THURSDAY, NOVEMBER 9, 1893.

DR. WERNER VON SIEMENS.

Personal Recollections of Werner von Siemens. Translated by W. C. Coupland. (Asher and Co., 1893.)

WERNER VON SIEMENS was a representative man of this nineteenth century, the century in which "the art of directing the great sources of power in nature for the use and convenience of man" has been more studied and applied than in any other, we were almost saying than in all others. And no other century has produced quite such a man—a man in whom the ability to apprehend the secrets of nature was united with the ability to apply them to industrial purposes. Many circumstances combined to favour him, both of a personal and public character. His father was evidently a man of strong common sense; his mother was refined in her tastes, cultured in her mind, and devoted to her children. The children were fortunate in having such parents to guide and watch over them. At that time, as now, first-rate schools and colleges existed throughout what now forms the German Empire, and in these a good mathematical and scientific education was to be obtained, which was taken advantage of by the Siemenses, both as boys and young men. Another matter which was specially favourable to Werner Siemens was his military training; regular drill, strict discipline, endurance, and implicit obedience, learnt and practised in his own person, helped to make a man of him. Besides this, these young men were born just at the right time, if we may say so, to take advantage of the recent discoveries in, and formulation of the principles of, the natural sciences of heat and electricity and magnetism. These sciences were at that period in the active, nascent state. Galvani and Volta, Gauss and Weber, Oersted and Faraday had set the world wondering, and themselves, the philosophers, thinking, analysing, and systematising, and the men of imaginative minds, the poets of industry, inventing. Great discoveries had been made in former days, but these were in the realms of the Cosmos; they were not suitable for application to the daily uses of men, and were not, as those were, startling and impressive.

One of the first applications of electricity was to electro-plating, the covering of the baser metals with a thin layer—almost a film—of the nobler metals. And when in 1842 Werner Siemens applied for and obtained a Prussian patent, no process of galvanic gilding or silvering was known in Germany. He tells us that he had experimented with all the gold and silver salts known to him, and besides the hyposulphites had also found the cyanides suitable. The use of the latter had been made and patented by the Messrs. Elkington of Birmingham, so that a patent was only granted to Werner Siemens for the former. His brother William was despatched to England, where he took out a patent which he succeeded in selling to the Messrs. Elkington for £1500, and this money helped the young men on their road to independence and fame.

Whether it is that the minds of those engaged on the problems connected with the application of the forces of nature to industrial purposes are necessarily turned towards the measurement and regulation of these forces, we would not say, but meters and governors seem to have a special fascination for them. And so it was with these men. The problem of the regulation of the steam-engine seems to have proposed itself to the mind of William; both brothers, however, were engaged in its solution, and the differential regulator or chronometric governor was the result.

In the work we are reviewing there are few dates, but fortunately Dr. Pole's "Life of Sir William Siemens," and the scientific and technical papers of the brothers themselves, already published by Mr. John Murray, supply these. Quoting then from a paper by C. William Siemens on the progress of the electric telegraph, we find that "in the year 1845, when the practical utility of electric telegraphs had been demonstrated in England, several continental governments had determined upon their establishment." A Royal commission was appointed in Prussia, of which Dr. Werner was the most active member. They favoured an underground system, and charged him to institute experiments.

Here we stand on the threshold leading to, and opening up on, one of the greatest achievements of modern days. The underground system was only a stepping-stone to submarine telegraphy, and was not in itself a permanent although a temporary success. But there in Germany just at this time something was wanted, and here in England it existed; and these two brothers—the elder there, the younger here—were the means of completing the circuit. In the winter of 1844-45, "I recollect well seeing the first specimen of gutta-percha exhibited at the Society of Arts, I think by Mr. Montgomerie. . . . He was kind enough to give me a piece, which I forwarded to my brother, Dr. Werner Siemens. . . . I sent him this piece of gutta-percha in order that he might try whether it was not superior to india-rubber for insulation purposes. He did so, and after some time, having procured for him at his request a further supply, he made experiments, and in the course of about twelve months he proposed to the Prussian Government the use of gutta-percha for insulating telegraphic land wire." Dr. Werner constructed a screw press, by which the heated gutta-percha was cohesively pressed round the copper wire under the application of high pressure; this was well insulated, and permanently retained its insulation. And so, just at the time that it was wanted, a substance hitherto unknown came to light!

In the summer of 1847 the first long subterranean wire from Berlin to Grossbeeren was laid, and the telegraph commission had under consideration the employment "both of the wires coated with gutta-percha by pressing, and also of my dial and printing telegraph in the telegraph system about to be introduced into Prussia." On October 12, 1847, the factory of Siemens and Halske was started, but Dr. Werner still retained his military commission. In June, 1849, he requested his discharge from the military service, and soon after also resigned his office as technical manager of the Prussian State telegraphs.

We are not attempting in any detail to survey the whole field of Dr. Werner von Siemens's activity; we are

simply drawing attention to the most prominent landmarks, which may be used as points from which to carry out the triangulation, and as stations on which to set up the necessary delicate instruments of observation. Dr. Werner von Siemens was a remarkable man; he had a most successful career; he left indelible marks on the progress, both scientific and industrial, of his day, and there are lessons to be learnt from his work, and from his systems and methods.

Let us rest here a moment. This factory was just the very thing that was required at the time. The two members of the firm were—the one, Dr. Werner Siemens, a man possessing clear scientific views of natural forces and phenomena, and an inventive mind; the other, Mr. Halske, a man thoroughly acquainted with mechanics, the use of machines and tools, and possessing the skill to make, and to teach others how to make, delicate mechanism. There was a demand in Germany, in Russia, in England, and elsewhere, for what they could make; their work was thoroughly to be relied upon, and orders streamed in on them.

Dr. Siemens says somewhere in this volume that everything he has done for natural science has been due to a claim made upon him by applied science. It was the absolute necessity under which he was to make accurate measurements that set him to work to invent an exact standard of resistance, possessing which he was afterwards able to elaborate a rational method for testing the electrical condition of submarine cables. Previously to this, Jacobi's standard, which was a determined length of copper wire of a determined section, was used at the Berlin factory, but copies of these standards were found to differ so much that Dr. von Siemens set to work to introduce a standard of his own. In revolving this matter in his mind he came to the conclusion that "it was both desirable and convenient to be able to combine a definite geometrical notion with the unit of resistance." He therefore used mercury, the only metal fluid at ordinary temperatures, whose resistance cannot be affected by molecular variations, made a series of important experiments, and finally having defined his unit as a metre length of mercury of a square millimetre section at 0° C., he sent copies of his standard to physicists and telegraph engineers suggesting their use in determinations of resistance. We refrain from entering into a discussion as to the relative values of units, whether Weber's absolute unit, the B.A. c.g.s. unit, the ohm, or others; the main point is that Dr. von Siemens wanted a clearly defined unit, he had found the absolute necessity for it in his electrical work, and now possessing it he was able to press forward to other achievements. Here was a decided step in advance. Measurements which had previously been variable were now uniform, tests which formerly could not have been made could now be applied, and work which was formerly carried on more or less by rule-of-thumb, could now be done with a certainty of result.

We have referred to submarine telegraphy as one of the great achievements of this century, and the brothers Siemens, Werner, William and Carl, have taken a share in it. Almost every submarine cable of importance has been shipped from the Thames. The first tentative efforts were made in England, and the final successful results have been achieved here. Cable-laying is now one of the scientific arts, and our author has had a large share in making it so.

We are here brought face to face with the two sides of the question, the scientific and the technical, and at the same time with two national characteristics, the combination of which has produced these results: English enterprise, German investigation. And there is yet another link in this chain of events, which it is difficult to see how we could have done without, the finally unsuccessful but at the time needful and useful practical experiment of underground cables in Prussia. "My friend Halske" . . . "was the first to encounter these phenomena." "Halske found, first of all, that with shorter lines our self-interrupting indicator telegraphs acted with much greater speed than corresponded to the resistance of the line. When communication between Berlin and Cöthen had been established, a distance of about 95 English miles, the giving apparatus ran with double velocity, whilst the receiving apparatus stopped altogether. This at the time inexplicable phenomenon occurred the earlier the better the lines were insulated, which induced Halske purposely to impair the insulation of the line by the addition of artificial watery by-passes." "When the underground line had been extended to Erfurt, Halske's watery by-passes were no longer sufficient. But meanwhile I had become convinced that the peculiar behaviour of the underground wires could only be ascribed to the electrostatic charge already observed at the testings in the factory, the wire namely forming the inner, the damp soil the outer coating of a Leyden jar." "The very surprising and disturbing phenomena of electrical charges in underground conductors required thorough study. Further, it was necessary to establish a system for the determination of the situation of faults in the conduction and insulation of underground wires by measuring currents at the end of the wires. The uncertainty of the measurements of currents led to the necessity of replacing them by resistance measurements, and thereby to the setting up of fixed reproducible standards of resistance and scales of resistance. For this purpose the methods and instruments for current and resistance measurements had also to be improved and adapted for technical use; in short, a whole series of scientific problems had cropped up, the solution of which was called for by technical needs."

And so later on, when the actual problems of submarine telegraphy had to be solved, Dr. Werner took his share in their solution all the more ably because of the experience he had already gained, and of his system of studying the science on which the art was founded. His narrative, especially in this connection, is full of adventures, not unaccompanied with danger, the description of which is always interesting and often graphic.

The lesson of the life, of which a few personal recollections are given in this volume, appears to be this: Find out the work you were sent here to do, and do it with your might. All the work that has to be done is not great work, but may be good work for all that; it may not lead to honour and fortune; but it has to be done, and if you are the one who has to do it, do it well.

Dr. von Siemens had a work to do; it matters little, it seems to us, whether others were engaged on the same work or not; he did his share. As to who the person is

that first made a particular discovery is often a difficult question to settle; it is, after all, perhaps a matter of accident, or shall we say rather a matter of gift. But the man who follows his guiding star, and is led by it to honour, and success, and fortune, is one whose example others may well follow, even though it may not lead those others there. A great work or a very little work has to be done; set to work and do it. There is your guiding star shining clear and bright; follow it. There may be bright scintillations to the right and left; they may be merely *ignes fatui*, or they may be other men's guiding stars; they have nothing to do with you. You may have to work hard, but any way try to work wisely!

IRON ORES.

The Iron Ores of Great Britain and Ireland. By J. D. Kendall, F.G.S. With numerous illustrations. (London: Crosby Lockwood and Son, 1893.)

ALTHOUGH numerous works relating to mineral deposits of particular districts have appeared at different times, besides larger treatises dealing with the subject generally, such as the late John Arthur Phillips' "Ore Deposits," the want of a systematic account of our present knowledge of the origin and occurrence of British iron ores, and of the means of working these ores, has long been noticed. This want will be supplied by the volume under consideration. The author is a mining engineer of thirty years' experience, and he has been able to supplement a careful study of the available literature by unpublished information derived from his own observations. The result is a volume that will prove of substantial value as a work of reference to all interested in the iron industry of this country, more especially as the published information can only be found by a laborious search through the volumes of the Journal of the Iron and Steel Institute, and of the Transactions of other societies.

Mr. Kendall has broken up his volume, which covers 430 pages, into four parts. In the first, he gives some interesting information regarding the early working of iron ores, of which there is indirect evidence in nearly all the valleys of the Lake district. The presence of Roman coins, some of them as early as Trajan, found in heaps of iron cinder in Sussex and near Monmouth, proves that iron was made at a very early period from the red and brown oxides. Indeed, it is possible that these beds were worked at an even earlier period, for flint flakes and rough unturned pottery were found by Boyd Dawkins on the surface of a slag heap near Battle. In the second part, the author discusses the geological position and mineralogical characteristics of iron ore deposits. The third section deals with the age and origin of the deposits, and the last describes the method of searching for and working iron ores, with useful information on working costs, selling prices, and conditions of leases.

The author's task is not a light one. Within the limits of 430 pages to describe even the main features of the long list of mines which give the United Kingdom (1891) its 12,777,689 tons of iron ore, valued at £3,355,860 at the pit's mouth, is by no means easy. With the aid of forty-one illustrations and five folding plates, he has, however, been enabled to compress a large amount of information within a comparatively small compass, the value of the descriptions being increased by the insertion of bibliographies for each district.

As would naturally be expected, all the ores noticed in the volume are not treated with equal fulness, preference having been given to those of the greatest commercial or scientific importance. It is to be regretted that the great lode of Perran, near Truro, should have been dismissed in a single line. The late Sir Warington Smyth made many attempts to introduce this curious deposit to the notice of ironmasters, and it has formed the subject of numerous important memoirs. The most interesting descriptions given by Mr. Kendall are perhaps those relating to the district with which he is specially acquainted—the hæmatite district of West Cumberland and Furness, a district which has received less attention from geologists than any other of equal importance in the British Isles. The ores are of special value for the part which they play in admixture with the poorer qualities of ironstone, as well as for the production of Bessemer pig-iron. So irregular, however, are these deposits that the boring-tool may easily pass within a few inches of a mass worth thousands of pounds without discovering a trace of it. There can be no doubt that the acquirement of an accurate practical knowledge of these irregular deposits, of which the surface tells no tale, is the most difficult subject with which the mining engineer has to deal, and yet in many cases the difficulty is entirely ignored, with the result that the cost of exploration is enormously increased.

The chapter on the ironstones of the carboniferous rocks contains little that is new, the bulk of the information being contained in the "Memoirs of the Geological Survey." The analyses given relate to the iron ores collected by S. H. Blackwell, and the author might with advantage have mentioned the fact. The formation of this collection marked an epoch in the history of metallurgy, for, notwithstanding the magnitude of the interests involved in the iron and steel industries, no systematic collection representing the workable ores of the kingdom had been made until the Great Exhibition of 1851. The want was then supplied by the liberal exertions of Mr. S. H. Blackwell, a Dudley ironmaster, who, after the exhibition, presented this extensive and interesting series to the Museum of Practical Geology, munificently placing a sum of £500 at the disposal of Dr. Percy towards defraying the cost of their analysis. The results were subsequently published at Government expense in the "Memoirs of the Geological Survey."

The perplexing and fascinating subject of the genesis of iron ore deposits is treated by the author with great fulness, and his conclusions deserve attentive consideration. He brings forward a large amount of evidence in support of the views propounded by Sorby and by Huddleston that the ores of Cleveland and Northamptonshire were produced by the replacement of an ordinary limestone, and extends the theory to all deposits occurring in the secondary rocks. The source of the iron, he believes, may have been in the clays, with which all these deposits are closely connected. In the case of the red hæmatites, he is of opinion that the most likely

source of the iron is to be found in volcanic emanations of ferric chloride, a theory that appears more ingenious than sound. The author does not appear to have consulted the writings of recent foreign workers in this field. A study of the memoirs of R. D. Irving, Kimball, Van Hise, and H. V. Winchell, on the genesis of American iron ores, might have induced him to modify some of his views.

The author's remarks on the value of geology to the mining engineer deserve attention. It is undoubtedly of urgent importance for the economical utilisation of the iron ore resources of the kingdom, that those entrusted with the management of mines should have a more extended knowledge of the nature of irregular deposits than is too often the case. In these days of technical education, it is surprising to see money wasted in searching for these deposits in situations where some knowledge of stratigraphy would have shown that there was no chance of finding them. It is surely not too much to ask that mineral explorers should understand the elements of their work. BENNETT H. BROUGH.

OUR BOOK SHELF.

The Shrubs of North-Eastern America. By Charles S. Newhall. 8vo, pp. 249, with 116 woodcut figures. (London: G. P. Putnam's Sons, 1893.)

THE author of the present volume had previously written a similar book on the trees of the same region, which he defines as "Canada and the United States east of the Mississippi and north of the latitude of Southern Pennsylvania." This region is peculiarly rich in both trees and shrubs, most of which are hardy and will flourish in this country; and, as a matter of fact, many are familiar here in cultivation. Therefore a work of this kind appeals to amateurs on this side of the Atlantic as well as the other, and, although an unpretentious production, we can recommend it as a useful aid to those interested in the subject, especially to such as already possess some general knowledge of shrubs. The descriptive part is as free from technicalities as it could well be, and intelligible to any person whose knowledge of botany does not go beyond the veriest rudiments. The figures are for the greater part merely outlines, and so far accurate; yet hardly sufficiently detailed for use in our gardens, where American plants are associated with those of all other temperate climes. In the fields and forests of America they would be more serviceable. Botanical and popular names are given, and the derivation of the former, at least as to genera. The descriptive matter is here and there enlivened by appropriate poetical quotations; and the properties and uses of the more important plants are given. The Ericaceæ are perhaps the most numerous and attractive among the shrubs of Eastern America. No fewer than ten genera of this family are enumerated. Missing the Rose Acacia, *Robinia hispida*, we had almost convicted the author of omitting a favourite shrub; but we find it does not reach quite so high a latitude as 40° in America, though it is quite hardy in most parts of the British Islands. We also missed the *Menispermum*, *Wistaria*, and other climbers; but we suppose they will be included in the "Vines" of North America, to be dealt with in a third volume, announced by the author. W. B. H.

Mensuration of the Simpler Figures. (Univ. Corr. Tutorial Series.) By William Briggs and T. W. Edmondson. (London: Clive Univ. Coll. Press, 1893.)

THOSE students who have acquired a fair knowledge of algebra, trigonometry, and Euclid, will find in this book a most excellent guide to the mensuration of most of the more simple figures generally met with. Instead of presenting the reader with the stereotyped "rule and example" system, the authors have treated them as just a series of problems giving proofs of the formulæ used and numerous examples. That the book throughout is clearly and yet not too fully written speaks well for the student, and its scope is intended to meet the requirements of candidates for such examinations as the Intermediate B.A. and B.Sc. of the University of London. The measurement of rectilinear figures and the circle are first treated, followed by chapters on the geometry of the rectilinear solids and their surface-areas. This is succeeded by the methods of measuring the volumes of the rectilinear solids, and the last two chapters deal conclusively with the cylinder and cone and the sphere. The definitions throughout are well expressed, and the problems neatly worked out, while the figures could hardly be improved. We may mention that in the chapters relating to the rectilinear solids all figures have been drawn in perspective and shaded, giving the student a clearer idea of the forms of the various figures.

The Discovery of Australia. By Albert F. Calvert (London: George Philip and Son, 1893.)

MR. CALVERT describes his book as "a simple statement of such historical facts as I could collect; and a reproduction of certain maps which more or less illustrate the gradual progress of knowledge regarding the great island continent, now called Australia." From this it will be inferred that there is nothing strikingly novel in the production. Mr. Calvert has found many tracings on old charts indicating a knowledge of the existence of a great southern continent, and he thinks that probably some individual navigator landed on the western coast of Australia in the fifteenth or sixteenth century, afterwards bringing the news of his discovery to Europe. A large portion of the book is devoted to the voyages of Capt. Cook, the reason being that "he was really the discoverer of Australia in its present geographical configuration." The volume is well printed, and the maps are finely reproduced. It is doubtful, however, whether the author has added much to elucidate the subject which he treats.

Graphic Arithmetic and Statics. By J. J. Prince. (London: Thomas Murby, 1893.)

