it attains no great elevation, travelling always in a small circle close round the northern pole. During winter the Sun is above the horizon only for a short time each day and is always close to the south, attaining only an elevation of a few degrees at noon. In such regions the change of climatic conditions are so rapid that no races subsisting upon our earth could possibly endure them comfortably.

But astronomers are yet far from finally accepting the above inclination of the axis. If that inclination somewhat resembles that of the Earth, there is every reason to believe that the physical conditions resemble those of the Earth, and the planet becomes quite suitable for habitation by creatures which exist on the surface of our planet.

Extracts from Publications.

On September 16 and 17, 1896, any one observing the Sun with the naked eye would have seen upon it a long, straight " canal," as straight, as regular, as hard and sharp as any " canal " that Mr. Lowell ever saw upon Mars. (Three photographs of the Sun on September 16, 1896, on different scales, shown on the screen). A field-glass would, however, have shown it as a chain of round dots, and a good telescope as a succession of small spots of great complexity and beauty. What did the apparent straightness of the group as seen with the naked eye mean ? Simply that the observer had not a sufficient magnifying power to show the great irregularity of the details. Yet the very best circumstances under which any one has seen Mars is only relatively equivalent to seeing the Sun or Moon with a magnifying power of 3 or 4 diameters. Where is the reasonableness of assuming that because we are at present not able to detect irregularities in certain markings upon the planet Mars, that, therefore, no possible improvement in our means of vision will ever show any details there ? The attitude is the more unreasonable because Schiaparelli himself, long before Mr. Lowell took up the study of Mars, had already succeeded in seeing some, at least, of the canals as knotted, somewhat sinuous, lines. And, in more recent years, the most experienced observers of the planet and the most favoured in the power of the telescopes at their disposal, and in the situation of their observatories, have abundantly confirmed Schiaparelli's work in this, and have found the "canal" not hard uniform "ruled lines," but full of minute irregularities without a suggestion of artificiality.

Journal of the British Astronomical Association, Vol. XXII, No. 3.

On Meteor.—I would point out, in the first instance, that no valuable instruments are required before commencing. A quick eye capable of locating the position of a meteor at the beginning and ending of its course, and of judging its direction in relation to known stars in the vicinity, is the most essential equipment. In recording the visible path it will be found very useful to have a wand in the hand and to project it upon the track; this will greatly facilitate the estimation of its direction. Of course, the eyes would be directed towards that part of the heavens from which the meteors were expected to radiate; these particular parts for various seasons are known to all, and it is not necessary to dwell further upon this point. When a meteor has been observed, the time, magnitude of the meteor, beginning and ending of its course, duration of flight, colour and character should be noted as quickly as possible in a book with separate columns for these details. Each observer will naturally use his own methods of abbreviation under these several particulars, so that as little time as possible may be lost in recording the flight. Many meteors might be missed if the attention were taken up for a long time in noting down the various details. The paths of meteors as recorded are, of course, often rough eye-estimates of position, so that a certain amount of error will generally occur. In determining the radiant, on which we shall speak immediately, the mean error will vary considerably, according to the individual's exactness.

Let us suppose that an observer has noted the apparent directions of a number of meteors on any night, and he pencils their paths out on a celestial globe or on a star chart. He will notice that their paths are of very different lengths, and that they show various velocities. But when the lines showing their tracks are produced backwards, they will be found to converge more or less approximately to a point. Of course, all the lines will not so converge, but a sufficient number will be found to show that this convergence is not merely fortuitous, but that there must be some connection between the mass of meteor tracks on the globe or chart. The determination of the radiant, as the place where these lines intersect is called, is an important part of the work of those who study meteors. It is from this part of the heavens that they radiate, and the name of the constellation in which this point appears is assigned to the shower which comes from it.

Journal of the British Astronomical Association, Vol. XXII, No. 3.

Members of the staff of the Paris Observatory have lately determined the difference of longitude between that place and Bizerta in Tunis by the help of wireless telegraphy. This is not the first time that astronomers have availed themselves of the Hertzian waves for such a purpose, but, remarks the *Athenæum*, the distance of 800 miles makes the achievement remarkable. Signals sent up from the Eiffel Tower at regular intervals were heard in telephone receivers and timed at Tunis and at the Paris Observatory, and similarly, signals sent from the wireless installation at Bizerta were heard in both places. By this means the clocks at the two stations where observations were being made were compared. A telegraphic longitude determination always gives as a by-product a value for the speed of the electric current, and the account of this work in the "Competes Rendus" states that the time of transmission of the Hertzian wave between Paris and Bizerta was in the mean 0·007S., which gives a value of the velocity, as was to be expected, of the same order as that of light.

