THURSDAY, JANUARY 30, 1896.

GROTH'S CRYSTALLOGRAPHY.

Physikalische Krystallographie und Einleitung in die krystallographische Kenntniss der wichtigeren Substanzen. Von P. Groth. Dritte, vollständig neu bearbeitete Auflage. Pp. 783. (Leipzig: Wilhelm Engelmann, 1894-5.)

NEARLY twenty years ago, in 1876, the present writer was acting as Demonstrator in Physics at the Clarendon Laboratory, Oxford, and chanced to see on Prof. Clifton's table a book just published, which differed in subject and treatment from any he had then met with. It contained in small compass (523 pages) that part of Physics which was more especially related to crystallised matter, and without delaying the reader with difficult or abstruse problems, gave in the most fascinating way a general idea of the physical and morphological symmetry of crystals. A few months later, and as a direct consequence of the interest in crystals thus aroused, the writer was advised to submit himself to Mr. Maskelyne as a candidate for the assistantship in the Mineral Department of the British Museum, just vacated owing to health-failure by Mr. Lewis, since appointed Professor of Mineralogy at Cambridge. The book was the "Physikalische Krystallographie" of Paul Groth, and the present writer is glad to have this opportunity, when giving a notice of the third edition of this useful book, to put on record his sense of gratitude to the author, a feeling which is doubtless shared by other crystallographic students in this country.

Prof. Groth was particularly well fitted for the work which he had taken in hand; he had already initiated and organised the teaching of Crystallography and Mineralogy at Strassburg (1870); gifted with great enthusiasm, he had also the rarer power of inspiring his students with the same quality; in this book he published (1876) the method which he had found to be practically useful in the course of instruction given by him as Professor of Mineralogy in that University. In the next year (1877) the *Zeitschrift für Krystallographie und Mineralogie* was started by Prof. Groth, who took upon himself the arduous duties of editor; this was the beginning of a new era for the subject. The pages of this periodical have since been at the service of crystallographic students of every country, and the twenty-four volumes already issued are a rich storehouse of the results of recent research. Succeeding von Kobell, Prof. Groth afterwards migrated to Munich, and has since completely reorganised the mineralogical collections and teaching in that University. With twenty-five years' experience as a University Professor, the editor of the many path-breaking memoirs which have appeared in the *Zeitschrift* could not fail, in the preparation of a new edition of his book, to keep his readers in touch with all that is best in the subject; and in a living subject like Crystallography, twenty years cannot pass away without the discovery of new facts and new methods, and the invention of new instruments of research.

In the case of any scientific book which is worthy of careful study, it must often be the fate of the student to react upon the author; and in this respect the present treatise is not exceptional. The treatment of the dilatation of crystals on change of temperature, as given in the first edition of the work, appeared to be out of harmony with the ideas there propounded as to crystal structure; at the suggestion of Mr. Maskelyne, the writer studied this thermal problem from a theoretical standpoint, and recorded his results in a short paper. Attracted to the subject once more, Prof. Groth had the problem practically investigated by one of his students (Dr. Beckenkamp) with the aid of the fine instrument which had then been just made for the University of Strassburg. The conclusions arrived at by Beckenkamp from his experiments, whether strictly justifiable or not is a distinct matter, were in complete agreement with those already suggested on theoretical grounds, and the variation of treatment which had been indicated was introduced by Prof. Groth in the second edition; this, indeed, was the only change of any theoretical importance at that time made. The third edition is, however, so different from those which have preceded it, that although the general aim is unaltered, the book is virtually new in its mode of treatment, and demands a more detailed notice than the new edition of a work generally calls for.

It may be remarked that the title ("Physikalische Krystallographie") suggests a more restricted survey than is actually undertaken by the author; for the morphological being regarded as likewise physical characters, geometrical crystallography falls within the scope of the book: the title is intended to be complementary to that of another treatise ("Chemische Krystallographie"), a work which Prof. Groth has long had in hand, and now looks forward to quickly completing.

A statement of the numbers of the pages allotted to the various parts of the subject will be useful as suggesting the relative degrees of importance assigned to them. The First Part begins with a discussion of the optical characters of crystals, and extends to no fewer than 163 pages; the thermal characters are allowed 24 pages; the magnetic and electrical 11 pages; the action of mechanical forces on crystals 43 pages; and the molecular structure of crystals 47 pages. The Second Part is devoted to the geometrical characters of crystals, and occupies 248 pages. The Third and last Part treats of the calculation and graphic representation of crystal forms (65 pages), of goniometers and refractometers (81 pages), and of polarising instruments (82 pages).

There are three great changes introduced in the present edition. In the first place, the optical part has been re-modelled on the basis suggested in the Tract on the "Optical Indicatrix," a work which was some time ago noticed in these columns. As stated by Prof. Groth in his preface, "the optical part is no longer based on the theory of an elastic ether, but on the purely geometrical treatment proposed by Fletcher; this method, without involving any mathematical speculations whatsoever, suffices to give even for the most complicated optical phenomena, such as conical refraction, that correct insight which is indispensable to the student in his microscopical investigations." The "Optical Indicatrix" itself, it may be here observed, was written not so much for the instruction of the ordinary student as to indicate to the teacher a method of escape from a very awkward difficulty. Prof. Maskelyne, for whose book on Crystallography the method was devised, has the intention of presenting the method in text-book form, and of making it accessible and useful to the English student; unfortunately the many distractions of a busy public life have led to prolonged delay in the completion and issue of that part of his crystallographic treatise. Prof. Groth, however, has been quick to show that the method is one which is practically useful both to the teacher and the student; in the course of years the idea of optical elasticity will disappear from crystallographic text-books, and an unnecessary obstacle will vanish therewith from the path of the optical student. One word on a trivial matter, that of nomenclature: Prof. Groth has translated the term Indicatrix into Index-fläche, on the ground that the word Indicatrix is not acceptable in a Teutonic language. To an Englishman it is not intelligible on literary grounds why Index should be within and Indicatrix be without the limits of what is acceptable in Germany; nor were any objections to the term Indicatrix made by the German Professors (König and Ambronn), by whom the Tract itself was translated into German and rendered more accessible to the German student. In any case the constant repetition of the word "surface" in the proofs of the various geometrical propositions would make "Index-surface" unacceptable for common use in English, and it would have been a simplification of nomenclature if the term Indicatrix (*i.e.* the indicating surface) could have been adopted bodily in the other European languages.

The second great change is the total exclusion of the Naumann symbols from the text. There was much to be said for the use of the Naumann symbols in the indication of a limited number of crystallographic forms, but they are too complex in others, and are thus not generally useful: further, in the specification of particular faces and in crystal calculations, the Millerian symbol is infinitely superior, and is quite indispensable for the more advanced student. Looking to the slightness of the advantages of the Naumann symbol even in the most favourable cases, it has seemed better to Prof. Groth to now completely dispense with its consideration; this saves much valuable time to the Professor in his lectures, much space in the text-book, much unavailing toil for the student.

The third great change has involved a complete alteration of treatment of the geometrical characters of crystals. A century ago the Father of Crystallography, Romé de l'Isle, introduced the idea of a primitive form, and showed that all the crystal forms of the same kind of substance are such as could be derived from a single primitive form by similar alterations of all those parts which are geometrically similar to each other; the octahedron and the tetrahedron, for instance, were different kinds of primitive form, and were regarded as mutually independent. Later on, the idea of a primitive form was discarded by crystallographers, and that of crystalline axes, systems and symmetry, was introduced. This necessitated the recognition of symmetry as being either complete or partial in each crystalline system; and the forms presenting incomplete symmetry were treated as resulting from the suppression of half or three-fourths of the faces of forms having a complete symmetry proper to the system. Certain elements of symmetry were regarded as being then in abeyance. One educational disadvantage of this method is that the student is almost led to imagine that the axes and planes of symmetry have a physical existence anterior to that of the matter itself, and to think that the inert matter is compelled to arrange itself in a particular way through the action of these pre-existing axes and planes. Or again, he imagines that the tetrahedron was at one time an octahedron, and that it only arrived at the tetrahedral form through the excessive growth of four alternating faces of an eight-sided crystal. In the present edition Prof. Groth has followed a method suggested amongst others by Fedorow, now the Professor of Mineralogy at Moscow, and one which presents some analogy to that of Romé de l'Isle; in that, for instance, it treats the octahedral and tetrahedral symmetries as quite independent of each other. It has now been known for some decades that thirty-two, and only thirty-two, classes of symmetry are consistent with that law of whole numbers which had been discovered by Haüy to control the positions of crystal faces. This limitation of the classes of crystal symmetry was first established by Hessel in 1829, but, owing to some extent to the repellent form in which the reasoning was presented, did not then attract the attention of other crystallographers. It was re-discovered, however, by Axel Gadolin, and made known by him (1866–7) in a very lucid memoir; since that time the law has been universally recognised.

The thirty-two classes of symmetry can be grouped in various ways; and one method is that of the old so-called "systems of crystallisation." In the new mode of treatment, the six systems are merely conventional and have no structural importance; it is the thirty-two classes, not the six systems, which are fundamental, and the classes themselves are regarded as independent of each other and co-equal in importance.

In his exposition of geometrical crystallography, Prof. Groth starts from the simplest type of form, that in which there is no symmetrical repetition at all, and thence gradually advances to the most complex type, in which the existence of a single face may involve the co-existence of forty-seven others. This method, so long as it does not involve trigonometrical calculation, presents no greater difficulty than the usual mode of treatment; indeed, Prof. Groth asserts from practical experience that the student in this way makes quicker progress in the acquisition of knowledge. Each of the thirty-two classes being regarded as independent of the rest, the idea that a form may be hemimorphous, hemihedral, tetartohedral or holohedral, is completely eliminated from the science. In one respect the method actually adopted seems to the writer to fail of the desired simplicity; in the case of an ordinary crystal belonging to the Anorthic system, a crystal of albite for example, every face is accompanied by one which is parallel and opposite, and the crystal is usually regarded as having a centre, but no planes, of symmetry. For some reason not clear to the writer, Groth, following Federow, rejects the idea of a centre of symmetry, and regards such a crystal as being one in which there is no centre of symmetry at all, and every plane of the crystal, actual or crystallographically possible, is a plane of what is termed "composite symmetry." Such an artificial and complicated method of interpreting the result of the old-fashioned centre of symmetry seems to involve its own condemnation, and to be quite unsatisfactory for the purposes of the teacher. As regards the nomenclature of the thirty-two classes, the sooner the Professors of Mineralogy can come to a decision as to the best names to be applied to them, the better for the student. Some of the names here suggested are too long to be often used: Class 28, for example, is termed the "tetraëdrisch-pentagondodekaëdrische Klasse." Though nomenclature is not of essential importance, the giving of a name is by no means a small matter; still, even a long adjective of thirty-four letters will be better than a constantly changing adjective of seventeen.

A very brief account of the researches of Bravais, Sohncke, and Schönflies, relative to the nature of crystal structure, is all that could possibly be included in a work which is to be useful to the general student; such a sketch has been given in this edition, and has had the benefit of revision by one of the great pioneers in the subject, Prof. Sohncke himself.

The above are the more important of Prof. Groth's constitutional innovations, and all that can be referred to in this brief notice. We would only add that the book is well illustrated, there being no fewer than 702 figures and three excellent coloured plates, and that it is furnished with a very complete index to its contents. By the issue of this last edition of his book, Prof. Groth has conferred one more boon on the students of Crystallography.

L. Fletcher.

ELEMENTARY IDEAS OF MANKIND.

Ethnische Elementargedanken in der Lehre vom Menschen. By A. Bastian. 2 vols. Pp. xvi + 314; xlv + 224. (Berlin: Weidmannsche Buchhandlung, 1895.)

PROFESSOR BASTIAN has here added to his numerous works on ethnology what must be regarded as, in some sense, the crown of the edifice he has spent his life in rearing. It is an attempt to trace out the elementary ideas of mankind. For long ages every historical people, shut up within a very limited area, both physically and mentally, when inquiring through its foremost thinkers into the mental constitution of the race, had no other means of finding an answer to its questions than an analysis of the individual mind. The philosopher examined his own consciousness, forgetful that it was the consciousness of an individual in an advanced stage of civilisation, and that what might seem to him elementary, from his familiarity and the familiarity of those with whom he came into contact with it from earliest years, might really be the result of long development, or an amalgam of numerous, perhaps but slightly related, ideas. The results, therefore, of his inquiries were shifting, uncertain, in many cases absolutely untrue. And, when he came to apply those results objectively to the society in which he found himself, still greater uncertainties and divergencies of course followed. What was needed, was an external means of checking and comparing the conclusions arrived at from time to time. For want of this, the conclusions themselves remained without practical influence, or (especially, it may be added, when applied to social and political organisations) became positively disastrous. Man did not really know himself; and thinking that he did so, he often committed great and deplorable blunders.

But at last, in the gradual progress of discovery—first of geographical discovery, afterwards of scientific, and more particularly biological, discovery—the essential unity of mankind has been demonstrated. Reports of discoverers and the great ethnographical collections, formed chiefly in the capitals of Europe and at Washington, have exhibited unity, not merely physical, but mental and spiritual. It has thus become possible to set the ideas, the customs, and the organisation of the more advanced peoples over against those of the less advanced, and thus to effect that "parallelisation with equivalent corresponding existences" which gives the long-wanting means of checking the results of introspective psychology.

Starting then from the postulate of the essential unity of mankind, the veteran Professor follows the comparative method for the purpose of ascertaining in the order of conception-types, as they emerge in ethnical ideal creations, what are the elementary ideas of mankind, and thus of grasping what is involved in the totality of these conceptions, and of discerning oneself in every child of man, so far as intelligence reaches. Accordingly, although the book is addressed primarily to metaphysicians, Dr. Bastian writes not without a practical aim. A thorough comprehension of the mental and spiritual unity of mankind, a realisation of the fact that under all superficial divergencies of expression, whether in language, in myth or in custom, the same ideas, the same purposes rule in all men, and a consequent conviction that patience and tact only are required to reconcile all these divergencies by discovering their underlying identity, and tracing the devious path whereby each of them has travelled—these are qualifications not merely of the ideal anthropologist, but of the ideal statesman: qualifications more than ever necessary in these days, when discoveries and inventions have brought the foremost nations of Europe into relations of one kind or other with so many of the more backward races all over the world, making continually fresh demands on the sympathy born of knowledge to avoid difficulties and bloodshed, promote good feeling, and clear away obstacles to the progress of civilisation. Even among the civilised nations themselves, all of which have their social questions, sprung from the ferment of mutual intercourse under the influence of modern conditions, knowledge of the elementary ideas of mankind and of their expressions in social form—that is to say, in institutions—is calculated to assist materially in the solution of the problems which are now presenting themselves.

The book has, therefore, been written with these things in view; and there is no nation to which they are more important than our own: none, perhaps, to which they are so important. Yet the British Government has done less than any towards the systematic study of anthropology. The Imperial Institute might have served the purpose of a great national school of anthropology, where the rulers of our subject-peoples could be trained. It has been turned, instead, into a second-rate club. Meanwhile, those whose mission it is to direct the destinies of tribes remote and strange alike in space and in culture, remain in total ignorance of the ideas which govern them, or are driven to acquire what little information they may ultimately obtain in the course of years by actual contact and repeated mistakes, learning their business at the expense of the unfortunate savages they are set to manage, as well as at ours, or else to seek for it in a desultory way without a trustworthy guide through that vast and tropical wilderness, the literature of travel and research.

Unhappily it cannot be said that the book before us will be of very much use to such inquirers, or to many anthropological students in this country. Addressed, as I have said, in the first instance to metaphysicians, it is written in an involved and allusive style, bristling with metaphysical technicalities; and the learned author has too little respect for his readers to assist them by dividing his work into chapters or sections, or to give them more than, at most, the bare names of the authorities for his numerous citations. What good is there in telling us vaguely, in a little aside, "see Hiekish," or "see Schwebel," or "see Swan"? We want to be able to verify the statements, and test the use that is made of them; and the scientific writer, be he professor with world-wide reputation, or obscure student, who neglects to enable us to do this, foregoes half his title to our confidence. Some of these faults, indeed (especially the last), disfigure all the author's works. To call attention to them is not a pleasant task; nor do I deny—I cordially acknowledge—Dr. Bastian's many claims on our gratitude and admiration. At the same time, a protest in favour of lucidity and exactness is all the more needful where the transgressor is so able and so justly distinguished as Dr. Bastian. E. SIDNEY HARTLAND.

THE BIRDS OF GREEK LITERATURE.

A Glossary of Greek Birds. By D'Arcy W. Thompson, Professor of Natural History in University College, Dundee. Pp. xvi + 204. (Oxford: Clarendon Press, 1895.)

BOSWELL once told Johnson that he had a plan for collecting the poetry of the Border, a task which he fortunately left to be undertaken by a more skilful hand. Not indeed that he feared he would be unequal to it, but, as he told his master, he doubted whether it would be of much good to any one. "Sir," replied the sage, "never mind whether it is going to be any good to any one: do it." It is in the spirit of this answer, that Prof. D'Arcy Thompson has been for years accumulating the material brought together in this volume. He must have often had doubts as to the practical value of his labour, and as to the reception it would meet with from scholars on the one hand, and scientific men on the other. The region of scholarship invaded by a Professor of science, the precious time of a scientific researcher given up to laborious reading of a voluminous Greek literature! It is true enough that if called upon to explain to any ordinary man of business what the value of the work is, we should find it hard to do so; yet we feel all the more disposed to admire the indefatigable perseverance which has carried the author through his self-imposed task to its completion, dogged as he must have been by the sense that he was travelling all the time in a mist, where no certain conclusions could be drawn as to bird, or legend, or etymology.

Yet it would be by no means true to say that the book will be of no practical value. In the first place, it is compiled with such laborious thoroughness, that it will serve as a thesaurus of reference and information for all scholars who may have to deal with passages in Greek literature relating to birds; and such passages are abundant. Their difficulty often arises from the tangle of myth which grew up around certain birds, *e.g.* the Hoopoe, the Cuckoo, the Nightingale, &c.; and what a scholar needs for the elucidation of his author, is a handy book of reference to all that has been written or bears on the matter, both in ancient times and modern. Here is exactly the book for him; he will find (so far as I am able to judge) the whole available material in two or three pages. It matters little whether the guesses, combinations, conclusions are sound or not; it is the collection of material that will be really valuable. Nor is the pure scholar the only workman who may profit; the numismatist, the mythologist, the student of the ancient science of divination, may find their advantage in this volume.

