of the great lines of faulting crossing Manchuria, indicated by Richthofen.

THE current number of the *Zeitschrift der Gesellschaft für Erdkunde* (vol. xxxiv, No. 2) is entirely devoted to the official reports of the members of the German deep-sea expedition in the *Valdivia*. Prof. Chun gives a narrative of the expedition and its progress; Dr. Gerhard Schott reports on the oceanographical work; and the navigating officer, Herr Walter Sachse, adds an account of the re-discovery of Bouvet Island. A summary of the contents of these reports has already appeared in these columns (p. 114).

A NUMBER of students from the Paris École Supérieure d'Électricité visited electrical works and manufactories in Switzerland at the end of last March, this being the second excursion arranged by the authorities of the School. A report upon some of the objects and installations examined was presented to the Société internationale des Électriciens in May, and has just been published as an excerpt from the *Bulletin* of the Society, by M. Gauthier-Villars, Paris.

THE additions to the Zoological Society's Gardens during the past week include a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, presented by Mr. R. Hilliard; a Brown Capuchin (*Cebus fatuellus*, ♀) from Guiana, presented by Colonel Bourchier; a Common Kingfisher (*Alcedo ispida*), British, presented by Mr. John Porter; an Alexandrine Parrakeet (*Palaeornis alexandri*, ♀) from India, presented by Miss J. M. Pott; a Common Boa (*Boa constrictor*) from South America, presented by Mr. C. W. Lilley; an Alligator (*Alligator mississippiensis*) from Southern North America, presented by Commander H. Woodcock; two Grevy's Zebras (*Equus grevyi*, ♂ ♀) from Southern Abyssinia, a Malayan Bear (*Ursus malayanus*) from Malacca, deposited; three Pink-headed Ducks (*Rhodonessa caryophyllacea*, ♂ ♀ ♀) from India, six Edible Frogs (*Rana esculenta*), European; twelve Paradise Fish (*Macropus viridi-auratus*) from China, purchased; a Japanese Deer (*Cervus sika*), a Puma (*Felis concolor*), a Burchell's Zebra (*Equus burchelli*, ♀), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

HOLMES' COMET 1899 *d* (1892 III.).—

Ephemeris for 12h. Greenwich Mean Time.

1899.	R.A.	Decl.	Br.	
			r^{-2}	$(r\Delta)^{-2}$
	h. m. s.	° ′ ″		
August 24	2 57 44·22	+38 17 15·7	0·1888	0·04999
25	58 33·92	38 32 21·3		
26	2 59 22·11	38 47 22·9		
27	3 0 8·77	39 2 20·4		
28	0 53·85	39 17 13·7	0·1869	0·05109
29	1 37·31	39 32 2·7		
30	2 19·13	39 46 47·1		
31	3 2 59 26	+40 1 26·8		

During the ensuing week the comet is in a good position for observation by observers having sufficient optical power; it passes closely to the south of the second magnitude variable star β Persei (Algol).

THE PARIS OBSERVATORY.—The annual report of M. Lœwy, the director of the Observatory, contains a detailed review of the work accomplished during the past year.

Special attention has been devoted to the improvement of meridian observations, chiefly in the attempt to eliminate instrumental errors by greater precision and stability of the mountings.

The small equatoral coudé has been provided with several accessories, and the building covering it so altered that the whole is now adapted for astrophysical observations.

The volume of observations made during 1897 will shortly be published in four separate parts, by different authors, who will each be responsible for all reductions, descriptions and discussions contained in the part under their names.

The fourth part of the Paris Observatory Catalogue (of which the first three parts already published contain all the meridian observations made from 1837–1881) has just been completed. The meridian circles have been in use for fundamental observations, for a revision of Lalande's Catalogue, and for work on the variation of latitude.

Coudé Equatorial.—The large instrument has been chiefly used in obtaining further series of photographs of the moon (scale about 6·5 inches to the lunar diameter) for the large lunar atlas now in progress of publication. During the year 591 plates have been obtained for this purpose. The method of enlargement of the negatives has also been improved.

Accompanying the report is a heliogravure of the moon when 20d. 5·9h. old, reproduced the same size as the original plate.

For part of the year the photographic objective was replaced by the visual glass, and the instrument then used by M. Hamy for measuring the diameters of small celestial objects by an interference method. The satellites of Jupiter and the planet Vesta have been measured in this way, the diameter of the latter agreeing very closely with the value obtained by Prof. E. E. Barnard.

Astrographic Equatorial.—The actual photographic work is now almost completed, all that remains to be done being the replacement of a small number of defective plates. The reduction of the plates for the Catalogue is well in hand, and seven of the Chart plates have been engraved for heliographic reproduction.

