peninsula culminating in that of the Dorians, came from the middle or lower Danube valley. Hence the importance of prehistoric remains in Hungary for a knowledge of prehistoric events in Central Europe.

Another important paper is contributed by M. Moissan to the current number of the *Comptes rendus* upon carbon tetrafluoride, CF_4. Five modes of preparing the gas are described, together with several new properties which have been investigated since the publication of the preliminary notice a few weeks ago. When gaseous fluorine is allowed to enter a platinum tube filled with marsh gas, CH_4, a violent combination, accompanied by incandescence, takes place, carbon being deposited and a mixture of various fluorides including carbon tetrafluoride formed. Fluorine also reacts somewhat violently with chloroform, $CHCl_3$. When the free element is led into cooled chloroform it is largely absorbed, carbon tetrafluoride being again produced, and for the most part remaining dissolved in the excess of chloroform. If the fluorine is heated to 100° before passing into the chloroform incandescence occurs, a flame appears at the exit opening of the platinum apparatus, carbon is again deposited, and the tetrafluoride largely found in the gaseous product. Fluorine also expels chlorine from tetrachloride of carbon, CCl_4, for if it is led into a quantity of the tetrachloride contained in a gently-warmed platinum flask, the issuing gas is found to be a mixture of free chlorine and carbon tetrafluoride. A large proportion of the latter gas remains dissolved in the excess of carbon tetrachloride, and may be readily obtained fairly pure by gently boiling the residual liquid in a glass vessel and collecting the gas over mercury. As described in our notice of the preliminary paper the lighter varieties of amorphous carbon, such as wood charcoal and lamp black, take fire in a stream of fluorine and continue burning as long as combination occurs, the product consisting of several gaseous fluorides, of which the tetrachloride is present in greatest proportion. The method, however, by which carbon tetrafluoride can be prepared most conveniently and in the purest form is as follows. A quantity of silver fluoride, AgF, is placed in a brass U-tube fitted with two side tubes. Through one of these latter a stream of vapour of carbon tetrachloride is driven; the other serves as exit tube for the products of the reaction. The apparatus is first filled with carbon tetrachloride vapour, the portion containing the fluoride of silver is then heated to 195°–220° C. and a steady stream of the tetrachloride maintained as long as gas is evolved at the mercury trough. It is advisable to add to the apparatus a small metallic spiral tube which can be cooled to − 23° in order to condense any escaping vapour of the tetrachloride, and which is so arranged that the condensed liquid can be returned to the vessel in which the tetrachloride is being vapourized and so passed again into the reaction tube. The last traces of carbon tetrachloride may be removed by allowing the gas to stand twenty-four hours over mercury in contact with a few scraps of caoutchouc. In order to free it from admixed heavier fluorides advantage is taken of the fact that large quantities of the tetrafluoride are absorbed by absolute alcohol. On agitation with a little absolute alcohol, therefore, the tetrafluoride is absorbed, and may be again liberated either by addition of water, in which the gas is scarcely perceptibly soluble, or by ebullition. If the latter plan is adopted the alcohol vapour may be removed by washing through sulphuric acid. It is important to use a metallic reaction tube in the preparation, inasmuch as glass is rapidly attacked by carbon tetrafluoride, the product of the reaction in a glass vessel consisting of a mixture of silicon and carbon tetrafluorides, carbon dioxide, and a heavier fluoride of carbon, $CF_4 + SiO_2 = CO_2 + SiF_4$. Carbon tetrafluoride liquefies at − 15° at the ordinary atmospheric pressure, and under a pressure of four atmospheres at 20°. When passed over heated sodium it is completely absorbed, carbon being deposited and sodium fluoride formed. Aqueous potash appears to be without action upon it, but alcoholic potash slowly absorbs it with formation of carbonate and fluoride of potassium.

