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573rd ORDINARY GENERAL MEETING,

HELD IN THE CONFERENCE HALL, THE CENTRAL HALL, WESTMINSTER, ON MONDAY, DECEMBER 13th, 1915, AT 4.30 P.M.

SIR FRANK W. DYSON, F.R.S., ASTRONOMER ROYAL, IN THE CHAIR.

The Minutes of the preceding Meeting were read and confirmed.

The SECRETARY announced the election of Mr. William Barnett, F.R.A.S., as a Member of the Institute, and of Mr. Maurice Gregory and Dr. A. Withers Green as Associates.

The CHAIRMAN introduced Professor A. S. Eddington, F.R.S., Plumian Professor of Astronomy in the University of Cambridge, and invited him to deliver his lecture on "The Movements of the Stars."

The lecture was illustrated throughout by lantern slides.

THE MOVEMENTS OF THE STARS. By PROFESSOR A. S. EDDINGTON, F.R.S., Plumian Professor of Astronomy in the University of Cambridge.

WHEN you come to hear an astronomical lecture, you come prepared to quit this earth for a time and to take a long journey out into the vast territories of the sky. But the lecturer may lead you a comparatively short journey, or a long one. He may only ask you to accompany him a paltry distance of a few hundred million miles in order to show you Mars or Jupiter or the other planets of the solar system; or perhaps the comets that wander among them may be the subject of his discourse. In that case you are still more or less at home; the same sun which we see in England—sometimes—will light you on your journey, and you do not seek to quit his small empire where he rules supreme.

On the other hand, the lecturer may presume further on your acquiescence. He may lead you through the midst of the universe of stars as far as the mind can conceive. That is where I ask you to accompany me to-day. As we pass through their midst, the constellations dissolve into unfamiliar forms. The sun has shrunk to a point of light, and is just one star among the crowd. As for the earth, perhaps it would be best for our sense of proportion if we could forget that so insignificant a globe ever existed.

Our journey must be somewhat hurried; if we moved with the speed of light, the exploration of the universe of stars would take thousands of years. We should take four years to reach the nearest star—other than the sun. But we shall move with the speed of thought and leave the laggard light-waves far behind.

We are going, then, to consider the stars—the fixed stars they are often called to distinguish them from the planets; but the name is a particularly unfortunate one, since our subject is the movements of these "fixed stars." It is a numerous company with which we have to deal. A photograph of the sky shows it crowded with these tiny points of light, and each point means a body of the same character as our sun—a globe of fire which may be anything from a million times the size of the earth upwards. Many of the stars are even bigger and brighter than the sun, only they are so far off as to be reduced to mere points. We can scarcely doubt that some at least of them have families of planets circulating round them, to which they give light and heat as the sun warms and illuminates the earth, but there is no evidence whatever on this point.

We ought to begin by getting some idea of the scale of this stellar universe. The stars number some hundreds of millions —a number that is quite inconceivable. I am sure that no astronomer can grasp such numbers, and I doubt whether even the Chancellor of the Exchequer can do so. But, though the number of the stars is vast, it is not a number beyond experience. If we took every star that has been seen or photographed, or indeed every star which could be photographed with the most powerful telescope yet built, and divided them among the inhabitants of the British Empire, it is unlikely that there would be enough stars to go round.

But when we come to the distances of the stars, the numbers are—to say the least—unusual. The nearest star is distant 24,000,000,000,000 miles, and that is only the beginning, because we must consider some of the most distant stars. However, if I were to add three more noughts on to that last number, that would represent a limit beyond which we shall not attempt to penetrate; in fact, we should be getting near the limits of the stellar system, at least in certain directions.

The distance which separates the sun from the nearest star is much the same as that which separates any typical star from its nearest neighbour. To form some idea of the sparsity of the stars in space, take a sphere with the sun as centre and radius a hundred billion miles (four times the distance of the nearest star); this would contain about thirty stars—we actually know the identical stars contained, or most of them. On a smaller scale this would be represented by thirty tennis-balls distributed through a volume of space as large as the earth. Imagine thirty tennis-balls wandering about in the whole interior of the earth; that represents the fine-grainedness and sparsity of stars in a typical portion of space. There is plenty of room for the stars to move without much fear of collisions. We are often inclined to think of the celestial bodies as moving under nicely-balanced forces, each with its own path arranged to prevent disaster; however that may be in the solar system, there is no need for regulation of the traffic in interstellar space. There is any amount of room for each star to take its own course, and the duty of a look-out man would be a sinecure.

