THURSDAY, MARCH 19, 1896.

THE PHYSIOLOGY OF THE EXCITABLE TISSUES.

Elektro-physiologie. Von W. Biedermann, Professor der Physiologie in Jena. Zweite Abtheilung. Mit 285 Abbildungen. Pp. 441 to 857. (Jena: Fischer, 1895.)

THE second volume of Prof. Biedermann's work, now before us, fully maintains the reputation of its author, and is, if anything, still more interesting than the preceding volume dealing with muscle.

This additional interest, though due in some measure to the subject-matter, embracing, as this does, the fundamental excitatory phenomena of nerve, the functional activity of electrical organs of fishes, and the electromotive phenomena of plant and glandular structures, is aroused and maintained by the evident drift of the writer towards a full expression of those views which he is known to share with Prof. Hering, and which the present volume affords him an opportunity of enunciating.

Such an exposition of the mental attitude of the present occupant of the Leipzig chair of Physiology (Prof. Hering), in regard to the play of those vital processes whose physical manifestations are the objects of the physiologist's investigation, is of the highest importance, since it is well known that the influence of this conception upon the physiological science of to-day is as great as was that of Hering's distinguished predecessor, Prof. Ludwig, on the science of a few years back.

The clear account here given of the two aspects of physiological change, association and dissociation, and their relation to the physical aspects of vital phenomena, is further increased in value by its setting. Placed at the end of the chapters on nerve, in that devoted to the theoretic views as to the electromotive phenomena of this structure, the author, adopting the historical method, leads up to Hering's theory through the earlier molecular theory of Du Bois Reymond and the very differently conceived theory of Pfluger, both of which rest upon a mechanical scheme as their basis, and the author then shows to what an extent the views of these two writers paved the way for that which he proceeds to present in Hering's words. Perhaps no more striking testimony to the universal character of the present acceptance of this latter view, could have been brought forward than the theory of Bernstein, the exposition of which follows that of Hering, since it brings into prominence the modifications in Hering's sense, which even such a staunch adherent of the molecular theory as the Hallé Professor has felt it necessary to elaborate.

The position here taken up by Prof. Biedermann is held by him to be the only one at present capable of embracing within its scope all the various phases of excitatory change, and its tenability is supported by an array of fundamental reaction phenomena, many of which have been ascertained by his own researches.

An interest of a very special kind is thus given to the description of the characters of the excitatory effects in nerves.

Such, for instance, is the experimental comparison between the circumstances which condition the excitatory effects produced on the opening of a galvanic current which has been led through a nerve. The initial, suddenly-developed, and comparatively short-lived muscular response to the opening nerve excitation (opening twitch) is shown to be essentially dependent upon a preceding constrained state of greater inexcitability (theoretically, *association*), and, as it is brought about by the removal of the constraining agent (the galvanic current), may be considered as a *dissociation* rebound from this condition. It is contrasted with a second more slowly developed and more lasting excitation, evoking in the muscle an opening tetanus, the essential productive factor of which is a preceding state of greater excitability (*dissociation*), a latent excitation now rendered kinetic in consequence of the slight additional dissociation effected by such a rebound. The play of different conditions upon the two effects is brought into prominence by the description of some most striking experiments, in which one is affected to the exclusion of the other by means of a special environment.

Such, again, is the description of the response evoked by nerve excitation in the muscles which respectively open and close the claw of the crayfish, a response which may be either the well-known contraction or a less familiar muscular relaxation (inhibition); experimental results which probably find their parallel in the well-known effects produced in cardiac muscle by excitation of the vagus nerve.

The excitatory electromotive changes localised to the neighbourhood of the poles when a galvanic current commences or ceases to flow through a nerve, the distinction between the vital reaction phenomena and the physical polarisation phenomena in special relation to the production of the extrapolar electrotonic currents, the specific reactions of etherised and of cooled nerves, the effect of different saline substances upon these reactions, are but a few of the many pertinent examples brought forward, the concise, clear statement of which renders the present volume such a valuable contribution to physiology.

It is perhaps to be regretted that the arrangement of subject-matter adopted by the author has involved the necessity of grouping such a large number of phenomena under the heading "Die elektrische Erregung der Nerven," with the result that this enormous chapter is 100 pages long. We venture to think that this portion might with advantage have been split into several subsidiary sections. A very large part of the present knowledge of nerve activity has been obtained by the use of electrical methods of excitation, and a vast amount of work has, in consequence, been carried out upon this aspect of the question. It is, therefore, an almost herculean task to set forth in unbroken continuity all the phenomena which fall within the scope of this title, and to do so without running the risk of making such narration wearisome to the reader, and annoying to the reference student who seeks information on one particular group of such phenomena. Prof. Biedermann has run this risk, and it cannot honestly be said that he has succeeded in avoiding the danger. As it stands at present, this chapter, although teeming with interesting details, because of this very fecundity, may not impossibly cause the reader to agree, during its perusal, with the remark

of Shakespeare's tinker listening to the play of *The Taming of the Shrew*:

> "'Tis a very excellent piece of work, madam lady,
> Would 't were done!"

We also venture to criticise the position which has been assigned by the author to the electromotive phenomena of plants. As a concise account of the present state of knowledge on the subject, this chapter is excellent; but we doubt if it is wise to place this apparently simple but really difficult branch of Electrophysiologie at the commencement of the volume. It is calculated to raise false hopes, and give the reader the impression that the phenomena in question form an easy prelude to those of nerve, which form the staple material of the work; and this, it need hardly be said, is by no means the case. The section on the electrical organ fitly follows that on the electromotive changes in nerve, and is an admirable one. If we are not mistaken, this portion occupies a unique position, since it is the first attempt to give a complete scientific account of the special functions of all known electrical organs. The excellence of the treatment is undoubtedly due to the evident necessity felt by the author to treat the subject *ab initio* from many points of view, yet to always tend towards one goal—that of explaining the nature of the specific electrical activity involved. To secure this, the section is far more amply illustrated than the others, and the illustrations themselves are extremely well chosen, whilst the hold upon the reader is strengthened by the descrjption of the structure of the organ and of its nervous connections in the different fishes, and by the excellent woodcuts which portray the chief histological features.

It may be confidently asserted that no book has yet appeared, dealing with the fundamental phenomena of the excitable tissues, which can be compared with the volumes of Prof. Biedermann. The wealth of experimental data alone must stamp the work as one which for many years will be not merely read by advanced students, but consulted as a reference book, and it thus worthily takes its place in this highest rank of scientific treatises. It is with pleasure, therefore, that we anticipate its translation, in the belief that its appearance in an English dress will, by making it more accessible, confer a boon on all those in this country who take a special interest in physiology.

F. GOTCH.

TAXATION.

Essays in Taxation. By E. R. A. Seligman, Columbia College, New York. Pp. 424. (London: Macmillan and Co., 1895.)

PROFESSOR SELIGMAN is one of the few economists that have influenced the politicians. The Tax Commission of Ohio made use of his book on "Shifting and Incidence of Taxation" (1892), and confessed they were not able to make full acknowledgment of the debt lest they should give their report too academic an appearance! ("Essays," p. 415.) Every one who reads Mr. Seligman's books will feel the reason of their influence; there is a firm grasp of principles; there is a close contact with facts; there is a constant testing of the one by the other.

The "Essays" were written in the first instance for Americans, and the illustrations are largely drawn from America. But the reasonings are of general application, and are more or less fully so applied. We need not dwell on the earlier part of Mr. Seligman's historical survey. Logic and experience, he thinks, conspire to show that not property, or even expenditure, but "income or revenue" is the best measure of ability to bear taxes (p. 18, *cf.* 21), and the world at large is slowly coming round to this conclusion.

"To arrange a system of taxation which shall, on the whole, correspond as closely as possible to the net revenues of individuals and social classes, and which shall take into account the variations in tax-paying ability, has thus become the demand of modern civilisation" (pp. 21, 22).

It has taken a long time to sift out and reject the wrong systems, and, as we might expect, there is a singular correspondence between one nation and another in the progress through blunders. For example, the General Property Tax, condemned by theorists and confessedly unsuccessful on the other side of the Atlantic, is by no means peculiar to the United States. It was not a blunder at first, and only becomes so when perpetuated. It is that form of taxation which is suited to a society

"where the only property is the collective indivisible property, where the landowner and capitalist are one. There is one kind of property, and therefore only one kind of property tax. But, as soon as property is split up into different parts, as soon as there are various kinds of property, just so soon does the single property tax become antiquated and useless. It is not only useless, but it is now absolutely iniquitous. For the attempt to include under one head the gains flowing from widely different pursuits . . . can end only in the virtual exemption of the new forms, and a consequent overburdening of the old" (p. 38).

In the Middle Ages it was for some time the prevailing tax, and was then quite fair because there was little differentiation of property (p. 46).

"History everywhere teaches the same lesson. As soon as the idea of direct taxation has forced itself into recognition, it assumes the practical shape of the land tax. This soon develops into the general property tax which long remains the index of ability to pay. But, as soon as the mass of property splits up, the property tax becomes an anachronism" (p. 53),

and the property tax reverts to real estate. The property tax in the United States is therefore "not an American invention, but a relic of mediævalism." In our times all kinds of property are not equally productive; property is not a sure criterion of individual gains; and there remains the consideration of the individual's indebtedness, suggesting the need of taxing him not on his property, but on his clear assets (p. 60). The General Property Tax can be evaded by every one except a bank shareholder (pp. 147, 148). Practically, as now levied in the States, "it is one of the worst taxes known in the civilised world" (p. 61). Mr. Seligman has an English frankness in dealing with the faults of his native country.

The Single Tax (chap. iii.) on the land escapes no better. Our author rejects it both on theoretical and practical grounds; and he says all that needs to be said on the

matter, though this field has been often traversed, and there is less scope for his originality. He shows us

"that it would be inelastic, and that it would intensify the inequalities resulting from unjust assessments; that, although proposed chiefly from social considerations, it would prevent the Government from utilising the taxing power for other social purposes, and that it would divorce the interests of the people from those of the Government; that it would offend against the canons of universality and equality of taxation, and would seriously exaggerate the difference between profits from land and profits from other sources; and, finally, that it would be entirely inadequate in poor and new communities, that it would generally have an injurious influence on the farmer, and that even in the large urban centres it would exempt large sections of the population without bringing any substantial relief to the poorer classes" (p. 93).

We have in this book what the title of it leads us to expect—a series of detached essays, and not any connected series of arguments, growing one out of another like the chapters of a book. There is nothing but a play of words, for example, to make "Double Taxation" follow the "Single Tax," for single and double are not used in the same senses in the two cases described. Perhaps the most important discussion in the chapter on "Double Taxation" is that on the taxation of aliens. Seligman considers that the principle of economic interest should be the guide here. We should find out from what place an individual gets his income, and in what place he spends it. "Only in this way can his real economic interests be located" (p. 111). The question is even more difficult in the United States than here, for members of different States are financially foreigners, and even the relations of Scotch law to English law do not quite help us to understand the relations of (say) the laws of New York to those of California. In the case of the United States among themselves, seeing that there is no real political severance, it ought to be easy to accept "economic allegiance as against the antiquated political allegiance" (p. 110). But between the United States as one unit, and Canada as another, for example, a critic might observe that such a view will not so readily find acceptance.

After a short chapter on inheritance taxes, we come to the taxation of corporations, or, as we should say, companies. Mr. Seligman here, as elsewhere, makes very effective use of the Swiss Federation and its difficulties as a European parallel to the case of the United States (p. 248). On the subject generally, perhaps his most striking contention is that the bonds and loans of companies should be taxed as well as their stock and shares, since the bonds and stock together form the working capital of the company, from which the said company derives its income. He thinks that in the case of an individual, on the other hand, interest on debt must be deducted from income, or else there will be double taxation (pp. 214, 215, &c.). This is one of the few cases where he does not produce conviction. The conclusion would more naturally be that all money borrowed to carry on or extend business may be included in the borrower's capital, whether the said borrower be an individual or a company.

After these essays on particular taxes comes a "Classification of Public Revenues" (chapter ix.), which might have been better placed at the beginning of the book. It brings out the author's favourite distinction of fees from taxes. There is a good chapter on the "European literature" about taxation. The author's wide knowledge of it makes us surprised at his inacquaintance with Grote's remarks on Greek taxation (see p. 85, note).

English readers will find little to criticise in Prof. Seligman's account of the Betterment Tax (embodied in the Tower Bridge Act of 1895), and Sir William Harcourt's Finance Act of 1894. Surely, however, the Professor is wrong in supposing that we have no special assessments on landlords (p. 312). They are certainly under obligation to pay for the making of the roads in front of their property; and his description of "special assessments" fits their case exactly. Perhaps the distinction of these assessments from fees is less strongly marked than Mr. Seligman thinks; they are at least species of the same genus.

The language of the "Essays" is excellently suited to the subject, and there is no waste of it. It is just possible that love of antithesis is occasionally a snare to the writer.

"In the case of the private business the monopoly [monopolist?] seeks only the greatest possible profits; in the case of the public monopoly the Government seeks the greatest possible public utility" (p. 296).

If this were so, France would be proverbial for the excellence of her tobacco.

In a new edition perhaps the arrangement might be improved, and possibly the lesser book on "Shifting and Incidence" incorporated, so as to make the whole a connected treatise on taxation with more evident order and connection of parts. Till Mr. Seligman has done this for his book, it will not produce on the general public the impression to which its high merits entitle it.

OUR BOOK SHELF.

Handbuch der Mineralchemie. Von C. F. Rammelsberg. Zweites Ergänzungsheft zur Zweiten Auflage. Pp. 475. (Leipzig: Engelman, 1895.)

NO fewer than fifty-five years have passed since the author issued his "Dictionary of the Chemical Part of Mineralogy," and yet his energy is unabated. The present work is the second supplement to the second edition (1875) of his well-known "Handbuch der Mineralchemie," a treasury of condensed information relative to the results of the chemical analysis of minerals, and the supplement is a concise record of chemical work on minerals published during the last decade. As in the original treatise, the author restricts himself to the expression and criticism of observed facts, and avoids as far as is possible the discussion or even mention of constitutional formulæ. And for the purposes of the student it is doubtless convenient to have collected for him into a single treatise the observed solid facts upon which all speculation relative to the chemistry of minerals is to be based. Once more the mineralogical chemist is reminded how rarely the analysed material is truly pure, and how necessary it is to record its morphological and physical characters, the mode of its occurrence, and the nature of the accompanying minerals: it is only by regard to such records that the true composition of a mineral can in many cases be deduced. And the author points out how imperfect is our knowledge of the chemical composition of many of the commonest minerals notwith-

standing the number of analyses which have been recorded. In the case of the plagioclastic felspars, for example, though the results of many analyses are in close agreement with the hypothesis of the admixture of molecules of albite and anorthite, there are others which deviate considerably therefrom, and are as yet unexplained. The caution of our chemical Nestor is perhaps carried to an extreme. He declines, for instance, to recognise the interchangeability of F and HO, notwithstanding the results independently obtained of each other by Penfield and Sjögren in the case of the Humite group, and by the former in the case of Topaz, and attributes the variations of composition to alteration—to loss of fluorine and gain of water. But in the case of Topaz the angle of the optic axes has been shown to be related to the percentage of the fluorine, and it is difficult to regard the variation of chemical and optical characters to be a result of mere hydration. Every one will hope that the Berlin professor will be spared to issue a third supplement of this standard work of reference. L. F.

Elements of Botany. By J. Y. Bergen, A.M., Instructor in Biology, English High School, Boston. Pp. vi + 275 + 57. (Boston, U.S.A., and London: Ginn and Co., 1896.)

IT is very seldom that we have come across an elementary book on botany which has impressed us so favourably as the one now under review. It is intended primarily for school use, but the admirable method which is maintained throughout its pages ought to be practised in all grades of class work. A general account is given of the simple morphological and physiological phenomena of plant-life, and the student is encouraged to put the knowledge thus acquired in each section to a practical test. A selected object or experiment is indicated to him, and he is shown how to put his own questions. He is *not*, however, told the answer—that he has to find out for himself as the result of independent observation.

The work is well illustrated with more than 200 figures, and contains, besides, appendices on material and methods, a useful chapter of about fifty pages on the commoner orders and species of flowering plants inhabiting the northern and middle States.

Although the author has naturally paid special attention to the needs and opportunities of American students, his book ought to be well received in this country also, for most of the plants mentioned are readily obtainable here, and from an educational standpoint the book is quite one of the very best we have met with.

Geology. By C. L. Barnes, M.A., F.G.S. Pp. viii + 181. (London: Rivington, Percival, and Co.)

THIS is not a very remarkable addition to the already large number of easy books on geology. When we have said that the volume is readable, and a suitable one to put into the hands of beginners, we have uttered all that is demanded by the text. The illustrations are the least attractive features of the book; none of them are striking, and few, if any, of them are new. A fact to which attention may well be directed, is that the book does not follow any examination scheme.

The New Photography. By A. B. Chatwood. Pp. 128. (London: Downey and Co., 1896.)

THE "new photography" described in this book is not confined to work with Röntgen rays, but includes also accounts of colour photography, psychic photography (retinal impressions) spirit photography, and anaglyphs. The book is, to say the least, a trifle premature as regards work with Röntgen rays; and the title, as well as the shadow of the bones of a hand, printed upon the title-page, is misleading as to the contents.

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.*]

Dr. Ball's Two Letters on the Ice Age.

SIR R. BALL'S last letter is a little embarrassing for those who have accepted his teaching. In it he claims that however faithless his other supporters may have proved, he can still rely on the countenance of Dr. Wallace. What does it all mean? Dr. Wallace is responsible for a theory of the Glacial period which has been before the world for many years, and which is entirely different both in essence and in its consequences from that proclaimed in "A Cause of the Ice Age." Are we to understand that Sir R. Ball has adopted Dr. Wallace's theory, or is it Dr. Wallace who has adopted Dr. Ball's? The differences between us are so important in view of modern geological conclusions, that I may be perhaps permitted to condense a few simple issues in a few questions. I could add more if necessary.

Sir R. Ball says he has not changed his views. Does he still then hold, as he once did, that astronomical causes alone will suffice to produce an Ice Age, or does he now hold with Croll and J. Geikie and Dr. Wallace that they will not, and must be supplemented by other causes?

Does he still maintain, as he maintained in the new edition of his book, the old-fashioned theory as to the laws of radiation, or does he believe in Stefan's law, which entirely alters the whole basis of the case, both as taught by himself and by Croll?

Does he still maintain that the Kabbalistic figures 63 and 37, which represent a constant and invariable factor, whatever variations there may be in the eccentricity of the earth's orbit, and which therefore cannot induce variability of climate, are not only the efficient element in producing an Ice Age, but represent, as he states in his work, the proportions of summer and winter heat received in the latitude of Britain either now, or at any time?

On page 27 of the same edition Dr. Ball says: *Our hemisphere was once covered with ice.* Does he still maintain this, the most extravagant doctrine ever propounded by a Glacialist?

