs arise as infoldings upon the posterior surface of the appendages of the second abdominal somite, in the same manner as described by Kingsley for the gills of Limulus. The tracheæ develop from the next pair of limbs. The lung-book condition is the primitive, the tracheæ of the Arachnids being derived from it. No ground is left for those who regard the "Tracheata" as a natural group of the animal kingdom.—The generation of chlorine for laboratory purposes, by F. A. Gooch and D. A. Kreider. Chlorine may be conveniently generated by the action of hot hydrochloric acid in a half-strength solution upon lumps of potassium chlorate. These

are placed in the upper chamber of a side-neck test tube constricted in the middle. The tube is fitted with a funnel tube reaching to the bottom, and immersed in a flask filled with hot water. When the acid is at 81° the percentage of chlorine in the gas given off is 84. The chlorine dioxide may be destroyed by passing the gases through a wash bottle containing a saturated solution of $MnCl_2$ in strong hydrochloric acid at 90°, and may be still further eliminated by passing the gas through a hard glass tube filled with asbestos and heated.

The Quarterly Journal of Microscopical Science for March contains studies in mammalian embryology (iii.). The placentation of the Shrew (*Sorex vulgaris*, L.), by A. A. W. Hubrecht. (Plates 31 to 39.) The author shows that the placenta is essentially an embryonic neo-formation, which is permeated by maternal blood that circulates in spaces devoid of endothelium. This embryonic neo-formation is preceded by a considerable proliferation of maternal epithelium, which, however, does not enter into the constitution of the ripe placenta, but affords facilities of fixation and nutrition for the embryonic neo-formation in its earliest stages. The discoid placenta is, in the later stages of pregnancy, the only connection between fœtus and mother.—On some further contributions to our knowledge of the minute anatomy of *Limnocodium Sowerbii*, by R. T. Gunther. (Plate 40.) Some further details regarding the structure of the tentacles, the sense organs, and the male reproductive organs are added to those already recorded by Allman and Lankester. Allman placed this medusa among the Leptomedusæ; Lankester, on the contrary, referred it to the Trachomedusæ. The author writes: "*Limnocodium Sowerbii* is a medusa descended from Leptomedusan ancestors, which has developed sense organs, with an endodermal axis independently of the Trachomedusæ." Allman's paper on *L. victoria*, in which he adopts Lankester's specific name of *Sowerbii*, was published in July 1880, not in 1881, as stated in the list of authors quoted.—Note on the mesenteries of Actinias, by A. Francis Dixon.

June.—Contains studies on the comparative anatomy of sponges (vi.). On the anatomy and relationships of *Lelapia australis*, a living representative of the fossil Pharetrones, by Arthur Dendy. (Plate 13.) By far the most interesting feature of this species is the very remarkable reticulated fibrous character of the skeleton, which appears to have hitherto escaped notice. This character is unknown in any other living calcareous sponge, while it forms the most prominent feature in the large fossil group "Pharetrones" of Zittel, hitherto regarded as extinct. *Lelapia australis* may therefore be regarded as the only known living representative of this important group. The author sums up his interesting and important paper by introducing the family Pharetrones into the system of recent Calcarea, and regards Lelapia as a very specialised type of Grantidæ.—The structure of the bill and hairs of *Ornithorhynchus paradoxus*, with a discussion of the homologies and origin of mammalian hair, by Ed. B. Poulton. (Plates 14, 15, and 15A.)—A contribution to our knowledge of the Oligochæta of tropical Eastern Africa, by Frank E. Beddard (plates 16 and 17), describes eight new species belonging to the genera *Eudriloides*, *Polytoreutus*, and *Gordiodrilus*, and describes the new genera *Pareudrilus*, *Alluroides*, and all the species collected in Zanzibar and Mombassa.—A further contribution to the anatomy of *Limnocnida tanganyicæ*, by R. T. Gunther. (Plates 18, 19.) The author bases his researches on material caught and fixed in osmic acid by Mr. A. Swann, on the shores of Lake Tanganyika.—Notes on the minute structure of *Pelomyxa palustris* (Greeff), by Lilian J. Gould. (Plates 20 and 21.) The appearance of "a central mass of doubtful significance" is noted; the "glanzkorper" of Greeff were found to stain with several reagents, and the rod-like bodies appear to be certainly bacteria.

