THURSDAY, FEBRUARY 20, 1896.

EMBRYOLOGY.

Text-book of the Embryology of Invertebrates. By Dr. E. Korschelt and Dr. K. Heider. Part I. Translated from the German by Edward L. Mark and W. McM. Woodworth. Pp. xvi + 484. (London: Swan Sonnenschein and Co., 1895.)

EMBRYOLOGY "is one of the most important subjects in the whole round of Natural History." So says Darwin, and so say all zoologists who have the knowledge to appreciate, and the training and patience to deal with, the innumerable facts which constitute that most fascinating branch of their subject.

Formerly the view was held—it is even now held by some zoologists—that embryology is a subject apart from the other branches of zoology; that a man might be a complete zoologist without any knowledge of it; that it could throw but little light upon those great questions of structure which it is the ambition of comparative anatomy to solve; and that it was a study which, if it did not actually narrow the mind, took it away from that pure and sympathetic contemplation of nature, which it was the object of all true zoological teaching to call forth. To such zoologists embryology was of but small importance.

And the reason for this attitude is not far to seek. In the good old days the equipment required by the zoologist was but slight, and the facts lay bare for every one to note. A collecting-box and a bottle of spirits, a pocket-lens and, by the more advanced, a pair of forceps and a scalpel were all that were required. With such simple instruments, combined with a certain power of observation and a love for nature, which had often more of an æsthetic than a scientific character, a man might go far. But this delightful time is past—the unaided pocket-lens is now of little service, the forceps and scalpel have revealed almost all that they are capable of revealing, and the bottle of spirits requires to be supplemented by a whole complement of elaborate reagents. And if this is true of the material requisites, how much more true is it of the intellectual. In addition to the elaborate technique, the complicated instruments and the whole routine of the modern laboratory, there are the immense accumulations of knowledge which must be mastered if nature is to be questioned with any hope of success. It is this training which is often irksome; it is these instruments which cannot be used without patience and practice; which bewildered the older zoologists, and which make the way so hard for those younger men who, with a collector's or an æsthetic's love for nature, wish to pose before the world, after the manner of their fathers, as experts in an important branch of science.

But to return to our question: What is the relation of embryology to the other branches of zoology? Clearly it is an integral part of the well-known and respected science of comparative anatomy; it is the part of that science which deals with the anatomy of the organism before the attainment of sexual maturity, and, inasmuch as most animals pass through several stages of structure during their growth, the study of it is, to the scientific anatomist at least, as important as the study of the adult. One would have thought that this position would have been conceded on all hands, and that there would have been no necessity to call attention to it here. But it is not so; for there are anatomists who hold that, in solving anatomical problems, the structure of the embryo is of very small importance indeed as compared with the structure of the adult.

But embryology is more than this. It has caused the use of methods and instruments which have extended the bounds of comparative anatomy; it has brought into the field men who, in their love of nature, in their capacity for patient labour, and in their powers of accurate observation, are at least the equals of the older naturalists; and it has brought to light facts of natural history which, but for it, would have remained in darkness, and which even that zoological butterfly, the amateur naturalist, would not pass by. To mention only a few such. What more wonderful phenomena can be mentioned in the whole round of natural history than the larval development and metamorphosis of the Echinodermata; the detachment and digestion of the brain and sense organs of the larva of Phoronis on the attainment of sessile life; the growth of the worm within the larval skin of the Pilidium; the double sexual life of the Ctenophora.

Of the relation of embryology to the evolution theory, we can only shortly refer. Apart from the construction of phylogenetic histories, to which unfortunately there appears to be no end, our science is of supreme importance as affording the most unanswerable, indirect corroboration of that theory which it is possible to obtain.

But embryology has wider bearings even than these. The systematist is powerless without it. He may ignore it, he may neglect it; but if he do so, he can have no true insight into the relations of the great groups. Until embryology was a science, the Tunicata were grouped near the Mollusca; and without its aid the great Cuvier himself was led into the error of placing the Cirrepedia in the same phylum. Nor can the student of species avoid his fate. To-day he may rejoice that he at least can pass by on the other side, and leave embryology to the embryologists. But, alas! it will not be so for long; even now embryonic characters are beginning to assert their claims for recognition, and in the near future a knowledge of development will be as indispensable to the species-monger as to any other kind of zoologist.

It would thus appear that embryology has a classificatory as well as an anatomical value, and should be dealt with in works on zoology. But while in works on anatomy it is quite impossible to ignore the facts of development, it is unfortunately true that in zoological treatises, systematic embryology is either entirely neglected or else treated in such a sketchy way as to be useless, or nearly so, to the student. But in saying this, we desire to impute no blame to zoological authors, who are already overburdened with the immense mass of facts which they have to treat. Hence the necessity for books specially dealing with the subject—books which had their model and initiator in the great work on comparative embryology by F. M. Balfour. The book before us may, indeed, almost be regarded as a second edition of that work, so closely are Balfour's plan and

method followed. And surely no greater praise could be given to it. Not only is the method of treatment almost identical, but the points of view from which the facts are looked at is almost exactly the same as that adopted by Balfour more than fifteen years ago. The passage—"In the group Metazoa or germ-layer animals, on the contrary, there always results a multicellular organism (cell-community or cell-corm), in which the single cells give up their independence for the good of the community, and accommodate themselves to a division of labour, in consequence of which there is brought about a diversity in the structure and function of the cells of the Metazoan organism" (Introduction, p. 1)—shows that the cell-theory in its modern form is the key-note of the work, and that the germ-layer hypothesis of Huxley and Kowalevsky still holds the prominent position assigned to it in Balfour's work. And we are very far from blaming the authors for thus adhering to the old faiths of the seventies; for though much may now be urged to diminish the importance of these hypotheses, which in their day have done yeoman's service to the furtherance of anatomical science, and though it might be argued, as has lately been done in more than one quarter, that they are moribund and powerless to lead us further in the intricate task of unravelling structure, still it would be foolish, to say the least of it, to cast them on one side in a didactic work of this kind, until some better, some more penetrating guide has been found to replace them.

After this, it is hardly necessary to say that it is our opinion that the authors are men of sound judgment, a fact which is shown in every chapter of their work. But we have said enough to indicate our admiration for the work. The authors are scholars in the best sense of the word. Their erudition is profound, their accuracy is minute, their industry and patience must be marvellous, and their critical powers are quite first-rate. In soundness and impartiality their judgment leaves nothing to be desired. So far as our knowledge goes, credit is always well apportioned, and conflicting statements are handled, if not with the consummate skill of Balfour, still in a manner which is unusual in works of the kind.

The volume before us is part i. of the German work, and deals with the Porifera, Cœlenterata, Platyhelminthes, Nematelminthes, Annelida, Echinodermata, Rotifera, Chætognatha and Enteropneusta, treated entirely in a systematic manner.

Parts ii. and iii., of which a translation is promised, complete the treatment of the invertebrata. In the authors' preface, a general part is spoken of, but so far as we know it has not yet appeared; and the vertebrata are expressly excluded from the scope of the work. This omission we hold to be a defect. The authors defend it on the ground that that department of the subject has been adequately treated recently by other hands. We entirely differ from this view; for not only do we hold that no entirely satisfactory treatment of the vertebrata has appeared since Balfour's work, but that no satisfactory treatment is possible apart from the rest of the animal kingdom. Moreover, though the phylum vertebrata is only one phylum of the animal kingdom, no scientific treatment of the subject as a whole is possible without at least a consideration of the facts of vertebrate embryology. One might as well, in a scientific treatise on chemistry, omit all reference to carbon and its compounds. We sincerely hope that the authors will change their minds, and will, when they issue the general part, append an account of vertebrate embryology.

In a work of this magnitude there must be a certain number of small mistakes and slips; but we have found surprisingly few of them. We might, however, call attention to two, which bear on subjects having a certain amount of general interest. On p. 3, it is stated that the "ectoderm germ-layer presides over the animal functions (sense, perception, locomotion)." This is of course an error; for not only are the most important muscles often endodermal in origin, but, if certain observations are to be trusted, it is highly probable that the main nervous tracts arise *in situ* in the mesoderm. On p. 31, a series of diagrams showing the structure of the canal-system in certain sponges is described as "a diagram of the development of the canal system in various sponges." This is obviously a loose statement. What the authors probably mean is, that the diagrams illustrate various conditions of the canal-system, which are actually met with in different sponges, and which may be supposed hypothetically to represent permanently stages of structure through which the more complicated canal systems have passed in phylogeny. This slip is of more importance than at first sight it may appear to be, because phylogenetic speculations, if they are to have any value at all, and not to be mere hindrances, must be described in the most precise language, and based upon the most exact ideas. It is very important at the present time, when so many loosely-conceived and worthless phylogenetic hypotheses are constantly being put forward, that the necessity for precision and clearness of thought at least should be regarded as indispensable in all attempts to trace the ancestry of living animals.

With this one exception, which is obviously a slip, this volume is happily entirely free from all blemishes of the kind. The phrase, "embryonic connective tissue," though no doubt sanctioned by usage, is one to which we take exception. The tissue so described has almost, if not quite always, nothing whatever in common with connective tissues as ordinarily conceived, but is a germinal or growing tissue which gives rise to most important organs.

The translators have performed their task with skill. There are short notices, made for the most part by the authors, of the more important memoirs which have appeared since the publication of the original in 1890. The German idiom is quite got rid of, and the book in its English form is eminently lucid and readable. The translators are to be congratulated on their work, and have earned the gratitude of all English zoologists. But, alas! there is one serious blemish. If the translators were Englishmen, we should call it an error of taste; but being Americans, we must make allowances, and put it down as another example of the curious incompleteness of their knowledge of the English language, which some Americans are known now and again to display. We all know how frequently the word *anlage* is used in German works on embryology; and we all know that some authors, notably those writing in America, refusing to use the English equivalent, have attempted to add this word to the English language. The translators of this work have

not taken this course—we almost wish they had—they have decided to use an English equivalent. But instead of using the English word *rudiment*, a well-known word, a respectable word, one might almost say a classic word in the ears of English zoologists—a word which well covers the meaning of the German word "anlage," and the use of which in this sense can be productive of no confusion, they have invented a new rendering; and—O ye gods!—what a rendering!

We would pardon the ignorance of one who did not know that the first and most common meaning of the word *rudiment* is the "original of anything in its imperfect form." But the editors have not stopped short at this: they have fallen from Scylla into Charybdis; they have employed a word with the meaning of which every schoolboy is familiar—often painfully familiar—a word which has only one usage in English, and that a usage which, to all people with a sense of humour, would entirely unfit it for the present purpose, even if it were required. They have displayed an ignorance which is almost incredible in men who speak the English language, an ignorance which, while it may help us to understand certain peculiarities observable in some of their countrymen, is fraught with the most ludicrous results in the present instance. We sincerely regret that we are obliged to call attention to this blemish. It is hard upon the authors to have their work served up to the English public with such a grotesque ingredient. We feel that the publishers, who at any rate are Englishmen, should have seen to the matter, and we sincerely hope that the pages of parts ii. and iii. of this most valuable work will not be defaced by such a misuse of a well-known and old-established English word.

It only remains to say that the book is well got up. The printing is good, the illustrations are excellent, and the size is convenient.

THE EVOLUTION OF CULTIVATED PLANTS.

Plant-Breeding: being Five Lectures upon the Amelioration of Domestic Plants. By L. H. Bailey. Pp. 293. Figs. 20. (New York and London: Macmillan and Co., 1895.)

WHEN, in 1859, Darwin's "Origin of Species" first saw the light, naturalists were astonished at the large number and variety of illustrations the author derived from cultivated plants. This feeling was accentuated in 1868, when the "Variation of Animals and Plants under Domestication" appeared. Previous to that time botanists had, for the most part, ignored the productions of the horticulturists, or looked upon them as so many sources of annoyance and confusion. With the publications just mentioned, there dawned upon the minds of thinkers the notion that what was done in nature slowly and gradually had been, and was effected by the gardener rapidly and, relatively, with equal certainty.

Variation, selection, adaptation, progressive evolution were seen to constitute the basis of the work of the gardener and the "florist" in their attempts to gain new and improved varieties. Cross-breeding and hybridisation had been practised for generations. The first artificially-produced hybrid on record was raised in the beginning of the eighteenth century by Fairchild—a gardener. It was a hybrid Pink. After him came Bradley, Logan, Philip Miller, who each and all carried on their experiments on evolutionary lines. With Thomas Andrew Knight and Dean Herbert, we are brought down to modern times. They were great gardeners. Assuredly they were great evolutionists. And the work is going on day by day with more activity than ever. In addition to the constant improvement recognised in the case of agricultural and garden plants, the evidence of which may be seen in the seedsmen's trial-grounds and in the experimental garden of the Royal Horticultural Society at Chiswick, there is a positive production of new forms, so different from pre-existing ones, that were the history not known they might be thought to constitute new genera, or, at any rate, new sections. Take the tuberous Begonia, for instance. Thirty years ago or so, there was nothing like it either in nature or in gardens. Now, by the blending of various species, entirely new races have been produced; and these, to a large extent, are reproduced from seed. From the seedlings selection is made, and so the progress goes on. But some will say, Will they not die out if not looked after by the gardener? Of course they will; but are there no such things as retrogressions and extinctions in nature? The Begonias in question would doubtless die here if uncared for, as they are not suited to the climatal environment; but they would at least have a very good chance if removed to the Andean forests, whence their progenitors sprang.

The gardener, moreover, is often in a position to demonstrate the hybrid origin of some wild plants. There are now numerous cases in which certain wild orchids have been supposed, from the blending of morphological characters which they present, to have had a hybrid origin. Some botanists have hesitated to accept this kind of evidence, though we may say incidentally, that it has been borne out, in other genera, by Dr. Macfarlane's histological researches. More to the point is it to say that certain of these hybrid orchids have been actually artificially produced in Messrs. Veitch's nurseries by crossing the species that were reputed to be the parents of the supposed natural hybrids. The evidence is complete; and it alone is sufficient to show to the evolutionist what a vast and fertile field lies open to him in the observation, and especially in the experimental investigation of ordinary cultivated plants.

The reader will find numerous valuable hints and suggestions on the subject in Prof. Bailey's little book. It contains the substance of five lectures on variation and its causes, and on their application to the practical purposes of the cultivator. The most successful hybridisers and selectors act on a preconceived plan, according to their requirements; but since so much attention has been directed to the subject, there has been—indeed there always has been—much indiscriminate, haphazard experiment. Prof. Bailey cautions experimenters against such unscientific procedures, and supplies directions whereby the aim and purpose may more surely be attained.

The fourth lecture is largely a reprint from Carrière's paper on bud-variation, and from Focke's work on the hybridisation of plants; whilst the fifth contains practical instructions as to the methods of crossing employed by experimenters. A glossary and an index terminate a book which, if it contains little that is not familiar to experts, will be extremely serviceable to beginners, and will furnish the naturalist, who wishes to gain a general survey of the matter, with just the information he requires. For this latter purpose, a fuller bibliography would be an improvement in a new edition.

MAXWELL T. MASTERS.

OUR BOOK SHELF.

Die Haustiere und ihre Beziehungen zur Wirtschaft des Menschen. Eine geographische Studie von Eduard Hahn. Large 8vo, pp. 581, and a map. (Leipzig: Duncker and Humblot, 1896.)

THIS volume is an important contribution to our knowledge of the relations existing between domestic animals and human economy. It forms a large octavo volume of nearly 600 pages, compiled from all sources, and of its interest the reader may form some idea from the following summary of its contents. After a brief introduction, we have our domestic animals considered from a zoological standpoint; here the interesting questions of hybridisation and of the returning of once-domesticated animals to a feral state, are investigated. Next the subject of the profitableness of such animals is considered, the author alluding but casually to the fact that some animals were decidedly domesticated, without an eye to profit; he cites the case of some South American aborigines keeping a "grylla" in their houses for the perfume, but has apparently overlooked the case of the Greeks domesticating the cigale. He on purpose omits the subject of animals in connection with "worship," quoting Tylor, that "it is a subject not wanting in interest, but is one abounding in difficulties."

The list of domesticated animals (using this term in the widest sense of animals kept for the use or service of man) given is a long one, comprising not only such familiar forms as the dog, horse, ass, horned cattle, sheep, goats, reindeer, &c., but also the yak, gaur, llama, guinea-pigs, and ferrets. The list of birds is extensive; reptiles are not mentioned, save the axolotl in an appendix; and among the fishes we find the carp, the gold-fish, and the paradise-fish. Bees and several silk-spinners are mentioned among the insects.

The concluding portion of the work is devoted to economic geography, and is illustrated by a map, in which an attempt is made to mark out the world into areas characterised by aboriginal industries. Certain regions are coloured as being those of the hunters and fishers, then of the several divisions of mankind living upon tubers and cereals, or further advancing to the culture of such plants as sugar-cane, tobacco, and the like; still greater progress is indicated by the type of gardening as practised, for example, by the Chinese. Of the various regions of the world alluded to, that of Australia is the one most unsatisfactorily treated; there is scarcely an allusion to the wonderful culture of vegetables by the Maoris, for a very good knowledge of which we are long since indebted to the labours of Colenso and others. The subject treated of in this volume is of the widest range—in space covering the known world, in time going back to days of indistinct tradition, and for its complete investigation requiring some knowledge of an immense range of literature, this work is a contribution towards this history, and as such is a most useful one.

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.*]

Velocity of Propagation of Electrostatic Force.

LORD KELVIN, in his letter published in NATURE, February 6, says that "it is an abuse of words to speak of the 'elastic solid theory of electricity and magnetism' when no one has hitherto shown how to find in an elastic solid anything analogous to the attraction between rubbed sealing-wax and a little fragment of paper . . . or between two wires conveying electric currents."

It has, no doubt, escaped Lord Kelvin's notice that in 1884 a paper was published in the *Cambridge Philosophical Transactions* (vol. xiv. p. 45), in which I showed that two spheres pulsating in an elastic medium will, if pulsating in opposite phases, attract each other as sealing-wax attracts paper, and if in the same phase will repel just as like electrified bodies do, the action being propagated in the medium with a finite velocity.

In a subsequent paper, published in 1885 (*Camb. Phil. Trans.*, vol. xiv. p. 188), I have shown that two straight oscillatory twists placed in an elastic medium will, if in the same phase, attract each other as like electric currents do, and if in opposite phases will be repelled. In fact, if the vibration of the surface of a solid placed in a vibrating elastic medium is resolved into normal and tangential vibrations, the normal vibrations will, as pointed out in these papers, cause the solid to exhibit several of the phenomena of statically electrified bodies, while the tangential vibrations will cause it to behave as if carrying a current and acted on by a magnetic field.

I only venture to mention these results because it appears from Lord Kelvin's letter that they are not generally known. They should, I believe, assist in forming a conception of a possible explanation of electric action, based on the supposition of an elastic medium which resists changes of volume and shape.

Firth College, Sheffield, February 11. A. H. LEAHY.