In his first letter to you, Dr. Ball admitted that Mr. Culverwell's calculation of the distribution of the sun's heat over different zones of the earth at present, and during the period of extreme eccentricity, is unassailable, but that the result is affected by convection of heat from other places. How does he reconcile this view, which was Croll's, and is also Mr. Culverwell's, with any part of the argument in his book, which was written, as he says, to enable us to dispense with other than astronomical causes?

Lastly, Sir R. Ball professes to account for *the* Ice Age—that is, the Glacial period of the geologists. In doing this he contrasts the effects of present eccentricity with the effects of the limit of *extreme eccentricity* as calculated by Leverrier and Stockwell. Does he seriously argue that the great Ice Age took place 850,000 years ago? As he well knows, we must go back to that period before we get a disparity of the seasons amounting to thirty-three days, and any time during the last 300,000 years this disparity has been always very much less. Is it either ingenuous or right to treat this extreme variation as a factor in any possible range of speculation on the Ice Age?

As I said, I could add largely to these issues; but they will suffice. The matter is not a private difference of opinion. It is one upon which the basis of a great deal of geological reasoning must be founded. HENRY H. HOWORTH.

30 Collingham Place, Earl's Court,
March 11.

The Röntgen Rays.

So many people are buying tubes for the "new photography," that I think it ought to be made known that the best results can be obtained with the original spherical tube used by Prof. Crookes in 1879, to show the incandescence of platinum under impact of the projected molecules which were focussed on it by a concave kathode. I have been using such a tube for my best work up to now. On January 29 last, I put in hand a larger tube of the same kind, with the same large concave kathode at the top and small disc anode at the bottom, but without the platinum in the middle. This tube is six inches in diameter. But the tube-makers have been so occupied with smaller tubes,

which are far less trouble to make, that it was only sent me yesterday. I at once used it to photograph a man's hand on an inverted celluloid film, the whole enclosed in a black bag in the usual way. With five inches of spark, and an exposure of three minutes at eight inches distance from the film, I obtained fine definition of the bones as far as the film went, including the junction of the two bones of the arm with the wrist. No Tesla apparatus was used. Had it been, doubtless the exposure could have been considerably shortened. An area of twelve inches by ten inches was covered perfectly. The tube was then set on for thirty minutes without stopping with a ten-inch spark coil, and showed no perceptible heating.

Although the definition was even better, the original tube with the platinum required an exposure of ten minutes under the same conditions.

I should like to draw attention to a curious dark shadow, which appears to be hanging in mid-air just above the anode, when the six-inch tube is set in action, and persists for some time afterwards. This shadow has the appearance of an ovoid dark space surrounded by a halo, and is probably the shadow of the kathode. Is it possible that rays proceed from a spot coincident with this shadow? A few rough experiments I have made, seem to lend colour to this view.

Chard, March 8. J. WILLIAM GIFFORD.

I SEE from a note in last week's NATURE, that some little doubt has been thrown upon the practical value of Röntgen's discovery in surgery. The following notes may therefore be of some interest.

With regard to the cryptoscope—after trying a number of substances, I have fallen back upon potassium or barium platinocyanide for the screen; the potassium salt was suggested to me, and I find the shadows show up in some respects better. The special form of cryptoscope which I have made is binocular, and with a good Crookes' tube I have had excellent results. I have been able to see distinctly shadows of the whole of the bones of the upper extremities, and a good portion of the lower; but what is most interesting, I have been able to look straight through a skull into which I had placed two or three bullets, and had no difficulty whatever in seeing shadows of them, although somewhat enlarged.

With regard to the photography—I have photographed the inner table of the cranium, the upper part of the spine in the neck, and half the spine and vertebræ in an adult. Not only have I got shadows, but distinct images of the surface of the bones of the spinous and transverse processes of the vertebræ; the ribs being particularly well defined. I have also photographed all the joints in the body with two exceptions, and this for the simple reason that I had not time to do them.

For practical purposes exposure is of importance. Fortunately the movable parts, such as the extremities, are more easily photographed than the denser and thicker tissues of the trunk. In other words, where we require quick exposures the conditions are more favourable.

I believe the Röntgen photography, and the cryptoscope, will prove to be one of the most valuable discoveries ever placed before us. JOHN MACINTYRE.

179 Bath Street, Glasgow, March 16.

WHILE a Crookes' tube discharges an electroscope charged with positive or negative electricity, when negative most rapidly, I have found with several of the ordinary spectrum tubes, particularly one containing oxygen, and another hydrogen, that these tubes produce the Röntgen rays, but act differently upon a charged electroscope. When the charge is positive, the leaves collapse immediately; when negative, they open out still further.

With the spectrum tube containing oxygen, good impressions have been obtained upon a photographic plate in four minutes.

London, March 16. F. J. REID.

The Huxley Memorial.

SINCE last a public announcement was made, the names of Sir H. H. Johnston, K.C.B., H.M. Commissioner and Consul-General in British Central Africa, and of Mr. Charles Hose, resident magistrate at Sarawak, have been added to the General Memorial Committee, which now numbers considerably over 700 persons, representative of science, literature and art, in all parts of the world.

The amount promised and received now exceeds £2300, and as a sufficient sum is thus guaranteed for the statue at the British Museum of Natural History and the medal at the Royal College of Science, London, the first two objects of the Committee definitely decided upon, Sub-Committees have been appointed to carry these objects through, and designs for the statue are now being prepared by Mr. Onslow Ford, R.A.

Appeal is now being made for the third object of the Committee, viz. "the furtherance of biological science in some manner to be hereafter determined, dependent upon the amount collected." The foundation of exhibitions, scholarships, or lectureships has been proposed, and for this purpose a considerable sum will be required. The efforts of the Committee to raise this are being promoted by the organisation of Local Committees in all parts of the world. Conspicuous among the results already obtained by this means is the receipt of £25 from the town of Leicester, through the mediation of its Literary and Philosophical Society; and it is hoped that this may be taken as a criterion of expectation from other localities. Donations of any amount will be gladly received by the Hon. Treasurer, Sir J. Lubbock, Bart., or by the Bankers, Messrs. Robarts, Lubbock, and Co. (15 Lombard Street, E.C.), or by myself.

A circular is now printed for distribution in lecture-rooms and elsewhere, and I should be very glad to communicate with friends or admirers of the late Prof. Huxley, or with persons connected with societies or institutions, who may be willing to aid the Memorial Committee by distributing copies of this letter or in any other manner. G. B. HOWES,

Hon. Sec. Huxley Memorial Committee.

Royal College of Science, South Kensington,
March 17.

Natural History Museum.—Bird Gallery.

MAY I ask when the "common people" Mr. R. B. Sharpe speaks of in your issue of February 20, will "have the opportunity to read, mark, learn, and inwardly digest what the Museum is trying to teach"? As regards the Bird Gallery, the "opportunity" seems to be no nearer than it was fourteen years ago. Surely there has been time during that period for the preparation of a "guide" for the Bird Gallery, equally with the Shell and various other departments. *All* the "common people" can learn at present, is the scientific and, in some cases, the popular name of the bird, and its habitat. Among the thousands of species exhibited, there must be many whose history, written in a few lines, as is done with the British specimens in the table-cases, would be both interesting and instructive. I may add that there is no "guide" to the Department of British Zoology.

E. S.

The Aurora of March 4.

THE fine auroral display, noticed in NATURE, March 12, pp. 437 and 444, was brilliantly visible from the streets of Dublin at 8 p.m. on March 4. The great beam, rising from the characteristic bank of cloud into a starry sky, originated due west, and, if continued, would have passed to the south of the zenith. At 8.5 three or four short parallel rays, resembling a gridiron, appeared in a patchy way some 20° to the north, in a similarly clear sky; they disappeared rapidly, and five similar parallel bars arose close to the north side of the main ray at 8.10. At 9.30 the display had faded, as far as the city was concerned. GRENVILLE A. J. COLE.

Royal College of Science for Ireland.

Inverted Images.

MANY years ago I tried the method of reading a book upside-down on people who had never consciously attempted it before. I was surprised at the very great difference of aptitude. Generally individuals who had clear recollections of form, and could reproduce sketches of what they had seen more or less correctly, read easily and at once; but the greater number read slowly, frequently spelling as they went along. A boy of nine years of age, who was in the habit of reproducing on paper, with scissors, horses, dogs, cats, coaches, &c., read upside-down at once. I noticed that in cutting his patterns he sometimes cut his horse upside down, but more frequently the normal way. The same

boy, in demonstrating geometrical propositions, was not the least put about with the reversal of the diagram. He afterwards turned out a clever pattern-designer. JAMES SHAW.

The Age of the Wealden.

IN a letter in NATURE for March 12, Prof. Marsh calls attention to the evidence of the vertebrate fauna of the Wealden rocks as being in favour of including that series in the Jurassic system.

It may be of interest to add that a recent examination of an exceedingly rich collection of fossil plants obtained by Mr. Rufford from the Wealden rocks near Hastings, and now in the British Museum, leads very decidedly to the same conclusion. Between the Wealden flora of the South of England, in which no traces of undoubted Angiosperms have so far been found, and the typical Jurassic plants from the Yorkshire coast, there is a very close resemblance. A. C. SEWARD.

Cambridge, March 16.

The Stress in Magnetised Iron.

DR. CHREE will meet, I think, with general support in his opposition to the view that there is of necessity, or even usually, an actual stress in a magnetised rod tending to shorten it; but in maintaining, as I understand him to do, the opposite view that the magnetic tension along the lines of force is necessarily accompanied by a mechanical stress of pull and the associated extension, he appears to me to be on more disputable ground. Dr. Chree's conception of the Maxwell distribution of stress seems, if I may venture to say so, to be too materialistic. What Maxwell really showed, of course, was that such a distribution would produce on every element of matter in the field the mechanical force which it was known actually to experience. It was not suggested, however, that these stresses were to be considered as transmitted by the matter by virtue of its mechanical properties, indeed this could clearly not be the case where the matter was liquid or gaseous; and so there are no grounds for supposing that the matter would exhibit strains directly associated with these stresses. The stresses, in fact, must be considered as transmitted by the ether which pervades the field, and it is in the ether that the associated strains are to be looked for.

If, however, we turn our attention from the ether to the matter in the field, and remember that certain portions of this matter will in general be experiencing mechanical forces, we see that if its equilibrium is to be maintained a suitable system of mechanical stresses and the associated strains must be set up in it.

In the case considered by Dr. Chree in his letter to NATURE, published on January 23, it is plain that if AA′ and BB′ are air-gaps, and are not filled up with a material capable of offering resistance to longitudinal compression, the portions A′ and B′ of the bar must be held or fixed in some way if there is to be equilibrium. This was pointed out by Prof. Ewing, but Dr. Chree does not seem to have appreciated its significance, and his disregard of the external forces required for this purpose is responsible for the apparent discontinuity to which he refers in his second letter. If A′ and B′, with these forces applied to them, are allowed to move up to A and B so as to close up the air-gaps, we pass without discontinuity to the case of a magnetised rod under external pull, and thus in a state of mechanical tensile stress and elongation. If now we consider these external forces to be gradually diminished to zero, and suppose that the question is not complicated by end effects at the outer ends of A′ and B′ (as it will be in the case of a straight rod unless external forces are kept applied at these ends), the mechanical tensile stress and elongation will diminish to zero also, and we have passed without discontinuity from Dr. Chree's result to Prof. Ewing's.

That Dr. Chree has obtained the correct result for the special case which he investigates, appears from the following considerations. Assuming that AA′ and BB′ are equal air-gaps, and that A′ and B′ are fixed, AB will be in equilibrium. The Maxwell distribution of stress gives equal mechanical forces on the surfaces A and B directed outwards, and consequently there will be tensile mechanical stress in AB with its associated extension. In this case, therefore, there is actual elongation of the metal in the direction of the lines of force. In the case of an endless ring, however, the Maxwell distribution of stress gives no mechanical force, and no mechanical stresses with associated strains will be set up. This is the case considered by Prof. Ewing, who obtained the same result. I must confess that I do not follow Dr. Chree's objections to Prof. Ewing's reasoning on this point. The mechanical stresses must be such that every portion of the ring is in equilibrium. Prof. Ewing does not complain that tensile stress in a ring is unimaginable, but that it does not comply with this condition. If Dr. Chree will reconsider his reference to the case of a rotating anchor ring, he will admit, I think, that as every element of such a body is not in equilibrium, but in accelerated motion, the fact that tensile stress can and does exist in it is not relevant.

As a further illustration of the variety of the mechanical actions which may accompany the Maxwell distribution of stress, we may consider the case of two sheets of tinfoil placed against opposite faces of a plate of glass and maintained at different potentials. It is readily seen that in this case the glass undergoes a mechanical stress of compression and the associated strain of shortening in the direction of the lines of electrostatic force, though the Maxwell stress in this direction is a tension. L. R. WILBERFORCE.

Cavendish Laboratory, Cambridge, February 26.

RECENT WORK OF THE GEOLOGICAL SURVEY OF THE UNITED STATES.[1]

II.

SINCE Gilbert (in 1887) published his classical monograph on the geology of the Henry Mountains, in which he gave to the world for the first time a clear and connected account of the nature and occurrence of Laccolites, we have waited many years for further original work on this type of physical structure in America. A study of the writings of Peale, and of the exquisite panoramic drawings of Holmes, made it abundantly clear that laccolitic masses must be frequent in the United States. Mr. Whitman Cross has now collected a number of instances from Colorado, Arizona, and Utah.[2] He has remarked on their structure so far as it has been made out by these observers, by Emmons, and by himself, given a description of the characters of the rock of which the laccolites consist, and offered some remarks on the general theory of laccolitic structure.

The theory has not been quite so fertile in results as might have been expected from the clear-cut nature of Gilbert's brilliant piece of work; nevertheless the author is able to show that, although Reyer refuses to accept the facts on which the theory is based, Suess, on the other hand, reproduced the illustrations, summarised the results of Gilbert, Peale, and Holmes, and applied them to European and other examples, while Neumayr added further arguments in favour of the intrusive nature of the Henry Mountain rocks themselves. It may be pointed out here that the existence of laccolites has been taken almost for granted by many British authors (not referred to by Cross), such as Kinahan, Geikie, Harker, Marr, and others, and that in one case at least a numerous group of laccolites has been described, and proof given that the igneous masses are conformably underlain and overlain by sediments.[3] The abstract of this paper, all that was published for many years, also anticipates some of the conclusions independently reached by Mr. Cross.

The familiar Henry Mountains are first described, then the West Elk Mountains to which attention was drawn by Peale, and in succession the San Miguel, La Plata, Carriso, El Late, Abago, and La Sal Mountains. All these are either on the verge of the great plateau, being thus geographically outliers of the Colorado Mountains, or they are isolated groups on the plateau itself. They are groups of laccolites intruded into nearly horizontal strata probably at about the same period—in Tertiary

[1] Continued from page 441.

[2] "Fourteenth Annual Report of the Geological Survey of the United States," 1892-93. (1894.)

[3] "Report of the British Association," 1886.

time, as they pierce rocks of Cretaceous age. The Mosquito Range of central Colorado, and the Ten-Mile district to the west of it, were studied by Jacob and Emmons, and in these areas intrusive rocks of the same composition occur as laccolites, sills, and dykes in more ancient rocks, and even in the fundamental Archæan complex. A few other cases are referred to.

The study of these examples reveals the fact that the theory has received several important accessions, and even some modifications. The laccolite is beginning to lose the familiar mushroom shape which, with its central stalk, has done much to cause incredulity; we find, instead, excentric dykes and pipes, complex groups of dykes, even sheets and dykes in suspicious proximity to important faults, indicated as the feeders of the lens-shaped masses of igneous material; this gives much more of structural verisimilitude to the type. Again the masses are shown to be more often irregular or unsymmetrical in outline, faults as well as folds give easement to the lifted cover, the so-called pine-tree laccolite, or group of anastomosing sheets is not infrequent; bunches of laccolities irregularly intruded into yielding shales take the place of the single "stone cistern," and the laccolite is sometimes shown to cross the strata both above and below. In addition to formal sections, many of the beautiful outline and panoramic sketches of Holmes are reproduced; these are drawn with such a wonderful feeling for the run of the country, that the igneous structure can often be made out from them alone. In fact, so much has been made out of what material has been already got together, that we feel bound to express a hope that selected examples of the group will shortly be mapped out in detail by the skilled stratigraphers of the Survey, in order to ascertain in such a favourably exposed region what is the precise relation of laccolitic groups to the folding of rocks, and the exact part played by them in tectonic history.

It is a remarkable fact that the rock in the laccolites is almost uniform in character. It is called a porphyrite, and contains phenocrysts of either hornblende, augite, hypersthene, biotite, quartz, and felspar, or several of these in a holocrystalline but compact matrix of quartz and orthoclase. The silica percentage, omitting one doubtful and exceptional type, varies from 69-55, but is generally about 63, and the proportion of potash to soda, 2·5-4, is fairly constant. The porphyritic crystals, chiefly intratelluric in origin, have increased in size after the intrusion of the rock, and it is thought that the phenocrysts of orthoclase, which occasionally occur, have been completely formed after intrusion. Gilbert's hypothesis, that the laccolitic structure is determined by conditions of density, is not accepted in its entirety, the author quoting with approval Dana's criticism that Gilbert's explanation "appears to be complete without reference to this difference of density. With so powerful a forced movement as the facts, if they are rightly interpreted, show to have existed, no other cause could be needed for a flow to the surface in the case of an open channel, or for a flow to any level in the strata at which a fissure might terminate; and this is true, whether the lava be light or heavy." Hints are given throughout the paper that orographic movements may often have had a determining effect in the localisation of laccolites, a result already reached by some observers in Britain.

An exceptionally interesting piece of experimental work is contained in Mr. B. Willis's "Mechanics of Appalachian Structure."[1] A long series of experiments was undertaken, and is here illustrated by twenty-one large plates, while a number of maps, sections, and photographs from the Appalachian ground are of use to compare with the experimental results. In addition to the usual types of folds defined by the opposed dips, we have a classification according to compression into open, closed, and carinate or isoclinal folds. In the Appalachians the following districts are recognised: the district of (1) open folding, (2) closed folding, (3) folding with faulting, (4) folding with schistosity. One of the great questions to which the observer is led is this: As the "conditions antecedent to deformation were the result of sedimentation, does the distribution of strata afford an answer to the questions raised?" To investigate this problem a mixture of beeswax with plaster of Paris and Venice turpentine of varying consistency was used, in thin, large sheets, resting on a plastic support, and covered by shot to act as a load. This was contorted by lateral pressure applied by means of a slow-motion screw. One of the first results to come out was that any slight dip in the layers of material was usually sufficient to initiate a fold. "In strata under load an anticline arises along the line of initial dip, when a thrust, sufficiently powerful to raise the load, is transmitted by a competent stratum. The resulting anticline supports the load as an arch, and, being adequate to that duty, it may be called a competent structure." From this it follows that the size of an anticline depends on the competency of the stratum and inversely on the load. Some evidence has been obtained in the field that the initial dips in the Appalachians have influenced the folding. An interesting by-product of the experiments is the fissuring of tissue-paper placed between the layers, along lines at right angles to the wrinkles. The work then goes on to consider the packing of folds and the formation of faults. The plates illustrate the successive steps of each experiment of which the details are thought worthy of publication.

