MR. JOHN DANIEL has sent us an advance-proof of a paper on "Polarization, using a thin Metal Partition in a Voltameter." The investigation had its starting-point in an observation of Dr. L. Arons', who noticed that ordinary gold leaf, used as a partition in an H_2SO_4 voltameter, allowed a current of ·2 or ·3 ampere to pass without any visible development of gas upon the metal, which was pasted over a hole 1½ c.m. in diameter, bored in a glass plate. The glass plate slid in grooves in a wooden frame, which was placed in the middle of the glass-voltameter. When platinium-foil (0·1 mm. thick) was substituted for the gold-leaf, there was a profuse escape of gas from the metal partition. Mr. Daniel has made similar experiments with partitions of gold, silver, aluminium and platinum of various thicknesses, and with various electrolytes, and has obtained for the different substances, values of the "critical thickness" above which polarization at the partition takes place, as well as some other interesting facts as to "critical current density," &c. He finds, for instance, that the "critical thickness" in good-conducting solutions of H_2SO_4, $CuSO_4$ and NaCl, is greater than ·00009 mm., but less than ·0004 mm., in the case of gold; while ·00015 mm., and ·002 mm. are the corresponding figures for platinum, with a current density of not more than 0·1 ampere per square c.m. of the metallic partition. Between these "critical limits" the polarisation for a given current increases with the thickness. In $CuSO_4$, all the plates except those below the critical thickness were destroyed by oxidation, and a similar effect was noticed in NaCl, in which gold and silver below the critical thickness were quite unaffected, while above it they could not be used on account of the chemical action.

NOTES from the Marine Biological Station, Plymouth.—Last week's captures include the Ascidian *Ascidia mollis*. The tow-nets continue to yield the regular autumn forms, among which the Liphonophore *Muggiæa atlantica* and the larvæ of the Polychæta *Magelona* and *Terebella* have generally been plentiful. An interesting feature of recent tow-nettings has been the presence of numerous minute free-floating colonies of certain Didemnidæ. Young *Echini* and *Asterinæ* of this season's growth are now plentiful at a depth of five fathoms and in coralline tide-pools respectively. The following animals are breeding:—The Hydroid *Sertularella Gayi*, the Nemertine *Amphiporus dissimulans*, the Archiannelid *Histriobdella Homari*, and the parasitic Cirrhipede *Sacculina*.

THE additions to the Zoological Society's Gardens during the past week include a Leadbeater's Cockatoo (*Cacatua leadbeateri*) from Australia, presented by Miss Mercy Grogan; a Common Quail (*Coturnix communis*) British, presented by Mrs. Mazelin; two Black-pointed Teguexins (*Tupinambis nigropunctatus*) a Crowned Snake (*Scytale coronatum*), a Tree Boa (*Corallus hortulanus*), a —— Snake (*Leptognathus nebulatus*) from Trinidad, W.I., presented by Messrs. Mole and Urich; two Hamsters (*Cricetus frumentarius*, white var.) European, a Black-headed Caique (*Caica melanocephala*) from Demerara, a Corean Sea Eagle (*Haliætus branickii*) from Corea, a Black-pointed Teguexin (*Tupinambis nigro-punctatus*), a Tree Boa (*Corallus hortulanus*), a Boddært's Snake (*Coluber boddærti*) from Trinidad, W.I., deposited; a Golden Plover (*Charadrius pluvialis*) British, purchased.

OUR ASTRONOMICAL COLUMN.

NOVA (T) AURIGÆ SPECTRUM.—In the current number of the *Astronomischen Nachrichten* (No. 3189) Mr. W. W. Campbell communicates his observations of the spectrum of Nova Aurigæ since its reappearance in August. At this time the continuous spectrum was very faint, the spectrum consisted of isolated bright lines, and the three brightest lines had the intensities and positions of the characteristic nebular lines, the result being that the spectrum of this new star was announced to be that of a planetary nebula. That this view has not been universally adopted is shown by Vogel's paper on the same star, and he inclines to the opinion that the bright lines are chromospheric, and that the brightest line is not the nebula line. In the present paper Mr. Campbell has made more visual and long exposure photographic observations of nebular spectra, and finds no less than five other lines which are in the spectrum of the new star. The nebulæ he uses here for comparison are: Orion, G.C. 4390, N.G.C. 7027, G.C. 4954, G.C. 4373, and in the photographs of their spectrum he obtains 12, 12, 7, 10, and 5 lines respectively that appear to him to be new. The tabulated list of lines brings out very clearly, that with the exception of the line 451, the identity of which is uncertain in these nebulæ, the Nova lines are matched perfectly in one or more of them, allowing for the fact that they (the Nova lines) were shifted about five-tenth metres (in August and November, 1892) towards the violet. The Nova spectrum, as Mr. Campbell says, "certainly differs no more from the nebular spectra than the nebular spectra differ from each other." As for the lines, 4857, 4336, 4098, and 396 are the well-known hydrogen lines; 5002, 4953, the first and second nebular lines, while all the others correspond well with the nebular lines. The presence of these four hydrogen lines and the chromospheric line 4472, strengthens, as he says, his argument, and he concludes with the words that "if the spectrum is not conceded to be nebular, I must ask what else we should expect in that spectrum if it were nebular?"