In making the statement quoted, I had fully taken into account all such considerations as those referred to in Prof. Leahy's letter. The rigidity of the solid absolutely prevents any phenomenon, analogous to the attractions by rubbed amber or lodestone, from being exhibited in an elastic solid. No such barrier exists if the elastic medium be fluid; and §§ 733–740 of article [1] xli. of my "Electrostatics and Magnetism" contain conclusions of hydrokinetic theory regarding mutual forces between movable tubes or rings with cyclic motion of an incompressible liquid through them, showing magnitudes identical with, *but directions exactly opposite to*, those of the forces in electro-magnetic analogues consisting of movable conductors conveying electric currents. The remainder of that article contains remarks on Guthrie's interesting paper [2] "On Approach caused by Vibration," and "On the Attractions and Repulsions due to Vibration, observed by Guthrie and Shellbach," from which the following (§ 744), being an extract from a report, in the *North British Daily Mail*, of an address by myself to the Philosophical Society of Glasgow on December 15, 1870, may possibly be read with interest in connection with Prof. Leahy's letter:—

"The speaker began by stating that interesting papers had recently appeared in the *Proceedings* of the Royal Society and the *Philosophical Magazine*, by Prof. Guthrie, in which some very curious hydrokinetic phenomena were described. From hints and suggestions in his paper, it seems that Prof. Guthrie connected, in his own mind, these phenomena with possibilities of explaining some of the more recondite actions in nature; and he (the speaker) believed that what gave the great charm to these investigations for Prof. Guthrie himself, and no doubt also for many of those who heard his expositions and saw his experiments, was, that the results belong to a class of phenomena to which we may hopefully look for discovering the mechanism of magnetic force, and possibly also the mechanism by which the forces of electricity and of gravity are transmitted. The speaker, however, did not lay any stress at present upon the possibility of applying these results directly to explain magnetism. He believed, on the contrary, that the true kinetic theory of mag-

[1] First published in the *Proc.* Roy. Soc. Edinb. for Feb. 1870.
[2] *Proc.* Roy. Soc., August 26, 1869.

netism (and the ultimate theory of magnetism is undoubtedly kinetic)[1] involves quite a different class of motions from those to which the beautiful phenomena discovered by Mr. Guthrie are due. He rather wished to point out the close connection that existed between the laws of some of these actions and the laws of magnetism, which, while involving some remarkable coincidences, involves certain contrasts decisive against any hypothesis, such as the ingenious one[2] of Euler, explaining magnetism by fluid motion directly comparable with that which forms the subject of the present communication." KELVIN.

The University, Glasgow, February 13.

The Stress in Magnetised Iron.

I AM glad to see from Dr. Taylor Jones' letter that he and Mr. Nagaoka contemplate a discussion of the *magnitude* of the magnetic stress really existing in iron under, I hope, natural conditions. A complete discussion of the sort would, I think, be of much value. It seems to me somewhat doubtful what is the true nature of the assumptions latent in Maxwell's work, vol. ii. arts. 630–646. I am uncertain whether his conclusions are strictly applicable to any case other than that of an infinite homogeneous medium in which the permeability is unity. In the ordinary case of a magnetic bar, some lines of force traverse the surrounding air, and complications also arise from the "free" magnetism at the ends. When, as in previous experiments on the magnitude of the stress, a magnetic bar or ellipsoid is cut in two, the stress measured is presumably that exerted across a minute air-film separating the opposed surfaces. Under such circumstances the formula $B^2/8\pi$ is, according to Dr. Taylor Jones' own experiments (*Phil. Mag.* for 1895, p. 254), a close approximation to the stress when the permeability of the bar is large.

Prof. Ewing's letter also calls for some comment at my hands. The view I advocated is hardly that he attributes to me. I expressed no opinion as to the correctness of the measure $B^2/8\pi$, assumed by Dr. More and others, for the *intensity* of the magnetic stress. Neither did I say the stress system reduced to a *simple* longitudinal tension. It is, I believe, in general considerably more complicated, and is accompanied by strain perpendicular to, as well as along the lines of force. Avoiding complications unessential to the point at issue, I simply supported the view that the magnetic stress along the lines of force is a tension, and that the associated strain in the metal along this direction is an extension.

Again, Prof. Ewing says that the case illustrated by me in p. 270 is a "special one." The illustration in question is, however, just as applicable to the case of an endless ring, to which he specially refers, as to that of a long rod. It is really based on three hypotheses or assumptions, as valid in one case as in the other: (1) that the magnetisation is uniform; (2) that the air gaps, real or imaginary, are narrow compared to the length of the element; (3) that the existence of an indefinitely thin air gap, such as may be found between two attracting pole faces in contact, does not affect the *sign* of the stress.

Now (1) is merely a definition, and (2) a mathematical expedient to simplify the proof, so that (3) alone remains. As regards (3), I merely followed Prof. Ewing in § 145 of his "Magnetic Induction," except in so far as I did not assume the existence of a narrow gap to be wholly immaterial. As Prof. Ewing admits that the stress in the case of my illustration is a *tension*, we should, if he adhered to his original views regarding (3), be now on the same side. He has, however, apparently completely altered his views, for he says: "Make the iron continuous by closing up the gaps, and the tensile stress disappears." This seems an explicit declaration that there is no such thing as a "Maxwell stress," and that consequently neither extension nor compression can be assigned to such a cause. Prof. Ewing's new view implies a sudden large discontinuity between the state of close juxtaposition of magnetic material, when the stress he admits is large, and that of absolute continuity, when the stress he says is nil.

It would, I think, be premature to do more than call attention to this apparent discontinuity until the arguments in favour of the new view are produced.

Prof. Ewing's remarks about the pulling and pushing of magnetised rings, indiarubber bands, &c., suggest that he experiences a difficulty in imagining any complete, homogeneous, isolated ring under conditions such that the normal stresses over all cross-sections are tensions. The consideration of the elastic stress system produced in an anchor ring by rotation about a perpendicular to the plane of its circular axis (line of centres of cross-sections) through the centre will be found, I think, to aid such a conception.

I must decline, I fear, to follow Prof. Ewing into the clothes-basket he refers to, though doubtless the experiment must be a fascinating one—for spectators. C. CHREE.

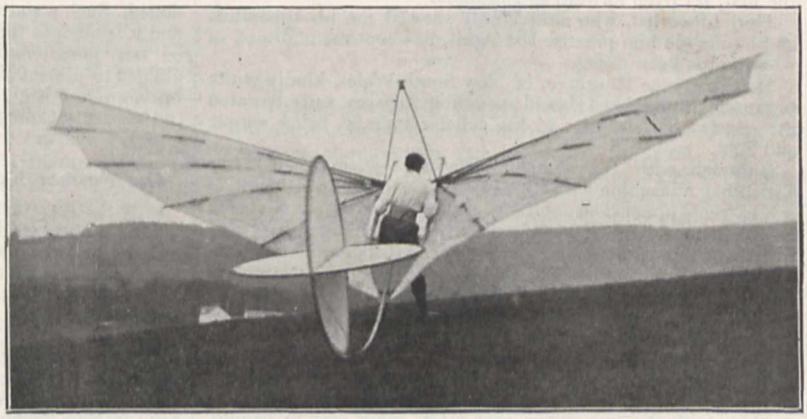
Kew Observatory, February 11.

[1] "Electrostatics and Magnetism," § 290 (Roy. Inst. Friday Evening Lecture, May 18, 1860); "Electrostatics and Magnetism," § 546 (*Proc.* Roy. Soc., May 10, 1856).

[2] "Electrostatics and Magnetism," § 573.

Experiments with Soaring Machines.

AT the end of the article on Herr Lilienthal's soaring experiments, in your issue of January 30, reference is made to my trials, with somewhat similar apparatus, at Cardross, and it is said that so far I have not been very successful.



I do not consider this to be the case. I think that, so far as I have gone, my work has been rewarded with as much success as could possibly have been hoped for.

I only commenced to build my first machine just a year ago, and being very busy with other things, was not able to take the machine out to practise till June.

At first my wings were, as is stated, very much raised, so that the machine should have transverse stability of its own in flight, just as a kite is stable sideways when it is of this shape, or as a sheet of paper folded to a V-shape will always fall on the folded edge.

There is, however, a great practical difficulty with the raised wings, and that is, that if one stands not exactly head to wind, the machine tends to "pay off" from the wind, which then comes more on one side, and rolls the machine over.

With the wing tips lowered more as a gull's wings are, if the wind (virtual or real) is not ahead, through a squall or any other cause, the machine has very little tendency to raise on the windward side, and so be turned over by the wind.

Not appreciating this, certainly caused me some delay and breakages; but when I realised how great is the objection to the raised wings in such a squally place as Cardross, I curved the wings as shown in the second photo which I enclose, and with this original apparatus have been picked up by a puff of wind over and over again, sometimes as much as 12 feet above the spot I was lifted from, and put down again on exactly the same place. At other times, when there has not been so much wind, I ran to meet the wind with the front of the wings depressed somewhat, so that my weight is only partially taken by the wings, and in this way I am, strange as it may appear, able to run very

much faster than without the wings; then raising the front edge a little, I am able to take a long soar down a slight incline. The only slopes on which I was able to practise, were not steep enough to make it possible for me to soar for any great distance; and therefore I have at times, on days when the wind was fairly steady, attached a string to the front of the machine, with which a boy has run and kept me in the air for about half a minute. I never used a line when there was enough wind to pick me up without forward movement, on account of the strong winds at Cardross being so very squally.

I had to stop experimenting at the end of September; but when I left off, I was pretty sure of my balance in the air, and was able to land without damage and without falling, even when soaring over the ground very fast. And this was the whole object of my work, so that I should be pretty sure of my balance before putting motive power into the machine to make horizontal flight possible. This I hope to do this year, with a petroleum engine, either working the screw propeller in the front of the machine, or two screws, one placed under each wing, so that the machine will then practically become a Maxim machine of the smallest size possible for one man to fly with.

Mr. Maxim has shown most clearly that his large machine at Bexley will rise on the underneath side of rails put down to prevent its rising further; and what is possible for this large machine, is just as possible for a small one. And I am confident that I could maintain horizontal flight with wings similar to those I have been using, or, better still, similar to those I am now making, which vary chiefly only in mechanical detail from the first, if driven forward as I propose.

Herr Lilienthal, who most kindly showed me his apparatus, and let me see him practise last April, has kept me informed of what he has been doing.

Mr. Lawrence Hargrave, of New South Wales, kindly wrote to me suggesting that I should use double surfaces, and advocated the construction he uses in his cellular kites, as being simple and light.

Although with the double surfaces now used by Herr Lilienthal a machine with the same area of sail can be made of less extreme dimensions, and a considerable saving can probably be made in weight, it has the disadvantage of having less area to act as a parachute in the event of speed through the air being lost, either by a sudden lull in the wind, or through want of skill on the part of the flyer. And I am as yet not at all sure that the upper surface with a puffy wind would not, from the very fact of its high position, prove a source of danger rather than the reverse.

My reason for saying this is because I tried a machine at Cardross with the wings just above my head, but found the machine with the low wings very much more easy to handle, especially when the wind was puffy; but in order to make more sure of this, I shall probably make a double surface machine at once.

It is quite possible that what is best at Herr Lilienthal's ideal practising place, where he has his cone-shaped hill and flat country for miles round, so that his wind is unbroken and steady, is not best in the proverbially squally district of the Clyde, where I have had to experiment.

The accompanying illustration will probably make my letter more clear.

PERCY S. PILCHER.

Science and Morals.

A HABIT has been growing of recent years among certain scientific men, which many of those with whom I have discussed the subject join with me in regretting. It is this:—After the announcement of an interesting discovery, a number of persons at once proceed to make further experiments, and *to publish their results*. To me it appears fair and courteous, before publication, to request the permission of the original discoverer, who probably has not merely thought of making identical experiments, but who has in many instances made them already, and has deferred publication until some grounds exist for definite conclusions.

The late President of the Chemical Society, Dr. Armstrong, has sought to justify such conduct. On p. 225 of the *Proceedings* of that Society for 1894, these words are reported as having been used by him:—"After having been told so much, chemists could not be expected to remain under the imputation that they had been eyeless for a whole century, and they would undoubtedly inquire into the matter. Although no one would seek to take the discovery out of the hands of those who had announced it, chemists unquestionably had the right, not only to exercise entire freedom of judgment, but also to critically examine the statements which had been made."

These words related to the discovery of argon by Lord Rayleigh and myself; and, as we were otherwise occupied, no notice was taken of them. Events, I think, have justified the course which we then took. But now that all personal element has been removed, I feel free to raise the question—Is this recommendation precisely consistent with the highest view of scientific morality.

An analogy will perhaps help. If a patenthas been secured for some invention capable of yielding profit, and some person repeats the process, making profit by his action, an injunction is applied for and is often granted. Here the profit of the business may be taken as the equivalent of the credit for the scientific work completed; no original idea, undeveloped, is of much value; before it produces fruit, much work must be expended; and it is precisely after the publication of the original idea, that sufficient time should be allowed to elapse, so as to give the author time to develop his idea, and present it in a logical and convincing form.

Should such trespassing on newly-sown ground come to be the rule, instead of, as I fervently hope, the exception, the result will be this:—Scientific men will provide their private laboratories with a good lock; they will communicate their ideas to none, until they are worked out; and the pleasant and friendly intercourse, which is now universal, must be abandoned. Such a state of matters would be greatly to be regretted; and it is obvious that the progress of scientific discovery would be not immaterially hindered, if every scientific man were obliged to protect himself against what, after all, comes near to a breach of the Eighth Commandment. WILLIAM RAMSAY.

University College, February 14.

The Former Northward Extension of the Antarctic Continent.

MR. BEDDARD, in NATURE for December 12 (p. 129) has called attention to a new fact, "loading still further the already over-weighted scale which now dips so deeply in favour of the Antarctic continent." Permit me to add another fact bearing on the question, but whose significance has been quite overlooked hitherto.

The most characteristic of types which occur in the cold and temperate fresh waters of the southern hemisphere is the genus *Galaxias*—a type whose representatives are popularly known as trout in New Zealand, Tasmania and Australia. Species nearly related (in one case claimed to be identical) are found in South America, and furnish the most cogent testimony in favour of a former connection of the several now isolated areas. None have been found elsewhere, and none were looked for from Africa; but in 1894 a species was described by Dr. Steindachner (*Sitzurgsb. k. Akad. Wiss. Wien*, ciii., abth. 1, p. 460, pl. 3, f. 2) as *Galaxias capensis*, and there is no apparent reason to doubt that the generic allocation is correct. The geographical range of *Galaxias* is then somewhat analogous to the worm genus *Acanthrodilus*, which is the theme of Mr. Beddard's note. His remarks are applicable with even greater force to the fish genus. "It is clear that, if the former northward extension of the Antarctic continent is not believed, some explanation of these remarkable facts is much wanted; on that hypothesis they are perfectly explicable."

Lest some may think the argument in question is invalidated by the so-called *Galaxias indicus* of Day, I may add that I do not think that fish has any relation to the genus to which it was referred. THEO. GILL.

Washington, January 24.

Children's Drawings.

THERE are two little boys in my circle (nephews, in separate families), who at an early stage in their attempts at drawing, have drawn things *upside down*. Thus a locomotive would be drawn with funnel pointing downwards, and wheels at the top of the figure. Has this peculiarity been noticed before, and is it common? It seems to me interesting in relation to the subject of erect vision, for the retinal image is, of course, *inverted*.

A lady who had lived in India mentioned, in this connection, that she had often noticed natives, after taking up a photograph to look at it, replace it upside down. One of those two boys, looking at pictures, preferred to hold them upside down.

A. B. M.

Lecture Experiment on the Nodes of a Bell.

REFERRING to Mr. Taylor's letter on the above subject (January 23), the method he describes requires, in the first place, a bell-jar of very wide edge—at least half an inch—and the result, when obtained, would only be visible to one or two persons at a time. May I suggest the following method, although, very probably, by no means new.

An ordinary bell-jar with a plain edge (not welted) is fixed firmly in an inverted position; from a metal ring, arranged above it, are suspended eight small beads by fine threads, in such a manner that they rest lightly against the outside of the edge of the jar. It is convenient (though not necessary) to so arrange the beads that they touch the circle of the jar at equidistant points. On then bowing, the beads are all jerked out from their positions, and can be heard rattling against the glass as they fall back; and it is easy to note that at the nodes the disturbance is comparatively slight, while it is more violent in the ventral segments.

H. G. WILLIAMS.

Middle School, Ipswich.

THE PLANET VENUS.

THE planet Venus, as every observer knows, is a difficult and, at the same time, a tantalising object for observation, for when she is in that part of her orbit nearer to us, and therefore greatest in size, she presents us with only a small illuminated crescent, from which it is impossible to gather much from her surface markings as a whole. Although at her greatest distance from us she presents her whole disc, yet the latter appears so small that even in this case satisfactory observation is not obtainable. We have to content ourselves, therefore, with observations made between these two stages, and when her apparent disc is thus semi-illuminated.

That such an important question as the time of rotation of the planet about her axis is not yet definitely settled, is quite sufficient to indicate that the observer has not everything his own way.

In a former number of NATURE (vol. xlvi. p. 469), a summary was given of the valuable observations made by the late M. Trouvelot at Cambridge, United States, and Meudon, extending over the years 1877-1891. The chief points to which reference there was made were the two kinds of spots, white and grey, one specially prominent in size having appeared on September 3, 1876; the snow caps at the poles, and the bright specks which appeared at their southern extremities; the varying shape of the terminator, which occurred sometimes in the space of a few hours; and, finally, the period of rotation. Trouvelot found that the whitish and greyish spots were very difficult to observe, even under favourable conditions. The former were situated near the terminator, and produced on it slight deformations, which seemed so to alter it as to suggest that these spots are at a higher level than the other parts. The greyish spots, on the other hand, when situated in about the same positions, also deformed the terminator to a small extent, but in an opposite way to those just mentioned, suggesting that these spots lie at a lower level than the parts near them. Another peculiarity of these two kinds of spots which he remarked was their size. The white ones seemed to assume a round or slightly oval form, and were nearly always small, while the grey spots were generally of an elongated shape and of large dimensions, forming sometimes straight bands. That the spots were not necessarily of long duration was also remarked, and they were analogous in their formation to "taches des couches nuages continues de notre atmosphère précédant les pluies, et qu'un simple jeu de lumière fait naître ou disparaître." Their contours were described as very vague, those of the white spots being less brilliant, and those of the grey spots less dark.

In the observations that were made at the Catania Observatory and at Mount Etna (*Astr. Nach.*, Bd. 139, No. 3329), and to which a brief reference is here made, the observer, Sig. A. Mascari, describes in detail the appearances of the spots during the years 1892-1895. He also differentiates between the two kinds of spots. "Le macchie oscure si presentano ordinariamente sotto forma di leggiere velature grigie a contorni mai netti, molto deboli, senza alcun limite deciso, ed è assai raro e fortunato quel momento in cui si può arrivare a distinguere con precisione qualche contorno netto." The second type, "Le macchie chiare si rilevano per un maggiore splendore rispetto a quello del resto del pianeta.