Owing to the small scale of the maps and to the rapidity with which surveying is carried out, it is often necessary to generalise the geological as well as the topographical features expressed on the maps, when it is desired to bring out important tectonic characters. This is pointed out by Prof. Iddings, and atoned for by the conscientious completeness with which he has worked out the petrological affinities of the intrusive and eruptive rocks of Electric Peak and Sepulchre Mountain.[1] Separated now by a great fault, with a downthrow to the north-east, along which a valley has been excavated, one of these masses—Sepulchre Mountain—was once situated almost directly over the other. Sepulchre Mountain is made up of volcanic accumulations, andesitic and rhyolitic breccias and lava-flows, with dykes and other eruptive volcanic products; Electric Peak consists of intrusive sheets, dykes, and "stocks" of porphyrite and diorite corresponding in a general way in composition with the rocks first mentioned, but differing in their coarser texture and more plutonic aspect. The relative date of the members of the intrusive series can be made out and paralleled stage by stage with the volcanic products, so as to make it clear that we have here side by side the surface and the deep-seated products of one volcano. This is expressed in tabular form, as follows:—

Electric Peak.	Sepulchre Mountain.
(*a*) Intrusive sheets of porphyrite.	(*a*) Andesitic breccias.
(*b*) Intrusion of dyke and stock rocks in the following order:—	(*b*) Andesitic breccias and dykes in the following order:—
Pyroxene-porphyrite to pyroxene- and hornblende-diorites.	Pyroxene-andesites to pyroxene-hornblende-andesites.
Hornblende-biotite-diorites and porphyrites.	Hornblende-biotites-andesites.
Quartz-biotite-diorite-porphyrite.	Dacites.

Such a parallelism cannot be the result of an accident, and it affords a most useful opportunity for the study of the relations of deep-seated and surface products; of this

[1] Thirteenth Annual Report of the Geological Survey of the United States, 1891-92. (1893.)

[1] Twelfth Annual Report of the Geological Survey of the United States, 1890-91. (1892.)

chance Prof. Iddings has not been slow to take the fullest advantage. The author does not use the word porphyrite in the sense of an altered or ancient andesite, but applies it to "medium-grained porphyritic rocks that occupy an intermediate position between the coarsely granular diorites and gabbros and the microlitic or glassy andesites." In describing the diorites, he gives a plate of examples of the intergrowth of such minerals as hornblende, biotite, augite, and hypersthene. The whole of the plutonic rocks are compared together as to structure and chemical composition, and shown to form a connected and overlapping series. Similar comparisons are effected between the volcanic products of Sepulchre Mountain. Mr. Iddings points out that it is impossible to trace any actual transition through stock and dyke rocks into the corresponding eruptive rocks, for the reason that they are often cut asunder while the volcano is in activity, and because the pipe is invaded by each magma in turn, the last alone remaining there to solidify, unless little patches of necessarily altered previous types happen by accident to survive.

In the nineteenth monograph, Messrs. Irving and Van Hise treat of the Penokee iron-bearing series of Michigan and Wisconsin. This is a monoclinal series of rocks dipping northwards off a mass of crystalline rocks which lie to the south, and extending a distance of eighty miles along their strike. The "Southern Complex" is a mass of schists of eruptive origin, with masses of granite intruding into them. Resting unconformably on this complex, comes a thin series of cherty limestones (300 feet) of aqueous origin, but whether chemical or organic is not known, and unconformably again on that, the quartz-slate (500 feet). The iron-bearing member (800 feet) in its least altered state is a water-deposited cherty iron carbonate, which can be seen to grade into ferruginous slates, these into ferruginous cherts with concretionary and brecciated structures, and these again into actinolitic slates containing much magnetite. This rock is penetrated by diabase dykes which, when intruded, appear to have been vertical, while the beds were horizontal. It results from this that, now both are tilted, V-shaped areas occur defined by the upper quartzite of the quartz-slate on the one hand, and the dykes on the other. It is in the apices of these V's, that the iron ore is now concentrated, the original rock being rendered very poor in ferruginous constituents, which have been re-deposited in the ore masses as hæmatite. In the area east of Gogebic Lake, the regular succession is disturbed by volcanic accumulations and greenstone conglomerates. The Upper Slate member (12,000 feet) rests on the iron-bearing rocks, but it does not extend quite so far as they do. The southern complex is placed in the Archæan system, the overlying beds into the Algonkian; these are covered by the Keweenawan series, after which the rocks received their monoclinal tilting; finally, the Eastern Sandstone was unconformably deposited on them all. The work is illustrated by a large series of illustrations of the microscopic structure of igneous and sedimentary rocks, and by maps and sections.

Mr. Walcott[1] gives an admirably illustrated account of the igneous rocks of the Unkar terrane, a group which underlies the Tonto Sandstone in the district of the Grand Cañon of the Colorado, and has been variously referred to the Algonkian, the Cambrian, and the Silurian by himself and other authors. The presence of a well-marked Middle Cambrian fauna in the upper part, and a strong unconformity at the base of the Tonto Sandstone, are sufficient in the opinion of the author to warrant our considering the Unkar beds as Pre-Cambrian, and correlating them with part of the Algonkian succession. The upper part of the Chuar terrane, which immediately underlies the Cambrian rocks, consists of 1700 feet of shales and sandstone, with 138 feet of limestone; the lower division of this terrane has 3420 feet of similar rocks, with 147 feet of limestone of a rather different type. Two of the limestones are spoken of as *Stromatopora* limestones, and they contain an organism which is probably a species of Cryptozoon.

The Unkar terrane which underlies that last described, is 6830 feet thick; there are magnesian limestones at the top, followed by lava beds 800 to 1000 feet thick, then sandstones and another lava bed from 80 to 180 feet thick on a limestone and conglomerate, which rest unconformably on the Vishnu schist, and the gneisses and schists of the Archæan System. The igneous rocks were probably submarine flows poured out from fissure eruptions, the dykes of which are still visible in the walls of the cañon, during a slow subsidence when beds of sandstone and shale were interleaved with the volcanic products.

Mr. Iddings, who contributes an appendix, describes the lavas as olivine-basalts sometimes fresh but more usually altered, the felspar passing into saussurite, the pyroxene to chlorite, and the olivine to serpentine and other products. When the original structure is well preserved, it does not differ much from that of the Tertiary lavas of the same area. The ground-mass of the basalts is usually microcrystalline, but in the middle of thick sheets it becomes ophitic, while the upper and under parts are scoriaceous and amygdaloidal.

In that lucid style for which his work is well known, Mr. Walcott[1] sketches out the physical history of the North American continent during Cambrian time. He shows that Dana's idea of the existence of a V-shaped skeleton, about which Palæozoic sediments accreted, is in the main correct, but he is able to fill in a number of details which were of necessity left blank by that author. The underlying massif is composed of Algonkian rocks resting unconformably on those of Archæan age; its rocks were tilted and uplifted into a land area, which Walcott proposes to call the Algonkian continent, and which was of wider extent than any land in this position until Mesozoic time. This continent consisted of four chief parts: (1) the V-shaped mass running parallel to the outlines of Hudson Bay, and possibly extending in a shield-like area to Texas and the Colorado River; (2) a Palæo-Appalachian range, with sub-parallel chains and spurs; (3) a Palæo-Rocky Mountain mass; and (4) a Palæo-Sierra Nevada mass. Sedimentation took place in all the seas defined by these land areas in early Cambrian (*Olenellus*) times; that is to say, in (1) the Atlantic Coast Province east of the Palæo-Appalachians; (2) the narrow sea extending from Labrador to Alabama; and (3) on the west side of the great V-shaped mass.

In Middle Cambrian times there was little change in the areas of deposition, except that partial barriers erected along the line of the Appalachians only allowed a small part of the typical (*Paradoxides*) fauna to penetrate westwards from the Atlantic basin. Strongly defined zoological provinces evidently existed in Middle Cambrian time, as proved by the study of the fauna of this period to the west.

Steadfast depression then began, and the Upper Cambrian Sea carried its sediments over the whole of the great south central region, including almost the whole of the United States as far north as Chicago, and from the Sierra Nevada to the Appalachians. The Appalachian barrier was, however, strengthened so that the fauna of the Atlantic coast in Upper Cambrian times was related to that of Europe, and quite distinct from that of the Central States. This great depression brought on the limestone deposits of the Ordovician system. The memoir is illustrated by several important geological and palæo-geographical maps.

[1] Fourteenth Annual Report of the Geological Survey of the United States, 1892-93. (1894.)

[1] Twelfth Annual Report of the Geological Survey of the United States, 1890-91. (1891.)

Volume xxiii. (1894) of the Monographs of the Survey is devoted to the geology of the Green Mountains in Massachusetts, by Messrs. Pumpelly, Wolff, and Dale. This district of Palæozoic rocks is complicated by two circumstances; in the first place, the limestones of Greylock Mountain appear to pass shoreward into the sandy and shaly beds of Hoosac Mountain to the west, and in the second place, metamorphism has proceeded much further at the western end of the series. Resting on the Stamford gneiss of Pre-Cambrian age comes the coarse gneiss of the east side of Hoosac Mountain, which is traceable into coarse conglomerate, "white gneiss," and quartzite as we pass towards the north and west. The lower part of the Hoosac schist passes similarly through the calcareous schist of the Hoosac Tunnel into the Stockbridge limestone. The upper part of this schist is perhaps to be correlated with the Berkshire and Greylock schist series, which are separated by the Bellowspipe limestone. The rocks are over-folded and faulted as well as metamorphosed, but patient mapping has unravelled the complex structure, and enabled the writers to assign the Stamford gneiss to the Pre-Cambrian System, the Vermont Formation and the Lower Stockbridge limestone to the Cambrian, and other rocks mentioned to the Silurian System. Much credit is due to the authors, and their assistants in the field, for such a careful and detailed piece of work, in which everything has been subordinated to the elucidation and presentation of the facts.

Mr. T. Nelson Dale,[1] in his account of the Renselaer Grit Plateau of New York, thinks that the grit occupies a place (probably unconformably) above the Hudson River shales, which are themselves equivalent to the Berkshire schists, but in a less altered condition, and in their turn rest on the Stockbridge limestone. The upper part of this last rock, which is crystalline and contains clastic grains of quartz and felspar, yields fossils of Trenton, Chazy, and Calciferous age, but its lower part represents much more ancient time, as it contains Cambrian fossils. and is thought to be the equivalent of the *Olenellus* limestone, which, further east, rests on Archæan rocks.

The grit itself is a coarse graywacké containing some secondary minerals, and interbedded with red slates and phyllites. On the west side of the syncline it is underlain by shales and phyllites of the Hudson River group, which pass towards the east into muscovite and chlorite schists which contain ottrelite, tourmaline, and more rarely albite. A map, coloured sections, some admirable photographs, and figures of rock-structure, illustrate the paper, which appears to be an excellent piece of minute stratigraphical and petrological work.

To the same author we owe an account of the structure of the ridge between the Taconic and Green Mountains in Vermont.[2] This consists of an anticline of lower Cambrian rocks overlain by Stockbridge limestone and Berkshire schist. The anticline is broken by a "keystone" fault, a thrust-plane, and one or two minor disturbances. Mr. Dale also gives another interpretation to the structure of Monument Mountain[3] differing from those advanced by Dana. He regards it as a synclinorium somewhat disturbed by faulting. The rocks involved are the Stockbridge limestone, the Berkshire schist, quartzite, and Silurian rocks.

Mr. A. Keith[4] gives an account of the Catoctin Belt, a region which is roughly the mountain tract of Maryland and Virginia, a geological continuation to the north-east of the Appalachian flexure system. The lowest rocks are relegated to the Algonkian System, and consist of a flow of diabase lava, followed by others of quartz-porphyry and andesite, and by intrusions of granite; these, again, are succeeded by other diabase flows: the diabases are now converted into the Catoctin schists. The overlying Cambrian rocks are divided into four, and the Silurian into three, divisions. A map of the whole area is given, and, in describing both igneous and sedimentary rocks, smaller scale maps are used to show variations in composition and structure. Lines are drawn on these maps through those points where a given band of rock has the same thickness (isometric or isodiametric lines, as they have been called), and by this means a very good idea of variation in thickness is given. Fossils found in the Cambrian rocks have been of the utmost use, not only in indicating the general age of the rocks, but also in making out the general succession, and in unravelling difficult bits of stratigraphy. The upper part of the Shenandoah limestone contains Silurian (? Ordovician) fossils, but its lower part yields lower Cambrian with some middle Cambrian forms. Above the representative of the Hudson River shales comes the Newark formation, of Jura-Trias age, which contains dykes and sills of diabase. The region underwent folding, thrusting, and metamorphism of Appalachian type before the Newark time, and subsequently was tilted and faulted on the monoclinal plan. It was planed down in Cretaceous times, and reduced to a base-level before the Lafayette period; certain portions which survived this second planing are delineated in a map. An interesting comparison is appended in which the amount of area planed down, and the amount of rock removed by different phases of denudation are used to obtain a rough estimate of the time elapsing during different parts of the Tertiary Period. This gives the following relative figures:—Tertiary, 134; Early Pleistocene, 1; Late Pleistocene, $\frac{5}{8}$; Recent, a small fraction.

Mr. C. S. Prosser's *Bulletin* on the Devonian Rocks of East Pennsylvania and New York[1] is an admirable piece of detailed stratigraphy, in which the fossils have evidently been carefully collected and identified from each important horizon, so as to place on record a number of facts that enable detailed comparison to be made with the better-known sections of western and central New York. About 8000 feet of rock are shown, of which 500 belong to the lower, 2200 to the middle, and 5300 to the upper division of the system. The bulk of the fossils are of marine type, but some land plants were discovered.

In his paper on a Geological Reconnoissance in Northwest Wyoming, Mr. G. H. Eldridge[2] gives a description of the great anticline of the Big Horn Mountains and the three basins lying east, west, and south of it respectively. The rocks belong to the Archæan, Cambrian, Silurian, Carboniferous, Triassic Cretaceous, and Eocene systems. The Palæozoic rocks appear to be conformable throughout, and there seems to be no break between them and those of Mesozoic age until the summit of the Laramie beds is reached; several breaks occur in the higher beds. Coal, a lignite of good quality, is found in the Laramie terrane, oil in the anticlines of Trias and Niobrara beds, building-stone everywhere, and gold in the north part of the Big Horn Mountains. The hot springs and agricultural qualities of the soils are described, and useful analyses of forty coals are appended.

An account of the economic geology of a portion of the main Appalachian coal-basin, and of an outlier called the Potomac field, is given by Mr. J. D. Weeks in the fourteenth annual report.[3] The chief coals are the Pittsburg seam of the Upper Productive Measures, the Upper Freeport and Lower Kitanning seams of the Lower Measures, and the New River and Flat Top seam of the Pottsville conglomerate. A description of the measures and their coals is given, but some of the vertical sections

[1] Thirteenth Annual Report of the Geological Survey of the United States, 1891-92. (1893.)
[2] Fourteenth Annual Report of the Geological Survey of the United States, 1892-93. (1894.)
[3] *Ibid.*
[4] *Ibid.*

[1] *Bulletin* of the United States Geological Survey. No. 120. (1894.)
[2] *Ibid.*, No. 119. (1894.)
[3] Fourteenth Annual Report of the Geological Survey of the United States, 1892-93. (1894.)

are at first rather misleading, as one scale is employed for the measures; another and much larger one for the interbedded coal-seams. It is pointed out that in many cases it is not the only, nor indeed always the best, seam which is actually mined at any particular spot.

Passing to the west side of the continent, we have first to deal with the work of Mr. H. W. Turner on the rocks of the Sierra Nevada.[1] The older set of rocks, which contain auriferous veins, and are spoken of as the auriferous series, are much disturbed, and it is very difficult to make out their exact relations, particularly as they are bent into a series of isoclinal folds. Fortunately, however, many of the beds contain fossils, by the aid of which it may be possible eventually to unravel their structure. The following Systems appear to be represented: the Silurian, Carboniferous (three divisions), Jura-Trias (?), Trias (two divisions), and Upper Jurassic or Lower Cretaceous. The last, or Mariposa formation, appears to overlap the others, and sometimes to rest on Carboniferous beds; but the maps which express this fact are not easy to interpret. These older rocks contain beds of lava and ash at many horizons, with intrusive rocks of all types, from granulite and granodiorite (or quartz-mica-diorite) to peridotites and pyroxenites. The sediments are often highly metamorphosed, and, so far as we may judge by the nature of the minerals produced, such as andalusite and sillimanite, in all probability by thermal action.

The newer rocks include representatives of the Upper Cretaceous, Eocene, Miocene, Neocene, Pliocene, and Pleistocene Systems. The Neocene rocks are the auriferous river gravels, and the Pliocene beds are shore gravels, which sometimes contain gold. These are associated with flows of rhyolite, basalt, and andesite of various types, and with great sheets of breccia and tuff derived from them. The Sierra appears to have received its chief uplift after the deposit of the Mariposa slates, and then to have been planed down in both Cretaceous and Tertiary times to an almost flat surface, which is in places preserved under the Tertiary volcanic accumulations. Late in Tertiary time came another great uplift, accompanied by faulting.

A very useful piece of economic work is that by Mr. W. Lindgren on the gold-silver veins of Ophir, California.[2] The country-rock consists of an area of schistose amphibolites towards the north-east, into which a mass of granodiorite was intruded at some date subsequent to the formation of the Mariposa slates. The amphibolites contain lath-shaped felspars set in hornblende, chlorite, and felspar, and they have evidently been derived from the alteration of diabases; the grandiorite consists of quartz, potash and soda-lime felspar, biotite, and hornblende. Dykes of amphibolite and the auriferous veins traverse both rocks, and the latter group themselves into four systems: a north-west and south-east set parallel to the strike of the schists, another set running north and south, a third west 10° north, and a fourth east 20° north. To some extent all the quartz veins bear precious metal, but the ore is concentrated into pockets and chimneys. While the veins in the granodiorite are more extensive, of low grade and rich in silver, those in the amphibolite are of smaller extent in depth and width, but richer in gold, poorer in silver, and frequently reduced to mere pockets. The amphibolite is in places impregnated with pyrites, and it is well known that where the veins cross these "iron belts" they become especially rich in ore. The minerals include native gold, silver, and copper, electrum, horn-silver, and many sulphides. Both types of rock are much altered along the walls of the veins, the amphibolite passing into an aggregate of carbonates, white mica, and pyrites.