The method adopted by the author makes reference to the glossary quick and easy. He begins with the identification of the species where it is at all practicable; sometimes, perhaps, stating it too definitely, and without the necessary warning-note for too precipitate readers. An etymology sometimes follows, which is, indeed, as a rule, superfluous; for no scholar will in these days listen to any one but a specialist in a science so difficult as comparative philology, and the attempts are here often obviously unscientific. But no harm is done in this way, for I have noticed hardly a case in which any serious conclusion is built upon an etymology—a form of Teutonic crime familiar to all scholars. Then follows the description of the bird, beginning with Aristotle as a rule, cited, as he should be, from the paging of the Bekker edition: and so onwards to the later Greek writers. Here a critic must point out that a list of the writers quoted, with their date and the edition used in the compilation of this work, would have been a great convenience to the student; for the Professor's reading has been so insatiable, that he sometimes quotes authors of whom even a good Greek scholar may never have heard in his life. Then come the habits of the species, *e.g.* nesting, song, migration, each point being clearly distinguished in a separate paragraph; and lastly, the myths attaching to the bird, with an attempt, instructive if not always convincing, to elucidate them. This account of the method pursued applies, it need hardly be said, only to those species which especially attracted the attention of the Greeks: *e.g.* the eagle, cock, kingfisher, crane, nightingale, swallow, &c. The great majority of glosses are naturally very brief.

Undoubtedly the most striking and interesting parts of the work are those in which the author ceases for the moment to be a compiler, and offers us a new key to the interpretation of certain myths. "I offer," he says in the preface, "a novel, and at first sight a somewhat startling explanation: to wit, that many of them (*i.e.* the fables about birds) deserve not a zoological but an astronomical interpretation." For example, the story of the halcyon days is hypothetically explained in this way: it "originally referred to some astronomical phenomenon, probably in connection with the Pleiades, of which constellation Alcyone is the principal star" (p. 31). A criticism of any one such explanation would be impossible in a limited space, even if the present writer were qualified to undertake it. Suffice it to say, that even if it could be proved that every one of these interpretations is wrong, and that simpler methods are applicable, yet credit would be still due to the man who indicated a possible way of dealing with these difficulties, and one which would not be likely to occur to the ordinary book-scholar. We must of course be on our guard against the danger of missing our footing while we thus gaze into the heavens for a missing clue; but I venture to say that any one who will carefully study the whole of the passage from which a sentence was just now quoted, or that in which is discussed the fable of the Swan and the Eagle, will hardly avoid the conclusion that there may be an astronomical aspect of the folk-lore of some peoples, which has still to be scientifically investigated.

In conclusion, it may be asked what contribution there is in this volume to zoological science. Positively and directly, there cannot well be any; the identification of species is in most cases too doubtful to allow us to compare them with those now familiar to us in regard to distribution, migration, nesting habits, &c. But, as a contribution to the history of the science, this book will be of great value, and the future editor of Aristotle's *Historia animalium* will find himself relieved by it in many particulars from a great deal of tedious research.

The revision of the proofs has evidently been carried out with scrupulous care—no easy task, considering the innumerable proper names and Greek quotations; and the accentuation of Greek words seems to be remarkably accurate. In a few unimportant points, I should differ from the author's views; but of these I will only mention one, about which I am confident. He declines to identify Aristotle's σχοινίλος as the reed bunting, on the ground that that species (*Emberiza schœniclus*) does not flick its tail as other buntings do. But the reed bunting *does* flick its tail, as I have every reason to know, and I believe the old identification to be probably right. I may just add that I see no difficulty in identifying Aristotle's κύανος with the wall-creeper, though he says that it is κυανοῦς ὅλος; for the Greeks were weak in discriminating colours, and I can testify that it is not so easy as one might expect to catch the crimson of the wing-coverts when the bird is on a rock high above you. And it is not likely that the Greeks should have been able to procure specimens of this shy species for closer examination.

W. WARDE FOWLER.

OUR BOOK SHELF.

Polyphase Electric Currents and Alternate Current Motors. By S. P. Thompson. (London: E. and F. N. Spon, 1895.)

THIS book resembles others by the same author, in being an amplification of a course of lectures. Every one who knows Prof. Thompson's later work, will expect to find evidence of a good deal of study; nor will he be disappointed. Not the least important part of the book is the list of works and articles which have been written upon this comparatively new department of electrical engineering. A chapter and many other paragraphs are of an historical nature, and if in some cases those who have been behind the scenes more than the author, may consider that he has not been quite fair in his conclusions, yet every one will admit that impartial fairness has always been aimed at by Prof. Thompson.

Here and there a little more care might have been exercised. On p. 24 the lettering on Fig. 28 is wrong. The views of M. Goerges on the comparative economy in copper when used with one, two, and three phases is not at all clearly put. The author has a liking for new terms. The "stator" and "rotor" of a dynamo or motor have an unpleasant sound, and are not so good as the French "inducteur" and "induit," but they will serve their purpose. "Star" and "mesh" groupings do not explain their meaning (referring to the connections for a three-phase system) so well as the old and appropriate symbols Y and Δ.

The mathematical theory of polyphase systems has been worked out by many writers and on different lines. The method selected by the author has the merit of being simple, and easily followed by those who do not handle mathematics easily. The parts of the book which relate to the design of machinery are not very complete, and would hardly suffice to enable the average electrical engineer to make a good polyphase dynamo or motor. But we must remember that this was a fault of the first edition of "Dynamo Electric Machinery," by the same author, which has steadily improved with each new edition, and has become one of the leading text-books of its kind. So, also, we expect that the book before us has in it at least the germ of a treatise which will be a standard work of great value as it passes through successive editions. As it stands, the book should be on the shelves of all those who are engaged in developing that most useful auxiliary of the electrician, a polyphase system for distributing electrical motive power.

G. F.

Elementary Physical Geography. By R. S. Tarr, B.S., F.G.S.A. (New York and London: Macmillan and Co., 1895.)

THE most prominent feature of this book is the wealth and excellence of its illustrations; in less than 500 pages there are close upon 300 of them, many being new, while numerous others are from official publications which are not accessible to most elementary students. The admirable photographic reproductions, illustrating a great variety of natural phenomena, are especially noteworthy, as are also the illustrative maps. The three main divisions of the book treat of the atmosphere, the ocean, and the land. Strangely enough, "the earth as a planet" falls into the first division, and meteorological instruments and methods are relegated to an appendix. "To present facts and furnish information" is the avowed object of the book, and although it is recognised that "the average mind learns unconnected facts with much less ease than those which are philosophically related," many objections to this method of teaching might be made. One of the defects of the method is the liability to employ terms without sufficient explanation, and we find the author so using the terms "waves of ether," specific heat, density, and temperature. Again, a student would be very much wiser for a demonstration that the air has weight, than for a mere statement of the fact. It is true that the introduction of laboratory and field work is strongly advocated, and some very useful suggestions for such work are made. If the facts and information furnished by the book are supplemented by laboratory and field study, the course may be made one of great educational value. Otherwise, to use the author's words "the value of the study will be very slight indeed," as a means of mental discipline. Nevertheless, the logical sequence of subjects, and the statement of sufficient evidence to justify the conclusions drawn as to the causes of many natural phenomena, combine to provide a useful course of reading. The information is fairly up-to-date, and the descriptions are clear as well as interesting. References to the literature of the various parts of the subject, and questions for examination, will greatly increase the value of the book to teachers.

An Introduction to the Study of Seaweeds. By George Murray, F.L.S. (London: Macmillan and Co., 1895.)

IN this little volume, one of the Manuals for Students Series, we have a fairly satisfactory account of those forms of Algæ which live in salt water. We had fancied that the English name "seaweed" had by this time lost its first or original meaning, and that it had come to be considered as equivalent to Algæ, in its widest sense; but Mr. Murray has drawn the line between those forms which live in fresh and those which live in salt water, and whenever it is possible he avoids all reference to the former. This being so, there is no account of the lovely Desmids, nor of the interesting species of Bulbochæte and Œdogonium. Noting this as a fact, but one to be regretted so far as the Chlorophyceæ, which "attain their finest development in fresh waters," are concerned, we welcome this little book as a useful and pleasantly written introduction to an ever-fascinating group of plants, which are easily, for the most part, preserved and are equally easy of observation. Their life-history, despite that many of them are so common, has still many a secret, which it will take long and patient research to find out. The introductory chapter condenses a great deal of valuable information into a few pages, and is accompanied by a useful list of books and memoirs on seaweeds.

Beginning with the Phæophyceæ, and with their more specialised forms, the Chlorophyceæ come next in order, then the Diatomaceæ, followed by the Rhodophyceæ, and ending with the Cyanophyceæ. Eight well-drawn and neatly-coloured plates illustrate the volume, which also abounds with numerous woodcuts; most of these latter are satisfactory, and all of them are selected from modern and authentic sources.

We trust that this help to a study of these "seaweeds" will be successful in attracting many to their study. When the late Dr. Harvey was writing his well-known "Phycologia Britannica," he had a very numerous set of correspondents, living on all parts of our coasts; some of them, like Mrs. Griffiths and Miss Hutchinson, were excellent botanists, but most of them were excellent observers. Is it too much to expect that others may arise to take their long-left places?

Public Health in European Capitals. By Thomas Morison Legge, M.A., M.D. (Oxon), D.P.H. (Cantab.). Pp. vi + 202. (London: Swan Sonnenschein and Co., 1896.)

THE author points out in the preface that the work is a record of his own observations during many visits to "some of the most important capitals on the continent"; and a very interesting and instructive record it is.

The cities dealt with are Paris, Berlin, Brussels, Christiania, Stockholm, and Copenhagen. It will be noted that several important capitals (Vienna, St. Petersburg, Rome), and many others the sanitation of which would be interesting, if not edifying, are omitted. It is to be hoped that Dr. Legge will be able to include these in a subsequent edition, for he has shown in the present volume that he can interest while he instructs.

A comparison is set forth of the methods employed in different countries for coping with the great problems of sewage disposal, water-supply, the spread of preventible disease, and the housing of the poor; and it is a work that can be read by all who take an interest in these vital subjects, for the information it conveys is not set in abstruse technical language. The book presents many instances of the experts of different countries differing in their methods and views, but the differences are mainly those of detail in the application of great principles of sanitation that are equally recognised by all.

The writer is perhaps at his best when treating of Paris. In that city, during the past two years, some much-needed sanitary improvements have been inaugurated; but it is only fair to our neighbours to concede that their appreciation of the principles of sanitation have for many years been in advance of that of a certain French judge, who, as Dr. Legge tells us, declared, as recently as 1885, that for a landlord to be compelled to lay on water to his house for the use of the tenants was an interference with the liberty of the subject, and that a water-supply was not an indispensable necessity for maintaining the healthiness of a dwelling.

It is a source of satisfaction, while reading of the various capitals, to find that, in matters relating to the public health, London is certainly *facile princeps.* In one particular, however, we fall far behind some other capitals, and that is in the matter of meat inspection. The sooner we adopt the Berlin system of skilled inspection of the live animals in public abattoirs, and the detailed examination of the carcases, the sooner shall we remove what is a very great reproach upon the thoroughness with which our methods of disease prevention are carried out in this country.

History of the Cholera Controversy. By Sir George Johnson, M.D., F.R.C.P., F.R.S. Pp. 78. (London: J. and A. Churchill, 1896.)

SIR GEORGE JOHNSON has held for years, as is well known, very strong views as to the treatment of cholera, and the above little volume, with its seventy-eight pages, is devoted to an elaborate exposition of these views, together with an account of their reception by the medical world. The so-called "Cholera Controversy" gathers, we are told, round the support given respectively to the "evacuant" and "astringent" treatment of this disease; or, in other words, the use of castor-oil *versus* opium in the handling of cholera cases. It is not possible here to enter into the various medical arguments and discussions which occupy these pages; but we cannot help regretting that in the treatment of this subject, the author has allowed the personal element to play so conspicuous a part, as it detracts from the value of its discussion and tends, necessarily, to restrict the area of observation. Thus it would have been of interest to have had some reference to the latest official document published last year in Germany on cholera, from which we should have learnt that calomel is frequently referred to as of great therapeutic value. The "historical" side of the question would thus not only have gained in interest, but the arguments, from a layman's point of view, would have been more convincing.

Mechanics. Part iii. *Hydrostatics.* By R. T. Glazebrook, M.A., F.R.S. Pp. x + 213. (Cambridge: University Press, 1895.)

A CLEARLY-PRINTED and well-arranged text-book of hydrostatics for colleges and schools. The subjects and order of the eight chapters are: states of matter, fluid pressure, propositions of fluid pressure, fluid-thrust centre of pressure, floating bodies, measurement of specific gravities, pressure of the atmosphere, hydrostatic machines. The descriptions are clearly written, and the exercises are numerous. Moreover, the treatment is experimental; so that altogether the book is calculated to give a good grasp of the fundamental principles of hydrostatics.

LETTERS TO THE EDITOR.

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

Prints of Scars.

THE accompanying print is sent with a two-fold object. First, for its intrinsic interest in showing how thoroughly and definitely a grafted slice of skin and flesh has established itself under its new conditions, retaining its original characteristics unchanged during thirty years. Secondly, because of its probable interest to surgeons in illustrating the ease and completeness with which a record can be kept of the process and results of the cicatrisation of wounds.

Prints are more clear, more cheap, and more trustworthy than photographs. They are not distorted through perspective, nor blurred owing to differences of focus; they can be taken in any light, and their scale is absolutely correct. They are made by rolling the scarred part on a porcelain pallet or metal slab, that has been covered evenly and very thinly with printer's ink; or, conversely, the pallet and paper are rolled upon the scar. As many duplicate prints can be taken as desired. I have written at so much length about these and alternative methods of printing in my book, "Finger Prints," and elsewhere, that I need say no more about them now. The print sent herewith is a photographic

Enlarged print of a misplaced graft of flesh on the side of a thumb, thirty years after it was made.

enlargement, being more suitable for rough process-printing than the somewhat minute originals; but one of these is also enclosed. The history of the graft is as follows: J. R. H., who is a solicitor in large practice, when he was twenty-five years old, sliced a piece clean off the thumb of his left hand. He was cutting cardboard with a sharp knife guided by a rule, upon which the thumb pressed, and which it slightly overlapped. The piece that was cut off fell on the table; it was at once picked up, clapped upon the wound, and the thumb was tightly bandaged. After a few days reunion had taken place, and the wound was healed. It then proved that the graft had not been replaced in its original position, but crossways to it, as seen by the papillary ridges in the accompanying print, taken in 1895, thirty years after the accident. FRANCIS GALTON.

The Cause of an Ice Age.

SIR ROBERT S. BALL appears to admit the correctness of Mr. Culverwell's argument against Croll's astronomical theory of an Ice Age so far as, that "the direct sun-heat received on any parallel at the time of greatest eccentricity is the same as that now received on the parallel not more than three or four degrees north"; and then proceeds to explain, with perfect truth, that "the actual temperature in a region depends, not merely upon the sun-heat there received, but also upon the transference of heat across the boundaries of that region."

Now the causes upon which the transference of heat depend, viz., the prevailing winds and the ocean currents, rest ultimately upon the sun-heat received over the whole globe. The soundness of Mr. Culverwell's argument therefore seems to hinge upon whether the general shift of the isotherms of *sun-heat* three or four degrees southward would be incapable of greatly altering the winds and currents. If this were so, it might be admissible to reason upon the sum total of the local climatal effects at a period of great eccentricity, with the winter in aphelion, from the conditions of temperature as they now exist. If a shift three or four degrees southward would not appreciably alter these currents, I think Mr. Culverwell's argument against Croll's theory a strong one; and to reply effectually to it, it ought to be explained that such a slight shifting of the isotherms of sun-heat would be likely to affect those currents to so great an extent that the then conditions of local temperature would not bear comparison with the present—as, for instance, of Cornwall then with Yorkshire now. O. FISHER.

Harlton, Cambridge, January 17.

Barisal Guns and Similar Sounds.

IN Colonel Godwin-Austen's interesting letter on the Barisal guns (page 247 *ante*), he mentions as suggested sources of these remarkable sounds fireworks (*i.e.*, bombs, cannon), bursting bamboos in jungle-fires, thunder-claps, landslips, the falling of river-banks or sand-banks, and seismic disturbances; but he does not add what seems to me to be a more probable source of the sounds, namely, ball or globular lightning, known to the French as *éclairs en boule*.

It is true, as I stated in my letter to the *Times* in August last, that Faraday, so late as 1838, said:—"That phenomena of balls of fire may appear in the atmosphere I do not deny, but that they have anything to do with the discharge of ordinary electricity, or are at all related to lightning or atmospheric electricity, is much more than doubtful." ("Researches," sec. 1641.)

Snow Harris, however, in his book on "Thunderstorms," 1843, recognises the phenomenon as a case of glow discharge, often terminating in disruptive discharge, as in the case of H.M.S. *Montague*. After this, the reported cases of ball-lightning and the damage caused by their violent explosion are numerous, and some remarkable ones have been described lately in NATURE. When of lower tension, these fire-balls, as they were called by the older physicists, may envelop the person without doing any harm, a striking example of which is given in Shakespeare's *Julius Cæsar*, Act i. Scene iii.

The explosive sounds heard by the Rev. W. S. Smith, while skating on Lough Neagh, may still be due to globular lightning. The dry atmosphere occasioned by frost is highly favourable to the development of atmospheric electricity; and we have still to learn whether these electrical globes will not account for the observed phenomena. C. TOMLINSON.

Highgate, N., January 20.

IN connection with the correspondence on mysterious atmospheric sounds, which originated with Prof. Darwin's communication in the issue of NATURE for October 31 last, I have official sanction for forwarding the following extracts from the meteorological logs of vessels visiting high latitudes.

S.s. *Resolute*, Captain W. Deuchars; 8 p.m., July 30, 1883, in 71° 9′ N., 12° 28′ W.—"Six reports like those of guns heard to the westward, supposed to be caused by electricity, as no ships are thought to be in the vicinity." Wind during the day calm to very light easterly airs; weather foggy; sea smooth, with a very slight south-easterly swell; pressure and temperature as follows:

	Barometer.	Air temperature. Dry bulb.	Air temperature. Damp bulb.	Sea temperature.
	In.	°	°	°
Noon ...	30·08	50·0	48·8	41·5
4 p.m. ...	30·09	42·0	41·8	37·0
8 p.m. ...	30·10	40·8	40·5	37·0
Midnight	30·11	46·5	46·5	35·0

S.s. *Windward*, Captain A. Murray; 4 a.m. June 12, 1883, in 71° N., 7½° W.—"There is a distinct murmur as of a waterfall from the island" [of Jan Mayen]. Calm; weather foggy;

sea very smooth; barometer 29·83 in., rising; temperature of air 33°, of sea 34°.