IN addition to questions in Practical Geometry, the Science and Art Department has given notice that in the future questions in Graphic Arithmetic and Statics will be included. The issue of this small book is intended to supply students with information on these two subjects, sufficient for both the elementary and advanced stages. In forty-eight pages the author has brought together all the important problems, working them out clearly for beginners with the help of diagrams. In addition to those of the more elementary kind, a graphical determination of the square roots of numbers, the resolution of forces, resultant of parallel forces, &c., are also dealt with. Nothing that the reader will find in this book will be found superfluous, though it could with advantage be slightly extended.

The Orchid Seekers. By Ashmore Russan and Frederick Boyle. (London: Chapman and Hall, 1893.)

UP the Sarawak river to Kuching, and thence to Sirambau, went a small party in search of a blue orchid reported to exist in that region, and supposed to be *Vanda cærulea* or *V. cærulescens*. The leader of the party was a German botanist well versed in orchidology, who identified each plant as it was found, and delivered botanical discourses whenever an opportunity occurred. The story

is mainly one of adventure; nevertheless, much of scientific interest is weaved into it, and the boy who reads it without skipping the closely-printed portions will obtain some useful knowledge of the natural history of Borneo.

LETTERS TO THE EDITOR.

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Human and Comparative Anatomy at Oxford.

I AM sorry that Prof. Burdon Sanderson should state that a "misstatement" occurs in the article written by me in your issue of October 26, and still more so that whilst making such a charge he altogether omits to cite the "misstatement" which he sets out to correct.

My knowledge both of the University of Oxford and of the teaching of anatomy is, as a mere result of individual history, far more intimate than is that of my colleague, Prof. Sanderson, a fact which may account for some difference in our opinions on these topics.

When in 1885 the Convocation of the University was asked to sanction the payment of a small salary for a limited period to a lecturer in Human Anatomy—out of University funds already taxed to an inconvenient extent—there existed four ancient foundations in Oxford assigned to the support of teachers of "Anatomy," viz.: the Linacre Professorship of Human and Comparative Anatomy, the Tomlinsian Lectureship of Anatomy, the Aldrichian Professorship of Anatomy, and the Lee's Readership in Anatomy. The small Tomlinsian and Aldrichian endowments had been united in 1803 by Parliamentary authority, and the salary arising from them was in 1858 assigned to the payment of a demonstrator or demonstrators nominated by the Linacre Professor. There were thus, as teachers of anatomy in the University, the Linacre Professor and his Aldrichian demonstrator, and the Lee's Reader. Whatever may have been the conceptions of the ancient founders as to the nature of that study which they designated "Anatomia," or the intentions of University Commissioners who gave the title of "Professorship of Human and Comparative Anatomy" to Linacre's revived readership in medicine, or by whatever conditions the result may have been determined, it is certain that in 1885 the holders of the Linacre, Aldrichian, and Lee's teacherships were not giving that "technical training in anthropotomy," that "topographical knowledge of the human body," which forms a part of medical professional education, and is administered in every hospital-medical school throughout the country. What these Oxford teachers were doing was to teach anatomy in its broad academical sense. They taught the anatomy of man and of animals as a branch of biological science, and I venture to assert that they taught the anatomy of man and of vertebrate animals with as ample material illustration, and in as complete and detailed a way, as is desirable for the training of University students intending to pursue the study of any one of the great branches of biology *as a science*. What they did *not* do was to furnish the *professional medical* student with that special acquaintance with the arrangements of tendons, nerves, and blood-vessels in each little tract of the human body which might be the seat of a surgical operation or a medical exploration.

Both the teaching and the acquirement of these details is tedious and uninteresting, although necessary for the surgeon. The subject-matter is called "human anatomy," or the "anatomy of man"—as distinguished from "anatomy" in its wider sense, and more especially as distinguished from comparative anatomy. Human anatomy is not a branch of science; it is topographical information. In order to render it less uninteresting than it would be (and under some teachers is) when strictly taught, it is customary for the teacher of human anatomy to introduce scraps of the various branches of science which bear upon the significance of animal structure into his text-books and lectures. He thus imports a little physiology and mechanics, a little comparative anatomy or animal morphology and embryology into his teaching. The real significance, however, of the facts learnt by the medical student in his course of "human anatomy" is in their application to surgical and medical practice, and it is in referring to these applications that the teacher of human anatomy finds the legitimate and most successful leaven for his dead weight of detail.

Such being the somewhat repellent character of the pursuit of human anatomy considered apart from the science of morphology or comparative anatomy, it is not surprising that the Oxford teachers of "anatomy" in 1885 had all devoted themselves to the latter study, and left the technical topographical human anatomy uncared for.

But unattractive and uninteresting as it is, this human anatomy has to be "gone through" by the medical student. Oxford had been roused to a sense of her obligations to medical study by a movement, in which I took a somewhat prominent part, and accordingly when in 1885 it was represented to Convocation that although the University had three teacherships of anatomy and splendid collections illustrating the structure of animals (including man), yet there was no provision for carrying on the instruction in anthropotomy necessary for technical students of medicine, that body generously and deliberately consented to provide a new teachership for the specific purpose of filling this gap in the machinery of the Oxford Medical School.

I should be very sorry to see any tendency to frustrate the excellent purpose of Convocation, and I feel confident that the renewal of the periodic grant made by that body to pay the salary of a lecturer in human anatomy must depend on the lectureship being strictly restrained within its original boundaries. We do not want at Oxford a fifth teachership of anatomy added to the four which have somehow slipped away from "anthropotomy" into pleasanter and more philosophic regions. The University ought not to be asked for more money with the object of effecting once more such a transformation. But this will certainly be the case if vague theories about "the academical teaching of human anatomy" are allowed to pass without protest.

Oxford, November 4. E. RAY LANKESTER.

P.S. It is strange that Prof. Sanderson (himself an Edinburgh man) speaks in his letter of the University professor of *Human Anatomy* in Edinburgh. There is no such professorship in Edinburgh. Sir William Turner is professor of *Anatomy* in Edinburgh, as is the eminent comparative anatomist Gegenbaur in Heidelberg. The separation of human anatomy from comparative anatomy has not been carried out in these Universities as it has been deliberately in Oxford. Anthropotomy is taught in the former by demonstrators and assistants acting under the direction of the professor of anatomy. That was the intention of the late University Commissioners with regard to Oxford when they constituted the Linacre Professorship of Human and Comparative Anatomy. Some persons, however, thought it best (I am not now discussing the merits of the arrangement) that the example of Edinburgh, Heidelberg, and other European Universities, should be departed from in Oxford, and that the functions of the Edinburgh Professor of Anatomy and his staff should in Oxford be divided between the Linacre Professor of Comparative Anatomy and an independent lecturer in Human Anatomy.

The Monros, Goodsir, Allen Thomson, and other distinguished Scotch teachers were, like Gegenbaur, Kölliker, and others in German Universities, professors of "Anatomy," not exclusively of "Human Anatomy."

The Oxford plan of relieving the titular Professor of Human and Comparative Anatomy of an important but technical branch of his teaching, by the appointment of a lecturer *ad hoc*, has not a precise parallel in other Universities. Moreover, in Germany the subject of microscopic anatomy or histology is very usually undertaken by the Professor of Anatomy (*e.g.* Kölliker, Waldeyer, His), although in Oxford the Professor of Physiology is by statute called upon to give instruction in histology. It would probably not meet with unanimous approval were the present Oxford lectureship in Human Anatomy—in imitation of "academical teaching" elsewhere—to be diverted wholly or partly to the subject of histology.—E. R. L.

"Geology in Nubibus." An Appeal to Dr. Wallace and others.

IN his timely and important letter to you, Dr. Wallace congratulated us all on having got rid of a *real* glacial nightmare by sweeping away the tropical glaciation which has been favoured

by some high authorities, including himself, Mr. Darwin, and Mr. James Geikie. While we may all share in this congratulation, it must be remembered what it involves.

It has been the fashion with an extreme and aggressive school of glacialists to postulate an excavating tendency in ice to which the formation of lake basins and valleys-without-outlets in mountain districts has been attributed. They will not allow that rock basins are due to any other cause than "omnipotent ice." They scoff at explorers of the mechanics of ice in Alpine countries, like Prof. Bonney and Mr. E. Hill. They jeer at those who have devoted much patience to unravelling the mysteries of Plutonic action, like Prof. Judd and others, who attribute a large number of lakes to dislocations and to foldings of the subjacent rocks. It is no use, in arguing with them, to refer to mechanical difficulties like those involved in conveying thrust of more than a certain amount through a substance like ice, which is known to crush under a moderate pressure, nor to produce any number of mechanical arguments against the capacity of ice to erode lake basins such as those in question; nor is it any use appealing to the stupendous geological difficulties against their conclusions which have been accumulated by quite a number of skilled geologists at home and abroad. All these efforts are futile, for we are told that the ice to which appeals must be made is quite a different thing to any ice we can experiment upon or examine, and that it must not therefore be measured by the ordinary laws that govern ice such as we know it, and this appeal to transcendental ice is considered to be orthodox science in the nineteenth century, an age when induction is supposed to have become a supreme law to us all, and when *à priori* postulates are generally discarded from the realm of physical research. Let this pass, however, and let us test the question in another way. Let us test it, in fact, by this very case of Brazil.

There has never been a glacial period in, nor are there traces of glacial action in the highlands of, Brazil, we are told by Dr. Wallace. Granted. How then can Dr. Wallace, and those who agree with him in this matter, explain the existence on the plateau of Bahia of perhaps the largest and most remarkable collection of rock basins in the world, rock basins existing, too, in close juxtaposition with most perfect examples of giants' cauldrons on the largest scale. This is assuredly a dilemma for the transcendental school of geologists.

Let me quote from Mr. Allen's graphic descriptions of these rock basins. Speaking of the plateau of Bahia, he says: "Over this whole region there is an almost entire absence of loose materials on the surface . . . slight knolls and shallow basins alternate which rarely differ more than 20 or 30 feet in elevation. In the rainy season many of these basins become filled with water, forming shallow lagoas varying in area from less than one to more than 50 acres, from most of which the water evaporates in the dry season . . . . So numerous were these lagoas for more than 50 miles that it seemed natural to speak of this region in my notes as the "Lake Plain." Almost everywhere the elevations are evenly rounded, indicating that the rocky crust has been exposed to rain and probably long continued abrasion. But the absence of abraded materials seemed most remarkable; very rarely were even loose boulders observed, though a few such were repeatedly noticed. At frequent intervals there were irregular holes in the rocks, usually nearly filled with water, to which the inhabitants give the name of 'caldeiraos.' These caldeiraos are of frequent occurrence. . . . . Nearly all of the considerable number examined proved to be genuine pot-holes, and some of them were of great size. The largest one I measured was elliptical in outline, 18 feet long, 9 or 10 in width, and 27 deep, with smoothly worn sides. . . . These pot-holes often occur out on the plain, far away from any high land, and they are sometimes found excavated on the summits of slight bulgings in the plain, or even on the top of a hill."

I would ask, in all seriousness, whether, if phenomena like these had been described from the Alps or from Nova Scotia, they would not assuredly have been pointed to by extreme glacialists as the unerring footprints of great ice-sheets, and yet Dr. Wallace, who is a champion of the school, repudiates the former glaciation of Brazil altogether.

What is to be said in regard to this dilemma then? It is quite clear that either the facts must be disputed (and who is to dispute them?), or else the champions of ice at-all-hazards must concede that rock basins and giants' cauldrons can be made by other agencies than ice. If so, they can be made as well in one place as in another. If they could be made by other causes on the plateau of Bahia, why not in the highlands of Tasmania?

I am bound to say I was taken aback by Dr. Wallace's comments on a letter from one of your correspondents, which appeared in NATURE a short time ago. That gentleman professed to make an exploration of certain parts of Tasmania with another experienced geologist. They were both champions of the glacial theory. They both went prepared to find traces of glacial action there, and certainly in our latitudes no evidence seems more easily discriminated, and they came back convinced that in the districts where the rock basins of Tasmania abound, there are no traces of glacial action to be seen. They could find none. Mr. Johnstone, who has written an elaborate and detailed geological memoir on the island, and who has explored it in many directions, could find none either, save on the western flanks and in the valleys of the Tasmanian Alps in the western part of the island, where it has been long known that traces of former local glaciers exist. There is absolute unanimity among the native geologists that nothing in the shape of ice-sheets existed there, and there is no ice-spoor in the central districts where the great Tasmanian lakes occur. Dr. Wallace's answer to all this was certainly unexpected. He has not himself visited the island, and yet he disputed not only the inferences but the facts and the observations. Why should the voice of Esau be listened to and approved in Brazil, and that of Jacob be repudiated in Tasmania? Mr. Johnstone and the other observers in Tasmania are assuredly to be trusted in such an issue quite as much as Prof. Branner. I cannot see on what ground the discrimination is made, except the desperate inconvenience of postulating a glacial nightmare in the tropics.

Assuredly the whole difficulty lies in championing a theory of the origin of lakes, unknown in geology until introduced by Ramsay, whose extravagance at times may be measured by some of his phrases addressed to the British Association when he presided over the geological section. From all sides there comes a revolt against this theory, which is based on no empirical evidence, and is at issue with the mechanical properties of ice so far as we know them, and with the observations of practised observers of the first rank. I am bound to say that those geologists who habitually make appeals to forces in Nature, and to properties of matter which are purely hypothetical and unwarranted by experience, are leading us back to times when Aristotle and deductive reasoning dominated European thought, and when Bacon had not yet taught us better things.

My attention has been called to an oversight in my previous letter. Among those who many years ago did good work in dissipating the particular glacial monster that was generated in the valley of the Amazons, was my old friend Dr. Woodward, whose papers on the subject in the volume of the *Ann. and Mag. of Nat. Hist.* for 1871, pp. 59 and 101, I had overlooked.

HENRY H. HOWORTH.

30 Collingham Place, Cromwell Road, October 27.

Correlation of Solar and Magnetic Phenomena.

I WAS glad to see (NATURE, vol. xlix. p. 2) in the notice of Miss Clerke's "Popular History of Astronomy," that attention was drawn (1) to the correspondence in time between a certain luminous outburst seen on the sun on September 1, 1859, by Carrington and Hodgson, and a disturbance of the magnets at the Kew Observatory; and (2) to the statement of the late Mr. Whipple that the magnetic movement was really a small one, and that in his opinion the observed correspondence was a mere accidental coincidence. Those who have read Carrington's original account (Monthly Notices of the Royal Astronomical Society, vol. xx. p. 13) will remember that at the time he himself did not lean towards hastily connecting the phenomena, remarking that "one swallow does not make a summer." But authors of text-books on astronomy, who may be only to a partial extent observers, are too apt to state the matter in such a way as to give an impression that we have here an undoubted instance of direct connection, instead of a case of apparent connection, to be taken merely for what it is worth, seeing that the occurrence has remained to the present time without corroboration. I should like to take the opportunity to support, in the fullest manner, the opinion of Mr. Whipple, which acquaintance with the Greenwich magnetic registers tells me to be a true one. The magnetic movement in question, as recorded at Greenwich, was similarly small.

But the erroneous impression lives long. May I therefore be

further allowed to give some reasons for the opinion expressed. That there exists a relation between sun-spots and magnetism is undoubted. And although those who are able to study the variations of sun-spots side by side with the variations of magnetism can very well see to what extent the relation definitely holds, it is difficult adequately to convey to others a due impression of all the circumstances of the case. Periods of maximum sun-spots are periods of great magnetic activity and energy, whilst periods of minimum sun-spots are periods of magnetic quiet. But it has not yet been found possible to trace direct correspondence in details. Thus, when a large spot is present there may occur one or more considerable magnetic disturbances or storms, some enduring it may be for a few hours only, others it may be for several days, but, assuming direct solar influence, what it is that precisely determines when such disturbances shall arise is unknown. Further, at times of sun-spots being numerous, there is also considerable general magnetic irregularity. Now, in these magnetic disturbances and irregularities there will be innumerable individual motions far exceeding in magnitude that accompanying the Carrington sun outburst, and yet during all the many years that have elapsed since 1859, through which period the solar surface has been continuously scrutinised by hundreds of observers in different lands, no second occurrence similar to that of 1859 has come to light. But if there be so close a connection between solar and magnetic phenomena as the occurrence in question would seem to indicate, the fact that we have no corroboration of the solitary observation of 1859 is surely remarkable, considering that, of late years, it is very much to correspondence in details that attention has been to a great extent directed. If irregular magnetic movements were comparatively few, the observation of 1859 might possess some significance, but they are, on the contrary, multitudinous, many at times occurring during the course of a single day, and often of considerable magnitude, but yet without any recorded accompanying solar manifestation.

To sum up, the points of the matter may be thus stated :—

(1) The solar outburst in 1859 was seen independently by two observers : the fact of its occurrence seems therefore undoubted.

(2) The corresponding magnetic movement was small.

(3) Many greater magnetic movements have since occurred.

(4) No corresponding solar manifestation has been again seen, although the sun has since been so closely watched.

The solar outburst of 1859 would thus appear to have been a rare phenomenon, and its observed occurrence at the time of a recorded magnetic movement quite an accidental coincidence.

This conclusion in no way invalidates the question of general relation between sun-spots and magnetism, whatever may be the true explanation of that relation.

Greenwich, November 6. WILLIAM ELLIS.

The Recent Earthquake.

AFTER the Pembroke earthquakes of August 1892, you were good enough to insert a letter from me (vol. xlvi. p. 401) asking for observations from different places. In reply to this letter, I received so many and such valuable records, that I should be greatly obliged if you would allow me to make a similar request for accounts of the recent earthquake of November 2, in Wales and the West of England. I should be very grateful for descriptions from any place whatever. The questions printed below indicate the points on which information is chiefly desired, but if any observers are able and willing to give further details, I shall be pleased to send them my fuller list of questions, which I may remark are somewhat different from those given in the letter referred to above.

(1) Name of the place where the earthquake was observed.

(2) Time at which it was felt, if possible to the nearest minute.

(3) Nature of the shock. (*a*) Were two or more distinct shocks felt, separated by an interval of a few seconds? (*b*) If so, which was the stronger? (*c*) What was the duration (in seconds) of each, and of the interval between them? (*d*) During this interval was any tremulous motion felt or rumbling sound heard?

(4) Duration in seconds of the whole shock, not including the accompanying sound.

(5) Was the shock strong enough (*a*) to make doors, windows, fire-irons, &c., rattle ; (*b*) to cause the chair, &c., on which the observer was resting to be perceptibly raised or moved ; (*c*) to make chandeliers, pictures, &c. swing, or to stop clocks?

(6) (*a*) Was the shock accompanied by any unusual rumbling sound, and, if so, what did it resemble? (*b*) Did the beginning of the sound precede, coincide with, or follow the beginning of the shock, and by how many seconds? (*c*) Did the end of the sound precede, coincide with, or follow the end of the shock, and by how many seconds? (*d*) Were the strongest vibrations felt before, at, or after the instant when the sound was loudest, and by how many seconds? CHARLES DAVISON.