That being the case, are we to regard each star as an independent islet in space, unrelated to any other? That is the grand question of stellar astronomy. With thirty tennis-balls distributed through the whole terrestrial globe, can we imagine anything more unlikely than that any connection should bind one to another? Is each star an independent entity; its birth, its motion and its history having no relation to any other? Or are there signs of some community of origin by which we can group the stars into relationship? In fact, is the universe a chaos or a system? I use the word *chaos* in no depreciatory sense, for it is one of the beautiful discoveries of science that out of chaos proceed some of the most simple and uniform laws of Nature.

Various suggestions were at one time made that the stars revolved around some central sun. Alcyone in the Pleiades was suggested for this centre, for reasons which seem to have been more sentimental than scientific; but we now know there is no simple arrangement of that sort. Very recently, however, there have been discovered anomalies in the way stars are moving, which, however they may be interpreted, forbid us to think of the universe as a pure chaos of stars. There seems to be some sort of association between even the most widely separated stars.

The clue to these associations is in the movements of the stars. In the early days of astronomy the fixed stars were regarded as marking out a definite background against which we could record the movements of the wandering stars or planets. They were like the figures on the dial of a clock by which we tell how the hands are moving. But in 1718 Halley, just before he became Astronomer Royal, made the discovery that some at least of the fixed stars were in motion. The star on which in particular he based this conclusion was Arcturus; there was no doubt that this star was changing its position with respect to the surrounding stars. It is interesting that this famous old star—mentioned, as we know, in the Book of Job—should be the one to open up a new branch of astronomy.

Now what does the change of position amount to? We now know that Arcturus is exceptionally fast-moving, but not the fastest; in fact, about twenty stars are known to exceed it in speed. I am speaking here of apparent rate of progress across the sky, not the actual velocity in miles per hour. The apparent rate is, of course, influenced by the nearness or distance of the star. The quickest of all is a telescopic star in the Southern Hemisphere (C.Z. 5h. 243), which travels at the rate of nine seconds of arc per year. As that may not convey much impression to you, I will put it another way. You know Orion and the three stars that form his belt. I will use the belt as a sort of standard race-track in the sky. The fastest star would take 1,050 years to travel from one end to the other of Orion's belt. That does not seem a very rapid rate, but still it is something quite appreciable without need for specially refined measures. Arcturus would take about 3,000 years to do the same course. But speeds so great as this are quite exceptional; a sort of average motion would be about one-twentieth of a second per year, or Orion's belt in 180,000 years. That is getting down to something very minute, but still it is quite practicable to detect this and even considerably smaller movements with certainty.

We have now at our disposal the measured movements of some thousands of stars, which we may proceed to examine.

There are a number of cases in which these motions reveal at once connections between stars which are certainly widely separated from one another, and between which we should scarcely have expected that any relation could exist. Incidentally we find that many pairs of stars near together in the sky move along together, and in such a group as the Pleiades all the stars have a common motion; but this tendency to a common motion is found in some much more widely scattered stars. If we select a certain region of the sky comprising Perseus and parts of the surrounding constellations, and take, not all the stars, but those characterized as particularly white-hot—as we should say, stars of the helium type of spectrum—it is found that these stars by their movements are sorted out into two distinct groups. The stars of one set are moving moderately fast, and the motion is the same in amount and direction for all of them (within the limits of observational error); these must clearly be associated. When we have picked out the stars of this group by their characteristic movements, and turn to see where they really are in the sky, we find that they form a long, rather open, chain stretching over quite a large arc in the sky—like a row of skirmishers advancing together.

Turning for a moment to the other set, we find that they are characterised by extremely small motions, scarcely detectable. We cannot infer that there is any relationship between these. The small motion may, and probably does, mean that all of these stars are extremely distant; the actual movements may be quite diverse and unconnected, but distance has diminished the scale so that we can scarcely observe their differences of motion. We have, therefore, detected a "moving cluster" of helium stars in the Perseus region, each moving with the same velocity across a background of much more distant stars of the same type.