FIG. 1.—October 12, 1892.

From the series of twenty drawings which accompany the observations in the communication referred to above, the surface markings can be clearly followed.

Fig. 1, which is one of a series of four drawings made in the months of October and November 1892, gives the general appearance of the surface as it was then observed. The three dark patches, A, B, and C, were nearly always visible; *a* was not always so prominent as is shown in the drawing. The terminator was also at times irregular in shape, being specially so on November 14. The edge of the south polar cap, near the terminator on October 13, assumed a somewhat similar appearance to that which Trouvelot recorded on September 27, 1876. The observations of the latter indicated that the most striking

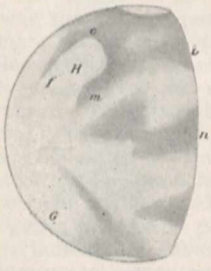


FIG. 2.—September 25, 1893.

irregularities were found at the extremities of the terminator close to the edge of the pole-caps, where deep notches were often recorded. They were of different sizes and shapes, and underwent rapid changes in periods of sometimes a few hours. These facts led Trouvelot to believe in a short period for the rotation of the planet. In the observations for 1893, the terminator was directed towards the east.

Fig. 2 shows the planet for September 25, 1893, from 13h. 50m. to 14h. 52m. The bright spot, H, is bounded on the east and west sides by dark, well-defined contours, *e*, *f*, and *m*. The region about G was somewhat obscure; the area enclosed by *i*, *m*, *n* was bright and sometimes circular, being bounded, for the most part, by dark indistinct contour lines.

Fig. 3 shows this more clearly. This drawing, made on October 13, seems to be more typical of the appearance of the disc for this year. The six comparatively large whitish spots, H, I, G, N, M, L, are here clearly shown. H is somewhat varied by an incursion of the dark contour line on the east side; I is also sometimes partially bisected by a dark streak, as was the case on November 27, 16h. 50m. (Fig. 4).

The different shapes which the terminator underwent during this year's observation were very prominent, that on November 27 being the most noticeable.

The disc in March 1895, the terminator being directed towards the east, presented the appearance shown in Fig. 5. One can easily recognise the large white spots, H, I, G, N, M; I appears, however, no longer divided,

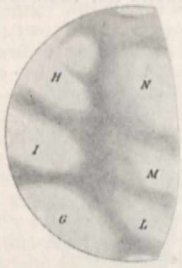


FIG. 3.—October 13, 1893.

while L seems to have more or less disappeared, giving place to a prominent circular spot a little more to the eastward. The detail observed during the months of July and August can be best seen by examining Fig. 6, which can be conveniently compared with Fig. 3 or Fig. 4.

With regard to the length of period of rotation of this planet, the difficulties of identifying the spots after brief intervals of time have rendered this point doubtful. Leo Brenner on this point writes (*Astr. Nachr.*, No 3300, p. 197): Obgleich ich bisher 107 Beobachtungen der Venus zu verzeichnen habe, konnte ich doch erst 22 Zeichnungen anfertigen, weil die wahrgenommenen Flecken gewöhnlich so schwach und unbestimmt sind,

FIG. 4.—November 27, 1893.

dass ein gewissenhafter Beobachter Bedenken trägt, ihre Wiedergabe zu versuchen, weil er fürchten muss, entweder ein Opfer von Selbsttäuschung zu werden oder die Ausdehnung der Flecke nicht richtig aufzufassen. Deshalb halte ich auch die Berechnung der Rotation aus Flecken, die so unbestimmt sind, für ganz und gar unmöglich. Anders verhält es sich aber mit Erscheinungen, welche so deutlich sind, dass sie ins Auge fallen und über deren Wirklichkeit mithin kein Zweifel bestehen kann."

It is at present uncertain whether a rotation is performed in, roughly, twenty-four hours, or whether it is accomplished in about 225 days. Trouvelot, from his numerous observations, gave a period amounting to nearly twenty-four hours; while Schiaparelli still adheres to 225 days. Quite lately also Tacchini, from observations made during last summer at the Collegio Romano, favoured Schiaparelli's view that the rotation period is equal to the sidereal revolution; and his observations (*Atti Reale Acad. Lincei*, vol. v. p. 3) towards the end of 1895, have led him to the same conclusion, The observations of Mascari seem, however, to have led him to adopt the longer of the two periods. Cerulli also, from observations made in July, August, and November of last year (*Astr. Nach.*, No. 3329) is inclined to adopt Schiaparelli's length of period. Writing in *Astr. Nachr.* (No. 3310, p. 368), he says: "Onde si conchiude che la configurazione delle ombre di Venere si mantiene sensibilmente invariabile per molti giorni, e non rivela nessun movimento conciliabile con rotazioni di breve durata."

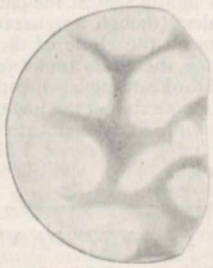


FIG. 5.—March 23, 1895.

Leo Brenner, on the other hand (*Astr. Nach.*, No. 3314), is decidedly in favour of the shorter period, and so is therefore of the same opinion as Trouvelot. The former argues that if the spots preserve their positions, then those near the terminator would be for some length of time under the same conditions of illumination, and therefore would appear the same. This he maintains is not the case, and is not even borne out by the drawings of Schiaparelli and other observers.

It may be remembered that Trouvelot determined his value of 23h. 49m. 28s. from the observations of certain spots, but he also stated that many of the general features visible on the planet's surface, such as the rapid deformations of the horns and of the terminator, &c., a

FIG. 6.—July 26 to August 5, 1895.

suggested a short period of rotation, and were "inconciliable avec la période de rotation, si lente et si inattendue, déduite par l'éminent astronomie de Milan."

Brenner, who has observed Venus some 275 times, says that the spots move with a velocity of 15°·030 in one hour, thus indicating a period of 23h. 57m. 7·5459s. In fact, he seems so convinced of the accuracy of his observations, that he has published a map of the surface of Venus, and finds that drawings by numerous observers agree well with it. He maintains, also, that the dark spots are true appendages on the planet's surface, and are not connected with the cloudy atmosphere. (See *Astr. Nachr.*, No. 3300, p. 198, in which he refers to a peculiar shaped spot situated near the South Pole, and a communication from Stanley Williams.

He accounts for the idea of a long period of rotation having been and still being upheld, on the ground that between 320° and 150° longitude there are several spots which are somewhat alike, six of which lie in a north and south direction, and two in higher latitudes in an east and west direction.

For this reason, if an observer does not steadily watch the planet from morning till evening every day, but simply makes an occasional observation, he can then easily mistake one spot for another, and imagine that he is observing the same one when he is really observing another, and thus conclude that no apparent motion of the spot is noticeable.

Whether this be so or not is, however, the question, but one does not feel quite at liberty to state definitely that therein lies the cause of Schiaparelli's, Tacchini's, &c., deductions of a long period, for certainly they must have convinced themselves thoroughly that such a rapid rotation, which according to Brenner is so apparent, was nevertheless to them very difficult of observation before they committed themselves to definite statements.

The following, but somewhat incomplete, list gives some idea of the views held by observers regarding the time of rotation of the planet under discussion. Column I. gives the names of those who advocate the short period of about 24 hours; column II., with one exception, those who are inclined to the period of, roughly, 225 days, and column III., those who are doubtful. The dates against some of the names refer to the times at which the respective observations were made.

I. Short period.	II. Long period.	III. Doubtful.
D. Cassini (1667)	Bianchini (1727)>24^{d}	Herschel, Sir W.
J. Cassini (1730?)	Schiaparelli	Beer and Mädler (1833–36)
Schröter (1788–93)	Cerulli	
De Vico (1840?)	Tacchini	
Trouvelot (1877–91)	Mascari	
Leo Brenner		
Stanley Williams		

During the first few months of this year the planet will be a morning star. From the middle of January to the middle of May, her time of rising before the sun diminishes from three hours to half an hour, her apparent diameter decreasing during this time from 16″ to 10″. After August she will become an evening star, her apparent distance from the sun increasing. In the middle of November she will set one hour and a half, and towards the end of December three hours, after the sun; her apparent diameter at this latter epoch being 15″. W. J. S. L.

THE SEEBOHM COLLECTION.

THE British Museum has always owed much to the generosity of private donors, and this has been exceptionally true in the case of the collection of birds, which is now the finest in the whole world. It is difficult for ornithologists of the present day to imagine what the collection was like five-and-twenty years ago in its old quarters at Bloomsbury. Its principal value then consisted of the type-specimens which it had received from the earlier voyages, and the celebrated Nepalese collection of Mr. Brian Hodgson; but the great series of Australian birds obtained by John Gould had been allowed to go to Philadelphia, apparently without a protest from any public body in England, and to the great regret of Gould himself. He had offered the collection to the nation on reasonable terms, which were afterwards eagerly accepted by Dr. Edward Wilson, who transferred the whole series, with its priceless types, to Philadelphia.

The birds' skins in past years were kept in an underground vault, in wooden boxes, so that if any particular specimen was wanted by a student, the whole lot had often to be turned out on the table, to render possible a search for the skin required. The time thus wasted was considerable, the damage to the specimens enormous, as they were heaped one upon another in the boxes, and every skin became more or less ruffled and spoilt as time went on. As regards the mounted collection, the absurd idea obtained that the public liked to see all the rare birds, and thus all the valuable types and priceless specimens were stuffed and exhibited, there to wither with the dust and exposure to light, and decay with age. Many specimens of great value, known to have been in the collection of the British Museum at the beginning of the century, are now no longer to be found there; they have doubtless fallen to pieces from decay, and have been thrown away. Even with the utmost care, I find it difficult now to preserve some of the old Montagu collection, the skins never having been properly preserved, and having been mounted with most of the bones inside them. In this way also were preserved the specimens of Captain Cook's voyage, most of which have vanished since the time that Latham described them, and they have doubtless crumbled to pieces.

It is quite certain, therefore, that twenty-five years ago the collection of birds in the British Museum was of small repute, and probably did not exceed 40,000 specimens. Little encouragement was given to travellers to help the national collection, and, excepting in the case of the Antarctic Expedition, and a few of the same kind, the specimens received from explorers on sea and land were few and far between. The best series were in the hands of private collectors. Thus, for the study of Palæarctic ornithology, students visited my collection and that of Mr. H. E. Dresser, or that of Mr. Henry Seebohm, already then commencing to loom large. For Ethiopian birds, my own collection and that of Captain Shelley were always available for the purposes of study, and far exceeded that of the British Museum in number of specimens. For Indian birds, that of the late Marquis of Tweeddale was the one generally consulted, and in India the influence of Mr. Hume was at work, and his collection was already assuming large proportions. The collection formed by the late Consul Swinhoe was the best as regarded Chinese birds, and Dr. A. R. Wallace still retained in his hands the chief set of the specimens obtained by him during his travels in the Malay Archipelago, with all the types. The best collection of Australian birds was that in the possession of Messrs. Salvin and Godman, though Mr. Gould had a large number of valuable specimens, gathered together during the previous thirty years, since the sale of his original collection. As regards American birds, the absolute dearth of species in the national collection can be estimated from a glance at the late George Robert Gray's "Hand-list of Birds," published in 1869–71, then the authentic record of what the Museum possessed, where genus after genus is scantily represented, and the series of species is lamentably defective. With regard to those of the Neotropical region, no great Museum, in the year 1872, probably stood at a greater disadvantage than the British Museum. The majority of the types of American Passeres were in the collection of Dr. P. L. Sclater, and, for a general series, nothing in Europe could surpass that of the Salvin-Godman cabinet.

In 1896 it is interesting to note the present location of the above-mentioned private collections. They are *all* in the British Museum. With the acquisition of the Wallace collection in 1874, commenced that era of improvement in the ornithological collection which has steadily progressed, and is still progressing at the present day. The Gould, Sclater, Shelley, and Sharpe collections, with many others of greater or less importance, have passed into the hands of the Trustees. Then came, in 1885 the, magnificent donation of Mr. Allan Hume, followed by that of the Tweeddale collection

presented by Major Wardlaw Ramsay, to whom it had been bequeathed by his uncle, the Marquis of Tweeddale. Messrs. Salvin and Godman not only gave their unrivalled set of American birds, but Mr. Godman supplemented this splendid present by employing a staff of collectors to work out the ornithology of Mexico, and presented the results of their expeditions to the Museum. He also purchased the celebrated Henshaw collection, and gave it to the nation. Many other collections have since been acquired by him, and likewise presented to the Trustees of the British Museum. Only lately can it be said that we possessed in England a representative set of North American birds.

Meanwhile, although the series of Indian, African, Australian, and American birds had become adequate and representative, the ornithology of the Palæarctic region was but feebly illustrated. Through the exertions of Lord Walsingham and other English ornithologists, the nesting-habits of our British birds have been successfully demonstrated by the well-known series of groups in the Natural History Museum; but the birds of Europe and Northern Asia were poorly represented in its cabinets. By the splendid bequest of Mr. Henry Seebohm, this vacuum in our Palæarctic collections has been filled, though there is no one in the Museum who does not feel that this addition to the strength of its ornithological section has been attained only through the loss of one of the truest friends of the institution which his dying wishes have enriched. There has not yet been time to register and incorporate the specimens of the Seebohm collection, but we know that we have now received the principal collection of Palæarctic birds of modern times.

A few years ago Mr. Seebohm presented his collection of eggs, and, with this as a basis for the work, the entire series of oological specimens in the Museum was set in order and arranged under his own supervision by my daughter, Emily Mary Sharpe, till it was found that, with the Hume and Salvin-Godman collections, the British Museum could boast of a series of 48,000 eggs of birds.

In the same generous spirit, he freely gave the type-specimens of any birds he possessed, that the value of the "Catalogue of Birds" might be enhanced thereby; and now, by leaving the contents of his Museum to the nation, the British Museum becomes possessed of several invaluable additions to its ornithological collection. Thus are added: the Swinhoe collection of Chinese birds, the Pryer collection of Japanese birds, the series of specimens obtained by Holst in the Bonin and Loo-choo Islands, and Formosa; and last, but not least, his own European and Siberian collections, the result of his travels in all parts of Europe, and of his expeditions to the valleys of the Petchora and the Yenesei. Of his collection of *Charadriidæ*, he had already presented hundreds of specimens to the Museum, but by his bequest is added the series which formed his special series of the plovers and snipes, on which, indeed, was founded his great work on the geographical distribution of the *Charadriidæ*. He had, moreover, in contemplation a "Monograph of the Turdidæ, or Family of Thrushes," and in pursuance of this object he had amassed a large collection of thrushes, which now passes into the ornithological collection of the British Museum. Nests and skeletons of birds are in plenty, and a set of the Layard collection of Oceanic birds and others from the Whitehead expedition to Kina Balu, the Prjevalski and Severtzov expeditions in Central Asia, make up one of the most important donations which the Trustees of the British Museum have ever received. His series of skins of the *Phasianidæ* was one of the finest in the world, and the value of the osteological collection cannot be overestimated, as it formed the material on which was founded his many essays on the "Classification of Birds."

In this necessarily imperfect sketch of the contents of the Seebohm collection, of which a fuller account will only be possible when it has been arranged and registered in the archives of the British Museum, it is impossible to give a detailed history of the various collections which constitute its importance to ornithologists. I feel, however, that I cannot close this article without expressing my opinion of the great loss which ornithology in general, and this country in particular, have sustained by the death of Mr. Seebohm, for, had I space to tell, it would interest naturalists to know how the great collection of birds in the Natural History Museum has been built up, by the help of such men as Henry Seebohm and the other munificent, though unostentatious, donors whose names I have recorded above. I believe, however, that under the enlightened sway of its present Director, the Museum has a still greater future before it than it has enjoyed in the past, and that when the common people have the opportunity to "read, mark, learn, and inwardly digest" the lesson which the Museum is trying to teach, the nation at large will still more fully appreciate the work of such men as Henry Seebohm.

R. BOWDLER SHARPE.

MOVEMENT.[1]

SOME of the results of the researches of M. Marey on the movements of men, horses, and fishes, have appeared from time to time in English papers. The skill and originality displayed by M. Marey in experimental work, involving great difficulties, must have astonished many, at a time when the idea of taking a rapid succession of photographs of a moving object was new.

The method of determining time-periods by means of a continuous chain of photographs appears to be due to Mr. Jansen, who used it in 1874 to record the transit of Venus across the sun's disc; he also suggested that the method might be applied to the study of animal locomotion. The subject of intermittent photography was attacked by Mr. Muybridge, who discovered, by means of a method different from that suggested by Jansen, the analysis of the locomotion of men, horses, and other animals. Mr. Muybridge took successive photographs of moving animals, using a battery of cameras and lenses, each plate being exposed automatically at the required instant; he also produced photographs of pigeons in flight. The end aimed at by Marey was to use a succession of photographs for chronographic purposes: photographs so taken have been called chronophotographs; his method of procedure is as follows. The object to be chronophotographed performs its movements in full sunlight before a black background of unilluminated velvet. The camera employed is furnished with a slotted disc (*disque fenêtre*) which can be uniformly rotated; as each slot cuts the beam of light reflected from the moving object, the sensitive plate receives an impression, which gives the exact form and position of the object at the instant, the duration of exposure being $\frac{1}{500}$th of a second, and the interval between the formation of each image $\frac{1}{10}$th of a second. A chronometric dial is so placed that the position of its revolving pointer is recorded on the same sensitive plate; this instrument serves to indicate both the time of exposure and the time between successive exposures, the pointer of the chronometric dial being driven at a known uniform velocity.

Provided with this instrument, and the photographic gun (which is described on pp. 108–115), and certain other special arrangements for the chronophotography of fishes, the excellent results shown in "Movement" have been obtained.

Mr. Eric Pritchard, assisted by his sister Mrs. Chalmers

[1] "Movement." By E. J. Marey. Translated by Eric Pritchard, M.A., M.B., B.Ch. (Oxon.) 323 pp., 200 illustrations. (London: William Heinemann, 1895.)

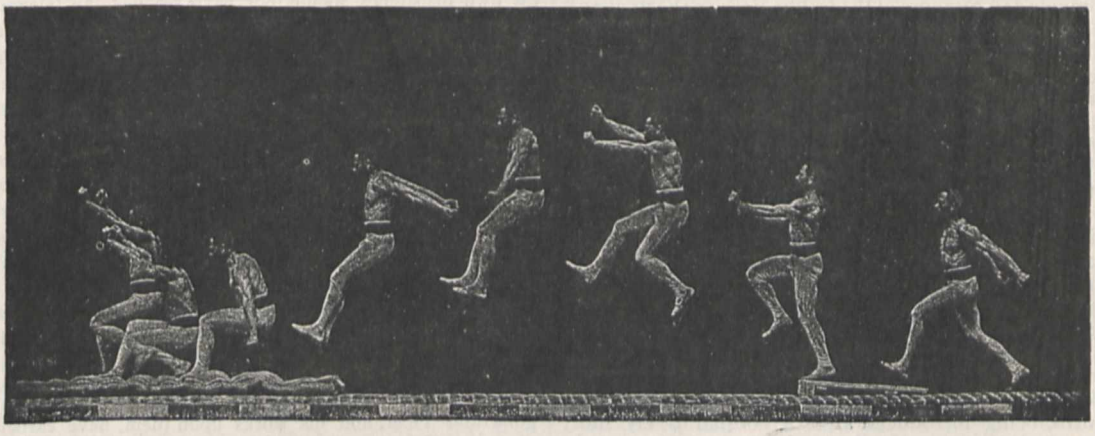
Mitchell, has produced an excellent translation of "Le Mouvement," by E. J. Marey (G. Masson, Paris), on which they may be much congratulated. The work will be most acceptable to a large number of readers widely differing in their lines of study. In many cases the details of the construction of the apparatus and its use are so clearly given, that but little difficulty should be experienced by any of those who wish to use chronophotography in researches on the movements of any animals, from elephants to microscopic insects. The translators have reproduced a large number of plates, amongst which the following seem to be good illustrations of chronophotography.

