Diameter of *Algol*	1,061,000 English miles.
Diameter of dark companion	830,300 ,,
Distance of centre	3,230,000 ,,
Motion of *Algol* in orbit	26·3 miles per second.
Motion of companion	55·4 ,,
Mass of *Algol*	$\frac{4}{9}$ of Sun's mass.
Mass of companion	$\frac{2}{9}$,,
Translation of System towards the Sun	2·3 miles per second.

Professor Vogel has assumed that both bodies have the same density, so that their masses are directly as their volumes. Professor Vogel is not unaware of many points of difficulty in connection with this hypothetical state of things in the system of *Algol*, and its relation to the known phenomena of the star's light-changes. He refers to one point, namely, the apparently great difference of temperature of two bodies not differing more greatly in mass, one intensely hot, the other dark to us. He does not think it necessary, however, to regard the companion as absolutely dark, but only relatively so to us, but it may be still glowing and emitting light, provided its brightness is less than $\frac{1}{80}$ of that of *Algol* itself. Professor Vogel calls attention in this connection to what we know of *Sirius* and his dark companion.

The Greenwich Observations give a similar difference of rate of motion at the two elongations, namely, 46 miles; Vogel's difference is 53 miles; but the motions do not so nearly balance each other, leaving a large motion of approach of the whole system.

It need scarcely be said that Professor Vogel's final results on *Algol* and the other stars photographed at Potsdam will be awaited with much interest. W. H.

Photographic Photometry.

The readiest and most effective means of determining the magnitudes of stars from an examination of the discs impressed on a sensitised film is a problem that has received much attention during the past year, and contributions to the literature of the subject have recently been made from the three observatories of Harvard, Stockholm, and Potsdam. It will, perhaps, be generally felt that in a problem of such importance and such interest the last word has not yet been said.

Professor Pickering's method is described, and his results are given in vol. xviii. of the *Annals* of the Harvard Observatory. The vigour and enterprise which characterise the direction of that institution have enabled the director to give no less than three catalogues of magnitudes, embracing, on the whole, some 2500 stars. The first of these catalogues gives the photo-

graphic magnitudes of all the stars brighter than the fifteenth magnitude, within one degree of the pole. The method employed in the determination of these magnitudes was to compare the trail of a star, obtained under various conditions, with the trails of those stars whose magnitude was sought.

The second catalogue contains the magnitudes of many of the stars in the *Pleiades* group. Here the method of trails was inappropriate, and the magnitude was derived by comparing the discs of two stars in the *Hyades*, as given by exposures of known but various lengths, with those impressed on the *Pleiades* plates. An additional check on the accuracy was supplied by means of a catalogue of 14 standard stars, whose magnitudes had been determined by the wedge photometer.

The third catalogue is deduced by the method of trails. It gives the photographic brilliancy of 1131 stars generally brighter than the eighth magnitude, situated near the equator. The object of this investigation is to furnish a catalogue free from systematic error with which stars in all parts of the sky can at any time be conveniently compared. A comparison between the photographic and photometric magnitudes of 500 of these stars leads to the conclusion that for stars brighter than the fifth magnitude the numerical photographic magnitudes are in excess by one unit. The photometric and the photographic scales continually approach each other as the stars grow fainter, till at 8·5 they are coincident. Here the scales cross and the photometric magnitudes are numerically greater than the photographic. Professor Pickering has given both the photographic magnitude and the same quantity reduced to the photometric scale.

The contribution from the Potsdam Observatory has been translated and published under the auspices of the International Committee for Promoting the Photographic Chart of the Heavens. It is confined to the discussion of the magnitudes of stars in the *Pleiades* as impressed on plates taken with a chemically corrected object-glass by Dr. Scheiner, and with the reflecting telescope of the Herény Observatory, supplemented by some photographs of the artificial stars in a Zöllner photometer.

Dr. Scheiner has not been fortunate in his negatives. The images on the *Pleiades* plates are in neither instance circular, probably from want of accurate driving, but Dr. Scheiner believes that by measuring both the major and minor axes of the resulting ellipses, and using the square root of the product in his researches, he has effectually removed any source of error from this cause. The principal results of the inquiry are twofold: first that the increase of the diameter of the disc varies as the square root of the time of exposure, and secondly that a simple linear relation exists between the observed diameter and the magnitude, or

$$m = a - bD,$$

where a and b are constants to be determined from each plate if accuracy be required; but, as a rule, Dr. Scheiner believes

that a simple inspection of the stellar discs, aided, it may be, by some mechanical contrivance to assist the memory, will be sufficient to give the magnitude with a fair amount of approximation.

