

PHOTOGRAPHIC OBSERVATIONS OF GIACOBINI'S COMET (1905 c)

By E. E. BARNARD

When near perihelion this comet was unfortunately situated for photographic observation. It was low in the east and was involved in dawn and daylight; when in a very active condition it disappeared in the direction of the Sun. In the latter part of December and the first part of January the comet began to show a strong activity and shot forth a tail 8° or 10° long. To the naked eye it appeared like a hazy star of the fourth or fifth magnitude. If the position had been favorable for observation, the comet would doubtless have become one of the most interesting yet observed. Despite the unfavorable situation, if the morning skies had been clear, a valuable series of photographs would have been obtained. The weather here, however, was unusually unfavorable, and the mornings, with but few exceptions, were overcast. Several photographs were secured, however, on the few mornings the comet could be seen. These pictures are extremely interesting, and I believe they are important. If photographs of the comet were made elsewhere on the same mornings, sufficient distinctive features were visible to give good data for determining the motion of the particles of the tail. Some of these phenomena were much like those of Swift's comet of 1892, while others seemed peculiar to this comet.

On December 7, 1905, the night following the discovery of the comet by Giacobini, it was photographed here with the 10-inch Brashear doublet, but it did not show any features of interest; a faint tail was visible for about $\frac{1}{2}^{\circ}$. The comet at this time was faint in the 5-inch guiding telescope.

The next photograph was made on December 25. On this plate the tail was about 4° long, and was faint and slender.

On December 29 the tail was remarkably and beautifully developed. The photograph on this date (Plate VI) is in some respects quite unique. From a rather large head and a slender neck the tail widens out on each side in a graceful curve, which partly closes

in again and gives a strong convexity to the tail. The edges of these convexities are sharply defined and are outlined by a rather narrow bright rim or border. The appearance of the tail strongly suggests a hollow convex transparent cone with a sensible thickness. A straight-edge placed along the sides of the tail shows this convexity strikingly, as may be seen on an examination of the plate. I have not noticed quite this appearance before in a comet's tail. Besides this peculiarity of convexity, there is considerable structure in the tail. Several very faint threadlike streams diverge backward from the head on each side at angles of approximately 15° , 20° , and 30° to the axis of the main tail. On the south side, about 1° back from the head, is a long diffused strip running out from the edge of the tail at a very slight angle. This strip seems to cross the bright rim on to the body of the tail, as if it were nearer to us. The entire length of the tail in the picture is about $4\frac{1}{2}^\circ$.

On the night following this, December 30, the head is small, and the first part of the tail seems to be made up of a great number of threadlike strands which diverge from the sides near the head; while the main part of the tail, at first narrow, spreads out in a diffused manner at a large angle from about 1° back from the head. The tail is almost bifurcated in places. The entire comet in this picture differs widely from its appearance on December 29.

No other photograph was possible until January 4, 1906, on which date the plate was much affected by daylight. The tail consists of one main strand, which slightly widens as it recedes from the comet. On the east side there is a slender lateral tail diverging only slightly from the main tail, which is about 8° long.

January 5.—The tail can be traced to the edge of the plate, a distance of $10\frac{1}{4}^\circ$. In this picture the brightness of the central part of the tail is irregular and wavy. There is at least one slender streamer on the west side of the comet. The exposure was closed in this picture when the Sun's center was $16\frac{1}{4}^\circ$ below the horizon. Even under these conditions the photograph was affected by the dawn.

January 7.—This is a very interesting photograph (Plate VII). The head is very slender; the tail widens out rapidly and seems to be made up of a great number of strands. About 1° from the head is a great deal of beautiful thread-like structure. At this point the

PLATE VI



GIACOBINI'S COMET (1905 *c*)
December 29, 1905, at 23^h 20^m G. M. T.
Exposure 1^h 38^m. Enlarged 2.5 times. Scale: 1°=63.5 mm.

tail is separated into three streams, the central one being very long with irregular masses on it.

January 8.—This plate is badly fogged by daylight. The tail is at least 10° long and irregular; the central brightness alone shows; there is a slender thread on the east side which does not diverge much.

January 9.—This picture was killed by daylight. Very little of the tail shows.

When in these notes reference is made to the length of the tail, it refers to the photograph taken with the $6\frac{1}{4}$ inch lens.

Following is a list of all the exposures made here with the 10-inch and $6\frac{1}{4}$ -inch lenses of the Bruce telescope:

1905 Dec. 7
 25
 29
 30
 1906 Jan. 4
 5
 7
 8 Injured by daylight
 9 Ruined by daylight
 Feb. 21

The exposure on February 21 was after the comet had passed perihelion, and shows only a suggestion of a tail.

An inspection of these photographs shows that, though the tail was subject to great physical changes, there were no deflections of its general direction. This will be seen by the following table of position angles. These values were obtained by locating the direction of the tail on the *B.D.* charts. I have also taken from these charts the position of the comet's head at the time of each photograph. They refer to the epoch of 1855.0.

TABLE OF POSITIONS OF THE COMET, AND OF THE POSITION ANGLES OF ITS TAIL

Central Standard Time		α	δ	P. A.
1905, December 25	17 ^h 6 ^m	16 ^h 7 ^m	+9° 0'	317°
“ “ 29	17 20	16 34	+5 12	312½
“ “ 30	16 58	16 41	+4 24	312
1906, January 4	18 2	17 18	−1 11	312
“ “ 5	17 37	17 25	−2 20	312
“ “ 7	17 45	17 42	−4 30	312½

I think there is no question that all the phenomena of this comet were due entirely to the action of the Sun. There does not seem to be any evidence of any outside influence to distort and rupture the tail, as was so evident in the case of Brooks' comet (1893 IV). Indeed, the more I see of comet photographs and of the changes they show in a comet's tail, the more I am convinced that the phenomena of the tail of Brooks' comet were unique, and that they were due to a disturbing influence foreign to the comet and the Sun.¹

It is a very serious question, in photographing a comet near the Sun, as to when the exposure can begin, if in the evening sky, and when it must cease, if in the morning. One's judgment is rather fickle, for there is always the desire to get as much exposure on the comet as possible. This sometimes leads the observer to carry the exposure too far, and he not only does not get more on his picture, but he may lose that which he has already secured. I have thought that a table might be constructed with the Sun's distance below the horizon as an argument to guide one in closing the exposure in the morning, or beginning it in the evening. But this would probably do more harm than good, for everything would depend on the proximity of the comet to the position of greatest dawn effect, and also on the purity of the sky. Each succeeding morning would bring the comet on a brighter background, if approaching the Sun, at corresponding moments of time, and hence dependence on such a table would be apt to result in ruin of the plate by overexposure of the bright sky. The only guide would therefore seem to be the observer's judgment of the appearance of the sky at the time. This can be fairly relied on, if much work of this kind is done, which we know is not often the case—for the want of opportunity. The best plan to pursue is to so regulate the exposure as to give rather less than the plate will bear, otherwise what has already been obtained is likely to be lost.

YERKES OBSERVATORY,

August 1, 1906

¹ See *Astrophysical Journal*, 22, 249-255, November 1905.

PLATE VII



GIACOBINI'S COMET (1905 *c*)
January 7, 1906, at 23^h 45^m G. M. T.
Exposure 50^m. Enlarged 3.4 times. Scale: 1°=80.4 mm.