The flight of the heron (p. 233).

The arrangement of apparatus for taking three simultaneous chronophotographs of a flying bird from three points of view—from the front, the side, and from above (p. 236). By means of these chronophotographs, bas-reliefs have been constructed, showing the successive attitudes of the bird during flight.

Different figures of rotation (Figs. 15-24); amongst which that of a certain sphere (p. 30) is most curious. "The inner and outer surfaces of this sphere can be seen at one and the same time."

Fig. 92. Successive phases of a long-jump; this should be of interest to the tyro in athletics, as by it the exact position of the champion athlete may be seen at any instant.



Successive phases of a long jump. (Chronophotography on a fixed plate.)

It is much to be regretted that several plates in the French edition have been omitted, notably that of the camera and revolving disc, which shows at a glance the disposition of the different parts of one of the most important instruments; and that of the print, at the end of the French edition, called "Escrime au Bâton," which is full of life and energy, and would certainly appeal much both to the scientific and to the artistic reader.

F. J. S.

THE NEW MUZZLING ORDER.

SINCE Darwin, in his "Journal of Researches," wrote of the occurrence of hydrophobia in Central and South America, much has been learned of the nature of this disease. He says: "In so strange a disease, some information might possibly be gained by considering the circumstances under which it originates in distant climates; for it is improbable that a dog already bitten should have been brought to these distant countries." It is now known that such a possibility must receive careful consideration. In the first place, it has now been placed beyond doubt that hydrophobia is a specific infective disease, which so far as can at present be ascertained, does not originate *de novo*, but can only be introduced into a district or country by being passed on from animal to animal, different species of which, however, are affected in very varying degree. In the second place, the disease may remain latent for a long period after an animal has been infected—through a bite, usually; for this reason it is sometimes a very difficult matter to trace the infection to its source, with the result that the method of spread of the disease was for long very imperfectly understood, although the means for preventing its extension, when once it had obtained a foothold in a district, had long been elaborated and found to be thoroughly efficient when properly applied.

In this country our statistics relating to the localisation of rabies are now so full and trustworthy, that it seems to be little short of a public health scandal that the disease has not long ere this been completely eradicated from our midst. Let us take this new muzzling order, which is undoubtedly a step in the right direction. For some time past it has been perfectly well known that an outbreak of rabies was not only imminent, but had actually occurred in the north of London. The disease has made its way apparently from Essex to Middlesex, or it may be from the north, but up to the promulgation of the muzzling order, which came into force on Monday, no definite effort had been made to circumscribe the disease. We may expect that the regulations now brought into force will very soon have the desired effect of diminishing the number of animals returned as rabid; but from the experience of the Berlin authorities, we cannot expect to stamp out the disease even in London so long as Middlesex, Surrey, and the surrounding counties of Essex, Sussex, and Hampshire return cases of rabies, and any one of them fails to enforce a muzzling order. In Berlin, up to July 1853, there was no muzzling order, and in 1852 there were 107 cases of rabies reported, and up to July 1853, 85 cases. After this there was a marked fall in the number of cases; but so long as the law was merely municipal, the disease had still to be reckoned with. Since, however, the Prussian Animals Diseases Acts, 1875 and 1880, were passed (relating to the whole of Prussia), the disease has become rare, and *only occurs along the French and Russian borders.*

It is to be noted that rabies in England and Scotland is at present confined entirely to certain populous counties and centres, and that it is especially common in those districts in which dogs are favourite domestic companions or pets. On examination of the Rabies Chart for the year 1894, it is found that the majority of cases occur in Lancashire, the West Riding of Yorkshire, then, *longo intervallo*, Cheshire, London, Ayr, Lanark, and

Renfrew, and then Dumbarton and Edinburgh in Scotland, and in England, Derby, Warwick, Essex, Middlesex, Surrey, Hants, Sussex and Cornwall. The disease is strictly localised in four very definite centres, each, with the exception of that in which Cornwall is situated, containing a group of five counties. These counties are, of course, under different local authorities, so that it is impossible, in some cases at least, to obtain combine action in the matter of taking measures to stamp out the disease. It is objected that each authority must take this matter into its own hands, and act as it thinks best; but where the welfare of adjacent districts is so closely involved, as in such a case as this, some central authority might surely bring pressure to bear in order to ensure conjoint action. The Board of Agriculture, for instance, might, either by diplomacy or financial argument, compel joint action on the part of the counties situated in the above infected areas, leaving the uninfected areas free to act as they think proper. A muzzling and registration order so enforced for a couple of years would, in all probability, bring about the disappearance of rabies from our island. It is sometimes objected that the muzzle is a cruel apparatus. We have it on the authority of the most eminent veterinarians, that the cage muzzle, when properly fitted so as to allow the animal to lap water and eat grass, but not to bite, causes little or no discomfort to the dog, but that the strap muzzle, which is recommended by some of those who pose as the "friend" of the dog, is not only an uncomfortable but actually an unhealthy apparatus, as it keeps the animal from opening its mouth and getting the free use of its tongue. In Norway, Denmark and Sweden, rabies is little known; a system of quarantine is insisted upon, so that none but valuable dogs, and therefore animals constantly under observation, can gain access to these countries. Once the disease has been stamped out, it would be a comparatively easy matter to prevent its reintroduction. Even Darwin, in his time, observed that there was no hydrophobia in Van Dieman's Land and Australia, and that it only made its appearance in South America in 1803, and that it had then apparently made its way south from Central America. In the old days of long passages to these places, dogs were for long under observation before they were introduced into the new countries, and in the case of America the disease must have first appeared in the north, being introduced after a comparatively short voyage, and then gradually making its way south. Muzzling, and the taking up of unmuzzled dogs, when properly carried out, has been so successful hitherto, not only locally in this country, but generally in other countries, that the new order will be warmly welcomed by all who have studied this matter carefully, as the first step towards a really efficacious measure—combined action on the part of the authorities in the rabies areas.

NOTES.

"THE Diffusion of Metals" is the subject of the Royal Society's Bakerian Lecture, which is to be delivered to-day by Prof. Roberts-Austen, C.B., who has obtained some singular experimental results connected with the mobility of solid metals. Many experimenters in this country, especially Prof. Graham and Lord Kelvin, have studied the diffusion of gases and saline solutions, and Prof. Roberts-Austen has measured the rate at which certain metals will penetrate each other. He finds that solid gold, for instance, will diffuse into, and move about slowly in lead, even at the ordinary temperature of the air, and with considerable rapidity if the lead be warmed, though far from melted. Evidence as to the presence of wandering atoms in a solid, possesses much interest now that views as to the nature of metals and other solids have been extended by the discovery that certain rays of light will penetrate them.

THE announcement of the attainment of the North Pole by Dr. Nansen has been received with great popular interest and even enthusiasm. According to Prince Kropotkin, the correct text of the telegram which was received at St. Petersburg concerning Nansen was as follows:—"Irkutsk, January 31 (February 12).—The contractor for Nansen, Kushnareff, through the Kolymsk *ispravnik* (chief of police) Kandakoff, by mail from Yakutsk to Kirensk, and thence by telegraph, informs the *Eastern Review* that Nansen has reached the Pole, has discovered land, and returns." M. Kandakoff appears not to be the chief of the police of the Verkhoyansk district, but a "councillor to the Provincial Government of Yakutsk and a member of the Yakutsk expedition," which fact gives a much greater weight to the news. The Russian Government immediately took steps to have the truth of the report tested, but some time must necessarily elapse before authoritative confirmation is received. The absence of date and of any hint as to whether a direct message from Nansen or his crew had been received, lead us to suspect that the report may be a rumour similar to that which reported the *Fram* in the ice east of Greenland last autumn. It seems rather late in the season, even allowing for the slow rate of travelling in North-eastern Siberia, for information to come from the New Siberian Islands; while if Nansen had landed himself on the Asiatic coast, it is difficult to believe that his own dispatches should not have reached the telegraph as soon as the vague report. On the other hand, it is necessary to remember that there is nothing improbable in the news. If land intervened and stopped the drift of the *Fram*, a land expedition would certainly have been made, and the ship afterwards taken south by the clearest route irrespective of destination. She might have been frozen up at the beginning of winter somewhere within reach of the New Siberian Islands, and it is possible enough that she was visited by native hunters, who may have carried a message. While, therefore, we fully recognise the possibility of the news being authentic, and it becomes more probable as the source of the information is inquired into, we must await further information before believing that the past record of Arctic exploration has really been so brilliantly surpassed.

MR. WILLIAM W. ROCKHILL, whose journeys through Mongolia and Tibet, and his works upon them, have earned him distinction among geographers, has been promoted to the assistant-secretaryship in the State Department at Washington.

MISS CATHERINE W. BRUCE has recently made another addition to her numerous benefactions to astronomy in both Europe and America, by presenting to the University of Chicago the sum of one thousand dollars, to be used for the purpose of providing illustrations for the *Astrophysical Journal*.

THE death is announced of M. Jules Reiset, member of the Section of the Rural Economy of the Paris Academy of Sciences, and the author of many valuable contributions to agricultural chemistry and animal physiology.

A LECTURE will be delivered, on Thursday next, at the Royal Artillery Institution, Woolwich, by Dr. G. H. Bryan, F.R.S., on "Flight and Flying Machines."

THE Ethnographical Survey Committee of the British Association would be glad to receive offers of assistance from persons capable of making the requisite measurements of individuals belonging to rural populations. The Committee would supply instruments and full information. It is requested that competent observers might find it interesting to occupy themselves during some part of the Easter vacation in this manner. Applications may be made to the Hon. Sec., Mr. E. S. Hartland, Highgarth, Gloucester.

PROF. D. KIKUCHI informs us that on December 28, 1895, an Imperial Ordinance was promulgated by which a new standard time was established in Japan. The ordinance read as follows: (1) The standard time of the Empire hitherto in use shall henceforth be called the Central standard time. (2) The time of the meridian of 120° east longitude shall be the standard time of Taiwan (Formosa), Hōko group (the Pescadores), and Taeyama and Miyako groups, and shall be called the Western standard time. (3) This ordinance shall come into effect on January 1 of the twenty-ninth year of Meiji (1896).

THE Hayden Memorial Medal of the Philadelphia Academy of Natural Sciences has been awarded to Prof. Karl von Zittel, whose services to the sciences of geology and palæontology extend continuously over a period of thirty years. Born in 1839, Prof. von Zittel was, at the age of twenty-four, appointed to the Professorship of Mineralogy at Karlsruhe, and three years later to the Professorship of Palæontology at the University of Munich, a position, jointly with that of Director of the Palæontological Museum, which he still holds. His published works cover a large range of personal investigation, not the least important of which are the researches into the structure and physiography of the Libyan Desert and the Sahara, and his monumental work, "Handbuch der Paläontologie," which has not long been completed.

THE work of the Marine Biological Association at Plymouth has, for a number of years, been carried on under great difficulties, owing to the want of a suitable steamboat capable of working in the Channel. We are glad to be able to announce that this difficulty has now been overcome by the purchase of the steam fishing yacht, *Busy Bee*, from Mr. C. E. Treffry, of Fowey. The vessel is 56 feet long, with a registered tonnage of 7·9, and is a good sea-boat, capable of going anywhere in the English Channel. With the increased facilities for marine work which will thus be offered, it is hoped that a still larger number of naturalists will visit the Laboratory. Applications for the use of tables during the Easter vacation, including, when desired, participation in the dredging and trawling work to be carried on by the new yacht, should be sent without delay to the Director.

WE regret to notice the death, on Sunday, of General J. T. Walker, C.B., F.R.S., whose work as Superintendent of the Great Trigonometrical Survey, and Surveyor-General of India, is widely known and appreciated. From an obituary notice in the *Times* we learn that he was born in 1826, and entered the Bombay Engineer Corps in 1844. He joined the Trigonometrical Survey in 1852, and, except for a short time during the Mutinies, he was incessantly employed on work connected with it, under Sir Andrew Waugh, until he succeeded that officer as Superintendent in 1861. He held this post for twenty-two years, combining with it during the last five years the Surveyor-Generalship and the charge of the Revenue Surveys. He continued and completed the original scheme of the Great Trigonometrical Survey, and conducted numerous collateral operations connected with it. General Walker's labours were not confined to geodesy. He was in the first rank as a geographer. On retiring from India in 1883, he became an active member of the Council of the Royal Geographical Society, and was an authority on all questions relating to Central Asia. Last July he took a leading part in the geodetical business of the International Congress, and was doing useful geographical work up to within a short time of his death.

WE cordially welcome the *Centralblatt für Anthropologie, Ethnologie und Urgeschichte*, edited by Dr. G. Buschan, as supplying a real need. Other sciences, such as zoology, botany, or chemistry, have journals the aim of which is to keep their readers abreast with the literature of their respective subjects. Till now the very comprehensive study of anthropology has been without such a necessary journal, although several anthropological serials make a point of giving some idea of current literature. Dr. Buschan has secured the co-operation of a large number of colleagues, which will ensure catholicity in the selection of notices. There are to be a few quite short original articles, and various items of general interest and personal notices. This first number contains short, clear notices of 112 papers and books. We hope that the "bibliographische Uebersicht," which is promised, will give the current literature as exhaustively as is possible. If this is done, the new journal will be of the greatest value to all those interested in the study of man.

AT the annual meeting of the Royal Astronomical Society, on Friday, the gold medal of the Society was awarded to Dr. S. C. Chandler for his many astronomical investigations, and especially for his work in connection with the variations of latitude.

THE successive deaths, following so soon one after the other, of the two great American systematic botanists, Dr. Asa Gray and Dr. Sereno Watson, suspended the publication of their great Synoptical Flora of North America, of which two parts were published, and were reissued by the Smithsonian Institution in 1886. Arrangements have now been made for carrying on the publication, and a fascicle of upwards of 200 large octavo pages is published, under the editorship of Dr. B. L. Robinson. It comprises the orders of Polypetalæ from Ranunculaceæ to Frankeniaceæ.

ACCORDING to the recent investigations of Dr. R. F. Kaindl (*Globus*, lxix., 1896, pp. 69, 90), the Huzulen retain many primitive customs; these people are Slavs who inhabit the Galician Carpathians, and are nominally Roman Catholics. Everywhere one comes across wooden crosses erected over buried brandy-bottles. In 1894 a "Brandy-prophet" appeared; he was a simple peasant who waged a successful warfare against brandy-drinking. The zeal of the people constrained the clergy to bury the spirit with ceremonies; and now in this country the use of brandy has ceased; and the words of an old Huzulen may be true, that at the present time only those drink brandy who are worth nothing. A gypsy, who had sent his wife away, bought the daughter of a Huzulen for fifty florins; he was had up by the magistrate, but that had no effect; in a year he was tired of her, and then he hired the wife of another Huzulen for sixty florins; again the law was powerless, and at the end of the year the husband came for his wife. There are two remedies for back-ache—one is for the priest to walk on the patient's back in church, and the other is to let a bear walk on it. Weasels, snakes, frogs, puppies, and kittens may not be killed, and there are numerous charms against the two first. For three days before the Huzulen moves into a new house he throws a black hen on it, so that snakes may not nest there. Black cattle are lucky. The mentioning of certain words for simmering and boiling is prohibited when applied to milk, lest harm should come to the cows. The grave-diggers and coffin-makers wash their hands over a grave to signify that they are not to blame for the sorrow, and the relatives ask the latter not to be angry with the dead for the trouble he has caused them, and not to ask for payment from him in the next world. Several original sketches illustrate this article.

GEOLOGY and agriculture, as well as meteorology, writes Prof. Abbe in the *Monthly Weather Review*, are interested in the part played by the small quantity of carbonic acid gas that exists in the atmosphere. The leaves absorb and assimilate a portion; the falling raindrops and the surface water of the ocean absorb

another portion; it is exhaled from the lungs, and given off in still greater quantities from every burning substance. It may accumulate temporarily in some regions, but the slow diffusion and swifter winds carry it away. It ought to diminish as we ascend above the earth's surface, but the rapidly rising and falling currents of air tend to preserve a fairly uniform mixture very much as they do in the case of aqueous vapour. Evidently there is a general balance between the production and absorption of carbonic acid gas, so that, like the temperature of the air and the quantity of rain or any other meteorological element, we find no great progressive secular increase or diminution. An article in *Wollny's Forschungen* (1895, vol. xviii. p. 409) reviews the latest additions to our knowledge of the distribution of carbon dioxide in air. A comparison of the proportion of the gas in samples of air obtained near the earth's surface with that of samples collected by S. A. Andrée at various altitudes, failed to prove any diminution of carbon dioxide with altitude up to the highest point, 4300 metres, obtained in the balloon ascensions. On the other hand, the percentages of the gas by volume throughout the different strata of air, are very much the same as those observed at the surface of the earth. An apparent dependence upon the wind was, however, suggested by the results, and when the percentages were discussed from that point of view, the general conclusion arrived at was that a descending mass of air brings with it a higher percentage of carbonic acid gas, which is subsequently diminished by absorption near the earth's surface, so that the ascending current has a smaller percentage. The question here raised is one of great importance in the theory of the interaction of the atmosphere and the earth, and it can only be brought to a definite solution when the greatest possible number of investigations into the percentages of carbonic acid gas in the atmospheric strata are carried out by means of balloon voyages.

UNDER the sensational title of "Longitudinal Light," a paper by G. Jaumann appears in *Wiedemann's Annalen der Physik und Chemie*. It is based upon the law of electric discharge enunciated by the same writer in 1888, according to which electric waves impinging at right angles upon a kathode surface favour the dissipation of the charge upon it. This was proved experimentally by Hertz in the case of ultra-violet light, and by Elster and Geitel in the case of ordinary light impinging upon a liquid electrode in a vacumn. Wanka also proved it in the case of electro-magnetic waves. Hence, so the writer argues, light vibrations must have a component in the direction of propagation; they must, in fact, contain longitudinal as well as transverse waves. That this is so, is made extremely probable by the analogy of kathode rays. The latter have the vibration period of waves in wires, and are therefore pretty certainly longitudinal. Now comes the question how Maxwell's electromagnetic equations, which do not admit of any but purely transverse vibrations, can be made to agree with these conclusions. Jaumann gives a simple answer. Let it be admitted that the specific induction capacity of a medium and its magnetic permeability are affected by the oscillations themselves. These "constants" will then be variable, and when introduced as such into the equations, longitudinal vibrations are at once seen to be possible. Each pencil of light will then be vibrating transversely along its centre line, and towards the outer edge the vibrations will become more and more longitudinal. This theory is a distinct innovation; but the author claims that it affords a natural and simple explanation of a large number of discharge phenomena. Thus the curious diffused reflection of kathode by a plane surface is easily reduced to the fact that Huyghen's principle of reflection no longer holds good.