S.s. *Labrador*, Captain A. Gray; July 14, 1882, about 56° N., 60° W.—"Saw an iceberg, which collapsed with a thundering squash." Next day, "icebergs all over the place, with an occasional collapsing roar."

It may be thought, perhaps, that the thundering roars of collapsing bergs would be the explanation of the six reports heard by Captain Deuchars; but as he had many years' experience whaling and seal fishing in the ice on both sides of Greenland, he would be well acquainted with the sounds from bergs breaking up, and there must have been, therefore, something peculiar about the "guns" to lead him to suggest an electrical origin.

With reference to M. Van den Broeck's explanation of the expression *mist-poeffers* as *fog-belchings*, not *fog-dissipators*, it may be interesting to add another extract from Captain Deuchars's log: June 15, 1883, in 71° N., 11° W.—"Weather dense fog, with a white bow to south-east, known generally as a *fog-scaffer* or *demolisher*." HY. HARRIES.

Meteorological Office, January 17.

WITH reference to the letters on this subject which have recently appeared in your pages, and more especially to the communication of my friend Rev. W. S. Smith, relative to Lough Neagh, the following extract from my notes may be of interest: "August 27, 1886.—While standing with Mr. S. A. Stewart in a recently-mown meadow, near Portmore Lough, on the eastern side of Lough Neagh, our attention was attracted by a rumbling noise. The day was very fine and warm, and dead calm, not a leaf stirring, and a few very light clouds were in the sky. The noise was like a short distant peal of thunder, but sounded faint rather than distant. While we watched, a whirlwind suddenly appeared in the direction whence the sounds had come [the north], and at a distance of about a hundred yards from us. A quantity of loose hay was instantly whirled upward to a height of about 100 feet, and, after floating about in circles, slowly settled down. A haycock at the spot was much disturbed, and presented the appearance of having endured a gale of wind. The time between the rumbling sound (which closely resembled the distant report of a cannon) and the appearance of the whirlwind was about half a minute, and the whirlwind lasted somewhat over a minute."

In W. H. Patterson's "Glossary of Words of Antrim and Down," we find the following: "Water Guns.—Sounds as of gunshots, said to be heard around the shores of Lough Neagh by persons sailing on the lake. The cause of the sounds, which are generally heard in fine weather, has not been explained." There is no doubt that the sound we heard was the mysterious "water guns," and there is also little doubt that the noise and the appearance of the whirlwind were closely connected.

R. LLOYD PRAEGER.

IN connection with the recent correspondence upon "Remarkable Sounds," the following quotation may be interesting. It occurs as a footnote in a paper by Prof. S. A. Forbes, of Illinois, upon the "Aquatic Invertebrate Fauna of the Yellowstone National Park, &c.," published in the *Bulletin* of the U.S. Fish Commission for 1891 (Washington, 1893), p. 215.

"Here we first heard, while out on the lake [Shoshone Lake, Yellowstone National Park] in the bright still morning, the mysterious aerial sound for which this region is noted. It put me in mind of the vibrating clang of a harp, lightly and rapidly touched, high up above the tree-tops, or the sound of many telegraph wires swinging regularly and rapidly in the wind, or, more rarely, of faintly-heard voices answering each other overhead. It begins softly in the remote distance, draws rapidly near with louder and louder throbs of sound, and dies away in the opposite distance; or it may seem to wander irregularly about, the whole passage lasting from a few seconds to half a minute or more. We heard it repeatedly and very distinctly here and at Yellowstone Lake, most frequently at the latter place. It is usually noticed on still, bright mornings not long after sunrise, and it is always louder at this time of day; but I heard it clearly, though faintly, once at noon, when a stiff breeze was blowing. No scientific explanation of this really bewitching phenomenon has ever been published, although it has been several times referred to by travellers, who have ventured various crude guesses at its cause, varying from that commonest catch-all of the ignorant, 'electricity,' to the whistling of the wings of ducks and the noise of the 'steamboat geyser.' It seems to me to belong to the class of aerial echoes, but even on that supposition I cannot account for the origin of the sound." D. J. SCOURFIELD.

Leytonstone, January 20.

IT may be worth while to put on record the following statements of the distances at which the firing of guns have been heard. They were related to me by the late Prof. C. J. Harris, of Washington, and Lee University, Lexington, Virginia, who, in speaking of the distances at which sounds could be heard, said that during "The War"—the Civil War of 1861-65—he had frequently heard the firing of the guns in battles taking place many miles from Lexington; and so distinct were the reports, that it was easy to distinguish between light and heavy artillery. In particular, I remember his saying that the sound of the cannonading at the Battle of Malvern Hill was distinctly heard at Lexington. Malvern Hill is about 123 miles "as the crow flies" from Lexington. At this battle gunboats were used by the Federals, and the reports of the heavy guns on the boats could be easily distinguished.

He also said that during the Battle of Manassas—or, as it is also called, Bull Run—the cannonading was heard at Lexington. The battle-field is about 125 miles from Lexington. These distances have been furnished me by the Assistant Superintendent of the U.S. Coast and Geodetic Survey, and are accurate within a mile or two. W. G. BROWN.

Washington, D.C., U.S.A., January 3.

The Place of "Pithecanthropus" on the Genealogical Tree.

WRITING to NATURE (January 16), under the above heading, Dr. Eugene Dubois makes the following statement: "In Prof. Cunningham's tree, figured in NATURE of December 5, p. 116, he regards the left branch as all human, the right one as entirely simian, and he placed Pithecanthropus midway between recent Man and the point of divarication." In this assertion there are two inaccuracies. I do not regard the left branch as being entirely human, but merely as representing a hypothetical line of human descent. During the debate which took place at the Royal Dublin Society, I was most careful to insist that at a certain point on such a line (marked on the diagram by a ×, NATURE, December 5, p. 116), we might expect to meet with an individual possessing ape-like and human characters in equal degree; whilst below that point ape-like characters would predominate, and the human characters diminish until, probably, before we came to the junction of the line with the main stem, the latter had reached a vanishing point. But, again, I did not place Pithecanthropus on the mid-point of the line, but much lower down, as may be seen by a reference to the diagram itself, where the upper mark of interrogation (?) indicates the place which I assigned to the fossil cranium.

I would wish to add that my diagram was not drawn with the view of elaborating in any detail a genealogical tree of Man and the Anthropoid apes, but simply for the purpose of eliciting from Dr. Dubois his views regarding the place he wished to assign to Pithecanthropus in relation to Man on the one hand, and the existing Anthropoid apes on the other.

It seemed to me that a definite statement from Dr. Dubois on this point was desirable, seeing that I considered that the title he had given to his memoir was apt to lead to misconception. D. J. CUNNINGHAM.

THE CHEMICAL SOCIETY'S HELMHOLTZ MEMORIAL LECTURE.

IN his Helmholtz memorial lecture, delivered last Thursday, Prof. G. F. Fitzgerald gave an able exposition and development of those branches of the work of the late Prof. Helmholtz which intimately affect chemistry, and at the same time made an important contribution to several much-vexed questions of higher chemical physics. A brief account of the chief points of the lecture is given in the following abstract.

Helmholtz made the great discovery that, by virtue of their vorticity, vortex rings floating in a perfect fluid are unable to destroy or create one another; although these vortices may distort each other, becoming drawn out into thin threads or rolled into spherical balls, one cannot destroy another. This discovery it was that afforded a basis for those speculations of Lord Kelvin which would identify atoms with vortex rings moving in a perfect fluid; the indestructibility of atoms finds a parallel in the permanency of vortex rings, and the two have many properties in common. As, however, our knowledge of vortices has increased, so obstacles to the acceptance of the atomic vortex hypothesis have arisen. Thus the energy and the inertia of vortex rings increase together whilst their rate of motion decreases, so that on raising the temperature of a gas composed of vortex atoms, and therefore increasing the rate of motion of its particles, it would seem that, in some mysterious way, more energy leaves the gas than enters it. Similarly, unless the weight of a body alters appreciably as its temperature changes, it is not easy to see how the simple vortex theory of matter can be true; the difficulty of determining weights at different temperatures of course stands in the way of an experimental examination of this point. Many modifications of the vortex theory have been proposed, but the only statement that can be made with certainty is that the space between the atoms, whatever their nature may be, must be filled with some complicated structure, the postulation of which is essential for the explanation of electro-magnetic actions. It is therefore impossible to believe that atoms are simply thin vortices floating in an otherwise motionless and structureless medium.

A curious analogy is noticeable between the stability of vortex systems and chemical valency. A system of two vortex rings, both rotating in the same direction, assumes a state of fairly stable equilibrium in which the two rotate round one another, whilst a system of three vortex rings is stable in a state in which the vortices are situate at the apices of a triangle. Similarly, a condition of stable equilibrium is possible for systems of four, five, or six rings; a system of seven vortex rings, however, is unstable, and vortex systems generally become unstable when composed of more than six rings. The curious analogy between this result and the fact that the atom of no chemical element requires to combine with more than six monovalent atoms, should be kept in view in default of a sounder dynamical conception respecting the limitation of chemical bonds.

The atomic vortex theory again meets with difficulties in connection with homologous series of organic compounds and with the atomic weights; the atomic weight of mercury is 200, that of hydrogen being unity, and it can be shown that the volume occupied by the mercury atom should be some 2800 times that occupied by the atom of hydrogen, a result hardly reconcilable with the known properties of these elements. Valency also presents obstacles to the theory; thus nitrogen and carbon should be respectively mono- and di-valent unless the vortex rings are doubled on to themselves, and even then the doubling indicates the existence of two allotropic modifications of carbon, a right- and a left-handed form, for which no evidence exists. The vortex theory of atoms and the experimental facts regarding atoms are thus sadly at variance, and much still remains to be done in clearing up the questions at issue.

The theory of semipermeable membranes, which is of such importance in certain branches of physical chemistry, is as yet in a very unsatisfactory state. The absolute disregard of any possible heating effects occurring during osmosis may lead to serious errors, corresponding to those which crept into the theory of galvanic cells by neglect of the thermal effects which arise when electrical currents enter or leave a liquid; possible causes of error, such as these, should be well borne in mind until the theory and practice of semipermeable cells are in better agreement than at present. These semipermeable membranes are frequently regarded as being only some kind of molecular sieves, although they are really much more analogous to Graham's second class of membranes, which only allow the passage of gases soluble in the membrane itself; the laws governing the two kinds of membranes are quite dissimilar. It is not easy to sharply distinguish between physical and chemical permeability when molecular magnitudes are dealt with, and one molecule may pass amongst others not so much by reason of possessing the right size as the right shape. There seems some hope of extending our methods of "chemical filtration" by means of sets of properly constituted diaphragms, each of which is penetrable by certain classes of molecular groups.

The application of thermodynamics to chemical investigations is full of pitfalls; the law of conservation of energy has been often misapplied, and it is not sufficiently realised that the second law of thermodynamics is not strictly applicable to irreversible chemical changes, such as explosions, &c.

The tendency to regard chemical forces as electrical ones is not altogether justifiable; too many instances of irreversible chemical changes exist to permit a parallel between chemical actions and simple reversible electrolysis. Chemical actions are of a far more complex nature than simple electrolysis, and that other than purely electrical forces are operative in solution is indicated by Helmholtz's investigations of electrical diffusion through fine tubes. No statical theory of solid or liquid media which supposes the action of none but electrical forces is possible, for such media would be essentially unstable; as far, then, as solids and liquids can be conceived as statical systems, the postulation of other than purely electrical forces is imperative. The success which has attended the accepted theories of crystal structure and of the asymmetric carbon atom, makes it pretty safe to conclude that many properties of molecules are deducible from purely statical theories of structure.

The enormous increase of knowledge which has attended the assumption that a substance in liquid solution behaves in some important respects like the same substance in a pure gaseous state, has led to the grave error of supposing that the physical conditions of molecules of a substance when gaseous and when dissolved are similar. A dissolved molecule is always within the spheres of action of countless neighbours; its path is of the order of one-hundredth of its diameter, and it receives, perhaps, 10^{14} blows per second, so that its vibrations are comparable with those of radiant heat; in the gaseous state, however, the molecule has a free path thousands of times its diameter in length. The dynamical conditions of gaseous and dissolved molecules are thus absolutely dissimilar. Although it is curious that the osmotic pressure of a dissolved substance should be even roughly identical with the vapour pressure of the same quantity of the substance as a gas under similar conditions of volume and temperature, it is wholly erroneous to attribute this coincidence to a similarity between the dynamical states in the two cases. Osmotic pressure is more nearly related to Laplace's internal pressure in a liquid, which depends on intramolecular forces, than to a gaseous pressure which is practically independent of the forces operating between the molecules. Considerations respecting the capillarity and vapour pressure of solutions and solvents shows that some very close connection exists between osmotic pressure and capillarity, and afford a trustworthy method of applying thermodynamics to the calculation of osmotic pressure.

It is almost impossible to explain dynamically the assumption that free electrically charged ions wander about in a liquid in a condition at all rightly described as one of dissociation. The term "dissociation" should be restricted to a condition in which the components of a molecule are in no way connected by chemical bonds; the possibility of the independent diffusion of the molecular components through porous membranes would afford a simple test as to whether molecules were really dissociated or not. The term dissociation as applied to electrolytes, in which this independence of the ions does not exist, is obviously a misnomer. There is said to be an electrical force acting between the various oppositely charged ions into which a dissolved molecule separates, which in some way still binds them. Even in dilute solutions this force is very considerable, and must make the condition of charged ions moving independently in the liquid so unstable as to be dynamically impossible unless other important forces operate at the same time. Although the present theory of free ions affords a rough working analogy, yet it is illusory and misleading, and threatens to prevent important advances by its illusive appearance of explanation. It must not be forgotten that the older theories of light and the caloric theory of heat constituted stumbling-blocks long after their inadequacy had been conclusively demonstrated.

Prof. Fitzgerald thus contends that the fundamental conceptions underlying many of the current physico-chemical theories, such as those of osmotic pressure and electrolytic dissociation, are dynamically unsound, so that all attempts to gain an insight of what occurs in solution by their aid are necessarily unsuccessful. He seems to consider that an unyielding adhesion to these theories has led to an illogical habit of thought upon such matters, and has made possible the inaccurate application of thermo-dynamical reasoning. W. J. P.

NEW EXPERIMENTS ON THE KATHODE RAYS.[1]

(1) TWO hypotheses have been propounded to explain the properties of the kathode rays.

Some physicists think with Goldstein, Hertz, and Lenard, that this phenomenon is like light, due to vibrations of the ether,[2] or even that it is light of short wave-length. It is easily understood that such rays may have a rectilinear path, excite phosphorescence, and affect photographic plates.

Others think, with Crookes and J. J. Thomson, that these rays are formed by matter which is negatively charged and moving with great velocity, and on this hypothesis their mechanical properties, as well as the manner in which they become curved in a magnetic field, are readily explicable.

This latter hypothesis has suggested to me some experiments which I will now briefly describe, without for the moment pausing to inquire whether the hypothesis suffices to explain all the facts at present known, and whether it is the only hypothesis that can do so. Its adherents suppose that the kathode rays are negatively charged; so far as I know, this electrification has not been established, and I first attempted to determine whether it exists or not.

(2) For that purpose I had recourse to the laws of induction, by means of which it is possible to detect the introduction of electric charges into the interior of a closed electric conductor, and to measure them. I therefore caused the kathode rays to pass into a Faraday's cylinder. For this purpose I employed the vacuum tube represented in Fig. 1. A B C D is a tube with an opening α in the centre of the face B C. It is this tube which plays the part of a Faraday's cylinder. A metal thread soldered at S to the wall of the tube connects this cylinder with an electroscope.

E F G H is a second cylinder in permanent communication with the earth, and pierced by two small openings at β and γ; it protects the Faraday's cylinder from all external influence. Finally, at a distance of about 0·10 m. in front of F G, was placed an electrode N. The electrode N served as kathode; the anode was formed by the protecting cylinder E F G H; thus a pencil of kathode rays passed into the Faraday's cylinder. This cylinder invariably became charged with negative electricity.

The vacuum tube could be placed between the poles of an electro-magnet. When this was excited, the kathode rays, becoming deflected, no longer passed into the Faraday's cylinder, and this cylinder was then not charged; it, however, became charged immediately the electro-magnet ceased to be excited.

In short, the Faraday's cylinder became negatively charged when the kathode rays entered it, and only when they entered it; *the kathode rays are then charged with negative electricity.*

The quantity of electricity which these rays carry can be measured. I have not finished this investigation, but I shall give an idea of the order of magnitude of the charges obtained when I say that for one of my tubes, at a pressure of 20 microns of mercury, and for a single interruption of the primary of the coil, the Faraday's cylinder received a charge of electricity sufficient to raise a capacity of 600 C.G.S. units to 300 volts.

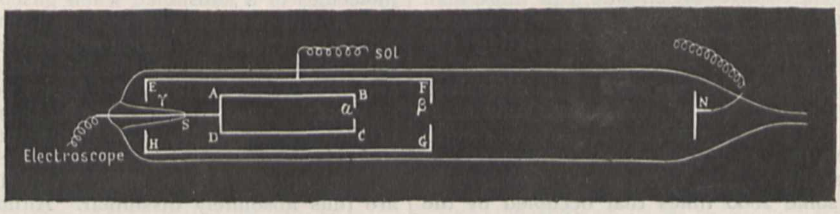


FIG. 1.

(3) The kathode rays being negatively charged, the principle of the conservation of electricity drives us to seek somewhere the corresponding positive charges. I believe that I have found them in the very region where the kathode rays are formed, and that I have established the fact that they travel in the opposite direction, and fall upon the kathode. In order to verify this hypothesis, it is sufficient to use a hollow kathode pierced with a small opening by which a portion of the attracted positive electricity might enter. This electricity could then act upon a Faraday's cylinder inside the kathode.

The protecting cylinder E F G H with its opening β fulfilled these conditions, and this time I therefore employed it as the kathode, the electrode N being the anode. The Faraday's cylinder is then invariably charged with *positive electricity*. The positive charges

[1] Translation of a paper by M. Jean Perrin, read before the Paris Academy of Sciences on December 30, 1895.
[2] These vibrations might be something different from light; recently M. Jaumann, whose hypotheses have since been criticised by M. H. Poincaré, supposed them to be longitudinal.

were of the order of magnitude of the negative charges previously obtained.