373 Gillott Road, Birmingham, November 6.

"An Ornithological Retrospect."

I HAVE been interested in reading "An Ornithological Retrospect," by your correspondent, Dr. Sharpe. His reference to myself by name in the concluding paragraph is partly my excuse for troubling you with a few remarks upon this article. Dr. Sharpe, in one long breath, deplores (pleonastically) the fact that "very little anatomical work has scarcely been done" recently in ornithology, and exults over a reviewer in a "leading London paper," who apparently took the same view—tomahawking him with the remark that "in every branch of the subject considerable progress has been made." I think that the opinion of the minority in this case is correct, and that our knowledge of bird anatomy is progressing. But those of us who are occupied with this study have frequently to regret the ignoring of anatomical facts by systematists ; this is particularly discouraging, since by far the larger proportion of papers upon bird anatomy are purely of systematic interest, dealing with the resemblances between bird and bird. Dr. Sharpe evidently feels that the British Museum Catalogues of Birds are not beyond criticism from this point of view. In one or two volumes there is a conspicuous absence of any arrangement in accordance with anatomical fact. Dr. Sharpe, therefore, is rather imprudently candid in saying that to understand these catalogues a man must be an ornithologist.

Zoological Society's Gardens. FRANK E. BEDDARD.

The Foam Theory of Protoplasm.

IN your issue of October 19 there appeared, under the title "Bütschli's Artificial Amœbæ," a review, by Dr. John Berry Haycraft, of Prof. Bütschli's work upon protoplasm. I venture to think that in many places Dr. Haycraft has misrepresented entirely Prof. Bütschli's researches, while other objections or criticisms which he brings forward are answered in the book itself. Since I have been engaged for some time upon a translation of Prof. Bütschli's work, which is now in the press, I must ask your readers to suspend their judgment until they have a better opportunity of forming an opinion for themselves.

2 Blackhall Road, Oxford. E. A. MINCHIN.

SCIENCE IN THE MAGAZINES.

AMONG the magazines received by us, the *Fortnightly* is well to the front as regards articles having a scientific interest. Dr. Alfred R. Wallace writes on "The Ice Age and its Work," with the object of explaining "the nature and amount of the converging evidence demonstrating the existence of enormous ice-sheets in the northern hemisphere, to serve as a basis for the discussion of the glacial origin of lake-basins, which will form the subject of another article." After briefly describing the foundation of the science dealing with glaciers and their action, and the early school of glacialists, Dr. Wallace states the phenomena which points to the former existence of glaciers in regions where the mountain-tops are at present below the snow-line. These are classified as follows :—(1) Moraines and drifts ; (2) Rounded, smoothed or planed rocks ; (3) Striæ, grooves, and furrows on rock-surfaces ; (4) Erratic and perched blocks. As a good example of a moraine, that in Cwm Glas, on the north side of Snowdon, is mentioned, together with those in Glen Isla (Forfarshire), and the Troutbeck alley near Windermere. In Cwm Glas, also, smoothed and rounded rocks are to be seen above the moraine. Striated, grooved, and fluted rocks are exemplified by those near the lakes of Llanberis, and by the remarkable effects exhibited at Kelly's Island, at the western end of Lake Erie. The enormous block near St. Petersburg, and the mass of Swedish red granite found at Fürstenwalde, south-east of Berlin, are given as in-

stances of erratic blocks. The erratic blocks from the higher Alps, which are found on the flanks of the Jura Mountains, are also shown to point conclusively to the former existence of glaciers stretching down the Rhone Valley as far as the Jura. The distribution of erratics in North America are next considered, and the crowning example of boulder transportation is said to be afforded by "the blocks of light grey gneiss discovered by Prof. Hitchcock on the summit of Mount Washington, over 6000 feet above sea-level, and identified with Bethlehem gneiss, whose nearest outcrop is at Jefferson, several miles to the north-west, and 3000 or 4000 feet lower than Mount Washington." After giving instances in Great Britain and Scandinavia of boulders carried above their source, Dr. Wallace says :—

We thus find clear and absolute demonstration of glacier ice moving up-hill and dragging with it rocks from lower levels to elevations varying from 200 to 2700 feet above their origin. In Switzerland we have proof of the same general fact in the terminal moraine of the northern branch of the Rhone glacier being about 200 feet higher than the Lake of Geneva, with very much higher intervening ground. As it is universally admitted that the glacier of the Rhone did extend to beyond Soleure, all the *à priori* objections to the various cases of rocks carried much higher than their origin, in America, the British Isles, and Scandinavia, fall to the ground. We must either deny the existence of the ice-sheet in the great Swiss valley, and find some other means of accounting for the travelled blocks on the Jura between Geneva and Soleure, or admit that the lower strata of a great glacier *can* travel up-hill and over hill and valley, and that the ice-sheets of the British Isles, of Scandinavia, and of North America merely exhibit the very same characteristics as those of Switzerland, but sometimes on a larger scale. We may not be yet able to explain fully how it thus moves, or what slope of the upper surface is required in order that the bottom of the ice may move up a given ascent, but the fact of such motion cannot any longer be denied.

Prof. T. E. Thorpe contributes a chatty paper on "Carl Wilhelm Scheele," whose life's work is summed up as follows :—

We owe to Scheele our first knowledge of chlorine and of the individuality of manganese and baryta. He was an independent discoverer of oxygen, ammonia, and hydrochloric acid gas. He discovered also hydrofluoric, nitrosulphonic, molybdic, tungstic, and arsenic acids among the inorganic acids ; and lactic, gallic, pyrogallic, oxalic, citric, tartaric, malic, mucic, and uric among the organic acids. He isolated glycerin and milk-sugar ; determined the nature of microcosmic salt, borax, and Prussian blue, and prepared hydrocyanic acid. He demonstrated that plumbago is nothing but carbon associated with more or less iron, and that the black powder left on solution of cast iron in mineral acids is essentially the same substance. He ascertained the chemical nature of sulphuretted hydrogen, discovered arsenetted hydrogen and the green arsenical pigment which is associated with his name. He invented new processes for preparing ether, powder of algaroth, phosphorus, calomel, and *magnesia alba*. His services to quantitative chemistry included the discovery of ferrous ammonium sulphate, and of the methods still in use for the analytical separation of iron and manganese and for the decomposition of mineral silicates by fusion with alkaline carbonates.

To this long list of successful labours must be added the memoir on "Air and Fire," which appeared in 1777, and the experimental material for which was partly collected in Malmö and Stockholm before 1770, and partly during Scheele's stay at Upsala, that is, prior to 1776. These dates, Prof. Thorpe reminds us, are important in view of Scheele's relations as a discoverer to Priestley and Lavoisier.

"The Geographical Evolution of the North Sea" forms the subject of an article by Mr. A. J. Jukes-Browne in the *Contemporary*. In the course of the paper the following conclusion is arrived at :—

The North Sea—that is to say, a sea lying east of Britain and opening northward—had no existence until after the formation of our Coralline Crag. The great change which submerged the northern land-barrier and permanently lowered the temperature of eastern England by letting in the waters of the Arctic Ocean took place during the formation of the newer "Crags" which overlie the Coralline Crag in Suffolk, and extend northward through Norfolk.

In proof of this statement, two salient facts may be mentioned : (1) the incoming and gradual increase in the number of northern species among the mollusca of the newer Crags ; (2) the occurrence of Crag shells in the glacial sands of Aberdeen, showing that marine Pliocene deposits once existed at no great distance from the Scottish coast and were destroyed by the ice of the Glacial Period.

According to Mr. Jukes-Browne, towards the close of the Pliocene period the whole area between East Anglia and the Netherlands appears to have become dry land. The estuary of the Rhine then lay off the coast of Norfolk, and the Thames was one of its tributaries. During the glacial epoch, the whole bed of the North Sea was dry land. The subsidence that afterwards submerged the North Sea floor and filled the valley of the English Channel with water, led to the silting up of the English river-valleys, and to the formation of the modern delta of the Rhine. Mr. Jukes-Browne believes that by it England was separated from the Continent ; for there is no proof that a continuous sea separated England and France at any earlier Pleistocene epoch.

The *Forum* (October) contains a contribution by Prof. E. S. Holden, the object of which is "to detail the history of the remarkable 'new star' of 1892, in the constellation Auriga." On this side of the Atlantic, a detailed account is understood to mean a more or less minute narration of particulars ; but Prof. Holden's paper shows us that in writing the history of a new star in detail, reference to some of the most important communications on the matter may be omitted. "The *Nova* was, no doubt, a star like our sun . . . ," says Prof. Holden. ". . . Let us imagine what fate ours would be, if our sun should suddenly increase in light and heat some hundreds of times, and then fall off some thousands," and so on. The learned Director of the Lick Observatory will find that there is very little, if any, evidence that Nova Aurigæ "resembles our sun" in physical constitution, which is the inference naturally put upon his remarks. We read that, "Nothing can be clearer than the identity of the 1893 spectrum of the *Nova* and that of the nebulæ"—a pill which some spectroscopists have had great difficulty in swallowing. Prof. Holden describes Prof. Seeliger's hypothesis of the genesis of the Nova, but inclines to Prof. Vogel's modification of it ; for he remarks, "We can at least say that up to the present time the new star has behaved as if it had entered a system of distant planets, rather than a swarm of cosmical meteorites." This, however, is simply an expression of opinion, and the statements that might justify it are not discussed, for the reason that "they relate to the minutiæ of observation."

The *Quarterly Review* (October) contains an excellent account of Vedic mythology, which should be of interest to astronomers, since it deals chiefly with the relation of the sun and moon to mythological thought and language.

An article on "Waves," in *Good Words*, and one on "Electricity and Health," in the *Humanitarian*, deserve mention, though neither contain much of scientific importance.

The *Medical Magazine* contains Part I. of an article on "Heredity and Disease."

ON A METEORITE WHICH FELL NEAR JAFFERABAD IN INDIA ON APRIL 28, 1893.[1]

PARTICULARS have recently reached this country concerning the fall of a meteorite near Jafferabad in the south-east of Kathiawar, a native State adjoining the

[1] Note read at the meeting of the Mineralogical Society, October 14, 1893.

Bombay presidency. Dr. J. W. Evans, the geologist to the State of Kathiawar, has kindly forwarded to me a translation of the report sent in by the local official. It is curious that a fall of Nagali Jaowar (a kind of seed used as food by the poorer people of the country) is said to have occurred at the same time as the fall of the stone. As suggested by Dr. Evans, the seed may have been carried a short distance by the wind, which is very strong on the coast of Kathiawar at the time of year when the fall occurred. The spot where the fall took place is a flat region of recent limestone. Dr. Evans adds that the official report is interesting, as it is the account of a man who never heard of a meteorite, and to whom the fall of grain is as probable as that of stones. The report is as follows :—

"There was thunder which lasted for a quarter of an hour on the southern side at between a quarter to eight and eight o'clock in the morning of April 28, 1893. At that time the sky was clear enough. It has been known that the thunder was heard in nearly all the villages of Babariawad. The reason for my giving you this trouble is that Nagali Jaowar has rained with thunder on a small piece of ground near the outskirts of a village called 'Wad,' situate on the eastern bank of a river named 'Dhatarwadi,' and about two kosh (miles) distant from this place, but there was not a drop of rain-water. A specimen of Jaowar that has come down is sent herewith. A coolie, named Hamo Shiyal, while working in his field on the same day and at the same time, saw a stone about five or seven tolas (a tola = 180 grains) in weight falling on to the ground, about two fields distant, on the southern side of a village called Covaya, situated south-west of, and three kosh distant from this place, with the noise of thunder. He picked it up, and came to the village with it. While showing it to the people of the village, they broke it to pieces. As a specimen, one piece of the stone, out of the two pieces found by inquiry, is also sent herewith. There was not a drop of rain, and the sky was clear enough. Notwithstanding the clearness of the sky, it has been said that there was a thunderbolt. Such were the details of the occurrence on the morning of Friday, at between a quarter to eight and eight. If any further details come to notice, they will be reported to you.'

The original stone was shown by Dr. Evans' investigations to have been 3·7 centimetres long, 2·9 centimetres broad, and 2·3 centimetres thick. It was broken up by the villagers, and only the two largest portions have been recovered by the officials. These weigh respectively 17·4 and 16·3 grammes. The stone is said to have been cold when picked up, and no hole in the ground made by its fall was noticed. The larger fragment of this meteorite has been entrusted to me by my friend Dr. Evans, and Mr. L. Fletcher, F.R.S., of the British Museum, has kindly made a preliminary examination of it, the results of which I give in his own words :—

"The fragment of stone weighing 17·42 grams (3/5ths of an ounce), sent by Dr. Evans, is undoubtedly part of a true meteorite, as is seen at once on examination of the crust and the fractured surface. The crust formed during the passage of the stone through the earth's atmosphere is dull black in colour, and in parts so rough as to be scoria-like in texture. On direct comparison with the stones from other falls preserved in the British Museum it is seen that in these respects the Jafferabad stone is very similar to parts of Pavlograd, Bachmut, Middlesborough, Tourinnes-la-Grosse, Pohlitz, and Gross-Liebenthal. The crust, however, is very remarkable for its thickness, which a little exceeds a millimetre, and at one part even reaches two millimetres: in most meteoric stones the thickness of the crust does not exceed half a millimetre, and in very few cases reaches a millimetre: the thickness in this instance surpasses that of the crust of any specimen preserved in this collection: of the above-mentioned meteorites, Pavlograd approaches most nearly in this respect. The broken surface of the stone is very white in colour, and shows the usual metallic spangles of nickel-iron and troilite, white and tomback brown respectively; the thin black veins, beginning at the crust and traversing the stone in various directions of former fracture, are unusually conspicuous, even more than in the case of the stone which fell at Gross Liebenthal in Russia on November 19, 1881, and which is very similar in its general characters. The aspect of the fracture is very uniform, and no round enclosures (chondrules) are to be distinguished. This, however, is often the case, even when chondrules are actually present, and in all probability a microscopic section of the Jafferabad stone, when allowed by the owner to be made, will reveal their presence. The specific gravity of the stone with crust is 3·55, and has an average value; that of Pavlograd, for instance, is 3·58."

It will be seen from the foregoing account that the Jafferabad meteorite presents some features of considerable interest; and it is to be hoped that, in the interest of science, his Highness the Nawab of Junagadh may permit the specimen now in this country to be subjected to a full microscopical and chemical examination.

JOHN W. JUDD.

NOTES.

THE following is a list of names recommended by the President and Council of the Royal Society for election into the Council for the year 1894, at the anniversary meeting on November 30 (the names of new officers are printed in italics) :—President : Lord Kelvin. Treasurer : Sir John Evans, K.C.B. Secretaries : Prof. Michael Foster and Lord Rayleigh, Foreign Secretary : *Sir Joseph Lister, Bart.* Other Members of the Council : Prof. Isaac Bayley Balfour, *Dr. Andrew Ainslie Common, Dr. Andrew Russell Forsyth*, Richard Tetley Glazebrook, *Prof. Alexander Henry Green, Sir John Kirk, K.C.B., Prof. Oliver Joseph Lodge, Sir John Lubbock, Bart.*, William Davidson Niven, Dr. William Henry Perkin, The Marquis of Salisbury, K.G., *Prof. J. S. Burdon Sanderson*, Adam Sedgwick, *Prof. Thomas Edward Thorpe*, Prof. William Augustus Tilden, *Prof. W. Cawthorne Unwin.*

IT is with deep regret that we announce the death of Sir Andrew Clark, Bart., on November 6, at the age of sixty-seven.

BY the death of Prof. E. Lecouteux, France has lost one of its foremost agriculturists. Lecouteux was born at Créteil (Seine) in 1819. He was one of the founders, and afterwards a vice-president, of the Société des Agriculteurs de France. He was also at one time president of the Société Nationale d'Agriculture. Many important additions to agricultural literature were made by Lecouteux, and the effects of his beneficial influence will be apparent in France for many years to come.

THE Municipal Council of Paris has had an elegant album designed for M. Pasteur, containing the address presented to him in the name of the city of Paris at the celebration of his seventieth birthday in December of last year.

BRUSSELS UNIVERSITY will shortly have a laboratory of Psychological Physics, endowed by private munificence. The Rector, Prof. M. H. Denis, has nominated Drs. G. Dwelshauvers and P. Stroobant to take charge of the researches and practical work.

DR. JOHN ANDERSON, F.R.S., who for the past two years has been collecting materials in Egypt for a work on the mammals and reptiles of that country, is, we understand, again returning to Egypt to continue his researches, proceeding in the first instance to Suakin.

PROF. GUIDO CORA, of Turin, in 1886 a gold medallist of the R.G.S., has received this year a special gold medal from the Imperial Russian Geographical Society of St. Petersburg.

MR. CHARLES STEWART has been elected Fullerian Professor of Physiology to the Royal Institution of Great Britain, the appointment to date from January 13, 1894.

DR. VON JHERING has been appointed Director of the Natural History Museum, Sao Paulo, Brazil.

DR. WOLDRICH, Vienna, has been nominated Professor of Geology in the Bohemian University of Prague.

DR. T. PLESKE has been elected to the Directorship of the Zoological Museum of the St. Petersburg Academy of Sciences, in the place of the late Prof. A. Strauch.

DR. CARL BERG has been reappointed Professor of Zoology at the University of Buenos Ayres, a chair he occupied between 1875 and 1890, and which remained vacant after he went to Monte Video.

PROF. G. E. HALE is expected to be present at the meeting of the Royal Astronomical Society to-morrow, and to give an address on the subject of his solar researches.

IN NATURE of July 20 (vol. xlviii. p. 268) we published a communication from Prof. P. F. Frankland, calling attention to certain objections which had been raised by some members of the Society for Promoting Christian Knowledge against the publication of his little book, "Our Secret Friends and Foes," in the Romance of Science Series. The objections were stated formally by the Secretary of the Victoria-street Anti-Vivisection Society, and endorsed in most forcible terms by Lord Coleridge, as set forth in the correspondence published in our issue referred to. The protest calling upon the S.P.C.K. to withdraw the book from circulation, on the ground that it favoured "experiments upon living animals," was handed in last July with some fifty signatures attached, and in accordance with a rule of the Society was submitted to the Standing Committee, whose judgment in matters of this kind is considered final. This Committee has just passed the following resolution :—"The Standing Committee having taken into consideration the statement of objections, made under Rule xxxvi., against the book entitled "Our Secret Friends and Foes," by Prof. P. F. Frankland, and the remarks thereon submitted respectively by the author and the General Literature Committee, are unable to see sufficient reason for withdrawing the book from the Society's list." The decision arrived at will give general satisfaction to English men of science, and forms a fitting sequel to the correspondence forwarded to us by the author of the book.

AT last there is a possibility that a scientific method of identification will become part of our prison system. The Home Secretary has appointed a committee to consider the means at present available in this country for the identification of habitual criminals, and to report to him whether they could be improved by the adoption either of the Bertillon method of identification in use in France, or of Mr. Galton's finger-print method, or in any other way. The report will be awaited with interest.

THE Exhibition of the Photographic Society of Great Britain will close on Wednesday, November 15.