ALTHOUGH we may still identify a particular disease with a particular microbe, yet there can be no doubt that the part played by other microbes associated with pathogenic germs is of very great importance in determining the course pursued by the disease. The co-operation of bacteria is, therefore, a subject which is gradually more and more occupying the attention of bacteriologists, and in the last document issued by the Russian Imperial Institute of Preventive Medicine, M. Maschevsky has published a very extensive series of investigations on the effect upon the cholera bacillus of cultivation in the presence of other microbes. Several varieties of bacteria were isolated from the intestinal tract of man and animals, as well as from apples and cucumbers, and with these the cholera bacillus was then grown. The number of bacteria from these sources in themselves proved to be harmless, but which served to exalt the virulence of the cholera bacillus, appears to be very considerable. Perhaps one of the most interesting results is the discovery that cholera bacilli which had lost their virulence, regained it completely when associated with perfectly harmless bacteria isolated from apples and cucumbers. M. Maschevsky considers, therefore, that he has discovered a scientific basis for the popular prejudice which condemns the consumption of uncooked fruit and vegetables during epidemics of cholera. Prof. Metchnikow has already dwelt at considerable length upon the effect produced by the nature of the bacterial flora present in the intestine upon the virulence of cholera bacilli, and seeks to explain in this manner what may be described as some of the "vagaries" of cholera epidemics. The whole subject is one of great importance, but one which, involving as it does experiments of the most extensive and laborious nature, still requires an immense amount of work to place on a satisfactory basis. M. Maschevsky's investigations must be regarded as an important contribution in this direction.

MESSRS. CROSBY LOCKWOOD AND SON have nearly ready for publication a volume entitled "Light Railways for the United Kingdom, India, and the Colonies," by Mr. John Charles Mackay.

TO the Hand-list of Orchids cultivated at the Royal Gardens, Kew, which has just been issued, is prefixed a preface giving an interesting historical sketch of the cultivation of orchids in this country. In the year 1890 as many as 766 species belonging to the order flowered in the Gardens.

THE first part o. a "Géométrie Descriptive," by M. A. Gouilly, dealing with the geometry of points, straight lines, and planes, has been published jointly by MM. Gauthier-Villars and G. Masson, in the Aide-mémoire Series. The second volume of the work will be concerned with the sphere, cone, and cylinder of revolution, and conic sections; while changes in planes of projection and rotation will form the subject of the concluding volume.

THE *International Journal* of Microscopy and Natural Science, the fifth volume of which (third series) has lately been issued, contains many important contributions to the knowledge of nature in the animal, vegetable, and mineral worlds. The *Journal* is the organ of the Postal Microscopical Society, and is edited by Mr. A. Allen, with the assistance of three associate editors, viz. Prof. V. A. Latham (Chicago), Mr. J. S. Brown (Montreal), and Dr. F. Vicentini (Chieti). Naturalists generally, and workers with the microscope, will find much interesting and serviceable information in the new volume.

WHEN the Austrian Government took over the administration of Bosnia and Herzegovina in 1879, meteorological observations were commenced at a few stations, the number of which has now increased to seventy-seven; three of these are of the first order, or provided with complete self-recording instruments. The Government of these Provinces has recently published its first volume, containing hourly observations and curves for

Sarajevo and Mostar, daily observations at four stations, and monthly and yearly results at all the stations, for the year 1894. A fully-equipped mountain observatory has also been established on the Bjelasnica (lat. 43° 42′ N., long. 18° 15′ E.), at an altitude of about 6800 feet; the publication of these results will commence with the next volume.

THE Kew *Bulletin of Miscellaneous Information* often furnishes us with material for notes; and in looking through the volume containing the numbers published during 1895, we are struck with the large amount of valuable information to be found in its pages. Kew has trained and sent out botanists to botanic gardens in most parts of the world, and it is chiefly due to them and the Director of the Royal Gardens, that the *Bulletins* are able to do so much to extend the knowledge of economic plants. The services thus rendered to the national welfare, by the publication of exact information with reference to botanical enterprise and the potentialities of newly-explored regions, cannot be over-estimated. All who wish to see how science can assist in developing the resources of our colonies, are advised to turn to the 1895 volume of the *Bulletin* of the Royal Gardens, and they will not be disappointed.

THE "Electrical Trades' Directory and Handbook for 1896" (14th year), published at the office of *The Electrician*, furnishes wonderful evidence of the extent of electrical industries at the present time. It consists of over five hundred pages of handbook matter, and nearly seven hundred pages of directorial information. The volume is invaluable to all who are concerned with the production and supply of electricity. Another handy book for electrical engineers and contractors is "The Universal Electrical Directory," published by H. Alabaster, Gatehouse, and Co. This publication, which has now reached its fifteenth year, contains a complete record of all the industries directly or indirectly connected with electricity and magnetism, and the names and addresses of manufacturers at home and abroad.

THE *Quarterly Statement of the Palestine Exploration Fund* (January 1896) contains the usual detailed record of careful exploring work. Of more general interest is the adventurous expedition of Mr. and Mrs. Gray Hill to the isolated and remarkable Crusaders' Castle of Khauranee, of which photographs are given. Lieut.-Colonel C. M. Watson has attacked the problem of the position of the Temple of Jerusalem. He states his views with much plausibility; his method is the scientific one of first considering the historical written evidence, and then the levels of Mount Moriah as it originally existed before Solomon began to build the Temple; and he has drawn his plans in accord with the historical documents, and also with what exploration has shown to be the actual facts. Lieut.-Colonel Conder has an essay on the Syrian language and the history of Samâla.

DR. G. BROWN GOODE'S report upon the condition and progress of the U.S. National Museum, under the direction of the Smithsonian Institution, during the fiscal year ending June 30, 1893, has come to hand. The report is especially noteworthy on account of the description Dr. Goode gives of the development, organisation, scope, and work of museums generally, and the National Museum in particular. The description is lavishly illustrated by full-page plates reproduced from photographs of objects and cases in the museum. Bound up with the report are ten papers describing and illustrating collections in the National Museum, among them being "The Poisonous Snakes of North America," by L. Stejneger; "The Onyx Marbles," by G. P. Merrill; "The Cowbirds," by Major C. Bendire; "The Weapons and Wings of Birds," by F. A. Lucas; and "Ethnology of Tibet," by W. W. Rockhill. These papers, which are accompanied by numerous full-page plates, are most valuable contributions to knowledge. The papers, together with Dr. Goode's report, fill nearly eight hundred pages, and the whole stands as striking evidence of the liberality of the Smithsonian Institution in matters of publication.

THE third annual report (vol. iv.) of the Iowa Geological Survey, dealing with the work accomplished under the auspices of the Survey during 1894, has been received. The report shows that a large amount of valuable information was accumulated with reference to the geological structure, and geological products of economic importance, in several counties of the State of Iowa. The method followed by Dr. Samuel Calvin, the State geologist, is to give reports of the geological features of each county separately. He recognises, of course, that this involves following an artificial subdivision of the State; for county boundaries have no relation to the distribution of geological formations. But, at the same time, he points out that the present citizens, as well as prospective settlers and investors, think not of naturally-defined areas, but of counties in which they become interested; and they will turn to the geological report of the several counties under consideration for information concerning the resources of them. Dr. Calvin reports that the work of the Survey continues to demonstrate that the Iowa coal-measures are far richer than they have been believed to be. The report is illustrated by numerous maps and figures, and is standing evidence of the vigour and thoroughness with which the work of the Survey is carried on.

AMONG the many interesting articles and notes in the number of the *Asclepiad* just issued (No. 44, vol. xi.), is a biographical paper on Dr. Thomas Young, by Sir B. W. Richardson, accompanied by a fine autotype portrait of him. Dr. Young is perhaps better remembered by his optical observations than for his medical researches. His mind was turned towards natural philosophy, and it was in that domain rather than in his profession that he earned distinction. He did, however, make some contributions to medical science. About the year 1813, he wrote an essay on the medical facts of climate, containing a large amount of valuable information. In the same year he prepared an introduction to medical literature, including a system of practical nosology, and his essay on consumption attracted considerable attention. Throughout his life he was a close student of vision and of the eye, and in the Bakerian Lecture which he delivered before the Royal Society in the first year of this century, he entered largely into the dimensions and refractive qualities of the eye, and the size of the pictures which are developed on the retina. It was in physical investigations that Young excelled, and especially in connection with interference and the wave-theory of light. He died in May 1828, after just completing his fifty-sixth year.

The current number of the *Berichte* contains an interesting historical note, by Dr. G. W. A. Kahlbaum, on the origin of the "Liebig's Condenser." The inventor of this indispensable piece of apparatus appears to have been C. E. Weigel, Professor of Chemistry and Botany at Greifswald. The account of this apparatus, with diagram, a facsimile of which is reproduced in the *Berichte*, first appeared in 1771, thirty years before Liebig was born. It should be noted, however, that Liebig never described this condenser as his own, but called it Göttling's; and the latter, again, who seems to have made these condensers for Liebig, distinctly refers its invention to Weigel. On these grounds, Dr. Kahlbaum thinks it should be henceforth known as "Weigel's Condenser."

THE chemistry of the simpler organic fluorine derivatives, after a period of comparative neglect, has during the last few years been vigorously followed up, more especially in France. At the meeting of the French Academy of Sciences on February 3, two papers were presented on the acid fluorides, one

by MM. M. Meslans and F. Girardet, the other by M. A. Colson. In the first paper, the method previously used with success by M. Meslans in the preparation of other organic fluorine derivatives, the treatment of the corresponding chloride with metallic fluorides, was employed. M. Colson used a rather different method, the action of the halogen acid upon the organic acid in presence of a dehydrating agent. With hydrogen fluoride, the anhydride of the organic acid gives the best results; thus with acetic anhydride the reaction is

$$(CH_3.CO)_2\,O + HF = CH_3.CO.F + CH_3.CO.OH.$$

The operation, which must be carried out in a freezing mixture in a metallic flask, gives a theoretical yield. Acetyl fluoride boils at 20°·8 under a pressure of 770 mm., and its density at 0° is 1·0369. Propionyl fluoride boils at 44°, and is lighter than water, its density at 15° being about 0·972. Benzoyl fluoride, which has already been prepared by M. Guenez, is best obtained by acting with benzoyl chloride upon dry zinc fluoride, and is a liquid of extremely irritating odour, boiling at 154°.

THE additions to the Zoological Society's Gardens during the past week include a Common Viper (*Vipera berus*), British, presented by Mr. S. Ockenden; four Japanese Teal (*Querquedula formosa*, ♂ ♂ ♀ ♀) from North-east Asia; two Smews (*Mergus albellus*, ♂ ♂), European, a Black Lark (*Melanocorypha yeltonensis*) from Siberia, purchased; a Purplish Death Adder (*Pseudechis porphyriaca*), a Punctulated Tree Snake (*Dendrophis punctularia*) from Australia, deposited; a Hybrid Pheasant Antelope (between *Tragelaphus gratus*, ♂, and *Tragelaphus spekii*, ♀), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

PERRINE'S COMET.—A telegram from Kiel announces the re-discovery of Perrine's comet by Dr. Lamp, on February 13. At 17h. 40m., Kiel mean time, it was in R.A. 19h. 44·8m. and decl. −2° 22′. The R.A. agrees well with the ephemeris published in NATURE on January 23, but the south declination is about a degree greater than that predicted.

A NEW COMET.—Another telegram from Kiel is as follows: "New comet Perrine Lamp, February 15, 17h. 28·6m., Kiel mean time; R.A. 19h. 26m. 44s., decl. −1° 1′ 56″; daily movement in R.A. 7m. 36s., in declination 2° 57′ towards the north; bright." The new comet is thus in the immediate neighbourhood of the original Perrine's comet, but it has a much more rapid movement. Both comets are in the constellation Aquila, rising about 4 a.m.

THE ZODIACAL LIGHT.—During the last three years the zodiacal light has been very carefully observed by E. Marchand, under the advantageous conditions afforded by the observatory of the Pic du Midi, at an altitude of 2860 metres (*Bull. Soc. Ast. de France*, February). Ordinarily this phenomenon is best seen during the evenings of spring or in the mornings of autumn; but in the absence of the moon, when the sky is clear, it is seen at all times of the year from the mountain observatory, completely encircling the celestial sphere. The limits of the luminosity have been plotted on charts, and taking the mean positions of the boundaries, it is found that the width of the belt of light is about 14°, and that it is very nearly a great circle inclined 6° or 7° to the ecliptic, with a longitude of about 70° for the ascending node. Now the inclination of the sun's equator is about 7°, and the longitude of the ascending node is about 74°; hence, it is concluded that the central plane of the zodiacal light coincides with the plane of the sun's equator.

The observations support the idea that the attenuated cosmical matter of which the zodiacal light is probably composed extends all round the sun, in the form of a very flattened ellipsoid of revolution, to a distance well beyond the earth's orbit.

In the part of the sky opposite to the sun, the brightness of the light is not greater than that of the most feeble parts of the Milky Way, but it becomes much more intense as the sun is approached. The increase of brightness in the direction of the sun, however, is more rapid than can be accounted for merely by the increased thickness observed, so that a greater condensation of cosmical matter in the neighbourhood of the sun seems probable. Near the horizon, the width of the zodiacal light seems generally greater than that which traverses the sky; but it is pointed out that this may be due to the same cause as that which makes the sun, moon, or constellations appear larger when near the horizon. The "Gegenschein," or counter-glow, does not appear to have been noted.

SURFACE DRIFT OF JUPITER.—A useful summary of the various determinations of the rotation period of Jupiter in different latitudes is given by Mr. Stanley Williams (*Monthly Notices*, lvi. No. 3). Nine distinct currents can certainly be recognised, and their boundaries are pretty sharply defined, though possibly varying slightly in position from time to time. These currents, with the exception of that including the red spot, completely encircle the planet, travelling due east and west, and giving little or no indication of any movement towards or from the poles. In the following tabular statement the number of the zone or current is followed by the zenographical latitudes of its boundaries; then follows the average rotation period of the zone expressed in time and in terms of the equatorial period.

Zones.	Lat.	Period. In time. h. m. s.	Period. In terms of equatorial period.
I.	+85° to +28°	9 55 37·5	1·0089
II.	+28° ,, +24°	9 54 30	1·0071
		9 56 30	1·0104
III.	+24° ,, +20°	9 48 0	
		9 49 30	0·9973
IV.	+20° ,, +10°	9 55 33·9	1·0089
V.	+10° ,, −12°	9 50 20	1·0000
VI.	−12° ,, −18°	9 55 40	1·0090
VII.	−14° ,, −28°	9 55 40	1·0090
VIII.	−18° ,, −37°	9 55 18·1	1·0084
IX.	−37° ,, −55°	9 55 5	1·0081

There is a remarkable want of symmetry in most of the currents. In the northern hemisphere the drift is nearly uniform from the pole to lat. 28°, and there is nothing equivalent to the red spot (zone VII.); in the southern hemisphere there is no counterpart of the region about lat. 25°, which is such a prominent feature in the northern hemisphere. It is suggested that atmospheric circulation in a north and south direction may take place through the narrow rifts which have been seen to traverse obliquely some of the belts and clear zones.

THE TEMPERATURE OF AIR AND THE PROBLEM OF AN ICE AGE.[1]

THE mean temperature t of the air is determined by the balance of radiations received from the sun and from the soil with that given up towards the sky, and is ruled by the action of meteorological factors. According to Maurer's and Trabert's discussion of nocturnal temperatures, air radiation in the atmosphere is a *linear* function of its temperature; so radiations from soil and towards sky are expressed as proportional to the differences $[(t_s - t), (t - t_c)]$ of t from the mean temperature t_s of soil, and from the mean temperature t_e of an ideal stratum, the radiations of which would be equivalent to that of the whole atmosphere and of all the celestial bodies except the sun. This temperature t_e I call *temperature of the sky*.

Similarly, the mean temperature t_s of soil is determined (if we abstract from meteorological agents, that is in *solar climate*) by the balance of its radiation towards the sky [which is proportional to $(t^s - t_c)$] with that fraction of mean solar heat which is bestowed upon heating the surface considered. The mean annual solar heat received by unity of surface at the limits of the atmosphere (which is 0·305 of the solar constant at the equator) diminishes with the latitude λ, not as $\cos\lambda$, but, according to Wiener's computations, as the cosine of an auxiliary angle ζ, which is 0° at the equator, and 65° 31′ at the poles, and which repre-

[1] I beg permission to briefly review the assumptions upon which Section II., III. of "I e Cause dell' Era Glaciale" (Pavia, 1865) is based, and which the reviewer of the book in NATURE (No. 1348, vol. lii. p. 412) judged as far from satisfactory.—LUIGI DE MARCHI.

sents zenithal distance of a fixed sun, the intensity of which would be 3/10 of the true intensity, and the annual effect of which would be equivalent to that of the true sun. At sea-level this quantity of solar heat is supposed to reduce itself, according to Bouguer's law, from 1 to $p^{\sec \zeta}$, where p is the mean transparence of the atmosphere.

Upon these assumptions, the *annual solar temperature* of the air on a *continental* globe is expressed (omitting here a little term for diffused heat) by a formula $t_1 = t_c + k_s \cos \zeta \frac{p^{\sec \zeta}}{m_s}$ where m_s is the transparence of the atmosphere for the earth's radiations, and k_s is a coefficient proportional to the *heating power* of solar radiation for soil, and depends then upon the physical constitution of the latter. On the sea the effect of solar heat is most complicated, but, abstracting from currents, arguments are given for accepting on *oceanic* globe a formula $t_0 = t_c + k_a \frac{p^{\sec \zeta}}{m_a}$, where m_a, k_a are the analogues of m_s, k_s for sea. Forbes expresses the mean temperature of each parallel by $t = t_0 + x(t_1 - t_0)$, when x is the fraction of parallel occupied by continents; but the same formula may express the mean temperature of every point on continents, if x means its *continentality*, whose expression by annual range e $\left(x = \frac{e - e_0}{e_1 - e_0}\right)$ is discussed.

