NOVA AURIGÆ.—In some further notes that we have referring to the brightness and the spectrum of the Nova, we find that most observers estimate the star's magnitude to lie between 10 and 10.5. Herr Belopolsky, who has examined the star spectroscopically, has been able to see one or two lines; a later estimation of the brightest gave a wave-length of 501, while the second line proved too variable in brightness to allow of a sufficiently correct measurement.

To *Astronomische Nachrichten*, No. 3118, Mr. H. Seelinger contributes a very important article, in which he suggests an hypothesis which may be said to approach that put forward by Mr. Lockyer some time ago. He assumes (and a very fair assumption too) that the cosmos contains innumerable more or less elongated forms of very thin and small particles, and that the Nova was produced by a body rushing into one of these, so to speak, clouds. On entering this cosmical cloud, at once there would be a condition for producing heat, and therefore light, and we have only to imagine the cloud to be of varying thicknesses to account for the peculiar fluctuations which attended the light of the Nova. That such a case should take place seems in itself more probable than that of two bodies passing very near one another, and we already know that such streams as suggested do exist. Our November shower, for instance, is such a swarm, only on a scale very much smaller than that inferred above.

GEOGRAPHICAL NOTES.

UNTIL recently the Samoan calendar corresponded with the Australian, but on July 4 last a change was made by order of King Malietoa. Tuesday, July 5, was reckoned a second time as Monday, July 4, thereby coming into harmony with the American and European reckoning. Samoa, lying to the east of 180°, had retained the old system of time, superseded by the general acceptance of that meridian as the line at which the date is rectified by vessels at sea.

CAPTAIN LUGARD reached London from Uganda on Sunday night. It is gratifying to know that his three years' residence in equatorial Africa, and the severe strain of recent events, have not told adversely on his health. He will probably communicate the important geographical results obtained by him to a special meeting of the Royal Geographical Society in November.

THE arrangements for the next session of the Royal Geographical Society present several new features. In addition to the ordinary meetings it is proposed to give a special series of Christmas lectures to young people; to be followed by a course of ten weekly educational lectures, specially adapted for teachers, by Mr. H. J. Mackinder. The ordinary meetings as provisionally arranged begin on November 14 by a paper on his proposed North Polar expedition by Dr. Nansen. Mr. Joseph Thomson will follow with an account of his expedition to Lake Bangweolo. Captain Bower will describe his journey across Tibet, and Captain Lugard will recount his discoveries in equatorial Africa. Prof. Milne and Mr. Savage Landor have promised papers on Yesso, Major Rundell on the Siyin Chins, Mr. H. O. Forbes on the Chatham Islands, and Captain Gallwey on Benin. It is hoped that Mr. Conway will return to describe his adventures in the Karakoram mountains. Apart from the records of travel to which the attention af the Society in its ordinary meetings has usually been mainly devoted, there will be papers dealing with the more general and scientific aspects of Geography. The Prince of Monaco will probably describe his experiments on the Atlantic currents, Sir Archibald Geikie will lecture on types of scenery, Prof. Bonney on the work of glaciers, Mr. J. Y. Buchanan on the windings of rivers, and Dr. Schlichter on his new photographic method of determining longitude.

THE last number of *Petermann's Mitteilungen* contains an important paper by Dr. Alois Bludau giving the co-ordinates for Lambert's equivalent area azimuthal projection of the map of Africa. An outline of the continent on this projection, the central point of which is on the equator in 20° E. long., shows the remarkable suitability of the map for representing Africa, the distortion being inappreciable.