An International Congress of Applied Chemistry will be held at Brussels on August 4, 1894.

THE Russian Chemical Society will celebrate its twenty-fifth year of existence by a special meeting at St. Petersburg on November 18.

THE Newcastle-on-Tyne and Northern Counties Photographic Association propose to hold an international photographic exhibition next April.

AN "Exposition Universelle" will be opened at Lyon on April 26, 1894, and will remain open until the following November. Sections will be devoted to electricity, hygiene, and agriculture.

At the meeting of the Museums' Association, held in July last, under the presidency of Sir W. H. Flower, K.C.B., F.R.S., the following officers were elected by the Council :—Dr. V. Ball, C.B., F.R.S., to be president, Prof. D. J. Cunningham, F.R.S., and Mr. Walter Armstrong vice-presidents. The Association will meet in Dublin next year, about the end of June or the beginning of July.

THE new session of the Royal Geographical Society will commence on November 13, when the president, Mr. Clements R. Markham, C.B., F.R.S., will discourse on "Geographical Desiderata, or Exploring Work to be done and Geographical Problems to be solved." On November 27, Dr. John Murray will read a paper on "The Antarctic Region and the Scientific and Commercial Results of its Exploration."

THE seventy-fifth session of the Institution of Civil Engineers will be commenced on November 14, and the meetings before Christmas are likely to be occupied, in addition to an address from Mr. Giles, president, with the design and construction of impounding reservoirs for water-works at Tansa (Bombay), Baroda, and Jeypore, with machinery for the manufacture of casks, and with the development of hydraulic power-supply in London.

THE first meeting of the 140th session of the Society of Arts will be held on Wednesday, November 15, when the opening address will be delivered by Sir Richard E. Webster, M.P. A course of Cantor lectures will be given by Prof. Frank Clowes in January and February next, his subject being "The Detection and Measurement of Inflammable Gas and Vapour in the Air." Captain Abney will deliver three Cantor lectures on "Photometry" in April. The following are among the papers down for reading after Christmas :—"London Coal Gas and its Enrichment," by Prof. Vivian Lewes ; "Experiments in Aeronautics," by Mr. Hiram S. Maxim ; "Pewter," by Mr. J. Starkie Gardner ; "Electric Signalling without Wires," by Mr. W. H. Preece, F.R.S. Two juvenile lectures on "Plants : their Foes and Defences," will be delivered by Mr. W. Gardiner, F.R.S., in January.

IT is reported that Vesuvius is in a state of activity, and streams of lava are distinctly visible at night.

AN earthquake was distinctly felt in various parts of Wales and the West of England on Thursday, November 2, about 5.45 p.m. From reports of the occurrence we gather that at Milford Haven the tremor lasted about twelve seconds, and appeared to travel from north to south. In the St. Helens district of Swansea the shock lasted about five seconds. A distinct upheaval of the earth is reported from Carmarthen, where the shock is said to have lasted thirty seconds. Two successive shocks were felt at Cardigan, accompanied by a rumbling noise travelling from the sea in a south-easterly direction. In Pembroke there was a heavy rumbling sound, and the earth was felt to tremble for about seven seconds. The wave appeared to be travelling from south-east to north-west. Very faint shocks were felt at Cardiff and along the Rhondda Valley. In North Wales, however, the tremor was of a very pronounced character. Both shores of the Mersey seem to have been affected. From correspondents of the *Times* it appears that at Aigburth, just south of Liverpool, the vibration was felt at 5.44. At Woodside, on the Cheshire side of the Mersey, the time was

5h. 45m. 30s.; at Crosby, about five miles to the north of Liverpool, 5.47; at Shrewsbury 5.48, the duration in this case being estimated as three seconds. In Bristol it is reported that the tremor was distinctly felt along a course from north-west to south-east for forty seconds. Mr. H. Courtenay, writing to us from Waterford, says that the disturbance was experienced there at 5.25. Mr. Lloyd Bozward, of Worcester, describes the occurrence as follows:—"On Thursday last, at 5.45, a smart shock of earthquake was experienced. At this house the shock was vertical; no noise was heard, but in a second or two after the first shock a feeble one followed. Persons on the ground-floor observed nothing. The shock was felt at Boughton Park, southwards a mile hence, and there also the servants on the ground-floor felt nothing. These places are on the west side of the Severn. It is somewhat rare for the same shock to be felt on both sides of the Severn, but on this occasion it was somewhat severely felt at some large ironworks on the eastern side of the river. There the motion is described as a swaying one, and a rumbling like the passing of a heavy waggon was heard. At Boughton and the ironworks the time given is 5.48 p.m. I took the hour at the time of the shock from a clock, a good time-keeper, in the room with me. At Callow End, Dermstone, a farmstead ten miles north-east of Worcester, no shock was felt, but a loud noise was heard."

DR. N. M. GLATFELTER reprints from the fifth annual report of the Missouri Botanic Garden "A Study of the Venation of *Salix*." Photographic reproductions are given of the leaves of twenty-four American species of willow, and an attempt is made to classify them according to their venation.

THE Deby collection of diatoms now in possession of the British Museum, and open for reference by students in the Cryptogamic Herbarium, is the finest in existence, both as regards the number of species, the authority of the nomenclature, and the beauty of their preparation and preservation. Besides those collected by M. Deby himself, it includes a large number of type-slides prepared by other eminent diatomists. The collection of diatoms in the British Museum is now estimated to amount to about 50,000 slides.

DR. H. WILD, Director of the Central Physical Observatory at St. Petersburg, has published in German a summary of the decisions of the various international meteorological conferences, from that held at Leipzig in 1872 until that held in Munich in 1891. The arrangement is first under subjects, and secondly according to chronological order, and the work will be found very useful for reference by persons who may be seeking for information upon any particular subject, instead of having to consult some thirteen different volumes.

WE have received the report on the operations of the German Meteorological Office for the year 1892, which closes an important period in the history of that institution, owing to the completion of the organisation of the rainfall stations which began with the year 1885, and the establishment of a first-class meteorological and magnetical observatory at Potsdam. The rainfall stations now number nearly 1900, and the stations which send special reports of thunderstorms exceed 1400. The report contains not only a list of the official publications for the year, but also a list of the contributions of the officials to both German and foreign periodicals. We also note that, in order to keep up an interest in the work, the office issues no less than 200 copies of the popular meteorological journal *Das Wetter* to its observers.

THE report of the Director of the Royal Alfred Observatory, Mauritius, for the year 1891 has just reached this country. The maximum shade temperature during the year was 95°·4 on December 8, and the minimum 51°·0 on August 3. The highest temperature in the sun was 162°·7, and the lowest on the grass 46°·0. The rainfall amounted to 44·63 inches, being 3·15 inches below the average, but at some other stations in the island the rainfall was much greater than at the Observatory. Dr. Meldrum collects observations from ships visiting the island, for the preparation of meteorological charts of the Indian Ocean; the number of days' observations tabulated during the year amounted to 9,600, taken between 23° N. and 46° S. latitude.

COLONEL A. T. FRASER has sent us an interesting note from Bellary with regard to two Hindoo dwarfs which he photographed in the Kurnoul district of the Madras Presidency, not far south of the river Kistna. In speech and intelligence the dwarfs were indistinguishable from ordinary natives of India. From an interrogation of one of them, it appeared that he belonged to a family all the male members of which have been dwarfs for several generations. They marry ordinary native girls, and the female children grow up like those of other people. The males, however, though they develop at the normal rate until they reach the age of six, then cease to grow, and become dwarfs. These stunted specimens of humanity are almost helpless, and are quite unable to walk more than a few yards.

MR. MILLER CHRISTY outlines a scheme for mapping the geographical distribution of vertebrate animals in the *Zoologist* for November. He proposes to construct a map showing, by means of different colours, the following points for each species:—(1) Its present (indigenous) area of permanent residence throughout the world; (2) its summer and winter ranges throughout the world (if migratory); (3) its relative abundance in different parts of its area; (4) its lines of migration (if any); (5) the additional area (if any) over which any species, now partly or wholly extinct, can be traced within historic times; (6) the additional area (if any) over which it has been naturalised by human agency; and (7) other points of interest, such as isolated occurrences, erratic movements, areas of hybridization, &c. Though it may be some years before a scheme of this kind is well under weigh, authors of monographs of genera or families would do well to systematise their works, so that they could easily be used in the compilation of a topographical catalogue or bibliography.

THE extensive and increasing demand for india-rubber renders it possible that the supply will eventually become exhausted, so attempts at artificial cultivation of rubber trees are being made in various rubber-producing countries. Mr. Hart remarks, in the June *Bulletin* of the Royal Botanic Gardens, Trinidad, that rubber has been procured in the Gardens from *Castilloa elastica*, and that trees of a mature size will produce it in paying quantities. It has also been proved that *Heveas* of several species will thrive well in Trinidad. In this connection a paper by Dr. Ernst, on the caoutchouc of the Orinoco, published in the first number of the *Revista Nacional de Agriculture*, and included in the *Bulletin*, is of interest. Dr. Ernst says that the rubber of the Orinoco is extracted from the juice of the *Hevea braziliensis*, Müll, a tree belonging to the family *Euphorbiacea*, and not to that of the *Hevea Guayanensis*. The milky juice obtained from the trees, through incisions made in the bark, has the consistency of cream, and the rubber existing in it in minute globules constitutes from thirty to thirty-three per cent. of the weight. The rubber collectors of the Amazons employ the slow, primitive, and contaminating process of evaporating the juice in the dense smoke of a wood fire, in order to separate the rubber from it. A far better method of obtaining coagulation is to add a six per cent. solution of alum to the juice, and then submit the coagulated rubber to pressure in order to extract the water it contains. Dr. Ernst thinks that every effort should be made to extend and conserve the forests, thickets, or groves of rubber trees, suggesting, among other things, that

when the collectors work a grove they should be made to plant a certain number of trees. Only by such means, and by adopting a chemical mode of coagulation, can the rubber production of the Amazon territory be increased in quantity and improved in quality.

MR. VERNON BAILEY has prepared a report, for the U.S. Department of Agriculture, on the haunts and habits of the spermophiles, known in America as gophers or ground squirrels, inhabiting the Mississippi Valley region. Five distinct species of the genus *Spermophilus* inhabit this region, and four are restricted to it. On account of the immense damage done to crops by these mammals, several States have endeavoured to exterminate them, and they have formed the subject of investigation at a number of agricultural colleges and experimental stations. The increase of the pest is probably due to the thoughtless destruction of its natural enemies. We learn that no less than sixteen of the seventy-three species and sub-species of hawks and owls found in the United States are known to prey on the various members of the genus *Spermophilus*. Among mammals, the spermophile's enemies include the badger, fox, coyot, wild cat, and weasel, all of which are hunted and killed for sport or because of poultry-yard depredations. In several States immense amounts of money have been paid as bounties for the destruction of the pest, but the results are far from satisfactory; and it is evident that a bounty is only a temporary expedient for the extermination of these or any other animals. Mr. Bailey says that in many ways spermophiles render valuable service to the farmer, so he does not recommend a complete destruction of them. The evil which they do to crops, however, is very considerable over more than two-thirds of the United States; hence there is a general demand for some economical means of destroying them. The animals can, of course, be shot, and in this way limited areas may be freed from their ravages. Fumigation and trapping have also been employed with more or less success; but the most effective and quickest results have been obtained by placing in the burrows a bunch of rags or waste saturated with carbon bisulphide, and closing up the hole. The information on this point given by Mr. Bailey should be of use to agriculturists; indeed, the whole of the bulletin is of high importance.

AT the request of the Royal Academy of Science in Vienna, Prof. V. Hirbel undertook a geological tour this season in Thessaly. One or two short reports from him are published in the journal of the *Mathematics naturwissensch. Classe* (No. 20, October 12). Respecting the geology of Northern Greece, he writes that calcareous formations of the Flysch have the most extensive outcrop on the three parallel chains of the Pindus range. Dykes of serpentine intrude through the Flysch, and occur as flows interbedded with the overlying Cretaceous limestones. The age of the much larger intrusive masses of serpentine in the sandstone zone of the upper Peneus has not yet been definitely ascertained.

IN the "Proceedings of the U.S. National Museum" (vol. xvi. pp. 471–478, pl. 56), Mr. William Healey Dall describes a "Sub-tropical Miocene Fauna in Arctic Siberia." This fauna consists of a few well-preserved specimens of molluscan genera, Ostrea, Siphonaria, Cerithium, &c., which were found in 1855 by a member of the "Ringgold and Rodgers Exploring Expedition in the North Pacific." The fossils occur in Miocene sandstones of the Sea of Okhotsk, which are exactly like those of the Alaskan coast, and they are of interest chiefly because they prove beyond doubt strong affinities of the Miocene mollusca of these northern seas with species now living in the warm seas of Japan and China. According to Mr. Dall, the annual mean temperature of the waters in the Okhotsk area has diminished by at least 30° to 40° F. since Miocene time.

THE U.S. National Museum has also published a report by Mr. James J. Peck, on the pteropods and heteropods collected by the U.S. Fish Commission steamer, *Albatross*, during the voyage from Norfolk, Va., to San Francisco in 1877-8. The pteropod collections of this voyage are, for the most part, from the Caribean and Panamaic provinces, and the material belongs almost exclusively to the family Cavoliniidæ. From none of the deeper dredgings in the Pacific were pteropod deposit shells reported, though at times the surface collections in the same regions showed an abundance of the live animals. Mr. Peck agrees with Agassiz that bottom distribution is largely determined by the course of the ocean currents, so that by means of pelagic fauna and their bottom distribution, light may be thrown upon the course of the currents. To this cause Agassiz ascribed the presence of Arctic pteropods along the New England coast, from the course of the Labrador currents, and Mr. Peck believes that the differences between the bottom and surface collections of the *Albatross* on the voyage in the Gulf of Panama and at the Galapagos Islands may be similarly explained.

SOME years ago, a discovery of fossil plants was made for the first time in the Trinity Division of the Comanche series of Texas. These have now been worked out in detail by Mr. Wm. Morris Fontaine, who has published his results, together with a series of illustrative plates, in the "Proceedings of the U.S. National Museum" (vol. xvi. pp. 261–282, pl. 36–43). There are twenty-three species described; by far the greater number are conifers belonging to the genera Abietites, Laricopsis, Pinus, Frenelopsis, Sequoia, &c., a few Cycad genera, and a new species of Equisetum are also present; ferns are of exceedingly rare occurrence, and angiosperms entirely wanting. Seven of the species have been identified with forms from the Lower Potomac deposits (Lower Cretaceous) of Virginia, and several others show striking points of similarity with the same flora; four species agree with Wealden types. The whole character of the "Trinity" flora, more especially the absence, so far as known, of angiosperms, seems in favour of Jurassic as well as Cretaceous affinities. It certainly does not bear the distinct Cretaceous impress of the flora in the Potomac or Wealden formations. Mr. Fontaine refers the "Trinity" flora, therefore, to the base of the Cretaceous deposits in Texas, occupying a slightly lower horizon than the very similar flora in the Potomac deposits of Virginia.

THE recent geological history of the Arctic lands is discussed by Sir Henry Howorth in the *Geological Magazine*. The general conclusions to which he arrives are as follows:—(1) During the Pleistocene period the Arctic lands, instead of being overwhelmed by a glacial climate, were under comparatively mild conditions, and were the home of a widely-spread and homogeneous fauna and flora, constituting, perhaps, the best defined life-province in the world. (2) Since Pleistocene times the climate of these Arctic lands has been growing more and more severe, resulting in the extinction of a portion of their vegetable and animal inhabitants. (3) While one portion of this Pan-Arctic fauna and flora still remains largely homogeneous, another portion has become differentiated by evolution in Northern America and Northern Europasia, into the Nearctic and Palæarctic regions respectively. (4) The true and the only glacial climate which we know to have prevailed in the Arctic lands was not during the so-called glacial age of geologists, that is during the Pleistocene period, but in that which is now current, and which is the product largely, if not entirely, of changes of level in the earth's crust which have occurred since Pleistocene times.

THE "Geology of Dublin and its Neighbourhood" has found a clear interpretation at the hand of Prof. Sollas, of Dublin University (*vide* Proceedings of the Geologists' Association, August,

pp. 91–121). Prof. Sollas discusses the origin of the ancient quartzites, grauwackes, and slates in that district, and gives drawings from microscopic sections to illustrate the evidence in favour of their originally sedimentary nature. Palæontological evidence is present in the form of numerous worm-tubes and the doubtful organic remains known as Oldhamia radiata and antiqua. The whole group is regarded as a deposit in the tranquil sea of a period, probably Cambrian or pre-Cambrian, which he rather happily characterises as the "Age of Worms." Just as in the Highlands of Scotland, this Irish area has been subjected to great earth-movements, not only once, but several times. First, in later Cambrian age, the sedimentary rocks were rolled up into a series of anticlinal and synclinal folds. Ordovician time saw the rocks once more below sea level, and a second elevatory movement set in with extreme slowness in Upper Ordovician time. The third period of movement is of post-Carboniferous date, and of simpler character than the two preceding, the flexures having in the main followed those of the Ordovician movements. In his concluding pages Prof. Sollas briefly refers to the absence of mesozoic and tertiary deposits, the general characters of the glacial period, and the distribution of the boulder-clay over the Dublin area. Sketch maps and diagrams illustrate the paper.

THE effect upon the optical properties of a plate of quartz of compressing it in a direction perpendicular to its axis has been investigated by M. F. Beaulard, who publishes his results in the *Journal de Physique*. A quartz plate was cut normally to the axis and compressed laterally, thus superimposing a double refraction, varying with the pressure, upon the rotatory power. Allowing a beam of plane-polarised light to fall normally on to the plate, he obtained inside the crystal two elliptic vibrations propagated with different velocities and exhibiting after emergence a certain difference of phase. These two vibrations interfered and gave an ellipse whose elements could be experimentally determined. The pressures were obtained by means of a Perreaux dynamometer, varying from 0 to 530 kgr. per square cm. The quartz was placed between two jaws which could be made to approach each other by turning a screw. One of the jaws was fixed firmly in a frame, the other moved on guides which communicated the pressure to an elliptical pair of springs, the amount being indicated on a dial through a rack and pinion arrangement. The dynamometer was mounted on two wooden platforms allowing of the orientation of the quartz plate normally to the incident ray. The rest of the apparatus consisted of a polariser, a quarter-wave mica plate, a pair of quartzes with two different rotations, an analyser, and a spectroscope with eye-piece slit. It was found that the rotatory power remains constant; that the difference of phase due to double refraction alone is proportional to the pressure, and that the angle between the major axis of the emergent ellipse and the original incident vibration increases at first with the pressure (for plates of given thickness), then oscillates, and at particular pressures the two directions are the same, so that at some points the major axis turns in a direction contrary to the natural rotation of the quartz plate.