The geology of the Eureka district, Nevada, by Mr. A. Hague,[1] contains an appendix on the fossils by Mr. Walcott, and another on the igneous rocks by Prof. Iddings. The work begins with a general description of the physical geography and geology, from which we gather that the following is the succession of the chief rocks of the district. The Cambrian rocks are 7700 feet thick, and are divided into the Prospect Mountain quartzite, the Prospect Mountain limestone, which contains an *Olenellus* fauna, the Secret Cañon shale, the Hamburg limestone with a Potsdam fauna in its lower and upper parts, and the Hamburg shale. The Silurian rocks are 5000 feet in thickness, made up of the Pogonip limestone with a Potsdam fauna at the base, then Chazy forms, and in the higher portion some of Trenton facies; the Eureka quartzite; and the Lone Mountain limestone with Trenton and, possibly, some Niagara fossils. The Devonian system is 8000 feet thick, divided into the Nevada limestone and the White Pine shale. The Carboniferous Formation has four members, the Diamond Peak quartzite, the Lower Coal Measure limestone, the Weber conglomerate, and the Upper Coal Measure limestone. The chief feature about the Carboniferous rocks is the fact that there occurs a freshwater fauna at the base of the Lower Coal Measure limestone, and a mingling of Devonian, Lower Carboniferous, and Coal Measure species in a limestone overlying beds characterised by a pure Coal Measure fauna.

These sediments are penetrated by granites, granite-porphyries, and quartz-porphyry, and are overlain by immense quantities of Tertiary or later volcanic rocks. The great eruptions for the most part cover subsided regions; where a mountain block has been uplifted, they occur at its borders. The succession of eruptions seems to have been as follows: hornblende-andesite, hornblende-mica-andesite, dacite, rhyolite, pyroxene-andesite, basalt. It is suggested that the original magma split up into two—one felspathic, the other pyroxenic; the felspathic eruptions become steadily more acid until rhyolite is reached, the pyroxenic eruptions more basic from andesite to basalt. The ore deposits are mainly of lead and iron rich in gold and silver. Originally deposited as sulphides, they have been oxidised by air and surface water. They occur in cavities in all the Cambrian, Silurian, and Devonian rocks except the great shale masses. One analysis gave 27·5 ounces of silver and 1·5 of gold to the ton.

Mr. Walcott's appendix includes a long list of fossils from all the beds. Mr. Iddings calls the granite an amphibole-granitite containing quartz, orthoclase, plagioclase, hornblende, and mica; the granite-porphyry is the chilled-edge phase of the granite-magma, of which the quartz-porphyry is the final phase. In all the volcanic rocks "there is a marked similarity between the individual crystals of the same mineral species wherever they occur . . . which links the various kinds of rocks together and suggests the possibility of a common source." The work is admirably illustrated by figures and photographs.

Mr. J. S. Diller gives an impressive picture of Tertiary denudation in his "Tertiary Revolution in the Topography of the Pacific Coast."[2] After the beds of the Shasta-Chico (Cretaceous) series were laid down, the country was planed down to a base-level. At the present time this "pene-plain" has an average maximum slope of 2°, which rises to 5°, and then somewhat rapidly up to 17°, on the flanks of the Klamath Mountains, a name used to designate the group which occurs at the junction of the Cascade range with the Coast range and the Sierra Nevada. The plain stretches across the head waters of the Sacramento River to the Sierra Nevada, and probably comes out at the other side of it in the

[1] Fourteenth Annual Report of the Geological Survey of the United States, 1892-93. (1894.) [2] *Ibid.*

[1] Monographs of the Geological Survey of the United States, vol. xx. (1892.)

[2] Fourteenth Annual Report of the Geological Survey of the United States, 1892-93. (1894.)

interior of North-East California and the adjacent parts of Oregon, being covered in the interval by Tertiary volcanic products. The plain is cut on to the Chico series and older rocks, and there rest on it the Ione formation, probably equivalent to the auriferous gravels, the Tuscan tuff, and the Red Bluff Pleistocene beds. It is noteworthy that the plant remains in the oldest of these rocks are of low altitude and not mountain types. There was evidently much movement in post-Chico time, then came erosion during the Eocene, and finally new movement with some warping and deformation. As the Eocene base-level was perfected erosion became much slacker, and was chiefly effected by solution, so that there was left much insoluble and dense material, including quartz and gold, ready to be deposited in the auriferous gravel when the next movement supervened, making the slopes steeper and giving the streams fresh impetus.

Returning now to the east, we have a lengthy account, by Mr. W. J. McGee, of the Lafayette Formation.[1] This writer has shown a remarkable adaptability in suiting his style to his subject, as he expresses it in the following sentence: "The history of development of the eastern land is recorded in nature in characters so grand that but a small part of a single one may be seen at once, so that the direct reading is difficult." The Coastal Plain of the United States is based on Cretaceous rocks, which are covered by the following rocks in order, the first having an uncomformable base: the Lignitic beds, the Claiborne and Meridian deposits, the Vicksburg-Jackson or White Limestone, the Grand Gulf beds, the Lafayette formation, and the Columbia beds. From this succession the author makes out the chief oscillations and changes in physical geography undergone by the Atlantic slope and the Mississippi embayment. The age of the formation we are left to judge from the following enigmatical sentence. "If the Cenozoic be not made to include the Pleistocene, and if the age be then divided into equal portions called Eocene and Neocene, and if then the Neocene be divided into ten equal parts, the Lafayette period may be supposed to correspond with the eighth or, perhaps, with the seventh or the ninth of these parts." The work closes with an account of the material resources of the formation, soils, siliceous clays, gravel, and iron, followed by the history of events recorded in the rocks. Mr. McGee illustrates his paper with some excellent maps, and also contributes to the fourteenth Annual Report a geological map of the whole of the United States at present surveyed.

W. W. W.

THE GAME FIELDS OF THE EASTERN TRANSVAAL.[2]

IN proceeding into the interior of Africa from almost any point on the eastern coast, the traveller passes over a low coastal plain to the foot of the scarp of a high plateau. This plateau is succeeded to the west by a still higher one, which is gained either by a second steep ascent or by a gradual slope. The existing river valleys and former earth-movements have in places interrupted this arrangement; but, notwithstanding a few such exceptions, it persists with remarkable uniformity from Abyssinia to Natal, where the dominant meridional geographical lines bend round into the east and west series that rules in Cape Colony. In the eastern Transvaal, this zonal arrangement of the country is well developed. Inland from Delagoa Bay is a tract of undulating lowland, ending at the foot of the Libombo Mountains, which separate Swaziland and the Transvaal from Portuguese East Africa. Seventy miles further to the west is the parallel range of the Drakensberg or Kahlamba (to adopt the author's spelling of the name, which is usually written Quahlamba). Between these mountain ranges is a belt of bush-covered veldt. The Crocodile River (a tributary of the Komati) and the Olifants River flow from west to east across this belt, at a distance of about 100 miles from one another. These, with the mountains, enclose a roughly quadrangular area, some 7000 square miles in extent, which is the favourite hunting-ground of Mr. F. V. Kirby. Small though this area is, it includes very varied types of country. To the west are the densely wooded eastern slopes of the Drakensberg, and part of the turf-clad plateaus or terraces beyond; to the east lies low country with sub-tropical vegetation, intervening between the Libombo Mountains and the Limpopo River.

FIG. 1.—A Head of the Great Kudu.

Most of the area consists of barren, scrub-covered plains known in this part of Africa as Bush-veldt, and near the equator as the Nyika. Most of this area was once rich in game. In the Bush-veldt lived the rhinoceros and buffalo, the sable and roan antelopes, the gnu, waterbuck, zebra and mpalla. The wooded foothills of the Drakensberg, or the "Kloof Country," was the home of the koodoo, the hill-leopard, the bush-buck, and the reed-buck. On the western plateau, or the "Krantz Country," in addition to some of the animals mentioned, lived the oribi and the mountain reed-buck.

This book relates the experience of nearly twenty years of hunting in this rich game country. The author tells his story in much better English than we are used to in books of sporting adventure. He is obviously not only a skilled sportsman, but a man with a keen eye for fine scenery, of literary tastes, and a careful and patient

[1] Twelfth Annual Report of the Geological Survey of the United States, 1890-91. (1891.)

[2] "In Haunts of Wild Game. A Hunter-Naturalist's Wanderings from Kahlamba to Libombo." By Frederick Vaughan Kirby, F.Z.S. 8vo. Pp. xvi + 567. With map, portrait, 16 full-page and 24 smaller illustrations. (Edinburgh and London: Wm. Blackwood and Sons, 1896.)

observer. His book is somewhat lengthy, and consists in the main of descriptions of successful stalks, night-watches, and exciting encounters in the chase of the various classes of game. Every page will be of interest to sportsmen; while the notes on the habits of the game, and the descriptions of variations from the normal forms, render it of importance to naturalists.

The book is divided into two parts. The first describes shooting in the "Krantz" and the "Kloof" countries; the second, that of the Bush-veldt. As the district is settled, and the natives friendly, and as the railway to Pretoria passes along the southern border of the country, the conditions of life are very comfortable. The author shot with dogs, generally on horseback, and in the case of smaller game, had the help of large parties of beaters. But the sport was not always by any means of the battue type. Five chapters out of the thirteen in the first part of the book are devoted to leopard hunting, which is always arduous, and one to buffalo hunting, which is generally dangerous. The author has great respect for the leopard, and protests against its being described, as he says it generally is, as "a contemptible sneak" and "utter coward." He describes it, on the contrary, as "an incredibly daring brute," and says it "will usually show fight where a far larger and more powerful animal would try to back out of it." But we thought that this estimate of the courage of the leopard was generally accepted, although the author describes the other as that which is invariably held. The five chapters on lions and lion-hunting, in the second part, will probably be the most generally attractive in the work. The author scorns the idea that the lion is not the king of beasts, and his experiences certainly show that its courage is sometimes superb. His remark, however, that in the case of lions, "if not interfered with or actually in a starving state, there is absolutely nothing to fear from them if met in the day-time," is not supported by recent accounts from Equatorial Africa. Some lions there recently, in broad daylight, attacked and routed a hundred men belonging to a Uganda caravan. The last chapter in the book is a discussion of the respective merit of rifles, in which the author takes the side of heavy weapons. He declares the ·303 to be a very over-rated gun, and most of his arguments seem to me quite sound, at least as far as concerns the professional sportsman. The author, however, perhaps does not sufficiently consider the case of those with whom sport is only secondary to other work. He says that the advantages claimed for the ·303, owing to its lightness and absence of recoil, are fictitious; for sportsmen must be so strong, that the few extra pounds make no difference, and that they do not feel the recoil of a ·577. This is no doubt true, if potting game is a man's sole occupation; but if in addition to a rifle he has to carry a butterfly-net and a satchel of collecting-bottles, every pound saved is of great importance. It is no doubt true, that during the excitement of the chase, a sportsman does not feel any inconvenience from half-a-dozen blows from a ·577; but if, during the next few hours, the traveller tries to take an altitude, or read a round of angles with a theodolite, he will find that he *has* felt the recoil, and has to pay for his sport by less accurate observations than he might otherwise have taken.

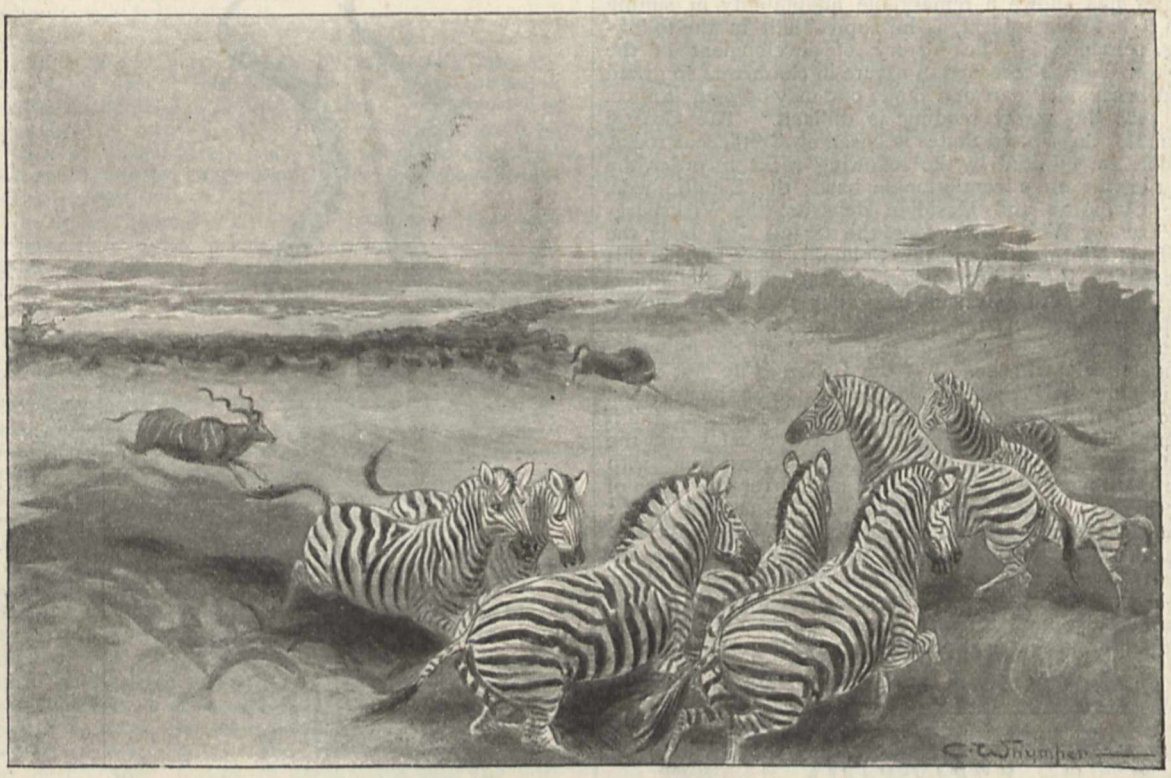

FIG. 2.—A Scene on the Game Fields.

The interest of the book is greatly enhanced by Mr. Charles Whymper's illustrations, which are a valuable addition to that artist's series of studies of wild animal life. By the courtesy of the publishers two are here reproduced as examples. In the picture of the game-fields, the artist has well illustrated the inquisitive zebras' stupid habit of swinging round occasionally to satisfy their curiosity as to danger, from which they might otherwise escape.

The most regrettable feature in the book is the author's habit of using native or local names for animals without giving the zoological name. Comparatively few of his readers are likely to recognise the *hyrax* or coney in the "dassie," especially as this term is not mentioned as a synonym in the notes on the fauna in the last chapter. The author's interesting remarks on some snakes lose much of their value, owing to the uncertainty of knowing which species he is describing.

The author's account of life on the game-fields shows that these are not Edens. His realistic account of a fight between a lion and a sable antelope, which resulted in the death of both combatants, and of a zebra which he shot, only to find that it had been so wounded by lions, that much of its flesh was putrid, and that it was full of maggots, help one to realise the tragedy of the struggle for existence. The author blames the Boer Government for allowing the destruction of the game; but the case of South America shows how a fauna, much richer than that of Africa, has become extinct in comparatively recent times, and without human intervention. The extermination of some species in regions of Africa where the game has not been seriously hunted, shows that natural agencies help in that destruction of the game, for which man generally bears the whole of the blame.

J. W. G.

GENERAL J. T. WALKER, R.E., C.B., F.R.S.

BY the death of General James T. Walker, on February 16, the Indian Army, all scientific bodies, and geographical societies, at home and abroad, have to deplore the loss of a gallant and accomplished officer. It is a loss which will be felt most by past and present members of the Indian Survey Department who survive him, who are better cognisant of and can appreciate the many years of service he rendered that Department from first to last, and the talents he devoted to its accurate execution.

Following in the footsteps of previous Superintendents of the Trigonometrical Survey, Colonel Lambton, Sir George Everest, and Sir Andrew Waugh, his principal aim, in guiding the trigonometrical work they had performed, was to carry it to a successful issue, and with the greatest accuracy, more modern instruments, and all that mathematical and geodetical knowledge could achieve. These operations could not have fallen into more zealous, able hands, for it may be said, for the information of those who hear and read little of such work (often insufficiently rewarded), that as a survey of a very large area of the earth's surface, no other area has been so laboriously measured, the observed angles so rigorously computed, and dealt with, and with so little resultant error. Many accomplished brave officers, assistants, and men have also fallen victims to the climate in which the operations were carried on, ranging as it did from the plains of India to the often deadly Terai up to the highest peaks of the Himalayas. In achieving this result, to General Walker, and the officers he directed, is due the greatest measure of praise for its perfectness. All that it entailed from the very commencement in 1800, is to be found in the "Account of the Operations of the Great Trigonometrical Survey of India," twenty volumes, the first nine of which were compiled by General Walker. My first knowledge of his name and work was as far back as 1855, when serving with my regiment at Peshawur I drew for the Quarter-Master General's Department, under the direction of Dr. P. Lumsden, the first map of the Kooram Valley, on which were laid down the peaks on the Sufaidkoh Range, of which Walker had been the first to fix the position. Lieut. Walker's name was well known then in the Panjab, for up to 1853 he had been working single-handed with his usual zeal at the military survey of the Trans-Indus territory. This was dangerous service in those days on that disturbed wild frontier of the north-west of India, which the East India Company had very lately acquired, where the tribesmen might be seen following their bullocks at the plough, *jezail* slung on back. On this survey it may be said Walker carried his life in his hand, he and his party often being the target for these same *jezails*. The ascent of Turturrah Peak in the Khyber Hills is only one instance of a very hazardous piece of work, but the dash and rapidity with which his plans were made and the distance done, surmounted the difficulties, and brought him safe out of the expedition with the coveted angles secured. Similar risky exploration was effected by him on the borders of Eusofzai and along the base of the hills, near where our troops have been lately employed at the Malakand Pass, and in the neighbourhood of Umbeyla. In fact, all we knew of that border topography for many years, and up to very recently, was the outcome of the young engineer's reconnaissance. Very little was said about this work at the time. In those days it was not the fashion to write up, and make so much of such travel, as is now the case. It took place far off in time and distance from home and headquarters, and only those in the district—his immediate superiors and his brother officers—knew the value of it, and the pluck and endurance it demanded. Moreover, by his tact with some of the chiefs, he managed to penetrate even beyond the frontier; but on returning to Peshawur, and reporting his success in this way, and making certain of praise, he received a severe reprimand. It was perhaps feared that in risking his own life, and the men of his party, he also risked embroiling his Government. It was not until 1865, when I had been in the Survey Department some years, and knew more of his work, that I became personally associated with him and under his immediate orders. He was then engaged on the compilation of his first map of Central Asia. I shall never forget the great pleasure of meeting him daily, and how much I learned from him, discussing portions of that country, looking up books of travel, and the latest work of the Russian Survey, and getting that map completed with the Himalayan Range as far east as longitude 81°. It was the first large map turned out in India by the process of photozincography, then but lately introduced into the office at Deyrah Dhoon, and it went through many subsequent editions. It was when engaged on such researches that Walker's knowledge and his intense love for geographical study showed itself. There was at that period much new topography coming in. The work of the Kashmir Survey, under Captain T. G. Montgomerie, R.E., had filled up an immense blank in the northern frontier of India, from the confines of Gilgit and Hunza Nagar to the Chang Chingmo. Mr. W. H. Johnson had just returned from his trip over the Karakoram range to Ilchi in Khotan; his route survey and observations had to be brought into place, and affected the position of other places in that part of Asia.