MAGNETIC INDUCTION.[1]

THE lecturer remarked that it was no less than forty-five years since the magnetic properties of materials had formed the subject of an evening discourse before the British Association. At the Oxford meeting in 1847 the lecturer was Michael Faraday, who had only a little while before made his great discovery of diamagnetism and been led to the splendid generalization that all substances are in one way or other, and in greater or less degree, susceptible of magnetic influence. And it was an interesting coincidence that in the same year, partly indeed at that same Oxford meeting of the Association, the foundation of the modern mathematical treatment of magnetism had been laid by that infant phenomenon, whom in the vigour of his maturity we were now learning to call Lord Kelvin. Discarding the arbitrary hypotheses of earlier theoretical writers, Lord Kelvin, then a stripling at Cambridge, had proceeded to give mathematical expression to the observations and intuitions of Faraday. In recent years the science of magnetism had advanced fast, keeping pace with the advance of its industrial applications. In common with other branches of electricity it had discovered the advantage of being useful. The debt which practice owed to science had been repaid with interest. In other departments of science it might be true that there were devotees whose chief pride in their work lay in their reflection that it could never be of any use to anybody: this temper of mind was not possible to an electrician. The language of electricians had passed with bewildering rapidity into Acts of Parliament and provisional orders of the Board of Trade, and the demands of industry had stimulated discovery and fostered exactness in measurement. It was the beneficent reaction of practice on science that had enabled the great work of the Electrical Standards Committee of the British Association to be brought to a successful issue. As a fruit of that work electricians were in high hope that this Edinburgh meeting would result in an international agreement with regard to the electrical units, so that whatever the Great Powers might find to differ about they would at least be of one mind as to the magnitude of the volt, the ampere, and the ohm. In the co-operation of Prof. von Helmholtz on the part of Germany, and of M. Mascart on the part of France, with Lords Kelvin and Rayleigh and their English colleagues, there were surely the elements of a Triple Alliance which should secure to the electrical world peace, not only with honour, but with precision.

The lecture of Faraday in 1847 had dealt with the condition induced by magnetic force in matter which was not ordinarily magnetic. Substances were broadly divisible into two classes, those which were strongly susceptible to magnetic influence and those that were only very feebly susceptible. The latter was by far the most numerous class, and it was with it that Faraday dealt in his lecture. The strongly magnetic substances were iron and its various derivatives, which passed by the general name of steel, also nickel and cobalt. A recent discovery by Prof. Dewar seemed to require that oxygen, in the liquid state, should be added to this list. The lecturer proposed to confine his attention to the phenomena of magnetization which were exhibited by the strongly magnetic metals. Let any one of these metals be submitted to the action of a magnetizing force such as would be produced if an electric current were passed through a coil of insulated wire surrounding the metal. As the current was gradually increased, the magnetization passed through three stages. It began very gradually; at first, while the current was still weak, there was but little magnetism developed. Then a stage came on in which the magnetic state was acquired with great rapidity; a small increase in the current now caused an enormous gain of magnetism. Finally, the process passed into a third stage, when the magnetism was again acquired slowly, and however much the magnetizing current was increased it was found to be impossible to force the magnetism to exceed a certain limiting value. This was the phenomenon of magnetic saturation. Recent researches had given definiteness to the rather vague idea which used to be expressed by this phrase, and it was now known not only that a limit existed, but what its values were in the several magnetic metals. The lecturer illustrated the three stages in the magnetizing process by means of the lantern, exhibiting curves which showed the connection between mag-

[1] Abstract of an evening lecture delivered before the British Association, at Edinburgh, August 8, 1892, by J. A. Ewing, M.A., F.R.S., Professor of Mechanism and Applied Mechanics, Cambridge University.

netism and magnetizing force, and pointed out that in special cases the three stages became extraordinarily distinct. Curves of the same kind were used to show what happened after a magnetizing force had been applied, if it were withdrawn or varied in any way. The magnetism in all cases tended to lag behind when the magnetizing force was varied, and hence these curves in any cyclic process became loops enclosing a certain area. It had been proved that this area served to measure the energy expended in carrying the substance through a cyclic magnetizing process, the reason why energy had to be spent being the tendency which the magnetism always had to lag behind the force that was operating to change it. To this tendency he had given the name "hysteresis," a term which was already of formidable significance in the ears of practical electricians. For the existence of hysteresis was the chief reason why the transformers which were used in alternate current systems of electrical distribution absorbed wastefully a considerable amount of power. The iron core of a transformer was being carried through a cycle of magnetization from a positive to a negative value and back again some 80 or 100 or 120 times a second, and every one of these periodic reversals of magnetism implied a waste of energy, which went on even when no useful current was being drawn off. It was a question of considerable practical interest, whether the amount of work wasted on the iron of a transformer was the same per cycle at high speeds of reversal such as were usual in practice, as it was in the slow speed laboratory experiments, by the help of which these cyclic curves had been drawn.

