and we find that the gaseous and proto-metallic stars increase in number as the proper motion decreases. We find also the ratio of the metallic to the gaseous and the proto-metallic. We begin with a ratio of 17, and end with something like a ratio of half, so that the results may be considered to be pretty definite. These results were obtained by Kapteyn with 591 stars which were common to Stumpe's catalogue of proper motions and the Draper catalogue dealing with spectra. The general result may, therefore, be stated that at the nearest distance the metallic stars are seventeen times more numerous than gaseous stars, and at the greatest distance they are not half the number. Here again the question arises, how far the intrinsic brightness of these bodies, in relation to their distance from us and the possible greater or less extinction of light in space, has to be taken into consideration. That is a problem which will require a considerable amount of work in the future. It is rather remarkable that if we take the stars with very great proper motion, very much greater than the average, we find with regard to four that three of them are undoubtedly metallic, but it is possible that the star 1830 Groombridge, which is always looked upon as the star which beats the record in velocity seeing that it would travel from London to Pekin in about two minutes, is not a metallic star.[1]

We are now in a position to make a general summary of the stellar distribution not only in relation to chemistry, but in relation to distance. Taking the chemistry as the basis, we can see what happens to the gaseous, proto-metallic stars and so on, with regard not only to their proper motions, but in regard to the Milky Way.

Summary of Stellar Distribution.

Group.	Proper motion.	Relation to Milky Way.
Gaseous stars	Smallest[2] (Monck)... ...	Condensed in Milky Way (Pickering and McClean)
Proto-metallic	Intermediate (Monck) ...	Brighter ones not notably condensed in Milky Way (McClean)
		Tend to collect in Milky Way, more especially the fainter stars (Pickering)
Metallic ...	Div. 1. Greatest (Kapteyn)	Not condensed in Milky Way (Pickering and McClean)
	Div. 2. Small (Kapteyn)	Collected in Milky Way (Kapteyn)
Mixed flutings.	?	?
Carbon ...	?	?

The gaseous stars, which we have seen have the smallest proper motion, are condensed in the Milky Way. The proto-metallic stars, which have but intermediate proper motion, are notably condensed in the Milky Way according to McClean, and tend to collect in the Milky Way more especially with the fainter stars according to Pickering. When we come to deal with the metallic stars, we find that there is no special condensation in the Milky Way. The greater number are not condensed in the Milky Way.

That being so, then, we may take a still further general view. We find that the bright-line stars, the new stars, are almost exclusively in the Milky Way and are far away from us; that the gaseous stars are chiefly in the Milky Way and are far away from us; that the proto-metallic stars are not so confined to the Milky Way, and they are not so far away from us. But when we come to the metallic stars and the carbon stars they have not much obvious connection with the Milky Way, and they are close to us. Unfortunately, with regard to the metallic fluting stars the information is not certain, so that it is best not to say anything about it. Mr. McClean has dealt with a very small number, and he shows that they, like Dunér's stars, the carbon stars, have very little relation to the Milky Way. We thus obtain a tremendous separation between the hot stars with their great distance and the cooler stars with their smaller distance.

But we can go further. As the stars become hot in consequence of meteoritic collisions, we should expect to find nebulous conditions following suit; seeing that nebulæ are masses of meteorites, we should expect to find especially the gaseous nebulæ and results depending upon their presence in the region where the hottest stars exist.

The planetary nebulæ consist of streams of meteorites moving generally in spirals or in circular paths. There is no very great disturbance. We get a bright line spectrum from them, and we know they are practically limited to the Milky Way. We have found that the bright-line stars are limited to the Milky Way; they are simply stars involved in nebulæ. There again we get a connection between the Milky Way and nebulæ. The new stars are due to fixed nebulæ driven into by moving nebulæ, and they are also limited practically to the Milky Way; there again we have the nebulous touch. A piece of work which has not been done, but which badly wants doing, is to see whether those nebulous regions which Sir William Herschel was the first to chronicle have or have not a strict relation with the Milky Way. I have, in fact, made a preliminary inquiry into this matter, and it suggests that these nebulosities are most profusely distributed in the vicinity of the Milky Way just as is the case with the gaseous nebulæ.

(*To be continued.*)

[1] These stars are—

1830 Groombridge	7"04	...	Gaseous or proto-metallic.
Σ 2758...	5"196	...	Metallic.
Σ 578...	4"049	...	Probably metallic.
D.C. 583	3"7	...	Metallic.