"THE BULLETIN ASTRONOMIQUE."—The August number contains several interesting and suggestive articles.—M. Flammarion contributes an article on "The World of Jupiter," in which he discusses at length the question of the various rotation periods of the planet, and also an illustrated account of the observation made by M. Antoniadi at Juvisy during the opposition of June 1898.—"The Rotation of Venus" is treated mathematically by Abbé Th. Moreux, based on observations made at Juvisy by M. Antoniadi.—"Observations of Mars" (illustrated) are contributed by MM. V. Cerulli and J. Chloudoff.—MM. L. Rudaux and Em. Touchet furnish an article on the "Systematic Observation of Meteors," giving a suggested form for recording observations systematically, and dealing with the determination of radiants, the physical characters of the swarms, heights of the meteors, and the photographing of them.

THE SUN'S HEAT.—Prof. T. J. J. See contributes a further article dealing with the extension of Helmholtz's theory of the heat of the sun, in *Astr. Nach.* (Bd. 150, No. 3586). The method he now pursues is the determination of the potential of a heterogeneous sphere as caused by itself. He finds that the energy developed by the condensation on this assumption is greater than that produced in the condensation of a homogeneous sphere in the ratio of 176,868 to 100,000.

IRON AND STEEL INSTITUTE.

THE autumn meeting of the Iron and Steel Institute was held this year at Manchester, on August 15 and 16, under the presidency of Sir William Roberts-Austen, K.C.B., and was attended by an unusually large number of members. The meetings were held in the Town Hall, the members being welcomed to Manchester in eloquent speeches by the Lord Mayor and by Mr. S. R. Platt, chairman of the Executive Reception Committee. In acknowledging the words of welcome, the President referred to the services rendered to metallurgy by Dalton and Joule, and by such great engineers as Fairbairn, Whitworth and Daniel Adamson, Manchester's distinguished sons. The programme was a long and varied one, no less than ten papers being on the list. The first read was by Prof. J. Wiborgh, of Stockholm, whose contribution, which was translated and read by Mr. H. Bauerman, dealt with the use of finely divided iron ore obtained by concentrating processes. By the introduction of such methods of separation, the power of enriching iron ores has been greatly increased; but the advantages are qualified by the circumstance that the product obtained is usually in the form of fine powder, which limits its utility to the smelter. The question of how such material can best be applied is one of importance, and the author shows how the material may be utilised by direct

addition to the charges in the blast furnace, by agglomeration previously to charging in the blast furnace, as a refining or softening material in the open-hearth furnace, and for the production of sponge iron for use in the open-hearth furnace.

Mr. H. C. McNeill next read a lengthy paper on some forms of magnetic separators and their application to different ores. The machines described were those invented by Wenström, by Delvik-Gröndal, by Heberle, and by Wetherill and the Monarch separator. Results obtained in practice in Sweden were discussed, and numerous illustrations were given. In the discussion of these two papers valuable remarks were made by Mr. James Riley, Mr. G. J. Snelus, F.R.S., Sir Lowthian Bell, Mr. Stead and others.

A new casting machine for blast furnaces was then described by Mr. R. H. Wainford. It is an ingenious apparatus for casting sandless pig iron in insulated moulds, so as to maintain a good crystalline fracture, equal to that of the pig iron made in sand beds, at a reduced cost of production. The advantages and disadvantages of this apparatus were discussed by Mr. E. Windsor-Richards, Mr. W. Hawdon, Mr. Cooper and Sir Lowthian Bell.

Mr. Syed Ali Bilgrami, Secretary to H.H. the Nizam's Government Public Works Department, Railways and Mines, then read a paper on the iron industry in Hyderabad. He described the geological structure of the Nizam's territory, and the various iron ore deposits met with.

Some interesting facts were brought forward by Major R. H. Mahon, of Cossipore, relating to the possibility of manufacturing at a profit iron and steel in India. In the absence of the author this paper was read by the Secretary, Mr. Bennett H. Brough. An interesting discussion followed, in which Mr. Bauerman and Mr. R. Price-Williams took part. The meeting was then adjourned until Wednesday, when a paper by Mr. C. H. Ridsdale was read. The microscopic examination of steel is a subject on which a good deal has been written during the last few years. Most of the papers hitherto published have dealt with the matter from a purely scientific point of view. The aim of the exhaustive paper contributed by Mr. C. H. Ridsdale was to show the practical value of the microscope to the steel maker and user at the present day. The time has now arrived, he points out, when it should be recognised that composition only indicates such well-defined effects as are generally understood without certain narrow limits of treatment, which are termed "normal." Outside these limits the effect of the treatment far outweighs that of the composition. In the discussion of this paper the President, Mr. Greiner, Mr. Harbord and Mr. Stead took part.

Mr. J. W. Miller contributed a paper on pig iron fractures and their value in foundry practice. He gave instances of the loss sustained by the manufacture of pig iron owing to the present method of grading pig iron by fracture.

