ON COMET 1919*b* AND ON THE REJECTION OF A COMET'S TAIL

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ABSTRACT

Comet 1919*b*, which is a return of Brorsen's comet V of 1847, is interesting both from a historical standpoint and because of its tails. During September and October, 1919, it was visible to the naked eye as a dim, hazy star without any tail, with a maximum *brightness* corresponding to about magnitude 4.5. Twelve *photographs* were taken. The first ones showed only a slender tail several degrees long, but later the comet became fairly active and about October 20 *discarded its tail* and developed a new one which made an angle of 12° with the old.

Rejection of a comet's tail.—The *instances* of this phenomenon which have been observed previously are the following: Borrelly's comet in 1903, Morehouse's comet in 1908, and Halley's comet in 1910. The case of *Morehouse's comet* on October 15, 1908, is particularly interesting, for the photographs when combined and viewed with the stereoscope clearly show that the rejection was associated with a cyclonic disturbance. Other features characteristic of the *various stages* of the phenomenon, the true nature of which the author was the first to recognize, are briefly described.

The first of the two comets discovered in August, 1919, by Metcalf was shown by Leuschner to be a return of Brorsen's comet V of 1847, which was originally discovered by Brorsen at Altona, Germany, on July 20, 1847, and passed perihelion about September 9 of that year.[1] At its present return the comet passed perihelion on October 16, 1919. It seems to belong to the Neptunian family of comets,[2] of which group Halley's is the best-known member. Photographs of it, therefore, are interesting from a historical standpoint, if from no other.

At the apparition of 1847 it was a rather faint object and apparently did not attain naked-eye visibility. Various orbits were computed from the observations of 1847 (the best of which was one by B. A. Gould), but though they showed the comet to be certainly periodic the periods assigned were discordant and unsatisfactory.

[1] *Astronomische Nachrichten*, **26**, 87, 155, 1847.

[2] In the *Scientific American* for November 1, 1919, Professor H. N. Russell has shown that Neptune could not be responsible (like Jupiter for his comet family) for the grouping of these comets. Though Neptune may not have been responsible for their capture, the term "Neptunian comet family" may still hold through courtesy.

At the present return this object was visible to the naked eye for over a month as a dim hazy star without any tail. The greatest brightness seemed to be at about $4\frac{1}{2}$ magnitude on the Harvard scale. For a while it was above the horizon throughout the night, and later it could be seen both in the evening and in the morning, and later still only in the morning sky just before dawn.

NAKED-EYE VISIBILITY OF THE COMET

Following are some of the notes made while the comet was visible to the naked eye:

1919 Sept. 15, 7^h45^m Central Standard Time. Distinctly visible to the naked eye as a hazy spot. Comparisons with 5 Canum Venaticorum made the comet's magnitude 5.4. With the field glass and the image out of focus comparisons with the above-mentioned star made its magnitude 5.0. At 8^h0^m to the naked eye the comet was very slightly brighter than the Andromeda Nebula, but very much smaller.

Sept. 19, 8^h0^m. Just visible to the naked eye.

Oct. 5, 16^h20^m. Visible to the naked eye as a small hazy spot of light. By comparison with several stars its magnitude was 4.0, but its light was mixed up with that of 93 Leonis, and the magnitude given is probably too bright.

Oct. 6, 16^h40^m. Visible to naked eye; $4\frac{1}{2}$ magnitude.

Oct. 7, 16^h30^m. Not visible to the naked eye because of moonlight.

Oct. 12, 16^h30^m. Too much moonlight to see it with the naked eye. Brightly condensed in the 5-inch guiding telescope but with no trace of tail on the bright sky.

Oct. 16, 16^h30^m. Not visible to the naked eye on account of moonlight.

Oct. 20, 16^h50^m. Faintly visible to the naked eye; 5.6 magnitude. In the 5-inch guiding telescope there was some tail.

The magnitudes are on the Harvard scale.

PHOTOGRAPHS OF THE COMET

During most of the time that the comet was present the Bruce telescope was not available for photographing it, but later, especially in the morning sky when near perihelion, photographs were obtained with the 6-inch and 10-inch lenses of this instrument. But the

exposures were short from moonlight and dawn. Bad weather also interfered with the observations during the most important period. Some of the photographs, however, are valuable. They suggest that had better conditions prevailed the results would have been extremely interesting.