The Mathematical Gazette, No. 2. (Macmillan, July.)—W. J. Greenstreet gives a summary of Herbart's views of the place of mathematics in education. The key-note to Herbart's position is "no one can be expected to think himself into the strict uniformity of nature, who has had no training in the rigorous discipline of mathematics and its deductions." G. Heppel takes for the first of his mathematical worthies Edward Wright, who was "probably born about 1560, and died in 1615." In the matter of the New River, Wright appears to have afforded an illustration of the Virgilian "Sic vos non vobis," as he conceived the project, but was ousted by Sir Hugh Middleton. Further interesting particulars of this too-little-known mathematician are given by (De Morgan?) in the *Penny Cyclopædia*, and in Ball's "History." E. P. Rouse contributes a note on the "Director circle of a conic inscribed in a triangle." Solutions of questions, and questions and short notes complete a good number.

Bulletin of the New York Mathematical Society, vol. iii. No. 10. (New York: Macmillan, July.)—Prof. A. Vasiliev (pp. 231–235) furnishes many items of interest in his note, Lobachèvsky as Algebraist and Analyst. In this it is shown that Lobachèvsky's genius was not confined to geometry only. In Macfarlane's "Algebra of Physics" (pp. 235–242), Dr. Chapman analyses the Principles of the Algebra of Physics, and the paper on the Imaginary of Algebra, by that mathematician. Dr. G. A. Miller supplements his note in the April number by a note on the substitution groups of eight and nine letters (pp. 242–245). Prof. Webster (pp. 245–248) reviews Byerly's elementary treatise on Fourier's series and spherical, cylindrical, and ellipsoidal harmonics, and at the outset discusses "a rather singular review (of the book) in a leading New York paper, in which a number of curious statements are made." Prof. D. E. Smith's review of Cajori's history (see NATURE, No. 1288, p. 235) is the subject of a critique, by Prof. Halsted, to which Prof. Smith replies (pp. 249–251). The concluding notice is on orthogonal substitutions, by Prof. H. Taber (pp. 251–259). A long list of publications, notes, and an index closes vol. iii.

Memoires de la Société d'Anthropologie de Paris, tome i. (3e serie), 2e fascicule.—Recherches Ethnologiques sur le Morvan, by Ab. Hovelacque and Georges Hervé. The district known as Morvan includes parts of four Departments—Yonne, Côte-d'Or, Nièvre, and Saône-et-Loire; it is distinguished from the surrounding country by the volcanic nature of the soil, and the central portion, or Upper Morvan, has a mean elevation of 600 to 700 metres (about 2000 feet) above sea-level. The climate is exceedingly inclement, the temperature cold and variable, the winters long and severe. Morvan is essentially Celtic, and the primitive inhabitants have been very slightly influenced by contact with the people around them. The stature indicates two ethnic elements, the one moderately tall—the Kymric; the other shorter—the Celtic, such as we find distributed over a great part of Central Europe. About two-thirds of the population of Morvan have grey or sometimes blue eyes; the others have brown eyes, light rather than dark. Usually the children have auburn hair, and the adults dark brown hair.

Memoires de la Société d'Anthropologie de Paris, tome i. (3e serie), 3e fascicule.—The Anthropology of France—Dordogne, Charente, Creuse, Corrèze, Haute-Vienne—by Dr. R. Collignon. The author has turned to good account the observations made during recruiting operations in the five departments mentioned in the title. The mean stature shows greater variation than in any other part of France, the maximum being 1·667m., while a minimum of 1·568m. was observed at Saint-Mathieu (Haute-Vienne). All the tall cantons are grouped at the circumference of the five departments, and the people of short stature are collected in groups in the centre. As the result of his investigations, the author shows that in this district we have three great groups: first, the brachycephalic—some dark, others fair—tall or short; second, dolichocephalic and fair; third, dolichocephalic and dark. This last group may be further subdivided into some three types: the first, platycephalic, with a disharmonic face; the next, dolichopsic, with a high head; the last, somewhat rarely met with and characterised by prognathism, a low and retreating forehead, black hair, and narrow face. The dolichocephalic brunettes are nearly allied to the Cro-Magnon type, while those who are prognathous, and who have the long narrow face, are perhaps distant relatives of the men of Canstadt and Spy, possibly also they may be distantly allied to the swarthy inhabitants of the south Algerian oasis.