The present position of the solution theory of carburised iron was discussed by Dr. A. Stansfield. The conclusions he has arrived at with respect to the atomic complexity in carbon are as follows :—

The carbon in molten iron is in a state of simple solution; the molecule of carbon must then contain one or two atoms, and is probably monatomic. The solidified iron is in the γ state and contains free carbon in solution. The molecular weight of this carbon has not been discussed, but it is probably the same as that in the molten iron. The carbon in solid solution combines with iron, on cooling, to form a carbide, which is probably expressed by the formula $2(Fe_3C)$. When, on further cooling, this carbide falls out of solution as cementite, its formula may become more complicated; the solution theory affords no information on this point; but Sir W. Roberts-Austen stated in his presidential address that the nature of the products of its solution in acids led to the conclusion that the molecule may contain six atoms of carbon, and is at least as complex as would be indicated by the formula $6(Fe_3C)$. There appears to be a belief that the solution theory is in a sense opposed to, and has gone far to supplant, the older allotropic theory; but this paper will, it is hoped, effectually dissipate such an error, as it shows how entirely the solution theory of the relations of carbon and iron involves the allotropic changes with which the distinguished name of Osmond is so inseparably connected.

In the discussion of this paper Mr. Snelus, Mr. Hadfield and Mr. Stead took part.

Mr. A. Sauveur, of Boston, contributed a paper on the changes of structure brought about in steel by thermal and mechanical treatment. He showed that as the smaller the grains of the metal the more ductile and tough it will be, as the finest possible structure results from heating to Brinell's point W, the temperature at which the passage of cement carbon into hardening carbon during the heating of steel takes place, namely, 655° to 730° C., it is evident that every finished piece of unhardened steel should as a last treatment be heated to that temperature.

Prof. E. D. Campbell, of Ann Arbor, Michigan, contributed a paper on the constitution of steel. The general method employed for studying the products of steel was to dissolve the steel in hydrochloric acid, pass the gas evolved through bromine in order to convert unsaturated hydrocarbons of the general formula C_nH_{2n} into their di-brom derivatives $C_nH_{2n}Br_2$; the gas passing through the bromine being measured, and the carbon existing as gaseous paraffins being determined by explosion and absorption of the carbon dioxide produced. The di-brom derivatives, after proper purification, drying, and weighing, were analysed and fractionally distilled for the purpose of qualitatively identifying the various constituents; although the fractional distillation of the di-brom derivatives had shown the presence of ethylene, propylene, butylene, pentylene, and hexylene di-bromides, and dibutylene tetra-bromide, later investigations had shown that this last product was the result of the polymerisation under the influence of heat during distillation of butylene di-bromide, and was not present to any considerable extent, at least in the original derivatives. Although the di-brom derivatives from ethylene dibromide ($C_2H_4Br_2$) to hexylene dibromide ($C_6H_{12}Br_2$) had been detected qualitatively, the separation of the various derivatives by fractional distillation *in vacuo* was not sufficiently sharp to give accurate quantitative results in regard to the amount of each constituent present. From the percentage of bromine in the di-brom derivatives the average number of carbon atoms in the molecule was calculated, the results of the examination of a few samples of steel by the above method being shown in the following table :—

Name.	Heat treatment.	Per cent. of carbon of steel.	Per cent. of carbon as derivatives.	Per cent. of carbon as gaseous paraffins.	Per cent. of carbon unaccounted for.	Per cent. of bromine in derivatives.	Calculated carbon atoms in carbon molecule of derivatives.
F	Annealed	0·55	37·1	33·6	29·3	72·56	4·32
F	Hardened and tempered	0·55	25·0	...	...	75·65	3·67
C	Annealed	1·14	43·4	37·9	18·7	73·85	4·05
C	Hardened	1·14	29·0	48·6	22·4	77·61	3·31
D	Annealed	1·28	31·0	44·3	24·7	77·80	3·26
	Pure Carbide from D anneal'd	6·64	35·3	25·2	39·5	...	4·41

The number of carbon atoms in the carbon molecule of the derivatives from the pure carbide, given in the above table, was obtained from the analysis of the gas by dividing the volume of carbon dioxide, produced from the explosion of the olefines, by the volume of the olefines exploded. The hypothesis suggested by the author made the fundamental assumption that carbon formed with iron a series of compounds which might properly be termed "ferrocarbons," on account of their similarity in structure to hydrocarbons. This series of ferrocarbons had the empirical formula $(CFe_3)_n$; or, C_nFe_{3n}, and should be considered as being derived from the hydrocarbons of the olefine series with the general formula C_nH_{2n} by the replacement of the H_2 by the bivalent group Fe_3. These ferrocarbons, dissolved in hydrochloric acid, yield as their primary products of solution the corresponding olefines and hydrogen.

During the meeting excursions were arranged to the locomotive works at Horwich, to the Simon-Carves coke ovens near Barnsley, to the Manchester Ship Canal, to the ironworks of Platt Brothers, Ltd., at Oldham, to the boiler works of Galloways, Ltd., and to the steel works at Crewe; and hospitality was lavishly dispensed to the members by the Duke of Devonshire at Chatsworth, by the Lord Mayor of Manchester, and by the Mayor of Salford.