The additions to the Zoological Society's Gardens during the past week include a Blossom-headed Parrakeet (*Palæornis cyanocephalus* ♂), two Red-eared Bulbuls (*Pycnonotus jocosus*) two Red-vented Bulbuls (*Pycnonotus hæmorrhous*), a Large Hill-Mynah (*Gracula intermedia*) from India, a Red-sided Eclectus (*Eclectus pectoralis* ♀) from New Guinea; two King Parrakeets (*Aprosmictus scapulatus* ♂ ♀), a Pennant's Parrakeet (*Platycercus pennanti*), a Chestnut-eared Finch (*Amadina castanotis* ♀) from Australia, a Ceylonese Hanging Parrakeet (*Loriculus asiaticus*) from Ceylon, a Mealy Amazon (*Chrysotis farinosa*), two Yellow-shouldered Amazons (*Chrysotis ochroptera*), a Blue-fronted Amazon (*Chrysotis æstiva*), a Red-crested Cardinal (*Paroaria cucullata*) from South America, a Levaillant's Amazon (*Chrysotis levaillanti*) from Mexico, two Panama Amazons (*Chrysotis panamensis*) from Panama, a Yellow-vented Bulbul (*Pycnonotus crocorrhous*) from Sumatra, two Orange-cheeked Waxbills (*Estrelda melpoda*), two Red-bellied Waxbills (*Estrelda rubriventris*), a Cut-throat Finch (*Amadina fasciata* ♂), a Shining Weaver Bird (*Hypochera nitens*), an Olive Weaver Bird (*Hyphantornis olivaceus*) from South Africa, a Crimson-crowned Weaver Bird (*Euplectes flammiceps*), a Grenadier Weaver Bird (*Euplectes oryx*), a Green Glossy Starling (*Lamprocolius chalybeus*) from West Africa, two Madagascar Weaver Birds (*Foudia madagascariensis* ♂ ♀) from Madagascar, a Red-headed Cardinal (*Paroaria larvata*) from Brazil, a Cardinal Grosbeak (*Cardinalis virginianus* ♀) from North America, presented by Dr. Seton; a Red-eared Bulbul (*Pycnonotus jocosus*), a Red-vented Bulbul (*Pycnonotus hæmorrhous*) from India, presented by Lieut.-General Sir H. B. Lumsden, K.C.S.I.; a Ring-necked Parrakeet (*Palæornis torquatus* ♀) from India, presented by Mrs. O. Harvey; a Redwing (*Turdus iliacus*), British, presented by Mr. J. Newton Hayley; a Common Viper (*Vipera berus*), a Slowworm (*Anguis fragilis*), British, presented by Dr. W. K. Sibley; three Green Tree Frogs (*Hyla arborea*) from France, presented by Mrs. Humphreys; two Hartebeests (*Alcelaphus caama* ♂ ♀) from South Africa, a Bennett's Wallaby (*Halmaturus bennetti* ♂) from Tasmania, a Black Wallaby (*Halmaturus walabatus* ♀), two Brush-tailed Kangaroos (*Petrogale penicillata* ♂ ♂) from New South Wales, four Common Quails (*Coturnix communis*), European, deposited; two Demoiselle Cranes (*Grus virgo*) from North Africa, purchased; a Japanese Deer (*Cervus sika* ♂), a Hog Deer (*Cervus porcinus* ♀), ten Cuming's Octodons (*Octodon cumingi*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

Objects for the Spectroscope.

Sidereal Time at Greenwich at 10 p.m. on May 15 = 13h. 34m. 18s.

Name.	Mag.	Colour.	R.A. 1890.	Decl. 1890.
			h. m. s.	° ′
(1) Uranus, May 15 ...	—	Bluish-green.	13 27 40	− 8 33
,, ,, 29 ...	—	—	13 26 4	− 8 24
(2) G.C. 3615	—	—	13 32 4	+ 9 27
(3) 163 Schj.	7	Reddish-yellow.	13 48 29	+40 47
(4) 84 Virginis	6	Yellow.	13 37 30	+ 4 6
(5) ζ Virginis	3	White.	13 29 12	− 0 2
(6) T Ursæ Maj.	Var.	Red-yellow.	12 31 23	+60 6

Remarks.