AT a recent meeting of the Académie des Sciences (Paris), M. Poincaré communicated an account of the experiments on the velocity of propagation of an electric disturbance along a wire, which have been carried on by M. Blondlot at Nancy. The wires used were of "high conductivity" copper, 3 mm. in diameter, and were fixed to the telegraph posts between the Préfecture and the Maxeville Asylum, a distance of about one kilometre. The method employed was very like that used by Wheatstone in his attempt to measure the velocity of the passage of an electric discharge, only instead of a rotating mirror M. Blondlot uses a rotating photographic plate. Matters are so arranged that two sparks pass between two knobs, one direct and the other after travelling round the 2 kilometre circuit. The mean of five experiments gives a velocity of 296 kilometres per second, the retardation being $\frac{1}{150}$ of a second. On a line 2 kilometres long, that is, one where the electricity has to travel over 4 kilometres, the velocity obtained was slightly greater, namely 298 kilometres per second.

IN a paper read before the American Institute of Electrical Engineers, Messrs. Bedell, Miller, and Wagner give an account of a new form of contact-maker which they have employed in their experiments on transformers. The contact-maker was required to connect for an instant a voltameter with the circuit of the transformer at any required part of the cycle. The instrument consists of discs carried by a spindle which was connected to the shaft of the dynamo. A needle projects from the face of this disc and forms one of the electrodes for making contact, the other being formed by a fine water-jet issuing from a nozzle which is insulated from the rest of the instrument. The water-jet is supplied by a jar of water, several feet above, the connection being through a rubber tube. The nozzle of the water-jet is carried by a disc which is capable of being rotated, and has its edge graduated in degrees. The needle cuts the water-jet near the nozzle before the continuous column has had time to break up into drops. It was found necessary to put a little salt in the water, as pure water does not work, while acidulated water corroded the nozzle. This form of contact-maker the authors find far superior to any of the usual mechanical devices, the contact being perfectly constant and reliable.

IN the *Zeitschrift für physikalische Chemie*, vol. xii. No. 4, Herr Humburg gives an account of a significant piece of work which was undertaken for the purpose of obtaining additional evidence as to whether the magnetic rotatory polarisation of solutions gave any support to the hypothesis of electrolytic dissociation. Measurements were made on solutions of the lower fatty acids in water, benzene, and toluene. The molecular rotation of the dissolved substance was calculated on the supposition that the value found for the solution was the sum of those given by the amounts of solvent and dissolved substance which it contained. The numbers thus obtained were found to be practically independent of the concentration and of the chemical nature of the solvent, and were identical with the values given by the free acids. Not only was this the case with acids such as acetic, proponic, and butyric, which are held to be but feebly dissociated in aqueous solution, but also of the chlor-acetic acids, which are supposed to be much more strongly dissociated. Similar results were obtained from observations on solutions of various inorganic salts, such as potassium iodide, sodium bromide, ammonium nitrate, and barium bromide in water, and in methyl alcohol. Although the molecular conductivity of the aqueous solution of any of the salts was invariably much greater than that of the alcoholic solution, nevertheless the molecular rotation of the salt was the same in both cases. In conjunction with the work of Schönrock on this subject (see Notes, vol. xlviii. p. 230), the above results indicate that the effect of electrolytic dissociation on the magnetic rotatory polarisation of solutions (if such an effect really exists) is too small to be detected by ordinary methods of measurement.

ALTHOUGH such a large number of investigations have been made on the bacterial contents of waters derived from such different sources as lakes, rivers, springs, and wells, only a few observations have been made on the microbial condition of sea-water. Giaxa's are the earliest recorded examinations, and exhibit the poverty in this respect of sea-water. Thus, in the Bay of Naples, at about a mile and a half from the shore, only ten organisms were found in 1 c.c. Russell, also working in this bay at distances of 2½ to 9 miles from the coast, obtained

from 64 to 6 n 1 c.c. respectively. Very different is, however, the bacterial condition of sea-mud, as many as 245,000 microbes being found in 1 c.c. of slime at a depth of 164 feet, and 12,500 at 1,640 feet, whilst sea-water examined at such depths contained 121 and 22 respectively. Russell has been recently extending his observations (*Botanical Gazette*, vol. xvii. 1892) to the sea-water and mud on the Massachusetts coast. The number of bacteria, both in the water and slime, was very much less in these more northern and cooler waters than in the Mediterranean at Naples. The microbes present in the mud from Buzzard's Bay average from 10,000 to 30,000 per c.c., being but a very small fraction of the number found in Mediterranean mud at equal depths. Samples of mud were also obtained about 100 miles from the shore at a depth of 100 fathoms, on the edge of the great continental platform skirted by the Gulf Stream. These samples are the farthest from land that have ever been bacteriologically examined, and bacteria were found in large numbers; moreover, the two prevailing varieties present were identical with those obtained near the Massachusetts coast. As in his earlier researches, Russell also here found but few varieties of bacteria in the mud, mostly two or three, and curiously one form, *Cladothrix intricata*, isolated from Mediterranean mud and frequently met with, was only rarely found in this Atlantic slime.

ETHYL and methyl derivatives of hydroxylamine, in which the alkyl radicles replace an atom of the hydrogen in the amido group, and are therefore directly linked to nitrogen, have been isolated by Dr. Kjellin, of Heidelberg, and their mode of preparation and properties are described in the current number of the *Berichte*. They have been obtained by the decomposition with hydrochloric acid of the esters of meta-nitro-benzaldoxim, which oxim was merely selected on account of its ready preparation in a state of purity. The process consisted in boiling the ester with seven times its volume of concentrated hydrochloric acid in a flask to which a reflux condenser was attached, subsequently cooling, saturating the liquid with hydrochloric acid gas, and again boiling for a few minutes. A large quantity of meta-nitro-benzaldehyde is deposited and removed by filtration, after which the hydrochloride of the substituted hydroxylamine is obtained by evaporation, first over a water bath, and finally over sulphuric acid. In order to isolate the free bases from the hydrochlorides, the same method was adopted as proved so efficacious in the isolation of hydroxylamine itself, namely, decomposition with sodium alcoholate, and subsequent fractional distillation of the resulting liquid *in vacuo*. The hydrochloride was dissolved in the minimum quantity of methyl alcohol, and a little less than the calculated quantity of sodium methylate added, the large evolution of heat being controlled by extraneous cooling. The deposited sodium chloride was removed by filtration through asbestos; filter paper cannot be employed on account of the strongly corrosive properties of these methyl and ethyl derivatives of hydroxylamine. Upon distillation *in vacuo* in the case of the methyl compound, after the greater portion of the methyl alcohol has passed over and at a temperature of 35–40°, an alcoholic solution of the base distils, then finally the free base admixed with a small proportion of alcohol. Upon submitting this last fraction to redistillation, at a temperature of 62° and a pressure of 15 m.m., the pure β-methyl hydroxylamine, $CH_3NH.OH$, distils as a colourless liquid, which solidifies to a solid composed of colourless and odourless prisms upon cooling with ice or agitation of the receiver. The crystals melt sharply at 42°, but do not resolidify until the much lower temperature of 20° is reached. Upon distillation *in vacuo* in the case of the ethyl compound, after the methyl alcohol has largely passed over an alcoholic solution of the base distils for a short time, then lastly the ethyl compound itself commences to sublime and condenses in the receiver in the form of large leafy crystals, filling the whole receiver. After pressing the crystals on porous plates to remove any superficial oil, pure β-ethyl hydroxylamine $C_2H_5NH.OH$ is obtained; the crystals are quite colourless and odourless, and exhibit a mother-of-pearl lustre. They melt sharply at 59–60° without decomposition.

THE β-methyl and β-ethyl derivatives of hydroxylamine are substances which are readily soluble in water and lower alcohols, but only very slightly in ether and benzene. The crystals of both deliquesce in moist air. In the case of the methyl compound the deliquesced substance rapidly volatilises; but in the case of the ethyl compound the deliquescence can only be observed in badly-stoppered bottles, for in the open air the spontaneous volatilisation is so rapid that the substance has not time to deliquesce before it entirely disappears. Both compounds react strongly basic, and reduce alkaline copper and silver solutions as energetically as hydroxylamine itself in the cold. They strongly attack organic substances, but do not etch glass, nor do they appear to be explosive substances like free hydroxylamine. Both compounds are rapidly destroyed by halogens with production of halogen acids; concentrated hydriodic acid converts them to amines. When heated for some time in a sealed tube with concentrated hydrochloric acid, the methyl compound suffers an interesting change, being converted into ammonia and formaldehyde—$CH_3NH.OH = NH_3 + HCOH$.

NOTES from the Marine Biological Station, Plymouth.—Last week's captures include another living specimen of *Lima Loscombii*, the Holothurian *Thyone fusus*, and the rare Nemertines *Carinella polymorpha* (second specimen), *Cerebratulus marginatus* (first record), and a large *Lineus bilineatus* (16 cm. long). The tow-nettings have been of a uniform character. The diatom *Coscinodiscus* has been present in remarkable profusion for several weeks past. Medusæ have been scarce. The most plentiful larvæ are those of Polychaetes, of Cirrhipedes, the *Mysis* stages of several Decapods, and *Scyphonautes*. Veligers are present in small numbers; and isolated specimens of the larvæ of *Cephalothrix*, *Porcellana* and *Carcinus* (*Megalops*) have also been observed. Very few individuals of *Crangon vulgaris* are now to be found bearing ova.

THE additions to the Zoological Society's Gardens during the past week include a Black-handed Spider Monkey (*Ateles geoffroyi*) from Nicaragua, presented by Mr. T. E. M. Rymer-Jones; a Rhesus Monkey (*Macacus rhesus*, ♀) from India, presented by Miss G. A. Gollock; two Macaque Monkeys (*Macacus cynomolgus*, ♂ ♂) from India, presented respectively by Mr. W. Wylde and the Hon. Mrs. E. Yorke; a Philippine Deer (*Cervus philippinus*, ♀) from Manila, presented by Capt. T. E. Saunders; seven Common Quails (*Coturnix communis*), two Common Terns (*Sterna hirundo*), two Common Toads (*Bufo vulgaris*) European, two Bull Frogs (*Rana catesbiana*) from North America, a Grey-headed Porphyrio (*Porphyrio poliocephala*) from India, presented by Mrs. Rickards; a Smooth Snake (*Coronella lævis*) British, presented by Mr. A. Green; a Bay Wood Owl (*Phodilus bodius*) from Java, deposited; two Rose-Hill Parrakeets (*Platycercus eximius*) from Tasmania, a Purple Sandpiper (*Tringa striata*) British, purchased.

OUR ASTRONOMICAL COLUMN.

A NEW SOUTHERN STAR.—Prof. Krueger has received a telegram from Prof. E. C. Pickering to the effect that a new star was discovered by Mrs. Fleming on October 26. Its Right Ascension is given as 230° 34′, and its North Polar Distance = 140° 14′. The magnitude on July 10 = 7·0. No further details have been received, but from the date for which the magnitude is given it is probable that the star was detected by

Mrs. Fleming upon a photographic plate taken in July. The telegram has been communicated to the observatories in the southern hemisphere.

"ASTRONOMICAL JOURNAL" PRIZE.—Owing to the fact that during the past six months only one comet has been discovered, and that its period of visibility was unusually short, and also to the probable prevalence of a bad time of observing weather during the winter, the period specified in the offer of this prize for observation of comets has been extended by six months. The closing time for this prize will now take place September 30, 1894.

COMET BROOKS (OCTOBER 16).—Last week we gave Bidschof's elements and ephemeris for this comet. This week, for the sake of comparison (*Astronomischen Nachrichten*, No. 3194), we give the elements of the comet as obtained from the observations made at Hamburg, October 17; Greenwich, October 18; Pola, October 19; Strassburg, October 23, and Vienna, October 24. They are as follows:—

Elements.

T = 1893 September 19·209 M.T. Berlin.

ω = 347° 20′·50 }
Ω = 174 53·20 } 1893·0
i = 129 45·77 }
log q = 9·90992

The current ephemeris is for 12h. Berlin mean time.

1893.	α App. h. m. s.	δ App. ° ′	Br.
Nov. 9 ...	12 58 50 ...	+30 27·2 ...	0·82
10 ...	13 0 53 ...	31 20·6 ...	
11 ...	2 59 ...	32 14·8 ...	
12 ...	5 9 ...	33 9·9 ...	
13 ...	7 22 ...	34 5·8 ...	
14 ...	9 39 ...	35 2·6 ...	0·80
15 ...	12 0 ...	36 0·4 ...	
16 ...	13 14 25 ...	36 59·1 ...	

Unit of brightness occurred on October 17.

MOON PICTURES.—In an article on the "Origin of the Lunar Craters," which has appeared in the last two numbers of *Prometheus* (Nos. 212, 213), the writer has been able to secure some excellent illustrations. These pictures are copies from photographs taken at Paris by the Brothers Paul and Prosper Henry, and illustrate regions near the South Pole. The current number of *Knowledge* also contains two fine reproductions of lunar photographs obtained by MM. Henry, illustrating an article by Mr. A. C. Ranyard, on the tints of the lunar plains.

METEOR SHOWERS DURING NOVEMBER.—During this month, in addition to some minor showers, Mr. Denning's table informs us that there are two which are above the usual brilliancy. The positions of the radiant points are as follows, the two most brilliant being printed in heavier type:—

Date.	Radiant. α	δ	Meteors.
Nov. 13 ...	150	+22 ...	Swift; streaks
16 ...	154	+ 41 ...	Swift; streaks
17 ...	53	+ 71 ...	Slowish
20 ...	62	+ 23 ...	Slow; bright
27 ...	25	+44 ...	Very slow; trains
30 ...	190	+ 58 ...	Swift; streaks

GEOGRAPHICAL NOTES.

SOME anxiety may have been caused amongst Dr. Nansen's friends by reports published in an evening paper from the slender testimony of some Samoyedes, that the Kara Sea was unusually hampered by ice this season. The *Nouvelles Geographiques*, it is satisfactory to see, reports on the authority of the captains of the Russian vessels carrying railway material to the Yenesei, and of Captain Wiggins, that the navigation of the Kara Sea was particularly easy this summer, the ice being thin and not compact. The Hammerfest whalers also reported that never within human memory has the sea been so free from ice. At the end of December one vessel saw not a single iceberg between Nova Zemlya and Franz Josef Land. In the Kara Sea the current, which is usually westerly at that season, was this year running north-north-west, at the rate of a mile an hour. The note indicates that Captain Wiggins entertained no doubt of Dr. Nansen having easily reached the New Siberian Islands, which were to be his real starting-point.

IN continuation of the soundings of the English lakes recorded in this column from time to time during the summer, Mr. E. Heawood, assisted by Mr. Shields, has last week made bathymetrical surveys of Ennerdale, Buttermere, and Crummock Waters.

THE annual report of the Tyneside Geographical Society shows that there is now a membership of 1011, and the society generally in a flourishing state. From its headquarters in Newcastle the Tyneside Society extends its operations over a considerable area, and has established a regular branch in the city of Durham.

DR. JOHN MURRAY, of the *Challenger*, has written an elaborate paper on the first voyage of Columbus in relation to the development of oceanography. It is published in the current number of the *Scottish Geographical Magazine*, illustrated by reproductions of a number of ancient maps. Dr. Murray deals incidentally with the origin of the name America, rejecting Horsford's fantastic guess that it came from the name of the Norse explorer Erik the Red, and inclining towards Marcou's theory of its native origin from the Amerrique tribe of Indians in South America. As to Amerigo Vespucci's connection with the name, the author views it as a playful nickname given to him on account of the similarity of his Christian name, which was superseded by *America*, just as he himself is frequently called "Challenger Murray" for the sake of distinction.

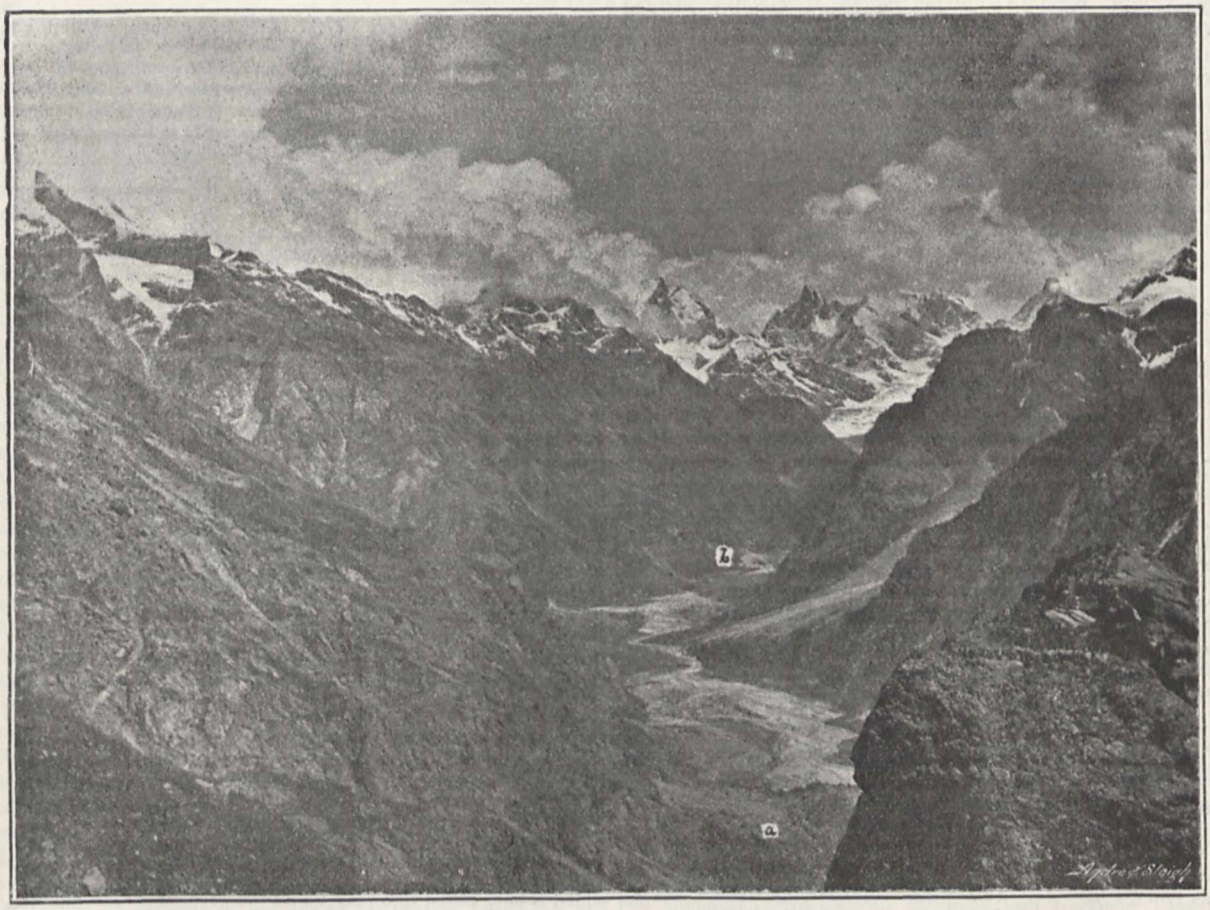
THE EROSION OF ROCK-BASINS.

