BORELLY'S COMET.

BY MARY PROCTOR.

From the time of the first observation, Borelly's comet grew brighter very rapidly and could be easily seen with the unaided eye as early as June 30. The comet is now fading rapidly from sight, and by this time is lost in the twilight.

In the Lick Observatory Bulletin, No. 47, an ephemeris given, locating the comet on my father's Star Chart, from July 14 to September 20, makes it possible to trace the path of the comet through these points for August and September.

	Right Ascension.			Declination.
	H.	M.	S.	
August 1.5	11	43	44	+ 51° 18′.8
" 3.5	11	32	21	48° 51′.6
" 5.5	11	21	50	46° 40′.4
" 7.5	11	14	49	44° 41′.2
" 9.5	11	7	31	42° 50′.8
" 11.5	11	0	49	41° 6′.3
" 13.5	10	54	23	39° 24′.1
" 15.5	10	48	12	37° 42′.9
" 17.5	10	42	2	35° 58′.0
" 19.5	10	35	58	34° 7′.2
" 21.5	10	29	54	32° 7′.0
" 23.5	10	24	3	29° 54′.8
" 25.5	10	18	30	27° 27′.0
" 27.5	10	13	31	24° 47′.3
" 29.5	10	9	20	21° 54′.6
" 31.5	10	5	59	18° 53′.8
September 2.5	10	3	36	15° 49′.9
" 4.5	10	2	1	12° 45′.1
" 6.5	10	1	8	9° 43′.1
" 8.5	10	0	50	6° 45′.1
" 10.5	10	1	2	3° 50′.8
" 12.5	10	1	37	1° 2′.4
" 14.5	10	2	27	— 1° 42′.8
" 16.5	10	3	35	— 4° 21′.9
" 18.5	10	4	52	— 6° 58′.7
" 20.5	10	6	19	— 9° 29′.5

The path can also be traced in the maps at the end of Young's "Lessons in Astronomy," by those who have not a copy of Proctor's Star Chart.

From July 14 to 30, the comet passed from Cygnus through the constellation of Draco to Ursa Major, where it was located for a while near the bowl of the so-called Great Dipper. From July 30 to August 27 it passes from Ursa Major, through Leo Minor, and will be south of Gamma in Leo by the 27th. This is the date of its nearest approach to the sun, its perihelion distance being 31,000,000 miles. On September 2 it will be half-way between Gamma and Alpha (Regulus) in Leo, and by September 8 it will be in Sextans, an insignificant group of stars midway between the constellations of Leo and Hydra. By the 20th it will have reached Hydra, being several degrees southeast of Alphard, which marks the heart of the monster, and close to Alkes in the Crater.

It will be seen, by glancing at the map for August (Map VIII., in my father's "Half Hours With the Stars"), that as Leo sets in the northwest early in the evening, the comet is no longer visible, being below the horizon at that time. A glance at Map IV., however, will give an idea of the path of the comet, if we draw an imaginary line (indicated by a dotted line in the map) passing from Cygnus, in the upper part of the map, through Draco, Ursa Major, Leo, and ending at Alkes above Hydra.

Prof. Barnard, of the Yerkes Observatory, has made a good series of photographs of the comet, with a lens only 1½ inches diameter. This shows the comet with a tail 20 degrees long. On July 24 the tail seemed to break off some three degrees back of the head. In a photograph taken July 30, the tail appeared single.

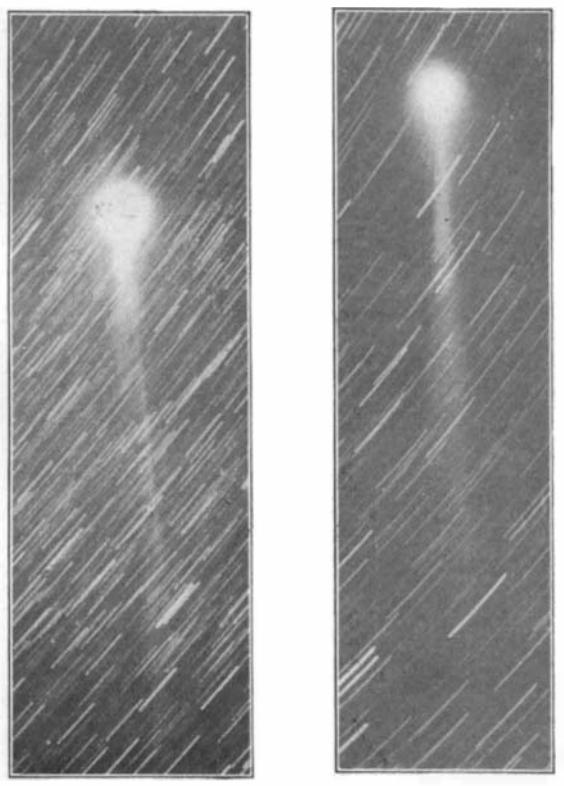
There is nothing specially remarkable about the comet, and it has been a disappointment to those who have watched for a display. Nevertheless the head has been as bright as that of many a great comet, though the tail visually has kept faint. The nucleus has not been at all active. Everything depends upon the activity of the nucleus, as far as a display is concerned.