THE FIREBALL OF JANUARY 13, 1893.—In the *American Journal of Science* (vol. xlvi. September, 1893), Prof. H. A. Newton contributes a discussion of all the observations that were made of the large fireball that was observed in America in January last. The great interest attached to this fall lay in the fact, as previously mentioned in this column, that Mr. Lewis, of Ansonia, Conn., happened to obtain a very good picture of the trail as it passed in the line of sight of his instrument while he was photographing the comet Holmes. Prof. Newton seems to have taken great pains to have the information as accurate as possible, and has even had some of the observers cross-examined, so to speak, on many particular points. The plate on which the photograph was taken is 4 by 5 inches, and the meteor went nearly centrally across it, the photographed portion being about 19° long. Several stars of the tenth magnitude in the middle, and some of about the eighth, near the margin of the plate, are shown on the negative, so that some fairly good measurements of the position of the track have been procured. The co-ordinates of seven points of the trail have thus been measured, and a very slight curvature of the path is indicated by the results but not clearly proven, the curvature being caused, as suggested by Prof. Newton, by "the atmosphere's resistance of the irregularly shaped body." An enlarged print of the photograph (about 26 inches long) accompanies the paper. The striking feature of it is the irregularities of light on the path, and also its increase in frequency as the end of the plate is reached. This is due, as supposed, to a rotation of the stony mass, "more rapid at the end than at the beginning, and that the unequal amounts of burned material were thrown off according as a well burned or a raw surface was for the instant in front."

NITRO-METALS, A NEW SERIES OF COMPOUNDS OF METALS WITH NITROGEN PEROXIDE.

A REMARKABLE new series of compounds, formed by the direct union of nitrogen peroxide with certain metals, and of a nature somewhat akin to that of the metallic carbonyls recently discovered and investigated by Mr. Mond and his co-workers, are described by MM. Sabatier and Senderens in the September number of the *Bulletin de la Société Chimique*. It was observed that when vapour of peroxide of nitrogen in a state of tolerable purity was allowed to stream at the ordinary temperature over metallic copper, cobalt, nickel, or iron, these metals being in the finely-divided and pure condition obtained by the recent reduction of their oxides by hydrogen, rapid absorption of the nitrogen peroxide occurred with the formation of definite compounds possessing properties of an

exceptionally interesting kind. These compounds are solid non-volatile substances, unlike the metallic carbonyls in this respect, and are represented by the general formula M_2NO_2, where M represents either of the four metals mentioned. Their discoverers propose the name *metaux nitrés*, which perhaps may be conveniently rendered into English as *nitro-metals*.

When a quantity of copper, recently prepared by the reduction of copper oxide in the usual manner by means of a stream of hydrogen or of carbon monoxide, is exposed at the ordinary summer temperature (about 25° being the average temperature of the laboratory while MM. Sabatier and Senderens were conducting these experiments) to a current of the reddish-brown vapour of nitrogen peroxide, it becomes rapidly attacked and converted into a brown substance, considerable heat being at the same time evolved and a large proportion of the nitrogen peroxide absorbed. The brown solid substance produced is found to react with great energy with water, the reaction being accompanied by a copious evolution of nitric oxide, NO. At 30° reduced copper absorbs no less than a thousand times its volume of nitrogen peroxide. Upon analysis of the product it is found to contain about 74 per cent. of copper. A compound of the composition Cu_2NO_2 would contain 73·4 per cent. The nitrogen present was also determined directly, by heating with excess of copper in a stream of carbon dioxide, the nitrogen being measured over caustic potash in the ordinary manner; its amount was found to correspond closely with that demanded by the above formula.

In preparing nitro-copper care must be taken to free the nitrogen peroxide from traces of the vapour of nitric acid, for this acid decomposes the compound with energy, effervescence occurring and the green nitrate of copper being produced. To prevent the deleterious effects of traces of admixed nitric acid vapour the red fumes are allowed to pass first through a column of litharge and afterwards over phosphoric anhydride.

Nitro-copper is unalterable in dry air at ordinary atmospheric temperatures. When heated in pure nitrogen it is dissociated, a temperature of 90° being ample to effect the change; nitrogen peroxide is evolved together with smaller quantities of nitric oxide and nitrogen, and partially oxidised copper remains. One of the most useful properties of nitro-copper is that it may be used for the purpose of liquefying nitrogen peroxide; if a quantity is placed in one limb of a Faraday V-tube and heated, the other limb being cooled, the nitrogen peroxide liberated by the dissociation rapidly collects in the liquid form in the cold limb. If the tube is removed and allowed to stand a short time, re-absorption of the peroxide by the copper occurs. Water reacts with nitro-copper as above mentioned with considerable violence, pure nitric oxide entirely soluble in solution of ferrous sulphate being briskly evolved. The aqueous solution contains cupric nitrate and nitrite, and a sediment of pure copper remains. In moist air, therefore, nitro-copper rapidly deteriorates, becoming enveloped in red fumes and its surface turning green. Hydrogen is without action upon it in the cold, but when heated to 180° large quantities of ammonium nitrite and free ammonia are produced. Dry ammonia gas reacts at the ordinary temperature with some energy upon nitro-copper. White clouds of ammonium nitrate and nitrite and of moisture first make their appearance, then suddenly the mass becomes incandescent and more copious clouds of ammoniacal salts and steam are produced, the residue consisting of copper mixed with ammoniacal oxide of copper. Sulphuretted hydrogen likewise reacts at the ordinary temperature with nitro-copper, heat being evolved, water, sulphur, and a blue sulphide of copper being the products of the reaction.