Thus, at the same time as negative electricity is *radiated* from the kathode, positive electricity travels towards that kathode.

I endeavoured to determine whether this positive flux formed a second system of rays absolutely symmetrical to the first.

(4) For that purpose I constructed a tube (Fig. 2) similar to the preceding, except that between the Faraday's cylinder and the opening β was placed a metal diaphragm pierced with an opening β', so that the positive electricity which entered by β could only affect the Faraday's cylinder if it also traversed the diaphragm β'. Then I repeated the preceding experiments.

When N was the kathode, the rays emitted from the kathode passed through the two openings β and β' without difficulty, and caused a strong divergence of the leaves of the electroscope. But when the protecting cylinder was the kathode, the positive flux, which, according to the preceding experiment, entered at β, did not succeed in separating the gold leaves except at very low pressures. When an electrometer was substituted for the electroscope, it was found that the action of the positive flux was real but very feeble, and increased as the pressure decreased. In a series of experiments at a pressure of 20 microns, it raised a capacity of 2000 C.G.S. units to 10

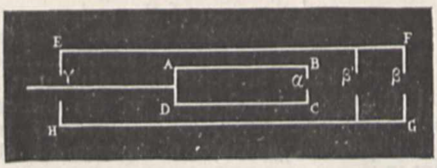


FIG. 2.

volts; and at a pressure of 3 microns, during the same time, it raised the potential to 60 volts.[1]

By means of a magnet this action could be entirely suppressed.

(5) These results as a whole do not appear capable of being easily reconciled with the theory which regards the kathode rays as an ultra-violet light. On the other hand, they agree well with the theory which regards them as a material radiation, and which, as it appears to me, might be thus enunciated.

In the neighbourhood of the kathode, the electric field is sufficiently intense to break into pieces (*into ions*) certain of the molecules of the residual gas. The negative ions move towards the region where the potential is increasing, acquire a considerable speed, and form the kathode rays; their electric charge, and consequently their mass (at the rate of one valence-gramme for 100,000 Coulombs) is easily measurable. The positive ions move in the opposite direction; they form a diffused brush, sensitive to the magnet, and not a radiation in the correct sense of the word.[2]

THE FRENCH MAGNETIC SURVEY OF THE WORLD.

IN Europe, as well as in the United States of America, the study of terrestrial magnetism has for some time played an important part.

M. le Commandant de Bernardières has written a most interesting account of the construction of new magnetic maps of the globe, undertaken by the Bureau des Longitudes. The following are a few facts given by him, which show to what extent it is contemplated to carry out the work.

From the magnetic determinations already obtained, some maps have been made; observatories too, permanent and otherwise, have been built. But the work is not entirely satisfactory. The maps are chiefly the result of observations made by navigators, and are only of limited parts scattered over the face of the earth.

In order to have a *general* magnetic map, numerous observations would have to be made, distributed over all regions, taken as nearly as possible at the same time, and in the same way with similar instruments. To this end the Bureau des Longitudes have appealed to Vice-Admiral Besnard, Minister of Marine, who has promised help, and put at their disposal officers and sailors, and also a great number of instruments. The Colonial Minister has also shown interest in the matter, and promised his assistance in the colonies.

Seven sets of observers have been organised, consisting each of a lieutenant, ensign or hydrographer, and one assistant. These expeditions have been arranged as follows:—

Atlantic Ocean	West Coast of Africa, East Coast of America, Antilles, &c.	M. Schwérer, lieutenant of the ship.
Pacific Ocean	West Coast of America	M. Blot, ensign of the ship.
Pacific Ocean	Oceana	M. Monaque, ensign of the ship.
Indian Ocean	Red Sea, South Coast of Asia, Oriental Coasts of Africa, Madagascar, and other islands	M. Paqué, ensign of the ship.
Chinese and Japanese Seas	Coasts of Indo-China, of China and Japan	M. Terrier, ensign of the ship.
—	Madeira, Canary Islands Azores, Cape Verd Islands, Senegambia	M. de Vanssay, hydrographic engineer.
Iceland	North Sea, Scandinavia, Denmark, Scotland	M. Houette, captain of the frigate, commanding the Iceland station; M. Morache, lieutenant of the ship.

With expeditions in these various parts of the earth, it will be possible to make observations almost simultaneously.

In order to determine the correct value of the magnetic elements, as well as to ascertain the exact variation of these elements, the missions have been supplied with the finest instruments, which have been adjusted at the observatories of Montsouris and Parc Saint-Maur; comparisons will also be made at every magnetic observatory at which they arrive during the expedition. Special instructions have been given with regard to calculations and method of observation, in order to insure a perfect comparison of results.

Six of these expeditions have started, and have communicated already the result of some of their first observations; the work, however, will have to be continued about two more years.

The ship *Manche*, which left France last spring, for Iceland, has returned with a great number of observations, obtained in Cherbourg, Scotland, the Shetland Isles, Iceland, Norway, and Denmark. In the observatory constructed by the *Manche* at Keykiawik, two complete observations of variations were obtained, having each a duration of eight days.

It will be very interesting to compare the results of the present day with those of the *Recherche*, obtained sixty years ago, and since then of several other expeditions. The successful return of the *Manche* certainly indicates that great things may be expected of the other expeditions, and makes it certain that a most important step has been taken by the French Government for the advancement of science.

[1] The breaking of the tube has temporarily prevented me from studying the phenomenon at lower pressures.

[2] This work has been carried out in the laboratory of the Normal School, and in that of M. Pellat at the Sorbonne.

LILIENTHAL'S EXPERIMENTS ON FLYING.

THERE are many of us, no doubt, who are watching with great interest the experiments of Herr Otto Lilienthal in his "Fliegesport and Fliegepraxis." These "Uebungen," which he is making from a hill thrown up in the neighbourhood of Berlin, have, from the very beginning, been rewarded with a distinct success; and it seems that, given time, he may present us, if not with a method of flying, then with an approximation to it, which perhaps at some later date may be more fully developed.

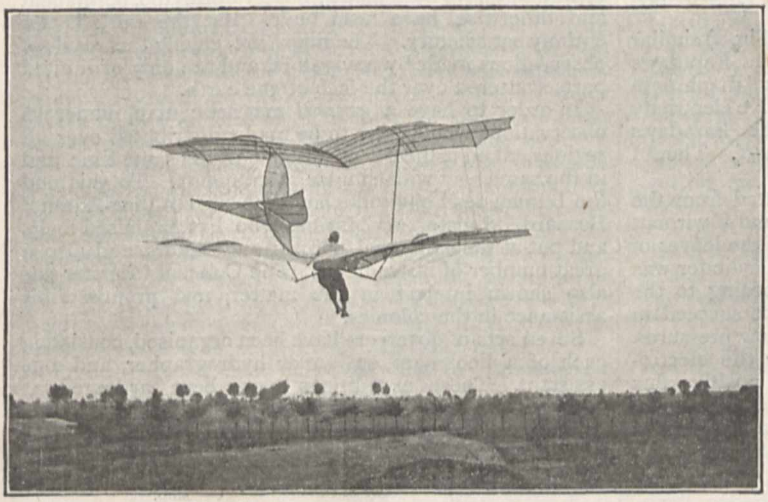


FIG. 1.

His experiments have, up to the present, shown that, by means of such an apparatus as he employs, fairly long flights may be indulged in with perfect safety, provided the operator does not attempt to do too much at the beginning, but contents himself with mastering the first elements of sustaining his equilibrium.

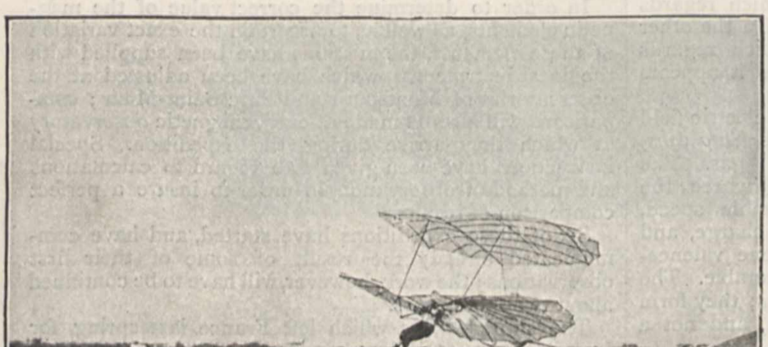


FIG. 2.

In a previous article (NATURE, vol. li. p. 177), a short account was given of Herr Lilienthal's earlier experiments on this subject, and it was then mentioned that falls must be expected in the preliminary trials, until the operator becomes accustomed to the many new conditions which make themselves apparent at every step, before they can be mastered instinctively.

Similar difficulties have, for instance, to be contended with when learning to ride a bicycle. The beginner is at first unable to keep his equilibrium, and so wobbles here and there with the loss of much power, until he eventually finds himself on the ground. This is simply because he is doing something unusual, and is not accustomed to the new conditions. An adept rider, on the other hand, never thinks of the possibility of falling, and quite unconsciously keeps his equilibrium without any exertion or loss of power on his part. So it is with this sailing machine, and it is only with practice that the required head can be obtained and success assured.

In the above-mentioned article, the machine Lilienthal employed consisted of a wing-shaped framework of a slightly curved nature, the advantage of the curved form, both as regards the amount and direction of the resistance, having been previously proved. The tail consisted also of two plane surfaces, one being at right angles to that of the horizontal framework, and lying in the direction of movement, and the other more generally in that horizontal plane, but capable of movement about a fixed point in it.

With the wind blowing at a moderate and more or less constant rate this machine has been found to be very satisfactory, and flights of comparatively long duration have been made with it.

Lilienthal's ambition, however (*Prometheus*, No. 322, p. 148), does not end here; but he looks further ahead than this, and wishes to be able to practise in such strong winds that he can be carried along with them. He, however, remarks that the size of the apparatus puts a certain limit to this; for if the spread of the wings be too large, then the whole arrangement becomes extremely awkward and hard to manage.

Up to the present, although he has practised in moderately rough weather, and had to perform fantastic feats in the air to keep his equilibrium, he has been fortunate in obtaining on nearly every occasion a safe landing. Experience has, however, convinced him that before trying to compete against strong winds in future, he must modify his machine to some extent, in order to make it easier to handle under these more trying circumstances.

To this end experiments were made with wings of various shapes; but these were given up, as it was found that the employment of a new principle, suddenly discovered, gave the required results with satisfaction that was scarcely dreamt of. The idea consisted in using, instead of one large framework covered with some light material, two smaller ones, placed parallel one above the other. These, of course, would, when sailing through the air, have a similar lifting effect; but, besides affording a simple means of increasing the sail-area without adding to the breadth of the machine, they would decrease very considerably the difficulties, referred to above, with respect to the management of the centre of gravity.

On this principle, Otto Lilienthal constructed his new double-apparatus (Fig. 1), the appearance of which will be noticed from the accompanying illustrations. Each separate surface has an area of nine square metres; thus he is able to employ the very large carrying surface of eighteen square metres with a breadth of only five and a half metres. The upper surface, which is placed at a distance of about three-quarters of a wing-breadth above the lower, proves in no way a disturbing factor in the machine, as might at first be supposed, but develops simply a vertical lifting force. It may be remarked that this double-surface machine is managed in exactly the same way as the single-framed one.

From Fig. 2 it is easy to obtain a good idea of the arrangement adopted, by which the upper surface is fixed rigidly to the lower one by means of two rigid stays, the whole surface being held in position by means of thin wires.

With this new apparatus, Otto Lilienthal has already found that a step in the right direction has been made. The energetic movement of the centre of gravity, and the consequent more safe management of the apparatus, has led him to practise in winds blowing at times over ten metres per second. "These experiments," he says, "have given the most interesting results that I have arrived at since I began." With a wind velocity of six to seven metres per second, the sailing surface of eighteen square metres carried him against the wind in nearly a horizontal direction from the top of the hill, without even having to run at the start, as is generally necessary. More interesting still, is it to learn that, with stronger winds, he allows himself to be simply lifted by the wind from the hill-top, and sail slowly against it. Fig. 3 is such a case in point. The same illustration also shows how strong at times may be the side-motion, the operator having to considerably alter the position of his centre of gravity to retain his equilibrium.

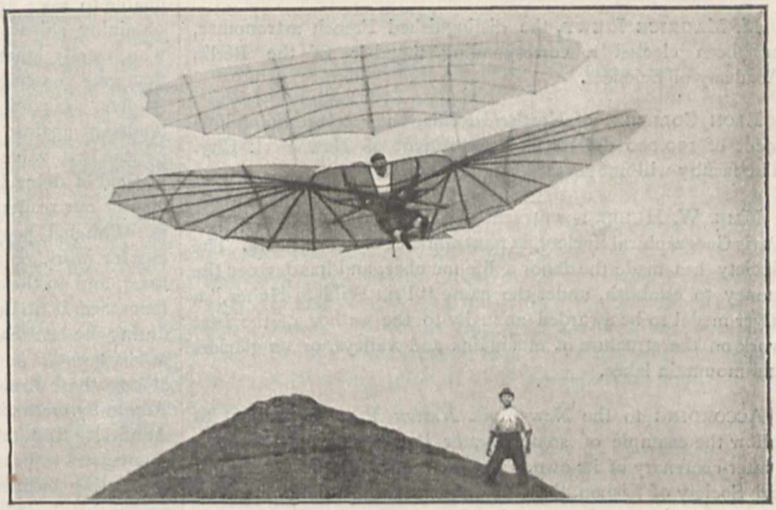


FIG. 3.

As experiments have shown, the sailing path is directed strongly upwards by increasing wind force, and this fact causes him sometimes to be higher in the air than he was at his original starting-point. In this position his apparatus has occasionally come to a standstill; and this leads him to make the following interesting statement: "At these times I feel very certain that, if I leaned a little to one side, and so described a circle, and further partook of the motion of the lifting air around me, I should sustain my position. The wind itself tends to direct this motion; but then it must be remembered that my chief object in the air is to overcome this tendency of turning to the left or right, because I know that behind and under me lies the hill from which I have started, and with which I would come in rough contact if I allowed myself to attempt this circle sailing. I have, however, made up my mind, by means of either a stronger wind or by flapping the wings, to get higher up and further away from the hill, so that, sailing round in circles, I can follow the strong uplifting currents, and have sufficient air space under and about me to complete with safety a circle, and, lastly, to come up against the wind again to land."

It may be remembered that Lilienthal has previously employed some mechanical aid, such as the flapping of the wings: an illustration of the apparatus so arranged was given in the article already referred to above (NATURE, vol. li. p. 178). Perhaps he will apply the same arrangement to the lower framework of his present apparatus, and thus accomplish the end he is wishing to attain.

One can quite understand that sailing against the wind is one thing, and with it another. In the latter case, since the framework is inclined slightly upwards in the direction of motion, the wind would meet the sailing surface from above and shoot the operator, arrow-like, to the ground if he were unable to come up again quick enough to the wind. That such circle sailing will be most probably successfully accomplished by Herr Lilienthal seems certain, but the first few attempts may prove, perhaps, rather rough.

The recent experience of Otto Lilienthal has thus shown that by means of his new apparatus a very close approximation to flying has been attained.

Should he, however, find that the accomplishment of circling is not attended by any great difficulty, and there appears no reason why it should, then there seems no doubt that an important step will have been made, and the future development of this *Fliegesport* will depend nearly directly on the *Fliegepraxis*.

It is interesting to notice that in America this Lilienthal-method is about to be tested. We have in the British Isles already a follower in Percy S. Pilcher, of Glasgow University, but his experiments at Cardross, in Dumbartonshire, have not as yet proved very successful, owing to the wings of his apparatus being too much inclined. He is, however, busy with the construction of a new machine, which will have a sail-area of 300 square feet (= 27·6 square metres). The experience of Lilienthal has shown, however, that with such a large expanse this machine will only be able to be used in moderate winds with safety. If its construction be not already too far advanced, it would seem advisable to add the second or upper surface, since its presence has been shown to be attended by greater stability and easier management of the whole apparatus. W. J. S. L

DEATH OF MR. ALEXANDER MACMILLAN.

We much regret to record the death of Mr. Alexander Macmillan, one of the founders of this journal. This is not the place to give a long account of his career. We may limit ourselves to the statement that outside the field of scientific workers there were few who possessed a greater sympathy with scientific aims, few who had a keener insight as to the place science should occupy in our national life and in our educational systems. It was the hope that a more favourable condition for the progress of science might be thereby secured that led him to enter warmly into the establishment of this journal in 1869. Mr. Macmillan was born in 1818, and died on Saturday last, at his residence in Portland Place.

NOTES.

M. MAURICE LŒWY, the distinguished French astronomer, has been elected a corresponding member of the Berlin Academy of Sciences.

ELON COLLEGE, of North Carolina, has received an endowment of 100,000 dollars from a resident of New York City. The faculty will not reveal his name.

MME. W. HUBER has presented a sum of 20,000 francs to the Paris Geographical Society, in remembrance of her husband. The Society has made the donor a life member, and has devoted the money to establish, under the name "Prix William Huber," a silver medal to be awarded annually to the author of the best work on the structure of mountains and valleys, or on glaciers and mountain lakes.

ACCORDING to the New York *Nation*, Portugal is about to follow the example of some greater Powers, and celebrate a quater-centenary of its own. At the request of the Geographical Society of Lisbon, the Government has just determined to celebrate, with much pomp, in 1897, the four-hundredth anniversary of the expedition which, on July 8, 1497, set out, under the command of Vasco da Gama, for the discovery of the route to India round the Cape of Good Hope. Few details of the celebration have as yet been settled upon, but it is expected that special expositions will be opened at Lisbon, and many scientific congresses held, to which the world will be invited.

WE have already referred to some of the honours given in commemoration of the centenary of the French Institute. How freely France distributes her decorations to men of science will be seen from the following list, given in the *Revue Générale des Sciences*, of the recent nominations to, and promotions in, the Order of the Legion of Honour. Grand Officer: M. J. Bertrand, Secrétaire Perpétuel of the Academy of Sciences. Commanders: MM. C. J. Bouchard, P. E. Duclaux, M. Lœwy, E. J. Marey, Members of the Academy of Sciences. Officers: MM. P. Appell, A. d'Arsonval, F. A. Fouqué, A. Gautier, E. Grimaux, H. Léauté, H. Moissan, E. Perrier, Members of the Academy of Sciences, and MM. A. Houzeau, R. Lépine, F. Raoult and E. Stephan, Correspondants of the same Academy. Chevaliers: MM. R. Blondlot, l'abbé A. David and G. E. Sire, Correspondants of the Academy of Sciences; and MM. Chappuis and Guillaume, of the Bureau international des Poids et Mesures.

