the ions. The path may be deviated by means of a magnet. When a point reaches an electrode it appears to attach itself and take a crystalline form. None of these appearances is observed in the case of a non-electrolyte, and the author considers he has proved beyond the possibility of doubt that the ultramicroscope provides a powerful means of studying directly the motions of the ions in electrolysis.

A SEPARATE copy has reached us of Prof. Zeeman's paper on the degree of completeness of the circular polarisation of magnetically divided lines, which was communicated to the Academy of Science of Amsterdam on October 30, 1909. It will be remembered that a luminous gas in a strong magnetic field gives a spectrum which, when viewed along the lines of the field, consists in the simplest case of two lines, which according to Lorentz's elementary theory of their production should be circularly polarised, one right-, the other left-handed. On examination of lines which normal to the field become triplets, quartets, sextets, and nonets, Prof. Zeeman finds that in each case, whether along the field a line becomes a doublet or a quartet, the lines so produced are circularly polarised, and the degree of circular polarisation found approaches more and more to completeness as the intensity of the light transmitted by the instrument increases. The orbits of the electrons in planes perpendicular to the magnetic field are therefore almost exactly circular.

IN an article in *Engineering* for December 31, 1909, on the command of the air and its effect on land warfare, some interesting points are dealt with. We may probably quite disregard the idea of balloons being used to drop bombs into towns for the sake of wantonly destroying private property. There are other and more legitimate ways in which the command of the air may probably be the deciding factor in a war. There is the facility it gives for ascertaining an enemy's disposition and movements, and flying machines may be of great use in war by acting on an enemy's communications. There is no reason why such machines should not start from a ship as well as on land, and, if capable of flying 300 miles, would have a striking distance of 150 miles inland from an enemy's coast. At present it looks as if the aëroplane rather than the navigable balloon would become universal, owing to its being faster, quicker at turning, harder to hit, and very much cheaper.

IN an article on latter-day developments of the American locomotive in the *Engineering Magazine* for December, 1909, Mr. H. Keith Trask deplores the fact that American locomotive practice has followed rather than led European practice in matters of design relating to increased efficiency from the standpoint of economy. Thus European designers had long considered the advantages offered by superheated steam before the question was seriously taken up in America. Cheap American fuel was responsible for this neglect, but the recent developments of the compound locomotive have rendered the American designers alive to the benefits resulting from the use of superheated steam. As developed for use on American railroads, the superheater is of two types, the smoke-box and the fire-tube. While both types were originally introduced several years ago, it is only within the past twelve or eighteen months that the American railroad world in general has awakened to their possibilities, and they are being applied to many new engines now building for various roads. The Canadian Pacific was the first road to adopt the fire-tube superheater exclusively, and the Santa Fe, although not the first road to test the smoke-box design, was the pioneer in adopting this device as a standard.

ONE of the chapters in the recent report of the U.S. Commissioner of Education deals with education in Central Europe. Among much other information of interest in this chapter is a reference to the attempt of Prof. Du Bois-Reymond, in his work on inventions and inventors, to prove that inventive productivity in different countries depends on social factors. General education, density of population, transportation facilities, social organisation, and so on, he maintains, determine this productivity, and despite the participation of working men in State affairs comparatively few patent applications come from them. The result of an inquiry made in 1900 shows that in England 15,300 applications for patents were made, or 37 to every 100,000 of inhabitants, and that the percentage of illiteracy was 3·7. In the United States the corresponding numbers were 22,900, 30, and 6·2, the percentage of illiteracy in this case being of the white population above ten years of age. In Germany the numbers were 14,800, 26, and 0·05. In France, however, only 7020 patents were applied for, or 18 per 100,000 inhabitants, the percentage of illiteracy being 4·6. The numbers in Italy, again, were 1030, 3, and 33·8 per cent. of illiteracy. Race characteristics, in other words, do not predetermine the inventive productivity of a country, nor does the high proportion of literates, but social factors, especially the high status of industry, do determine it. England, the United States, and Germany, the countries having the best developed systems of industry, are the most productive in inventions. Germany alone had, in 1900, 1500 patent applications concerning technical contrivances relating to electricity.