[2] Kapteyn finds small proper motions for gaseous and proto-metallic stars, but does not separate them into two groups.

SOME REMARKS ON RADIATION PHENOMENA IN A MAGNETIC FIELD.[1]

IN many articles which have recently appeared concerning the work which has been done in the study of radiation phenomena in a magnetic field, I find that, from the historical point of view, there are some statements which are not quite correct, and to which I now desire to attract attention. This appears to me desirable, as it is much easier, and much better, to test and correct errors of statement at the outset than after a lapse of time.

In the first place, it has been very generally accepted that the quartet form which occurs in the magnetic effect was first observed by M. Cornu; but on reference to the enclosed paper (*Trans. Roy. Dublin Society*, vol. vi., series ii., p. 385, read December 22, 1897), you will see that the quartet form,[2] the sextet, and other variations of the magnetic triplet were not only observed, but were photographed and exhibited to an audience in Dublin in the latter end of the year 1897. On the other hand, it was not until the following year (1898) that M. Cornu (working quite independently) announced in the *Comptes rendus* that he had observed the quartet form. Now the *Comptes rendus* being a weekly journal which is widely read, lends itself admirably to the rapid diffusion and circulation of new results, whereas the scientific *Transactions* of a local learned society are slow in appearing and little read or known outside their immediate place of publication. For this reason, the observations of M. Cornu became generally known, while mine remained unknown outside Dublin.

It is true, however, that I endeavoured to have them

[1] These remarks were addressed to Sir Norman Lockyer in the course of a correspondence, and have been thought of sufficient interest for publication.

[2] The quartets are clearly shown, as well as the triplet form, in the plate attached to the paper, and reproduced from the photographs shown at the meeting when the paper was read.