Another case of this kind is afforded by the Great Bear. Of the well-known stars forming the Plough, the five middle ones share just the same motion. The tip star of the tail and one of the Pointers do not belong—their presence is only accidental—but the other five are moving in exactly the same direction with the same speed as accurately as we can detect. But there is a still more curious fact: the Dog-star, Sirius, is also a member of this system. We happen to know the motion of Sirius thoroughly—not merely its apparent progress across the sky, but its actual linear motion in three-dimensional space—and it fits in exactly. The evidence is the more convincing because the system happens to be proceeding in a direction which is very unusual. (We shall see later that some directions of motion are much more common than others.) Very few stars are taking a course at all approximating to that of the Great Bear system; so when we find Sirius going in just this direction with just the right speed it is a pretty clear case. There are a few other stars in different parts of the sky which also seem to belong to this system, but we are not so certain of them as we are of Sirius. You now see that the constellations in the sky do not correspond well with the real relations of the stars. Taking the Great Bear, we have had to cut off two stars which are not really of that system, whereas Sirius, which is quite the other side of the sky, apparently in the Great Dog, must really (according to physical relations) count as part of the Great Bear. If only this had been known to the old mythologists I am sure they would have given us an entertaining legend as to how so important a part of the Great Bear has come to be situated between the teeth of the Great Dog.

In this connection you may be interested to know that the constellation Orion, except for one corner star (Betelgeuse), is probably a real physical system of stars, and not just an accidental configuration.

This Great Bear system extends our ideas of associations of stars enormously. The sun is more or less between Sirius and the stars of the Plough, so that the sun, and in fact many other stars, must be actually interloping in the Great Bear system. The tie is not between neighbouring stars, but between stars almost arbitrarily picked out from the crowd, with numbers of unassociated stars interspersed between. What may be the nature of the tie admits, I think, of only one opinion—the members must have started off from a common origin. Very slight deviations from truly parallel motions have in the course of ages made them spread wide apart; but they still preserve their common velocity almost unaltered, because nothing has ever happened which could disturb them.

But the flock of stars which has been most extensively studied is in the constellation Taurus. Our knowledge of this system is due to the late Professor Lewis Boss. Thirty-nine stars have been recognized as belonging to the group, and no doubt many fainter stars belonging to it will ultimately be detected. These stars cover a considerable area in the sky. If we mark their motions on a map or globe, we find that the motions all converge to a definite point or vertex. By the theory of perspective we know that that is what would happen if the actual motions in space were along parallel lines. Further, the apparent motions (which are rather large) are nearly equal for all these stars. We conclude that they form a moving cluster of the kind we have been considering.

Now, from this fact we are able to measure the distances of all the thirty-nine stars.* The distances range from 600 to 900 billion miles; so that the cluster is about 300 billion miles deep; light would take fifty years to cross it from side to side. We could not have measured the distances of these stars by the ordinary method of parallax—they are too remote for that;

* This piece of geometry was described in the lecture with diagrams. It is only necessary to know the position of the convergent point, the positions and proper motions (in angular measure) of the stars, and the spectroscopic radial velocity of *one* of the stars.

but by this roundabout argument it is possible to plumb depths inaccessible to the usual method.

Also now that we know the distances we can calculate the actual brightnesses of these bodies. It turns out that all of them are more brilliant than the sun:—

5	have a brightness from	5 to 10	times that of the sun.
18	" " "	10 to 20	" " "
11	" " "	20 to 50	" " "
5	" " "	50 to 100	" " "

I do not want to give you the impression from this that our sun is a very inferior star. The sun really occupies a very respectably high position among the stars. But there is a very natural tendency for us (in making these researches) to notice the very bright exceptional stars and overlook the vast multitudes of lesser bodies. I have little doubt that in this cluster the thirty-nine stars that have been found are just the exceptionally bright lights, and there will be a whole host of fainter ones to be picked out some day.

It is possible to trace the past and future of this interesting group; 800,000 years ago it made its nearest approach to us, being then about one-half its present distance. It is now receding, and as it becomes more distant it will contract and become more concentrated. At the same time the stars will grow fainter. In 60 million years, if the motion is not disturbed, it will look like a globular cluster about 20′ in diameter.

It would be interesting to know if the well-known globular clusters seen with the telescope are really groups like this. It is rather doubtful, but there is a great deal to be said for this view. If that is so, we can form a fair idea of what globular clusters are like, now that we have fairly full knowledge of one specimen. The very nearness of this Taurus cluster makes it lose effect as a picture; the stars are brighter, but the concentration is lost. A globular cluster is like an impressionist picture: you must stand well away from it to see it to advantage.