The lecturer proceeded to give some account of molecular theories which had been framed to account for the characteristics of the magnetizing process. It was suggested, originally by Weber, that the molecules of iron are always little magnets, and that when the iron, as a whole, is not magnetized, it is because as many of the molecular magnets are facing one way as another. According to this view the process of magnetization consists in turning the molecular magnets round, so that they face, more or less, one way. When a very strong magnetising force is applied, the molecules are forced all to face one way; the piece is then saturated. To explain why they did not at once turn round completely when any magnetizing force was applied, Weber postulated an arbitrary directing force, which tended to hold them in their original direction. The lecturer proceeded to show by means of experiments conducted on the projecting table of the lantern, and shown on a large scale on the screen, that no arbitrary directing force was necessary. The mutual actions of the molecular magnets on one another supplied all the control that was required. It accounted completely for the three stages of the magnetizing process and for all the phenomena of hysteresis. It accounted also for the effects which were found to be produced by mechanical vibration and mechanical strain. Experiments were made exhibiting the breaking up of molecular groups, bound together by their mutual forces, under the influence of a gradually increased external directing force. In these experiments models were used, consisting of a number of small magnets, pivoted like compass needles on fixed centres, and arranged on the horizontal table of a large projecting lantern. A pair of coils placed one on either side of the group supplied deflecting force, and as the current in these was gradually increased the three stages of the magnetizing process and the phenomena of hysteresis exhibited themselves in the manner in which rearrangement of the elementary magnets composing the group took place. In some of the models the magnets turned under water, so that their vibrations were rapidly damped out. Slides were also shown which gave some of the results of observations recently made in the lecturer's laboratory by Miss Klaassen, of Newnham College, which demonstrated an extraordinarily close agreement between the phenomena noticed in the magnetization of actual iron and those presented by a model consisting of groups of little pivoted magnets. Even the less conspicuous features of the actual process were reproduced in the model with a fidelity which went far to confirm this molecular theory of magnetism. It was shown, for instance, that the model reproduces a phenomenon familiar in real iron, namely, the tendency which magnetic changes exhibit to be imperfectly cyclic, under cyclic changes of magnetic force, until these are repeated several times, and also that in the model, just as in real iron, this tendency disappears if a process of demagnetizing by reversals of gradually diminishing magnetic force has been previously gone through.