It was never my good fortune to serve under General Walker in the field; but I can look back on a short spell of camp life with him, on the mountains north of Mussoorie, with those feelings of desire that the time might come over again. Walker had been working hard for months at his computations, and was overworked; I suggested his joining me in a collecting trip I had planned into the hills, and he fell in with the idea. How he enjoyed the complete rest, and entered with zest into my pursuits; how much there was to talk over that was interesting to both; how we revelled in the lovely scenery of the oak-crowned ranges, with the snows of Jumnutri in the distance, and enjoyed the splendid air of October in the Himalayas, which sent him back to duty again quite set-up. In those few days, however, I got to know Walker, and all the good traits in his character, better than per-

haps in a far longer interval of departmental work. Only as one of his many assistants do I now put on paper my own feelings on the loss we have all sustained. A full record of his service and life can only be written by some officer of the Survey who was closely and long associated with him in his geodetical labours.

General Walker passed out of Addiscombe into the Bombay Engineers in 1844, and landed in India in 1846; he retired in 1883. He was an officer of high training and ability, who worked zealously in his profession, and expected others to do the same, taking a keen interest in their work. He had a good record of hard military service during the Panjab campaign at the Siege of Multan and Battle of Gujerat, and during the Mutiny at the Siege of Delhi, where he was severely wounded; he also served in 1860 with the Mahsood Waziri Expedition. He was as good a field surveyor as a geodecist, with a reputation outside his own corps and country; for twenty-two years in charge of the Trigonometrical Survey, and five years Surveyor-General of India; and he was a constant writer on many subjects relating to geography, almost up to the time of his death. Fuller details of these services are to be found in an excellent obituary notice by Mr. Clements Markham, President of the Geographical Society, in the March number of the *Geographical Journal*. H. H. G.-A.

NOTES.

LORD KELVIN has communicated to us the following telegram which he has received from Edison: "Just found calcium tungstate properly crystallised gives splendid fluorescence with Röntgen rays far exceeding platino-cyanide rendering photographs unnecessary."

THE Committee of the Athenæum Club, acting under the provisions of the rule of the Club which empowers the annual election by the Committee of nine persons "of distinguished eminence in science, literature, the arts, or for public service," have admitted to membership Prof. Arthur Schuster, F.R.S.

WE regret to announce the death at Madras, on February 14, of Mr. Marmaduke Alexander Lawson, M.A., F.L.S., Government Botanist and Director of Cinchona Plantations to the Madras Government. Mr. Lawson held for many years the posts of Sherardian and Sibthorpian Professor at Oxford, which were separated on his resigning to take up a new position in India in 1882.

THE French Government has decided to continue to M. Pasteur's widow the annual pension of 25,000 francs (£1000) granted to her regretted husband in 1883.

PROF. ARTHUR AUWERS and Prof. Karl Weierstrass, both of Berlin, have been elected foreign members of the Royal Academy of Mathematical and Physical Sciences of Naples, in the place of the late Profs. Cayley and Hermann von Helmholtz.

THE Royal Academy of Mathematical and Physical Sciences of Naples offers a prize of 1000 lire for the best essay (illustrated by specimens) on the geology of the quaternary lakes of the Basilicate. The essays have to be sent in on or before June 30, 1897.

MR. W. L. SCLATER has left England to take up his appointment as Curator of the South African Museum, Capetown. His successor in the science-mastership at Eton College is Mr. M. D. Hill, of the University of Oxford.

MR. EDWIN WHEELER, of Clifton, Bristol, has presented to the Natural History Museum a valuable series of water-colour drawings of fungi—2449 in number—made by him in illustration of the British fungus flora. The drawings, which fill twelve bulky volumes, represent the result of assiduous labour and observation extending over many years, and the Museum authorities are fortunate in receiving so munificent a gift.

THE "Coral-Reef Expedition," under the command of Prof. Sollas, F.R.S., will shortly leave England for the Pacific. Mr. J. S. Gardiner, of Cambridge, who has been selected as Assistant Naturalist, will devote himself to an examination of the fauna and flora of the Ellice Islands, while a deep hole is being bored into the coral-beds of Funa-fute, with the object of ascertaining the depth and exact structure of the formations.

EXCELLENT accounts continue to be received of the progress made by Dr. Forsyth-Major in Madagascar, and several valuable collections made by him have already arrived at the British Museum. Amongst these are numerous remains of the extinct gigantic birds of the family *Æpyornithidæ*, the study of which will, it is expected, considerably increase our knowledge of the structure of this group. The specimens are being examined by the officers of the Geological Department.

AMONGST the natural history collections from British Central Africa, last received from Sir Henry Johnston, is a small series of birds obtained, by Mr. Alexander Whyte, on the previously unexplored mountain of Chiradzulu, half-way between Blantyre and Zomba. With the specimens is an example of a new and very beautiful species of Oriole, which Captain Shelley will describe and figure in the next number of the *Ibis*, as *Oriolus chlorocephalus*.

MR. J. E. S. MOORE, who is gone on a mission from the Royal Society to explore the fresh-water fauna of Lake Tanganyika, arrived at Zomba, British Central Africa, on his way there in December last. He was obliged to stop there on account of the Stevenson Road being blocked by the Arabs; but the road having been since cleared by the Commissioner's forces, will now be open for Mr. Moore's further progress to Lake Tanganyika, where we have no doubt he will reap an abundant harvest.

THE Zoological Society have lost the large male Indian elephant which was brought home by the Prince of Wales on his return from India in 1876, and presented by his Royal Highness to the collection. After carrying an innumerable number of children up and down the walks for the past twenty years, "Jung Pasha" died quite suddenly on the 8th inst. Although tuskless, he was pronounced by all those experienced in such matters to be one of the finest and largest of living Indian elephants. His skin has been presented to the British Museum of Natural History, and is being stuffed for exhibition in the Mammal Gallery.

As a direct outcome of Mr. Saville-Kent's book on "The Great Barrier Reef of Australia," Prof. Alexander Agassiz has, as already briefly announced, determined to undertake an expedition, having as its express object the investigation of the many subjects associated with this vast and specially interesting biological area. Soundings, and an examination of the ocean bottom and the study of the pelagic and surface faunæ, are subjects which will especially occupy Prof. Agassiz's personal attention. In order to utilise the opportunities that will be presented to their fullest extent, Prof. Agassiz takes with him a trained staff of artists and assistants, and has also engaged the services of the experienced American collector, Mr. W. Ward, to make typical collections of the Madreporarian corals characteristic of the Great Barrier region; and with the special purpose of securing extra large specimens, for exhibition at the Cambridge, Mass., and other of the United States museums.

Prof. Agassiz has been in communication with Mr. Saville-Kent for some months past with reference to the best season of the year and most favourable localities to adopt as the bases of operation for both himself and collectors, who will work independently. Mr. Saville-Kent has asked Mr. Ward to make a measurement of the selected coral growths at Thursday Island, of which he took photographs and constructed a diagrammatic chart six years since. He has also commissioned Mr. Ward to secure certain of the more appropriate of these types, with their registered accession of growth, as a supplementary addition to the extensive series of the Great Barrier reef and other Australian Madreporaria that he has already contributed to the Natural History Museum.

OUR American correspondent writes, under date March 6:—Mr. Daniel G. Elliot is on his way to Africa, where he will hunt large game for the Field Columbian Museum of Chicago. He will have charge of 150 men. At a meeting of the Board of Managers of the New York Botanical Garden, held on March 4, it was announced that the following persons had become patrons: J. Pierpont Morgan, Andrew Carnegie, Cornelius Vanderbilt, J. D. Rockefeller, Darius O. Mills, Addison Brown, James A. Scrymser, William C. Schermerhorn, Charles P. Daly, Oswald Ottendorfer, Samuel Sloan, George J. Gould, Miss Helen M. Gould, J. S. Kennedy, William Rockefeller, James S. Constable, Mrs. Esther Herrman (who contributed 10,000 dols., instead of 5000 dols., which was her first intention, as announced in NATURE of February 6), and James R. Pigeon. The Committee on plans and buildings submitted plans for the greenhouse. An acre is to be covered by glass, and a tower sixty feet high is to be erected in the middle. The Committee was authorised to obtain final plans from architects for the large museum which is to be erected. The scientific directors were authorised to purchase for the garden museum the herbarium of Mr. J. B. Ellis, of Newfield, N.J., consisting of 75,000 specimens of fungi.—The storm of March 2–5 was unparalleled at New York City for the protracted severity of the winds, which at one time reached the velocity of eighty-two miles an hour, being two miles faster than any previous record here. Great difficulty was experienced in navigation in the harbour on account of ice, and travel ashore was more interrupted by snow than at any time since the memorable blizzard of March 1888.

IN connection with the affiliation of Photographic Societies with the Royal Photographic Society, six experimentally-illustrated lectures will be delivered upon the subject of "Photography with the Bichromate Salts," beginning on Friday, April 10, and ending on Tuesday, April 28.

A MEETING of the Institution of Naval Architects will be opened in the hall of the Society of Arts, on Wednesday, March 25, and will be continued on the two following days. The Earl of Hopetoun, President of the Institution, will occupy the chair.

THE anniversary meeting of the British Ornithologists' Union has been fixed this year for Wednesday, April 22, when a large attendance is expected. The Union now numbers nearly three hundred members.

THE next Annual Meeting of the American Microscopical Society will be held at Pittsburg, Pennsylvania, from August 18 to 20. The President for the year is Dr. A. Clifford Mercer, of Syracuse, New York.

AMONG the lecturers and their subjects at the Royal Institution after Easter are:—Prof. James Sully, on child-study and education; Mr. C. Vernon Boys, on ripples in air and on water; Prof. T. G. Bonney, on the building and sculpture of Western Europe (the Tyndall Lectures); Prof. Dewar, on recent chemical progress; Mr. W. Gowland, on the art of working metals in Japan; Dr. Robert Munro, on lake dwellings; and Dr. E. A. Wallis Budge, on the moral and religious literature of Ancient Egypt. The Friday evening meetings will be resumed on April 17, when a discourse will be given by M. G. Lippmann, on colour photography; succeeding discourses will probably be given by Prof. G. V. Poore, Colonel H. Watkin, C.B., Prof. Silvanus P. Thompson, Prof. J. A. Ewing, and Prof. J. A. Fleming, among others.

WE regret to announce the discontinuance of the *American Meteorological Journal* after the forthcoming April number, which ends the twelfth volume. Mr. Robert Ward informs us that the journal has been carried on at a financial loss on the part of the editors ever since its foundation in 1864, and the present step has been decided upon because there seems no hope that it will become self-supporting. Arrangements have been made with the editor of *Science*, whereby Mr. Ward will contribute short notes on, and reviews of, current meteorological publications to that periodical. He therefore hopes authors will send their publications to him in the future as they have done in the past.

THE St. Louis Observatory, at St. Helier, Jersey, is being developed under the able direction of Père Dechevrens, formerly of Zi-ka-wei, in China, well known for his researches on wind, and other subjects in meteorology. This observatory is situated on a small open plateau above the Jesuit College, and one feature of it is a tower, of Eiffel type, about 170 feet high, with spiral staircase, and a number of instruments at the top, connected by a cable of twelve electric wires with recording apparatus in the house. Among these instruments is an anemometer of somewhat special design. A T-shaped support, with orienting arrangement, bears on one arm an anemometer with half cylinders instead of the usual cups, being thus made sensitive, it is claimed, to horizontal currents only; while a helical fan on the other arm gives the vertical component. The *Bulletin* for 1895 (the second year) contains very full information of the various weather elements, including hourly variation of pressure and temperature, and of the velocity of the wind. It is a curious fact, observed at this station, as at the Eiffel Tower in Paris, that the diurnal variation of wind velocity shows an opposite character near the ground and at the top of the tower; in the former case the velocity reaches its maximum about midday, and in the latter about midnight. The climate of the Channel Islands is interesting in many respects, and a well-equipped station like that of St. Louis may be expected to add largely to our knowledge of it.

THE Report of the Meteorological Council for the year ending March 31, 1895, has just been presented to Parliament. The Council have continued the practice of lending instruments to captains of merchant vessels for the purpose of obtaining observations made at sea, and of supplying instruments to the Royal Navy. A very large proportion of logs returned are classed as "excellent," and these observations have been largely supplemented by the Remark Books kept on H.M. ships, and by logs received from the Ocean Steamship Company of Liverpool and others. Among the works actually published, or in course of publication, are charts of the Red Sea, current charts for all oceans, and meteorological charts embracing the area from the Cape of Good Hope to New Zealand. It was for the purpose of collecting and publishing information of use to seamen that the Meteorological Department of the Board of Trade was first established in 1854, as the outcome of the Maritime Conference of Brussels in the previous year. But as time went on, the attention of Admiral FitzRoy was turned to the more practical branch of weather prediction, and this subject now forms an

entirely distinct and important department of the Office. Storm signals are supplied to all ports at which the local authorities will undertake their management. The report shows that the signals were hoisted at 180 stations, but more recently the number has been considerably augmented by their exhibition at exposed lighthouses, for the benefit of passing vessels. Weather forecasts are prepared three times daily, and are also sent to a selected number of agricultural districts during hay-making. A comparison of the results obtained for these forecasts gave a total percentage of 89, which is considered to be very satisfactory. The department dealing with climatology of the British Isles receives observations from 245 stations; the results are collated and published in various forms, available for present or future discussions. Much attention is also paid to the collection of rainfall values, the comparison of various kinds of anemometers, and other researches.

THE report of the Committee, appointed in May of last year, to inquire into the causes of the explosion, and the precautions required to ensure the safety, of cylinders of compressed gas, has now appeared. The Committee, in addition to examining manufacturers of the cylinders in which compressed gases and liquefied gases are sold, and some of the engineers who make and compress the gases, visited works where the manufacture is carried on, and conducted a series of experiments to determine the causes of the accidents to cylinders, and on the amount of damage such explosions are likely to produce. The information thus obtained has enabled them to draw up a detailed statement of the conditions which are necessary to secure safety in the transport and use of compressed gas cylinders, and as to the regulations which would be desirable to prevent risk. The risks of explosion fall into two classes, viz.: (1) risks due to negligence in the manufacture, annealing, and testing of the cylinders; (2) risks due to neglect of precautions in filling the cylinders. As the manufacture is carried on very extensively, and is likely to increase, the Committee think that the risks would be reduced if there were some control of the trade of making cylinders by official inspection. They suggest that there should be a general inspection of all factories manufacturing compressed or liquefied gases. If an inspector were satisfied that the arrangements at any factory were adequate, and that the precautions laid down in this report were being taken, a certificate would be granted authorising such factories to test and mark cylinders. It is suggested that a first thorough inspection, and an occasional inspection subsequently, at intervals of about six months, would be sufficient as a ground for granting and renewing certificates. The report is signed by Profs. W. C. Unwin, C. V. Boys, H. B. Dixon, Dr. A. Dupré, and the Rev. F. J. Smith.

HITHERTO most experiments with the Röntgen rays in this country have been made with the object of photographing living human hands and feet, in which only the bones are represented. On the continent, however, the "new photography" has been employed with remarkable success to delineate the arteries in a hand injected with a substance opaque to the Röntgen rays. Some experiments of this kind are described by Dr. Uberto Dutto, of Rome (*Att. R. Acc. Lincei*). Observing that the opacity of bones to the new rays is probably due to salts of calcium, of which they so largely consist, a human hand was injected with a paste of plaster of Paris sufficiently thin to penetrate the smaller arteries, and as soon as this had hardened, the hand was photographed in the usual way, the Crookes' tube being fixed at sufficient distance from the plate to produce sharp outlines. It would be interesting to try obtaining stereoscopic views of such specimens; this could, no doubt, be readily done by projecting the rays obliquely on the specimen and plate, first from one side and then from the other. Dr. Dutto points out the great value of this method in facilitating the study of anatomy.

IN one of a series of articles on the use of the Crompton Potentiometer, which he is communicating to *The Electrician*, Mr. Fisher gives some very interesting tests which have been applied to standard Clark cells. The form of cell used is that supplied by Messrs. Muirhead, in which the positive pole consists of a spiral of platinum wire amalgamated and filled with mercury. It is very generally believed that if by any chance a Clark cell becomes short-circuited, then the cell is either totally ruined or only recovers after a very long time. Mr. Fisher has shown that the Clark cell will stand very much rougher usage than one would think, and still recover even in a very short time. In one set of experiments a Muirhead pattern cell had for one minute a potential applied to the terminals of $\frac{1}{100}$ volt in excess of the electro-motive force of the cell. As a result, the electro-motive force rose about three parts in 14,000; but regained its normal value after ten minutes. After short-circuiting for one minute through 500 ohms the electro-motive force fell from 1·4323 volts to 1·431, but recovered its normal value after thirty minutes. Short-circuiting the cell through two inches of No. 18 copper wire for thirty seconds caused a drop from 1·4319 volts to below 1·431; but after thirty minutes it had almost recovered. A cell having been short-circuited through a few inches of copper wire (No. 20) for twenty hours, its electro-motive force fell to 0·17 volt. The recovery was at first very slow, and continued so till it reached 0·5 volt, the average rate of recovery being 0·03 volt per hour. After this the recovery was much more rapid, and in twenty-four hours the cell had almost completely recovered. The effect of applying a constant potential of 1·4 volts to a cell which had been "dead" short-circuited for twenty hours, was to very much hasten the recovery, so that after two and a half hours it had regained its former value. The author has found that the resistance of a Clark cell rises very rapidly if the cell is used to send any appreciable current, and he supposes that whatever is the cause of this increase of resistance and the fall of potential, it in is a great measure of the character of a "skin effect." Some tests made of two cells set up by Prof. Fleming in 1886 or 1887, seem to show that when these cells were in continuous use, so that they were employed to send small currents, and had small currents driven through them, their electro-motive forces were in very much better agreement than when standing idle. From these and other experiments the author concludes that the passage of these small currents through standard Clark cells is decidedly beneficial.

The South Slavs have a number of independent folk-songs which, unlike the great Homeric epics, have not been welded into an harmonious whole. Dr. Krauss (*Internationales Archiv für Ethnographie*, vol. ix.) elucidates these songs by notes on various customs and beliefs, especially those relating to death and burial. The South Slavs save money during the whole of life in order to ensure a grand funeral, and they honour graves and graveyards in many ways, considering it a crime to cultivate the ground of a graveyard; but the Catholic priests of Pozega did not hesitate to do so, and grew in them the best cabbages and the largest turnips in the district. There is an amusing account of cuckoo folk-lore in the same journal; and though the legends vary slightly, the cuckoo is regarded by all the South Slavs as a woman changed into a bird for excessive mourning over a dead son or brother.