We must now leave these special groups of intimately related, though widely-scattered, stars, and turn to certain vaguer but much more widespread laws of stellar movement. If you take a region of the sky at random, and map out the principal stars with arrows showing the way they are moving, it is usually quite conspicuous that the arrows tend to point in one special direction. Not all the stars are moving the same way; but, as a matter of averages, there is a large preponderance of arrows in a particular direction. This general motion of the stars is a most conspicuous phenomenon. The first man who detected it was Sir William Herschel, and, although at that time he had only seven stars of known motion to work with, he detected even in those few stars the systematic movement, and (no doubt rather luckily) he pointed out quite closely the point towards which the motion was directed.

At first sight this seems a remarkable bond between the stars, widely scattered as they are; but a little consideration shows that it is illusory. When you are in a train, waiting at a station with another train alongside, if one train starts it is often difficult to tell whether it is your own train or the other that is moving. For some reason, I believe, there is a tendency to guess wrong; you think it is the other train moving backwards when it is really your own train moving forwards. Now, in the stellar universe we are in an even worse position: not only is it impossible to tell whether the effect which we see is really the whole system of the stars moving towards Canis Major, or our own sun, carrying the earth with it, moving in the opposite direction towards Lyra—not only is it impossible to find out which of these is taking place, but even the distinction between the two ideas disappears. Relative to the sun, the stars are moving towards Canis Major; relative to the stars, the sun is moving towards Lyra—either phrase expresses the same fact, and it is impossible to go behind it and say which, if either, is at rest.

But the point of immediate importance is that, if the whole effect can be attributed to a motion of the sun, it clearly cannot imply any particular bond among the stars. To find any trace of organization we must look further, and, making allowance for this solar motion, as it is called, see if the residual movements of the stars show any peculiarities, or if they are haphazard.

It was in 1904–5 that Professor J. C. Kapteyn, of Groningen, first examined this question thoroughly and showed that the stars are not moving in a haphazard way. He arrived at the startling result that the stars form two great streams moving through one another. What an amazing conception this is! I have tried to show the enormous scale of the universe of stars; and now we find that they are ordered in two mighty streams. If you will follow me through a somewhat elaborate argument I will show how these two streams manifest themselves.

[The evidence was shown by means of a number of diagrams summarizing the statistics of the proper motions of the stars, each diagram corresponding to a different region of the sky. The diagrams show that in each case there are two favoured directions of motion along which the stars tend to move more predominantly than in other directions. For comparison, it was shown what kind of a diagram we should obtain if the stars were moving haphazard (except for the solar motion already mentioned); and it was pointed out that this was entirely different from the diagrams representing what is actually observed. Finally, a method of dissection was explained by which we can show that the observed motions would correspond very closely to two streams moving in definite directions.]

I have shown you diagrams for eight different regions of the sky, and in this particular case the whole sky was divided into seventeen equal regions. I daresay there may be some even in this audience, cynical observers of human nature, who may suspect that I have picked out the best examples to support what I am trying to persuade you, and that the other nine regions might not look quite so convincing. You know the frailties of scientists. Well, you are right. Three of the remaining regions show the effect well enough; but in the other six there is very little that suggests two streams. But if I hold out my arms to represent two streams, from in front you see them plainly separated; imagine them looked at from all points, above, below, to one side and the other—as we look at the star-streams in different parts of the sky. There are some points of view from which the two arms would come into line and not be seen separated. The six remaining regions of the sky are just those regions where the point of view necessarily confuses the two star-streams—where they come more or less into line. The fact that we do not separate them plainly in these regions is all in favour of the theory, and confirms us in believing we are on the right track.

It is interesting to plot on a globe the directions of the two streams, found in the different regions of the sky discussed in these investigations. If we pick out one of the streams—Stream I—the directions found for it all converge to a point on the globe. That means that the Stream I directions are parallel, or nearly so, in all parts of the sky. Similarly the directions of Stream II are found to converge. In other words, the different parts of the sky agree in showing the *same* two favoured directions of motion.

The result of a number of discussions of different series of proper motions, as well as some work on radial velocities, is to give a fairly definite knowledge of these two streams. Stream I is moving faster relative to us than Stream II, and it contains rather more stars than the latter in the proportion of 3 to 2. The two motions are inclined to one another at an angle of about 100 degrees. But these motions are distorted by our own arbitrary point of view, since we are looking at them from the sun, or—what comes to the same thing—the earth. If we clear out the solar motion we shall find that the two streams are moving, not at an obtuse angle, but in exactly opposite directions. (That sounds like a remarkable fact, but in reality it is only a truism.) Further, the line along which they move (in opposite directions) is exactly in the fundamental plane of the stellar universe, viz., the plane of the Milky Way. The stars are not scattered in a globular form, but flattened something like a bun. The plane of the bun is marked conspicuously in the sky by the Milky Way, and it is interesting to find that the two great streams of stars move in that plane.