[*English Mechanic.*

Lecturing at the Royal Institution last week on "The New Astronomy," Professor A. W. Bickerton described the manner in which, he believed, new stars are caused by solar collisions. The collision of two suns, he said, as reported in the *Times*, resulted in the formation of a third body. If two dead suns came into collision they would burst into flame. The collision would take about three-quarters of an hour. In each case the collision would take the same time, as the colliding bodies would get up a velocity proportionate to their size. Then there would flash out a brilliant star, which would become a permanent body. The effect of a complete collision of two gaseous suns would be to make a new Sun. Such collisions were not accidental. They did not occur at random. Included among a number of agencies tending to develop such collisions was gravitation. Before suns collided, they fell towards each other and got up speed for hundreds of years. The tremendous speed thus developed was stopped suddenly in the colliding parts and converted into heat. Thus in about an hour a new star was born, explosive force expanded it, and it swelled out its diameter at a speed of millions of miles an hour. The sudden flare-up of a light thousands of times the brilliancy of the Sun had induced astronomers to imagine that a collision of suns had caused the phenomena. The spectra observed, however, were absolutely inexplicable to them because they had overlooked the third body, the new star. The lecturer contended that the appearance of Nova Persci, a new star so brilliant that nothing equal to it had appeared for 300 years, was explained by his theory. Nova Persci was ten thousand times as brilliant as the Sun.

[*English Mechanic.*

At the January meeting of the Royal Astronomical Society, after the reading of the rather sensational telegram from America, mentioned in last week's "Scientific News" column, about the breaking up of Saturn's Ring—a suggestion which did not receive very much support from Mr. Phillips, who had been observing the planet rather carefully, and told us he had seen no signs of dissolution—the Fellows present listened with more interest to a paper by Mr. H. C. Plummer on the subject of stellar movements and distances, which is rather a frequent topic now-a-days. The problem that astronomers are setting themselves is to find, besides the parallax, the actual direction of motion of stars in space, and their velocity in miles per second, the data at command for the solution of the problem being the observed motion of the star on the celestial sphere (*i.e.*, its proper motion), the velocity in miles per second in the line of sight, and the distance of the star, but the knowledge of the last two quantities is sparse, because their determination, being somewhat difficult, has been effected for comparatively few stars. Therefore, in default of complete information, those who make investigations of this kind generally begin with some assumption, and then find out how well it fits with known facts. Mr. Plummer had some new material in the shape of determined velocities in the line of sight of stars of type A and B, which had been put in his hands by Professor Campbell, of Lick, and for certain reasons he made the assumption that stars move parallel to the plane of the Milky Way, and then combining this assumption with the observed proper motion of the individual stars, and with their radial velocity, was able, by very simple geometry, to deduce values of the star's distance or parallax. A table of the hypothetical parallaxes of groups of these stars so determined was the main result of the paper. Many of them agreed quite reasonably with the parallax determined by more direct methods, thus giving support to the original assumption, and it also appeared from examination of the figures, that there is a group of stars about twenty in number, most of them well-known stars, in different parts of the sky as seen from the Earth, which move with parallel and equal motion, this being the same as that of the stars in Taurus which were said by Prof. Boss, not long ago, to form our family.

[*English Mechanic.*

The Movements of the Stars.—Turning to the position of the stars, Professor Schuster said that irrespective of the daily motion due to the rotation of the Earth, we did not notice in ordinary circumstances any change in their distribution. But motions and velocities which were enormous were going on in space. Arcturus moved at the rate of something like 500 miles a second. The distance it travelled could be detected with telescopes in a few weeks, and in 450 years the distance travelled would appear about equal to the diameter of the Moon. The velocities of the stars generally ranged from ten to thirty miles a second. A systematic investigation of their movements gave some remarkable results. For a considerable time it had been known that the Sun and the whole Solar System was moving through space with a velocity of about 15 or 16 miles a second. Recently it had been discovered that the stars could be divided into two groups, which, with reference to the position of the whole stellar system, moved in exactly opposite directions. These movements of the Sun and the stars through space were comparatively small, and no marked difference could be seen in a couple of years. But in, say, ten million years, the position of the stars would have altered altogether. Ten million years was really a very short time. (Laughter). The first crust of the Earth was formed certainly more than a hundred million years ago—according to some authorities a thousand million years ago—and our present stellar system was therefore no indication whatever of what was seen when the Earth first began to solidify.

In addition to the two main "drifts" he had mentioned there were other movements of groups of stars. In the case of Pleiades, for example, the great majority of the stars—and in addition to the six or seven visible to the naked eye in this group there were over 2000 visible to the telescope—were moving in the same direction and with the same velocity as though they were rigidly connected. Five of the stars of the Great Bear group also moved in the same direction, and with the same velocity, and several other stars, including Sirius and one close to Capella, moved with them. Each of these stars gave out forty times as much light as the Sun, and each was the same distance from us—940 miles on the scale.