OWING to the death of the late Colonel Bingham, editor of the "Fauna of British India," no volume of the series has been issued for some time. This month, however, Mr. Malcolm Burr's half-volume on the earwigs of British India will appear, which is the first monograph on the Dermaptera which has been published since De Borman's monograph in "Das Tierreich." It will contain a description of a number of new and recently established genera, and will be well illustrated.

OUR ASTRONOMICAL COLUMN.

HALLEY'S COMET, 1909*c*.—Some interesting measures of Halley's comet, made with the micrometer of the Yerkes 40-inch refractor, are published by Prof. Barnard in No. 605 of the *Astronomical Journal*. With this large telescope the comet was quite an easy object, and the measures should be good; but, as Prof. Barnard suggests, the edges of such a nebulous body are not easy to set on.

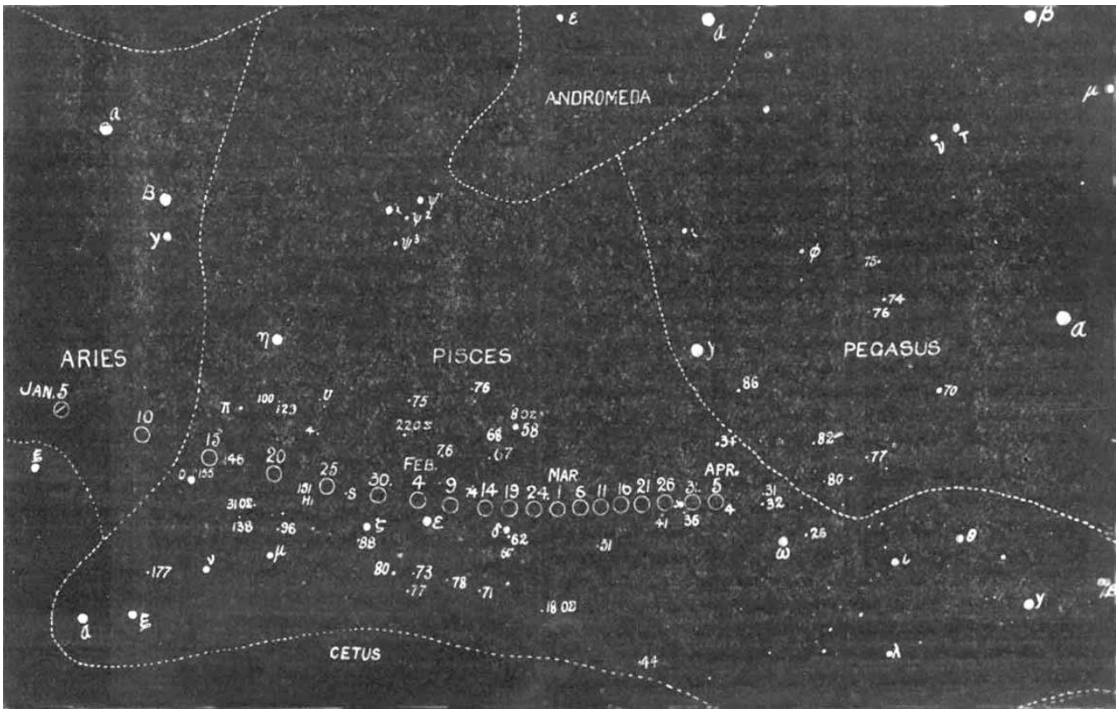
The measures extend up to November 30, 1909, when the estimated magnitude was about 11·0, and the comet showed a condensation of some 7″ diameter. The diameter of the whole object was 41″, and possibly an ill-defined nucleus was seen, but this feature was very doubtful. From September 17 to November 14 the measured diameters, reduced to miles, ranged from 16,400 to 9200 miles, the mean being 12,600 miles, or about 1½ times the earth's diameter.

At the December (1909) meeting of the Royal Astronomical Society, reported in No. 418 of the *Observatory*, the Astronomer Royal announced that a photograph secured with the Reynolds reflector at Helwan, on August 24, shows the comet's image; its position agrees within 0·12s. in R.A. and 1·7″ in declination with the position calculated from the Cowell-Crommelin orbit corrected by the Greenwich observations. Messrs. Keeling and Knox-Shaw are to be congratulated heartily upon securing the first known photograph of the comet.