We are led then to a conception of the stellar universe in which there are two vast streams of stars sweeping through one another in opposite directions. They are thoroughly intermixed and interpenetrating. Of course the stars do not move exclusively in the two directions; but they are two preponderating tendencies. I do not think that any objection can be taken to this *description;* it is, I believe, an inevitable conclusion from the observations. But we need not jump to the conclusion that these two streams—these two opposing tendencies—really indicate that two great systems of stars have come together and are rushing through one another. That may be the case, and it is the most obvious and direct interpretation of what we see. But I think most astronomers would rather cling to the idea of some essential unity in the stellar system, believing that the two streams arise in some natural way as parts of one whole. However that may be, it is safe to *describe* what is going on as a streaming of the stars in two directions; we are introducing some amount of speculation when we *account* for these streams as two definite systems.

There is yet another remarkable thing that we have recently learnt about the movements of the stars. You know that by the spectroscope a minute examination of the quality of a star's light can be made, and important conclusions as to its physical condition deduced. The spectroscope, like a prism, spreads out the different constituents of the star's light side by side for detailed examination. Without going into technicalities we may say that the appearances of these "spectra" are sufficiently distinctive to enable us to group the stars into different classes according to the quality of their light. Those who have studied these questions are pretty well agreed that these classes or "types" represent different stages in the life of a star, and we may class the stars in this way as young, middle-aged or old. Now the remarkable result has been found that on the average the older a star is the faster it moves. I refer now not merely to its apparent displacement across the sky but to its actual speed in miles per second. There is a steady increase in the speed from about 6 km. per second for the youngest stars to 17 km. per second for the oldest.* That is true provided that you take the average of a considerable number of stars; of course, speeds of individual stars may differ widely from the average of their type.

I have only described to you our studies of the *movements* of the stars. In another branch of the subject parallel investigations are being made of the distribution and magnitudes of the stars, which are also extending our knowledge of the stellar universe. It appears from these that we are in the midst of a great mass of stars arranged in an oblate or flattened shape, something like a bun, or perhaps a lens. We are somewhere towards the middle of this distribution. In its thinnest direction our telescopes penetrate quite easily to the limits, or rather to the place where the stars thin out very much, for we cannot suppose there is a definite edge. Round the circumference of this mass, and continuing its plane, are coiled a great series of star-clouds which appear to us as the Milky Way. The whole structure would probably bear some resemblance to one of the flat spiral nebulæ which form such remarkable objects in the sky.

We know scarcely anything about these spiral nebulæ, but the question suggests itself, may they not be replicas of our own stellar system? That is to say, island universes, not contained among the stars but separated from them at a much greater distance than any we have yet spoken of? There are some hundreds of thousands of these spiral nebulæ, so that the conception is almost appalling in its vastness. Suppose that

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* I have given, in accordance with the usual practice, the average value of one component of the motion, *e.g.*, the velocity of recession or approach. The three-dimensional speeds are twice the values given.

each one of them is a great system, equal to the great system of hundreds of millions of stars that we have hitherto considered. The name "nebula" has been used to denote a number of celestial objects having entirely different characters; the great gaseous irregular nebulæ, such as that in Orion, are undoubtedly within the stellar system; but the spiral nebulæ are not at all of the same character, and we have as yet no evidence as to whether they are within or without the system.

The spiral nebulæ are a great puzzle; if they are not other universes, it is hard to say what they are. Many astronomers consider that we should not let our imaginations run to such grandiose ideas until we have some clear evidence that they cannot be within our own system. The stellar system is vast enough beyond conception. Can we not be content with it? Must we still run on

> "From star to star, from kindred sphere to sphere,
> From system on to system without end"?