Bulletins de la Société d'Anthropologie de Paris, tome v. (4e serie), No. 1, January; No. 2, February.—In a paper on the various forms of the teeth of different races, Dr. F. Regnault says that the canines of the lower races of man differ from those of the higher races, in that the crown of the tooth is larger in comparison with the neck, and that, like those of the apes, they terminate in a sharp point, which is usually much worn. M. Émile Schmit, in a paper on the "Boves" of Champagne, describes two of these curious subterranean

chambers, excavated in the chalk, and approached by low narrow passages of some length.—A paper by M. Zaborowski, on ten crania from Rochefort, is continued from the January to the February number. M. Zaborowski argues in favour of the primitive ethnical identity of the blondes, wherever they are found in a state of purity, whether in the Caucasus, in England, or in Charente-Inférieure.—M. Zaborowski also contributes a paper on the circumcision of boys and the excision of girls as initiation ceremonies. He traces the origin of the custom in Asia and Europe to the influence of ancient Egypt.—M. de Saporta describes certain popular medical practices in Provence. In cases of delirium or meningitis, if the warm body of a recently killed pigeon is not available, they have recourse to a fried egg, which is placed, burning hot, on the forehead of the patient. M. de Saporta does not think that any supernatural virtue is attached to these practices.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 31.—"On the Effect of Magnetisation upon the Dimensions of Iron Rings in Directions perpendicular to the Magnetisation, and upon the Volume of the Rings." By Shelford Bidwell, F.R.S.

A recent communication (*Roy. Soc. Proc.* vol. lv. p. 228) to the Society contained an account of some experiments relating to the effects of magnetisation upon the dimensions of two iron rings, one of which was annealed and the other hardened. The rings had the form of short cylinders about 6 cm. in diameter, 3 cm. in height, and 0·4 cm. in thickness. The experiments in question were concerned with the circumferential variations which took place along the lines of magnetisation; those to be here described deal with the concomitant variations in the height of the cylinders (width of the rings) transversely to the magnetisation. On the assumption that variations similar to the latter occur at the same time in the thickness of the

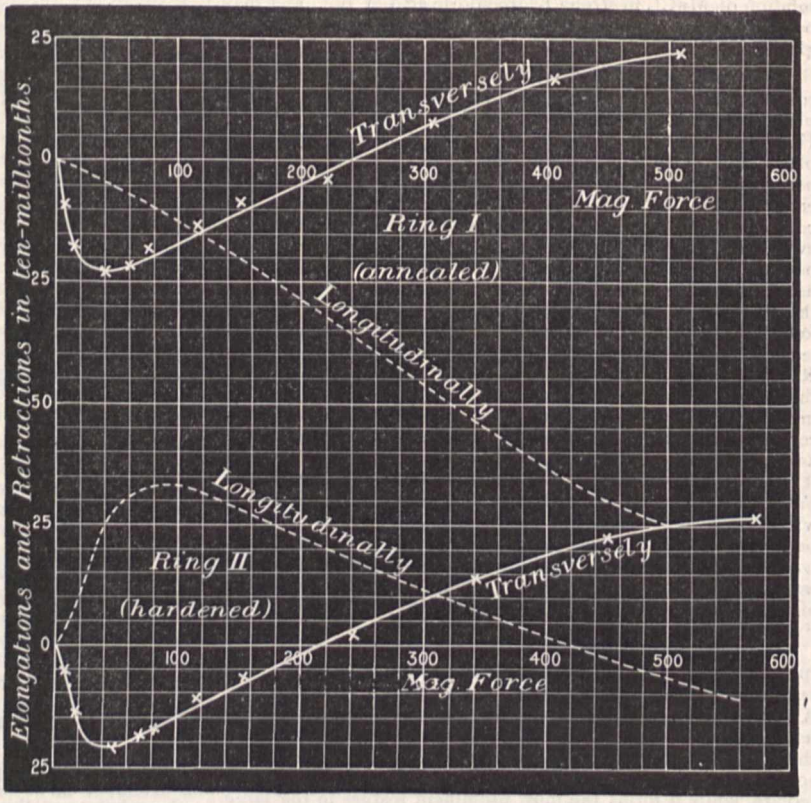


FIG. 2.—The curves marked "longitudinally" relate to circumferential changes, *along* the lines of magnetisation. Those marked "transversely" relate to changes in the width, *perpendicularly* to the magnetisation.