WE have on several occasions called attention to the blunders which are made, and the disputes in which the country is involved from time to time, because of the unintelligent way in which the work of various Government departments is carried on. Each branch of the public service, instead of being advised by a scientific staff, is controlled by an officialdom which believes in its own omniscience; a condition of things as deplorable as it is derogatory to national honour and advancement. As we have before pointed out, administrators of departments in which questions involving scientific knowledge continuously arise are, to put the point mildly, *not* chosen on account of their scientific qualifications, and they have to pick up their information as best they can, the result being that they arrive at unsound decisions, and create dissatisfaction everywhere. The *Engineer* of January 17 has something to say which strongly supports our complaint of the neglect of scientific knowledge in the public service. Referring to Admiralty contracts, our contemporary says: "The duty of the Admiralty is to obtain the best possible ships, engines, guns, &c., that can be had; and that those who have to consider the tenders ought to know when a tender is too high or too low. In a word, they ought to know the value of what they propose to buy. Whether the knowledge does or does not exist in the Controller's department, we are unable to say; apparently it does not. The actual method of obtaining ships is strictly analogous to that adopted by a man who, totally ignorant of what a dwelling-house ought to cost, first gets drawings from an architect, and then advertises for tenders. Having obtained them, he proceeds to pit the tenderers against each other, assuming that in this way he will get the best value for his money. The mere mention of this method of doing business will be enough to condemn it in the eyes of our readers. But there is ample evidence available that the Whitehall people do not know what is the proper price to pay for work or materials, and to this ignorance on the one hand, and on the other to a fear of being cheated based on that ignorance, is no doubt due the bargaining and bartering which, during the last few years, have gone on at Whitehall, and have at last become so vexatious that it is matter of common talk among those firms who have laid themselves out to execute Admiralty orders." It is clear that if the relations between the Admiralty and the shipbuilding and engineering firms of the country are to be of a cordial description, the present system of conducting business will have to be greatly altered, and the sooner the alteration comes the better it will be for the country's welfare.

MR. F. E. WILLEY, of the Royal Gardens, Kew, has been appointed Curator of the newly-founded Botanic Station at Sierra Leone. Mr. J. M. Henry has retired from the post of Superintendent of the Baroda State Gardens. He was sent out from Kew in 1867, and after twelve years' service in Madras and Bengal was appointed to Baroda in November 1879.

DR. JOHN S. BILLINGS, Director of the Department of Hygiene in the Pennsylvania University, has been elected librarian of the new consolidated libraries of New York, representing the Lennox library, the Astor library, and the Tilden bequest. Dr. Billing's Index Medicus, and the Index Catalogue of the Surgeon-General's Library at Washington, furnish stupendous evidence of his capacity for cataloguing, and, with his experience in other directions, make him eminently fitted for the responsible post he has taken.

MR. A. G. CHARLETON presided on Friday, the 24th inst., at the Criterion Restaurant, over the twenty-third annual dinner of the old students of the Royal School of Mines. About a hundred and twenty guests were present, amongst these being the professors at the School and several distinguished visitors. In proposing the toast of "The Mining and Metallurgical Industries," the Chairman commented upon the relation of peace and monetary matters, and showed how the School of Mines was of the highest importance in training men to open up gold and other mining centres. Profs. Roberts-Austen and Le Neve Foster replied for metallurgy and mining, respectively. The toast of "The Professors" was proposed by Prof. Page, and replied to by Prof. Judd. Mr. G. T. Holloway proposed "The Learned Societies," and Prof. Tilden responded. "The Health of the Old Students" was dealt with by Mr. B. H. Brough and Mr. S. H. Cox. The question of the formation of a register of the old students was referred to by several of the speakers, and a guarantee fund for its publication was raised.

A NOTE received from Mr. John Plummer, Sydney, New South Wales, calls attention to the way in which science is represented in the colony. The Royal Society of New South Wales originated in 1821 as the Philosophical Society of Australasia, the present name being adopted, by Royal sanction, in 1856. The Linnean Society of New South Wales was established mainly by the efforts of the late Sir William Macleay, a devoted naturalist, in 1875, and has numbered among its members many of the leading scientific men in Australasia. The Royal Geographical Association, established in 1883, has branches in Victoria, South Australia, and Queensland. The headquarters of the Australasian Association for the Advancement of Science, based on the lines of the British Association, are in Sydney. The meetings of the Association are held alternately in the various colonies. Among other scientific associations in Sydney are the New South Wales Zoological Society, branches of the British Astronomical and British Medical Associations, Australian Economical Association, Pharmaceutical Society, Engineering Association, Insurance Institute, Institute of Architects, Institute of Bankers, Electric Club, Institute of Surveyors, &c.; not a bad record for a country which has but recently completed the first century of its existence, and is yet practically in its infancy as a nation.

A HYGIENIC EXHIBITION will be held at Warsaw during the present year. The *Journal* of the Society of Arts says that there are nine Committees at work, to whom have been assigned the following subjects: (1) Air, water, light; food in general, and articles connected with the above; also kitchen utensils, paints, wall-paper, and poisonous vegetables. (2) The question of sterilisation; also the utensils used for the culture of bacilli, showing exhaustively the method of ascertaining their presence and the means for their destruction. (3) Human dwellings in general, past and present, and the latest improvement in hygienic building. (4) The hygienic mode of caring for children; construction of school-houses, all systems of school education, and school-rooms and furniture. (5) The hygiene of industry; the hygienic conditions prevailing in the homes of labourers, shops, and factories; also food, and drink, and vital statistics. (6) The history and statistics of hygiene and the modern hospitals of the world. (7) The literature and history of pharmacy, patent medicines, furniture, and medical instruments, and all pharmaceutical utensils. (8) Statistical plans, diagrams, drawings, and all printed matter on the subject of hygiene, meteorology, geology, hydrography, and anthropology, in all their detail, and all sciences connected therewith. (9) The manner of living, dwellings, &c., of all classes of the population from a sanitary point of view. Awards of gold, silver, and bronze medals will be made, and also diplomas and letters of honour.

THE French Meteorological Office has recently issued its *Annales* for the year 1893, consisting of three parts: (1) memoirs, containing discussions on thunderstorms, distribution of hail, terrestrial magnetism, &c.; (2) observations made at stations in France and its colonies; and (3) a very detailed account of the distribution of rainfall. From the introductory text we see that weather forecasts are regularly issued to seaports and to agriculturists, and also warnings of storms. In both of these departments a large amount of success has been achieved, part of which is attributed to the regular receipt of telegrams from the Azores and from America, a comparison of these data allowing a more accurate idea to be formed of the changes which approach from the Atlantic Ocean. Observations are regularly collected from ships, and the observers, both on land and at sea, are encouraged in their work by the presentation of medals to those who have kept the best registers. Comparative observations are made at the Central Office and on the Eiffel Tower; the next year will complete a series of five years' observations, when a discussion of the more important results obtained will be undertaken, with especial reference to the influence of altitude on the various meteorological elements.

A SIMPLE instrument for recording the time of occurrence of an earthquake is described by Prof. C. F. Marvin in the *U.S. Monthly Weather Review*. A heavy lead weight is suspended on a short steel link, to which it is pivoted by means of a sharp-pointed screw, the point being just above the centre of gravity of the weight. A similar pointed support is provided for the top of the link, which hangs from a small projection in the frame of the instrument. The link is prolonged upwards as a needle about 6 inches long, the top of which passes through a small hole in a plate connected with the frame. The plate is electrically insulated from the rest of the instrument. A movement of the ground is magnified by the end of the needle, and the contact of the needle with the sides of the hole in the plate can, by connection with suitable electrical apparatus, be made to stop a clock or produce an automatic record on a sheet of paper. The instrument is a modification of one devised by Prof. Marvin in 1885, and has been in operation at the U.S. Weather Bureau since the winter of 1892–93. The recording apparatus used with it is the so-called "weekly anemometer register," and the time of a disturbance can be read to less than half a minute. It will be seen from this brief description that Prof. Marvin's seismoscope is almost identical with that used to start the revolving plate in Prof. Ewing's well-known seismograph.

THE first number of *The Scalpel* contains an article, by Mr. Lennox-Browne, on the new serum treatment of diphtheria, in which the writer comments upon the statistics derived from its application here and on the continent respectively, and attempts to explain the great discrepancy which so far exists between British and foreign results. Without entering into all the details of the controversy, there is one point which may be of some significance in the discussion; and this is the complaint made to the Clinical Society, that with the English serum supplied, no indication was given of the varying strength with which it was endowed. It may be of interest to know that in Germany the antitoxic serum is subject to State control as regards its preparation, the estimation of its activity, and its sterility, and that each phial which is issued, bears as a guarantee the official control number, as well as the date of the official test of the serum. The fact that in England such striking results have not so far been obtained as on the continent and in America, cannot alter the fact that we have undoubtedly in the serum-treatment of diphtheria a new departure in therapeutics, the far-reaching importance of which can hardly be exaggerated, and certainly not denied.

THE number of icebergs met between the Cape of Good Hope and Australia are vastly greater in some years than in others. Within the past few years, for instance, an extraordinary accession of enormous icebergs has occurred. As an explanation of this, it has been suggested that unusual falls of snow may account for it by accelerating the motion of the ice; but Mr. H. C. Russell, F.R.S., remarks, in a paper read before the Royal Society of New South Wales in September last, that the circumstances forbid the acceptance of this view, because the motion of the glacier depends mainly on the declivity down which it is descending, and that does not alter, and the piling up of snow could not in one year cause such a marked increase in the rate of flow as would be necessary to account for the enormous increase in number of icebergs which appear from time to time. There must evidently be a force sufficient to break off the icebergs which are slowly forming on shore, and to do it at irregular periods separated by many years. He is of the opinion that the true cause resides in the volcanoes of the Antarctic continent, when they burst forth in eruption, and by the act so shake the foreshores, that the icebergs are broken off from the glaciers. In connection with Mr. Russell's paper, it is interesting to note a report, issued from the U.S. Hydrographic Office, descriptive of the floating ice seen during 1892 and 1893 in the South Atlantic east of Cape Horn. It is said that the icebergs were of such size that they could not have been formed on small, low-lying islands, but only on a large continent of such height that great glaciers could be formed.

Is there a connection between crime and the weather? The relations between certain meteorological conditions and many diseases has been fairly well established, and more knowledge about the connection is likely to be obtained now that a department having for its object the collection of statistics referring to climate and health has been formed in the U.S. Weather Bureau. And if bodily disease is affected by atmospheric changes, why not those mental diseases which result in the perpetration of crimes? Several attempts have been made to reveal a connection between the moods and impulses of the people and the weather, and a description of the results obtained in the latest of these investigations is contained in the current number of the *American Meteorological Journal*. The investigator is Mr. C. E. Linney, Director of the Illinois State Weather Service, who has considered the police records of the city of Chicago for each month in the years 1888–1894, the total number of arrests for each month, and for each division of crime, being examined with his "weather eye" open. While it is admitted that there are some cases which seem to go against the general rule, Mr. Linney thinks that the results do show a marked increase in crime with the increase in temperature, probably daily, at least for the months, seasons, and the year. Also that there is an increase in crime with a marked deficiency in rainfall, temperature conditions remaining normal; and again a greater increase where both conditions are aggravating causes. As for humidity, there seems to be no special connection, and also little connection with the cloudiness, except possibly a slight increase in clear, and a slight decrease in cloudy, weather. On the other hand, it is thought that the figures show a decrease in crime with a deficiency in temperature, especially during winter months, or with excess in rainfall in summer, and a greater decrease when both are restraining causes. Mr. Linney also thinks his results indicate that there is a decrease in crime with a north-east over a south-west wind. Perhaps the day will come when police stations will possess a full equipment of meteorological instruments, by reference to the readings of which police inspectors will regulate their vigilance.

Nos. 5 and 6 of the "Records of the Botanical Survey of India" are devoted to a report on a botanical tour in the Lakhimpur District, Assam, by Mr. G. A. Gammie; and notes on a journey from Poona to Nagotna, by Mr. G. M. Woodrow.

We have received a copy of the memoir of the late Mr. Frederic Kitton, the well-known diatomist. His life affords one of the numerous instances of the great additions to our scientific knowledge due to men immersed in business, who can only devote to science their hard-earned leisure.

A catalogue just received from the General Electric Company shows to what a vast extent the electrical industry has grown. The catalogue, which runs into nearly one thousand quarto pages, appears to include illustrations and descriptions of almost every invention known in connection with the application of electricity to useful purposes, and an abundance of information of value to electricians, while students will obtain from it a good idea of modern electrical work.

Nos. 4 and 5 (vol. iii.) of the "Contributions from the United States National Herbarium," issued by the Department of Agriculture, have reached us. The former is devoted to a report, by Mr. J. M. Holzinger, on a collection of plants made by Mr. J. H. Sandberg and assistants in Northern Idaho in the year 1892. The latter contains a report, by Prof. J. M. Coulter and Mr. J. N. Rose, on Mexican Umbelliferæ, mostly from the State of Oaxaca, collected by Mr. C. C. Pringle and Mr. E. W. Nelson; and descriptions of plants, mostly new, from Mexico and the United States, by Mr. J. N. Rose.

Mr. Arthur Lister, the monographist of the Mycetozoa, who recently presented to the British Museum a magnificent collection of these organisms, together with a number of microscopic slides, has now prepared a "Guide to the British Mycetozoa," founded on these collections, which can be obtained in the Botanical Gallery of the Museum. It contains a most valuable, though concise, account of the life-history of these interesting structures, and a synopsis of the British genera and species. Each genus is illustrated by at least one woodblock drawn by the pencil of Miss Galielma Lister.

A "Review of Mineral Production in India" for 1894, compiled by Mr. G. Watt, has been published by the Indian Government. It is carefully prepared, and as regards the important materials salt, coal, and petroleum, the statistical returns of production, import and export, are complete. Iron ore is also fully treated; but it was not found possible to give complete statements of other minerals, though a great deal o information, both statistical and descriptive, has been brought together. In view of the great difficulties in the way of obtaining full information, the result is very satisfactory, and will probably lead to greatly improved reports in the future.

With the January number, the *National Geographic Magazine*, published by the National Geographic Society, Washington, commences a new series, and makes its first appearance as a monthly publication. It is intended that the magazine shall be the exponent of the geography—physical, political, and commercial—of the New World; in fact, the aim is to be American rather than cosmopolitan. The articles in the first number are "Russia in Europe," by the Hon. Gardiner G. Hubbard; "The Arctic Cruise of the U.S. Revenue Cutter *Bear*" (with illustrations), by Dr. Sheldon Jackson; and "The Scope and Value of Arctic Exploration," by General A. W. Greely.

The eleventh volume of "Travaux et Mémoires" of the International Committee of Weights and Measures, has just come to us from MM. Gauthier-Villars, together with a volume containing the "Procés-verbaux" of the meetings of the Committee in 1894. Under the title, "Determination expérimentale de la valeur du mètre en longueurs d'ondes lumineuses," the former contains a detailed account of Prof. Michelson's work in connection with the use of the light-wave as the ultimate standard of length. There are two other papers in the volume, viz. "Mètres prototypes et étalons," by M. J. René Benoît and

M. C. E. Guillaume, and "Nouvelles déterminations des mètres étalons du Bureau international," by the same authors.

WE have received the 22nd and 23rd Annual Reports of the Geological and Natural History Survey of Minnesota (for 1893 and 1894). Among the contents of the latter are a criticism on the late Dr. G. H. Williams's explanation of the Archæan greenstones, by N. H. Winchell; a preliminary report on the gold region of Rainy Lake, by H. V. Winchell and U. S. Grant; an historical sketch of Lake Superior mining, by H. V. Winchell; and a study of the late Glacial earth-movements of the St. Lawrence basin, by Warren Upham. Geologists will be interested to know of the issue of an official "List of Publications" of the Geological Survey of Canada (Ottawa: 1895), which includes all reports, with their separate contents, maps, and certain papers on Canadian geology, reprinted from various publications.

THE ninth annual report of the Liverpool Marine Biology Committee contains an account of much useful work done at the Port Erin Station during the past year. (1) In his consideration of the submarine deposits of the Irish Sea, Prof. Herdman suggests the recognition of a neritic group of deposits in addition to the pelagic and terrigenous deposits defined by Murray. The neritic deposits are largely organic in origin, formed from the remains of plants and animals living on the bottom, and so differ on the one hand from the terrigenous deposits derived from the waste of land, and on the other from the deep-sea varieties due chiefly to the accumulation of the remains of pelagic organisms. (2) So far as experiments with drift-bottles have been able to show, the prevailing currents on the west of the Isle of Man seem to be towards the Irish coast, and on the east towards the Lancashire, Cheshire, and Cumberland coasts; these observations are interesting on account of the existence of flat-fish spawning grounds in the neighbourhood of the Manx coast. (3) The report also furnishes additional evidence in favour of the Darwinian view that closely-related species are not, as a rule, found together. In addition to the investigations on these general problems, the report includes various contributions in regard to the local fauna.

THE 1896 edition of that very comprehensive volume, the "Annuaire du Bureau des Longitudes," has now been issued. To say that no year-book is of greater service to astronomers and physicists than this "Annuaire," is but to record the opinion of all workers in the domain of physical science. The present edition has been brought thoroughly into line with recent knowledge. M. Lœwy has added a brief note on the proper motion of the sun, and the apex of the sun's way. M. Cornu contributes two new notes—one on the bright lines in the spectrum of the chromosphere recently identified with those of terrestrial substances, and the other on the identification of lines in stellar spectra. The list of minor planets has been brought up to 416; and some changes have been made in the list of double-star orbits. M. Moureaux gives the values of the magnetic elements determined at 644 points in France; and M. Cornu contributes new chapters on specific heats, and on the latent heats of fusion and vaporisation of water. Among the articles, we notice one on action at a distance and waves, and another on Fresnel's works, both by M. Cornu; and there is also an article on the proposed magnetic survey of the earth, by Captain de Bernardières; and an account, by M. Janssen, of his third ascent to the observatory on the top of Mont Blanc.

