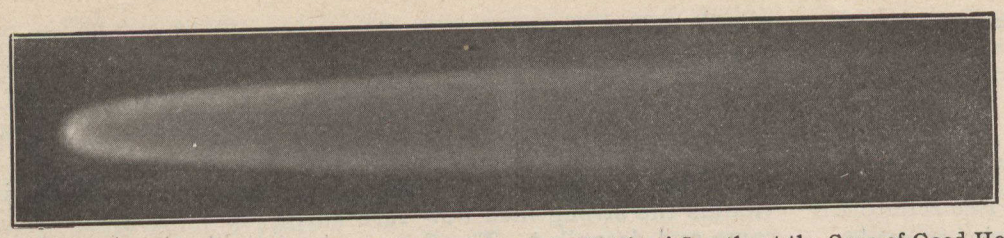


Halley's Comet as seen on November 11th, 1835. Drawn by C. Piazzi Smyth, at the Cape of Good Hope. Smyth afterwards became Astronomer Royal for Scotland. His investigations relating to the Great Pyramid of Egypt are also well known.

HALLEY'S COMET

By C. A. CHANT, Professor of Astro-Physics, University of Toronto.

THE appearance of a comet in the sky always arouses interest and sometimes fear. The motions of the moon and the planets are so well known that the astronomer can predict their positions at any time, past or to come, with extraordinary accuracy. But a comet usually comes without previous intimation, and to the ordinary person the majestic uniformity of the celestial motions seems deranged. On this account it gives rise to a feeling of fear. The last few weeks have shown that the dread of comets is by no means gone but it is not nearly so prevalent as in former times. Though we cannot usually predict when a comet shall appear, yet the way in which such bodies move is now well known; and the beginning of our real knowledge of these matters dates from the time of Halley. Before his time they were thought to be phenomena of the atmosphere or exhalations from the earth.

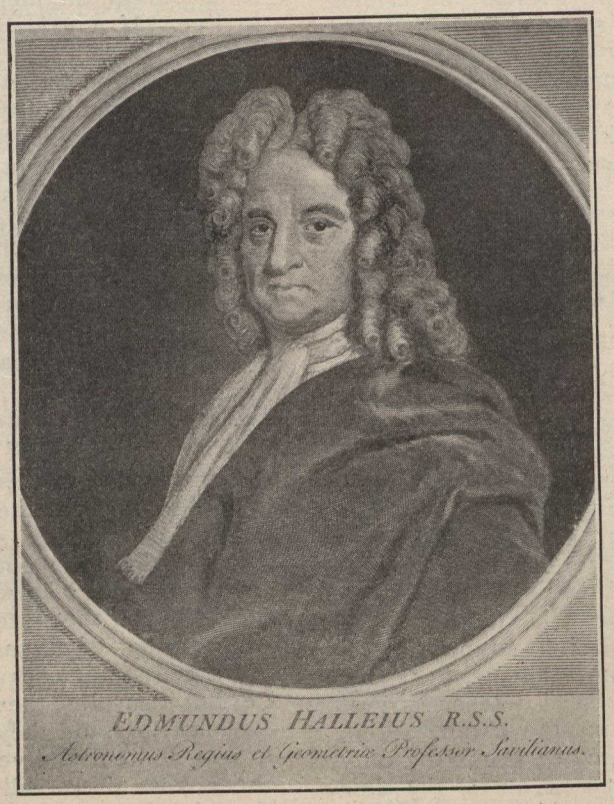
Comets vary widely in their appearance. Some of them are magnificent objects with tails stretching in graceful curves across the sky, but many are just faint hazy patches of light, visible only in a telescope. There has not been a conspicuous comet since the year 1882, although since then 135 — averaging five a year—have been discovered. Most of these could be seen only with a telescope, though occasionally one has been bright enough to be detected with the naked eye.

Of all comets Halley's is the most famous, and the most important in the history of astronomy.

Edmund Halley was born on October 29th, 1656. In youth he showed great ability—both in classics and in mathematics—and at the age of nineteen he entered Oxford University; but before completing his course he embarked for St. Helena, where he spent two years charting the stars of the southern hemisphere. After his return home he was given various important commissions by the British Government, and in 1703 he was chosen Savilian Professor of geometry at Oxford.