The first photographs, in September, showed only a slender tail several degrees long and of no special interest. The later pictures, however, when, unfortunately, short exposures only were possible, are quite interesting and show that the comet finally became fairly active, especially when past perihelion. This was strikingly the case on or about October 22, when the tail was discarded and a new one formed. The table gives a complete list of the photographs which were secured by the writer with the Bruce telescope. The approximate position angles and length of the tail are also given:

Date	C. S. T.	Exposure	Length of Tail	Position Angle
1919 Sept. 21..	$16^h 27^m$	$0^h 7^m$	$\frac{3}{4}°$	2°
22..	7 37	0 28	$\frac{1}{2}$	.....
22..	16 5	0 45	3	5
24..	7 33	0 47	$\frac{1}{2}$	9
Oct. 5..	16 20	0 41	3	328
6..	16 14	0 57	7	328
7..	16 26	0 41	7	$331\frac{1}{2}$
12..	16 33	0 43	5	315
16..	16 27	0 50	$8\frac{1}{2}$	312
20..	16 50	0 33	7	$307\frac{1}{2}$
22..	16 51	0 24	6	307 nearer part, or new tail
28..	16 50	0 40	5	302

In some of these plates the tail is very faint toward its end. The rejected part, in the photographs of October 22, makes an angle of 12° with the new tail. The nearest point of this drifting tail is 51′ from the head. October 23 was cloudy here so that no photographs could be made. This was unfortunate, as material for the motion of the particles of the tail would have undoubtedly been obtained. The photographs of October 20 may show an earlier stage of this separation. On that date the tail proper seemed disconnected from the head. The rearward portion, which

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PLATE X

North

North

a

b

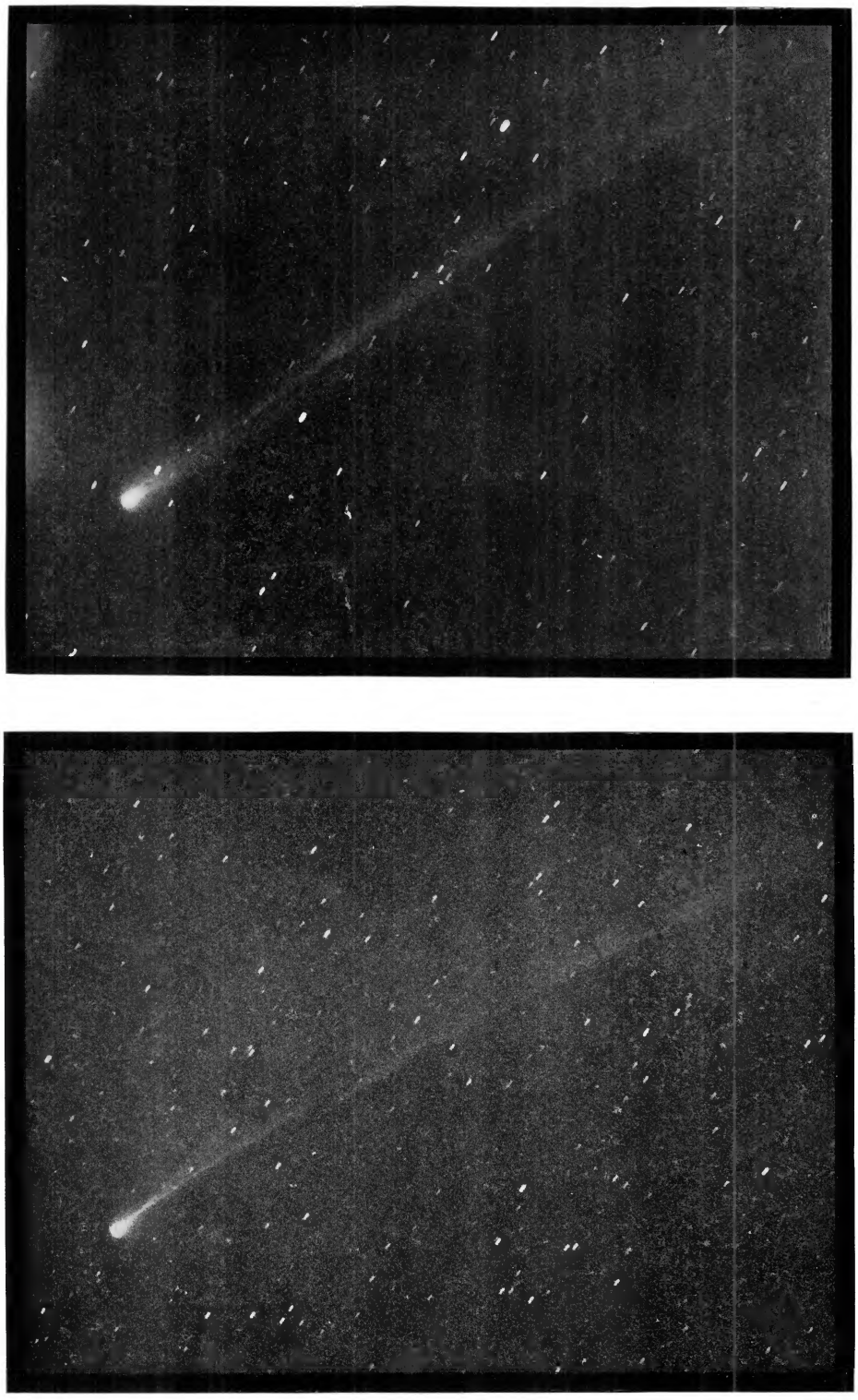
COMET 1919*b* (METCALF-BRORSEN)