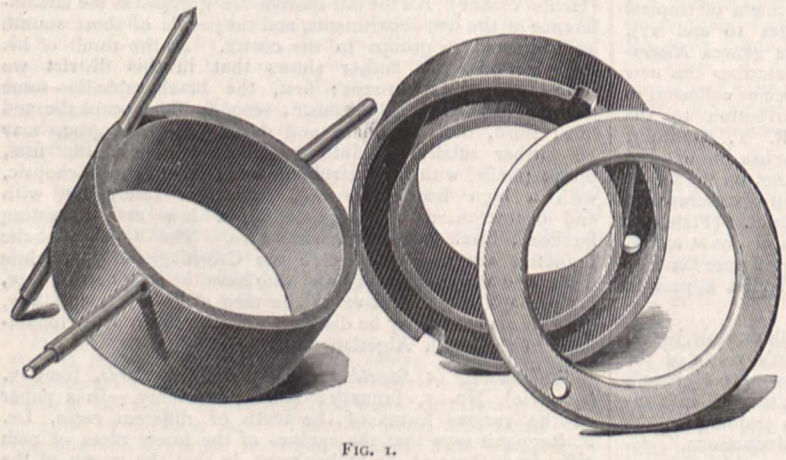


FIG. 1.

metal, it is possible to deduce the changes in the volume of the ring which attend magnetisation.

Fig. 1, from a photograph, shows how the rings were prepared for the experiments. Four brass rods were hard-soldered to the iron, two of them being in a line with a diameter, while the other two were attached to the edges, opposite to one another, and parallel to the axis of the ring. The ring was inserted in a wooden case, also shown, through holes in which the four brass rods projected. Insulated wire for carrying the magnetising current was wound over the wooden jacket.

For the new experiments the ring was placed in a horizontal position, one of the edge rods resting upon a brass socket on the adjustable base of the instrument, and the other, which had a chisel-shaped end (not shown in the figure), actuating the lever. To counterbalance the weight of the ring a horizontal arm, carrying a sliding weight, was fixed to the lower rod.

The annealed ring will, as before, be distinguished as Ring I. and the hardened one as Ring II.

The changes observed in the widths of the two rings (transversely to the magnetisation) are indicated in the curves of Fig. 2. It will be seen that they are quite similar in the two cases, little or no effect being produced by annealing. Under gradually ascending forces both rings first become narrower, then recover their original width, and ultimately become wider than when unmagnetised.

As was shown in my last paper, the effects along the lines of magnetisation are very different in the two rings. The annealed ring (Ring I.) begins to contract circumferentially with the smallest forces, and continues to contract with the large ones; while the hardened ring expands with small forces and contracts with large ones. These effects are indicated in the figure by the dotted curves.

By combining the results of the old and of the new experiments we can ascertain the nature of the changes produced by magnetisation in the volumes of the rings. These are indicated

in Fig. 3, which shows that the volume of the annealed ring is rather suddenly diminished by a small magnetising force, passes a minimum under a force of about 50 units, and then slowly increases, until, with a force of 500 units, it is about 30 ten-millionths less than at starting. The unannealed ring also at

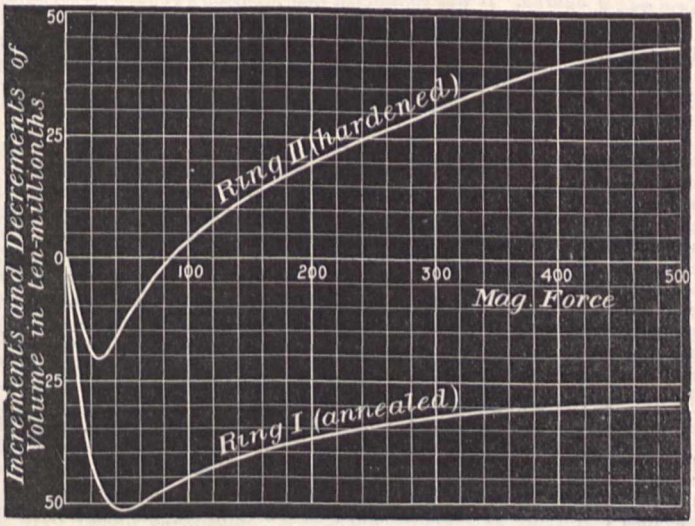


FIG. 3.

first suffers diminution, but its original volume is recovered with a force of about 90 and with higher values is increased.