MESSRS. DULAU AND CO. have made arrangements to publish a work on "The Coccidæ of Ceylon," by Mr. E. E. Green. All the species at present recognised in Ceylon, including several new genera and numerous new species, will be described, and illustrated by 120 coloured plates. The work will be published in four parts, for which Messrs. Dulau are now inviting subscriptions. In the prospectus announcing the proposed publication is an inset, in which the opinion of members of the B.A. committee on the Coccidæ of Ceylon is set forth. It is there pointed out that what is known of the distribution of this cosmopolitan group justifies the belief that many of the new species from Ceylon described by Mr. Green will prove, as inquiry advances, to be world-wide. The Committee therefore recommend the work to the consideration of subscribers, believing that it "will be of great assistance to gardeners and to naturalists generally, and of considerable value to those engaged in economic entomology or in the management of plantations in any part of the world, as well as to systematic entomologists and morphologists."

SEVERAL new editions of scientific works have lately been received. Messrs. E. and F. N. Spon have published the third edition of Prof. J. H. Cotterill's classic volume on "The Steam Engine considered as a Thermodynamic Machine." A few slight changes and additions have been made in the appendix, but the book has been practically reprinted without substantial alteration. The eleventh edition of "Discoveries and Inventions of the Nineteenth Century," by Mr. Robert Routledge, has been published by Messrs. G. Routledge and Sons. The text has been emended, and the volume has been enlarged by a few pages of notes, and by new sections dealing with some of the engineering achievements and scientific discoveries of the last five years. The final part (vol. iii. part iv.) of the tenth edition of "Quain's Elements of Anatomy" (Longmans, Green, and Co.), edited by Profs. Schäfer and Thane, has now appeared. Its subject is Splanchnology; the anatomical descriptions belonging to which have been revised, and in many cases rewritten, by Dr. J. Symington, while the histological portion has been re-edited by Prof. Schäfer. It is proposed to issue a chapter on superficial anatomy, in the form of an appendix to the work. The fourth edition has been issued of Mr. W. T. Lynn's slender book on "Remarkable Comets." From the useful list of the dates of the returns of interesting comets, we see that, in the spring of this year, Faye's comet (period 7½ years) is due, and in the spring or summer, Brook's comet (period 7 years). All the information in the book has been carefully brought up to date.

THE additions to the Zoological Society's Gardens during the past week include a Black-faced Kangaroo (*Macropus melanops*, ♀) from Australia, presented by Mr. E. Mitchell; a Himalayan Bear (*Ursus tibetanus*, ♀) from Upper Burmah, presented by Captain Gale; a Slow Loris (*Nycticebus tardigradus*) from Upper Burmah, presented by Captain J. W. Carrothers; a Salt-water Terrapin (*Clemmys terrapin*) from the West Indies, presented by Mr. J. Lea Smith; Seven Galliot's Lizards (*Lacerta galloti*), a Delalande's Gecko (*Tarentola delalandii*) from Madeira and Tenerife, presented by Mr. H. B. Hewetson, two Indian Jerboas (*Alactaga indica*) from Baluchistan, purchased.

OUR ASTRONOMICAL COLUMN.

THE DOUBLE STAR 70 OPHIUCHI.—Of the numerous orbits which have been computed for this well-known double star, that derived by Dr. Schur in 1893 is perhaps entitled to greatest confidence. Nevertheless, even in the short interval which has since elapsed, Dr. See finds that the companion is several degrees in advance of the theoretical position based on Schur's orbit. In explanation of this, as well as of other departures from the orbit which appear on close investigation, Dr. See suggests that the companion is attended by a dark satellite, moving in a retrograde direction with a period of about thirty-six years, the period of the visible pair being a little less than ninety years. The distance of the companion from the centre of gravity of itself and satellite is probably about 0''·3; and a circular orbit with node and inclination identical with the similar elements of the visible pair sufficiently explains the observed changes of position angle and distance. Adopting the parallax 0''·2, the semi-axis major of the primary orbit is 22·74 astronomical units, while that of the secondary orbit is 1·5 astronomical units, and the combined mass is 1·6 times that of the sun. The whole system of 70 Ophiuchi is thus contained in a space less than that occupied by the solar system; the orbit of the bright companion being intermediate in size between those of Uranus and Neptune, while the action of the dark satellite causes it to describe a secondary orbit corresponding in size with that of Mars (*Astronomical Journal*, No. 363).

MINOR PLANET PHOTOGRAPHY.—The great value of the photographic method of recording the positions of known minor planets, and in searching for new ones, is admirably illustrated by the results obtained by M. Charlois (*Bulletin Astronomique*, January). Between November 18, 1894, and August 29, 1895, forty-one plates were exposed by him at the Nice Observatory on suitable parts of the sky, and only nine of these failed to show traces of the objects sought. In the remaining photographs forty-four known planets and eleven new ones were recognised. Four of the new ones were of the 11th magnitude, three of the 12th, one of the 13th, and three of the 14th, while eleven of the old planets were of 10th magnitude or brighter. The newly-discovered planets are thus among the smallest of this class of bodies. Up to the end of last year the patience of M. Charlois had been rewarded by the discovery of eighty-three minor planets, or a little more than one-fifth of the total number at present known.

THEORY OF COMETS' TAILS.—It has long been imagined that the phenomena of comets' tails are in some way due to a solar electrical repulsion, and additional light is thrown on the subject by recent physical researches. Several investigators have shown that when ultra-violet light falls on an uncharged body the surface disintegrates, the particles which fly off being charged negatively, while the body itself becomes positively charged. Applying this to the case of a comet, Prof. Fessenden suggests that negatively charged particles are emitted from that side of a comet which is turned towards the sun, while the nucleus has a positive charge (*Astrophysical Journal*, vol. iii. No. 1). According to J. J. Thomson's experiments, the fact that the C line of hydrogen is brighter than the F line indicates that the sun's chromosphere is negatively electrified, and hence the disintegrated particles of the comet will be subjected to four forces; namely, the force due to gravitation, a second force to the repulsion of the negative charge on the sun, a third due to the attraction of the positively charged nucleus, and a fourth due to the repulsion of all the other similarly electrified particles. The shape of the tail is the resultant effect of these four forces. The observed effects do not demand an improbably great solar potential, the value calculated being 15,000 volts. Accepting the theory, the contraction of the head, the partition of comets, multiple tails, and other appearances seem to find a reasonable explanation. The increasing positive charge of the nucleus as the sun is approached will result in an increased solar electrical attraction, and the effect will be the same as that which would be produced by a resisting medium; that is, the period will be shortened, as in the case of Encke's comet.

The fact that the most frequently observed spectrum of a comet's tail is like that of a candle flame, indicates, according to J. J. Thomson's experiments, that the particles of carbon are negatively electrified, and this is quoted in favour of the theory. It may be pointed out, however, that there is no such direct evidence to show that the nucleus is positively charged, as required by the theory.

THE ROTATION PERIOD OF VENUS.—A valuable contribution to the study of the rotation period of Venus has been made by Prof. Tacchini (*Atti Reale Acad. Lincei*, vol. v. p. 3). Observations made at the Collegio Romano during last summer, tended in favour of Schiaparelli's view that the rotation period of the planet is 224·7 days, that is, equal to the sidereal revolution. He now announces that continued observations, made under the best atmospheric conditions towards the end of 1895, have led to the same conclusion. The observations terminated on December 19, and on some occasions they extended over very considerable intervals on the same mornings. On November 28, for example, work was commenced at 5.45 and continued until 11 o'clock, and during this time the same features were constantly observed on the illuminated part of the planet. A nebulous arc on the dark part of the planet, near the southern cusp, observed in September last, was not seen in the recent observations.

THE INTERNATIONAL GEODETIC CONGRESS AT BERLIN.

LAST month, in the new Reichstag palace, in Berlin, the official international Congress of Geodesy met together. The members represented seventeen States of Europe, Asia, and America.

At this conference the delegates of France were: MM. H. Faye, Vice-President of the Bureau des Longitudes; Tisserand, Director of the Paris Observatory; Bouquet de la Grye, the retired Engineering Hydrographer in charge of the Marine; Bassot, Superintendent of the Geodetic Section of the Geographical Service of the Army; and Ch. Lallemand, Director of the General Levelling of France.

The Congress was welcomed, in the name of the Prussian Government by Dr. Bosse, Minister of Public Instruction. After recalling the fact that the International Geodetic Association was founded by the Prussian General Baeyer, Dr. Bosse briefly sketched the history of progress made in the different sections of geodesy during the last ten years, under the happy influence of the Association.

In reply to the Minister, M. Faye, President of the Association, very appropriately remarked that although Germany has done much for geodesy in the last fifty years, still France has the honour of having, during the last century, set the example.

Following this Prof. Foerster, Director of the Berlin Observatory (President of the Congress), described the recent discovery of the variation of latitude.

M. Fergola (Director of the Naples Observatory) has proposed since 1883 that observations should be organised in a permanent manner in observatories equally distributed round the earth, and situated at more or less the same latitude, in order to observe the small possible movements of the terrestrial axes. The first signs of these movements, noticed by M. Küstner at the Berlin Observatory, were reported to the Conference held at Salzburg in 1888 by the International Geodetic Association. The Association took up the question, and instituted two years afterwards an astronomical station of observations at Honolulu (Sandwich Isles), to control the results made in Europe. The success of this undertaking has now led the permanent commission of the Association to propose the realisation of M. Fergola's plan. This realisation will be greatly facilitated by the recent construction of a special photographic telescope, of which the first results were very interesting.

We will confine ourselves to naming some of the principal scientific communications made to the Congress. M. de Kalmar (Austrian delegate, and reporter on accurate levelling) announced the fact that, in the last three years, the total length of these levellings in Europe has increased from 20,000 kilometres, and exceeds to-day 120,000 kilometres. Colonel Bassot reported that three geodetic bases have just been measured in Roumania with the instruments of the Geographical Service, and with the help of French officers. Another base must be measured next in Turkey under the same conditions. M. Bouquet de la Grye announced that the Bureau des Longitudes have just undertaken, with the help of the officers of the French Marine, the execution of a new magnetic map of the world. M. Lallemand reported, amongst the principal networks of accurate levellings of Europe, the existence of systematic errors—the cause as yet unknown—the probable value of which, although much greater than those of accidental errors, only considered up till now, is calculated to be between 0·1 mm. and 0·2 mm. per kilometre for the French, Spanish and Prussian networks. This being so, the researches and efforts of those in charge of great levelling undertakings should certainly aim at reducing the systematic errors.

According to verifications made in Austria by Colonel Sterneck, and confirmed by other observers, the intensity of gravity has a slight diurnal oscillation. The communication of the captain of the ship *Von Kalmar* states that the officers of the Austrian Marine have determined the intensity of gravity in thirty-nine stations, situated in different seas of the world. Prof. Vogler, of Berlin, exhibited an accurate levelling instrument (*niveau de précision*) constructed on the principle of the cathetometer, and metallic levelling rods, formed of two rods of steel coupled with a rod of zinc, and covered with a layer of aluminium. These new arrangements would permit the inventor to reduce the accidental errors of the levelling; but it is doubtful if it would be the same for systematic errors.

The principal and most laborious task of the Congress consisted in drawing up a new diplomatic convention, in place of that which, since 1886, has governed the existence of the Association, and expires next year. For this reason, important modifications have been introduced into the future functions of the Association.

In view of the construction and maintenance of international stations for geodetic or astronomical observations, its budget will be increased from 20,000 to 75,000 francs.

Under the new organisation, the various German States have been fused into the German Empire with one vote. The old permanent commission, which used to meet once a year, now disappears. Only the general conferences will be continued, and they will take place every three years, as formerly. In these assemblies special commissions will be formed for each branch of study of the Association.

M. Faye has been unanimously re-elected as President of the new Association, with General Ferrero, Italian Ambassador in London, as Vice-President, and Dr. Hirsch, Director of the Observatory in Neuchâtel (Switzerland), as Secretary.

MEETINGS OF AFFILIATED SCIENTIFIC SOCIETIES IN AMERICA.

AN important series of scientific meetings was held at Philadelphia, December 26-28, under the leadership of the American Society of Naturalists, and including six other Societies. The opening address of President Edward D. Cope to the Naturalists' Society was on the formulation of the natural sciences. A discussion on the flora and fauna of the Antarctic and adjacent regions occupied most of the time of this society. Angelo Heilprin opened the discussion. He said that very little was known about the Antarctic region. It appeared to him that the coast-line of this region did not outline a continent, but only a group of islands. The supposed continent had been regarded as destitute of vegetable life till lichens were discovered there last year. It is thought from geological formations that the continent was once connected with Australia, South America, and perhaps Africa. W. B. Scott said that a study of fossils of animals shows that Australian forms are found in South America, but no South American forms in Australia; thus indicating that there was first a connection between Australia and the southern continent, and later between South America and the southern continent.

N. L. Britton gave a list of plants, and Theodore Gill of fresh-water fishes, to show the connection between the southern continent and Australia and South America.

The officers elected for the Naturalists' Society are: President, W. B. Scott; Vice-Presidents, W. G. Foster, C. O. Whitman, and Theodore Gill; Secretary, H. C. Bumpus; Treasurer, J. B. Smith.

There was a large attendance at the meeting of the Geological Society of America. President N. S. Shaler (in the chair) read a paper on the relations of geologic science to education. Among other papers read were one by C. R. Van Hise, on the movements of rocks under deformation, and a description, by Sir Robert Bell, of the land about Hudson Bay.

Officers elected were: President, Joseph Le Conte; Vice-Presidents, Charles H. Hitchcock and Edward Orton; Secretary, H. L. Fairchild; Treasurer, J. C. White; Editor, J. S. Brown.

The American Psychological Society listened to the annual address of the President, J. M. Cattell, and to a large number of papers by members. An interesting discussion on "Consciousness and Evolution," was opened by William James, and participated in by E. D. Cope, J. M. Baldwin, C. Sedgwick, G. T. Ladd, G. S. Fullerton, J. H. Hyslop, D. S. Miller, and Wesley Mills.

The Anatomical Society of America was briefly addressed by the President, Thomas Dwight. An interesting paper was read by Burt G. Wilder, on "The Cerebral Fissures of Two Philosophers." The brains referred to were those of Chauncey Wright, of Cambridge, and James Edward Oliver, of Cornell, both of which the lecturer exhibited.

Officers elected were: President, Frank Baker; Vice-Presidents, B. G. Wilder and F. J. Shepherd; Secretary and Treasurer, D. S. Lamb.

The American Morphological Society had papers by C. S. Minot, Bashford Dean, and others, and elected the following officers: President, E. L. Mack; Vice-President, H. F. Osborne; Executive Committee, E. G. Conklin and W. Patten.

A meeting of the American Physiological Society was held, at which several papers were read.

The meeting of the American Folk-lore Society was, of course, the most popular. Washington Matthews presided, and read a paper on the poetry and music of the Navajoes. He finds that the tribe has many legends, songs, and formulated prayers. They have an elaborate religion, with symbolism and allegory that might vie with the Greeks. Daniel G. Brinton read a paper on "American Cuss Words," and J. H. McCormick on "Folk-lore of the Southern Negroes." Captain John G. Bourke read "Notes on some Arabic Survivals in the Language and Folk-lore of the Rio Grande Valley," in which he traced the similarity of names which the Mexican uses for his common articles of food with those used by the Moslem; and also showed similarity of customs of the two nations.

Officers elected were: President, John G. Bourke; Vice-Presidents, Stewart Culin, Franz Boaz; Councillors, J. W. Ellsworth; Hall Chatelain, J. H. McCormick.

A general lecture was given on Thursday evening by Prof. Wm. B. Scott, on the "Lacustrine Formations of North America and their Mammalian Fossils." The vast plains east of the Rocky Mountains were, in the Pliocene age, fresh-water lakes. Large numbers of fossils, particularly mammals, have been taken from them. Prof. Scott argued the identity of the American fauna of that age with that of France and the valley of Lausanne in Switzerland at the same period.

The affiliated societies were entertained during the days of session by the University of Pennsylvania, and a banquet was given on Friday evening at the Hotel Lafayette. Prof. Cope presided, and the address of welcome was made by Dean Fullerton, of the University.

GEOLOGY IN GLASGOW UNIVERSITY.[1]

YOU are doubtless aware that last year I entertained and expressed the rash expectation that I should not again meet a class as lecturer on geology. "I thought to pass away before, and yet I still am here." An explanation is therefore necessary; I must, in fact, detail the history of the subject in this University, so as to purge myself of censure in respect that the University is, in this particular, behind the time, and far behind what Glasgow, above all, has a right to expect that its University should be.

When I came to Glasgow the old custom prevailed of interlarding the lectures on zoology with those on geology. In my time in Edinburgh, Edward Forbes gave four lectures on zoology, setting aside Friday for geology. In 1867 I separated the two subjects, lecturing twice daily during that summer, and raising a brief revolt amongst the medical students, who thought themselves defrauded of their rights. Brief, for the clamour died quickly when they found themselves at liberty to attend the second lecture without paying a fee; their abnormal thirst for knowledge at once contented itself with what was required for the professional examinations. This was the first complete course given in Scotland, and anticipated by four years the foundation of the Murchison chair in Edinburgh. In 1872, on the establishment of a degree in science, geology was made compulsory for that, as it had previously been for the certificate of proficiency in engineering science. Thereon I began to urge the claims of a subject which had been thus quietly introduced to a prominence not previously granted to it in this city. The Mining School started in Anderson's College some years before had collapsed, those who owed wealth to their mineral property taking no interest in the effort which not even the excellence of Mr. Prior as a teacher could sustain. The hearty support given me in my crusade by Dr. (now Sir Charles) Cameron deserves to be recorded, for he was the only one who appreciated the importance of the movement, the only one who stirred a finger to help me. Wealthy coal- and iron-masters saved their money, some by the Mrs. McLarty plea that they did well enough without trained men, others by modestly saying that they could not properly intrude where their wealthier neighbours saw no need for action. I need not comment on the want of public spirit, of patriotism displayed, which astonished me more perhaps than it would now; but it seemed, and seems strange that a country which boasted Hutton, Playfair, Hall, Macculloch, C. Maclaren, Hugh Miller, Lyell, Murchison, A. C. Ramsay,

[1] From Introductory Lecture to Course of Geology in Glasgow University by Prof. John Young.

should be without a chair in the subject which they had raised from dependence on mineralogy to the rank of an independent science. Still more did it astonish me, and the astonishment is unabated, that no one among those who owed money to the discoveries of geology was prepared to spend a penny in the way of gratitude. It was not among the wealthy that Pringle Nichol's genius had kindled the zeal for knowledge.

