

tolerably favourable one, but it is distinctly inferior to that of 1900.

Ast. Nach. 4498 contains an investigation of the perturbations of Eros, by H. Samter. The principal Earth terms are:—

	Period. y
$-703'' \cos (79_{\text{Eros}} - 49_{\oplus})$	40.6
$+212'' \sin (37 \text{ ,, } -21 \text{ ,, })$	82.6
$+148'' \cos (37 \text{ ,, } -21 \text{ ,, })$	82.6

These, especially the long-period ones, are very sensitive to errors in the assumed mean motion, which is taken as $2015''.0$.

The *Berliner Jahrbuch* has altered the shape in which it prints details of planetary positions. Approximate ephemerides (each consisting of four positions at 10° intervals) are given for 563 planets; that is, practically all of those that are in opposition in 1912, for which sufficiently accurate elements are available. The year of the last observation is also given, so that it is easy to see which planets specially need observing. For the majority of the planets perturbations are not applied, but the orbits will be empirically corrected from time to time by the observations. Perturbations are applied in the case of orbits of special interest (14 in the present year). Professor Berberich has published approximate tables for the positions of 307 planets: they give the quantities $r \cos$ latitude and $r \sin$ latitude for every 10° of heliocentric longitude, also the first date in the twentieth century when the planet passed each position. Herr M. Brendel gives some further tables in *Ast. Nach.* 4545 for facilitating the computation of the position of planets.

Professor Lowell has an article in *Astr. Jour.*, No. 630, on the librations of planets of the Hilda type whose period is about $\frac{2}{3}$ of Jupiter's. He concludes that their mean motions do not pass through the critical value which would make the commensurability exact, but go through small oscillations, remaining always on the same side of the critical value.

A. C. D. C.

Comets of 1911.

The observations of three comets seen in 1910 were prolonged into the following year. Of these three, Halley's was observed at Helwân up to May 18, and at Yerkes, at Lick, and at the Flagstaff Observatories till the beginning of June. Metcalf's, discovered August 8, 1910, was followed up to the beginning of May, and the periodic comet of Faye was seen at Algiers as late as March 1911. The number of comets discovered during the

year, including the periodic comets whose positions could be indicated with more or less precision, is no less than eight.

Comet (*a*) 1911 is a return of Wolf's periodic comet of 1884. It was found at the Heidelberg Observatory by Dr. Max Wolf on June 19, when it was described as a very faint object of the fifteenth magnitude. An ephemeris had been computed by Dr. Kamensky, of which the error at the time of discovery was scarcely more than the error of observation. The comet will not be in perihelion till February 24, but at that time will be too near the Sun for observation. The elongation from the Sun has not been favourable for observation. At present the comet sets about two hours after the Sun, and as the year advances even this interval will be curtailed. So far as is known, observations ceased last December.

Comet (*b*) 1911 was discovered by Mr. Kiess of the Lick Observatory on July 6. This comet was a comparatively bright object; with very small optical power a tail could be seen. It became visible to the naked eye and was very generally observed. Its motion carried it rapidly southwards, and it disappeared from European observatories early in August, at a time when it was still fairly bright. Observations, both spectroscopic and for position, have been very general. Further observations from the southern hemisphere are much to be desired, because the orbit has some resemblance to that of Comet 1790 I. Some deviation from a parabolic path was disclosed by the northern observations, but this might be explained by the difficulty of seeing the comet distinctly at a low altitude and in moonlight. It is, however, to be noticed, as tending to disprove any connection, that there is a considerable disparity in the longitude of the node; and since the inclination of the comet is large, this element is likely to have been determined with accuracy in 1790, and to have suffered small perturbation since.