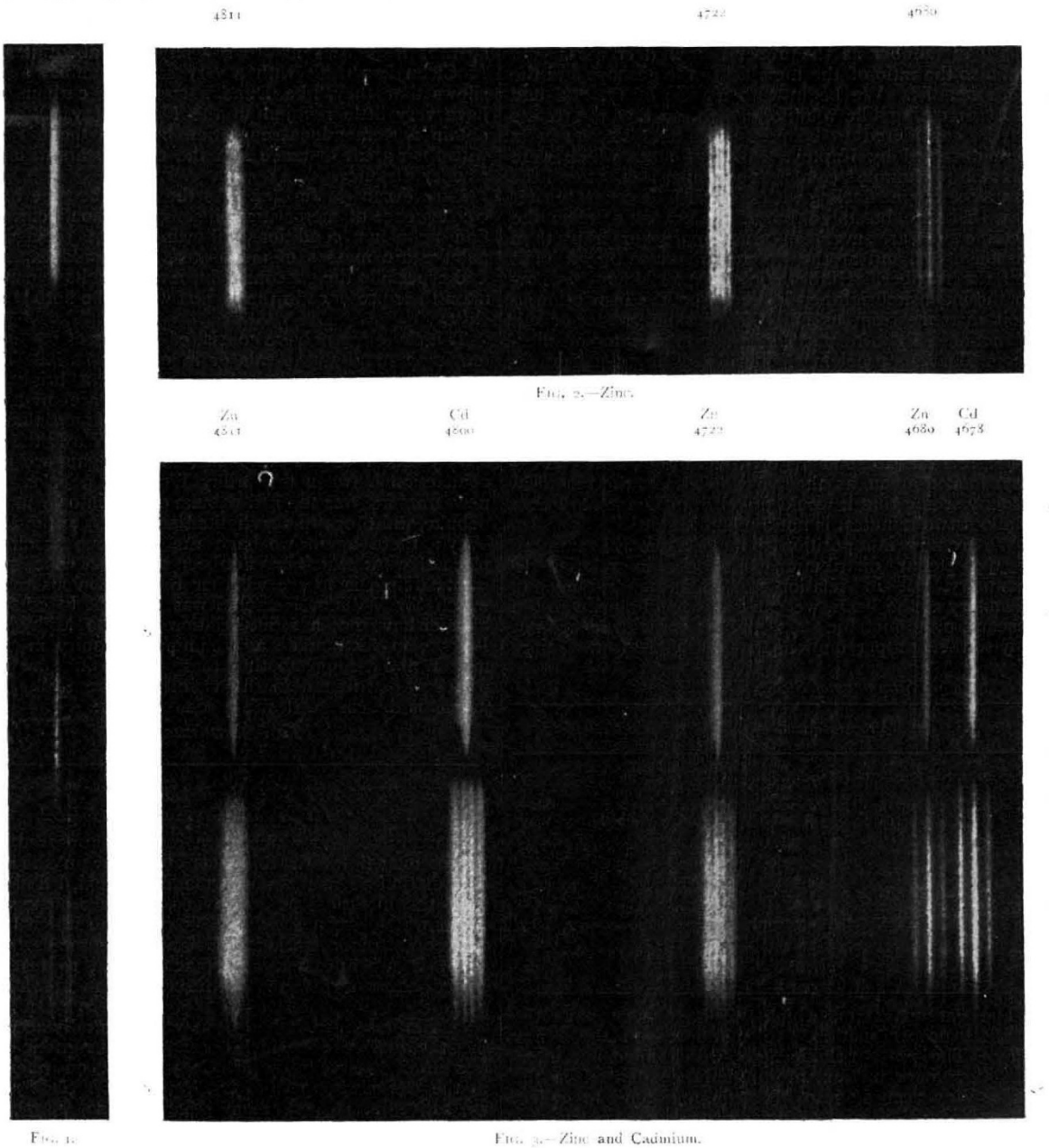

Fig. 2.—Zinc.

Fig. 1.

Fig. 3.—Zinc and Cadmium.

EXPLANATION OF PLATE.

In the accompanying plate, Fig. 1 shows the effect produced on the violet line of cadmium 4678. At the top, *a*, we have the line photographed with the magnet unexcited, that is, in the free field. Underneath this, at *b*, the same line is photographed with the magnet excited, but the field is not strong enough to resolve it into its three constituents. It accordingly appears to be merely broadened by the magnetic field. A Nicol's prism was then introduced into the path of the light and the line photographed in the same magnetic field, with the result shown at *d*, where the middle is seen to be removed from the affected line, so that it appears as a doublet. The nicol was then turned through a right angle, and the line again photographed in the same field. The result is shown at *c*, which proves that the sides of the broadened line have been cut off, while the middle has been allowed to pass. This agrees with the supposition that the magnetic field resolves the line into a triplet, but does not absolutely prove it.

The further resolution necessary to prove this point is shown in Figs. 2 and 3. In Fig. 2, a photograph of the zinc lines 4811, 4722 and 4680 is shown, and it will be observed that 4680 shows as a pure triplet, while the others do not. Fig. 3 is a photograph in a still stronger field taken from a spark passing between two electrodes, one of cadmium and one of zinc, so that the lines of cadmium and zinc are obtained simultaneously under precisely the same circumstances. It will be seen that the lines most affected are 4678 of cadmium and 4680 of zinc, and these both show as pure triplets, while the lines 4722 and 4800 show as quartets.

made generally known through the medium of the widely circulated journal NATURE, for on November 19, 1897, I sent photographic negatives to the office of NATURE for reproduction in that journal. These negatives showed the quartets as well as the pure sharp triplets and the diffuse triplets[1] which occur in the spectra of cadmium and zinc. They were produced by me in the end of October 1897, and were, I believe, the first photographic record of the actual magnetic tripling and quadrupling of the spectral lines. These negatives, however, were not considered suitable for reproduction in NATURE (see letter to NATURE, p. 173, December 23, 1897), but were subsequently enlarged and reproduced with great clearness in the *Philosophical Magazine* (April 1898).

In my letter to NATURE accompanying the negatives I did not dwell on the quartet form, as I did not wish to commit myself, or persuade others, to the belief that the quartet was really a magnetic quartet, *i.e.* produced exclusively by the magnetic field. It was quite open to belief at that time that the quartet form might be produced from the triplet by other mechanical causes, for example by reversal of the central line of the triplet, or in other ways, as noticed in my paper mentioned above. After prolonged effort I proved beyond all doubt that these variations of the triplet type (the quartet, &c.) are true magnetic perturbations, and are not due to any other cause; but this required *to be proved*, and for this purpose a very strong magnetic field was necessary.

With this field I found, as already announced in NATURE, that the quartet form becomes resolved into a sextet by the splitting up of the side lines into doublets. It is, therefore, not really a quartet after all, but a sextet.