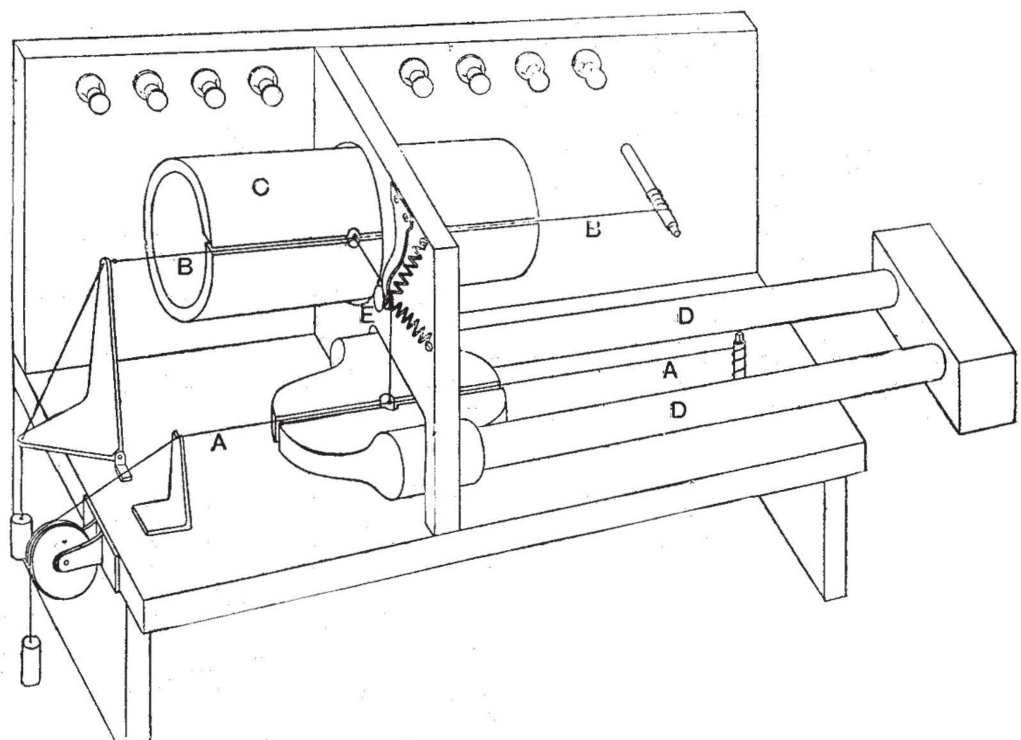

FIG. 1.—Prof. Ewing's Mognetic Curve Tracer. General view of apparatus.

The lecturer proceeded to show in action a novel apparatus he had devised to exhibit the magnetizing process in actual iron, and to test the magnetic qualities of metals. This magnetic curve tracer (Fig. 1) consists of two wires—AA and BB—tightly stretched in two narrow gaps in the magnets DD and C respectively. The magnet C consists of a piece of slotted iron tube, which is kept constantly magnetized. Consequently, when a variable current passes along the wire BB that wire sags out or in, giving azimuthal movement to a mirror E. The variable current which passes through the wire B serves to magnetize the electromagnet DD, which consists of two bars of the iron to be tested, sunk into fixed pole pieces and united at the back end by a short yoke-piece of soft iron. When the magnetism of DD varies it causes the wire AA, which carries a *constant* current, to sag up and down, and this gives movement in altitude to the mirror E. The mirror is pivoted on a single needle point, and has freedom to respond to the motion of both the stretched wires AA and BB. Since its azimuth movement is proportional to the magnetizing current, and its altitude movement is proportional to the magnetism acquired by DD, the mirror causes a spot of light reflected from it to trace out the ordinary magnetization curve, showing the relation of magnetism to magnetizing force. By making the variable current change continuously from a positive to an equal negative value and back again, a complete cycle of magnetization was performed in the bars DD, and in this way the magnetic characteristics of the bars could be completely determined in a few seconds. The lecturer proceeded to test in succession a pair of wrought-iron bars, then a pair of hard steel bars, and finally a pair of cast-iron bars, causing the cyclic curve for each material to be automatically drawn on the screen, on a very large scale, to exhibit the features of difference. The mirror and other moving parts of the apparatus were so dead beat that it was possible to go through a cycle ten or even twenty times a second without experiencing inconvenience from the effects of inertia. In that case, however, the iron must be laminated to avoid sluggishness in the magnetizing process itself. Using an instrument with a magnet consisting of a split ring of iron wire, a process of periodic reversal was performed at a speed sufficient to make the curve traced out by the light-spot become a continuously luminous line (Fig. 2), and the process

