

## Halley's Comet.

On 11<sup>th</sup> August 1910 the position was taken using BD - 5°3268, a 9<sup>m</sup>8 star for comparison. The star was easily observed in the 9-inch refractor but the comet was a most difficult object. On the 12<sup>th</sup>, the comet could only be recognized by moving the field rapidly and measures could not be taken. It is therefore much fainter than 7<sup>m</sup>4, the magnitude given in A. N. 4423.

Places from observations July 26 - August 11 indicate a correction of about -11" in  $\alpha$  to Ebell's ephemeris given in No. 4423, whilst  $\delta$  is nearly correct. When last seen, the comet was a nebulous object showing slight condensation to a centre and about 1' in diameter.

Transvaal Observatory, Johannesburg, 1910 Aug. 13.

*R. T. A. Innes.*

## On the Acceleration of the Receding Masses in the Tail of Halley's Comet 1910 June 6.

By *E. E. Barnard.*

The opportunities here for determining the motion of the tail-forming particles of Halley's comet have been few, definite masses suitable for the purpose were seldom shown on the plates. Cloudy and smoky skies almost wholly prevented satisfactory morning observations while the comet was at its brightest. When it appeared in the evening sky the conditions were better, and the comet was a splendid object. The photographs of May 26 showed a peculiar twisted appearance in the tail, which was moving rapidly away from the comet. But the most interesting phenomenon occurred in the pictures of June 6, when a large separate section of the tail was shown, the rear end of which was about 1°5 from the head. The successive positions of this can be seen, for instance, in photographs taken by Morehouse at Des Moines, Iowa, Ellerman at Honolulu, and by Joy at Beirut, Syria. These photographs, or copies of them, have been placed at my disposal by these gentlemen, and I have measured the position of the rear end of the receding tail on the various pictures, and have deduced from these measures the motion of the particles of the tail.

The interval between Mr. Morehouse's photograph and mine, 22 minutes, is too small to be used in the investigation, but the picture serves admirably as a check. The intervals of time between the Yerkes Observatory photograph and those of Mr. Ellerman and Mr. Joy are 4<sup>h</sup>15<sup>m</sup> and 15<sup>h</sup>9<sup>m</sup> respectively. These intervals are sufficiently large to show the change in the motion of the mass.

Because of the diffused nature of the object, it was not possible to make the measures on a measuring machine. They were therefore made with dividers and a scale of inches. This method seems accurate enough for the purpose.

The intention of this paper is to give only the results of this investigation. The details will be printed in a later paper on the comet. It is interesting to state, however, that the distance of the rear end of the tail from the head of the comet at the times of the different photographs was 2007000, 2364000, and 3847000 miles, respectively.

The following table will show the results that have been obtained from the investigation of the three photographs.

Station	Interval	Hourly Motion	Recession per second			
			From Comet		From Sun	
			Miles	km	Miles	km
Y. O. - Honolulu	4 <sup>h</sup> 25	3'60	23.1	37.2	39.7	63.9
Y. O. - Beirut	15.15	5.17	33.1	53.3	49.7	80.0
Honolulu-Beirut	10.90	5.78	37.3	59.7	53.9	86.4

At this time the recession of the comet's head from the Sun was 16.6 miles (26.7 km) per second.

These results show a strong acceleration in the receding mass. The acceleration in the last two photographs was about 14 miles or 22 km per second.

Many interesting changes in the form of the disconnected portion of the tail took place between the photographs.

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*E. E. Barnard.*

## Velocities of Particles in the Tail of Halley's Comet.

By *Percival Lowell.*

The photographs taken here of Halley's comet have furnished experimental evidence of the mode of genesis of the tail. Measurement of certain irregularities in that appendage has shown its particles to be moving under the action of a repulsive force directed from the Sun.

Although the comparatively orderly behaviour of Halley's comet has made measurable caudal irregularity rare, it has

been possible on occasion to detect lapses from monotonous uniformity sufficiently pronounced to be capable of identification on successive plates. On May 23, 1910, two such plates were taken by Mr. *Lampland*, Dr. *V. M. Slipher* and Mr. *E. C. Slipher* with a Brashear doublet of five inches aperture, one exposed from 9<sup>h</sup>23<sup>m</sup> to 9<sup>h</sup>58<sup>m</sup>; the other from 10<sup>h</sup> to 10<sup>h</sup>53<sup>m</sup>. The irregularities are of two kinds, thick-

enings or thinnings of the tail in places and abrupt changes of direction in it; knots and notches. As these are of necessity long drawn out great accuracy is not possible and therefore the resulting determinations for the velocities cannot be considered exact. The interesting thing about them is their pointing unmistakably to solar repulsion.