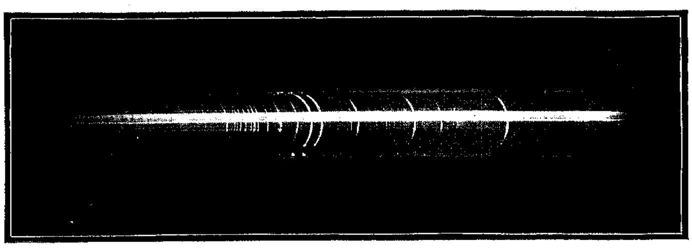
The Evolution of a Star.—The composition of the stars, or at any rate of their surfaces, was determined by spectrum analysis. By their spectra the stars could be arranged, roughly, in four groups. The first showed mainly hydrogen. The second had a marked resemblance to the Sun, and showed the presence of a great many metals, notably iron. The third and fourth showed metallic oxides and carbon compounds. The hydrogen group could be subdivided, for it included one class of spectra which showed helium. The theory had been formed that these different spectra did not indicate that the stars contained different substances, but merely that they were in different stages of development. It was conjectured that there was a kind of evolution going on, and that as the stars gradually cooled, the hydrogen was absorbed, and the metals appeared on the surface. The theory was very plausible. Coupling it with the discoveries as to the star "drifts," one found that the stars of the earlier type—the helium stars—deviated less from the general direction of their group than the older stars; the solar type and they in turn deviated less than the third and fourth groups.

In conclusion Professor Schuster said it might be asked "what is going to happen ultimately?" Few questions were more puzzling. One would imagine that when stars were "drifting" and some were moving more rapidly than others, they would gradually sort themselves out.

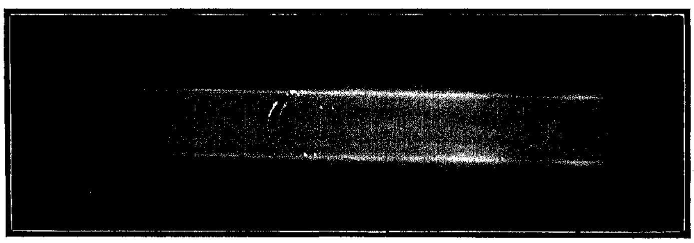
The two main streams ought ultimately to get past each other and separate, so that in one part of the heavens we should have only stars moving in one direction and in another part only stars moving in the opposite direction. But at present there seemed to be no indication of anything of the kind.

[*English Mechanic.*

On the day when this letter is published the Gold Medal of the Royal Astronomical Society will be presented to Mr. A. R. Hinks, one of the honorary Secretaries of the Society, and Chief Assistant at the Cambridge Observatory, for his determination of the Solar Parallax from observations of Eros. Everybody knows that when the small planet Eros was discovered in 1898, and it was realised that it would be only about thirty million miles from the Earth at the end of the year 1900, an international campaign was started to utilise this fine opportunity of finding the scale of dimensions of the Solar System. The photographs were taken according to a plan laid down in conference, and then, after a preliminary trial, Mr. Hinks proposed to Mr. Loewy, who was taking the lead in the organisation, that he (Mr. Hinks) should finish



No. 1, FLASH SPECTRUM AT SECOND CONTACT.



No. 2, SPECTRUM AT MID-ECLIPSE.

No. 3, SPECTRUM OF CHROMOSPHERE.

Photographs of Solar Spectra

taken by Mr. J. Evershed, F.R.A.S., at Talnai, India, on January 22nd, 1898.

Photo.-Engraved & printed at the Offices of the Survey of India, Calcutta, 1912

the work and deduce the solar parallax. The photographs taken at Greenwich were reduced, and a value of the parallax determined under the direction of Sir William Christie, then Astronomer Royal ; but most of the other co-operating observatories entrusted their photographs, or their visual observations, to Mr. Hinks, who has derived from the photographs 8·807″ as the value of the Solar Parallax, and 8·806″ from the micrometric measures, and for this work he deservedly receives this high honour from the Royal Astronomical Society. He has already been honoured in France, for the Paris Academy of Sciences last year awarded him the Leconte Prize for the same work.

A parallax of 8·806″ corresponds to a mean distance of the Earth from the Sun of 92,830,000 miles, so that if we say roughly that the Earth is 93 million miles from the Sun we are not far wrong ; but we are fully justified in saying more correctly that it is ninety-two million nine hundred thousand, for all recent direct determinations cluster about 8·80″, which corresponds to that length. The final result of the Greenwich determination abovementioned was given as 8·800″ with a possibility of its being a little larger. A variation of 0·01″ in the parallax corresponds to 100,000 miles in the distance. It will be understood that astronomical observation gives only the angle, and to deduce from it the distance of the Sun in miles, it is necessary to use a value of the radius of the Earth's equator. In finding the above figures Colonel Clark's second value has been used ; but an early determination of the size of the Earth differing much from this would have caused an alteration, if it had been used, of only about twenty thousand miles on the Sun's distance.

[*English Mechanic.*

Memoranda for Observers.

Standard Time of India is adopted in these Memoranda.

For the month of April 1912.

Sidereal time at 8 p.m.

	H.	M.	S.
April 1st	8	38	19
,, *8th*	9	5	55
,, *15th*	9	33	31
,, *22nd*	10	1	6
,, *29th*	10	28	42