With regard to other points, namely, the fact that the magnetic effect does not conform to the law deduced by the simple theory (viz. that $\delta\lambda \propto \lambda^2$), and the surmise that some such law might hold for groups of lines, a reference to my first paper, already mentioned (*Trans. Roy. Dub. Soc.*, December 22, 1897), will show both these points clearly emphasised there. On p. 387 I state that while some lines were converted into triplets "others photograph as doublets, or weak middled, greatly broadened lines, having the appearance of quartets; while on the other hand many lines appear to be simply broadened in the same magnetic field, and *others seem to be scarcely influenced in the same magnetic field.*" Thus the effect appeared to be lawless for the spectral lines taken as a whole in any one substance; but I go on to say that "perhaps it might be possible to group the spectral lines of each substance into sets, so that some law of wave-length might apply to the lines of each set."

At this early date I was already seeking for some such law, and I had before the close of 1897 proved that the law, whatever it might be, was *not the same* as that which governs the pressural shift of the spectral lines studied by Messrs. Humphreys and Mohler (see *Proc. Roy. Soc.* of London, January 1898).

My search has resulted in the discovery of a general law which has so far proved to be in complete agreement with all the observed facts.

With regard to the spectrum of iron, you will observe in my note in the *Proc. Roy. Soc.*, January 1898, that I was at that early date of opinion that the spectrum of iron exhibited no peculiarities of its own in the magnetic field. I examined iron early because I thought that by reason of its magnetic properties its spectral lines might show some decided peculiarities (but iron is not magnetic above 700° C., therefore my hopes were not very decided). On the whole I still adhere to that opinion, for although the spectral lines of iron show a variety of effect, yet these effects are the same in character or in kind as those which are observed in other substances. This and other matters I have already treated of fully elsewhere (*Phil. Mag.* and NATURE).

The accompanying illustrations (Figs. 1, 2, 3) have been reproduced from the plate given in the memoir read before the Royal Dublin Society on December 22, 1897. They show that the quartets were observed and photographed by the author certainly before that date.

THOMAS PRESTON.

[1] Really nonets as subsequently determined.

NOTES.

DR. JANSSEN, director of the Meudon Observatory, has issued a circular in which he announces that the success of last year's observations of the Leonid meteors from a balloon has led to arrangements being made to repeat the experiment during the forthcoming shower. Last year, a number of these meteors were observed from a balloon above Paris, though the city itself was at the time enveloped in a thick fog. It is important that numerous observations of the Leonid meteors should be made from as many places as possible; and as balloons render observers independent of cloudy skies, they are evidently of great advantage upon occasions such as that to which astronomers are looking forward. We are informed that two balloon ascents are to take place near St. Denis. The first ascent will be made on the night of November 14-15, with the *Aerostat*, and the second, on the following night, with the *Centaure*. Two seats in each balloon will be at the disposal of Dr. Janssen, who will nominate observers to occupy them, without distinction of nationality. The names of the observers will be announced at the next meeting of the French Astronomical Society, on November 8.

THE opening meeting of the new session of the Institution of Electrical Engineers will take place on Thursday, November 16, when the premiums awarded for papers read or published during the session 1898-99 will be presented, and the president, Prof. Silvanus P. Thompson, F.R.S., will deliver his inaugural address.

A SERIES of monthly lantern lectures has been arranged by the Royal Photographic Society. The first lecture will take place on Tuesday, November 7, when Mr. J. J. Vezey will describe "Some Mediæval Towns of Germany," illustrated with slides by Commander C. E. Gladstone, R.N.

THE death of Mr. Grant Allen, at the age of fifty-one, removes one of the most popular of scientific authors whose writings have induced many readers to watch the workings of animate nature. His first scientific work, on "Physiological Aesthetics," was published in 1877, and was followed, in chronological order, by "The Colour Sense," "The Evolutionist at Large," "Vignettes from Nature," "Colours of Flowers," "Colin Clout's Calendar," "Flowers and their Pedigrees," "Charles Darwin," "Science in Arcady," "The Evolution of the Idea of God," &c. In addition, Mr. Allen contributed numerous articles on natural history topics to periodical literature. All his scientific articles and books are attractively composed, and they have been the means of imparting much popular instruction to general readers.

AMONG the privileges which the Hampstead Astronomical and Scientific Society is able to offer its members is the use of a reflecting telescope of 10½-inch mirror, which is erected in a small observatory on the East Heath, by permission of the London County Council. Interest in practical astronomy is aroused by this means, and the instructive lectures given at the meetings of the Society direct attention to facts and things terrestrial as well as celestial. A course of five lectures on astronomy will be given by Mr. P. E. Vizard in connection with the Society on Monday evenings, commencing on November 20. Mr. Vizard will also lecture on November 10,