It would thus appear that nitro-copper is of a kindred nature to the metallic carbonyls, the nitrogen peroxide being held in a similar manner to the carbon monoxide of the latter compounds, and capable of being liberated in a regular manner by the dissociation of the compound by heat. The substance may, in fact, be employed as a convenient means of storing nitrogen peroxide, with the certainty of being able to liberate it by a comparatively slight rise of temperature whenever it is desired to procure some for experimental purposes.

Metallic cobalt reduced from its oxide by means of hydrogen at a temperature below redness is only difficultly pyrophoric in air, not becoming incandescent on admission into air with anything like the readiness of iron. It burns energetically in the cold, however, in nitrogen peroxide. When the nitrogen peroxide vapour is diluted with nitrogen, the heat of the reaction is modified, and the formation of nitro-cobalt occurs in a regular manner, as in the case of copper. It is necessary in the case of cobalt to conduct the preliminary reduction in hydrogen in the same tube as is afterwards used for the preparation of the nitro-compound, in order to avoid re-oxidation of the metal, and it is advantageous to employ as low a temperature for the reduction as possible.

Nitro-cobalt is a black solid substance. Its reaction with water is very violent, but less nitric oxide is produced than in the case of nitro-copper. The rose-coloured solution contains mainly nitrate of cobalt, and a quantity of basic nitrite is found amongst the residual copper. When nitro-cobalt is heated in an atmosphere of nitrogen, a small quantity of nitrous fumes are first evolved, then almost immediately violent deflagration, accompanied by a flame of great brilliance, occurs. The same explosive deflagration occurs if, at the end of the preparation, the supply of diluting nitrogen is shut off before the nitrogen peroxide. When mixed with a combustible substance nitro-cobalt forms a dangerous explosive. If a small quantity wrapped in paper is introduced into an eprouvette filled with mercury at the top of which is a little water, a violent explosion at once results upon the arrival of the small paper packet at the surface of the mercury, owing presumably to the heat of the reaction of a portion of the nitro-cobalt with water causing sudden dissociation of the whole, the organic matter of the paper burning in the gaseous products of the dissociation.

Nitro-nickel is more difficult to obtain in a pure state, for cold reduced nickel reacts so vigorously with nitrogen peroxide that even when the latter is largely diluted with nitrogen a partial oxidation of the metal occurs. Actual incandescent combustion is, however, avoided, and a regular absorption of the peroxide vapour occurs. In a careful experiment a product containing 20 per cent. of NO_2 instead of the theoretical 28 per cent. was obtained. Nitro-nickel closely resembles nitro-cobalt; it is a black substance which reacts with water with evolution of nitric oxide, and which deflagrates with explosive force when heated in a current of inert gas.

Nitro-iron is still more difficult to isolate. When the peroxide is diluted with a very large excess of nitrogen, it is quickly absorbed by reduced iron up to a certain point, when the passage of more peroxide invariably brings about brilliant deflagration and consequent destruction of the product. There is ample evidence, however, that iron does form a nitro-compound of a similar interesting nature to that of the nitro-compounds of copper, cobalt, and nickel above described.

A. E. TUTTON.

PHYSICS AT THE BRITISH ASSOCIATION.

SECTION A met in the well-appointed lecture theatre of the Nottingham University College. Mr. Glazebrook had only just finished his presidential address when an incident occurred which was of interest as showing that members meant business, and were not disposed to allow the authority of the chair to be questioned. Perhaps the experimental work communicated was not of striking novelty or importance, but some of the informal communications and discussions—notably those on electrical theory, the connection between ether and matter, and the teaching of elementary physics—were of great interest, especially to teachers of physics. This was largely due to the active part taken by Lord Rayleigh, Profs. Fitzgerald, Carey Foster, Oliver Lodge, Rücker, and other leading physicists. The discussion occasionally tended to resolve itself into an exchange of ideas around the lecture-table, but as the ideas were for the most part interesting (and energetically expressed) members did not appear to object. At first there was an occasional grumble against Dr. Lodge's innovation of starting at 10 a.m., but the wisdom of the change was shown by the fact that the Section had generally to sit until 2 p.m.

At the first sitting on Thursday (September 14), after the President's address, the "Report of the Committee on Solar Radiation" was communicated. Observations have been made with a thermometer enclosed in a non-conducting case, an image of the sun being thrown upon the bulb. Simultaneous readings of screened thermometers within the case were also taken, and the excess of temperature noted from minute to minute. The thermometer has since been replaced by a thermo-junction, which works very sharply, the readings becoming steady in about six minutes, whereas with the thermometer twenty