Scale: 1 cm=36′

a. 1919, October 5, 16^h20^m C.S.T. Exposure, 0^h41^m
b. 1919, October 6, 16^h14^m C.S.T. Exposure, 0^h57^m

PLATE XI

North



a

b

COMET 1919*b* (METCALF-BRORSEN)

Scale: 1 cm = 36′

a. 1919, October 20, 16^h50^m C.S.T. Exposure, 0^h33^m
b. 1919, October 22, 16^h51^m C.S.T. Exposure, 0^h24^m

was sharply pointed, was 9′.6 from the head, while a new and widening tail filled the space between it and the head. If these parts of the tail were the same on the two dates, the recession of the particles was at the rate of 21′ a day. Photographs made elsewhere will probably decide this question. On the photograph of October 20 a brighter condensation about 2° long is shown in the tail 2°30′ back from the head. Four of these pictures of the comet, on the dates October 5, 6, 20, and 22, made with the 10-inch lens of the Bruce telescope, are reproduced in Plates X and XI.

This discarding of the entire tail of a comet is not a new feature, though I believe it was unknown previous to the successful introduction of photography to the study of comets. The first known case really occurred in 1903, when on July 24 Borrelly's comet discarded its tail and at once formed a new one. On that date the comet's tail presented a puzzling appearance. It seemed to be split diagonally into two tails. To explain this phenomenon the present writer suggested[1] that the comet had discarded its entire tail and had formed a new one at a slightly different angle and that the old tail was drifting away bodily into space. Though this explanation was somewhat antagonistic to the then received ideas of a comet's tail, it proved to be the true one. It has been amply verified since then by Morehouse's comet on several dates, by Halley's comet on June 6, 1910, and by comet 1919*b*. In the various cases of this kind a new tail (and sometimes a system of tails) is always sent out at once by the comet, generally in a somewhat different direction from that of the rejected tail.

Perhaps the most interesting case of rejection is that of Morehouse's comet on October 15, 1908, when the nearer end of the receding tail presented a twisted or knotted appearance. Fortunately photographs on that date were secured at a number of observatories, both in this country and in Europe. My own photographs of it cover a period of over seven hours. Thus a fairly full record of these changes was obtained. I have combined for the stereoscope several sets of my own pictures of the comet at that time. The results are very interesting. They clearly show the gradual transformation of the near end of the old tail. At

[1] *Astrophysical Journal*, **18**, 213, 1902.

first it was twisted or cyclonic in form, as if it had received some twisting motion when it left the head. It slowly formed into a thickish fragment of a ring, from all parts of which streams of particles swept back to form the old tail, giving it the appearance of part of an open sack, or a partly opened scroll, with irregular sides. Without the aid of the stereoscope one would never have guessed the real form of the tail. It seems that immediately after the separation of the tail from the head a new and slender tail was shot out from the head at a different angle from that of the receding one. In the stereoscope this new tail is seen to pass behind the old one—away from us and toward the background of the stars. It was moving out much faster than the rear portion of the old tail—a peculiarity that seems to be always present in the general process of forming a new tail. This fact was very strongly shown in the case of Borrelly's comet of 1903. It would therefore seem that the rear part of a receding tail is made up of the more sluggish, or larger, particles and is not moving as fast as the other parts of the rejected tail. Measurements of this part will therefore give the minimum velocity of the tail-forming particles.

In *Popular Astronomy*, **17**, for November 1909, Plate IX, I have given two photographs of Morehouse's comet on 1908 October 15, that form a stereoscopic view, which beautifully shows the earlier stages of the separation of the tail from the head.

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