The behaviour of this latter ring may be regarded as probably similar to that of the great majority of rods and rings, the annealed ring used in these experiments being the only specimen of iron that has yet been found to contract along the lines of magnetisation with the smallest forces that produced any effect at all.

EDINBURGH.

Royal Society, May 28.—Prof. James Geikie, Vice-President, in the chair.—Dr. Ramsey Traquair described some fossils from Forfarshire.—Dr. James Buchanan Young read a paper on the chemical and bacteriological examination of soil, with special reference to the soil of graveyards. He discussed the results of a series of experiments which he had made on samples of virgin soils, pure agricultural soils, and soils which had been, and were being, used for purposes of inhumation. From these results as judged by the amount of organic carbon and nitrogen present in the various samples, it would appear that soil which has been used for burial, does not materially differ as regards the amount of organic matter it contains from pure good agricultural soil. This fact goes far to support the idea that inhumation properly conducted in suitable and well-drained soils can cause no risk to the public health. The results of the bacteriological examination of the various soils goes to corroborate the results arrived at by chemical means. No pathogenic organisms were found in graveyard soils; and, although the number of bacteria present was greater than at similar depths in virgin soil, the number found was by no means so great as one might have expected. There was, moreover, a very marked and sudden fall in the number of micro-organisms in the soil below the layer containing the coffins. So that, as Reimers has pointed out, the "ground-water region" is practically free from bacteria. The broad results of the chemical examination of the samples is well seen in the annexed table. The results are stated in parts per hundred.

	Carbon.	Nitrogen.
Virgin soils	0·265 ...	0·0257
Pure agricultural soils ...	0·842 ...	0·0936
Soils used for inhumation	0·870 ...	0·1073

—A paper, by Dr. J. G. Gilchrist, on the pallial complex of *Dolabella*, was read.—Dr. James Walker communicated an account of hydrolysis in some aqueous solutions.

June 4.—The Hon. Lord M'Laren, Vice-President, in the chair.—Prof. Tait read a note on the application of Van der Waal's equation to the compression of ordinary liquids.—Prof. Geikie read a note, by Messrs. G. Sharman and E. T. Newton, on fossils from Seymour Island, collected by a recent Dundee expedition to the Antarctic Seas. Nine specimens had been found in a district farther south than districts previously explored. All represented existing genera of wide distribution, but the fossils indicated more genial climatic conditions than those now existing.—Prof. D'Arcy Thompson read a paper on certain difficulties in the study of classical zoology.

June 18.—Sir W. Turner, Vice-President, in the chair.—Prof. Copeland read a paper on the path of the meteor of May 18, 1894. This was a large meteor seen in daylight, and first observed somewhere between the island of Mull and the north end of Jura. It was last seen in the north-west district of Yorkshire. Observers judged it to be moving slowly, but calculation showed that it moved over 190 miles in about fifteen seconds.—Prof. Tait read a paper on the elastic equations of the ether in æolotropic dielectrics. He has not yet discussed the question of the stability of the condition of the ether indicated by his equations.—Dr. John Murray gave a comparison of the extra-tropical marine fauna of the northern and southern hemispheres. The similarity of the Arctic and Antarctic marine fauna, and the difference of both from the fauna of intermediate waters, indicate, according to Dr. Murray, a not very remote geological time at which a universal fauna—implying uniformity of temperature—existed. He believes that in Mesozoic times forms of life were driven from the poles towards the tropics, while the fauna which was able to remain under the altered polar conditions gave rise to the present polar fauna.—Prof. Tait gave some illustrations of the range of application of Van der Waal's equation, contrasting the results got from the equation with observed results regarding the compression of liquids.—Dr. C. G. Knott and Mr. A. Shand read a paper on magnetic induction in nickel tubes. Three nickel tubes were compared, as regards their magnetic properties, with a nickel bar. All were cut from the same rod, were of the same length (44 cm.), and the same external diameter (4·2 cm.), but differed in diameter of bore. As with the iron and steel tubes formerly described (*Proc.* R.S.E., 1893), a tendency was shown, in low fields, for the magnetic movements to approximate to the same value. But the tendency was not so well marked. The explanation seems to be that, because of the comparatively low susceptibility of nickel in low fields, the "diamagnetising factor" (so called by Dr. Du Bois) is not of the same paramount importance as in the case of iron or steel. A simple calculation showed that this factor was approximately proportional to the area of section of the metal wall of the tube.