The calculation of coefficients in the complex formulæ so obtained is very much simplified by comparison with known empirical formulæ. Mendeléef's formula for vertical distribution of temperature leads to the fundamental fact that the mean temperature of the sky, t_c, is a constant for all points at sea-level, and from evaluations of Mendeléef's constant by Woeikof I assume it as $-45°{\cdot}4$ C. ($-49°$ 7 F.). So is numerically expressed what Mr. Culverwell calls the *blanketing* function of atmosphere, and its function of conforming temperature on the earth's surface; and Croll's fallacy of evaluating effects of solar heat by differences from a hypothetical temperature of space is placed in evidence. Values of t_0, t_1 at equator, discussed from Forbes' formulæ, give values of $\frac{k_s}{m_s}$, $\frac{k_a}{m_a}$; p is assumed as 0·60.

Solar temperatures so obtained give a very satisfactory representation of facts; their differences from true temperatures are a striking reflex of the distribution of meteorological and physical agents (sea and air currents, convective motions, shore-ice, &c.) not accounted for in deduction of formulæ.

An attempt is made for a theory of annual range, where Wilson's principle of the constancy of nocturnal cooling of bodies, whatever may be the temperature of the air, allows the assumption that the temperature of the sky follows in its variations temperature of soil. Comparison of theory with facts indicates the enormous smothering influence of meteorological agents.

Discussions of astronomical and geographical theory of an Ice Age, in the light of the formulæ given, accounts for variability of physical and meteorological agents. None seems to me to satisfy either the theory or the actual conditions for variation of climates, as developed *on facts* by Brückner's classical work on "Klimaschwankungen." These conditions seem to the author to be satisfied by the suggestion of a small *diminution* in the transparence p, attended by a proportional, or by a smaller, diminution of m_s, m_a. So the difference $t - t_c$ is diminished, less at low latitudes, more at higher, above all at 70° Lat., the variation diminishing further. Diminution is greater on sea and less on continent, so diminishing at high latitudes thermic difference between earth and sea, what is, according to Brückner's demonstration, the capital condition for a rainy period on continents, and indirectly for glaciers pushing forward. Also the difference between equator and poles is strengthened.

Inversely, an increase of p and m_s m_a would bring, as in Tertiary periods, a more equal distribution of temperature between equator and poles, by increasing for several degrees the temperature in higher latitudes. Mars is probably in a similar condition, as polar ice-caps do dissolve, notwithstanding that the intensity of sun is there much less than on earth; but the Martian atmosphere is extraordinarily more transparent than ours. Annual range would be strengthened; but the flora of East Siberia suggests that also Heer's polar floras might have sustained severe winter, provided that summer's heat was sufficient to support them, and that abrupt variations were avoided.

THE RÖNTGEN RAYS.

THE field of investigation opened up by Prof. Röntgen's researches on the new actinic rays has attracted explorers from all parts of the civilised world. So numerous are the communications being made to scientific societies that it is difficult to keep pace with them, and the limits of our space would be exceeded if we attempted to describe the whole of the contributions to the subject, even at this early stage. It may assist, however, in the organisation of the facts if we bring together a few of the results obtained since the publication of Prof. Röntgen's paper.

The most important British communication on the subject was made by Prof. J. J. Thomson to the Royal Society on Thursday last, in the following paper, on the "Discharge of Electricity produced by the Röntgen Rays, and the effects produced by these Rays on Dielectrics through which they pass."

"The Röntgen rays, when they fall upon electrified bodies, rapidly discharge the electrification, whether this be positive or negative. The arrangement I have used to investigate this effect is as follows: The Ruhmkorff coil and the exhausted bulb, used to produce the rays, are placed inside a large packing case covered with tin plate; this is done to screen off from the electrometer any electrostatic disturbance due to the action of the coil. The needle of the electrometer is suspended by a quartz fibre; thus, as there is no magnetic control, the needle of the electrometer is not affected by changes in the magnetisation of the core of the coil.

"The exhausted bulb is placed so that the phosphorescent part of it is about 1½ inches from the top of the box, and a hole about an inch in diameter is cut in the lid of the box just over the bulb, so as to allow the rays to emerge from the box; a thin plate of either aluminium or tinfoil is used to cover up the hole. The electrified plate, which is a little larger than the hole, is placed outside the box about two inches above the hole in the lid, so that the Röntgen rays which passed through the hole fall upon the plate. This plate is kept permanently connected with one of the quadrants of a quadrant electrometer; the greatest care is taken with the insulation of this plate and of the quadrants of the electrometer. The insulation was so good that there was no appreciable leak when the coil was not in action. The following is the method of making the experiments: The two pairs of quadrants are connected together, and the plate charged to a high potential by an electrophorus, or by temporary connection with a large battery of small storage cells. All the quadrants of the electrometer are now at the same potential. The two pairs of quadrants are now disconnected; if the insulation is good the potentials will remain the same, and there will be no deflection of the electrometer; in our experiments the leak is so small that under these circumstances the movement of the spot of light is hardly perceptible. If, now, the Rontgen rays are directed on to the plate a violent leakage of electricity from the plate occurs, the potential of the quadrants connected with the plate changes, and in a few seconds the spot of light reflected from the mirror of the electrometer is driven off the scale. This leakage of electricity occurs whether the plate is positively or negatively electrified; if the plate is uncharged to begin with, I have not been able to detect that any charge is acquired by the plate by exposure to these rays. When the potential to which the plate is raised is high the leakage from the plate is a most delicate means of detecting these rays, more so than any photographic plate known to me. I have found these rays produce distinctly perceptible effects on a charged plate after passing through a zinc plate a quarter of an inch thick. The charged plate and electrometer are much more expeditious than the photographic plate and more easily adapted to quantitative measurements.

"To determine how the radiation of the Röntgen rays depended upon the degree of exhaustion of the bulb, the bulb was kept in connection with the pump and the leakage was observed at different degrees of exhaustion; no leakage could be detected until the pressure was so low that phosphorescent patches appeared on the bulb, and, even after the phosphorescence appeared, the leakage was small as long as there was any considerable luminosity in the positive column; it was not until this had disappeared that the leakage from the charged plate became rapid.

"If the greatest sensitiveness is required, it is, of course, advisable to charge the plate as highly as possible. The leakage due to

the rays, however, occurs when the potential of the plate does not exceed that of the tin-plate cover by more than 3 or 4 volts, and I have not yet met with any phenomena which suggest that there is a lower limit of potential difference below which leakage does not take place.

"This leakage differs from that produced by ultra-violet light, the laws of which have been unravelled by Elster and Geitel, in several essential features, in the first place ultra-violet light only discharges a negative charge, while the Röntgen rays discharge both positive and negative. Again, the effect of ultra-violet light is only considerable when the electrified body is a strongly electro-positive metal with a clean surface. The effects of the Röntgen rays are, on the other hand, very marked whatever the metal, and take place when the electrified plate is surrounded by solid or liquid insulators as well as when surrounded by air. I have embedded the plate in solid paraffin wax, in solid sulphur, placed it inside a lump of ebonite, wedged it in between pieces of mica, and immersed in a bath of paraffin oil; in each of these cases, though the insulation was practically perfect when the insulator was not traversed by the Röntgen rays, and the potential of the plate differed from that of the metal covering of the box by from 10 to 15 volts, yet, as soon as the Röntgen rays passed through the insulator, the charge of the metal plate leaked away. I have found that the electricity leaks from the plate even when the space between it and the nearest conductors connected to earth is entirely filled with solid paraffin; hence we conclude that when the Röntgen rays pass through a dielectric they make it during the time of their passage a conductor of electricity, or that *all substances when transmitting these rays are conductors of electricity*. The passage of these rays through a substance seems thus to be accompanied by a splitting up of its molecules, which enables electricity to pass through it by a process resembling that by which a current passes through an electrolyte. By using a block of solid paraffin in which two pairs of electrodes were embedded, the line joining one pair being parallel, that joining the other pair perpendicular, to the Röntgen rays, which were kept passing through the block, I found that there is but little difference between the rate of leakage along and perpendicular to the rays."

Prof. Thomson has investigated the question of longitudinal vibrations in connection with the recent discoveries. In a paper read before the Cambridge Philosophical Society on January 27, he discussed the theory of longitudinal waves from the point of view of the electro-magnetic theory of light, and showed that on that theory longitudinal waves can exist (1) in a medium containing moving charged ions; (2) in any medium, provided the wave-length is so small as to be compared with molecular dimensions, and the ether in the medium is in motion. It was shown that it follows from the equations of the electro-magnetic field that the ether is set in motion in a varying electric field. These short waves would not be refracted, but in this respect they do not differ from transverse waves which on the electro-magnetic theory would not be refracted if the wave-length were comparable with molecular distances. The properties of the longitudinal waves were developed in the paper. Prof. Thompson exhibited a number of photographs which had been taken at the Cavendish Laboratory by Prof. Röntgen's method, and experiments made on the Röntgen rays were described. In one of these experiments the photographic plate was placed inside the vacuum tube so as to intercept the rays between the kathode and the walls of the tube; in this case the plate was not affected, showing that the fluorescence of the glass is necessary for the production of these rays. Other experiments were made to see if they could be excited by fluorescence without a kathode; the ring discharge was produced in bulbs, and caused a vivid phosphorescence; a plate protected by cardboard when exposed to the bulb for an hour was not affected, nor was any greater effect produced when the bulb was filled with a gas such as oxygen, which phosphoresces under the discharge. It thus appears that both a kathode and a phosphorescent substance are required for the production of these rays, and that one without the other is inoperative. A series of experiments were made by taking photographs through tourmaline plates, (1) with their axes parallel, (2) with their axes crossed; it was hoped by this method to get some evidence as to whether the rays were longitudinal or transverse. A considerable number of photographs were taken in this way, but no difference could be detected in the obstruction offered to the rays by the tourmaline plates in the two cases. Another method of investigating the same question was described, based on Elster and Geitel's discovery of the influence of the plane of polarisation of light on its power to discharge electricity from a metallic surface. The experiments, which were not concluded until the day after the meeting of the Society, show that these rays exert the most powerful effect in discharging electricity, whether positive or negative, from an insulated electrified metal plate exposed to their influence. A bulb separated from the charged plate by a board three-quarters of an inch thick covered with several layers of tinfoil exerted a most powerful effect, and it was not until the thickness of the metal between the bulb and the electrified plate was nearly quarter of an inch that the effect ceased to be perceptible. The electrified plate is a much more delicate detector of these rays than the photographic one, and is more suitable when measurements are required. These results, though by no means conclusive, are in favour of the vibrations being longitudinal.

We have already mentioned, in our abstracts of the *Comptes rendus*, and in notes, the many papers which have been read before the Paris Academy descriptive of developments of Röntgen's work. In France, both the chemical and surgical sides of the discovery are being studied. As recorded in our issue of February 6 (p. 324), Prof. Lannelongue, assisted by MM. Barthélemy and Oudin, have demonstrated to the Academy of Sciences the applicability of the discovery to surgery, and observations made by Prof. Lannelongue since then bear out his conclusions that in diseases where there is an actual loss of substance in the bone, or an abnormal growth of bony tissue, photography by means of Röntgen's rays will be a valuable aid to diagnosis. The current number of the *Comptes rendus* contains several papers dealing with the chemical properties of the rays. M. Meslans has studied the influence of the chemical nature of substances on their transparency to the rays. He has found that the varieties of carbon —diamonds, graphite, and charcoal—and their compounds are easily traversed by Röntgen's rays, as also are compounds of hydrogen, oxygen, and nitrogen. Alkaloids are also transparent, but sulphur, iodine, and silicon are opaque. M. Charles Henry has found that by coating coins opaque to the rays with phosphorescent sulphide of zinc, photographic impressions of substances beneath the coins can be obtained, metals coated in this manner appearing to lose their opacity to the Röntgen rays. M. Henry has also found that phosphorescent sulphide of zinc emits, in addition to green light, a large number of the new actinic rays.

The properties of Lenard rays—that is, kathode rays which have travelled outside the tube in which they had been produced—are also being investigated. A note in the *Chemical News* states that Prof. Slaby, of Charlottenburg, has obtained good photographs by means of Lenard rays. Dr. J. Joly has also been successful in this direction of work. At the Dublin University Experimental Science Association, on February 11, he showed photographs of various objects taken after the manner of Röntgen by the Lenard rays. One of a pair of spectacles within its case showed well the transparency of wood and cardboard and the comparative opacity of glass, and the still higher opacity of the heavy metals. Experiments on refraction of the rays have in the case of paraffin oil given no evidence of refraction. This substance proved very transparent. Experiments upon the reflection of the rays have, however, yielded positive results. The rays were reflected by a silvered copper mirror on to a sensitive plate. The plate was in the geometrical shadow of a thick lead shield, the rays passing through a slot in the shield and through thick millboard before reaching the mirror, which was inclined at an angle of about 45° to the plate. Exposures of two hours gave distinct photographic effects. Reflection from a concave mirror placed behind the plate and facing the sensitive film, did not give any trace of a focus, but a darkening of the full diameter of the mirror, and rather more marked at the edge; thus suggesting irregular reflection of the rays. The experiment of Prof. J. J. Thomson on the discharge of a charged electroscope by the rays was also shown by Dr. Joly, and, at the conclusion of the meeting, it was demonstrated that this effect was not obtained at short distances from the tube, the electroscope then becoming positively electrified.

Several important letters on the subject of Röntgen rays have come to us. Lord Blythswood communicates the following, in continuation of his letter published last week:—

"Since I last wrote to you, I, at the suggestion of Lord Kelvin,

placed my sensitive plate in a metal zone with an aluminium window in it. The whole was well earthed. This precaution was taken to prevent any sparking inside the zone. The zone was placed between the poles of my Wimshurst machine, and photographs of various objects taken. This is, I think, conclusive that the influence at work is not the ordinary electrical waves or discharges. For in a carefully-closed metal zone there can be no electrification, neither do the photographs of metal objects show any trace of discharge or sparking."

The following important communication on "Photography through Opaque Bodies without Crookes' Tube" has been received from Dr. John Macintyre:—

"At the demonstration given by Lord Blythswood and Dr. J. T. Bottomley before the Glasgow Philosophical Society on Feb. 5, I was requested to show some results in shadow-photography obtained by the use of comparatively simple apparatus. My remarks were then intended to show that as we became familiar with this new art the apparatus would become less complicated. As the present notes are written for another purpose I simply mention the fact that the experiments noted below were made with the same apparatus exclusive of Crookes' rube. It consisted of an induction coil giving not more than a two-inch spark, the primary coil of which was excited by four small secondary cells giving two volts each; a very small Tesla coil made by Messrs. Baird and Tatlock; and a Crookes' tube selected from the stock of an instrument-maker, but not specially prepared.

"Lord Blythswood on that occasion described the experiments published in the last issue of NATURE by means of which he was able to demonstrate that photographs could be taken without Crookes' tubes. Mr. Sydney D. Rowland in his interesting contribution to the subject in the same issue raises the question of the possibility of a 'contact phenomenon' being the explanation of Mr. Gifford's results, and not Röntgen's rays at all. As the same doubt was suggested to my mind as the result of my own experience I should like to record the following experiments which were made by me with a view of confirming the extremely interesting results recorded by Lord Blythswood. In doing so I wish it clearly understood that I do not suggest that the photographs taken through opaque bodies by Lord Blythswood were not the result of Röntgen's rays; my statements simply bear upon my own experience and the results I have been able to obtain.

"In my first experiment the sensitised paper was enclosed in a mahogany box, the sides of which were three-sixteenths of an inch thick, and the object to be photographed was a perforated zinc plate; bromide paper was substituted for glass plates in order to do away with resistance, and the whole was placed between the terminals of the small Tesla coil. The current coming from the negative pole before reaching the positive had therefore to pass through the following structures: (1) Three-sixteenths of an inch of mahogany, (2) a sheet of aluminium one-sixteenth of an inch thick, (3) the zinc plate, (4) the bromide paper, (5) some black cardboard for packing, (6) the other end of the box, also three-sixteenths of an inch. The box was insulated from the earth and held between the poles for ten minutes. On developing, a distinct image of the plate was obtained, the perforations showing black on the paper, while the part upon which the zinc rested had not been acted upon at all. It was clear from this experiment that I had obtained a photograph without a Crookes tube, and a negative—that is to say, had it been printed from the bromide paper we would have had a reproduction of the original perforated plate.

"The second experiment was different from the first inasmuch as I placed a metal plate behind the bromide paper, and consequently there was the following arrangement proceeding from the negative to the positive pole: (1) The end of the mahogany box, (2) the aluminium plate, (3) the zinc perforated plate, (4) the bromide paper, (5) a copper disc, (6) black cardboard for packing, (7) the other end of the mahogany box. This was again placed between the terminals of the Tesla coil for the same time, and the bromide paper developed in the usual way. This time the perforations did not mark the paper, but I had a distinct impression of the zinc; in other words, I had obtained a positive, because, had I printed a copy, the perforations would have appeared black, quite the reverse of the last experiment.

"It will be observed that in neither case had I, like Mr. Sydney Rowland, connected the positive pole of the coil with the metal plate behind the sensitised surface.

"On submitting these results (which were obtained previous to the date of Mr. Sydney Rowland's letter) to Lord Kelvin and Dr. Bottomley they agreed with me that the picture had possibly not been taken by means of Röntgen's rays at all; and Lord Kelvin suggested the following third experiment, in which the sensitised paper was enclosed in a metal box. In this experiment the following structures were placed in definite order between the negative and positive pole: (1) The front of the mahogany box, (2) several layers of black paper, which formed a covering for the metal box, (3) the front of the metal box, (4) the zinc perforated plate, (5) the bromide paper, (6) the metal plate, (7) the back of the metal box, (8) the black paper surrounding the metal box, (9) the other end of the mahogany box.

"It will be noticed that in this experiment the metal plates in front and behind the bromide paper were enclosed in a metal case which attracted the current round it. The result was as we had anticipated, because repeated attempts with different and prolonged exposures failed to produce any impression whatever upon the bromide paper.

"Had the photographs been obtained by the X-rays, one might have expected that while the current was conducted past the sensitised paper some impression would have been got by the Röntgen's rays piercing the metal box. As yet, however, I have not been able to obtain this result, although I have tried to with thin aluminium sheets in contact with each other at the edges and enclosing the metal plates and bromide paper.

"I should like to point out that Lord Blythswood's experiments differ from the above in many respects. He used glass sensitised plates; the apparatus was exceedingly powerful; and the objects were not placed between the terminals of the machine, but at some distance below the line of the sparks.

"From the above-mentioned experiments it is clear (1) that photographs may be taken without Crookes' tubes; (2) that different results may be obtained according to the conditions to which the sensitised surface is subjected. And I would suggest the following questions as suitable for further investigation:—(*a*) Are they not the result of a force different from the Röntgen's rays? (*b*) what is this force which is now described as a 'contact phenomenon'—a term, of course, which does not explain the actinic power? (*c*) what is the actinic power which we have hitherto considered to be a property of ordinary light? (*d*) were Röntgen's rays not generated between the metal plates?

"There is one point in this experiment which has not been touched upon by other writers, and which I should like to allude to in conclusion. It is quite clear, whether the photographs produced without Crookes' tubes were obtained by means of Röntgen's rays or not, that a current may be conducted through metal plates to a sensitised surface and impressions obtained thereon. In Mr. Sydney's Rowland's letter he makes no mention of metal plates having been placed in front of the sensitised plates. I have placed three plates of different metals in front of the object to be photographed during the time of exposure and obtained a picture, so that we have here a method of photographing certain objects through opaque bodies in the form of metal plates, and, theoretically speaking, the thickness would be a matter of comparatively little importance."