(1) A question of great interest was raised last year by spectroscopic observations of the planet Uranus. As is well known, the spectra of Uranus and Neptune differ very widely from those of the other planets. They show no solar lines in the visible spectrum even when telescopes of very large apertures are em-

ployed; but in place of them there are several broad dark bands to which no origins have yet been assigned. Secchi first observed the spectrum in 1869, and he pointed out that, if the luminosity of the planet be due to solar light, it must undergo great modifications in the atmosphere of the planet. Vogel and Huggins re-observed the spectrum and mapped it in considerable detail, Vogel giving the positions of no less than twelve bands. The five principal bands have the following positions:—

618. Darkest part of a broad band, ill-defined towards the red.
596. Middle of a faint narrow band.
573·8. Darkest part of a broad band.
542·5. Middle of darkest band in spectrum.
486·1. Middle of a dark band.

It has not yet been possible to explain any of the dark bands by comparisons with known absorption spectra; one band is certainly coincident with the F line of the solar spectrum, but it is much too broad to be due to reflected sunlight. Prof. Lockyer gave his attention to the spectrum last year, and thought it possible that many of the apparent dark bands were simply contrast appearances due to the presence of radiation flutings. At his suggestion I examined the spectrum, and came to the conclusion that he was right. I afterwards made observations, in conjunction with Mr. Taylor, with Mr. Common's 5-foot reflector. A full account of the results is given in Mr. Taylor's paper on the subject (*Monthly Notices*, vol. xlix. p. 405). We decided in favour of bright flutings, and Mr. Taylor afterwards mapped them very carefully. The brightest fluting is near *b*, and it is remarkable that Secchi noted this brightening in his light-curve of the spectrum. Mr. Espin has since observed that the blue end of the spectrum is broken up into bright bands and dull shadings. If the apparent bright flutings are not contrast effects, as has been suggested, the planet must be to a great extent self-luminous. Dr. Huggins has since photographed the violet end of the spectrum, and finds nothing but solar lines—a fact which is very difficult to explain, when the remarkable character of the visible spectrum is considered.

It is highly important that further observations, by as many different observers as possible, should be made. The apparent diameter of the planet is so small that a Maclean spectroscope shows the bands very well, but the brightnesses are best seen when the spectrum is narrow, as is the case with bright-line stars.

(2) This nebula is thus described in the General Catalogue: "Bright; large; extended in a direction 150°; pretty suddenly brighter in the middle to a resolvable nucleus." The apparent size of the nebula, according to the Harvard College observations, is 3′ × 1′. The spectrum has not been recorded.

(3) This star is one of considerable interest. Dunér says: "It appears to have a narrow band in the red, and a wide one in the green. Perhaps III.*a* (Group II.), but by no means III.*b* (Group VI.)." It has been suggested, from a discussion of the other members of the group, that the star is a representative of the very earliest stage of Group II., but further details are necessary before it can be said with certainty. The condition here should be almost cometary, and hence, in further observations, the bright flutings of carbon should be particularly looked for. So far, this is the only observed star which may possibly belong to the first species of the group.

(4 and 5) These stars are included in Vogel's spectroscopic catalogue. The first is stated to be of the solar type, and the second of Group IV. The usual observations are required in each case.

(6) This variable will reach a maximum about May 20. The range is from 6·4–8·5 to 13 in 255·6 days. The spectrum is one of Group II. (Dunér), the bands being wide, but not very dark. The usual observations for bright lines and other variations are suggested.