The third contribution to this subject is from Dr. Charlier, of Stockholm, whose aim is to determine the form of the function which expresses the connection between the photographic brilliancy of a star and its photographed image in such a manner as to ensure a coincidence as far as possible between the photographic and photometric magnitudes. The research, which is conducted with great care, is founded upon two series of plates, made with a chemically achromatised object-glass of 81 mm. aperture and 100 cm. focal length. In one series of photographs the *Pleiades* group is taken on four plates, with times of exposure varying from 13 to 180 minutes, and thus stars of great difference in brilliancy have been photographed in the same time on the same plate; in the second series *Polaris* is photographed on the same plate with different exposures, and therefore the light is constant and the time variable.

The formula employed in the reduction of the observations differs from that adopted by Dr. Scheiner and more nearly resembles that suggested by Professor Pritchard in 1886, inasmuch as both agree that a simple linear expression is not admissible, and prefer a logarithmic function. Dr. Charlier expresses the relation between the magnitude m and the diameter D by the equation

$$m = a - b \log D,$$

and remarks that where only one instrument and one kind of plate are concerned b may be assumed constant, and for the Stockholm apparatus he finds from the *Pleiades* series

$$b = 6{\cdot}75.$$

If the sensitiveness of the plate be supposed to remain constant and the observations are made only at those times when the atmospheric conditions are at their best, a may be regarded as a function of the time of exposure, and Dr. Charlier proposes the following form:

$$a = 17{\cdot}2 + 1{\cdot}69 \log t,$$

t being expressed in minutes. The value of a, however, given by this formula is not that used in the subsequent reductions, but a value has been computed for each plate by inserting Lindemann's photometric magnitudes m of the 52 Besselian stars in the formula

$$a = m + 6{\cdot}75 \log D.$$

The *Polaris* series of negatives is well adapted for the discussion of the variation of the diameter with the time of exposure, and Dr. Charlier thinks the evidence warrants the conclusion that

this increase varies as the fourth root of the time. This result, which disagrees with that mentioned above as found by Dr. Scheiner, is in accord with that given by Prof. Pritchard.

Adopting, however, this law of increase, Dr. Charlier finds that his observations of measured diameter can be reduced consistently to photometric magnitude by the formula already given, or by

$$m = 17{\cdot}2 - 6{\cdot}75 \log . \frac{D}{\sqrt{t}}.$$

We are thus in possession of the photographic magnitudes of the stars in the *Pleiades* determined by three different methods. In one of these series, that of Dr. Scheiner, the inquiry is limited to the brighter stars of the group only, and it is owing to this limitation that he has been able to use so simple a formula as that quoted. Dr. Charlier has shown that when stars greatly differing in brilliancy are compared the employment of such a formula is misleading. The other two series, however, viz. those of Harvard and Stockholm, which contain the fainter stars of the group, are available both for mutual comparison and also for comparison with the magnitudes assigned to the same stars by M. Wolf.

The comparison of the scales of Charlier and Pickering is not altogether satisfactory, and suggests the possibility of systematic error in one or other of the two series. For stars of the tenth magnitude the scales coincide, but to fainter stars Prof. Pickering ascribes a larger, and to brighter stars a smaller, numerical magnitude than does Dr. Charlier. This peculiarity, however, is not noticeable in the comparison of the Harvard fourteen standard stars, referred to above, and from this fact Dr. Charlier concludes that the cause of the systematic error will not be found in the Stockholm observations. From a comparison of either series with the magnitudes assigned by M. Wolf, it would seem that there is no reason to conclude that stars much fainter than 15·5 magnitude have yet been photographed. W. E. P.

The Photographic Chart of the Heavens.

The Permanent Committee, appointed by the Astrophotographic Congress of 1887, held their first meeting at the Paris Observatory in September of the past year, under the presidency of Admiral Mouchez, and the proceedings have been published, like the *Bulletin*, through the liberality of the Académie des Sciences.

The meeting was attended by eighteen members of the committee:—MM. Anguiano, Baillaud, Bakhuyzen, Beuf, Christie, Cruls, Dunér, Paul Henry, Prosper Henry, Janssen, Kapteyn,