Prof. J. Wertheimer, Principal of the Merchant Venturers' Technical College, Bristol, has, at the suggestion of Mr. C. A. Morton, Surgeon to the Bristol General Hospital, taken a radiogram of an amputated foot into which Mr. Morton had introduced nine foreign bodies (bullets, splinters of needles, and glass wedges). Six of these were plainly seen on the radiogram, although Mr. Morton found that a fellow-surgeon could only locate one by palpation.

Prof. Wertheimer says: "Two points of interest arise on examination of the radiogram. Mr. Morton had endeavoured to place a fragment of needle through the last joint of the great toe on its plantar aspect. On dissecting the foot, after the radiogram had been taken, he found that the fragment had penetrated the inner corner of the distal end of the first phalanx, and had passed *beneath* the bone, leaving a small portion embedded in the phalanx itself. This fragment shows up plainly in the radiogram, and, as the foot rested on its plantar aspect, the rays must have passed through the whole thickness of the bone. The radiogram does not, however, show that the needle is *beneath* the bone. It appears, therefore, that in such cases two radiograms will be needed—one taken with the dorsal, and the other with the plantar aspect uppermost, the conditions being other-

wise precisely alike. A comparison of these should show whether the foreign object is nearer the dorsal or the plantar aspect of the foot.

"The second point refers to the three objects not seen clearly in the radiogram. The tube used was the ordinary 'shadow of the cross' one, and, though the cross was bent back, the shadow of its supports was visible; two of the objects were directly under this shadow. The third lay parallel and very close to a bone, and hence is not plainly distinguishable."

Photographs have been obtained by utilising other sources of luminosity than high vacuum tubes. The following experiments, performed by Messrs. Wm. Wallace and H. C. Pocklington in the Physical Laboratory of the Leeds Central Higher Grade School, are of interest:—

"A cheap German incandescent lamp of low candle-power was used in place of a Crookes' tube, a piece of tinfoil applied to the outside serving as one electrode, and the filament as the other. The current employed was the high frequency one obtained from a Tesla coil actuated by a large Ruhmkorff. The sparking distance of the Tesla was about 5/8 inch. This apparatus gave a vivid green phosphorescence of the glass, which soon grew less, and in fifteen minutes had almost disappeared. Three exposures were made in succession, each of fifteen minutes: the first when the lamp was new; the second immediately afterwards, the lamp being tired by the previous exposure; for the third, the tinfoil electrode was shifted round about 90°, so as to utilise a fresh part of the surface of the glass. The three negatives were developed simultaneously; the first was good, the other two were under-exposed to about the same extent. In the last experiment, the green phosphorescence, though not as brilliant as in the first, was much more brilliant than in the second. This seems to show that the production of X-rays is due to some cause different from that which produces the phosphorescence."

Mr. J. W. Gifford has obtained photographs by Röntgen's methods, and also by means of the ordinary discharge of an induction coil. Replying to a suggestion that results obtained by him with metal discs were due to a "contact" phenomenon, and not to Röntgen's rays, he says:—

"I notice in your issue of February 13, p. 340, that Mr. Sydney D. Rowland thinks that he has evidence to prove that my results without a Crookes' tube were not due to the 'Röntgen rays.' I have already replied to his observations elsewhere (*British Medical Journal*); but will you allow me to say that I think the evidence he advances entirely turns on whether the electrograph was a shadow or an impression, or, in other words, whether surface markings of the objects electrographed were reproduced, or not. Now, the discs I used bore numbers stamped on them, but in no case were these numbers, or any surface markings whatever, to be found in the resulting negative, a print of which I enclose.

"With regard to what Mr. Rowland says about the objects, in his case, being behind or in front of the film, I would suggest that the discharge from a coil is an oscillatory one, and that glass is fairly transparent to the 'Röntgen rays,' almost as transparent as aluminium, in fact. But conditions are often so different, that I do not feel justified in criticising another man's work without having seen his experiments myself. I must, however, most emphatically disclaim any positive assertions in the present stage of the inquiry. I have, as far as I am aware, only mentioned tentatively what seem to me the general indications of my experiments up to now, and feel that in investigations of this kind the balance is generally in favour of one's first impressions being wrong.

"I do not know if you have observed that when Crookes' tubes are employed for the purpose, after about an hour's use they become coated, both above and below, with a thin layer of dust. This happens, at least, time after time in my own laboratory."

Mr. W. A. D. Rudge, writing from the Science, Art and Technical Schools, Plymouth, says that he has obtained a radiogram of a crayfish, and found the exoskeleton to be as transparent to the new radiations as glass and aluminium.

Our United States correspondent sends us descriptions of work being done in America, in continuation of Röntgen's discovery. He says very successful photographs have now been obtained by Prof. A. W. Wright, of Yale. Prof. Wright has photographed a piece of metal having a fracture which had been welded, but showed no flaw or line of puncture to the eye. The photograph, however, revealed the fracture. This last result was considered by ordnance officials of the Government to be of profound significance, as indicating a means of testing armour for hidden defects and discovering hidden flaws in machinery. Prof. John Trowbridge, of Cambridge, Mass., has also obtained some results. He arranged strips of glass an eighth inch thick in a wooden box of inch board, and passed the rays through the board, thus obtaining a photograph of the strips of glass. By passing the rays through prisms of wood and of vulcanite he has confirmed the observation that they were not refracted.

THE MANUFACTURE OF ALUMINIUM BY ELECTROLYSIS.

AT the ordinary meeting of the Institution of Civil Engineers on Tuesday, February 11, a paper was read on "The Manufacture of Aluminium by Electrolysis, and the Plant at Niagara for its Extraction," by Mr. Alfred E. Hunt. The author's description of the ores of aluminium best fitted for electrolytic reduction to the metallic state, and of the general principles governing the extraction of the metal from its compounds, makes interesting reading.

The Hall process, which is that adopted by the Pittsburg Reduction Company, involves the direct electrolysis of the sesquioxide, alumina, dissolved in a molten bath of the mixed fluorides of aluminium, calcium and sodium. One cubic foot of the solvent serves for an hourly production of one pound of metallic aluminium, the bath used being capable of dissolving one-third of its own weight of alumina. The electrical energy required for extracting this amount of metal is 3730 watt-hours for the decomposition of the alumina, with a further supply to maintain the bath at the temperature necessary for the molten condition. The fluorides remain unchanged, so that the operation is continuous. The bath is made either from a mixture of fluorspar and cryolite, or from the artificial fluorides; and it may be fused in a separate vessel when starting work, or in the bath by the current itself. Alumina is added at frequent intervals to prevent too great a variation in the resistance of the bath, and the aluminium, as it is produced, is siphoned from beneath the layer of fluoride, where it collected, without interference with the progress of the operations. The oxygen of the alumina is liberated at the carbon anode, which, at the temperature of the bath (980° C.) oxidises to carbon monoxide. Outside the bath this is burnt at once to carbon dioxide, and is allowed to escape into the working apartment. The carbon anodes are consumed at nearly the same rate as the aluminium is produced, the amount being about two-thirds of the quantity actually used. The difference of potentials theoretically necessary for the separation of the constituents of alumina is about 2·8 volts, but a greater difference is due to the resistance of the bath. The pots employed are of iron with carbon linings, but these can be dispensed with if a high degree of purity is not required.

The chief impurities in the finished product are silicon and iron. These are derived from the alumina as well as from the carbon anodes. Aluminium can be produced containing 99¾ per cent. of the pure metal, and is regularly delivered with 99 per cent. The electrolytic baths are joined in series, the positive bar of the switch-board being joined to the carbon anode of one of the baths, and the last pot of the series being joined to the negative board of the switch-board. All the copper connections are necessarily very heavy, on account of the large currents employed.

The electrical energy is generated at the works of the Niagara Falls Power Company, and is conveyed, without the intervention of transformers, over a distance of about half a mile, by stranded copper cables 1¼ inches in diameter. The loss in transmission is about 1½ per cent. of the energy conveyed.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Mr. D. H. Nagel, Fellow of Trinity College, has been elected as a Delegate of Local Examinations in place of Mr. E. Chapman, Fellow of Magdalen College, resigned.

Mr. F. T. Richards, Fellow of Trinity College, has been re-elected a Curator of the Botanic Garden.

Mr. J. E. Marsh, M.A., Balliol College, has been reappointed Lecturer in Materia Medica and Pharmacology for the year 1896.

CAMBRIDGE.—Mr. J. E. Marr, F.R.S., Fellow of St. John's College, has been reappointed University Lecturer in Geology for five years.

The Council of the Senate propose to submit a grace for the appointment of a syndicate to consider what further rights or privileges (if any) should be granted to women students by the University, and in particular whether they should be admissible to degrees.

The Special Board for Biology propose that the arrangement subsisting for the last twenty years between the University and the Zoological Station at Naples should be renewed for a further period of five years. This arrangement secures for University students the use of a table in the laboratory and facilities for research, in consideration of an annual payment to Dr. Dohrn of £100 from the Worts Travelling Scholars Fund.

THE Board of Agriculture has made a grant of £650 to the Glasgow and West of Scotland Technical College. The same amount was granted to the College last year.

IN Paris the Société de Topographie is making an effort to establish topography as an ordinary subject of instruction, and has published a circular and syllabus for the purpose.

THE Russian Government has, says the *British Medical Journal*, assigned an annual grant, equivalent to about £10,000, to the Medical School for Women in St. Petersburg. The city undertakes to provide £2400, and private munificence has raised an endowment fund of £70,000. Preliminary courses are already being given.

THE following are among recent appointments abroad: Dr. Eigenbrodt to be Extraordinary Professor of Surgery at Leipzig; Dr. Lenhossék to be Extraordinary Professor of Anatomy at Tubingen; Dr. M. Valsilieff to be Extraordinary Professor of Theoretical Surgery at Warsaw; Dr. Eliza M. Mosher to be Professor of Hygiene in the University of Michigan.

THE following announcements are made in *Science*:—Mr. Joseph Bannigan has given 4000 dols. to the Catholic University of America, and has made known his intention to donate for twelve years 4000 dols. a year for library purposes. By the will of the late Mrs. Doyon, the University of Wisconsin has received 5000 dols., the income of which is to be devoted to scholarships for young women. Two scholarships of 2000 dols. each have been presented to Tufts College, one by Mrs. A. B. Perkins, and the other by J. S. and H. N. White.

THE disasters of the late war seem to be teaching the Chinese that the traditional attitude of distrust and exclusion of Western civilisation cannot any longer be safely maintained. It may be taken as a sign of the times that the Vice-Regent of Tientsin has entertained a proposal to start a university upon the European model. The university is particularly intended to foster the technical sciences, and will be connected with a preparatory school. Mr. Charles D. Jenney will undertake its direction, and the staff will be partly composed of foreigners. The autumn of this year is to see the opening of the school and university.

THE Apprentices' Institution has recently instituted inquiries among a large number of trade societies and workmen's clubs with a view to ascertaining the opinion of working men themselves upon the apprenticeship system. From the standpoint of the advocates of technical education, the results of their enquiry are very satisfactory. A unanimous affirmative was given by all the trades to the questions—Is your Society of opinion that instruction for a number of years in the workshop is essential to the trained mechanic? But especially valuable and significant is the emphatic "No" to the question—Is your Society of opinion that the instruction afforded in the technical schools is sufficient training for a skilled mechanic with apprenticeship? Asked what they think, whether the instruction in technical schools should be given during apprenticeship or before it, the answer was in the large majority of cases "during apprenticeship." Putting side by side with this the remark of Mr. Reynolds, of Manchester, the Chairman of the Directors, and Organising Secretaries for Technical and Secondary Education, at their recent meeting, that the great difficulty the technical schools had to contend with was the want of preparation exhibited by the pupils who present themselves for instruction in the technical schools, it becomes abundantly manifest what policy ought to be pursued by the Technical Instruction Committees throughout the country.

As we recorded in our issue of February 14, 1895, the County Council of Hampshire resolved to devote £6000 of the surplus of the funds available for technical education during the preceding year to general purposes in the county. It would seem that they are not to be deterred from their retrograde policy by the unanimous protests of the various educational papers, for at the quarterly meeting of the Council, held on the 10th inst., a motion was proposed by the Chairman of the Finance Committee—"That the Finance and Technical Education Committees be instructed to meet together and report to the meeting in May 1896, their opinion upon the manner in which the balance remaining after the annual expenditure on technical education has been defrayed, shall be dealt with." It appears that, notwithstanding the transfer of £6000 from the technical education account towards the cost of the county buildings, up to December 31 last, and taking the estimate to the end of March next, there would be a balance of £12,000. Though the Chairman of the Technical Instruction Committee assured the Council there was no prospect of having a large balance to deal with in the future, evidently meaning that the Committee had every need of this money which they were reserving, the motion was put and carried. It would be supposed from an action such as this, that Hampshire is already well supplied with every kind of secondary education; but is it so? At Southampton, which it is true receives *its share* of the whole grant, there are at least two institutions which are in want of assistance. The Hartley Institution, which receives a county grant of only £75 per annum, is badly crippled for want of funds. The Grammar School similarly is greatly in want of help to develop the technical side of its work, and the same condition of things is true in many other of the local centres. In addition to all this, one hears repeatedly of the urgent need of Schools of Forestry in this country, and yet Hampshire, with the New Forest in its midst, has £12,000 for which it has no educational use!

PARTICULARS are tabulated in the *Technical Education Gazette* of the principal scholarships which are awarded in London, giving free education or education at reduced fees—(1) at the public secondary schools; (2) at universities, university colleges, polytechnics, technical institutes, and other places of higher education; (3) at schools of art. The tables are intended to give some idea as to the opportunities that are offered to the inhabitants of London of obtaining education above the elementary grade, either entirely free or at greatly reduced cost. The total number of scholarships tenable at public secondary schools appear to be as follows: Boys—1240 per annum (of which all except 85 may be regarded as actually available for pupils in public elementary schools). Girls—543 per annum (of which all except 8 may be regarded as actually available for pupils in public elementary schools). Total—1783 per annum (of which as many as 1690 are actually available for pupils in public elementary schools). Taking the average number in attendance in public elementary schools (exclusive of infants) as 382,121, it is found that the number of scholarships available per 1000 children in attendance is 4·4, of which 1·5 per 1000 children are provided by the Technical Education Board of the London County Council. The majority of the scholarships tenable at universities, university colleges, polytechnics, and similar institutions, are restricted as regards the school previously attended, but unrestricted so far as residence is concerned, though some are confined to residents within the county of London. No notice is taken of the numerous scholarships and exhibitions offered by university authorities outside London, such as the colleges of Oxford or Cambridge, but an attempt is made to show the facilities for acquiring training of a university type offered to pupils who are educated or who reside in London. The table shows that the scholarships available in London for giving training of a university type are as follows: open to young men only, 240; open to young men or young women, 120; open to young women only, 40; making a total of 400. These scholarships do not include, however, those that are specially awarded by the City Companies.

SCIENTIFIC SERIALS.

American Journal of Mathematics, vol. xviii. No. 1, January, 1896.—"Sur la réduction à sa forme canonique de la structure d'un groupe de transformations fini et continu," by E. Cartan. This memoir occupies 61 pages. We state the most important results in the writer's own words: "On peut toujours par des

opérations *rationnelles* ramener le problème au cas où le groupe est *semi-simple*, et même reconnaître d'avance la *nature* des sous-groupes invariants simples qui *composent* le groupe. . . . Quant à la réduction à sa forme canonique de la structure d'un groupe simple, elle dépend d'une certaine équation algébrique dont le *groupe* de substitutions, au sens de Galois, est connu ; cette équation s'appelle *l'équation caractéristique* du groupe. Les différents groupes de substitutions qui s'introduisent ainsi ne présentent rien d'interessant et se relient immediatement aux groupes symétriques de *n* lettres. Néanmoins trois d'entre eux offrent un intérêt particulier et sont isomorphes, l'un avec *le groupe des* 27 *droites d'une surface du* 3^{e} *ordre*, l'autre avec *le groupe des* 28 *tangentes doubles d'une courbe du* 4^{e} *ordre*, le dernier avec le 7^{e} *groupe hypoabélien de* 120 *lettres*. Ce n'est pas un des résultats les moins intéressants et les moins inattendus de cette étude, que d'établir une relation entre ces groupes de substitutions de Galois et les groupes de transformations de M. Lie."—Mr. A. L. Baker writes upon algebraic symbols. The symbols considered are $+$, $-$, $i(\sqrt{-1})$, and $-i$. The closing sentences will indicate the line of reasoning. "In tri-dimensional domains we have $(\sqrt{-})^{\infty}x = x + iy + jv + ku$, a quaternion. Is this a hint that in the Calculus of Reals, Complex Functions and Quaternions, we have run the gamut of the Algebraic Calculi?" There is some (to us) novel notation in this article. To express the roots of the Solvable Quantics as symmetrical functions of homologues, is the title of an interesting algebraic article by C. H. Kummell. There is, it may be inferred, some stiff reading in these three articles.—Two short notes on singular solutions by J. M. Page, and on a point of the theory of functions by A. S. Chessin, close the number, which is adorned with a fine portrait of the French mathematician, M. Paul Appell.

Bulletin of the Mathematical Society, vol. ii. No. 4, January. —On the convergence of the series used in the subject of perturbations, by Dr. G. W. Hill. M. Poincaré ("Les Méthodes nouvelles de la Mécanique céleste") has recently insisted that certain series, in this subject, under a certain condition, are, in the rigorous mathematical sense, divergent. Dr. Hill thinks that the reasons brought forward to sustain this opinion are scarcely convincing, and so, without attempting to find a flaw in M. Poincaré's logic, he aims at pointing out a class of cases where the convergency can be shown in spite of the incommensurability of the component arguments.—Mr. R. A. Roberts contributes an article on the locus of the foci of conics having double contact with two fixed conics.—Note on the common tangents of two similar cycloidal curves, by Prof. F. Morley. This is the application of a new method, given by the writer in vols. xv. and xvi. of the *American Journal of Mathematics*, to a question proposed by Prof. Aiyar, in the *Educational Times* for November 1895.—The list of new publications is an extended one, and the notes, as usual, are of interest. There is, however, an error in the quotation from our pages. On p. 651 (vol. lii.) is given a list of names proposed for the Council of the London Mathematical Society, and at the end of the note it is stated that Mr. Jenkins and the late G. C. De Morgan were elected joint secretaries (in January 1866). The *Bulletin* says, "the late Prof. De Morgan." It is a matter of common knowledge that Prof. *Augustus* De Morgan was the first President. The Secretary was his son.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 23.—"An Attempt to Determine the Condition in which Helium and the Associated Gases exist in Minerals." By Prof. W. A. Tilden, F.R.S.