IN a recent letter to NATURE (vol. xlviii. p. 247, July 13, 1893), Sir H. Howorth attacks the views of those extreme glacialists who hold that a glacier is able, by means of the fragments of rock frozen into its under surface, to excavate rock basins: and with justice, so far as the larger basins, such as those of the great Swiss and Italian lakes are concerned, for it has been frequently shown, especially by Prof. Bonney, that such a cause is quite inadequate to account for the excavation of those basins. It seems inconceivable that a glacier which is barely able to move the loose *débris* lying in its path, should be able to plough out hard rocks to any depth whatever below the general valley level. On the other hand, the frequent occurrence of rock basins in regions which are now, or were in former times, subjected to glaciation, is so remarkable, that it appears as though there must be some connection between the two sets of phenomena.

Sir H. Howorth says that, "so far as we know, the mechanical work done by ice is limited to one process. The ice of which glaciers are formed is shod with boulders and with pieces of rock which have fallen down their crevasses. These pieces of rock abrade and polish and scratch the rocky bed in which they lie when they are dragged over it by the moving ice. Without this motion they can of course effect nothing either as burnishers or excavators." But there is another agent of erosion which is only called into play under the peculiar circumstances afforded by glaciers, and one which, I venture to think, is sufficient to account for the formation of these hollows. This is, briefly, the action of the water, derived from the melting of the surface of the glacier. It is now some five years since I had the good fortune to be able to explore some of the large glaciers in the higher regions of the Himalayas, and formed the conclusions which I am now about to put forward; but it seemed to me so likely that they had occurred to others, and probably been dismissed as unsatisfactory—though of this I could not assure myself, as it is long since I have had access to any library in which papers relating to such questions might be found—that I hesitated to publish them. It seems, however, from the remark in Sir H. Howorth's letter, quoted above, that no weight has hitherto been attached to this cause of erosion, however slight it may be, and therefore my observations may possibly be of some value.

Before going into details, I wish to draw attention to one or two facts which have been overlooked by Sir H. Howorth, and which have an important bearing on the discussion. In the first place, whatever be the cause of motion, it is an undoubted

fact that the lower portions of large glaciers do move over level or nearly level ground, and that for considerable distances. Whether the bottom layers of the glacier move at all under such circumstances does not matter much, but that the surface layers move is proved by the manner in which stones are carried down and deposited in a moraine often several miles distant from the foot of the steep slopes at the head of the valley. I am inclined to think that the amount of plasticity attributed to ice, founded on laboratory experiments, has been considerably underrated, and that under the conditions in which it exists in a large glacier it does actually flow, though very slowly, like a viscous body. Why gravity should cease to do any work on the ice, when it rests on a level surface, as Sir H. Howorth states, I cannot see, and when we consider the enormous thickness and weight of ice in a large glacier, there seems nothing strange in its spreading out or flowing in the only direction in which motion



Glacier at head of Bhutna Valley, Zanskar Rang, Kashmir. *a* Old Moraine; *b*, present termination of glacier.

is possible, if we allow any degree of plasticity whatever. In the second place, that erosion of some kind, and that to a large amount, does go on beneath a glacier is proved by the turbid state of the water which issues from the end of it, and it must be remembered that this turbidity of the water is not occasional like that of a river in flood, but is continuous, or at least is recurrent every twenty-four hours, throughout a great portion of the year.

In ascending one of the larger Himalayan glaciers we notice at least three well-defined stages. First, at the foot of the glacier, and for a considerable distance up, perhaps a mile or more, the ice is almost completely concealed by the burden of moraine stuff brought down from above, which, as the ice melts away, is continually being deposited on the floor of the valley. As a result of the continued renewal of these loose deposits, the stream which rushes out from beneath the glacier *is* unable to cut down into the solid rock. Therefore, supposing the end of the glacier to remain at or about the same position for a long period, and allowing for a moment that there is *any* erosion whatever going on beneath the glacier higher up, there is undoubtedly a tendency towards the formation of a hollow, closed at its lower end by a rock barrier.

Having clambered over the masses of moraine matter which conceal the lower end of the glacier, we enter upon a broad expanse of ice comparatively free from boulders. Here the surface of the ice usually lies at a very gentle inclination, and may continue in this manner for several miles, until the foot of the steep snow-covered slopes, riddled with crevasses, forming the third stage alluded to above, is reached. It is to this middle, gently sloping portion of the glacier that I wish especially to draw attention, as it is here that the agent of erosion, to which I refer the digging out of the hollows, is alone effective. And it is in such positions—that is, immediately below a point where the inclination of the valley decreases more or less abruptly—that in a formerly glaciated region rock-basins are most commonly found.

The ice in this portion of the glacier is traversed by occasional narrow crevasses, into which the streams, often of considerable size, arising from the melting of the surface ice under a hot Indian sun, plunge sooner or later, carrying down numerous pieces of rock with them. Even if the crevasse does not originally extend to the bottom of the glacier, a shaft must quickly be worn out, so that the falling water is enabled to exert the whole of its force directly on the solid floor of rock. These waterfalls are, of course, well known under the name of "moulin," but I do not think that sufficient weight has been

attached to them as an agent of erosion. They must act like so many gigantic drills upon the rock surface, and dig out hollows similar to those found at the foot of an ordinary waterfall. It may be objected that, when the glacier has retreated, we ought to find, instead of one large hollow, a series of pits corresponding to the position of each moulin; but here the peculiar conditions afforded by the presence of the ice come into play. Any particular moulin never keeps the same position for any length of time, not only because a new crevasse may open at any point in the course of the stream, but also because the water is continually cutting back the edge of the fall, as in an ordinary waterfall, but much more quickly. Thus the drills, in course of time, work backwards and forwards over the whole of the area occupied by this portion of the glacier. Indeed, their action may be compared to that of a rapidly revolving drill moved slowly over the surface of a piece of wood, which would ultimately be cut out to any desired depth, or to the action of a sand-blast directed on a piece of plate-glass.

It may be noted that none of the streams find their way down the glacier as far as the mass of moraine matter near its lower end, so that they can have no effect on the rock barrier, which, as I have pointed out, has a tendency to form beneath that portion of the glacier. Moreover, the majority are swallowed up before they reach the lower third or so of this middle portion of the glacier, and thus the well-known section of the bed of those rock basins which have been attributed to glacial action, deepest near their upper ends, and gradually shallowing lower down, is simply and easily accounted for.

It is a curious fact that, in the Himalayas, true rock basins are of very rare occurrence, although the conditions for their formation on the above hypothesis are conspicuously present. It is not, however, difficult to account for their absence if we consider the enormous amount of *débris* carried down by the Himalayan glaciers as compared with that borne by most European glaciers, to judge from pictures and photographs of the latter. It is only the lower portion of the Himalayan glaciers that is so entirely covered by *débris*, and the difference may be partly due to the fact that the hill-sides above this portion of the glacier are much less protected by ice and snow than in the case of the northern glaciers. On the retreat of the glacier this burden of moraine stuff would be quite sufficient to fill up any hollow that may have been formed beneath it. This is well shown in the accompanying illustration, where there is a well-defined old moraine at *a*, the present termination of the glacier being at *b*. Between these two points stretches an almost level plain, some four or five miles long, in which we should have expected to find a lake, supposing a hollow had been worked out beneath the glacier; but in place of it we find this broad stony plain covered with *débris*, evidently derived from the main glacier and from the side valleys. But suppose the glacier were to advance again, all this loose material would in course of time become frozen into the bottom of it, and carried out. Then if a rapid retreat of the glacier were to occur, leaving no time for the hollow—if any exists—to be filled up again, we might have a lake where the plain now is. Or, the contrast may perhaps be accounted for by a difference in the rate of change of climate since the glacial period, which may have been more slow in these southern latitudes than further north, so that the northern glaciers had not sufficient time during their retreat to fill up the hollows formed beneath them. If, as has been supposed, the extension of the European glaciers was partly due to a diversion of the Gulf Stream, might not the rapid breaking down of the barrier which caused that diversion have given rise to the rapid amelioration of climate required?

It would not, I think, be difficult to carry out a few measurements of the erosion that goes on beneath a glacier, which might throw much light on the question. If one visits the mouth of one of these glaciers early in the morning, the stream which issues from it is seen to be nearly, but never quite, free from sediment. This amount of sediment might, I think, be taken as that due to the rasping action of the ice itself, aided by the rocks frozen into its under surface. As the day proceeds, and the surface of the glacier begins to melt, the volume of water issuing at its foot quickly increases, and at the same time it becomes thick with mud. It would be easy to measure the velocity of the stream, and the amount of sediment at intervals during the day, and from this, knowing the area of the glacier, we could estimate the erosion due respectively to the rasping action of the ice and to the drilling action of the moulins. That the latter would be enormously in excess of the former I have no doubt whatever, and I think that it is worth considering whether this may not be an adequate cause of those hollows which do undoubtedly occur in positions that seem to connect them with a former extension of glaciers.

T. D. LATOUCHE.

CHRONO-PHOTOGRAPHIC STUDY OF THE LOCOMOTION OF ANIMALS.[1]

THE chief interest in the study of organised beings is to look for the similarity which exists between the special conformation of each species, and the particular characters of the functions in this species.

The union of comparative anatomy and physiology is becoming more and more close, and will, without doubt, lead to the discovery of the fundamental laws of morphology—laws by means of which the inspection of an organ will permit us to foresee the particularity of its function.

These relations begin to be comprehensible in the case of the organs of locomotion of vertebrates. The size and length of the muscles, the relative dimensions and form of the bony supports of the members, the extent and the form of the articulating surfaces enable us to infer the character of the movements of mammals; and, on the other hand, the accuracy of these deductions can be proved by controlling them by chrono-photography, which gives the geometrical character of these movements.

Attempts have been made to extend this method of analysing the movements of a number of different animal species by chrono-photography, and they have been successful not only with mammals, but also with birds, reptiles, fishes, molluscs, and arthropods.

It will no doubt be a lengthy enterprise to collect the numerous series of pictures necessary for this comparison, but we have been able to assure ourselves that it is nearly always possible to obtain such pictures by varying the conditions according to the kind of animal studied.

Reptiles, for example, must be put in a kind of circular canal, where they can run at their ease; the chrono-photographic apparatus is placed above the path in which the animal runs, and thus photographs the successive attitudes during the course.

The fish swim in similar troughs filled with clear water, and illuminated underneath, in order that their silhouettes should appear on a clear background. At other times the animal is lighted from above, and thus appears light on a dark background. Similar arrangements are employed for insects. It is not necessary to have here the dark background which served for the study of mammals and birds. The principal difficulty is to ascertain whether the animal under experiment is moving in its normal fashion. With the domestic and tame kinds this is not considerable, but with wild species it requires much patience and many attempts to secure the natural movement.

On comparing some of the types of which chrono-photographic images have been obtained, very interesting analogies are found. Thus, for locomotion on land, as well as in water, it is possible to follow the gradual transitions between simple reptation and the more complicated kinds of locomotion. An eel and an adder put in water, progress in the same way; a wave of lateral inflexion runs continually from the head to the tail of the animal, and the velocity of the retrograde progression of this wave is slightly greater than the rate of movement of the animal itself.

If an eel and an adder are placed on the ground, the manner of reptation is modified in the same way with both species. The undulatory movement has here and there a greater amplitude, and this amplitude increases with the smoothness of the surface on which the animal moves.

With fish, provided they have fins, and with reptiles which have feet, there remains, in general, a more or less pronounced indication of the undulating movements of reptation.

With the dog-fish, for instance, the retrograde wave which goes the length of the body is very pronounced; it is much less with salmon, and exists hardly at all, except at the end of the tail, with fish with thicker bodies.

The retrograde wave during the terrestrial movements of the Gecko is plainly visible, but is less pronounced with the grey lizard and green lizard.

The batrachians present, during the successive phases of

[1] Translation of a communication by M. Marey to the Paris Academy of Sciences.

their evolution, varied types of locomotion, familiar to every one, of which the chrono-photographic analysis is very interesting. The tadpole of the toad, for example, exhibits progression in the first stage by the undulation of the fin, when the feet appear there is a mixed type of locomotion ; the tail undulates, and on both sides the posterior members execute the movements of swimming which is usual to them. These movements of the posterior limbs alone remain some time after the tail has disappeared. Of these movements, which resemble so much those of human swimming, one is especially noticeable ; in this the anterior limbs do not take any part, and the posterior, after having formed a right angle with the axis of the body, approach each other till they become parallel, then bend and stretch themselves again to begin anew. The movements of the lizard's limbs escape direct observation on account of their rapidity, but on the chrono-photographic images, taken at the rate of forty to fifty a second, one can easily follow the successive movements of the limbs in front and behind. With the grey lizard, as well as the Gecko, the normal pace is that of a trot, that is to say, the limbs move diagonally. The great

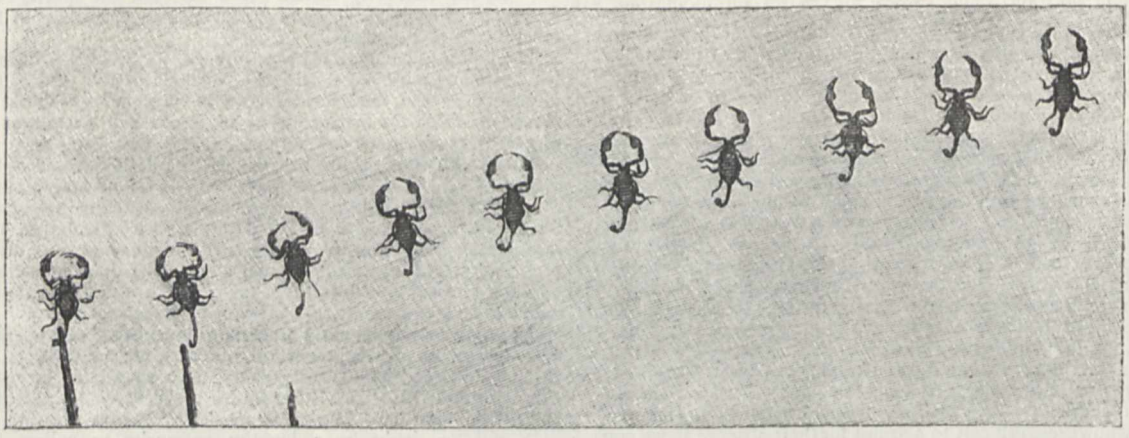


FIG. 1.—Movements of the Scorpion.

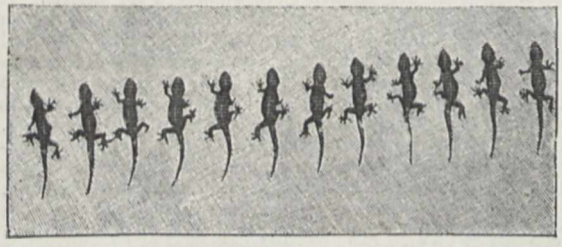


FIG. 2.—Movements of the Gecko.

amplitude of the movements of the limbs, combined with the undulation of the axis of the body, causes the limbs to approach one another very much on one side. and the next instant to separate. The Gecko carries its hind foot nearly under the armpit on the side where the body becomes concave ; the instant afterwards, this side becomes convex, the anterior limb advances very much, and the two limbs (the body presenting on this side a convex arc) will be wide apart.

Many other very interesting observations can be made relating to the movements of insects and arachnids.

THE MAN OF MENTONE.[1]

FEW groups of prehistoric finds have provoked a more persistent controversy as to their date and character than those of the Mentone Caves. Were they Palæolithic or Neolithic? Did they belong to the same age as those of the Reindeer Period of the Dordogne? Or should they, on the other hand, be referred to some still living race of men already settled on that Ligurian coast in the "Polished Stone Period"? Other inquirers, again, have sought a third alternative, and referred them to an intermediate period, to which the name "Miolithic," or, better, "Mesolithic," has been speculatively given.

In view of these differences of opinion, the discovery in February of last year of fresh human remains in one of these grottoes associated with relics that throw a clearer light on the culture and surroundings of those deposited with them than any hitherto discovered there, has naturally created considerable interest.

The caves in which these discoveries have been made are formed in the sea-face of the promontory of lower cretaceous limestone that rises just across the Italian frontier on the Ventimiglia side of Mentone, and which, from its red bastions, is locally known as Baoussé Roussé, or, in its Tuscan shape, Balzi Rossi. As early as 1858 the Swiss geologist, M. Forel, had obtained from a superficial layer of one of these caves various animal bones associated with implements. Subsequently Mr. Moggridge dug a section in the grotto known as the Barma dou Cavillou, revealing five floors "formed in the earth by long-continued trampling," with traces of a hearth in the centre of each, and around flint flakes, axes, hammer-stones, and bones of animals. The animal bones were, however, of existing species, and this evidence clearly pointed to Neolithic habitation. But later, M. Rivière, whose patient exploration of these caverns deserves our warm recognition, whatever may be thought of the conclusions drawn by him, unearthed in the same cave, only a foot or two from the point where Mr. Moggridge's excavations had ceased, the perfect skeleton of a man. The skeleton lay on its left side in the attitude of sleep. A stone lay beneath its head and another behind the loins. An ornament composed of bored shells—which may recall the trochus-studded nets still worn by Venetian peasants—was found adhering to the skull, their adherence being due to a ferruginous substance, fragments of which lay near, and which gave a ruddy colour to the whole. Evidently this ochreous substance had been used by the departed in his life-time to paint his face and body, and the whole character of the deposit clearly points to careful interment. From the discovery of bones of extinct animals mixed with the ashes in the overlying stratum, M. Rivière concluded nevertheless that the skeleton was palæolithic.

The fact that the skeleton of the Barma dou Cavillou was undoubtedly embedded amongst Quaternary remains lent some weight to M. Rivière's opinion, and his view of the matter found acceptance from such competent judges as Mr. Pengelly and others. But the presence of the Neolithic hearths, noted by Mr. Moggridge, in an adjacent part of the cave, combined with other circumstances, led M. De Mortillet and Prof. Boyd Dawkins from the first to take a different view. They saw only the evidence of a Neolithic interment in a Palæolithic stratum.

The annexed diagram (Fig. 1) will give an idea of the general conformation of the cave or cleft known as the Barma Grande,

[1] "On the Prehistoric Interments of the Balzi Rossi Caves near Mentone, and their Relation to the Neolithic Cave-Burials of the Finalese." By Arthur J. Evans. A *résumé* of a paper communicated to the Anthropological Institute. (The cuts are kindly lent by the Institute.)

in which the most recent discoveries have been made. From the data that I was able to gather on the spot from quarrymen who at one time or another had taken part in its excavation, the original floor of the cave, at its mouth, over the spot—that is, where the skeletons were found—was 7·50 metres above the stratum in which they lie. But this depth only includes what has been artificially removed from the cave. There are reasons for believing that the deposit had originally been somewhat higher, but that the original level of the floor had been previously lowered by natural agencies.