Newton's law of gravitation, which states that two bodies attract each other with a force inversely proportional to the square of the distance between them, has been made the subject of an exhaustive investigation by Prof. E. W. Brown, of Haverford College. Prof. Brown announces that his calculations show that Newton's laws represent the motion of our moon to within one-millionth of one per cent and that no other physical law has been expressed with anything like the precision of its simple statement.

OBSERVATIONS OF BORELLY'S COMET AT LICK OBSERVATORY.

BY W. W. CAMPBELL, DIRECTOR.

The comet discovered on June 21 by Astronomer Borelly at Marseilles, though invisible to the naked eye at time of discovery, was a conspicuous object in the evening sky in the latter half of July. The nucleus was considerably brighter than a fourth-magnitude star, and at first sight most observers would mistake it for a star. A closer examination, however, showed that it was very hazy in appearance and had a considerable diameter. In our clear skies, a tail some 4 degrees in length was visible to the naked eye. The power of the photographic plate was such that a maximum length of tail of some 10 degrees was recorded. The distance of the comet from the earth at the time was about 36 million miles, and the linear length of the tail observed was approximately six million miles.



Borelly's comet, July 15, 1903. 2 hours, 16 minutes' exposure.

Borelly's comet, July 20, 1903. Four hours' exposure.

LICK OBSERVATORY PHOTOGRAPHS OF BORELLY'S COMET.

Stars appear as lines, because the motion of the comet was followed by the telescope.

The accompanying photographs were made on July 15 and July 20. The tails should be shown by them to have a length of 4 inches or more, corresponding to about 7 degrees. The difficulty of reproduction is so great that it is doubtful if the reader can trace them to that extent. The comet was moving rapidly among the stars during the long exposure, and inasmuch as the telescope was caused to follow the nucleus of the comet very closely, the surrounding star images are drawn out into straight lines.

The original negatives show that the details of structure in one photograph are wholly different from those in the other. Comet photography of the past ten years has determined the fact that the tails undergo very rapid transformations. The structure of one night is often entirely replaced by a different one the next night. Some force residing in the sun evidently exerts a repulsion upon the finely divided matter ejected from the head, in such a way that this material is driven in a direction opposite from the sun, and with such speed that in twenty-four hours it is usually lost in space and an entirely new tail has replaced it.

Spectroscopic observations of the present comet show that a large portion of its illumination is due to reflected sunlight; other components are due to the presence of carbon and nitrogen vapors; still others are due to the presence of vapors not yet identified.

The relation of comets to other stellar bodies, so far as their origin and the history of their development is concerned, remains extremely obscure. Why the sun should so powerfully increase the activity within a comet is entirely unknown. It has recently been proven, however, that light and heat falling upon any surface exert a minute pressure upon that surface, very much in the same way that a breath of air exerts a pressure. The supposition that these forces of light and heat acting upon the highly rarefied cometary matter may develop it in size and activity, and repel the gases in such a way as continuously to form a tail, is a most interesting and promising one.

The orbit of the comet was very accurately computed by Prof. Perrine, who found that it is moving in a parabola. It is difficult to supply a drawing showing the position of the comet's orbit with reference to the orbit of the earth, for the reason that the plane of the former makes nearly a right angle with that of the latter; to be exact, the angle between the two planes is 85 degrees. The comet has come into the solar system practically from an infinite distance, and will retire from our system never to return. The point of nearest approach to the sun will be reached on the evening of August 27, at a distance of 31 million miles. Before the publication of this note it will, no doubt, have been lost to view for a time on account of its nearness to the sun.

Metal in Yacht Construction.

The hulls of large racing yachts present many problems other than the general design and the lines. The question of material is one which constantly troubles the marine architect. It now seems that aluminium and manganese bronze are to have a competitor, if the accounts in the newspapers prove to be worthy of credence. It is said that a new metallic element (?) has been discovered and has been christened "selium." From the meager information available it seems that the new metal has certain properties which will render it invaluable for air-ship and yacht construction. It is said to be lighter and stronger than aluminium and the cost is only one-twelfth as much. On August 8, 1903, aluminium 99 per cent pure, in ingots, was quoted at 33 to 37 cents a pound in ton lots. This would make selium about 3 cents a pound. This compares quite favorably with pig-iron, which is quoted at $18.25 a ton at tidewater. It is extraordinary that a new metal should be produced at once at such an astonishingly low price. We are used to having new elements doled out from the laboratories at about $5 a look, and now we have a whole pound for 3 cents! We should be more inclined to credit the discovery if it was given to the world in a more legitimate manner.

It is not, however, its cheapness which will commend it to the yacht designer. It does not rust and takes a fine polish like nickel. If it should be found that it will not pit under the influence of sea water and that no electrolytic action sets in, it will be an ideal material for the maker of hulls to conjure with. It still remains to be seen if Mother Nature has been good to Messrs. Herreshoff, Fife, and Watson.

A decree is published fixing May 1, 1904, for presenting tenders in Santiago for the construction of the Chilian section of the Transandine Railway. The government guarantees 5 per cent on a capital not exceeding $7,500,000.

APRIL CHART (MAP VI.). AUGUST CHART (MAP VIII.).

PROF. PROCTOR'S STAR MAPS OF THE HEAVENS IN SPRING AND SUMMER, SHOWING IN DOTTED LINES THE COURSE OF BORELLY'S COMET FROM JULY 14 TO SEPTEMBER 20, THE TIME OF ITS DISAPPEARANCE.