WE have received from Miss E. A. Ormerod the nineteenth of her valuable "Reports on Injurious Insects," dealing with insect pests which were specially noticeable during 1895. It is fully equal, both in size and importance, to its predecessors, and is

divided into three sections, the first being devoted to insects, &c., injurious to cultivated plants; the second to flies injurious to horses, cattle, &c.; and the third to ticks. In her preface, Miss Ormerod alludes to the fact of the terribly cold weather experienced during January and February, 1895, having had no apparent injurious effect whatever on insect life. She also alludes to the great loss which entomologists have lately suffered by the death of Prof. C. V. Riley. As usual, the report is fully illustrated; but a new and striking feature is the insertion of two full-page illustrations of the foot of the Forest Fly (highly magnified, of course) the thick curved claws of which, as thus represented, present a curious and by no means remote resemblance to a pair of cow's horns. The first insect mentioned in the report is the Eyed Hawk-moth, the larva of which seems to be very injurious to apple-trees at times, though often overlooked from its colour resembling that of the leaves of the tree. As a rule, however, the larger *Sphingidæ* are rarely common enough in England to be destructive; but it is self-evident that no insects which feed on cultivated plants can be harmless, when unusually abundant. We hope to have the pleasure of receiving Miss Ormerod's annual reports for many years to come. The practical usefulness of entomology was formerly held in doubt; but such reports alone ought to be amply sufficient to remove the last remains of uncertainty on the subject.

IN a paper in the *Transactions* of the English Arboricultural Society for 1895, "On the Effect of Frost on Trees and Shrubs," by Dr. William Somerville, the growth of the Black Austrian Pine is recommended in exposed situations subject to severe cold, that tree having escaped almost entirely unscathed from the effects of the intense frost of the winter of 1894-95.

WE have received the report of the proceedings of the Annual Meeting of the American Microscopical Society, held last year at Cornell University, Ithaca, New York, contained in the *Transactions* of the Society. The address of the President, Mr. S. H. Gage, was on the "Processes of Life revealed by the Microscope: a Plea for Physiological Histology." The volume includes also reports of a number of papers in various departments of microscopy and natural history.

THE *Kew Bulletin of Miscellaneous Information* for February contains an interesting report of the result of an inquiry on a point of some importance to the Excise, the presence of natural sugar in tobacco. It has been established that saccharine matter may be present in unadulterated Virginian tobacco to the extent of 15·2 per cent., and even in tobacco grown in this country to the extent of 9 per cent. Dr. Hugo Müller is of opinion that the sugar is not in the form of either lævulose or glucose, but that it is composed of at least three different carbohydrates which appear to be new to chemistry.

PRINCE BALTHASAR BONCOMPAGNI'S heirs have decided to sell his valuable library in the Palais Cenci, Rome. The library comprises more than eleven thousand different works, and will be sold *en bloc*. The Mathematical Section contains a very rare collection of works on arithmetic; and there are also numerous works on natural science and archæology in the library. Applications for catalogues should be sent to M. l'Avv. Francesco Sirani, 14 via del Nazareno, Rome.

THE thirty-third annual issue of that most useful publication, "The Statesman's Year-Book" (Macmillan), edited by Mr. Scott Keltie, with the assistance of Mr. J. P. A. Renwick, has just come to hand. A new feature, which will be much appreciated by the numerous people who consult the annual, is the insertion of four coloured maps, to illustrate the Anglo-Russian delimitation of the Pamirs, the Anglo-French arrangement with respect to Siam, the British Guiana and Venezuela boundary dispute, and recent arrangements in Bechuanaland.

A PAPER on the progress of science in England from the seventh to the thirteenth century inclusive, read before the Manchester Literary and Philosophical Society, appears in the number of the *Memoirs* of the Society just received (vol. x. No. 1, 1895-96). Other papers to which attention may well be directed are: "On Helium and its place in the Natural Classification of Elementary Substances," and "The Indefinite Quantitative Relations of the Physical and Chemical Forces," both by Dr. Henry Wilde, F.R.S., and an account of "Experiments on the Latent Heat of Steam," by Dr. J. A. Harker.

THE second volume of "Contributions to Canadian Palæontology" (*Geol. Surv. Canada*) consists of three papers on Arthropoda, by S. H. Scudder. Of these the most generally interesting one is that describing certain Myriapods and Scorpions from the famous hollow trunks of Sigillarians found in the coalfields of Nova Scotia. Another group of palæontological papers from the same region come from the *Transactions* of the Royal Society of Canada. They contain descriptions, by J. F. Whiteaves, of Cretaceous fossils from British Columbia, which afford some confirmation of Dr. Kossmat's views as to the distribution of Cretaceous land and sea, summarised some months back in these columns.

A DETAILED account of the Upper Palæozoic (Permian and Carboniferous) formations of Central Kansas, by C. S. Prosser, is to be found in the *Journal of Geology*, vol. iii. No. 7. The importance of this region in the general correlation of these beds has long been recognised, since here, unlike the Eastern States, coal is rare, and there is an almost unbroken series of marine strata from Carboniferous to Permian. The author shows that the Carboniferous brachiopod fauna does not extend as high as had previously been asserted, and that the higher beds contain a characteristic Permian lamellibranch fauna. He is thus able to draw a fairly definite line between Carboniferous and Permian (or Permo-Carboniferous), which he draws, for convenience of mapping, at the top of certain fossiliferous shales overlying the *Fusulina*-limestone. According to these views, Waagen, in his correlation of the Upper Palæozoic strata of India and of other countries, drew the base of the Permo-Carboniferous in the Western States too low; but this correction does not affect the general value of his correlation.

A NEW monthly review—the *Revue de l'Université de Bruxelles*—has made its appearance, its foundation being a sign of the era of prosperity and expansion inaugurated by the creation of the new institutes with which the "Université libre" has lately been endowed. The review is not to be the organ of any particular school of thought, but will include within its purview history, philosophy, science, social economy, and all branches of higher education. It is intended to be the focus of all the efforts made in the University world, and particularly in the Université libre de Bruxelles, for the advancement of science and study. The first two numbers of the new publication contain articles on penal law; great biological discoveries made during this century; the Botanic Garden at Buitenzorg; constitutional law; the work of Hittorf, Lenard, Goldstein, and Röntgen; and the International University Alliance.

THE twenty-sixth volume of the *Proceedings* of the London Mathematical Society, containing the papers read before the Society during the session 1894-95, has come to hand. In Mr. A. B. Kempe's presidential address, with which the volume opens, definitions of mathematics are discussed, and a new one formulated. According to dictionaries, mathematics is "the

science of number and magnitude," "the science which treats of the propertie and relations of quantities," or more briefly, "the science of quantity." Occasional definitions of a more comprehensive character are to be found scattered here and there in mathematical and other writings, but Mr. Kempe doubts whether any of them would satisfy a large body of modern mathematicians; therefore he suggests the following as a provisional definition: "Mathematics is the science by which we investigate those characteristics of any subject-matter of thought which are due to the conception that it consists of a number of differing and non-differing individuals and pluralities." Perhaps this definition will provoke some one to formulate another.

THE playgrounds of our public schools are said to be the arenas in which British battles are fought; and, in a similar sense, we may say that the scientific societies of our colleges are the training schools of scientific investigators. The system of compulsory games tends greatly to limit the time which public schoolboys can devote to natural history or other research, but a few enthusiasts contrive to gratify their curiosity to know something about natural facts and things. The twelfth annual report of the Felsted School Scientific Society testifies to the existence of this spirit of inquiry. Among the papers it contains, we notice one on "The Geology of Felsted," by Mr. J. French, and another on "Recent and Proposed Arctic Exploration," by Mr. J. F. Hartin. The Society used only to be concerned with natural science, but its field of operations has been enlarged, and its usefulness increased, by the creation of a Chemical Section. Stern methods are taken to keep up the attendances at the meetings, for we read: "That any member failing to attend at least one ordinary general meeting in each term in which such meetings are held, without reasonable excuse, be liable to ejection from the Society." It is appalling to think what would be the result of the application of this rule to many learned societies.

A LARGE number of students, as well as persons who do not pretend to possess any special scientific culture, will be glad to know that Tyndall's "Glaciers of the Alps" (Longmans, Green, and Co.), first published nearly six-and-thirty years ago, and for a long time out of print, has been reprinted. Upon Lord Kelvin's advice, no changes have been made in the controversial portions of the book, so the text has been left practically unaltered. Messrs. Kegan Paul and Co. have published a popular edition of Sir John Lubbock's standard work on "Seedlings," reviewed in these columns in January 1893 (vol. xlvii. p. 243). The parts included in the new volume are those of most general interest, and 282 of the 684 illustrations in the original work are used to elucidate the text. A new edition has been published of "Griffin's Electrical Engineers' Price-Book," edited by Mr. H. J. Dowsing. Nearly seventy pages of new matter have been added, and the whole of the prices have been brought up to date. Electrical and other engineers and contractors know that the volume is a ready and trustworthy means of reference to the prices with which they have to deal. The new and improved edition of "Historical and Future Eclipses," by the Rev. S. J. Johnson, just published by Messrs. James Parker and Co., will be appreciated as fully as the original little volume, which came out twenty-one years ago. The book is extremely handy, and contains not only a vast amount of interesting information with regard to eclipses of past and future time, but also notes on planets, double stars, and other celestial matters, thus making it valuable to practical astronomers.

THE additions to the Zoological Society's Gardens during the past week include a Campbell's Monkey (*Cercopithecus campbelli*, ♂) from West Africa, presented by Miss Lilian Frost; two Black-backed Jackals (*Canis mesomelas*), a Puff Adder (*Vipera arietans*) from South Africa, presented by Mr. J. E. Matcham; a Condor (*Sarcorhampus gryphus*) from South America, presented by Mr. C. J. Wedderburn; a Guillemot (*Lomvia troile*), British, presented by Mr. J. L. Palmer; a Moorish Tortoise (*Testudo mauritanica*), from North Africa, presented by Mrs. Powell; a White-crowned Mangabey (*Cercocebus æthiops*, ♀) from West Africa, an Isabelline Lynx (*Felis isabellina*, ♂) from Ladakh, Cashmere, deposited; a Maguari Stork (*Dissura maguari*), a Guira Cuckoo (*Guira piririgua*), a Burrowing Owl (*Speotyto cunicularia*), a Brown Milvago (*Milvago chimango*), a Condor (*Sarcorhamphus gryphus*), a Boa (*Boa constrictor*) from South America, six Mexican Quails (*Callipepla squamata*) from Mexico, a Scarlet Tanager (*Ramphocælus brasilius*), three Scarlet Ibises (*Eudocimus ruber*) from Para, a Ruff (*Machates pugnax*), two Redshanks (*Totanus calidris*), British, purchased.

OUR ASTRONOMICAL COLUMN.

VARIABLE STAR CLUSTERS.—The recent announcement by Prof. Pickering, of the discovery of variability in a large number of stars forming parts of star clusters (NATURE, vol. liii. p. 91), has led Dr. Belopolsky to examine some of the photographs of clusters taken at Pulkowa. Two photographs of the cluster M3 (N.G.C. 5272), in Canes Venatici, were taken in March 1894, and two more in April 1895. In the later photographs one sar was found to be two magnitudes brighter than in 1894, anddiff erences of brightness can also be traced in the case of other stars among the 1800 shown upon the photographs (*Ast. Nach.*, 3338). The Arequipa negatives of the same cluster indicated a variation of brightness in eighty-seven stars, amounting in some cases to at least two magnitudes.

THE SPOTS ON SATURN.—The inability of Prof. Barnard to detect any spots on Saturn with the aid of the Lick telescope may possibly have thrown some doubt upon the existence of such spots. Nevertheless, the observations of them by Mr. Stanley Williams have given such remarkably consistent results, that it is difficult to believe them illusory. In a recent article (*Observatory*, March, p. 112) Mr. Williams points out that there has been some misconception as to the nature of the Saturnian spots and the conditions for their satisfactory observation. While generally admitting the superiority of large telescopes, Mr. Williams holds that the spots on Saturn are such as to require a sight specially trained for their observation. The characteristics of the spots are (1) considerable size, (2) faintness, (3) extreme indefiniteness. The bright equatorial spots average about 2″ in diameter, while the dark spots on the broad double belt in the northern hemisphere have sometimes appeared as large as 4″ long by 2″ or 3″ broad. Similar spots have been noted by other observers, and the estimated positions have been sufficiently accordant to make it probable that the same objects were observed.

The planet will be in opposition on May 5, and it is to be hoped that the spots will receive the attention of observers. The spots appear to be best seen with low powers; with a power of 140 an equatorial spot has been observed to shine with almost stellar brightness, but with higher powers this peculiar brilliancy disappeared. Another point in Mr. Williams' experience is worth putting on record, namely, that in the south of England, at least, definition is usually much better about the time of sunset and for an hour afterwards than at other times.

COMPUTATION OF THE TIMES OF SOLAR ECLIPSES AND OCCULTATIONS.—In the *Revista do Observatorio* (Rio de Janeiro) for 1886, an account was given of a graphical method by which the approximate times of occurrences of solar eclipses and occultations, sufficiently accurate for first approximations, could be determined. Three years later, in a subsequent *Revista*, an application of this method to the eclipse of the sun of December 22, 1889, was made by Mr. Morize, of the Observatory of Rio. With the idea of making this method more general and applicable for all latitudes, the Director of the Observatory, Mr. L. Cruls, has published a short account of the method, simplified both as regards the computations and the graphical construction. The principle is based on the parallactic displacement of the moon in right ascension and polar distance, the values of which

have to be calculated for certain suitable and equidistant intervals of time. Knowing the hourly movements of the moon in right ascension and polar distance for the same instants from the almanack, and the elements of the phenomena, whether it be eclipse or occultation, the tracing of the positions of the bodies may be proceeded with. The plane of the drawing is supposed to represent that plane which is at right angles to the line joining the centre of the moon and the observer, at any one of the chosen instants near the time of conjunction of the two bodies. On this plane the successive projected true and apparent positions of the two bodies, sun and moon, or moon and star, are considered. The line passing through the centres of the moon in her different positions will thus represent the apparent lunar orbit, and if in addition we know the position at the moment of true conjunction of the two bodies, occupied by the centre of the sun or star, according as we are dealing with an eclipse or occultation, it will be easy to find the positions of the centres at the moments of contact, or of immersion and emersion, and also the times.

The calculation of the elements necessary for making the drawing would have for its aim the determination of the co-ordinates of the points of the apparent orbit occupied by the centre of the moon. This work is here rendered very easy by using the series of tables which have been prepared for reducing the calculation to a minimum. As an illustration showing the method of procedure, Mr. Cruls gives two complete worked-out cases, one of the eclipse of the sun at Rio de Janeiro April 16, 1893, and another of the occultation of α Virginis on March 22, 1894, at Greenwich. The accuracy of this graphical method may be gauged from the *observed* minus *calculated* values obtained in the two cases just mentioned.

		m.	
Eclipse of the sun	1st contact ...	−2·4	Observed—Calculated.
	2nd ,, ...	−0·3	
Occultation of α Virginis	Disappearance	+0·8	*Nautical Almanac*—Graphical Method.
	Reappearance	+1·2	

PENDULUM OBSERVATIONS IN GERMANY.

IT is a well-known fact that, at different places on the earth's surface and at the same sea-level, pendulums change their rates of swing. The numerous observations of von Sterneck, made in the region of the Alps, suggested that such deviations from the normal might be, and were most probably, explained on the supposition of unequal distributions of the masses in the neighbourhood—that is, either inside the mountains or in the earth's crust itself. Such observations as these indicated that good work might be done in this direction, and in consequence measurements were made on Mont Blanc, while in other directions observations were being organised by the scientific societies in Vienna, München, Leipzig, and Göttingen. The gravity determinations on Mount Blanc were made at the new observatory, and M. Jannsen informs us that besides those made in Chamounix in the previous summer, and on the Grands Mulets (3050 metres elevation), by M. Bigourdan, an effort will be made to continue them this summer on the summit itself. The results which have been obtained up to the present are as yet unpublished. A region which appeared full of interest for investigating the different rates of swinging pendulums is that in the region of Göttingen and the Harz Mountains. Prof. von Könen singled out what he thought were the three most suitable spots on account of their different geological conditions for such investigations, and observations at these stations were all compared with those made at Göttingen, this being the chief observing station on account of the observatory. It is true that the instrument employed in these determinations was far too rough for accurate and reliable measurements, it being the one which Dr. von Drygalski had previously used on his Greenland expedition, and with which Sterneck made his first experiments. The actual observations were made by Prof. Wilhelm Schur and Dr. Grossmann, and the results were communicated to the *Nachrichten der K. G. der Wiss. Gött.*, Heft 2, 1895. These may be summed up as follows. In the cases of the two stations at Grünenplan and Teichmühle, the very small differences when compared with Göttingen may be neglected when the kind of instrument employed be taken into consideration. The difference for the station Sack, on the other hand, was comparatively large, the numbers being—

For Grünenplan	Sack	Teichmühle
−0·00018 ...	−0·00081 ...	−0·00028

The conclusion drawn by Prof. von Könen from this somewhat rough determination was that the diminution in the intensity of gravity for the station Sack might possibly be due to the present condition of the positions of the underlying superposed strata (Schichtenüberschiebung).

Since the above determinations were made, the same ground has been covered, in September and October last, by Herr Haasemann, who, at the request of Geheimrath Helmert, undertook to make a series of measurements at the same observing stations as used by Prof. Schur. In this new investigation the instruments employed were more accurate and of later design, so that the results may be looked upon as more trustworthy and accurate. Limiting ourselves to giving the actual numerical results, the differences for the three stations when compared as before with Göttingen were—

For Grünenplan	Sack	Teichmühle
+0·00007 ...	−0·00003 ...	−0·00011

Comparing these figures with those obtained by Prof. Schur, the large difference for Sack entirely disappears. This indicates that at these places the determinations of the rates of the pendulums give no trace of any variation in the intensity of gravity, or at least of any variation which is capable of being detected by the apparatus employed. D.

PETROLEUM LAMP ACCIDENTS.

THE report of Mr. Alfred Spencer, chief officer of the Public Control Department of the London County Council, as to the causes of petroleum lamp accidents, and as to the measures necessary for preventing them, which has just been issued, is an important document. The number of accidents due to the use of cheap and unsafe petroleum lamps has assumed alarming proportions within the past few years, that the means by which the accidents can be prevented cannot be too prominently or too frequently brought before the public. Mr. Spencer has made a thorough investigation with numerous lamps and stoves in which petroleum is used, in order to determine the conditions of safety. The results of his experiments lead him to conclude that raising the flash-point fixed by the Petroleum Acts would not alone be effectual in preventing lamp accidents, as this would not prevent the sale and use for illuminating purposes of oil below that flash-point. He remarks, however, that the prohibition of the retail sale, and the prevention of the use for illuminating purposes of mineral oil below a flashing-point sufficiently high to prevent all lamp accidents, would be effectual if it were practicable. The prohibition by statute of the sale of unsafe lamps would be another means of putting an end to lamp accidents, as both experience and experiment have proved that mineral oils, such as are now in common use, can be safely burnt in properly constructed lamps. The difficulties in the way of prohibiting the sale of unsafe oil are far greater than would be met in regulating the construction and sale of safe lamps; therefore Mr. Spencer suggests that the latter is the means of safety which should be enforced by order of the Secretary of State. His suggestions for the safe construction and proper management of lamps, revised in the light of recent experiments, are as follows:—

CONSTRUCTION.

(1) The oil reservoir should be of strong metal, properly folded and soldered at the joint, and should not be of china, glass, or other fragile material.

(2) There should be no opening between the reservoir and the burner, other than through the tube which holds the wick; and this tube should be extended to within ¼ in. of the bottom of the reservoir, and should have no opening into the reservoir except at its base.