July 2.—The Hon. Lord M'Laren, Vice-President, in the chair.—A paper, by Prof. Cayley, on co-ordinates *versus* quaternions, was communicated.—Prof. Tait read a paper on the intrinsic nature of the quaternion method.—Dr. C. G. Knott and Mr. A. Shand communicated a preliminary note on volume changes which accompany magnetism in nickel tubes. The three tubes, referred to the authors in their previous paper on magnetic induction in nickel, were employed. In high fields the internal volumes were markedly diminished in all three. The greatest measured change in volume was 2·4 cubic millimetres; this was in the tube of thinnest wall in field 600. The greatest cubical dilatation was $-2{\cdot}3(10)^{-5}$, which was got in the tube of narrowest bore in field 600. The cubical dilatation, though negative in high fields, was positive in moderate fields, the change of sign occurring in a field which was lower as the wall of the tube was thinner. With the tubes of widest and intermediate bore, the cubical dilatation was negative in very low fields, each having critical fields for which the dilatation was zero. The tube of narrowest bore did not show this double change of sign. As was perhaps to be expected, the volume changes in the nickel tubes were distinctly greater than the like changes in the iron or steel tubes formerly investigated.—Dr. Gustave Mann communicated a paper on histological changes produced in nerve cells by their functional activity. Experiments on rabbits and dogs have shown that the nuclei and cells were larger in stimulated, than in non-stimulated ganglia. In the stimulated ganglia the lymph spaces practically disappear, while they are quite evident in the non-stimulated ganglia.

PARIS.

Academy of Sciences, August 20.—M. Lœwy in the chair.—Electricity considered as a vortical movement, by M. Ch. V. Zenger. The author shows that an electrical discharge produces a whirling movement in the gas through which it is discharged, which may be said to be a cyclone on a small scale, so completely are the phenomena of cyclones reproduced. The particles appear to describe a trajectory which may be represented by a screw of variable pitch traced on a conical surface. —New experiments permitting the comparison of the delivery of liquids, gases, and vapour from the same orifices, by M. H. Parenty. (1) The coefficients of delivery of gases are precisely equivalent to those of the submerged delivery of liquids. (2) These coefficients are not sensibly varied when the pressure and the back-pressure are modified in various ways; they are independent of the temperature and the atmospheric pressure. (3) There exists, for liquids, no analogous phenomena to the regularity of delivery of gases. The delivery of liquids is exactly and always the ordinate of a parabola, of which the loss of charge is the abscissa.—On the periodicity of the absorption rays of isotropic substances, by M. G. Moreau. The author concludes a mathematical investigation of this question as follows: In an isotropic absorbent, there should be two possible kinds of waves of propagation. The one gives bands by anomalous dispersion (they may be reduced to very fine and black rays by regular dispersion), the other gives less intense rays, but they are periodic and more numerous. They would form a kind of double refraction which observation does not seem to have indicated.—On the action of the halogen hydracids on formaldehyde in presence of alcohols, by M. Louis Henry. A claim for priority as against M. C. Fabre.—Action of camphoric anhydride on benzene in presence of aluminic chloride, by MM. E. Burcker and C. Stabil. Two substances besides the principal product, phenylcamphoric acid, have been isolated, namely, phenylcamphoric anhydride, $C_{16}H_{18}O_2$, and a diphenyl compound represented by the formula $PhCO \cdot CPh\begin{matrix}CO \cdot CH_2 \\ CH_2 \cdot CH_2\end{matrix}CH \cdot C_3H_7$.—The extraction of free acids from beeswax, by M. T. Maire.—Influence of lesions of tissues on their aptitude for fixing dissolved substances, by MM. A. Charrin and P. Carnot. It is shown that dissolved substances tend to accumulate in unhealthy or injured tissues.—On some antitoxic properties of the blood of the terrestrial salamander (*Salamandra maculosa*) against curare, by MM. C. Phisalix and Ch. Contejean. The salamander requires eighty times as much curare as the frog for poisoning to take place. The immunity of the salamander may be due to the presence in its blood of some substance which neutralises the effect of this poison. In support of this hypothesis, it is found that a mixture of salamander-blood and curare in proper proportions does not act on the frog. This substance has a physiological action conferring immunity against curare, and not a direct chemical action on the latter, for the inoculation of frogs with salamander-blood twenty-four hours before the injection of curare enables the frogs to withstand a much larger dose than when the salamander-blood has been mixed with curare previous to injection.—On the budding of Diplosomidæ and Didemnidæ, by M. Maurice Caullery.—Researches on the respiration and assimilation of the Muscineæ, by M. B. Jönsson. There are great differences among the Muscineæ in regard to the intensity of respiration and chlorophyllian assimilation. For example, the different species disengage in the dark very different quantities of carbon dioxide per gramme of dry weight. The proportion of water present in the plants is an important cause of variation, the greater this proportion the more intense are the gaseous exchanges. Specimens taken from a very damp place give off more gas than specimens of the same species taken from a dry location. The reddish coloration of many mosses, very marked when the plants have been developed in the light, diminishes considerably the intensity of respiration and assimilation.—On the perithecæ of the "Rot blanc" of the vine (*Charrinia diplodiella*), by MM. P. Viala and L. Ravaz.—On the chemical constitution of the atmosphere, by M. T. L. Phipson.

