

photograph taken of it at Bothkamp on September 28 records a tail  $3^{\circ}5'$  long.

The comet is in a good position for observation in the evening, and its movement northwards will make the conditions more favourable. It is at present passing through the constellations of Equuleus and Delphinus, but later will reach Vulpecula and Cygnus.

In *The Times* of October 2 we read that Westphal's comet is the fourth member of the Neptune group of comets that has been observed at a second apparition, the others being those of Halley, Olbers, and Pons. Two other members of the group appeared in 1846 and 1847, and are expected back about 1921 and 1927. Westphal's comet has much the shortest period (61.118 years) of any member of the group, its aphelion being at almost exactly the same distance from the sun as the orbit of Neptune.

#### PHOTOGRAPHIC STUDY OF THE SOLAR PHOTOSPHERE.—

In an abstract from the *Annals of the Observatory of Zô-sé* (Tome iii., 1912), M. S. Chevalier, S.J., describes the results of his research on the solar photosphere as studied photographically. He first of all describes the early observations of the solar surface by Sir W. Herschel, and rapidly surveys those who followed him, concluding with the photographic researches of M. Janssen at Meudon. M. Chevalier points out that on these latter photographs the famous granules observed by Secchi, Dawes, &c., were recorded.

He then directs attention to the possibility of errors creeping in when photography is employed. Is the image recorded on the photographic plate necessarily a faithful representation of the object photographed? M. Chevalier says it is not, and in the present investigation he attempts to show that the *réseau photosphérique* discovered on Janssen's clichés is not solar. The phenomenon, he says, is chiefly due to deviations undergone by the luminous rays refracted in an abnormal manner. This abnormal refraction takes place in the interior of the telescope, and more especially in the neighbourhood of the secondary magnifier. M. Chevalier accompanies his memoir with a series of fine reproductions from photographs of the solar surface which he has taken to demonstrate his views, and it is by an examination of these that his conclusions must be studied.

**STATISTICS OF NEBULÆ AND CLUSTERS.**—In the *Arkiv för Matematik, Astronomi och Fysik* (Band 9, No. 15), Prof. C. V. L. Charlier has published a preliminary paper on the statistics of nebulae and clusters. This contribution is part of the work of the Lund Observatory, which has undertaken a discussion of the position of the nebulous stars in space, and these statistics form a preliminary part of the investigation. In this publication Prof. Charlier represents both in statistical and graphical form, the information collected on card catalogues of the co-ordinates, brightness, size, and form of nebulae, as well as other observations of interest. The base of the card catalogues was the three great catalogues of Dreyer. In these pages the results are given purposely without any discussion regarding their bearing upon the question of the distribution of the nebulae in space. He remarks, however, that while in many respects they speak for themselves, in others conclusions must be drawn with great caution. The main interest here are the relations between the Milky Way and the positions and numbers of the nebulae.

When it is remembered that distinction is made between five different classes of nebulous objects, namely, clusters, globular clusters, planetary nebulae, annular nebulae, and nebulae, and that the objects number 13,223, some idea of the work involved in the investigation will be gathered.

**SPECTROHELIOGRAPHIC RESULTS FROM MEUDON.**—A memoir by MM. H. Deslandres and L. d'Azambuja, appearing in No. 9 of the *Comptes rendus* of the Paris Academy of Sciences, contains an interesting historical survey of the spectroheliographic work carried out at Meudon. The paper is more especially concerned with the *qualitative* results obtained by examination of the spectroheliograms secured since 1908, when the spectroheliograph of high dispersion was erected. Whilst careful to point out that the evidence does not permit the formulation of general laws, the authors are content to state that during the period in question the "filaments" (dark and definite stream-like markings seen in hydrogen and calcium light) have followed, but with a distinct lag, more pronounced in the case of the polar disturbances, the sun-spot variations. In this regard the polar disturbances recall the secondary maximum of high-latitude prominences. On the other hand, the "alignments" (markings somewhat less dark and sharp seen only in calcium light) have been without noticeable variations.