On the plates the respective distances of the several knots and notches from the nucleus, measured in half millimetres for greater accuracy, proved to be as follows:

	Plate I	Plate II	Differ. in $\frac{1}{2}$ mm
Knot 1	40.3	43.3	3.0
" 2	92.2	95.8	3.6
" 3	134.3	138.3	4.0
" 4	182.6	188.8	6.2

We must now apply to these measures the correction for refraction. The lengths of the star-trails on the two plates at the head and at the points occupied by the knots were:

	Plate I	Plate II
Head	5.9	8.6 half-mm
Knot 1	5.9	9.0
" 2	5.9	9.5
" 3	5.9	9.9
" 4	5.9	10.5

The first plate witnesses to a practically uniform refraction throughout. The plate was taken at a considerable altitude above the horizon. The time of its exposure was 35 minutes. That of the second was 53 minutes. Consequently under similar conditions the second's star-trails should have been 8.85 half-mm long. The table shows this to be nearly the case for those about the head and the star trails to have increased from there outward. Now the effect from guiding on the head is to keep the star-trails normal in the neighborhood of that head but to lengthen them out elsewhere by the amount of the differential refraction. The half-difference in the star-trails at any two points must, therefore, be added to the outer to get its true place.

Thus we find the following table of differential distances of the knots from the nucleus.

	Uncorr.	Corrected f. refr.	Red. to arc
Knot 1	3.0	3.2	6.2
" 2	3.6	4.1	7.9

Lowell Observatory, May, 1910.

	Uncorr.	Corrected f. refr.	Red. to arc
Knot 3	4.0	4.7	9.1
" 4	6.2	7.2	13.9

For the date of the photographs, May 23.75 Gr. M. T. we have, calling  $r$  = the comet's distance from the Sun,  $A$  = the comet's distance from the Earth,  $R$  = the Earth's distance from the Sun,  $a$  = the semi-major axis of the comet's orbit

$$\log r = 9.9662 \quad \log R = 0.00552$$

$$\log A = 9.3303 \quad \log a = 1.25395$$

which from  $V^2 = \mu \left( \frac{2}{r} - \frac{1}{a} \right)$  gives 26.53 miles a sec.

for the speed of the comet's nucleus.

From the data also we deduce

$$R = 1.013 \quad A = 0.214 \quad s-b = 0.151$$

$$r = 0.925 \quad s = 1.076 \quad s-c = 0.862$$

and from the relation

$$\sin \frac{1}{2}A = \sqrt{\frac{(s-b)(s-c)}{bc}} \quad \frac{1}{2}A = 54.2$$

whence the tail proceeding from the Sun was inclined to the line of sight  $71.6^\circ$ .

We have for the distances in degrees from the head of the several knots examined

	Apparent	Corrected for refraction	Corrected for inclination
Knot 1	43.5	$1^\circ 24'$	$1^\circ 28'$
" 2	96.3	3 6	3 12
" 3	139.0	4 28	4 36
" 4	189.8	6 6	6 15

and for the differentiated distances corrected for inclination:

Knot 1	6.5	Knot 3	9.4
" 2	8.2	" 4	14.2

giving for the speed of the particles composing the knots:

Knot 1	13.6 miles a second	Knot 3	19.7 miles a second
" 2	17.2 " " "	" 4	29.7 " " "

Here we are confronted by an increase in velocity away from the head as the particle gets farther away, an excess of speed which betrays the action of a repulsive force. Owing to the diffuse character of the knots more detailed information is not possible.

Percival Lowell.

## Nota sobre las velocidades y aceleraciones de una bocanada del cometa de Halley.

Por José Comas Solá.

Unas fotografías del cometa de Halley obtenidas en el Observatorio de Madrid, y que ha tenido la amabilidad de remitirme su director don F. Iniguez, me llevan á completar las observaciones más que se publicaron en las A. N., no. 4421, referentes á la emisión, del núcleo del cometa, de un grupo de globos fosforescentes, el 4 de junio.

Del examen de una fotografía del señor Iniguez y de otra obtenida por mí 80 minutos antes (momentos medios de las exposiciones) resulta que en ambas fotografías aparece una importante bocanada gaseosa, con la circunstancia de que el movimiento propio de la bocanada, con relación al núcleo, se hace perfectamente sensible en este intervalo