NEW SOUTH WALES.

Linnean Society, June 27.—Prof. David, President, in the chair.—Description of five new fishes from the Australasian region, by J. Douglas Ogilby. Of the species described, *Gilchthys mirabilis* and *Clinus whiteleggei* were from the coast of New South Wales, *Ophioclinus de visi* from Queensland, *Petroscirtes icelii* from Lord Howe Island, and *Eleotris huttoni* from New Zealand.—The land molluscan fauna of British New Guinea, by C. Hedley. Two new species, *Sitala anthropophagorum* and *Otopoma macgregoriæ*, were described and figured. It was considered that Mousson's genus *Trochonanina* should be merged into *Sitala*. Anatomical details of several species not before dissected were added.—Studies in Australian entomology. No. vii. New genera and species of *Carabidæ*, by Thomas G. Sloane. Three genera—*Notolestus* (type, *Abax sulcipennis*, Macl.), *Setalimorpha* (Feronini), and *Lestianthus* (Helluonini)—and thirty-six species were described as new. —Wood moths: with some account of their life-histories, chiefly compiled from the notes of Mr. R. Thornton of Newcastle, by W. W. Froggatt. This paper gave a general account of the habits and food-plants of several species of *Eudoxyla* and *Charagia*, and of *Leto Stacyi*.—Botanical notes from the Technological Museum, Part ii., by J. H. Maiden and R. T. Baker. The notes included (1) a list of additional localities of New South Wales plants, (2) new varieties of New South Wales plants, (3) Queensland species new for New South Wales, (4) remarks on naturalised species in the colony, and (5) descriptions of unrecorded fruits.—Notes on plants collected on a trip to the Don Dorrigo Forest Reserve, by J. H. Maiden. The author traced the southern extension of plants hitherto recorded from the Clarence River and further north, and the northern extension of plants hitherto not recorded further north than the Macleay River, Blue Mountains, &c. He also described a number of well-marked varieties of certain species, and added notes on imperfectly-described or little-known plants.

BOOKS, PAMPHLET, and SERIALS RECEIVED.

BOOKS.—Peregrinazioni Psicologiche: Dr. T. Vignoli (Milano, Hoepli).—The Sportsman's Handbook: R. Ward, 7th edition (R. Ward).—Controversen in der Ethnologie: A. Bastian, i. ii. iii. (Berlin, Weidmann).—Celestial Objects for Common Telescopes: Rev. T. W. Webb, vol. 2, 5th edition (Longmans).—A Journey in other Worlds: J. J. Astor (Longmans).—Précis de Météorologie Endogène. F. Cann (Paris, Gauthier-Villars).—Evolution and Ethics: T. H. Huxley (Macmillan).

PAMPHLET.—The Molecular Tactics of a Crystal: Lord Kelvin (Oxford, Clarendon Press).

SERIALS.—American Naturalist, August (Philadelphia).—Bulletin de L'Académie Royale des Sciences de Belgique, 1894, No. 7 (Bruxelles).—English Illustrated Magazine, September (198 Strand).—Good Words, September (Isbister).—Sunday Magazine, September (Isbister).—Longman's Magazine, September (Longmans).—Chambers's Journal, September (Chambers). — Geographical Journal, September (Stanford). — Natural Science, September (Macmillan). — Humanitarian, September (Hutchinson). —Century Illustrated Magazine, September (Unwin).

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