I carried my plaint to the Science Commission, the first Universities Commission, and finally to the second Commission, created in 1889 to "improve the teaching" in the Universities of Scotland. To all the same tale was told, with increasing earnestness as time went on, and the evils correspondingly increased. It was worse than absurd to expect one man to teach two subjects, either of which was more than any one could follow, even with ample time at his command, so rapid were the advances and so unexpected the specialisations enforced by the discovery of new methods and new fields of inquiry. The medical students were always the more numerous class, and the increasing stringency of the regulations for examinations left me no choice but to devote myself to those whom I had to teach summer and winter. Since 1867 the progress of Geology has been marvellous, Mineralogy has entered on a new phase, Microscopy has assumed an indisputable position as arbiter in problems that never could have been discussed, never perhaps have been raised without its aid. I had no time for the field work, which I had carried on as long as possible. Before the G. A. Clark scholarship was founded I had employed lecturers at my own cost to supplement my class work in Mining and Chemical Geology. Thereafter these graduates did as much as possible when they happened to take special interest in my subject. After many years of disappointment and drudgery, such as, I hope, my successors will be spared, drudgery which has deprived me of the chance, save at rare intervals, of original work, with joy I hailed the new, the present Commission with its instruction to "improve the teaching," for now surely was a Commission about to secure for this University, for Scotland, for science, what Murchison in loyalty to his native country and to his beloved studies had rendered possible for Edinburgh. The Commission is now approaching the end of its sittings, and I am still the "double-barrelled gun" that Murchison called me when I took leave of him on resigning the Survey appointment I had held.

In 1874 Mrs. Honyman Gillespie endowed my chair with £200 a year in respect of Geology, and named me a trustee on her gift, a position I accepted, as it was through an indirect and, let me add, an unwitting suggestion of mine that the benefaction was decided on. My intervention, later on, in the case of the W. Baxter scholarship was direct. It was made a proviso that the Professor of Natural History should not vacate the geological lectureship in the event of a chair of Geology being founded unless an equal stipend were continued to him during his incumbency. It shows how carefully Mrs. Gillespie and her advisers had considered the circumstances, that they thus removed from the incumbent any inducement to delay for personal reasons the separation of the two subjects, which the endowment was implicitly intended to bring about. After the evidence I submitted to the Commission, I was amazed to learn that they contemplated the creation of a new chair, not of Geology, but in a subject new to the Scottish Universities, not compulsory for a degree but optional; nay, it is one of six subjects which the candidate for M.A. may select from, viz. English, French, German, Italian, Spanish, History; a collocation which tempts to the suspicion that the subject of imperative necessity was, after all, an after-thought. Such an addition meant diminution of the fee fund, but this concerned my colleagues interested in the financial consequences. My concern was that a subject which an unreformed university had deemed of sufficient importance to have included twenty years before in the requirements for a degree should be passed over, while the new chair of Pathology was the recognition of an exactly parallel want. No; not exactly, for the pathologist had always had ample opportunities for study and research, undisturbed by the need of teaching even a cognate subject, far less one widely apart from his proper work. Parallel, however, in so far as its relation to a degree, the time this relation had existed and the compulsion of attendance were concerned. In contrast with the position of History, let me tell you the relations of Geology: it is compulsory for the degree of B.Sc. in Agriculture, and the certificate in Engineering Science; it is optional for B.Sc. in Pure Science and Engineering; optional also for M.A. Need I say that it is not to the addition of History I object, but to the circumstances attending the addition. The new subject was made to hang loosely to the University, yet it was at once raised to the rank of a professorship, and the means of endowing Geology finally diverted. It seemed a first duty to provide for the better teaching of a degree subject, and under this impression I addressed a very strong remonstrance to the Commissioners. When the evidence and correspondence are published, the reading will be curious and interesting. The interest would have been discounted if the meetings of the Commission had been public, but there would have been less disappointment if precedent had been departed from. After my protest had been disregarded another source of help was revealed, the Bellahouston Trust. The trustees have acted with great generosity, and would have doubled their benefaction by speed had the matter been solely in their hands. It would be wrong to comment on negotiations still pending after two years, but I may say that the salary demanded by the Commissioners as the condition of their consent to the separation of the subjects is not fully realised; the University has no longer in its power the money, which with the Honyman-Gillespie fund and the Bellahouston gift would have met the requirements of the Commissioners. No doubt a lectureship might be established, and perhaps the legal difficulties might be got over; but this is not what the subject is entitled to, either on its own merits or in respect of the position it has so long held in the University curriculum. Here the matter rests.

I hope to have made it clear to those who have blamed me for remissness that I have done all that I can; that the only wrong thing which has brought me into this impass was my voluntary separation of the two subjects. I was younger and more sanguine then. My colleagues in St. Andrews and Aberdeen are still safe in this respect, and I would advise them to keep as they are; the new chairs will come more rapidly.

I regret that no acknowledgments are due to others besides Sir C. Cameron. The General Council of the University has never mentioned the case of Geology; it would not have helped them to any increase of power. The University Court—I mean that created by the Act—has done what it could to forward the chair; it erred, as I think, only in assenting to the creation of another chair without giving due consideration to the elder degree subject, rather to the degree subject, for the other is only an option. The position of the Commissioners is less easily understood, and in the absence of evidence it is but right to conclude that they had sufficient reason for the course they have taken; what it is will appear in their report. My chief complaint goes back of these; it is directed against the mineral proprietors, who have left till now unfulfilled the duty they owe to science and their city. Had the moderate sum I asked twenty years ago been then contributed, there would have been by this time a well-endowed chair, and Glasgow would have been on a footing of equality with Edinburgh as a school of science. It is painful, by way of contrast, to read of the munificence with which citizens have endowed the Mining School of Chicago, to cite one of the many American colleges where public and private spirit have vied in securing the best training that money and skill can give for their engineers, where the presidents of colleges ask and receive abundantly.

But do not imagine that you will not be taught geology. It is true that you will not learn all that I wish you had opportunity of learning. Not one, but three chairs would really content me; but, on the other hand, you will have your attention directed to aspects of the science which another might pass by. It is the practical side of the teaching on which the deficiency lies. If I cannot make you go through the methods of microscopic investigation as we do in the zoological laboratory, you will hear the conclusions to which microscopists are leading us. You will learn the bearing of biological speculation on geology, the value of fossil evidence from the zoological side, and the direction in which we shall probably have to travel in that most important quest, that geological grail, the estimate of geological time.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—Mr. P. E. Bateman, Fellow of Jesus College, has been appointed an Assistant Demonstrator in Experimental Physics at the Cavendish Laboratory.

The Conference on Secondary Education, previously arranged for the Long Vacation, will be held in Cambridge during April next, probably towards the end of the month. A large concourse is expected.

Science states that the late Franklin Baldwin, of North Grafton, Mass., has made the following bequests, to take effect on the death of his wife:—Wellesley College, 50,000 dollars to found a chair in Mathematics in memory of his daughter, Katie Emma Baldwin; Smith College, Northampton, 12,000 dollars for scholarships; the University of Vermont, 10,000 dollars for scholarships; Dartmouth College, 6000 dollars for scholarships. The residue of the estate (some 20,000 dollars) is left to Clark University. It is also stated that Mrs. E. G. Kelly, of Chicago, will erect a chapel, at a cost of 100,000 dollars, for the University of Chicago, as a memorial to her brother.

THE following are among recent appointments abroad:—Dr. C. A. Strong to be Lecturer on Psychology in Columbia College; Prof. L. S. Luther to be President of Kenyon College, Gambier, Ohio; Prof. Theodore von der Goltz to be Professor of Agriculture in the University at Bonn; Dr. Dock to be Professor of Pathology and Bacteriology at Jefferson Medical College, Philadelphia; Prof. W. I. Blake to be Professor of Geology and Mining in the University of Arizona; Dr. Hüfner to be Professor of Physiological Chemistry at Strassburg; Dr. H. Rubens, Privat-docent in Physics in the Physiological Institute at Berlin, to be Extraordinary Professor; Dr. L. Neumann, Extraordinary Professor of Geography at Freiburg, to be Ordinary Professor; Dr. Max Le Blanc to be Extraordinary Professor of Physical Chemistry at Leipzig; H. F. Wiebe and Dr. K. Feussner, of the Charlottenburg Reichsanstalt, to be Professors; Dr. A. Weiss to be Assistant in the Mineralogical Institute of Greifswald University. Among recent nominations are: Dr. Otto Mügge to the chair of Mineralogy at Königsberg; Dr. Klemenčic to be Professor of Physics at Innsbruck.

ONE of the best products of the Technical Education movement is the *Journal* of the Essex Technical Laboratories—a monthly bulletin issued by the Technical Instruction Committee of the Essex County Council. The current number contains short descriptions of tuberculosis in cattle, the influence of various manures on pasture, the pruning of trees, the growth of plants, and other subjects, most of them instructively illustrated. A note at the end of the *Journal* announces that "The resources of the County Technical Laboratories are always at the disposal of correspondents as far as such services do not interfere with the regular work of the classes. Such work as testing germinating power and purity of seeds, identification of grasses, weeds, &c., examination of diseased plants and injurious insects, bacteriological examination of milk, &c., may be cited as the kind of help hitherto rendered to inquirers." By affording such opportunities for the acquisition of knowledge, and by the encouragement to observation and exact work offered in the *Journal*, the Essex Technical Instruction Committee is doing work which will benefit the county and the nation.

A MOVEMENT was started last year to secure greater facilities at the University of Paris for such prolonged study with the acquisition of learned degrees as hitherto has attracted English and American students chiefly to Germany. The *Times* correspondent at Paris now calls attention to the promulgation, a few days ago, of a decree reforming the Licence ès Sciences. Partially owing to the greater liberty permitted in the choice of studies, the possibility of moving from one University to another, and the privilege of being examined when they wish, English and American students have hitherto patronised almost exclusively the German Universities. The new decree will permit France to offer, at least as far as the scientific faculties are concerned, attractions equal or superior to those of Germany. As compared with the old regulations, the important provisions of the new decree are as follows:—First, the principle of election is introduced into the groups of studies chosen by the student; secondly, the student may migrate from one institution to another; and, thirdly, he may pass his examinations as he chooses, either singly or *en bloc*. After taking the Licence, the student may secure the doctor's degree upon presenting a satisfactory dissertation. Under the German system the candidate submits his thesis first and passes his examination afterwards, the doctorate being the only recognition he receives. In France, on the contrary, the student by passing his examination first will secure a certificate for every subject which he takes up, and will receive the Licence when he has completed the whole group, regardless of whether he ever takes the doctorate or not.

THE annual general meeting of the Association of Technical Institutions was held on Friday last. The Right Hon. A. J. Mundella, M.P., was elected president for the year, in succession to Mr. W. Mather. In his presidential address, Mr. Mundella referred to the systems of technical education abroad, and said that England was suffering from her past neglect and from over-confidence. As a consequence of the industrial training which the people of Switzerland had received, that country had exported a greater proportion of manufactured articles per head of her population than any other nation in the world. This he attributed wholly to education, the country being without coal and iron. German manufacturers also had the great advantage of employing a body of highly-disciplined men, who thoroughly understood the technique of their occupation. He held that if this country wished to make further progress in technical education there must be co-operation by employers. Elementary education should also be improved, and children should remain a longer time at school. The Association of Technical Institutions existed for the purpose of developing industrial education, but he warned them against becoming mere grant-earners. In a discussion that followed, upon the new syllabus for practical chemistry, regret was expressed that the Department of Science and Art still requires students in the elementary stages to have had practice in qualitative analysis. The alternative scheme for the award of grants based upon attendances as well as examination was discussed, and several alterations in the conditions of the scheme were suggested. Other subjects which were considered by the Association were the standard of success in the Department's examinations last May, and the Report of the Royal Commission.

SCIENTIFIC SERIALS.

American Meteorological Journal, January.—The audibility of fog-signals, by Prof. H. A. Hazen. The recent grounding of a passenger steamer on Great Gull Island in a dense fog, within five thousand feet due west of a second-class siren which was sounding at the time, calls attention to several points referred to in a paper by the same author in the journal for October last. This siren has been heard to a distance of twenty miles under favourable circumstances; but the captain of another steamer, which approached the island from the west at the time of the accident, states that his look-out was unable to hear any sound as they approached the island, whereas, after passing, the whistle could be plainly heard.—Atmospheric phenomena in the Arctic regions in their relation to dust, by Prof. W. H. Brewer. The author states that none of the fogs in high latitudes are so white and opaque as those seen south of lat. 50°, and that it is rare that they are so opaque that large dark objects cannot be seen at a distance of two hundred feet. In the Greenland seas the fogs were, as a rule, very much wetter. Often when the fog was so transparent that objects could be seen for half a mile or even a mile from the ship, the water would drip like rain from the rigging. On returning to the south, where the fogs were very dense and objects could not be seen at a ship's length, there was a marked contrast in their wetness; the air did not appear as if entirely saturated. The dust particles in the air over the southern waters were ample to collect all the moisture, while in the Greenland fogs condensation went on as if there was not nearly dust enough in the air to supply the demand.

Bulletin de l'Académie Royale de Belgique, Nos. 9-10.—At the request of M. Spée, astronomer at the Royal Belgian Observatory, a sealed packet was opened which had been deposited by him on January 8, 1887, and contained the description of an apparatus to enable astronomers to obtain the spectroscopic conditions of a total solar eclipse for the observation and photography of the corona and prominences. It is best described as a body generated by the revolution of a longitudinal section of a direct-vision spectroscope about its longer side, thus producing a series of cones and cylinders. This body is used for the spectroscopic analysis of a cylindrical beam of light proceeding from the chromosphere, and obtained by means of a circular slit of diameter equal to that of the sun's image suitably inserted in the telescope. The less highly refractive glass may also be replaced by a liquid, thus leading to considerable simplification, or the whole may be replaced by a circular grating. It should be noted that an apparatus very similar to this was described by Mr. C. Zenger in 1893.—Does a net impede the passage of winged insects? by Felix Plateau. The difficulty experienced by insects in passing through a net with meshes three or four times their own size has been variously explained. Some attribute it to the resemblance to a spider's web, others to the apparent multiplicity of obstacles. Experiments made with nets of various shapes and materials show conclusively that the peculiarity of insects in this respect is due to the construction of their eyes, which are more adapted to the perception of motions or changes in surrounding objects than to the perception of form. When flying, insects are incapable of distinguishing a net from a continuous translucid surface, and it is therefore only very rarely that an insect will fly straight through it. It must strike the meshes or alight on them, and will then pass through as it would through any hole of the same size.

SOCIETIES ANDACADEMIES.

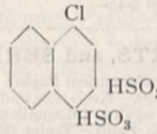
LONDON.

Royal Society, January 16.—"The Rotation of an Elastic Spheroid." By S. S. Hough, Isaac Newton Student in the University of Cambridge.

Recent researches on latitude-variation have brought to light the phenomenon of a periodic motion of the earth's axis of rotation in a period of 427 days. This period being in excess of the theoretical period of 305 days hitherto accepted, Prof. Newcomb has proposed to account for the extension by the failure of the old theory to take into consideration the flexibility of the solid parts of the earth. The author gives an analytical investigation of the motion of a solid body when slightly disturbed from a motion of simple rotation about a principal axis, taking into account elastic distortions due to variations in centrifugal force; the results are found to agree in the main with those obtained by Prof. Newcomb from geometrical considerations. The analysis deals with the case of a homogeneous spheroid of revolution, the ellipticity being such that the body is free from strain when rotating uniformly. Such a spheroid, if of the same size and mean density as the earth and rotating with the same angular velocity, would oscillate in a period of 232 days if perfectly rigid; it is shown that this period would be extended to 335 days in virtue of elastic distortions if the rigidity were equivalent to that of steel. In the case of the earth the period would be still further prolonged in consequence of variations in density, and the period which corresponds to the above degree of rigidity is estimated at about 440 days; whence it is concluded that the observed period may be accounted for by supposing that the earth is capable of elastic deformation, and that its effective rigidity is slightly in excess of that of steel.

Physical Society, January 24.—Captain Abney, President, in the chair.—Mr. Campbell Swinton exhibited some photographs which he had taken by Prof. Röntgen's method. These included several of metal objects inside wooden and cardboard boxes, and a very clear and sharp photograph of the bones of the hand.—Mr. E. Scott showed some geometrical instruments invented by himself and Signor Monticolo. The instrument designed by Signor Monticolo is intended for drawing arcs of circles of such large radius that compasses cannot be employed. It can be used to trace arcs of circles of which the radii vary from 50 cm. to infinity. The second instrument exhibited was a modified form of hatchet planimeter, which Mr. Scott has devised with a view of avoiding some of the defects of the ordinary form of instrument; thus, to avoid the cutting of the paper, which occurs when the knife-edge is sharp, and the side-slip, which occurs when the knife-edge is blunt, the author uses a wheel with a sharp edge. To avoid the inclination of the instrument to one side, which may easily occur with the ordinary form, a flat celluloid plate with a dot at the centre is used as the "tracing point," this plate being kept pressed flat on the surface of the paper. A small wheel with a recording disc is attached, and may be used to measure the distance between the first and last position of the knife-edge. Mr. Scott also described a form of planimeter which he had invented, and in which the l . c and cylinder movement is used to perform the integra .on.- Mr. C. V. Boys said that an instrument designed by Mr. Clarkson had been exhibited before the Royal Society, which was capable of drawing arcs of circles of large radius. This instrument only drew an approximation to a circle, but the approximation was so close that it nowhere was more than the thickness of a thin ink line away from the truth. It would be interesting to hear from the author whether Signor Monticolo's instrument drew a rigorously exact circle or not. The upright position of the hatchet planimeter might be secured by using two wheels in place of one. The planimeter described was really a modified form of one he (Mr. Boys) had described before the Society in 1881. Mr. Blakesley gave a short geometrical proof showing that the curve traced by Signor Monticolo's instrument was rigorously an arc of a circle. Mr. Blakesley also drew attention to the fact that the instrument in its present form cannot be used to trace the arc on both sides of the zero line.—Dr. C. V. Burton described an idea for an instrument for drawing circular arcs, which had occurred to him, depending on the use of two wheels of different radii connected by an axle carrying a tracing-point. In the absence of the author, a paper by Prof. J. D. Everett on resultant tones was read by Dr. Burton. The author, after giving a short summary of the Helmholtz theory of the production of resultant tones, goes on to discuss his objections to this theory, and to elaborate a theory of his own. This theory depends on the consideration that, if you analyse into a Fourier series a periodic curve which is compounded of two simple harmonic motions of frequencies n and m, then only two terms are obtained. If, however, some error has been originally made in adding the two simple harmonic motions together, this error being repeated for each wave, then in addition to the two terms of frequency n and m there will be obtained, when the curve is analysed, a term of frequency f, where f is the greatest common measure of n and m. This term of frequency f the author calls the common fundamental of the tones n and m. The "error" in the production of the compound curve the author supposes to be produced during the transmission of the sound by the ossicles of the ear. In support of his theory the author finds that in the violin where the sound-post, like the ossicles of the ear, transmits the vibrations from one portion of the instrument to another, it is easy by sounding two strings in conjunction to obtain combination tones which agree in frequency with those required by this theory. Thus, when the major sixth (3 : 5), the major second (8 : 9), or the minor seventh (5 : 9) are sounded, the fundamental (1) is clearly heard and also felt by the hand holding the instrument. The author has also succeeded in picking out and strengthening this resultant tone by holding a Helmholtz resonator in contact with the body of the violin.—Dr. C. V. Burton, after explaining several portions of Prof. Everett's paper, said that he (Dr. Burton) considered that the author's view in many ways seemed to fit in with the observed facts better than the accepted theory, but still did not appear itself quite free from objection. Prof. Everett supposes that the first term in a Fourier series is always the most important, and although in most cases which occur in practice this may be so, it hardly seems legitimate to take this as a characteristic of a Fourier series.—The thanks of the Society having been given to Prof. Everett and Dr. Burton, the meeting adjourned to February 14.

