In order of perihelion-passages, as the orbits are catalogued, these comets will stand thus :—

1877	I.	Borrelly	Jan. 19.
	II.	Winnecke	April 17.
	III.	Swift	April 26.
	IV.	(D'Arrest's Comet)	May 10 predicted.
	V.	Tempel	June 27.
	VI.	Coggia	Sept. 11.

The parabola appears to suffice for the five new comets of 1877.

The Discovery of the Satellites of Mars.

As the discovery of the satellites of *Mars* by Professor Asaph Hall, of Washington, forms one of the most remarkable episodes in the annals of contemporary astronomy, it seems desirable to give, in his own words, Professor Hall's account of the discovery, which he kindly sent Mr. Glaisher in reply to a private request for more detailed information upon this subject than had been published. Professor Hall's letter is dated December 28, 1877.

"The question whether *Mars* had a satellite or not, although at times occurring to me, I did not seriously consider until the spring of 1877. At that time several things had happened that brought this question prominently before me. Perhaps the principal of these was the discovery, in December 1876, of a white spot on the ball of *Saturn*, which gave me the means of determining the time of rotation of that planet, and taught me how untrustworthy may be the statements of the text books; this had made me ready to doubt the phrase one reads so often, "*Mars* has no Moon." Again, the favourable opposition of *Mars* in 1877 naturally attracted my attention. I then set to work to see what had been done in searching for satellites of this planet. Beginning with the observations of Sir William Herschel in 1783, I found, of course, a great mass of observations of the planet; but since the time of Herschel, who appears to have looked for satellites of *Mars*, no serious search had been made, except by one astronomer—Professor D'Arrest, of Copenhagen. A reference to his work is made by Dr. Klein, in his *Handbook of Astronomy*, vol. i., p. 140, and a more complete statement is given by D'Arrest himself, in the *Astronomische Nachrichten*, vol. lxiv., p. 74. As D'Arrest was an accomplished astronomer and a skilful observer, the fact that he had found no moon on such a favourable occasion as the opposition of *Mars* in 1862 was discouraging; but, remembering the power and excellence of our glass, there seemed to be a little hope left. The southern declination of the planet in the opposition of 1877 was, however, against us, and the chances seemed to be in favour of the powerful reflector at Melbourne.

"The search was begun early in August, as soon as the geocentric motion of the planet made the detection of a satellite easy. At first my attention was directed to faint objects at some distance from *Mars*; but all these proving to be fixed stars, I began to examine the region close to the planet, and within the glare of light that surrounded it. This was done by keeping the planet just outside the field of view, and turning the eye-piece so as to pass completely around the planet. While making this examination on the night of August 11, I found a faint object on the following side and a little north of the planet, but had barely time to secure an observation of its position when fog from the Potomac River stopped the work. Cloudy weather intervened for several days. The search was resumed on August 15; but a thunderstorm in the early part of the night had put the atmosphere in a very bad condition, and *Mars* was so blazing and unsteady that nothing could be seen of the object, which we now know was at that time so near the planet as to be invisible. On August 16 the object was found again on the following side of the planet, and the observations of that night showed that it was moving with the planet. On August 17, while waiting and watching for the outer satellite, the inner one was discovered. The observations made on the 17th and 18th put beyond doubt the character of these objects, and their discovery was publicly announced by Admiral Rodgers on the 18th. For several days the inner moon was a puzzle. It would appear on different sides of the planet in the same night, and at first I thought there were two or three inner moons, since it seemed very improbable to me, at that time, that a satellite should revolve around its primary in less time than that in which the primary rotates. To settle this point I watched this moon throughout the nights of August 20 and 21, and saw that there was, in fact, but one inner moon, which made its revolution around the primary in less than one-third the time of the primary's rotation, a case unique in our solar system.

"The satellites were observed by me until October 31, and the Washington observations alone give sufficient data for an accurate determination of their orbits. Good observations of both satellites were made at the Harvard College Observatory with the 15-inch refractor by Professor Pickering and his assistants; and a fine series of observations of both these faint moons was made by Mr. Henry Pritchett, at Glasgow, Missouri, with a $12\frac{1}{4}$-inch Clark refractor. Observations of the outer satellite were made at several observatories in Europe, but, so far as I know, the inner moon, which is the brighter one, but more difficult to observe on account of its proximity to the planet, has not been observed in Europe. At the Harvard College Observatory, besides the observations for position made by Mr. L. Waldo, Professor Pickering and his assistants, Messrs. Searle and Upton, made an elaborate series of photometric measures of the brightness of these moons. From the results of these measures Professor Pickering infers that the diameter of the outer satellite is six miles, and the diameter of the inner satellite is seven miles. How nearly correct these values are it is hard to say. Both moons are always inside the glare of light that surrounds the planet, and perhaps the best way of determining their apparent magnitudes is that proposed by Mr. Wentworth Erck, of England, viz. to compare the satellite with a star which is at the same distance from the planet, and then, when the planet has moved away, to determine the magnitude of the star. But there remains the uncertainty of passing from a photometric measure of magnitude to the diameter of the reflecting body. Hence it seems probable that a considerable degree of uncertainty will remain concerning the real size of these satellites. Their apparent stellar magnitudes may be inferred with tolerable accuracy from the apertures of the telescope with which they were seen. The outer satellite was seen by Professor Eastman, with the 9·6-inch refractor of the Naval Observatory, on August 21, and again by Professor Eastman and myself, with the same telescope, on August 28. In this telescope it was a faint object, but distinctly seen. The night of August 28 was the finest, at Washington, of the opposition; and in the 26-inch refractor both the satellites appeared remarkably bright, and both were measured with ease with *Mars* in the field of view. The outer satellite was seen again, with the 9·6-inch telescope, by Mr. H. M. Paul, assistant in the Naval Observatory, on October 1, and by using a magnifying power of 430 Mr. Paul was able to see the satellite with *Mars* in the field of view. Both satellites were seen at several places in this country with Clark telescopes of 12 inches aperture; and in England the outer satellite was seen with a 7-inch Clark glass by Mr. W. Erck. If we adopt Argelander's scale of magnitudes, the smallest star visible in a 9·6-inch refractor is 14·1, and in the 7-inch glass 13·4. Allowing therefore for the glare of light around *Mars*, I think that at opposition we may assume that the outer satellite at its elongation was of the 12th magnitude. The inner satellite must be essentially brighter than the outer one, since I was able to observe it when it was less than 8″ distance from the limb of the planet; while I could not observe the outer satellite at a distance of less than 25″. Assuming the outer satellite to have a diameter of six miles, the angle subtended by this diameter on September 26, the date of Mr. Erck's last observation, was 0″·032; and on the date of Mr. Paul's observation this angle was 0″·031. At the distance of our own Moon this angle, 0″·031, would correspond to a distance of 187 feet on the Moon's surface. Hence, if we assume that the diameter of six miles is nearly correct, it appears that the proposition of a German astronomer to establish on the plains of Siberia a system of fire signals for communicating with the inhabitants of the Moon is by no means a chimerical project.