Comet (*c*) 1911, discovered by Mr. Brooks of Geneva, U.S.A., on July 20, like the last, was also visible to the naked eye, and became a very conspicuous object in the morning sky. Its path was also southwards, rendering it invisible to European observers in the latter end of November. Observations of physical changes and of position have been numerous. Dr. Doberck, observing in England, states that the comet displayed the peculiarity of subdivision of the nucleus. On September 24 no nucleus was visible, on October 1 two nuclei were distinctly separable, but on October 6 the separation was considerably reduced. Accurate and interesting observations of the spectrum were made by Dr. Bépolsky at Pulkova. Photometric estimations of the brilliancy were made by several observers. M. Esclangen, observing at Bordeaux, witnessed an occultation of the star B.D. + 40° No. 4503 by the comet. For some twelve seconds it was impossible to separate the nucleus of the comet from the star. The light of the two objects was completely blended, but the centre of the comet may have passed one or two seconds of arc to the north of the star. The brilliancy of

the star was thought to diminish very sensibly whilst the star and nucleus were inseparable. The light of the star did not apparently increase that of the comet, but, on the contrary, it appeared to diminish, recovering its brilliancy after separation.

Comet (*d*) 1911, a reappearance of Encke's comet, first detected by M. Gonnessiat on July 31, at Algiers. The observation was exceedingly difficult from the fact that, owing to the near approach of sunrise, the comet had to be observed only three degrees above the horizon. The comet was fairly bright, much brighter than might have been expected from the 1908 report: allowing for the unfavourable position in which it was seen, probably as bright as a star of the seventh magnitude. This observation, and one on the following morning, displayed a greater discrepancy between the predicted and the observed places than was probable, considering the care bestowed on the preparation of the ephemeris. Complete agreement was not expected, since the 1908 observations had not been accurately represented, the deviations pointing either to an increase in the assumed mass of Mercury or a decrease in the acceleration of the comet's mean motion. The disagreement here, however, was far greater than could be explained by such minute quantities. Dr. Crommelin pointed out that apparently a clerical error had been made in forming the excentricity used in the osculating elements for 1911, and Professor Backlund, in an interesting note, has admitted the accuracy of this suggestion. Having computed an ephemeris from the corrected elements, the observations made at Algiers before the perihelion passage (August 24), and in South Africa and at Santiago after that date, are represented with great accuracy. Professor Backlund is therefore able to decide, in a preliminary and cautious way, that the observed disagreement in 1908 is to be explained by a further diminution of the acceleration of the mean motion, and cannot be ascribed to an erroneous value of the mass of Mercury. This planet's mass cannot differ much from 1/9,700,000, and though it is probable that the decrease in the acceleration took place about the time of perihelion in 1904, this point cannot be definitely set at rest till 1914, since three consecutive returns are necessary to afford an independent determination of the acceleration.

Comet (*e*) 1911, the return of the Comet of Borrelly discovered in 1905, was first announced from the observatory at Helwân on September 19, and independently detected by M. Schaumasse on the same night at Nice. The ephemeris had been prepared by M. Fayet, who, owing to the uncertainty of the mean motion, had calculated the position on the assumption that the perihelion might be in error by four days in either direction. The correction needed, however, did not much exceed half a day; and since the comet had been observed at the 1905 return only, the result is very gratifying, the more so as the perturbations were very heavy, accelerating the return some three months. At the time of discovery the comet was in considerable southern declination, but was travelling northwards, and when nearest the Sun and Earth

in December became a fairly easy object. This comet is still under observation.

Comet (f) 1911, discovered by M. Quénisset at Juvisy on September 23, and independently by Mr. F. Brown of Lee, Kent, was another bright comet. It had been conveniently situated in our skies for some months previously, being for the greater part of the time circumpolar in Central Europe. At the time of discovery it was moving southwards and was lost to northern observers early in November, when it was fairly conspicuous. Just as the orbit of Kiess' Comet had some resemblance to that of 1790 I, the elements of Quénisset approach those of 1790 III. The agreement in this latter case is even more marked, but probably the similarity is accidental, and both will ultimately prove parabolic.