In 1884 a discovery of a human skeleton had already been made in this cave by Louis Julien, the foreman of the men employed in quarrying the cliff; and so far as the details of this

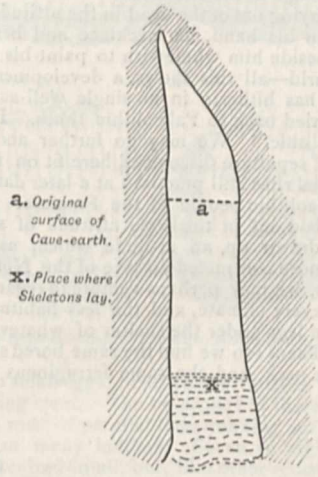


FIG. 1.

find have been preserved, they answer very closely to that of the Barma dou Cavillou. The discovery of 1892 was made close to the spot where the skeleton of 1884 had been unearthed.

Unfortunately, as in the former case, it was not made by a scientific excavator, but by men engaged in quarrying the limestone cliff. I visited the spot shortly afterwards on more than one occasion, but the ornaments and implements had been removed by the owner of the quarry to his house, and there was some difficulty in ascertaining the exact position in which the several relics were discovered.

The subjoined sketch (Fig. 2) will give a fair notion of the position in which the bodies were found. They lay across the present mouth of the cave, with their heads to the east. The

many *nassa neritea*, and on the legs a little below the top of the tibias were two Cypræas.

Immediately behind this lay a skeleton, recognised by Dr. Verneau as that of a woman. It rested on the left side with the knees slightly drawn up, and its right hand almost resting

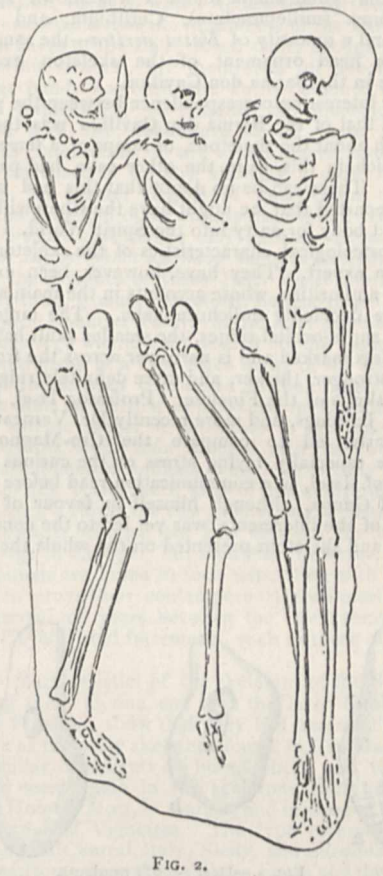


FIG. 2.

on the giant's shoulder. It is said to have held another flint knife. This female skeleton was not so richly decked with ornaments as the other two, the bone and tooth pendants being absent in this case. The third skeleton, of a youth, lay in much

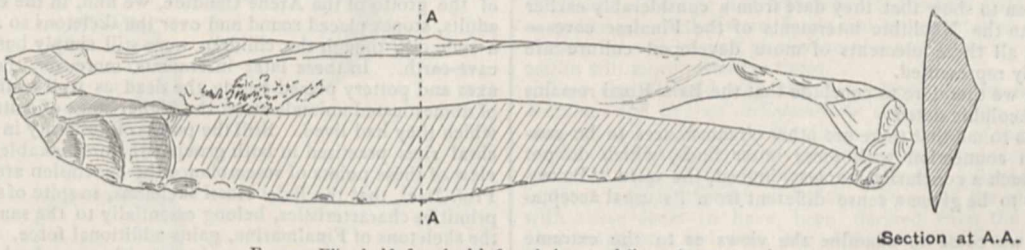


FIG. 3.—Flint knife found with first skeleton. ½ linear (23 × 5 cm.).

outermost skeleton was that of a man apparently well on in life. Unfortunately the skull was broken with a blow of a pick at the moment of discovery, and the length of the skeleton can therefore be only approximately given. From his heel to his shoulder he measured 1·85 metres, so that he was probably at least as tall as the taller of the three adult skeletons found in 1872–1873, which reached the length, according to M. Rivière, of 2 metres. This gigantic frame was somewhat turned to the left, but it lay more on its back than the other two. By his left hand, laid close to his femur, lay a long flint knife (Fig. 3). About the neck and on the skull were remains of ornaments of teeth and bone, fish vertebræ and pierced shells, among them the same attitude as the second, with its right hand raised as if to be laid on the shoulder of the individual in front of it. Under or near its head a third flint knife was discovered. Both the two inner skeletons, though of tall stature, were distinctly smaller than the first discovered.

From the position in which the bodies lay it seems natural to conclude that the two smaller individuals here interred were in a position of dependence on the old giant. Amongst the objects found, chiefly, as far as I could gather, about the heads and necks of the skeletons, were remains of necklaces or head ornaments of shell and bone, amongst which may be mentioned bored shells, fish vertebræ, and teeth—apparently canines of

deer—which had been much rubbed down and in some cases adorned with incised lines and nicks (Fig. 4). Of the bone ornaments discovered, the most remarkable were some curious objects like double eggs or acorns connected by a common stem Fig. 6). These, too, were incised in a similar manner. Amongst the bored shells found I was shown specimens of small Cypræa (millepunctata), Cerithium, and a kind of Trochus, and a quantity of *Nassa neritea*—the same shell that formed the head ornament of the skeleton excavated by M. Rivière in the Barma dou Cavillou.

Another interesting correspondence between the present discovery and that of the Barma dou Cavillou was the presence, in the earth about the skeletons, of lumps of a ferruginous substance, which in this, as in the other cave, had partly stained the bones. There can be no doubt that this had been placed with the departed that he might have the wherewithal to paint his face and body for entry into the Spirit World.

On the osteological characteristics of the skeletons I cannot speak as an expert. They have, however, been examined by competent authorities, whose accounts in the main agree. The skulls were decidedly dolichocephalic. The large skull has prominent supra-orbital ridges, the smaller skull has these prominences less marked and is narrower across the frontal bones, but, still, stronger, thicker, and more definitely ridged than the Neolithic skulls of the Finalese. Professor Issel, M. Rivière, Mr. A. V. Jennings, and more recently Dr. Verneau have been independently led to compare the Cro-Magnon skulls—M. Rivière especially laying stress on the curious rectangular orbits. Prof. Issel, in a communication read before the Natural History of Genoa, although himself in favour of the Palæolithic date of the interments, was yet led to the conclusion that the crania and skeletons presented on the whole the same racial

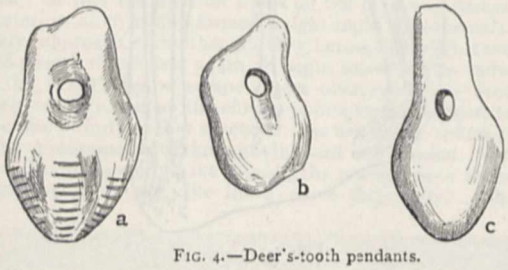


FIG. 4.—Deer's-tooth pendants.

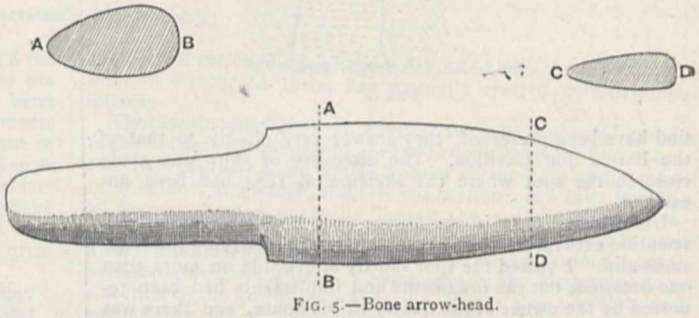


FIG. 5.—Bone arrow-head.

characteristics as the undoubtedly Neolithic skeletons of the caves of the Finalese further along the same Ligurian coast.

The great depth at which these skeletons occurred, and the absence, in this whole group of finds, of pottery, polished stone implements, and the bones of domestic animals, must be certainly taken to show that they date from a considerably earlier period than the Neolithic interments of the Finalese caves—in which all these elements of more developed culture are abundantly represented.

But are we therefore to conclude that the Balzi Rossi remains are of Palæolithic date?

It seems to me that there are other circumstances to be considered in connection with these latter finds, which do not admit of such a conclusion—unless, indeed, the word "Palæolithic" is to be given a sense different from its usual acceptation.

When we come to examine the views as to the extreme antiquity of the instruments, such as M. Rivière has not hesitated to put forward in the most unqualified manner, we find, in fact, a curious illustration of the danger of proving too much. The skeletons lie in all cases beneath a vast mass of cave-earth in which the remains of extinct animals are undoubtedly associated with implements of flint and bone that may justly be regarded as the work of Palæolithic man. Therefore we are told the interments themselves must belong to the same age. Long flint knives such as those discovered, may, it is true, find parallels in some of the later Palæolithic caves such as that of La Madeleine, though like implements were also in common use in Neolithic times. But the argument invoked by M. Rivière leads us to consequences far beyond this. In the cave-earth of the overlying stratum implements occurred not only of types characteristic of the Magdalenian group, of Solutré, and of Laugerie Haute and Basse, but there were included quartzite and other forms peculiar to the still earlier art of Le Moustier. In the same way the bones of extinct animals found lead us on this showing to the conclusion that the "Man of Mentone" dated back to the days of the earliest group of Pleistocene mammals. But as a matter of fact among several cases of bones of animals found in the immediate neighbourhood of the skeletons that have been recently examined all are of recent species, and not a single characteristic Quaternary form occurred. It is to be observed, moreover, that the mere fact that these were interments, implying as it does previous excavation, makes the appearance of Pleistocene remains, and even Palæolithic implements at higher levels in the cave-earth, of no value for determining the age of the skeletons.

The careful laying out of the dead in the attitude of sleep with his flint knife in his hand, his necklace and head ornaments, and the ochre beside him wherewith to paint his face and body in the other world—all this shows a development in religious custom which has hitherto in no single well-authenticated instance been carried back to Palæolithic times. It is characteristically "Neolithic." We may go further and say that the special forms of sepulture discovered here fit on in a suggestive way to the burial rites still practised at a later date on this same coast by the Neolithic people of the Finalese. There too we find the body laid out in the same attitude of sleep, with the legs partially drawn up, an attitude which, as distinguished from the still more contracted posture of the Northern races in primæval times, we may perhaps venture to regard as characteristic of a less severe climate, and the less habitual necessity for drawing up the legs under the shelter of whatever served them as a mantle. There too we find the same bored shells and teeth hung round the neck, and the same ferruginous substance laid beside the departed to deck his person in the Spirit World; there too flint and bone objects (some of these latter of very similar forms) were placed ready to his hand. In the caves of Balzi Rossi, however, the skeletons were at most propped up or pillowed by large stones; in the Finale interments, such as those of the grotto of the Arene Candide, we find, in the case of the adults, stones placed round and over the skeletons so as to form a rude cist, though the children were still simply buried in the cave-earth. In these later interments, moreover, the polished axes and pottery placed beside the dead as well as the remains of domesticated animals attest the higher stage of culture amidst which they had lived. Still the points of similarity in the sepulchral rites practised in both groups are unmistakable. And in view of these points of resemblance the conclusion arrived at by Prof. Issel, that the Balzi Rossi skeletons, in spite of some more primitive characteristics, belong essentially to the same race as the skeletons of Finalmarina, gains additional force.

The bone implements supply us with some fresh points of relationship. The bored pendants, formed of canines of deer much worn down, found with the skeletons both in the Barma Grande and the Barma dou Cavillou are identical even to their notched decorations with ornaments of the same kind found by Prof. Issel in the Caverna delle Arene Candide near Finalmarina associated with undoubtedly Neolithic remains. Identical pendants have also been found in the Neolithic deposit of the Grotta di Sant' Elia in Sardinia. It is to be observed that very similar deer's tooth ornaments, though without the notches, were found in the caves of La Madeleine, Laugerie Basse and Les Eyzies, where they are ascribed to the Reindeer Period. A stumpy bone punch also found near the Barma Grande skeletons, in the possession of Mr. A. V. Jennings, is of the same type as a bone implement from the excavations of the Neolithic deposit

in the grotto of the Arene Candide. Another very close parallel is afforded by the cusped bone instrument represented (Fig. 5), which the Rev. J. E. Somerville, of Mentone, obtained from the neighbourhood of one of the last discovered skeletons of the Barma Grande. Though blunter and thicker, it greatly resembles some of the bone arrow-heads from the Neolithic burial-place in the Arene Candide cave.

Of all the bone objects, however, discovered with the present interments the most interesting are those already referred to as

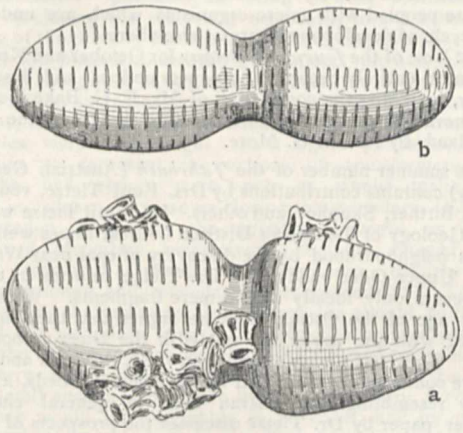


FIG. 6.—Bone ornaments, (*a*) with fish-vertebræ adhering.

resembling two small eggs, or acorns, with their big ends united with a connecting stem. The bossy part of these ornaments was decorated with rows of parallel lines running up the sides like the rungs of so many ladders. Seven or eight of these are said to have occurred in all, but, like other relics found, most of them have since disappeared. The shape of different specimens varied slightly, some being more elongated than others.

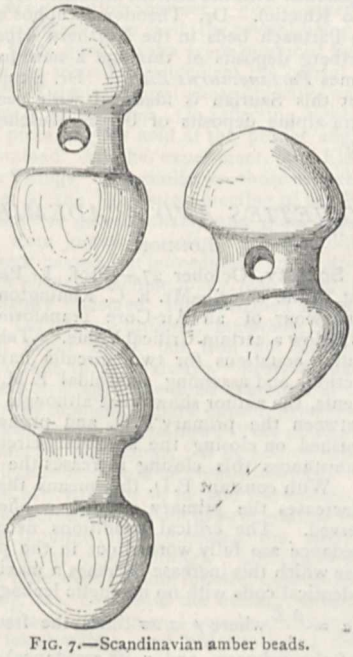


FIG. 7.—Scandinavian amber beads.

But what at once struck me on seeing these objects was the great resemblance they presented to certain amber ornaments discovered with early Neolithic skeletons in the galleried tombs of Scandinavia and North Germany. The objects in question are certain double-bossed ornaments of amber, in Scandinavia generally known as "hammer-shaped" beads, and which, from their supposed resemblance to the stone-hammers of the same period, have been by many supposed to have been worn as amulets. (Fig. 7.)

The geometrical system of ornamentation on the bone ornaments from the Mentone Cave seems to be foreign to that found on bone and horn relics of the "Reindeer Period." On the other hand, like the bone ornaments themselves on which it occurs, it presents the closest analogy to a style of decoration very characteristic of the Later Stone Age in Northern Europe.

The conclusion, then, to which we are led by these converging lines of evidence is that the interments of the Barma Grande and the other caves of the Balzi Rossi cliffs, though embedded in a Palæolithic stratum, are themselves of Neolithic date. On the other hand, however, the entire absence of pottery, of polished implements, of remains of domestic animals, as compared with the abundance of all these features in the Neolithic interments of the Finale Caves further up the same Ligurian coast, is on any showing a most remarkable phenomenon. A greater degree of petrification is also observable in the bone and other objects discovered. *In all probability, therefore, we have here to deal with an earlier Neolithic stratum than any of which we have hitherto possessed authentic records.* If the evidence of these Balzi Rossi interments is to count for anything, it must henceforth be recognised that a race representing the essential features of the later population of the polished Stone Age was already settled on the Ligurian shores of the Mediterranean at a time when many of the civilised arts, which have hitherto been considered as the original possession of Neolithic Man on his first appearance in Europe, were unknown. It will no longer be allowable to say that these supposed immigrants from Asia brought with them at their first coming certain domestic animals, and had already attained a knowledge of the potter's art, and of the polishing of stone weapons. And, if this is the case, something at least will have been done towards bridging the gap between the earlier and later Stone Age in Europe. Till such time, however, as remains of extinct animals are found in such association with human interments as to prove their contemporaneity we must still allow for a vast interval of years between the latest remains of the "Reindeer Period" and interments, such as those of the Mentone Caves.

The racial characteristics of the skeletons of the Balzi Rossi, while linking them at one end with the later Neolithic occupants of the Finalese, show that they had essentially the same physical type as the early skeletons found in Cro-Magnon Cave with very similar ornaments of bored shells and teeth. The same features occur again in the skeletons from the Neolithic grotto of the Homme Mort, in Lozère, and in some of the French dolmens, as that of Vignettes. The type recurs East of the Apennines and in Central Italy, Sicily, and Sardinia; and the field of comparison extends to Southern Spain and the Canaries.

The physical connection with the Dolmen people derives additional interest from the comparisons established between the bone ornaments found with the Barma Grande skeletons and the amber hammer-beads of the Scandinavian Gallery Graves, and the decorative system of the pottery found in the same. It looks as if in the polished Stone Age the Neolithic settlers in the North of Europe had transferred to the new materials, such as amber and earthenware, forms and ornamentation which had already been an ancient possession of a race settled on European soil in still more primitive times.

Two shells found with the Balzi Rossi interments, *Pecten maximus* and *Cypræa millepunctata*, seem to point to Atlantic connexions. In the later Neolithic interments of the Finalese, on the other hand, which may represent the same race in a more advanced stage of development, we see new influences coming in from a very different direction. Some of the shells found with these seem to have been derived from the Southern Mediterranean, and one, the *Mitra oleacea*, found by Prof. Issel in Caverna della Arene Candide, must have made its way by some primitive line of intertribal barter from the Indian Ocean.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Mr. Theodore J Pocock, of Corpus Christi College, has been elected to the Burdett-Coutts Scholarship in Geology. For the Merton Biological Fellowship a strong list of candidates is reported, including among others Messrs. F. E. Beddard, M. S. Pembrey, E. A. Minchin, P. C. Mitchell, and R. T. Günther.

As the result of a memorial addressed to them by the demonstrators in the various departments of Natural Science, the Hebdomedal Council have appointed a committee, consisting of Mr. T. Raleigh, of All Souls, and Mr. T. H. Grose, of Queen's College, to inquire into the position and status of the demonstrators at the museum.

CAMBRIDGE.—Dr. Forsyth has been appointed chairman of the Examiners for the Mathematical Tripos, Part II., and Mr. Welsh, of Jesus College, for Part I.

Prof. Ramsay, of University College, London, has been elected Examiner in Chemistry for the Natural Sciences Tripos.

At St. John's College, Mr. E. W. Macbride, Hutchinson Research Student, and University Demonstrator in Animal Morphology, has been elected to a Fellowship. Mr. MacBride took a first class in both parts of the Natural Sciences Tripos (zoology and botany) in 1890–91, and is the author of various morphological papers based on researches conducted in Cambridge and at the Zoological Station at Naples. He has been President of the Union Society, and is well known as a vigorous debater. At the competition for Fellowships on this occasion there were no less than seven candidates in Natural Science, who had all taken first class honours in the Tripos as students of St. John's.