In No. 25 of the *Gazette astronomique*, Signor Pio Emanuelli discusses the probable encounter between the earth and the comet's tail in May next. At 10 a.m. (G.M.T.) on May 18 the comet will pass the descending

node of its orbit, whilst the earth will pass the same point eighteen hours later. For an encounter between the tail and the earth to take place, it is shown to be necessary that the latter should be 22,100,000 km. (13,812,500 miles) long, and that its breadth should be such that it extends, from its axis earthwards, 400,000 km. (250,000 miles).

The accompanying chart shows approximately the apparent path of the comet, according to Mr. Crommelin's ephemeris, up to April 5.



Apparent Path of Halley's Comet, 1910, January 5–April 5.

THE TOTAL SOLAR ECLIPSE OF MAY 8.—From the *Times* of January 5 we learn that Australian observers are already well advanced in their preparations for the observation of the total eclipse of the sun, in Tasmania, on May 8. The conditions of the eclipse—the sun's altitude will be only about 8°—are not sufficiently favourable for the sending of a Government expedition from this country, but the Australian Eclipse Committee is being assisted, by the loan of instruments, &c., by the Joint Eclipse Committee of the Royal, and Royal Astronomical, Societies.

The observations will probably be made from the locality of Port Davey, fourteen hours' journey from Hobart, in difficult country, and a reconnaissance of the district is being arranged for by the Surveyor-General of Tasmania. Messrs. Baracchi, Baldwin, and Merfield are to form the expedition from the Melbourne Observatory, and contingents are expected from the Perth, Sydney, and Adelaide institutions.

Mr. Frank McClean, of Tunbridge Wells, who was so successful at the 1908 eclipse on Flint Island, is about to start for Tasmania, privately, equipped with instruments for photographing the corona and the chromospheric spectrum, &c.

COMETS DUE TO RETURN THIS YEAR.—In addition to Halley's, two other comets are due to pass through perihelion this year. The first is known as Tempel's second periodical comet, discovered in 1873 July 3 at Milan. Its period is about $5\frac{1}{4}$ years, and it was re-observed in 1878, 1894, 1899, and 1904, making its perihelion passage, on the last occasion, in November; it should therefore return this coming spring. D'Arrest's comet, discovered in 1851, is the second object, and is due to return during the summer of this year. Its period is about $6\frac{1}{2}$ years, and it was re-observed at its returns in 1857, 1870, 1877, 1890, and 1897, but it escaped observation, being unfavourably placed, in 1903.

Mr. Lynn, who gives these particulars in No. 418 of the *Observatory*, also recalls some of the historic occurrences which have coincided with the returns of Halley's comet.

OPPOSITIONS OF MARS, AND SIMULTANEOUS DISAPPEARANCES OF JUPITER'S SATELLITES, 1800–1999.—Two useful long-date ephemerides are given by M. Enzo Mora in No. 4379 of the *Astronomische Nachrichten*. The first gives all the dates of the oppositions of Mars between the years 1800 and 1999, the dates of, and the distances and apparent diameters at, perigee, and the relative maximum brilliancy of the planet at each opposition. In the second table are given full particulars of the thirty-six occasions, during the nineteenth and twentieth centuries, on which the four Galilean satellites of Jupiter were, or will be, simultaneously invisible; the next occasion is not until October 21, 1913.

A BRILLIANT FIREBALL.—In No. 418 of the *Observatory* Mr. Denning describes the path of a brilliant fireball which was observed at Harrow and at Bournemouth on November 7, 1909. The true path of this meteor was over Tours and Angers, in France, at a height of from fifty-nine to forty-five miles, and, on the assumption that its radiant was near *e* Tauri, at 58°, +9°, the motion was due east to west. Observations from France, where the meteor must have appeared very bright, are desirable.

ANCIENT IDEAS OF THE PHYSICAL WORLD.—In an article which appears in No. 72 of *La Revue des Idées* (December 15, 1909), M. Leon Jaloustre gives an account of the ideas held by the ancients, at different epochs, anent the physical constitution of the universe. Most of these ideas were, of course, connected with astronomy, and the hypotheses of philosophers from Plato onwards are discussed in a very interesting manner.

MINOR PLANETS.—In *Astronomische Nachrichten*, No. 4380, Dr. Neugebauer continues the list giving the adopted numbers and the orbital elements of minor planets. The present table includes Nos. (661) to (673) inclusive, which were discovered in 1908.