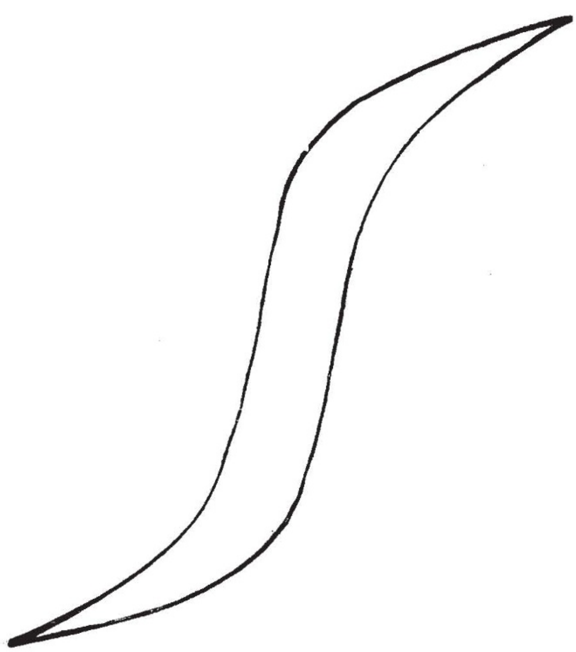

FIG. 2.—Photograph of Magnetization Curve traced by Prof. Ewing's Magnetic Tester.

of demagnetizing by reversals was illustrated by making this curve gradually contract itself to zero by slowly reducing the strength of the current while the rapid periodic reversals were continued. The effect was also shown of superposing one periodic alternation upon another, by which loops resembling those of Fig. 3 were drawn. The lecturer pointed out that these experiments went some way towards answering the question whether the magnetizing process went on in the same way, and involved the same dissipation of energy through hysteresis, at

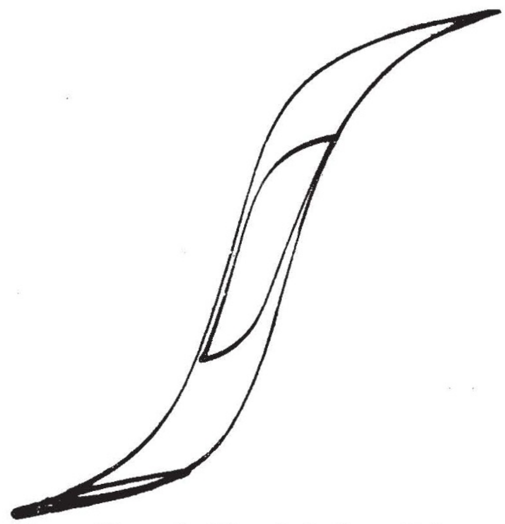

FIG. 3.—Photograph of Magnetization Curve with Loops.

high speeds as at low speeds. He concluded by expressing the hope that this apparatus would prove of some service to the builders of dynamos and transformers by giving them a novel means of testing the magnetic properties of their iron with great completeness and in a manner sufficiently simple for workshop use.

BOTANICAL PAPERS AT THE BRITISH ASSOCIATION.

IN our account of the proceedings of Section D of the British Association (NATURE, August 25, p. 403), we promised to refer on a later occasion to some botanical papers which could not then be noticed. The following are abstracts of several of the more important of these papers :—

"Observations on Secondary Tissues in Monocotyledons," by Dr. Scott and Mr. Brebner. (1) The secondary tracheides in Dracæna and Yucca develop simply by the enormous growth in length of single cells, the nuclei remaining undivided, and not by cell fusion, as many authors suppose. (2) The cambium in the roots of many species of Dracæna does not appear in the pericycle, but in the cortex outside the endodermis. The secondary growth starts from the insertion of a rootlet, the cambium being pericyclic near, and cortical at a greater distance from, the rootlet. (3) Description of secondary thickening in Iridaceæ.

"On the Simplest Form of Moss," by Professor Goebel. The author stated that previous researches had led him to the conclusion that mosses and ferns did not stand in direct genetic relationship with each other, but that they are descended from simple alga-like forms; in fact the mosses pass through a developmental stage so alga-like in appearance that it was formerly described as an algal genus *Protonema*. If the sexual organs of the moss arose not on the stem but on the protonema, we should have the sexual generation agreeing perfectly with the filamentous algæ. The leaves of the moss would then arise originally as protective organs for the antheridia and archegonia. This, up to the present, hypothetical form, actually occurs in Buxbaumia. In this moss the antheridia occur at the end of a protonema-branch, surrounded by a mussel-shaped envelope. The female plant is more highly organised, but is still much simpler than in other mosses. These and other observations lead Prof. Goebel to the conclusion that Buxbaumia is a very ancient form which stands in the closest relation to the lower algæ.