A. Fowler

Changes in the Magnitudes of Stars.—At the April meeting of the Royal Astronomical Society Mr. Isaac Roberts presented a photograph of stars in the regions of Tycho Brahe's Nova taken on January 12, with an exposure of 2 hours 55 minutes. D'Arrest charted the stars in the region of the Nova in 1864 down to the 16th magnitude, and this chart has been used by Mr. Roberts to compare with his photograph. He finds no appearance of either a nebula or of a star on the photograph in or about the position indicated by D'Arrest, but a comparison of the chart and catalogue with the photograph shows that changes have taken place both in the positions and magnitudes of several of the stars since 1864. The changes particularized are important when it is considered that they apply to less than half a degree in right ascension, and one degree in declination. That six of the stars shown on D'Arrest's chart and not shown on the photograph, are absent on the latter on account of some physical change having taken place in the stars, receives confirmation from the fact that the photograph shows more than 400 stars on a sky space where D'Arrest has charted only 212 stars.

A Mechanical Theory of the Solar Corona.—Prof. Schaeberle of the Lick Observatory, has propounded an entirely novel theory of the solar corona, a discussion of which will appear in the report of the eclipse of December 22, 1889. His investigations seem to prove that the corona is caused by light emitted and reflected from streams of matter ejected from the sun by forces which in general act along lines normal to the surface. These forces are most active near the centre of each sun-spot zone. Owing to the change of the position of the observer with reference to the plane of the sun's equator, the perspective overlapping and interlacing of the two sets of streamers at these zones causes the observed apparent change in the type of the corona. To roughly test the theory Prof. Schaeberle has stuck a lot of needles in a ball to represent the streams of matter, placed the model in a beam of parallel rays, and allowed its shadow to fall upon a screen, the result being that an infinite variety of forms similar to the coronal structure can be reproduced by simply revolving the model. It remains to be proved whether a comparison of the forms that are seen according as the observer is above, below, or in the plane of the sun's equator, agree with those that should be seen on this theory.

THE IRON AND STEEL INSTITUTE.

The annual meeting of the Iron and Steel Institute was held on Wednesday and Thursday of last week, in the theatre of the Institution of Civil Engineers, the President, Sir James Kitson, occupying the chair. There was a fair programme of ten papers, and another was added after the list had been printed. The following were the papers read:—

On a new form of Siemens furnace, arranged to recover waste gases as well as waste heat, by Mr. John Head, London, and M. P. Pouff, Nevers.

Calculations concerning the possibility of regenerating the gas in the new Siemens furnace, by Prof. Åkerman, Stockholm.

On the critical points of iron and steel, by M. F. Osmond, Paris.

On the carburization of iron by the diamond, by Prof. W. C. Roberts-Austen, London.

The changes in iron produced by thermal treatment, by Dr. E. J. Ball, London.

On the Robert-Bessemer steel process, by Mr. F. Lynwood Garrison, Philadelphia.

Aluminium in carburetted iron, by Mr. W. J. Keep, Detroit.

On certain chemical phenomena in the manufacture of steel, by Mr. W. Galbraith, Chesterfield.

The estimation of phosphorus in the basic Siemens steel bath, by Mr. W. Galbraith, Chesterfield.

On the Rollet process for producing purified castings, by Mr. A. Rollet, St. Etienne.

The first six of these papers were read and discussed at the first day's sitting (Wednesday); and the remaining four were disposed of before lunch-time on Thursday. It is seldom that we have seen papers "rattled off"—the phrase most aptly describes the procedure—in so rapid a manner. The members who were present may certainly be congratulated upon having got through a great many papers in a very short space of time; but it is a question whether there would not have been a gain to knowledge had the discussions been of a somewhat more deliberate nature.

In addition to the above papers there was on the agenda a memoir by Sir Henry Roscoe, on the action of aluminium on iron and steel. This, however, was not forthcoming; a fact which is to be regretted, as also is the cause which led to it, the subject being one of considerable scientific and industrial importance at the present time, when the production of aluminium is being so much cheapened, and such great things are promised by those who advocate its use in the metallurgy of iron and steel. Fortunately Mr. Keep's paper was forthcoming, and this elicited a brief but useful discussion, in the course of which Mr. James Riley, of the Steel Company of