#### AN EXHIBITION OF PROGRESS IN LIGHTING AND HEATING BY COAL GAS.

THE National Gas Exhibition at Shepherd's Bush, which will be open during the whole of October, affords the best object lesson in gas lighting that the public has ever had the opportunity of studying, and the fascination is greatly increased by the absence of competing stalls, the exhibits being shown in model rooms, shops, studios, &c., under all the conditions in which they are likely to be used in practice.

It is something of an achievement to have induced the leading gas undertakings, municipal and private, and the leading manufacturers of gas appliances in the United Kingdom, to sink their individuality and rivalry and to cooperate in a coherent exhibition of the varied uses to which gas can be efficiently and profitably applied. The result should be of benefit both to the industry and to the public generally.

The exhibition impresses one with the enormous strides that have been made during the last few years in the application of gas for manufacturing, domestic, and public purposes. The introduction of vertical retorts, improved methods of purification, and the resulting greater yield of gas, coke, and by-products obtained from the coal carbonised, have resulted in its price being kept down in spite of the gradual rise in the cost of coal, whilst the enormous progress that has been made in the methods employed in its combustion has popularised it to an extent that could hardly have been foreseen a few years ago.

There is not the least doubt but that the introduction of the atmospheric burner and the incandescent mantle has been the real factor which has made gas the most important fuel for both heating and lighting, and in the present exhibition the progress that has been made from the inception of the union jet by Nielson in 1820, which gave less than one candle per cubic foot of gas consumed, to the modern high-pressure incandescent burner, with its sixty candles per cubic foot of gas, is demonstrated in a striking manner.

Various apparatus for raising gas to the pressure of several pounds per square inch, necessary in high-pressure lighting, is to be seen at work in the Industrial Hall, and the bearing which the high-pressure distribution has upon commercial applications is shown by the exhibition of a number of furnaces for a multiplicity of purposes, such as melting metals and hardening steel. In these cases it is necessary to concentrate the temperature over a defined area, and

by increasing the pressure at which the gas is supplied very high temperatures under perfect control can be attained. Specimens of these different types of furnaces are also to be seen in other sections of the exhibition.

In domestic heating the grasping of the conditions necessary to make gas a hygienic domestic fuel has been the great factor that has led to progress. In the early days of the gas fire, only 25 to 33 per cent. of the heat was given out as radiant heat, and convection was relied upon largely to give the heating effect, this giving hot air to breathe, and at the same time leaving the objects in the room often so far below the body temperature as to lead to chill; whilst the capacity for moisture of the heated air caused a degree of discomfort that led to prejudice being raised against this method of warming living-rooms.

When, however, it was realised that a stove to be hygienic must always give a larger amount of radiant heat than of convected heat, advance was at once made, and the severe competition in which, in the last three years, the different makers of gas fires have indulged has resulted in the production of gas stoves which give a high radiant efficiency. Further advances are being made constantly, and it is anticipated that in a short time the percentage of radiant heat given by gas fires will be more than double that which was possible even three years ago. Meantime, the claim that there are gas fires in the exhibition which can transmit 50 per cent. of the heat energy into the room in the form of radiant heat is undoubtedly true, whilst in one case as high as 70 per cent. is claimed. Apparently there is no exhibit of Prof. Bone's interesting "flameless combustion" stove, which would have proved very attractive, but the steam used in the kitchens is generated by a Boncourt boiler, which is a modification of the same principle.

A very fine collection of products from tar and ammonia liquor are shown in the shops that serve to illustrate the best methods of show-window lighting. These are divided into three classes, tar, ammonia, and cyanogen products, the first class especially being worthy of attention.