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"I am now collecting and reducing the observations of these satellites preparatory to computing orbits. But the elements of these orbits are approximately known. Both satellites move nearly in the plane of the equator of *Mars*, and both orbits are probably very nearly circular.

	h	m	
The period of the outer satellite is	30	18·0	M. T.
„ „ inner „	7	39·5	„

"The angular distance of the outer satellite from the centre of *Mars*, at the distance from the Earth of unity, is $32''\cdot5$; and that of the inner satellite is $13''\cdot0$. At the time of opposition their distances were $85''$ and $34''$, and occurred when the satellites were in the angles of position of 72° and 252°. The mass of *Mars* which results from the above period, and distance of the outer satellite, which are more exactly known than the corresponding quantities for the inner satellite, is

$$m = \frac{1}{3054000},$$

a value which probably will not be much changed by future calculations. If we adopt Bessel's value for the angular diameter of *Mars* at the distance unity, viz. $9''\cdot328$, and assume that the Earth's distance from the Sun is 93,000,000 miles, the diameter of *Mars* is 4,200 miles, the distance of the outer satellite from the surface of *Mars* is 12,500 miles, and the distance of the inner one is 3,760 miles.

"The peculiar appearance of these two moons to an inhabitant of *Mars* is evident on the slightest consideration. On account of the rapid motion of the inner moon it will rise in the west and set in the east, and, meeting and passing the outer moon, it will go through all its phases in about eleven hours. By observing the culminations of this moon the astronomers of *Mars* have a very exact method of determining Martian longitudes, since, instead of the factor 29, which in the case of our own Moon multiplies the error of observation, the Martians will have a factor less than $\frac{1}{2}$. However, one cannot doubt that the Martian astronomers have their own troubles; perhaps a dense atmosphere and an enormons refraction hinder the accuracy of their work, and the most zealous astronomer might tire of observing a moon that may culminate three times in a day. Moreover, no approximate formulæ would suffice for computing the parallaxes of these moons, which, at the Martian horizon, may amount to eight degrees for the outer one, and to twenty-one degrees for the inner one.

Of the various names that have been proposed for these satellites I like best those suggested from Homer by Mr. Madan, of Eton, viz. *Deimos* for the outer satellite, and *Phobos* for the inner one.

The Secretaries have received communications informing them that the outer satellite has been observed in England by Messrs. Christie and Maunder at Greenwich, by Prof. Pritchard at Oxford, by Lord Lindsay and Dr. Copeland at Dun Echt, by Dr. Wentworth Erck, by Mr. A. A. Common, by Mr. Cooper Key, and by Mr. Brett. The inner satellite, they are informed, has been observed by Mr. Maunder twice, at Oxford once, and (query) once by Mr. A. A. Common. Mr. Common's observations have already been published in the *Monthly Notices*, and the other communications will probably appear in a future number.

Drawings of Jupiter.

In answer to a circular sent out by the Committee, referred to in last year's *Annual Report*, 264 drawings of the planet have been received. These were forwarded to Dr. Osw. Lohse, of Potsdam, for examination. He writes: 'The greater number of the drawings which I have received belong to the period of the opposition of 1876. A single year is only a fraction of the time necessary for the study of the periodical appearances which present themselves upon the body of the planet. However, this much can already be recognised by a comparison of the observations of 1869, 1870, and 1871 with those of 1876. The appearance of the planet has since then essentially changed. The arrangement of the belts is not so permanent (*ausgepragt*). There are also wanting those peculiar rows of oval clouds so characteristic of the planet in 1870. In their place there were, in 1876, in this zone only long loops of clouds. In 1877 the equatoreal zone appeared again altered. The broad chief belt was divided into two dark belts by a narrow bright division. The reddish colouring of the dark parts in the neighbourhood of the equator is, in comparison with 1870, considerably faded. Dr. Lohse is preparing a special pâper on the subject, in which further details will be given, as also the results of his comparisons of earlier drawings.

The Period of Saturn's Rotation.

On the night of December 7, 1876, Professor Asaph Hall, while observing *Japetus*, noticed a bright spot on the ball of *Saturn*. On the next day letters were sent to astronomers, asking them to assist in observing the appearance of the spot, and with these letters was sent an ephemeris of the spot, computed by assuming the time of rotation of *Saturn* to be $10^{h}\ 29^{m}\ 16^{s}{\cdot}8$ M.T., which is given in nearly all the modern text-books as Sir W.