Chemical Society, December 19, 1895.—Mr. A. G. Vernon Harcourt, President, in the chair.—The following papers were read: The liquefaction of air and research at low temperatures, by J. Dewar.—Researches on tertiary benzenoid amines. (1) Derivatives of dimethylaniline, by Miss C. de B. Evans. On heating dimethylaniline with chlorosulphonic acid only the para-sulphonic acid is formed; fuming sulphuric acid must be used in order to obtain the meta-sulphonic acid. The bromination and nitration products of these sulphonic acids are described.—Experiments on the formation of the so-called ammonium amalgam, by J. Proude and W. H. Wood. Solutions of phenols in aqueous ammonia contain ammonium salts because they give ammonium amalgam on addition of sodium amalgam; no mercurial froth is obtained from ammoniacal aqueous solutions of several inorganic salts, so that these contain no ammonium salts. Ammonium salts, when fused or dissolved in anhydrous solvents, cause no swelling of the sodium amalgam; the presence of water seems essential to the formation of ammonium amalgam.—The molecular volumes of organic substances in solution, by W. W. J. Nicol. The atomic volumes of the various elements may be accurately determined from the molecular volumes of organic substances in solution; the constants thus obtained differ somewhat for different solvents.—2 : 1 β-naphthylaminesulphonic acid and the corresponding chloronaphthalenesulphonic acid, by H. E. Armstrong and W. P. Wynne. The 2 : 1 β-naphthylaminesulphonic acid is converted, by the Sandmeyer method, into 2 : 1-β-chloronaphthalenesulphonic acid of which a number of derivatives are described; 2 : 1 : 4'-β-naphthylaminedisulphonic acid is obtained by sulphonating the amido-acid with fuming sulphuric acid.—1 : 3-α-naphthylaminesulphonic acid and the corresponding chloronaphthalenesulphonic acid, by H. E. Armstrong and W. P. Wynne.—Studies on the constitution of tri-derivatives of naphthalene, No. 15. The disulphonic acids obtained by sulphonating 1 : 3-α-naphthylamine- and 1 : 3-α-chloronaphthalene-sulphonic acids, by H. E. Armstrong and W. P. Wynne. On sulphonating these two acids with fuming sulphuric acid, disulphonic acids of corresponding constitutions are obtained; the acid prepared from the amido-acid may be converted by Sandmeyer's method into the acid having the constitution



obtained from the 1 : 3-α-chloro-acid.

Zoological Society, January 14.—Dr. W. T. Blanford, F.R.S., Vice-President, in the chair—A communication was read from the Rev. W. J. Holland, containing a preliminary revision and synonymic catalogue of the butterflies of the family Hesperiidæ of Africa and the adjacent islands, with descriptions of some apparently new species. The total number of species of African Hesperiidæ catalogued by Mr. Holland was 349, of which twenty-one were new to science. Fourteen new genera were characterised.—A communication was read from Dr. Arthur G. Butler, which gave an account of a collection of butterflies obtained by Mr. R. Crawshay in Nyasa-land between the months of January and April 1895. Many of the species in this consignment had been obtained at considerable altitudes. It was therefore surprising that comparatively few of them proved to be undescribed, though some of the new forms were of exceptional interest. Nine species altogether were characterised as new.—Mr. P. Chalmers Mitchell read a paper on the intestinal tract of birds.—Mr. F. G. Parsons read a paper on the myology of rodents, in continuation of a former paper read before the Society in 1894.—Mr. F. E. Beddard, F.R.S., gave an account of some earthworms from the Sandwich Islands collected by Mr. R. L. Perkins, and appended descriptions of some new species of *Perichæta*. Of the nine species of earthworms of the Sandwich Islands Mr. Beddard was unable to say that any one was indigenous.—A communication from Mr. Oscar Neumannn gave the description of a new species of antelope obtained during his expedition to East Africa in 1892–95, which he proposed to name *Adenota thomasi*, in honour of Mr. Oldfield Thomas.

Royal Microscopical Society, January 15.—Annual meeting.—A. D. Michael, President, in the chair.—After the annual report and the Treasurer's statement of accounts had been read and adopted, the following were elected as officers and Council for the ensuing year:—President: Albert D. Michael. Vice-Presidents: Rev. Edmund Carr, Frank Crisp, Dr. Richard G. Hebb, Edward Milles Nelson. Treasurer: William Thomas Suffolk. Secretaries: Prof. F. Jeffrey Bell, Rev. W. H. Dallinger, F.R.S. Members of Council: Conrad Beck, Alfred W. Bennett, Dr. Robert Braithwaite, Thomas Comber, Edward Dadswell, George C. Karop, the Hon. Sir Ford North, Thomas H. Powell, Charles F. Rousselet, Prof. Charles Stewart, John Jewell Vezey, Thomas Charters White.—The President, Mr. A. D. Michael, then delivered his annual address. The subject taken was the anatomy of the Acari. It was pointed out that the ordinary text-book definition of an Acarus as a creature in which abdomen and cephalothorax are completely fused is not correct, but that still the great characteristic of the anatomy is concentration; this was illustrated by the author's recent researches relative to the brain and nerves of the Hydrachnidæ (water mites) and other families. The address then dealt with the alimentary organs fully, and several remarkable modifications of the different organs to meet the wants of various creatures were explained.

PARIS.

Academy of Sciences, January 20.—M. A. Cornu in the chair.—On two new invariants in the general theory of algebraic surfaces, by M. E. Picard.—On keeping up the motion of a pendulum without interference with its time of oscillation, by M. G. Lippmann. In a pendulum clock certain minute impulses must be given by the movement to the pendulum to overcome the energy losses due to friction, and these interfere to a slight extent with the natural period of vibration. In an ordinary precision clock, attention is directed rather to keeping this disturbance constant than to eliminating it. That a given instantaneous impulse, however, considered by itself, should give rise to no disturbance, it is necessary and sufficient that it should take place exactly at the instant that the pendulum passes through its position of equilibrium. An electrical arrangement is described which fulfils this condition.—On the circulation of the air in the soil, by MM. P. P. Dehérain and Demoussy. A description of an apparatus for the experimental study of the porosity of soils. Air is sucked out from the bottom of a layer of soil of fixed dimensions, and the steady difference of pressures hereby set up is measured, this increasing with the porosity of the soil. The same apparatus serves for the study of the passage of water through soils.—The law of equivalence in the transformations of energy in animals, by M. A. Chauveau. Experimental details of the relation between the work (positive and negative) done by the muscles and the carbon dioxide excreted by the lungs. The conclusion is drawn from these experiments that the mechanical work done by the muscles in lifting a weight requires only an equivalent expenditure of energy. This is stated by the author to be the first experimental demonstration of the law of equivalence for work arising in the activity of animal tissues.—On the specific heats of gases and the properties of the isotherms, by M. E. H. Amagat.—A note on some experiments of M. Witowski on the thermal constants of air between 0 and − 140°.—Morphology of the limbs of the bony fishes, by M. A. Sabatier.—On the problems of variations relating to double integrals, by M. G. Kœnigs.—On the flexure of beams, by M. M. Duplaix.—Difference in the action of ultra-violet light on static and dynamic critical potentials, by M. R. Swyngedauw. Some experiments in support of a law announced in a previous note.—On a spherical Crookes' tube, showing the reflection of the kathode rays by glass and metal, by M. G. Séguy.—On the reflection and refraction of polarised light, by M. E. M. Lémeray. A geometrical interpretation of some formulæ of Fresnel.—On the solubility of sodium thiosulphate in alcohol, by M. P. Parmentier. Ordinary sodium thiosulphate has been obtained in two modifications, melting at 32° and 47°·9 respectively. Solubility determinations on these, and also on the superfused salt, gave results which are not in agreement with the experiments on the same subject previously published by M. Brunner. The conditions of equilibrium are very complex, and do not appear to follow any simple law.—On the nitrosulphides of iron, by MM. C. Marie and R. Marquis. A new method of preparing Roussin's salt. Sulphide of iron and sodium nitrite are treated at 100° with carbon dioxide. On cooling the pure salt crystallises out, the results of the analyses of which best agree with the composition $Fe_3S_2N_5O_6 + 1{\cdot}5\ H_2O$. The reactions towards boiling alkali solutions, and water at 200° were examined, but the complete study of the products is reserved for a future paper.—Action of carbonyl chloride upon some hydrogen compounds, by M. A. Besson. The reaction with phosphonium bromide is given by the following equation

$$6PH_4Br + 5COCl_2 = 10HCl + 6HBr + 5CO + 2PH_3 + P_4H_2.$$

Hydriodic acid gives carbon monoxide, hydrogen chloride, and free iodine only, no derivative corresponding to carbonyl iodide being formed. With phosphonium iodide the principal reaction is

$$4PH_4I + 8COCl_2 = 16HCl + 8CO + P_2I_4 + 2P.$$

Hydrogen phosphide, PH_3, is without action upon carbonyl chloride, as is also H_2S in the cold. At 200°, however, the latter gives carbon oxysulphide, COS.—On dichloralglucose and monochloralglucosane, by M. J. Meunier. A study of the condensation products obtained from chloral hydrate and glucose under the action of sulphuric acid.—The weight and composition of the dead covering layer of forests, by M. E. Henry. Figures are given for two classes of deposit, under fully-grown trees, and under brushwood. The weight of the dead layer gradually increases with time for about ten years, and then remains very nearly constant (about 7000 kg. to 8000 kg. per hectare). Complete chemical analyses are given, rendering it possible to construct a chemical balance-sheet for the forest.—The volcanic tufas of Ségalas (Ariège), by M. A. Lacroix. These tufas present a remarkable analogy with the basaltic tufas of Auvergne. A microscopical examination showed that they are undoubtedly volcanic, consisting of labroadorite and andesitic scoria.—On the discovery of a tertiary stratum bearing land fossils in the neighbourhood of Liverdun (Meurthe-et-Moselle), by M. Bleicher. The fossils include the bones of large mammals and terrestrial shells, including one species of Helix. The shells are rarely intact. As regards the age of this deposit, the evidence points to its being Tertiary, or possibly Pliocene, certainly not Quaternary. This is the first proof of the formation of purely continental land deposits at that time, and in the east of France.

BERLIN.

Physical Society, November 22, 1895.—Prof. von Bezold, President, in the chair.—Prof. Thiesen gave an account of some of his scientific publications; of these, the first deals with a comparison of various mercurial thermometers, of which two were made of Jena glass and one of hard French glass. The others deal with the thermal expansion of solids and liquids. Among these the first treats of the so-called thermic after-effect, and this the author explained by the assumption of minute non-conducting particles distributed throughout the conducting substance. He further developed this hypothesis into mathematical formulæ. The second deals with the linear expansion of rods of glass and zinc, and the third with the relative coefficients of expansion of water, mercury and glass between 0° and 100° C.

DIARY OF SOCIETIES.

LONDON.

THURSDAY, JANUARY 30.

ROYAL SOCIETY, at 4.30.—On the Rhythmic Contractility of the Spleen: Prof. Schäfer, F.R.S., and B. Moore.—The Electrical Measurement of Starlight. Observations made at the Observatory of Daramona House, Co. Westmeath, in January 1896. Second Report: Prof. G. M. Minchin, F.R.S.—Contributions to the Chemistry of Chlorophyll. No. VII. Phylloporphyrin and Hæmatoporphyrin: a Comparison: E. Schunck, F.R.S., and Dr. L. Marchlewski.

INSTITUTION OF MECHANICAL ENGINEERS, at 7.30.—Telemeters and Range-Finders for Naval and other Purposes: Profs. Barr and Stroud.—Calculation of Horse-power for Marine Propulsion: Lieut.-Colonel Thomas English.

SOCIETY OF ANTIQUARIES, at 8.30.

FRIDAY, JANUARY 31.

ROYAL INSTITUTION, at 9.—National Biography: Sidney Lee.

INSTITUTION OF MECHANICAL ENGINEERS, at 7.30.—Notes on Steam Superheating: William H. Patchell.

INSTITUTION OF CIVIL ENGINEERS, at 8.—(1) Ironfounding in Green Sand; (2) Malleable Cast-Iron: F. A. Lart.

SUNDAY, FEBRUARY 2.

SUNDAY LECTURE SOCIETY, at 4.—Rubbish: Dr. T. W. Drinkwater.

MONDAY, FEBRUARY 3.

SOCIETY OF ARTS, at 8.—Alternate Current Transformers: Dr. J. A. Fleming, F.R.S.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Manufacture of Linoleum: W. F. Reid.

MEDICAL SOCIETY, at 8.30.

VICTORIA INSTITUTE, at 4.30.—Mount Sinai: Prof. Hull.

TUESDAY, FEBRUARY 4.

ROYAL INSTITUTION, at 3.—The External Covering of Plants and Animals: Prof. C. Stewart.

SOCIETY OF ARTS, at 8.—The Garden in Relation to the House: F. Inigo Thomas.

ZOOLOGICAL SOCIETY, at 8.30.—Second Report on the Reptiles and Batrachians collected by Dr. A. Donaldson Smith on his Expedition to Lake Rudolf: G. A. Boulenger, F.R.S.—On a Collection of Fishes made by Dr. Donaldson Smith during his Expedition to Lake Rudolf: Dr. A. Günther.—Remarks on the System of Coloration and Punctuation in the Beetles of the Genus Calligrapha: Martin Jacoby.—On the Oblique Septa in Passerines and other Birds: F. E. Beddard, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Recent Developments in Gas-Engines: Dugald Clerk.—Monthly ballot for Members.

ROYAL VICTORIA HALL, at 8.30.—Rubies: Prof. J. W. Judd.

WEDNESDAY, FEBRUARY 5.

SOCIETY OF ARTS, at 8.—The Mexican Drainage Canal: F. H. Cheesewright.

GEOLOGICAL SOCIETY, at 8.—On the Morte Slates and Associated Beds in North Devon and West Somerset: Dr. Henry Hicks, F.R.S.—Evidences of Glacial Action in Australia in Permo-Carboniferous Times: Prof. T. Edgeworth David.—On the Structure of the Plesiosaurian Skull: C. W. Andrews.

ENTOMOLOGICAL SOCIETY, at 8.—On the Relation of Mimetic Patterns to the Original Form: Dr. F. A. Dixey.—The Rhynchophorous Coleoptera of Japan. Part IV. Dr. D. Sharp, F.R.S.—The Diptera of St. Vincent: Prof. Williston. Communicated by Dr. D. Sharp, F.R.S.

SOCIETY OF PUBLIC ANALYSTS, at 8.—The Determination of Oxygen in Commercial Copper: Bertram Blount.—The Composition of Milk and Milk Products: H. Droop Richmond.—A New Form of Carbonic Acid Apparatus: Cecil H. Cribb.—Laboratory Notes: Alfred H. Allen.

BRITISH ARCHÆOLOGICAL ASSOCIATION, at 8.

THURSDAY, FEBRUARY 6.

ROYAL SOCIETY, at 4.30.

LINNEAN SOCIETY, at 8.—On Polystelic Roots of certain Palms: B. J. Cormack.—On a Remarkable Use of Ants in Asia Minor: R. Morton Middleton.

SOCIETY OF ANTIQUARIES, at 8.30.

CHEMICAL SOCIETY, at 8.

FRIDAY, FEBRUARY 7.

GEOLOGISTS' ASSOCIATION, at 7.30.—Presidential Address: Some Structural Characteristics of the Granite of the North-West Himalayas.

QUEKETT MICROSCOPICAL CLUB, at 8.

SATURDAY, FEBRUARY 8.

ROYAL BOTANIC SOCIETY, at 3.45.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—The Collected Mathematical Papers of Arthur Cayley, Vol. ix. (Cambridge University Press).—Evolution and Man's Place in Nature: Prof. H. Calderwood, 2nd edition (Macmillan).—Ice-Work Present and Past: Prof. T. G. Bonney (K. Paul).—Traité de Chirurgie: A. Le Dentu and P. Delbet, tome i. (Paris, Baillière).—Graphic Arithmetic: H. D. Ellis, charts 1 and 2 (Philip).—Géométrie Descriptive: A. Gouilly (Paris, Gauthier-Villars).—Remarkable Comets: W. T. Lynn, 4th Edition (Stanford).

PAMPHLETS.—Die Gletscherlawine an der Altels am 11 Sept., 1895 (Zürich).—Misure Assolute degli Elementi del Magnetismo Terrestre: Dr. L. Palazzo (Roma).

SERIALS.—Annuaire de L'Académie Royale des Sciences, &c., de Belgique, 1896 (Bruxelles).—Bulletin Ditto, tome 30, No. 11 (Bruxelles).—Journal of Malacology, Vol. 4 (Dulau).—Revista Sperimentale di Freniatria e di Medicina Legale, Vol. xxi. Fasc. 4 (Reggio Nell' Emilia).—Astrophysical Journal, January (Chicago).—Quarterly Review, January (Murray).—English Illustrated Magazine, February (198 Strand)—Good Words, February (Isbister).—Sunday Magazine, February (Isbister).—Longman's Magazine, February (Longmans).—Chambers's Journal, February (Chambers).—Natural Science, February (Rait).

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