I do not agree with this prohibition; it seems to me that in the absence of definite information we may, nay we must, keep both alternatives before us. And for the moment the idea that the nebulæ are stellar universes co-equal with our own seems to present great advantages as a working hypothesis. It suggests a model of our own system which we can try to follow out and test. For instance, Mr. Easton has discussed how the Milky Way works out in detail on the assumption that it is the outer part of a spiral. Again, all the spiral nebulæ known are double spirals, that is to say, they have two arms. We do not understand the dynamics of spiral nebulæ, but I think it is clear that matter must be flowing in along the two arms, or flowing out—it does not matter which. Let us suppose it is flowing in. Now, taking the stars in our own neighbourhood, will there not be some trace there of the two opposing currents which flow in from opposite directions? That gives us a possible interpretation of the two star-streams as due to the two arms of the spiral. Moreover, the line of flow is—as it should be—exactly in the plane of the spiral, *i.e.*, of the Milky Way. That is at least one point in favour of the island universe theory.

Marcus Aurelius wrote in his "Meditations"—

> "Now among them that were yet of a more excellent nature, as the starres and planets, though by their nature farre distant from one another, even among them beganne some mutual correspondencie and unitie." (Casaubon's translation.)

We have long ago learnt to recognize that the planets are mutually related and form a system governed by a simple physical law; but among the stars the "mutual correspondencie and unitie" has been hard to find. I do not think we shall ever see in the great stellar universe that harmony of movement which prevails in our own little system; there will be no music of the spheres; but we are learning that there are associations, vague though they may be, which bind star to star and unite even the most distant of them into some kind of an organization.

DISCUSSION.

The CHAIRMAN invited the Meeting to return their cordial thanks to Professor Eddington for the admirable Lecture to which they had just listened. They were particularly grateful to him for taking their minds away from the War and all its sorrows and anxieties and turning their thoughts to so lofty and attractive a subject.

Professor Eddington had referred to the researches of several other astronomers in this particular field of astronomy, but he had been silent as to his own work. But this enquiry into the existence and relationships of stellar systems, as evidenced by the movements of stars, was one in which Professor Eddington had done especially valuable work. Earlier in the year Professor Fowler had shown the Institute how the evidence of the spectroscope as to the constitution of the stars pointed to the unity of the stellar universe; now, from a line of evidence quite distinct in character, that unity was shown from the mutual correspondences in the movements of the stars.

Mr. MAUNDER said: A well-known astronomer not very long ago expressed the fear that the progress of the science would inevitably slacken because the number of data which were being accumulated would greatly exceed the power of scientific men to discuss them. Fortunately, we possess men who are able enough and bold enough to tackle these problems. Thus in three succeeding Sessions of the Victoria Institute we have been favoured by addresses from Dr. Chapman, Professor Fowler and Professor Eddington, each dealing with a special aspect of the problem of the sidereal universe; each a chief worker in the department which he expounded. Dr. Chapman showed the Institute how the number of the stars had been determined; Professor Fowler placed before us the evidence of the chemical unity of the stars, and the course of the successive changes through which they passed. And now Professor Eddington has revealed to us the evidence which the movements of the stars supply as to the form and structure of the sidereal universe. These three remarkable addresses, all in different ways from different lines of evidence, lead up to one and the same conclusion : the whole celestial universe forms but a single organic structure. I have great pleasure in seconding the vote of thanks to Professor Eddington.

The CHAIRMAN said that the lecture to which they had listened was scarcely one for discussion in the ordinary sense, but if any members present had any questions which they wished to ask, he was sure that Professor Eddington would be pleased to answer them.

A number of questions were accordingly asked by the Rev. J. J. B. COLES, the Rev. Canon E. McCLURE, Professor LANGHORNE ORCHARD, Mr. M. L. ROUSE, and others.

Professor EDDINGTON, in replying to these enquiries, stated that some of the eighteen observatories engaged on the Astrographic Chart had completed their share of the work ; others were very much in arrear, and it was to be feared that the war would greatly postpone its completion. With regard to variation in the law of gravitation throughout the universe, it was difficult to determine what would be the relation between the particles of matter in a nebula. With regard to the suggestion made by Mr. Shaw in a recent paper before the Royal Society as to the possibility of the constant of gravitation changing with the temperature, he felt it very unlikely that astronomers would accept it. As to the place of the sun, it did not appear to be a member of either of the two streams which he had described. In reply to Professor Langhorne Orchard, astronomers of course meant by "the age of the sun" the stage of development which it appeared to have attained. To Mr. Rouse the reply was that there was no significant relation between the poles of the Milky Way and of the Ecliptic. The pole of the Milky Way appeared to be in the constellation Coma Berenices.

A very hearty vote of thanks was returned by the Meeting to the Lecturer, and the Meeting adjourned at 6 p.m.