Comet (g) 1911, a fine naked-eye comet, was discovered on September 28 by M. Beljawsky, and independently by several observers in California, but too near the Sun to make a good display. It was first visible in the morning sky, but towards the middle of October was seen in the evening, when, notwithstanding the low altitude, the tail could be traced for some six or ten degrees. When last seen the comet presented the appearance of a condensed nucleus, from which extended two luminous jets with well-defined contours curved to form a parabolic arc, the branches being extended some four or five minutes from the nucleus. The observations in the northern hemisphere did not extend beyond the end of October. The comet can still be observed south of the equator. The orbit is probably parabolic.

Comet (h) 1911, the last cometary discovery of the year was announced by M. Schaumasse on November 30, who described it as a faint object of the twelfth magnitude. Observations are still in progress. The orbit will apparently present some interesting points. The early observations, embracing, of course, a very small arc of anomaly, gave for a parabolic orbit the date of perihelion passage 1912, February 5. An elliptic orbit based on a longer arc gives the perihelion passage November 12, 1911, and indicates that the comet has a period of about seven years.

In addition to this list, Dr. Franz of Breslau announced that on July 22, while looking for Kiess' Comet, he saw a nebulous object with a rapid motion, which he believes must have been a comet near the Earth. The right ascension increased three minutes in six minutes of time, and the declination altered considerably. The object, which was of the seventh magnitude, and about six minutes in diameter, has not been seen since.

Barnard's Comet, of which the period is uncertain to about half a year, probably passed through perihelion in the autumn unnoticed. Similarly, Tempel's first periodic Comet, due at perihelion last October, could not be observed. The circumstances attending its return were very unfavourable. Brorsen's Comet has not been seen since 1890: it should have returned this autumn, supposing the elements to have remained sensibly unaltered. This comet must be regarded as lost.

Definitive elements of the following comets have been published during the year :—

Comet.	Character of the Orbit.	Calculator.	Authority or Source.
1823	Parabolic	A. Hnatek	<i>Ast. Nach.</i> , 4510
1859 (Tempel)	Hyperbolic	O. Klein	„ „ 4511
1886 I.	Hyperbolic	E. Redlich	„ „ 4477-8
1893 I.	Hyperbolic	J. Polak	„ „ 4513
1902 III.	Elliptical	Peek & Lindsay	<i>Ast. Jour.</i> , 625

W. E. P.

Solar Activity in 1911.

Sun-spots.—The falling-off in the solar activity, which was so marked a feature of the record for 1910, was even more strongly accentuated in 1911. In 1908 and 1909 the days upon which the Sun's disc was clear of spots were 6 and 4 respectively; in 1910 the register of spotless days had increased to 65, but in 1911 to 180. The groups of spots observed on the remaining days were mostly small and short-lived, so that the mean daily spotted area observed was less than one-fourth that found in 1910, less than one-tenth that for either 1908 or 1909. The distribution of the spots in latitude was quite in keeping with this diminution in their number and area; for, with one exception, all were in the equatorial zone lying between $+15^\circ$ and -15° , and the great majority were within 10° of the equator. The last phase of the present cycle seems therefore to have commenced, and the point of minimum must be near at hand.

So rapid a decline in this part of the sun-spot cycle is unusual; indeed there is no recorded case to furnish a complete parallel, or to indicate whether the minimum will be short and followed by a rapid rise to a high maximum, or long drawn out as a prelude to a slow rise to a feeble maximum.

The faculæ, like the spots, showed a marked decline of activity in 1911, but as usual at this part of the cycle, the decline has been less in proportion and steadier in character than with the spots.

April supplied the chief spot-groups of the year, opening and closing with fairly important spots on the disc. Group 6938, a large composite spot, speedily breaking up into three components, appeared at the east limb on April 1 and was the largest spot of the year. Groups 6943, 6944, and 6945, three circular spots ranged along the same meridian, were first seen on April 23 and 24, and the last two persisted into May. July and December were the two quietest months, each of the remaining months being marked by the presence of one group of moderate size.

E. W. M.