But before this had occurred the most important incident of his life, namely his meeting with Isaac Newton. About fifty years before (1617-1620), Kepler had published his three famous laws of motion. These laws state that each planet moves about the sun in an ellipse of which the sun occupies one focus; that the straight line joining the planet to the sun, called the "radius vector," moves over equal areas in equal time; and lastly, that there is a definite relation between the time in which the planet makes a complete revolution about the sun and its mean distance from the sun. (The square of the time is proportional to the cube of the distance.) Kepler deduced these laws from an exhaustive examination of the records of the positions of the planets, chiefly Mars, made by his predecessor Tycho Beabe, but he assigned no physical cause for them.

Among others, Halley was searching for the underlying reason for these laws, but the question was beyond his powers. So in August, 1684, he



PORTRAIT OF HALLEY

(From the frontispiece in Halley's *Astronomical Tables*. 1752).

Halley was born in 1656, and died in 1742 From 1720 to his death he was Astronomer Royal.

went to Cambridge to consult Newton, and to his great surprise and delight he found that the latter had completely solved the problem. Halley learned, too, that Newton had made important investigations into the motions of bodies, and though at first he refused to publish them—being modest and retiring and shrinking from jealous contemporaries—yet after persistent urging by Halley he at last consented to do so. In this way the famous "Principia" which is the short name for the "Mathematical Principles of Natural Philosophy," was presented to the Royal Society. This body ordered it to be printed at its expense, but the funds were exhausted, and so Halley with generous loyalty assumed the entire labour of editing and the cost of publishing the book. This work is considered to be the greatest contribution ever made to science by anyone, and but for Halley we might never have had it.

In the "Principia" Newton enunciates his law of gravitation, and he showed that Kepler's laws could all be explained by it. He showed also how to apply the principles of gravitation to determine the path of a comet, and he demonstrated that a fine comet which had appeared in 1680 actually moved about the sun in accordance with this law. He showed that its path was either a very elongated ellipse or a parabola, which is the same as an ellipse with one end at an infinite distance.

Now Halley worked over this part of the great book, and as soon as he was appointed at Oxford he set about applying Newton's method to all the comets he could get records of. In two years, after "a prodigious deal of calculation," he published his results giving the positions of the orbits of twenty-four comets which had appeared between 1331 to 1698, and on comparison of these he recognised that the orbits of three of them, which had appeared in 1531, 1607 and 1682, respectively, were identical, and so he concluded that they were in reality but one comet which came back every 76 or 75 years. Now if we add 76 to 1682 we get 1758, and Halley says: "I think I may venture to foretell that it will return again in the year 1758." As time went on he became even more convinced that the comet would come back, and in his "Astronomical Tables," published in 1752, he states his firm belief, and with a patriotic pathos he concludes: "Wherefore if according to what we have already said it should return again about the year 1758, candid posterity will not refuse to acknowledge that this was first discovered by an *Englishman*."

Halley died in 1742, and as the time came round for the comet's reappearance great interest was aroused. Clairant, a famous French mathematician, computed that the comet would reach perihelion, *i.e.*, get to that point in its orbit nearest the sun, within a month of April 13th, 1759. Though watched for anxiously by professional astronomers all through 1758, it was first seen on December 25th by an amateur named Palitzch, living near Dresden. On May 5th the tail was 47 degrees long and the comet reached perihelion on May 12th, just within the limit allowed by Clairant.

If we add 76 to 1759 we get 1835, and true to computations the comet appeared in that year, arriving at perihelion on November 16th. The greatest length of tail observed was 30 degrees. By adding 75 to 1835 we obtain 1910, and as everyone knows the comet arrived again on time.

Its Re-appearance Last Year.

But it was observed long before this. On September 11th, 1909, Wolf of Heidelberg in Germany, announced that he had taken a photograph on which Halley's comet was shown—almost exactly in the position in the sky where it was predicted. At that time the comet was extremely faint and could be seen only in the very largest telescopes. Indeed, it is easier to obtain evidence of the presence of a very faint object by photography than by eye-observation.

It was followed by telescopes during the evening

Photograph taken May 27th, 15h. 40m. (G.M.T.)—Exposure 40m.

Photograph taken May 28th, 14h. 35m. (G.M.T.)—Exposure 60m.

TWO PICTURES OF THE COMET TAKEN AT THE DOMINION OBSERVATORY, OTTAWA.