Another very suggestive exhibit is a series of compartments illustrating the effect of the colour and surface of wall-papers on the amount of illumination obtained from equal sources of light. Some valuable conferences have been arranged to take place during the period that the exhibition remains open, and especial interest will be felt in the promised discussion on the sanitary influence of gas lighting and heating, whilst the influence of gas as a fuel on smoke abatement will also receive its due share of attention.

#### CARNEGIE SCHOLARSHIP MEMOIRS.

VOL. v. of the Carnegie Scholarship Memoirs has just been issued by the Iron and Steel Institute. The volume contains six papers which differ very widely in merit and interest, but on the whole it represents a considerable amount of important research work. It is unfortunate, however, that the practice of publishing these papers in a separate volume tends to relegate them to oblivion, and at all events robs them of the advantages of discussion even by correspondence, thus lessening materially the value of the work done under the Carnegie scheme.

The preservation of iron is dealt with by Dr. Newton Friend; his results, if confirmed by future practical experience, are of considerable importance. He finds that the addition of small quantities of paraffin wax to paint lessens very materially corrosion in iron and steel merely exposed to the air, but rather assists corrosion in the case of plates actually immersed in water. Increasing the number of coats

of paint beyond two also appears not only to offer no increased protection, but actually to promote corrosion. This result leads one to inquire whether the constant repainting of iron-work often practised on ships may not actually do more harm than good; at all events, an examination of some of these thickly painted surfaces should afford interesting evidence on the point. Finally, Dr. Friend finds that painting over a slightly rusted surface, from which, however, all lumps of scale, dirt, &c., have been removed, is actually more effective as against further rusting than the same paint applied to a completely cleaned surface—the only advantage of thoroughly cleaning the iron before painting lying in a better surface finish of the painted work.

Another paper of special interest is that by Mr. J. A. Pickard dealing with the determination of oxygen in steel. This is a question of steadily increasing importance, and the older methods are known to be quite unsatisfactory. Mr. Pickard's method consists in heating the drillings to be analysed in an atmosphere of hydrogen which is simultaneously kept in contact with phosphorus pentoxide, so that the concentration of water-vapour always remains very low. His results indicate a very satisfactory degree of accuracy, and the further application of his method will be awaited with interest.

A lengthy paper by Mr. A. Kessner deals with the development of the drill test for ascertaining the machining properties of steel; the author, working at Charlottenburg, has developed a form of apparatus whereby the rate of cutting under standard conditions can be measured with a considerable degree of accuracy, and has used this to study the effect of several factors upon the machining properties of metals and to compare the ball-hardness and tensile properties of materials with their machining properties. That ball-hardness is not a guide to machining properties is a result which might have been anticipated, but whether the author's form of drill test does not depend upon the measurement of a quantity which depends upon too large and complicated a system of factors yet remains to be proved.

Of the more theoretical papers, that of Mr. Humfrey, dealing with the influence of the intercrystalline cohesion of metals upon their mechanical properties is perhaps the most interesting. It is another step in the development of our conceptions of the internal mechanical constitution of metals, and although to some extent speculative, it is certainly suggestive, particularly as it offers the first attempt at explaining the mechanism of the effects of mechanical over-strain, which, while it raises the elastic limit in tension, and thus apparently hardens the metal, at the same time lowers the elastic limit in compression. Humfrey explains this by the development of severe internal stresses residing in the amorphous matter at the intercrystalline boundaries, these stresses tending to resist further deformation in the direction of previous strain, but assisting stresses tending to produce deformation in the opposite sense.

The remaining papers, by Messrs. Hailstone and Swinden, are less satisfactory. The latter attacks the problem of the constitution of molybdenum steels by means of numerous cooling-curves and other data, but does not make use of the well-known methods of discussing and considering the equilibria of a ternary system. As a result of this lack of general theoretical guidance in the work, the data lead to no satisfactory conclusion. This want of systematic attack is typical of much of the work which has been done on steel, and especially on alloy steels, and probably accounts for the confusing differences of opinion which still exist in regard to their nature and constitution.