Halley's Comet in 1909–11

AN exhaustive discussion of the phenomena of Halley's comet and its envelopes, based on the examination of a large number of photographs taken at the Lick Observatory, at its Chile station, and at Mount Wilson, Johannesburg, Helwan, Kodaikanal, Cordoba, Yerkes, Tokyo, and Beirut, is given by Nicholas T. Bobrovnikoff in a memoir on "Halley's Comet in its Apparition of 1909–1911"; which appears in Lick Observatory Publications, Part 2. The outward motion of luminous patches in the tail was studied, and the repulsive force deduced, the assumption being made that the hyperbolic orbits of these objects were in the same plane as the orbit of the comet's nucleus. The resultant repulsive force was calculated in 31 cases; in 3 cases it exceeded 1,000 times gravity; in 4 cases it was between 100 and 1,000 times; in 6 cases it was between 50 and 100 times. The two tails of the comet on May 29, 1910, are traced on page 457 of the memoir. That of Bredichin's type I is nearly straight, the indicated repulsive force ranging from 9 to 16; the tail of type II is highly curved, the repulsive force being only 0·1 to 0·2. The presence of this curved tail explained the surprising fact that a tail could be seen in the morning sky for some time after the nucleus and straight tail had become evening objects. On account of the curvature of the tail, the author is doubtful whether the earth passed through any portion of it; in any event only the outlying portions could have been traversed.

A study is made of the curved envelopes that surrounded the comet's head. A parabolic outline has generally been assumed for these, but the author finds, as Bond had done in his study of Donati's comet of 1858, that the catenary gives a better representation; it is suggested that the shape may be accounted for if the different envelopes exert some electrical action on each other.

A description was given by Barnard of the appearance of the nucleus. What was taken with a low power to be the nucleus was seen with greater power to be a dense nebulosity of a bluish colour, with a stellar nucleus, 2″ or 3″ in diameter. It may be noted that a similar small nucleus was seen with large instruments at the near approach of the comet Pons-Winnecke to the earth in June 1927.

Reasons are given for believing that the activity of emission, responsible for sending out the envelopes and luminous masses in the tail, is not confined to the small nucleus, but extends to some distance from it. Comparison is made between the envelopes in Halley's comet with those of Morehouse's comet of 1908, which were studied by Eddington. In the case of Morehouse the envelopes showed rapid motion, sensible in a few minutes, and the repulsive forces were several thousand times that of gravitation.

There were a few cases of sudden explosive action in the case of Halley's comet, notably on May 13 (Innes) and May 24 (Barnard), but on the whole the disturbances seem to have been much weaker than in Morehouse's comet.

In 1835 Bessel found evidence of rotation of the nucleus; this phenomenon was therefore looked for, but the fact that jets around the nucleus retained their direction for some days, in one case for a week, makes rotation unlikely. Examination was made whether any of the secondary regions of activity round the nucleus gave evidence of separating from the comet (a phenomenon noted in Biela's comet, in the great 1882 comet, and in Taylor's of 1915). The author thinks that Halley's comet may have been on the verge of disruption, but that this was never quite reached.

An estimate is made of the mass of Halley's comet. The author gives 3×10^{-10} of the earth as a lower limit. This is about the mean of the widely different values given by Orlow, but in neither case is it considered more than a guess. As regards the total brightness of the comet in 1910, Holetschek's results are quoted that the comet has not appreciably declined either in light or in length of tail during the last five apparitions. A very different estimate was reached by many English observers in 1910, but this was due to twilight and the comet's low altitude; in the tropics the tail was described as like a great searchlight beam, 140° long; the great length was due to its nearness to the earth. The length in linear units was difficult to compute, owing to great foreshortening; according to Holetschek's discussion it was about a quarter of an astronomical unit on April 21, two days after perihelion, and increased to nearly a unit at the end of May.

The memoir also discusses the comet's spectrum; the continuous spectrum of the nucleus closely resembled that of the stars of solar type λ Serpentis and α_1 Centauri. There is, however, a more rapid falling off of light at the violet end in the comet's spectrum. In this respect the comet resembles the brighter asteroids; the author considers that it denotes the presence of iron in each case.

The author deserves thanks for this painstaking memoir, which describes in close detail the phenomena exhibited by the comet during the time of greatest brightness. Many beautiful photographs are reproduced, including some spectra, and there are many diagrams. The author commenced the work while he held the Martin Kellogg fellowship at Lick Observatory (1927–1929) and finished it when he was a research fellow in the University of California.

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Carbon Dioxide in the Sea

IN the biochemical study of life processes in the sea, an understanding of the rôle of the carbon dioxide system is very desirable. In virtue of the excess base always present, sea water contains not only free dissolved carbon dioxide but also many times as much in combination as carbonates and bicarbonates. The equilibrium existing in this system under naturally occurring conditions is a complicated one. It may be displaced by photosynthesis, changes in calcium due to vital processes, decay of dead matter, temperature, salinity and pressure. To the geologist also its study is of importance since it controls the formation of calcareous sedimentary rocks.

The commonest line of attack is to determine hydrogen ion concentration and excess base. The