SCIENTIFIC SERIALS.

Wiedemann's Annalen der Physik und Chemie, No. 10.—On air vibrations, by A. Raps. The changes of density at the nodes of open and closed organ pipes were recorded by allowing a beam of strong white light to fall upon the mirror of a Jamin interference refractor. One of the reflected beams was sent through a pipe at the node, the other through a box containing undisturbed air. After reunion by the second mirror, these two beams gave rise to interference fringes, which were displaced during the changes of density accompanying the sound of the pipe. A section across these fringes, consisting of bright and dark points, was received upon a revolving drum carrying sensitive paper, and the oscillation of the points gave rise to a series of curves representing the sound vibrations with very fair accuracy. A series of eighty-eight photographs are reproduced, which give valuable hints concerning the structure of the various notes, and also some vowels and consonants produced in the open air.—Luminous phenomena in electrode-less vacuum tubes under the influence of rapidly alternating electric fields, by H. Ebert and E. Wiedemann. This paper, a sequel to the general investigation published in No. 9, deals with the details of the phenomena observed between the condenser plates of a Lecher wire system in the case of spheres, cylinders of various lengths, conaxial double cylinders, and glass parallelepipeds with plane ends.—Heat of dissociation in electro-chemical theory, by H. Ebert. Calculations based upon heat of dissociation and electrolytic work show that the forces of chemical affinity are chiefly of an electric nature, that the forces due to "valency-charges" are the most powerful of any atomic forces, and that any additional chemical forces are, in comparison, infinitesimal.—Equipotential lines and magnetic lines of force, by E. von Lommel. Some further photographic tracings of these lines are given, and their bearing upon the Hall effect is discussed.—Objective representation of interference phenomena in spectrum colours, by the same author. Simple arrangements are described for exhibiting Newton's rings, gypsum fringes, convergent polarised light phenomena, and fringes produced by the rotation of the plane of polarisation in quartz prisms, upon a screen. For Newton's rings the light from the heliostat is reflected by a colour plate, and falls upon a lens which produces an image of the sun at its focus. By placing a slit at this focus and a prism between slit and lens, the rings in all the spectrum colours may be thrown upon the screen by shifting the slit.—Papers by Kayser and Runge, P. Czermak, and R. J. Holland have already been mentioned.

THE pages of the *Botanical Gazette* for September contain but little except reports of the proceedings of the Botanical Section of the Madison meeting of the American Association for the Advancement of Science, of the Madison meeting of the Botanical Club, and of the Madison Botanical Congress. That for October contains several important papers:—On the fructification of *Juniperus*, by Mr. J. C. Jack, who states that in America the fruit of the English species of juniper does not mature until the autumn of the third year after blossoming; on the development of the embryo-sac of *Acer rubrum*, by Mr. D. E. Mottier; on the achenial hairs of *Compositæ*, by Miss M. A. Nichols; and on the bacterial flora of the Atlantic Ocean in the vicinity of Woods Holl, Mass., by Mr. H. L. Russell. The results obtained by the author accord in a general way with those previously made in the Mediterranean. While the water and underlying sea-flow are filled with bacterial life, they are by no means in an entirely quiescent condition. Both water and mud are peopled with micro-organisms which are undergoing their cycle of development here as elsewhere.

THE Nos. of the *Journal of Botany* for October and November are almost entirely occupied by papers on local and descriptive botany, including the completion of Mr. E. G. Baker's synopsis of Geneva and species of *Malveæ*, and a sketch of the botany of Ireland, by Mr. A. G. More.

THE summer number of the *Jahrbuch* (Austrian Geological Survey) contains contributions by Drs. Emil Tietze, von Wöhrmann, Bittner, Skuphos, and others. Dr. Emil Tietze writes on the "Geology of the Ostrau District." Great hopes were raised in this neighbourhood by the discovery of coal near Wagstadt, in the Upper Oder valley, but Dr. Tietze informs us that the coal occurs only locally and in mere fragments. With regard to the age of the Ostrau beds, he argues that they should be grouped with the *upper* and not with the *lower* carboniferous series. They rest unconformably on the Culm grits and shales and are conformably succeeded by the Schatzlar beds, a deposit closely resembling the Ostrau beds in general character. Another paper by Dr. Tietze discusses the prospects of the salt industry in East Galicia.—Baron v. Wöhrmann contributes an article on the "Systematic Position of the Trigonidæ and the Descent of the Nayadidæ." He shows that both the Trigonidæ and the Nayadidæ have true heterodont hinges, and that therefore the classification into schizodont and heterodont bivalves suggested by Neumayr cannot be carried out. Taking the fresh-water bivalve Unio as type-form of the Nayadidæ, v. Wöhrmann traces the phylogenetic relationship of this family with the genus Trigonodus (Up. Triassic shore deposits), and through Trigonodus with the ancient ancestral type, Myophoria (Devonian to Rhætic).—Dr. Theodor Skuphos completes his survey of the Partnach beds in the Northern Alps. He found in the Vorarlberg deposits of this age a new fossil Saurian, which he names *Partanosaurus Zitteli*. Dr. Skuphos thinks it probable that this Saurian is identical with certain remains found in extra-alpine deposits of Upper Muschelkalk age in Würtemberg.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, October 27.—Prof. J. Perry, F.R.S., vice-president, in the chair.—Mr. E. C. Rimington read a paper "On the Behaviour of an Air-Core Transformer when the Frequency is Below a certain Critical Value." Taking the ordinary differential equations for two circuits having self and mutual induction, and assuming sinusoidal E.M.F.'s and constant coefficients, the author shows that although the difference of phase between the primary P.D. and primary current is always diminished on closing the secondary circuit, yet under certain circumstances this closing increases the impedance of the primary. With constant P.D. this means that closing the secondary decreases the primary current, a phenomenon not usually observed. The critical conditions necessary for increased impedance are fully worked out in the paper, as well as those under which this increase becomes a maximum. In the case of two identical coils with no magnetic leakage, the critical value of α ($\alpha = \frac{pL}{r_1}$ where $p = 2\pi$ times the frequency, L the inductance of the primary, and r_1 its resistance) is $\sqrt{2}$, whilst that to give maximum impedance is $\frac{1}{\sqrt{2}}$. The maximum increase possible is 15½ per cent. The corresponding values are given for various amounts of magnetic leakage in tabular form, and curves were exhibited at the meeting showing how the impedance, current, power, and magnetising effect vary for different values of α. To test his conclusions the author made experiments on two coils close together, the observed increase in impedance amounting to 3·2 per cent. In addition to the analytical

investigation, the subject is treated geometrically at considerable length. Prof. Minchin showed that the impedances might be represented by two hyperbolas, having p^2 as abcissæ and the squares of the impedances as ordinates. These could be readily constructed from the data given. A line representing the primary inductance drawn on the same diagram intersects one hyperbola, showing that the impedance has always a maximum value. By a simple construction the phase angle between the primary and secondary currents could be determined for any given conditions. Dr. Sumpner observed that increased impedance on closing the secondary necessarily meant a decrease in the lag of the primary current behind the primary P.D. Mr. Blakesley was pleased to see the geometrical method of such service, and thought it much simpler than the analytical one. The reason why increased impedance on closing the secondary of ordinary transformers had not been noticed was because their lag angles were very large. In a figure published some years ago to represent the actions of transformers, the angles he had chosen were such as would make the primary impedance increase on closing the secondary. Giving an expression connecting the primary currents on open and closed secondary respectively, he now showed that to get increased impedance, the sum of the lag angles in primary and secondary must exceed 90°. To get large power in the secondary the primary lag should be nearly 90°, and the secondary about 45°. He also pointed out that some of the figures in the paper might be simplified considerably. Prof. Perry said he had long had the impression that if a sufficiently small current were taken from the secondary, increased impedance would be observable in all cases, and he quoted some numbers he had given in the *Phil. Mag.* for 1891, showing a decided increase. Mr. Rimington, in reply, said he was not aware that the effect he had now brought forward had been observed previously. The result was completely worked out analytically before using geometrical methods.—Mr. W. B. Croft showed "Two lecture-room experiments." One, on "The Rings and Brushes in Crystals," was performed by very simple apparatus in two ways. In the first, a bundle of glass plates was used as a polariser, and a Nicol prism as analyser. When a Nicol could not be conveniently obtained, a glass plate could be used as a reflecting analyser. For a convergent system two glass card-counters were used, the crystal being placed between them. Very good results were produced by this simple apparatus. In the second arrangement the crystal was placed on the eye-piece of a microscope (whose objective was removed), and covered by a tourmaline. On reflecting light up the tube by means of a piece of glass held at the proper angle excellent results were obtained. Another experiment, on "Electric Radiation in Copper Filings," was similar to those described by Dr. Dawson Turner at the Edinburgh meeting of the British Association. A battery, galvanometer, and glass tube containing copper filings were joined in series. Under ordinary circumstances no current passed, but immediately an electric spark was produced by an electric machine many feet away, the galvanometer was violently deflected, and remained so until the tube was tapped. On trying different materials, aluminium and copper seemed about equal, but iron not so good; carbon allowed the current to pass always. Prof. Minchin said the phenomena were strikingly like those exhibited by his "impulsion cells," for the moment a spark passed, even at a distance of 130 feet, they became sensitive to light. Very minute sparks were capable of producing the change, but by adding capacity to the sparking circuit the effect could be greatly modified. Replying to a question from Mr. Rimington, he said the change was due to electromagnetic vibrations, and not to light emitted by the sparks. Mr. Blakesley inquired if lengthening the sparks produced greater effect on the copper filings. Mr. Lucas asked if the resistance of a tube ever became infinite again if left for a long time. In reply, Mr. Croft said the current sometimes passed before the spark actually occurred between the knobs. He had not left tubes for very long, and had not found the resistance reappear without tapping.

Royal Microscopical Society, October 18.—A. D. Michael, President, in the chair.—Mr. J. G. Grenfell described some marine diatoms, recently found at Plymouth, belonging to the genera *Melosira* and *Surirella*, which were of interest owing to the presence of pseudopodia. Mr. A. W. Bennett objected to the term pseudopodia being applied to these processes unless it could be shown that they were actual prolongations of the internal protoplasm. Mr. T. Comber said that Prof. Grunow was of the opinion that the processes were spines.—Mr. E. M. Nelson exhibited and described a new model of a microscope by Messrs. Watson.—Mr. F. Chapman read Part V. of his paper "On the Foraminifera of the Gault of Folkestone."—Prof. Bell gave a *résumé* of a paper by Dr. R. L. Maddox, "On Progressive Phases of *Spirillum volutans*." The author had traced the development of this organism, and had discovered some points which appeared to be entirely new in the history of bacteria.

PARIS.

Academy of Sciences, October 30.—M. de Lacaze-Duthiers in the chair.—The grape-vine harvest of 1893 and the produce of the Camargue, by M. Chambrelent. In spite of the severe drought the vineyards of the Gironde have given the richest yield in the century. This has been due to a unique combination of favourable circumstances during their development. The facility with which they withstood the drought may be attributed to the fact that vine-leaves have a peculiar power of absorbing dew, which has been very abundant. This year has also witnessed the earliest date of harvest known in the century. In 1822 it took place on August 31, whilst this year it was eight days earlier. The quality of the harvest, which improves with the quantity, may be expected to prove very good.—On the application of sound vibrations to the analysis of mixtures of two gases of different densities, by M. E. Hardy. The apparatus, called the formenephone, consists of two organ pipes, one of which is filled with pure air, the other containing the mixture of gases to be analysed. The pipes are of the same dimensions, and give the same note when blown under the same circumstances. If one of them is filled with air containing 1 per cent. of formene, the unison is disturbed and one beat is heard every three seconds. With 2 per cent. there are three beats in two seconds, with 3 per cent. two beats per second, and so on. Similar results may be obtained with carbonic acid as an impurity. The figures given apply to pipes sounding C_4. For mixtures whose density closely approaches that of air C_5 is more suitable. Each determination is finished in a few seconds. The apparatus is well suited to the determination of the amount of fire-damp in mines.—Observations of Comet Brooks (1893, Oct. 16) made at the Algiers Observatory by MM. Rambaud and Sy.—Observations of the sun made at the Lyon Observatory (Brunner equatorial) during the first half of 1893, by M. J. Guillaume. This is a summary of the observations made of sunspots and faculæ, with particulars of their positions and areas.—On a new theorem of mechanics, by M. N. Seiliger.—On carboxyl derivatives of dimethylaniline (dimethylamidobenzoic acid) by M. Charles Lauth.—On the baking temperature of bread, by M. Aimé Girard. Numerous experiments have proved that 101° C. is the normal temperature in the interior of bread and biscuit during baking if the product is to be satisfactory.—Study of the reproduction of wasps, by M. Paul Marchal. Careful observations of the physiological function of the workers, miscalled neuters, of a common wasps' nest have proved parthenogenetric reproduction by the workers, without the cooperation of the males, and the exclusively male sex of the individuals thus produced. It appears that there is a division of labour between the queen, who produces mainly females and workers, and the workers themselves, which are only capable of producing males.—On the localisation of the active principles in *Tropæolum*, by M. Léon Guignard. In the Tropæolum family, all the organs enclose myrosine, localised in cells distinct from those which contain the glucoside, which it decomposes to produce the essence. The latter does not pre-exist in the tissues and cannot be formed without the intervention of the ferment. The family shows in this respect a complete analogy with the Crucifers and Capparideæ.—On the existence of gismondine in the geodes of a basalt of the environs of Saint-Agrève (Ardèche), by M. Ferdinand Gonnard.—Fractures of the coal measures of southern Chili, by M. A. E. Noguès. In the lignite region extending from the Bay of Talcahuano to Lebu, there is found a large fault running from east to west, which it is proposed to call the Lebu-fault. To the north of this fault the strata incline towards the west; to the south, they incline towards the east. Between San Rosendo and Lebu may be traced a system of parallel north-to-south faults which have affected the older strata; a system o parallel east-to-west faults, which have dislocated the arenaceous lignite territory; and a system of secondary faults, which have brought about changes of level in this same formation.—General

characters of the *bogheads* produced by Algæ, by MM. C. E. Bertrand and B. Renault. A study of the *boghead* of Autun, the kerosene shale of Australia, and the brown torbanite of Scotland show that these deposits are due to the thalli of a single species of alga, that of Autun containing *Pila bibractensis*, the kerosene shale Reinschia australis, and the Torbanite another *Pila*.

BERLIN.

Meteorological Society, October 10.—Prof. von Bezold, President, in the chair.—Prof. Hellmann spoke on the frequency of halo phenomena, after having first described their typical features and their causation by reflection and refraction from hexagonal ice-prisms. From observations at Upsala extending over seven years he had ascertained that the 22° halo is most frequently observed, then mock suns and moons, then the 46° halo, and least frequently the vertical pillars of light. On the whole the phenomena are five times more frequent in connection with the sun than with the moon. During the course of a year the phenomena follow a regular course; solar-halos are at a maximum in May and a minimum in December, whereas lunar-halos are at a maximum in December and a minimum in May. If snow-crystals were equally plentiful in the air at all periods of the year, then solar-halos would be most frequently seen in June, at the time when the sun is above the horizon for the longest period on each day. But inasmuch as there are fewer snow-crystals in the air in the summer, the maximum is put back to May. The maximum for lunar-halos occurs when the nights are longest and there are most snow-crystals in the air. Statistics from the polar stations for 1882–83 show that only solar phenomena occur during the period of midnight sun, and only lunar phenomena during the polar night, their frequency being solely dependent on the occurrence of clouds. An account was given of a stroke of lightning in Heligoland which had smitten two persons near the railroad, killing one and stunning the other. Photographs were exhibited of the latter as showing the characteristic marks on the arm, chest, abdomen, and legs. After a member of the Society had suggested a new method of estimating clouds—which, however, requires further working out and testing—the President drew attention to wave-clouds as described by Von Helmholtz in his most recent theoretical work on the dynamics of the atmosphere. They occur when two layers of air travelling with different velocities pass one over the other, in which case waves are formed and clouds at the junction of the layers. These clouds are then drawn out into long strips, formerly called polar-bands. They occur not only in the layers of cirrus clouds, but also at lower levels. A wish was expressed that these clouds might be photographed.

Physical Society, October 20.—Prof. Kundt, President, in the chair.—Dr. Raps gave an account of his work on the photography of aërial vibrations. The method is based on the use of a Jamin's refractometer, which produces interference phenomena by means of reflection and refraction of a ray of light at the surfaces of two parallel glass plates. When the air between the two plates is transmitting waves of condensation and rarefaction, the interference bands are displaced, and if they fall on a slit behind which a sensitized paper is kept in motion on a drum, the waves of aërial vibration may be recorded. The experiments were first made on a closed organ-pipe, near whose upper end were two openings facing each other but closed with glass. Through these the two rays of light passed before they were made to interfere. When the pipe was gently blown, sine curves alone were obtained, corresponding to the fundamental note of the pipe. As the pressure was increased, the overtones became more and more prominent, until at last they alone determined the shape of the curve. Further experiments were made with closed reed pipes, after it had been ascertained that the tongue of the reed vibrates like a pendulum. The phenomena were the same as in the first case. Experiments with open pipes were found to be much more difficult, but even in this case good photographs of the vibrations were obtained. Dr. Raps had also been able, by the same method, to photograph the vibrations resulting from the singing of vowels, and to show that definite harmonic overtones are characteristic of each vowel. Similarly photographs had been taken of the vibrations due to a hunting-horn. Dr. Raps further exhibited an Ampère apparatus for lecture purposes, in which the current was supplied by means of metallic instead of mercury contacts.

Physiological Society, October 27.—Prof. du Bois Reymond, President, in the chair.—Dr. Lewin gave an account of researches on the physiology of the ureter, carried out in conjunction with Dr. Goldschmidt. These had shown that the entry of urine into the upper end of the ureter is due to pressure exerted by the kidney; that the peristaltic waves of contraction of the ureter either pass right down to the bladder, or occasionally stop short in their course along the ureter; that the point of entry of the ureter into the bladder is possessed of a sphincter, but that notwithstanding this it is occasionally possible for fluid to be driven back out of the bladder into the ureter.—Prof. Senator spoke briefly about the experiments he made some seventeen years ago, on the results of varnishing the skin in men, defending their validity, and the conclusion that varnishing does not affect the health, against objections which had recently been brought forward.—Dr. Cohnstein described experiments on the influence of diffusive processes on transudation. When salt solutions were allowed to flow under a constant pressure through a ureter or jugular vein surrounded by fluid, it was found that the amount of salt passing through into the outer fluid increased with the pressure on the latter. Similarly a solution of egg-albumen diffused more copiously into an external fluid than could be observed when it was forced by filtration into a space filled with air; but the amount of albumen which passed through was independent of the external pressure. This diffusion must play a very important part in the transudation of fluid from the blood-vessels, and in the tissue-cells of the living organism, and may suffice to explain many as yet incomprehensible phenomena.

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