(3) The burner should be securely attached to the reservoir, preferably by means of a strong and well-made screw attachment.

(4) There should be no openings through which oil could flow from the reservoir should the lamp be upset.

(5) Every table lamp should have a broad and heavy base, to which the reservoir should be strongly attached.

WICKS.

(6) Wicks should be soft, and not tightly plaited, and should quite fill the wick-tube without having to be squeezed into it.

(7) Wicks should be frequently renewed, and before being put into lamps should be dried at a fire and then immediately soaked with oil.

MANAGEMENT.

(8) The reservoir should be filled with oil before the lamp is lit.

(9) The lamp should be kept thoroughly clean, all oil should be carefully wiped off, and all charred wick and dirt removed before lighting.

(10) When first lit the wick should be partially turned down, and then gradually raised.

(11) The wick should not be left turned down, as there is then a greater liability to explosion in lamps of unsafe construction.

(12) Lamps which have no extinguishing apparatus should be put out as follows:—The wick should be turned down until there is only a small flickering flame, and a sharp puff of breath should then be sent across the top of the chimney, but not down it.

(13) Cans or bottles used for oil should be free from water and dirt, and should be kept thoroughly closed.

Note.—These suggestions apply to ordinary petroleum or paraffin lamps such as are generally used, and not to benzoline or spirit lamps.

FORTHCOMING SCIENTIFIC BOOKS.

WE print below a list of books on science promised for publication during the spring season:—

Messrs. Swan Sonnenschein and Co., Limited, announce:—Analytic Psychology, by G. F. Stout, 2 vols.; Outlines of Logic and Metaphysics, by Johann Eduard Erdmann, translated from the fourth German edition, with a prefatory essay, by Dr. B. C. Burt; An Introduction to the Study of Philosophy, by Prof. Oswald Külpe, translated under the supervision of Prof. E. B. Titchener; Text-book of Palæontology for Zoological Students, by Theodore T. Groom, fully illustrated; The Indian Calendar, with Tables for the Conversion of Hindu and Muhammedan into A.D. dates and *vice versâ*, by Robert Sewell, with Tables of Eclipses visible in India, by Dr. Robert Schram; Practical Plant Physiology, by Prof. Wilhelm Detmer, translated by S. A. Moor; Introduction to the Study of Organic Chemistry, by J. Wade; Fishes, by the Rev. H. A. Macpherson; Mammalia, by the Rev. H. A. Macpherson; Birds' Eggs and Nests, by W. C. J. Ruskin Butterfield; Mosses, by J. E. Bagnall, fourth edition; The Dynamo, how Made and how Used, by S. R. Bottone, ninth edition; Geometry for Kindergarten Students, by Adeline Pullar, 499 illustrations.

Messrs. Cassell and Co., Limited, give notice of Cottage Gardening, Poultry, Bees, Allotments, Food, House, Window and Town Gardens, edited by W. Robinson, fully illustrated and containing coloured plates, half-yearly volume; new volumes of the "Century Science" Series, edited by Sir Henry Roscoe, F.R.S.:—Sir Humphrey Davy, by T. E. Thorpe, F.R.S.; J. Clerk Maxwell and Modern Physics, by R. T. Glazebrook, F.R.S.; Birds' Nests, Eggs, and Egg Collecting, by R. Kearton, illustrated; Lessons in Carpentry Workshop Practice, by Charles F. Mitchell, new and revised edition; Cassell's Gazetteer of Great Britain and Ireland, with numerous illustrations and maps in colours, vol. iii.; The Countries of the World, by Dr. Robert Brown, profusely illustrated, vol. ii. of the cheap edition; The World of Wonders, illustrated, vol. i. of the cheap edition; Science for All, illustrated; Cassell's Concise Cyclopædia, illustrated.

Messrs. Macmillan and Co., Limited, will publish Miscellaneous Papers by Heinrich Hertz, with an introduction by Prof. Philipp Lenard, authorised English translation by D. E. Jones and G. A. Scholt; Studies in the Art Anatomy of Animals, being a brief analysis of the visible forms of the more familiar mammals and birds, designed for the use of sculptors, painters, illustrators, naturalists, and taxidermists, by Ernest E. Thompson; Text-book of Comparative Anatomy, by Dr. Arnold Lang, translated into English by Henry M. Bernard and Matilda Bernard, part ii.; Macmillan's Geography Readers, book v., Europe, book vi., the Colonies of Great Britain, illustrated; A System of Medicine, by many writers, edited by Thomas Clifford Allbutt, F.R.S.; Domestic Science Readers, by Vincent T. Murché, for standards i.-vi.; Science Class Books:—Physics for Medical Students, by Alfred Daniell; the Scenery of Switzerland, by Sir John Lubbock, Bart., F.R.S.; a Dictionary of Chemical Solubilities, Inorganic, by Dr. Arthur Messenger Comey; the Theory of Sound, by Lord Rayleigh, F.R.S., vol. ii., second edition, revised and enlarged.

The Cambridge University Press has in preparation:—The Collected Mathematical Papers of the late Arthur Cayley, F.R.S., to be completed in thirteen volumes, vol. ix.; An Introductory Treatise on the Lunar Theory, by Prof. E. W. Brown; The Scientific Papers of John Couch Adams, F.R.S., vol. i., edited by Dr. William Grylls Adams, F.R.S.; A Treatise on Abel's Theorem, by H. F. Baker; Cambridge Natural Science Manuals, Biological Series, general editor, A. E. Shipley; Elementary Palæontology, Invertebrate, by H. Woods, new edition; A Manual of the Phanerogams and Ferns, Morphology, Natural History and Classification, alphabetically arranged by J. C. Willis; Physical Series, general editor, R. T. Glazebrook, F.R.S.; Electricity and Magnetism, by R. T. Glazebrook, F.R.S.; Cambridge Geographical Series, general editor, Dr. F. H. H. Guillemard; Geographical Distribution of Mammals, by R. Lydekker, F.R.S.

Mr. W. B. Clive (University Correspondence College Press) announces:—A Manual of Psychology, by G. F. Stout; A Manual of Logic, by J. Welton, complete in 2 volumes, vol. i., 2nd edition; Questions on Welton's Logic, with Illustrative Examples, by H. Holman, Key to Holman's "Questions on Welton's Logic"; A Primer of Logic, by J. Welton; Euclid, Books i.-iv., by Rupert Deakin; Deductions in Euclid, by T. W. Edmondson and J. Briggs; Geometrical Conic Sections, Co-ordinate Geometry, part ii, A Higher Text-book of Dynamics, A Higher Text-book of Hydrostatics, each by Dr. G. H Bryan, F.R.S.; Key to the Elementary Mechanics of William Briggs and G. H. Bryan, F.R.S.; The Tutorial Trigonometry, An Intermediate Text-book of Statics, An Intermediate Text-book of Dynamics, The Tutorial Algebra, each by William Briggs and Dr. G. H. Bryan, F.R.S.; The Properties of Matter, an Introduction to the Tutorial Physics, by E. Catchpool; Inorganic Chemistry, First Stage; A Synopsis of Non-Metallic (Inorganic) Chemistry, by William Briggs, 4th edition, revised by W. Hurtley; A Synopsis of Metallic Chemistry, by W. Hurtley; The Tutorial Chemistry, by Dr. G. H. Bailey; part i. Non-metals; part ii. Metals; Magnetism and Electricity, First Stage; Sound, Light and Heat, First Stage, by John Don.

Messrs. Crosby Lockwood and Son's announcements are:—Light Railways for the United Kingdom, India, and the Colonies: a Practical Handbook on their Construction, Equipment, &c., by J. C. Mackay; Nitro-Explosives: a Practical Treatise on their Manufacture, Properties, and Analysis, by P. Gerald Sanford; Colliery Working and Management: comprising the Duties of a Colliery Manager, and the Different Systems of working Coal Seams, by H. F. Bulman and R. A. S. Redmayne; The Detection and Estimation of Inflammable Gas and Vapour in the Air, by Prof. Frank Clowes, with a chapter on the Detection of Inflammable Petroleum-Vapour, by Boverton Redwood; Handy General Earthwork Tables, by J. H. Watson Buck; a fourth edition of F. W. Simms's Practical Tunnelling, revised and greatly extended, with additional chapters illustrating recent practice, by D. K. Clark; and a new edition of Warn's The Sheet Metal Worker's Instructor, rewritten and greatly extended by J. G. Horner.

Mr. John C. Nimmo promises The Flora of the Alps, being a description of all the species of flowering plants indigenous to Switzerland, and of the Alpine species of the adjacent mountain districts of France, Italy, and Austria, including the Pyrenees, by Alfred W. Bennett, with 120 coloured plates, 2 vols.; A Natural History of British Moths, by the Rev. F. O. Morris, fourth edition, with an introduction by Dr. W. Egmont Kirby, and 132 plates coloured by hand, 1933 figures of moths; A History of British Birds, by the Rev. F. O. Morris, in 36 monthly parts, vol. ii., containing 7-12, with 69 plates coloured by hand.

Messrs. Sampson Low, Marston, and Co., Limited, are preparing:—Text-book of Zoology, by Dr. J. E. V. Boas, translated by J. W. Kirkaldy and E. C. Pollard, illustrated; Short Studies in Physical Science, by Vaughan Cornish, with fourplates; Handbook of Arctic Discoveries, by General A. W. Greely, with portrait and maps; The Land of an African Sultan, Travels in Morocco, by Walter B. Harris; The Wild North Land, by General Sir W. F. Butler; Textile Calculators, by E. A. Posselt; Health and Condition in the Active and the Sedentary, by N. E. Yorke-Davies, third edition, revised and enlarged.

Messrs. A. and C. Black promise Artistic and Scientific Taxidermy and Modelling, by Montagu Browne; Text-book of General Pathology and Pathological Anatomy, by Prof. Thoma,

translated by Dr. Alexander Bruce, 2 vols; Plea for a Simpler Life, by Dr. George S. Keith, fifth edition; The Evolution of Bird-song, with observations on the influence of heredity and imitation, by Charles A. Witchell.

Messrs. Smith, Elder, and Co.'s list is as follows:—The Spas and Mineral Waters of Europe, with Notes on the Utility of Spa Treatment in various Diseases and Morbid Conditions, by Drs. Hermann Weber and Frederick Parkes Weber; The Treatment of Phthisis, by Arthur Ransome, F.R.S.

Messrs. G. P. Putnam's Sons' announcements include:—The Evolution of Horticulture in New England, a History of the Art of Gardening in New England from its earliest plantation to the present day, by Daniel Denison Slade; A Scientific Demonstration of the Future Life, by Thomson Jay Hudson; Handbook for Hospitals, a manual of practical suggestions, by Abby Howland Woolset.

Messrs. W. H. Allen and Co., Limited, will publish Allen's Naturalists' Library, edited by Dr. R. Bowdler Sharpe, illustrated; British Birds, vols. iii. and iv., by the editor; Butterflies, vol. ii. by W. F. Kirby; Game Birds, vol. ii., by W. R. Ogilvie Grant.

Mr. Young J. Pentland's list contains:—Atlas of the Fundus Oculi, illustrated with figures in colours by W. Adams Frost; The Principles of Treatment, by Dr. J. Mitchell Bruce; The Edinburgh Hospital Reports, vol. iv.; a new edition of Prof. Cunningham's Manual of Practical Anatomy, in 2 vols., with additional illustrations.

Mr. Wm. F. Clay, Edinburgh, has in the press:—The Histopathology of the Diseases of the Skin, by Dr. P. G. Unna, translated from the German with the assistance of the author by Dr. Norman Walker, with double coloured plate containing nineteen illustrations and forty-two additional illustrations in the text.

Mr. Erwin Nägele, Stuttgart, announces Researches on Mimicry on the basis of a Natural Classification of the Papilionidæ, by Dr. E. Haase, translated by Dr. C. M. Child, with eight coloured plates, 4to, part ii.

Messrs. Whittaker and Co. will publish immediately:—Future Trade in the Far East, by C. C. Wakefield, fully illustrated, and containing a map showing the latest developments in the trade routes.

The Rebman Publishing Company, 11 Adam Street, Strand, W.C., have ready for immediate publication, Water and Water Supplies, by Dr. J. C. Thresh.

Mr. F. Furchheim, Naples, announces Bibliografia del Vesuvio e del suo Territorio, compiled by Federigo Furchheim.

Mr. David Douglas (Edinburgh) will issue The Vertebrate Fauna of Scotland, vols. vi. and vii.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE recent decision of the Supreme Court of the United States in favour of Mrs. Stamford, and adverse to the Government in its claim for 13,000,000 dollars, means the salvation of the Leland Stamford Junior University, at Palo Alto, California; as Mrs. Stamford will now be able to carry out the munificent plan of endowment, which has been held in abeyance pending the issue of this litigation. The Johns Hopkins University at Baltimore, on the contrary, is seriously crippled by the collapse of the Baltimore and Ohio Railroad system, which has just been put into the hands of a receiver. The University held a large amount of the securities of this line.

THE County Council of Southampton has decided not to levy a rate of a halfpenny in the pound, under the Technical Instruction Act, which had been recommended by the Finance Committee with a view of assisting the Hartley Institution, a school of science and art, in that town. As far as we can gather, Southampton is suffering from a plethora of educational authorities. Besides the Council of the above institution, the Endowed Schools governors and the School Board are also engaged in providing different grades of technical education.

WE notice that on Monday, the 16th inst., a deputation of the Lancashire Committee of the Incorporated Association of Head Masters waited upon the Technical Instruction Committee of the Lancashire County Council, to urge the claims of the secondary schools in the county upon the Committee. They based their claims upon the admitted imperfect education of the students who presented themselves at the technical schools for instruction, urging that the want of proper preliminary education could be avoided by a liberal offering of scholarships to the secondary schools, which out of the increased income resulting from the augmentation of numbers, could easily ensure a satisfactory introductory training for the future students. Attention was also very properly called to the work of this kind which had been carried out in other counties. Though the chairman expressed a fear that want of funds would prevent very much being done for secondary schools, we are sure, in view of his admission that the Committee agreed that these schools were the proper places for much of the early work in a good system of technical education, that it will not be long before the Lancashire authority does something to meet the claims urged by the deputation.

THE latest report of the Technical Instruction Committee of the Derbyshire County Council is very refreshing reading. The pamphlet is prefaced by an explanation of what the Committee considers to be the proper scope of technical education. It is rightly affirmed that a complete system has two main objects: (1) to provide for those who may naturally be expected to occupy positions of control, *i.e.* the "managers"; (2) to provide for the class from which individuals are constantly rising to positions of control, *i.e.* the "men." Recognising that the recent industrial developments of Germany are in a very large measure due to the scientific training of the managers and foremen, the Derbyshire Committee very early turned its attention to the secondary schools, as being the institutions where this class receives its early education. Very much has been done to improve the standard and nature of the instruction given in the grammar schools of the country. In giving help to these educational establishments it has in every case been insisted upon that it is desirable only to give a general education in English and languages, and to add a solid groundwork of mathematics, drawing, and pure science, without dealing with their application to specific industries. At the same time it has not been lost sight of that those students who will naturally pass on to occupy positions of high responsibility, must receive special courses of instruction at technical schools and higher educational institutions. In dealing with the requirements of the "men," the Committee have wisely decided that the teaching in elementary schools is best supplemented by a course of object-lessons in elementary science. To ensure this being well done, classes for elementary school teachers have been organised, with a view to teaching them how to give instruction in this way. The scholar's education can then be suitably continued in evening schools and science and art classes, which have been arranged in each district according to its needs. For the more advanced study which is necessary for most of the first class of students and for a considerable proportion of the second, who themselves desire it, a technical school is naturally stated to be of great importance. Instead of attempting to found such an institution themselves, the Committee have decided that the wisest course is, by a careful system of grants, scholarships, and exhibitions, to utilise the excellent colleges of Nottingham, Sheffield, Manchester and Derby, which all border upon their administrative county.

In addition to the above work, we would especially notice the initiation of the Midland Dairy Institute, the inauguration of a Department of Mining at Firth College, Sheffield, the establishment of local classes in "hosiery" at Heanor, in "calico printing, bleaching, &c.," at New Mills, and in the principle of design at various centres. The year's work is a decidedly successful one, and we hope to see several other counties following the logical and scientific methods of procedure which the Derbyshire Committee have laid down.

SCIENTIFIC SERIALS.

THE *Quarterly Journal of Microscopical Science* for February, 1896, contains:—On the early development of Amia, by Bashford Dean (Plates 30-32). *Amia calva*, possibly the sole survivor of the race of the Mesozoic Ganoids, claims our special interest as the nearest ancestral form of some, if not of all, of our recent Teleosts. In embryology the Ganoid and the Teleost still stand widely separate; there has even been a tendency to look upon these kindred forms as representing different phyla, early divergent from a primitive chordate ancestor. This, therefore, renders the details given by Dr. Dean

of special interest. About the general habits of this fish, he thinks it unnecessary to write much, as Fülleborn's notes, so recently published, are but confirmed; but we are glad that he has added some on the breeding habits, which are illustrated with sketches of the nest and of the cloud of young fry attended by the male. The author concludes that the early development must certainly be regarded as furnishing abundant evidence of intermediate characters; to the Ganoids, on the one hand, and to the Teleosts, on the other. These ontogenetic nearnesses become, accordingly, of the greatest interest, since they confirm the results of the structural study of recent and fossil forms upon the Amioid descent of Teleosts.—On *Kynotus cingulatus*, a new species of earthworm from Imerina in Madagascar, by W. Blaxland Benham (Plates 33 and 34). This interesting species is remarkable for the great number and small size of the segments composing the body; there were three anterior portions sent for examination, each about 225 mm. in length; each piece consisted of some three hundred or more segments; the whole worm being probably about 450 mm. to 500 mm. in length; it possesses a clitellum of relatively enormous dimensions, with most peculiar "claspers."—Notes on the ciliation of the ectoderm of the amphibian embryo, by R. Assheton (Plate 35), describes the distribution of the cilia over the surface of the bodies of the tadpoles of *Rana temporaria and Triton cristatus*. As the author notes, the existence of a ciliated embryo among craniate vertebrates seems often to be overlooked.—On the ontogenetic differentiations of the ectoderm in Necturus (Study II.).—On the development of the peripheral nervous system, by Julia B. Platt (Plates 36-38). Even if we assume Necturus to be a monotypic genus, it would have been advisable for the authoress to have cited a specific name for the Batrachian, whose peripheral nervous system she has so painstakingly elaborated. The summary, occupying two pages, is too long to be cited, and does not admit of being further condensed; we note that "although delicate protoplasmic prolongations connecting cell with cell initiate the specialised coordination of the nervous system, a common reticulum, such as Sedgwick describes, into which nuclei migrate, does not exist in *Necturus*" [*lateralis*]. This number contains a title and index to Volume xxxviii.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 13.—"On the Behaviour of Argon and Helium when submitted to the Electric Discharge." By Dr. J. N. Collie and Prof. William Ramsay, F.R.S.