From the results of the experiments recorded in this paper, it seems that helium exists in the minerals in which it is found in a condition comparable with that in which hydrogen is associated with many metals, and carbonic oxide especially with iron. Whether this condition is rightly distinguished from ordinary chemical combination is a question which admits of debate. The stability of all dissociable compounds is influenced by pressure and by temperature in the same kind of way as "occlusion," which, like ordinary chemical combination again, is a phenomenon in which the bodies concerned exercise a power of selection.

The presence of hydrogen as well as carbon dioxide in granite, if already observed, is not known to geologists generally. From observation on variations in the critical point of carbon dioxide in minerals (*Journ. Chem. Soc.*, 1876, ii. 248), Hartley seems to infer that the incondensable gas present with carbon dioxide, is usually nitrogen. A passage in Geikie's "Text-Book of Geology," third edition, p. 110, refers to the presence of hydrogen in cavities ; but no information is given as to the evidence upon which this statement is based. The presence of hydrogen in such a rock as granite must be attributed to the existence of this gas in large proportion in the atmosphere in which the rock was crystallised. Whether this was the primeval atmosphere of the earth before the hydrogen had escaped or had been oxidised into water, or whether it resulted from the local action of water upon unoxidised metals or other materials in the interior of the earth, is a question which may be of some interest to the geologist. If the former hypothesis were adopted, it would perhaps be difficult to explain the absence of helium from the gas included in the rock ; and, on the whole, the latter view appears to afford the more probable explanation.

Experiments show that hydrogen is present in even larger proportion in the granite from the neighbourhood of Dublin, and it is proposed to examine some other examples of the ancient crystalline rocks in order to determine the nature of the gases enclosed in them.

Physical Society, February 14.—Annual General Meeting. —Captain W. de W. Abney, President, in the chair.—The Chairman, after referring to the position of the Society, called upon the Treasurer to read the balance-sheet. After a discussion on the financial status of the Society, in which a number of members took part, the ballot was held for the election of a President and Council for the ensuing year. The following gentlemen were declared duly elected : President—Captain W. de W. Abney, C.B., F.R.S. Vice-Presidents—Shelford Bidwell, F.R.S. ; Major-General E. R. Festing, F.R.S. ; Prof. J. Perry, F.R.S. ; G. Johnstone Stoney, F.R.S. Secretaries—T. H. Blakesley, 3 Eliot Hill, Lewisham, S.E. ; and H. M. Elder, 50 City Road, E.C. Treasurer—Dr. E. Atkinson, Portesbery Hill, Camberley, Surrey. Demonstrator—C. Vernon Boys, F.R.S. Other members of Council—Walter Baily, Dr. C. V. Burton; L. Fletcher, F.R.S.; R. T. Glazebrook, F.R.S. ; Prof. A. Gray, G. Griffith, Prof. G. M. Minchin, F.R.S. ; Prof. W. Ramsay, F.R.S. ; Prof. S. P. Thompson, F.R S. ; and Prof. S. Young, F.R.S.—The Chairman read an obituary notice of the late Right Hon. T. H. Huxley.—A vote of thanks to the auditors was proposed by Prof. Carey Foster, seconded by Mr. Enright, and carried unanimously. A vote of thanks to the officers was proposed by Prof. A. Gray, seconded by Mr. Rhodes, and carried unanimously. A vote of thanks to the Chemical Society for the use of their rooms, was proposed by the Chairman, and carried by acclamation.—The meeting was then resolved into an ordinary science meeting, and a paper, on the determination of high temperatures by the meldometer, by Prof. Ramsay and Mr. Eumorfopoulos, was read by the latter. The meldometer—an instrument invented by Dr. Joly, of Dublin —consists essentially of a thin platinum strip which can be heated by the passage of an electric current. Small fragments of a solid substance are placed on the platinum strip, and the temperature at which they melt is deduced from the length of the platinum strip, which has been previously calibrated by means of solids of known melting-point. The authors have used gold for the purpose of calibrating the strip, and have assumed Violle's value, 1045° C., for the melting-point of gold. A number of measurements have been made of the melting-point of salts of sodium, lithium, strontium, barium, calcium, and lead. The results obtained, however, differ considerably from those of Heycock and Neville, and the authors have not been able to account for these differences. Prof. Ramsay said the chief advantage of the meldometer was that only a very minute fragment of the substance was required for the measurement, so that extreme purity of the sample could be secured. There was the disadvantage, however, that many substances undergo some change when heated in air. In reply to a question from Mr. Blakesley, Prof. Ramsay said that the property of the platinum which was used to measure the temperature was its expansion. Mr. Campbell asked whether the zero of the instrument was found to be constant. In Cardew voltmeters it often took several hours for the needle to come back to zero after heating. Mr. Eumorfopoulos, in reply, said that the zero was constant to within a quarter of a degree.—Prof. Ramsay also exhibited a small direct-vision spectroscope, in which the eye-piece is moved

in a plane perpendicular to the axis of the instrument by means of a micrometer screw. This form of spectroscope was found to be of great utility in verifying the position of lines in the spectrum.

Geological Society, London, February 5.—Dr. Henry Woodward, F.R.S., President in the chair.—On the Morte Slates and Associated Beds in North Devon and West Somerset. —Part 1, by Dr. Henry Hicks, F.R.S. In a paper read before the Society in 1890 the author stated that he had found the Morte Slates to be fossiliferous, and had come to the conclusion that they were the oldest rocks in the North Devon area and had been thrust over much newer rocks, producing a deceptive appearance of conformity ; and that there was not a continuous upward succession in the rocks from the Bristol Channel to the neighbourhood of Barnstaple. Since that paper was read, the author has obtained much additional evidence bearing on the succession, which was described so far as the position and age of the Morte Slates in the Ilfracombe area are concerned.—Evidences of glacial action in Australia in Permo-Carboniferous Time, by Prof. T. W. Edgeworth David. The author, after summarising the work of previous observers, gave an account of recent observations made by himself. In Hallett's Cove, near Adelaide, the pre-Cambrian rocks were strongly glaciated, striæ being seen when the overlying glacial beds are removed, as sharply cut as though caused by recent glacial action, and trending nearly north and south, the ice having come from the south. The overlying glacial beds were in places fairly stratified, while parts contain abundance of well-striated boulders ; these beds are from 23 to over 100 feet thick. Proofs were obtained that in this case the glaciation occurred in an age intermediate between Miocene and pre-Cambrian, and probably did not antedate the close of the Palæozoic period. In Wild Duck Creek, near Heathcote, Lower Silurian (Ordovician) beds exhibited strongly-grooved, polished surfaces, the grooves being from S. 5° E. to N. 5° W., the ice having probably come from the south. They were succeeded by Permo-Carboniferous glacial beds, consisting chiefly of mudstones with well-glaciated boulders. At Bacchus Marsh Ordovician beds were also well-striated and polished, and more or less *moutonnés*. There also the ice came from a southerly point. These beds were succeeded by Permo-Carboniferous glacial beds having an approximate thickness of at least 2000 feet, consisting of mudstones with well-glaciated boulders. It was extremely probable that the glacial beds of Bacchus Marsh, Wild Duck Creek, and Springhurst in Victoria were of homotaxial if not contemporaneous origin, and they may probably be correlated with the glacial conglomerates at Mount Reid in Tasmania, these correlations being mainly based on lithological evidence.

CAMBRIDGE.

Philosophical Society, January 27.—Prof. Liveing, Vice-President, in the chair.—On longitudinal vibrations in connection with recent photographic discoveries, by Prof. J. J. Thomson (see p. 379).—On the equilibrium of isotropic elastic solid shells of nearly spherical form, by Dr. Chree. Attention was chiefly devoted to the case of a thin shell exposed to uniform, but different, normal pressures over its two surfaces. The effect of external pressure, it was proved, is to increase, while that of internal pressure is to diminish the original departure from sphericity.—A harmonic analysis of the amount of solar radiation received at the different latitudes on the earth's surface, by Mr. R. Hargreaves. The amount of solar radiation falling on the earth's surface in any latitude is expressed by a harmonic series containing constant, annual, semi-annual terms, and so forth. The dependence of the coefficients on latitude, and also on the astronomical elements obliquity of the ecliptic, eccentricity, and longitude of perihelion, was fully discussed. Numerical results were given in connection with each point, showing the extent to which the present values may be modified by such secular changes as are known to astronomers ; and complete numerical data are thus provided for the discussion of the question whether these astronomical changes are a *vera causa* in the explanation of changes of climate.

EDINBURGH.

Royal Society, January 20.—Rev. Prof. Flint in the chair.—Dr. Buchan read a paper on the recent great atmospheric pressure. So far, the highest reading had been that recorded at Ochtertyre, in Perthshire, where 31·107 inches was registered on the 9th. This place, curiously enough, had the "record" for low readings, a pressure of 27·333 inches having been recorded there in January 1884. This was the lowest ever recorded anywhere. —Prof. Crum Brown showed and discussed an experiment illustrating the modern theory of salt solutions.—Dr. A. Lockhart Gillespie gave statistics from the Infirmary records of the past fifty years, illustrating the relations of weather, influenza, and disease. Diseases of the respiratory system were more common during cyclonic weather, and cardiac troubles showed a marked increase after epidemics of influenza. The idea that influenza was more severe than it used to be was not borne out by facts.—Dr. John Murray and Mr. Robert Irvine contributed a paper, replying to criticism, on the chemical changes in marine deposits.—Prof. Tait illustrated the looped, concave-upward path of a rotating spherical projectile by means of a spherical india-rubber balloon.

January 27.—Prof. McKendrick in the chair.—By request of the Council, Mr. Frederick Ives, of Philadelphia, gave an address on the stereo-photochromoscope. The essential features of Mr. Ives' method are as follows. By means of a specially constructed stereoscopic camera, three pairs of negatives are taken at once. Each pair, by a suitable intervention of colour-filters, secures those parts of the object from which one of the Young-Helmholtz three primary colours is reflected. When the six positives are subjected to the synthetic action of the photochromoscope, a coloured, solid-looking, optical illusion is the result. Not the least interesting feature of the process, as was remarked at the meeting, is the light which it throws on the Young-Helmholtz theory of colour vision.

February 3.—Prof. Chrystal in the chair.—Prof. Tait read an obituary notice of Prof. Blackie by the Rev. Dr. Walter Smith.—Dr. W. W. J. Nicoll described experiments he had carried out on the behaviour of the iodine molecule in solution. His method was different from any yet tried, viz. the determination of the molecular volume of the iodine in different solutions, and his results agreed well with those of others approaching the problem from different sides. He found that the value of the iodine molecule in solution was about 85, and this whether it was of the form I_2 or I_4. His conclusion was that the molecules, in the gaseous form, and in dilute solution, were truly comparable.—In Dr. E. H. Barton's absence, Prof. Tait read a paper on the temperature-variation of the magnetic permeability of magnetite. His results, as exhibited graphically, showed that the permeability reached its maximum about 300°, suffered a very sudden decrease about 500°, and remained constant afterwards.—Prof. Tait gave a note on centrobaric shells. Thomson and Tait prove the proposition that a shell, whose density is inversely as the cube of the distance from an internal point, has a true centre of gravity, by considering the forces of attraction. Prof. Tait gave a demonstration of a very much simpler and shorter proof, which had since occurred to him, from the point of view of potential.

PARIS.

Academy of Sciences, February 10.—A study of uranium carbide, by M. H. Moissan.—Action of high frequency currents upon bacterial toxines, by MM. d'Arsonval and Charrin. In these experiments especial care was taken to eliminate, as far as possible, all electrolytic action of a chemical nature. Two different cultures were used (pyocyanic and diphtheric toxines), and in both cases these were found to have their virulence diminished after passage of the high frequency current. It was also noticed that this attenuated virus more or less protected the animals against further injections of the original virus.—On the application of the Röntgen rays to surgical diagnosis, by MM. Lannelongue and Oudin. An application to some diseases of the knee and thigh. The conclusion is drawn that although the application of the new light to surgery has not led to the discovery of any points previously unnoticed, yet it has in all the experiments given results in agreement with the clinical diagnosis.—Microbial associations and tuberculous suppurations, by MM. Lannelongue and Achard. A discussion of the conditions under which other microbes are associated with the tubercle bacillus.—On the structure of Mount Joly, near Saint-Gervais, by MM. Marcel Bertrand and E. Ritter. The view previously held about this mountain, that it had escaped the violent actions to which the neighbouring rocks had been subjected, and that foldings had not taken place, is shown to be untenable. This spot is, in fact, the region where the displacements of the strata have been pushed to the greatest extent.—On campholide, the reduction product from camphoric anhydride, by M. A. Haller. Camphoric anhydride reduced

with sodium amalgam in acid solutions gives the lactone campholide, $C_{10}H_{16}O_2$, not identical with the substance of the same composition obtained by Dr. M. O. Foster (*J. C. S.*, January 1896).—Copernicus and the geographical discoveries of his time, by M. Daubrée.—On the equation of the tides, by M. Maurice d'Ocagne.—On surfaces of lines of spherical curvature, by M. E. Blutel.—On a generalisation of the formula for the area of a spherical triangle, by M. X. Stouff.—Note on the resistance of beams, by M. Paul Toulon.—Method of measuring double refraction in monochromatic light, by M. R. Dongier.—Influence of the chemical nature of substances on their transparency to the Röntgen rays, by M. Maurice Meslans. Compounds of carbon, hydrogen, oxygen, and nitrogen are very nearly transparent for these rays, but the introduction of phosphorus, sulphur, or the halogens (especially iodine) largely increases their opacity.—Application of the method of M. Röntgen, by M. A. Londe. The dark and light parts of a photographic negative are equally transparent to the rays.—Increase of the photographic effect of the Röntgen rays by phosphorescent zinc sulphide, by M. C. Henry. It was found that by coating coins opaque to the rays with phosphorescent sulphide of zinc, photographic impressions of substances beneath the coins could be obtained, metals coated in this manner appearing to lose their opacity to the Röntgen rays.—Photographs obtained by means of the X-rays, by M. C. V. Zenger.—On a mechanical action proceeding from a Crookes' tube, analogous to the photogenic action discovered by Röntgen, by MM. Gossart and Chevallier. In attempting to show the heating effect of a Crookes' tube by means of a radiometer, it was found that the latter, instead of rotating, took up a fixed position under the control of the tube. If the radiometer arms were set in motion by heat, oscillations about this fixed direction ensued, which were the more rapid the smaller the distance between the tube and the radiometer. This force was stopped by the same media as the X-rays.—On the silicide of copper, by M. Vigouroux. Silicon and copper, heated in the electric furnace, give homogeneous products which may contain silicon up to 15 per cent. Prolonged heating at a temperature sufficiently high to drive off excess of copper, leaves the definite compound $SiCu_3$.—On the bromide and chlorobromide of thionyl, by M. A. Besson. Dry HBr, acting on $SOCl_2$ at its boiling-point, gives rise to a mixture from which SOClBr, $SOBr_2$, and S_2Br_2, which can be separated by fractional distillation under reduced pressure. Thionyl bromide is not formed by the action of sulphur dioxide upon phosphorus pentabromide.—On a crystallised sulpho-phosphide of tin, by M. A. Granger. Tin sulphide, acted upon by phosphorus vapour, gives the compound SnP. 2SnS.—Oxyiodides of zinc, by M. Tassily.—Method for determining the purity of butter by means of the density, by M. R. Brullé.—Retineal stroboscopy, by M. Aug. Charpentier.—The expulsion of blood as a means of defence in some Sauterelles, by M. E. Cuénot.—On the frontal expansion of some insects of the family of the Muscides, by M. J. K. d'Herbulais. A criticism of a note on a recent communication on the same subject by M. A. Labboulbène.—On the signification of the fertilisation in the Uredineæ, by M. Sappin-Trouffy.—On the sugars produced in leaves, by M. G. Bonnier. It is shown that in many cases these sweet liquids are directly exuded from the stomata of the leaf, and are not always of animal origin. The rate of production of this vegetable honey is at a maximum during the night.—*Mucor* and *Trichoderma*, by M. J. Ray. Reply to a criticism of M. Paul Vuillemin.—The Hippurite bearing layers in the Valley of the Rhône, by M. H. Douville.—On the existence of numerous Radiolaria in the Ardèche, by M. L. Cayeux.—On the mode of formation of the auriferous minerals of the Witwatersrand in the Transvaal, by M. L. de Launay. The hypothesis of a chemical precipitation of the gold and pyrites during the actual sedimentation is shown to be the most probable.—On a hypothetical mode of formation of the auriferous conglomerates of the Transvaal, by M. E. Cumenge.—On some new and rare forms of calcite at Couzon (Rhône), by M. F. Gonnard.—On the high atmospheric pressures during the month of January 1896, by M. P. Dechevrens.

BERLIN.

Physical Society, January 17.—Prof. du Bois Reymond, President, in the chair.—Dr. Frölich spoke on the protection of physical laboratories from the effects due to electric tram-lines, and described the arrangement used by Siemens and Halske. This consists of two coils of wire-netting at right angles to each other, which being stretched round a wooden frame, and surrounding the instrument it is desired to protect, are put into metallic contact by a cable with the conducting rail of the tram-line. The disturbance due to the passage of a car is thus compensated, and the effect on a magnetised needle is reduced to a small percentage.

January 31.—Prof. du Bois Reymond, President, in the chair.—Dr. Kaufmann gave an elaborate demonstration of Röntgen's X-rays. He also exhibited a very striking photograph of a mouse, which showed in detail the separate vertebræ of the tail, the ribs, and other bones.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Chemistry for Engineers and Manufacturers: B. Blount and A. G. Bloxam, Vol. 1 (Griffin).—A New Natural Theology based upon the Doctrine of Evolution: Rev. J. Morris (Rivington).—Universal Electrical Directory (Alabaster).—Geology: C. L. Barnes (Rivington).—Life and Exploits of Alexander the Great: Dr. E. A. W. Budge (Clay).—Grundriss der Krystallographie für Studirende und zum Selbstunterricht: Dr. G. Linck (Jena, Fischer).—Traité des Matières Colorantes: L. Lefèvre, 2 Vols. (Paris, Masson).—*Electrician* Electrical Trades' Directory and Handbook for 1896 (*Electrician* Company).

PAMPHLETS.—Report of S. P. Langley, Secretary of the Smithsonian Institution, for the Year ending June 30, 1895 (Washington).—Classification Chart of the Commoner British Orders of Flowering Plants: W. P. Winter (Cheltenham).—Über Germinal-Selection eine quelle Bestimmt Gerichteter Variation: A. Weismann (Jena, Fischer).

SERIALS.—Journal of the Franklin Institute, February (Philadelphia).—American Naturalist, February (Philadelphia).—Journal of the Chemical Society, February (Gurney).—The Asclepiad, Vol. 44, Vol. xi. (Longmans).—Proceedings of the Physical Society of London, Vol. 14, Part 2 (Taylor).—Journal of the Institution of Electrical Engineers. No. 119, Vol. xxiv. (Spon).—Internationales Archiv für Ethnographie. Band ix. Heft 1 (Leiden, Brill).—Astrophysical Journal, February (Wesley).—Strand Magazine, February (Newnes).

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