Some years ago, Natterer published the results of experiments on the passage of electricity through various gases and vapours at the ordinary atmospheric pressure; he found that the length of the spark, or the "spark-gap" varied in length in a manner approximately proportional to the number of atoms in the molecule of the gas; thus in mercury gas the distance was very much greater than that obtained in hydrogen, oxygen, nitrogen, or other diatomic gases; and in these, the spark-gap was longer than in substances of more complex molecular constitution.

Experiments of a similar nature, carried out by us on some common gases and on argon and helium, gave the results which are summarised in the following table:—

	mm.
Oxygen	23·0
Air	33·0
Hydrogen	39·0
Argon	45·5
Helium	Probably 250 or 300

The current was of constant potential and quantity; and the hammer of the coil was kept in a constant position during the experiments. Indeed, on re-testing the spark-gap with air, after the experiments were finished, the original number was reproduced.

On lowering pressure, this spark-discharge changes into a ribbon-like discharge, before the "fluffy" appearance of a so-called vacuum tube becomes visible. It appeared that this change, occurring at a definite pressure, might be measured with fair accuracy. The results of a series of such experiments is to show that the character of the discharge changes for the undermentioned gases at the pressures stated:—

	mm.
Air	73 or 74
Hydrogen	42 ,, 43
Oxygen	81
Carbon dioxide	92 or 94
Cyanogen	23
Nitrogen	33
Carbon monoxide	49
Helium	1270

A tube filled with helium shows all the phenomena of a vacuum tube when containing the gas at atmospheric pressure.

The visibility of the spectrum of one gas in presence of another was next investigated. For a full description of the method of filling the tubes, and altering the pressure, the original paper must be consulted. Only the final results are here reproduced.

Amount of Gas detectable in a Mixture.

	Per cent.	
(1) Helium in hydrogen	33	of helium invisible at 2·61 mm.
	10·9	,, barely visible at the lowest pressure.
(2) Hydrogen in helium	0·001	visible at all pressures.
(3) Nitrogen in helium	0·01	almost invisible.
(4) Helium in nitrogen	10	of helium difficult to detect.
(5) Argon in helium	0·06	still visible at all pressures.
(6) Helium in argon	33	invisible at 2·62 mm. pressure.
(7) Nitrogen in argon	25	,, 2·58 ,, ,,
	0·42	,, 1·7 ,, ,,
	0·08	,, 0·18 ,, ,, though just visible at 1·05 mm.
(8) Argon in nitrogen	37	barely visible at any pressure.
(9) Argon in oxygen	2·3	difficult to distinguish at 1·04 mm. pressure.

From these experiments it appears that at high pressures, a discharge passes much more readily through helium than through other gases; but at a low pressure, if passage of current can be inferred from luminosity of spectrum, all other gases convey current more readily than helium does; and nitrogen conveys current more readily than argon. This is probably connected with the known fact that decrease of pressure promotes dissociation. The experiments on the relative luminosity of these gases were made with electrodeless tubes, hence it cannot be objected that the passage of current is determined by the attraction of the material of the electrodes for the gas under experiment.

"On the Absorption of the extreme Violet and ultra-Violet Rays of the Solar Spectrum by Hæmoglobin, its Compounds, and certain of its Derivatives." By Dr. Arthur Gamgee, F.R.S., Emeritus Professor of Physiology in the Owens College, Victoria University.

The investigation, of which the chief results are communicated in this paper, had for its starting-point the observation of the late Prof. J. L. Soret, of Geneva, who showed that, in addition to the absorption bands in the visible spectrum, solutions of the blood-colouring matter are characterised by an intense absorption band in the extreme violet between G and H. The present research has been conducted with the aid of photography, quartz prisms and lenses being employed.

The following are some of the principal results of the investigation:—

I. The compounds of hæmoglobin with oxygen, carbonic oxide, and nitric oxide present, even in highly dilute solutions, an absorption band between Fraunhofer's lines G and H. In the case of oxy-hæmoglobin the mean ray absorbed coincides with λ 414·0, that is to say, the centre of absorption is slightly nearer the red end of the spectrum than Soret had stated; this observer placed the centre of absorption at *h* (λ 410·1). As Soret had indicated, in the case of the compound of carbonic oxide with hæmoglobin, the absorption band is slightly displaced towards the less refrangible end of the spectrum. The combination of hæmoglobin with nitric oxide presents an absorption band occupying precisely the position of that of the CO-compound. In the case of these two compounds, the mean ray absorbed corresponds to λ 420·5.

II. When the molecule of *dissociable* oxygen is removed from oxy-hæmoglobin, either by the action of reducing agents, or by boiling *in vacuo*, the absorption band in the extreme violet is remarkably displaced towards the less refrangible end of the spectrum, the centre of absorption corresponding to λ 426·0.

III. The absorption of the extreme violet depends on the iron-containing moiety of the hæmoglobin molecule, for, whereas it is not presented by the albuminous product of the decomposition of the blood-colouring matter, it is characteristic of the acid compounds of hæmatin and of hæmochromogen.

IV. Solutions of alkaline hæmatin, even when enormously diluted (1 : 30,000 of water), exert a general absorption of the ultra-violet and extreme violet, but present no trace of definite absorption, either in the extreme violet or the adjacent ultra-violet region.

The compounds of hæmatin with acids, *e.g.* hæmatin hydrochloride, present even in solutions of great dilution (1 : 25,000—1 : 50,000) an intense absorption band, which encroaches more and more on the ultra-violet as the strength of the solution increases. With a solution containing one part of crystallised hæmatin hydrochloride in 20,000 parts of glacial acetic acid the band extends between *h* and M, the most intense absorption being between *h* and L. In highly dilute solutions the band which is still intense absorbs both H and K.

V. Solutions of hæmochromogen (reduced hæmatin of Stokes) exhibit an intense absorption band between *h* and G. The band has the same position as the band of CO-hæmoglobin, but is more intense. From the examination of solutions of various strengths, it results that the mean ray absorbed corresponds to λ 420·0.

VI. The absorption of the extreme-violet and ultra-violet by methæmoglobin indicates that this body is the product of a partial decomposition of the molecule of oxy-hæmoglobin.

VII. The band in the extreme-violet (and ultra-violet), which is characteristic of hæmoglobin, its compounds, and certain of its iron-containing derivatives, in no respect depends upon the iron in the molecule. This conclusion is based (1) on the fact that none of the compounds of iron, organic or inorganic, possess the property of producing a definite absorption in the extreme-violet or the adjacent ultra-violet; (2) upon the study of hæmatoporphyrin, a body derived from hæmatin by the removal of the iron which this body contains.

Acid solutions of hæmotoporphyrin of extreme dilution exhibit an absorption band between *h* and H. If the solution be slightly more concentrated K is absorbed, and with increasing concentration of the solution the absorption of the ultra-violet extends more and more. Alkaline solutions of hæmatoporphyrin absorb the same spectral region, but the intensity of the absorption is greater.

VIII. Neither bilirubin, hydrobilirubin, nor urobilin present any definite absorption band in the region of the spectrum, where the absorption band of hæmoglobin and its derivatives occurs.

Physical Society, March 13.—Prof. Carey Foster, Vice-President, in the chair.—Mr. J. H. Reeves read a paper on an addition to the Wheatstone's bridge for the determination of low resistances. The piece of apparatus described can be used for measuring the resistance of metre lengths of wires of low resistance, the only additional apparatus required being a sensitive galvanometer, a Post Office form of resistance box, and a metre bridge. It differs from the ordinary Kelvin bridge in that instead of balancing by varying the length of the standard wire between the two contacts, the distance between these contacts is maintained constant, as is also the length of the wire which is being measured, and balance is obtained by altering other resistances in the network. The author has made a number of tests which show that by his arrangement the resistance of metre lengths of copper wires between the limits of No. 22 S.W.G. and a stranded cable of 7 No. 16's can be determined with an accuracy of 0·1 per cent.—Mr. Reeves also read a note on the exact value of Matthiessen's standard. Prof. A. Gray (communicated) said that the author had in his arrangement combined the fixed standard employed in Matthiessen and Hocking's modification of the ordinary bridge with the greater celerity of working arising from the smaller number of operations to be performed when the Kelvin bridge is used. Prof. Gray thinks that he, and probably others, used a method similar to that of Mr. Reeves; but that the paper is of great utility, since it shows how time may be saved and existing apparatus utilised. Prof. Ayrton said that the advantage of the method described lay in the fact that it was independent of the resistances at the contacts. In Carey Foster's method, however, the coils had to be interchanged, and inaccuracy might be introduced owing to the varying resistance of the mercury contacts. Unless the mercury cups and the copper plates at the bottom were cleaned every day and the contacts re-amalgamated, the resistance of the mercury cups was very variable. With regard to the question of Matthiessen's standard, it is to be remembered that the specific conductivity of copper has been steadily increasing. This increase was particularly noticeable in the copper prepared by the Elmore process, where, during the deposition of the metal, an agate burnisher is kept continually passing over the surface. Fitzpatrick had explained the rise in conductivity of copper by supposing that the density of the copper now supplied was greater than that of the copper used by Matthiessen, and this explanation seemed quite satisfactory. Mr. Reeves's experiments, however, have conclusively shown that this is not the true explanation. It was now possible to obtain copper in large quantity having a conductivity of 103 on Matthiessen's scale. The Chairman (Prof. Carey Foster) explained how, when using his method, the accuracy of the result depends not on the elimination of the small resistances at the mercury cups, but on the constancy of these resistances. Matthiessen and Dr. Russell found that the specific gravity of copper was apt to be low on account of the presence of dissolved oxide, and they were the first to pass hydrogen gas through the molten metal to remove this oxide. Mr. Appleyard gave a simple diagramatic sketch of the author's arrangement, and also pointed out that better results would probably be obtained with a galvanometer of one or two ohms resistance. Mr. Campbell said that it ought to be definitely settled whether Matthiessen's standard was the conductivity per unit volume or per unit mass. Since copper was always bought by weight, he, as a practical man, strongly advocated the adoption of the mass conductivity; further, in this case the measurement of the specific gravity would be avoided. Mr. Reeves having replied, a communication by Herr Puluj on kathode rays was read by the Secretary.—Herr Puluj exhibited some Röntgen photographs taken by means of a form of Crookes' tube, which he had described in a memoir published in 1889. With this tube he has succeeded in obtaining impressions with exposures of only two seconds. Herr Puluj considers that the particles of matter torn from the kathode, which convey negative electrostatic charges, by impact on the glass walls, or on screens, equalise their electric charges, and in this process call forth not merely a disturbance of the material molecules, but also of their ether envelopes. Each portion of the glass or screen bombarded by the kathode stream becomes the starting-point of ether waves, which, according to their oscillation period and oscillation character are either visible rays (phosphorescence) or invisible Röntgen rays. The oscillations of the invisible rays may take place in the longitudinal direction, but no convincing argument has up to now been brought forward to support this view.—The Secretary also read a note on permeability to Röntgen rays, by Messrs. Ackroyd and Knowles. The authors have exposed a plate on which a number of pieces of metal, oxides, and sulphates were placed to the Röntgen rays in order to see whether the permeability of bodies to these rays depends on the atomic or molecular weight of the body. In each case it was found that the opacity increased with the molecular weight. Mr. Blakesley said that he considered the Röntgen rays to be the propagation of electrostatic strain through space. With reference to the non-refrangibility of these rays, he had observed in one of the photographs, exhibited by Mr. Swinton, a dark line at the edge of the shadow of a wooden pencil, which might have been due to the refraction of the rays by the wood. Mr. Blakesley has, however, found that this line is due to the varnish on the pencil. Some Röntgen photographs of quartz and ebonite rods not only did not exhibit these dark lines, but there was a very slight indication of a bright line just on the edge of the shadow, which would indicate that the refraction of these rays was less in the rods than in the surrounding medium.—Mr. Edser exhibited some photographs taken with Mr. Jackson's form of tube, in which a concave kathode is employed. Mr. Edser said that the whole of the tube on the kathode side of the anode plate phosphoresced, so that the Röntgen rays seem to partake of the character of diffused light. Prof. Ayrton said Mr. Jackson had found that the kathode rays form a parallel beam and do not first come to a focus and then again spread out. The Chairman said that some observations made by Mr. Porter agreed with those of Mr. Edser. Mr. Blakesley described the tube used by Puluj, in which a mica screen coated with green calcium sulphide is placed between the kathode and the anode. Mr. Gardner said that there seemed to be some confusion, for when a concave kathode is employed, the kathode rays are brought to a focus and then again diverge. The phosphorescence on the inside of the glass had been shown by Lenard to be due to electricity travelling round the inside surface of the glass. Mr. Pidgeon asked if any one had tried the effect of mounting the photographic film on a metal plate. The Chairman said that Captain Abney had found that if the film was

mounted on a ferrotype plate no action took place. Prof. Perry said that he, for one, was of opinion that the Röntgen rays were undulatory. Prof. Larmor has given an explanation which seems to agree with the observed facts. This explanation supposes that the intermolecular spaces respond to vibrations of a certain frequency. The reason no refraction or diffraction effects had been observed was probably because of the extreme smallness of the wave-length of the undulation.—After a few further remarks by some of the members, the Society adjourned till March 27.

PARIS.

Academy of Sciences, March 9.—M. A. Cornu in the chair.—On the divergence of trigonometrical series, by M. H. Poincaré. A reply to some remarks by M. Hill.—On some new properties of the invisible radiations emitted by some phosphorescent bodies, by M. Henri Becquerel. The rays emitted by potassium uranyl sulphate, which has been kept in the dark for some days, are capable of discharging a gold leaf electroscope even after passing through a plate of aluminium 2 mm. in thickness. Clear evidence was obtained that these invisible rays are capable of reflection and refraction.—On the use of artificial hexagonal blende in the place of a Crookes' tube, by M. Troost. By means of the light given off by a crystal of artificial blende, rendered phosphorescent by exposure to burning magnesium ribbon, good images of metallic objects upon a sensitised plate were obtained, the rays passing through blackened paper readily. The effects produced are the same as with a Ruhmkorff coil and Crookes' tube. The time of exposure is not given.—On some conditions which govern gaseous combinations. The combination of oxygen and hydrogen at low temperatures, by MM. A. Gautier and H. Helier. By circulating the gaseous mixture through a porcelain tube packed with porcelain rods, kept at a constant temperature, and then passing the products over tubes containing phosphoric anhydride, combination can be shown to occur at as low a temperature as 180° C., explosions not occurring until about 840° C.—On the carbides of yttrium and thorium, by MM. H. Moissan and Etard. Yttrium carbide, prepared in the electric furnace, is attacked readily by the halogens, with difficulty by acids. With water the carbide yields a mixture of acetylene (72 per cent.), methane, ethylene, and hydrogen, together with a small quantity of liquid hydrocarbons. Thorium carbide, produced by a similar method, forms a crystalline transparent mass, and gives a mixture of hydrocarbons on treatment with water of the same qualitative composition as that obtained from yttrium carbide.—Aberration and regression of the lymphatics in the course of development, by M. L. Ranvier. The growth of the lymphatics at the time of their formation is often so active that they appear in organs in which they have no functional significance, from which they have to be reabsorbed. Hence occasionally long vessels, closed at both ends, are found, corresponding to portions of the lymphatic system isolated by the atrophy of the intermediate parts. These small cysts may give rise to large cystic tumours.—On malformations of the hip, by M. Lannelongue.—Influence of vaccinal exanthema on microbial localisations, by M. S. Arloing.—Remarks on communication to M. Hermite, by M. Hugo Gyldén. A correction of a previous paper.—Observations of the comets. Perrine (1895, *c*), and Perrine-Lamp (1896, *a*), made with the large equatorial at the Observatory of Bordeaux, by M. L. Picart.—Observations of the sun, made at the Observatory of Lyons, during the last quarter of 1895, by M. J. Guillaume.—On asymptotic lines, by M. E. Goursat.—On the determination of the mass of the cubic decimetre of distilled water, free from air, and at its maximum density, by M. J. Macé de Lépinay. As the final result of a series of weighings in water of a quartz cube, the mass of a cubic decimetre of pure water at 4° C. is 0·999954 kilograms with a possible error of six units in the last figure.—*Rôle* of the different forms of energy in photography through opaque bodies, by M. R. Colson. The actions capable of affecting a sensitised plate are classified as mechanical, chemical, thermal, the infra-red rays, and the X-rays.—Electric effects of the Röntgen rays, by M. A. Righi. The X-rays are capable of producing the dispersion of electric charges upon dielectrics. By dusting a mixture of sulphur and red lead, or better, of talc and manganese peroxide over the plate of ebonite, images of interposed objects resembling photographs can be produced.—On some facts relative to the Röntgen rays, by MM. A. Battelli and A. Garbasso.—On some specimens of glass submitted to the action of the X-rays, by M. V. Chabaud.—On the Röntgen rays, by MM. C. Girard and F. Bordas. An experiment tending to show that the Röntgen rays proceed from both anode and kathode, and that the fluorescence produced on the walls of the Crookes' tube has only a slight effect upon a sensitive plate.—On the technique of photography by the X-rays, by MM. A. Imbert and H. Bertin-Sans.—Remarks added by M. d'Arsonval on the same.—On the centres of emission of the X-rays, by Prince B. Galitzine and M. de Karnojitzky.—On the direction of the X-rays, by M. A. Buguet.—Photography in colours; substitution of organic colours for reduced silver in photographic prints, by M. G. A. Richard.—Action of nitrogen peroxide and air upon the chloride of bismuth, by M. V. Thomas.—On the modifications of the grisometer and on the accuracy obtainable with it, by M. J. Coquillion.—On argon in the gas from the swimming bladder of fishes, by MM. T. Schlœsing, jun., and J. Richard.—Thermochemical study of the amides and ammonium salts of some chlorinated acids, by M. P. Rivals.—On the determination of the acidity of pyroligneous products, by M. Scheurer-Kestner.—On a new series of sulphophosphides, the thiophosphites, by M. Ferrand.—On some derivatives of triphenyl-silico-protane, by M. C. Combes.—On Russian essence of aniseed, by MM. G. Bouchardat and Tardy. This essence contains a large quantity of anethol, together with small quantities of anisic aldehyde, anisic acid, fenchone, and hydrocarbons of the composition $C_{15}H_{24}$.—On a case of lumbar *spina bifida*, by M. V. Ménard.—Influence of franklinisation upon menstruation, by M. E. Doumer.—Explanation of the flowers of the Fumariaceæ from their anatomy, by M. O. Lignier.—On an old schistous synclinal, forming the heart of Mount Blanc, by MM. J. Vallot and L. Duparc.—On the eruptive rocks of the Belledonne chain, by M. Louis Duparc.—On the mode of formation of the auriferous conglomerates, by M. A. Lodin.—Examination of the meteorite that fell at Madrid on February 10, 1896, by M. S. Meunier. The substance of the meteorite appears to be identical with the mineral chantonnite.—On mathematical synthesis, by M. L. Mirinny.—On a point in the kinetic theory of gases, by M. Chapel.—On photography through substances by electric currents, by M. Vaysse.—Remarks by M. Armagnac confirming the preceding.—On a probable cause of the explosion of meteors in the terrestrial atmosphere, by M. E. Hauser.

CONTENTS.