

lightful harmony with all demonstrable facts of the natural world.

In view of the subjectivity of the evidence upon which a decision on the matter of origins must be made, creationists and evolutionists should each hold the other in respect. Because all men

are equal before God, and every one is a free moral agent, we must eschew demeaning and derogatory assertions about, and condemnatory opinions of, a man just because he is a creationist, or an evolutionist.

KOHOUTEK, COMETS, AND CHRISTIANITY

PETER A. STEVESON*

When compared to predictions and expectations of many, the comet Kohoutek was the disappointment of the century. Still, the immense publicity which it received raised questions to which creationists should find answers. The author notes that, while comets do not, as some have hoped, contain evidence about the origin of the universe or of the solar system, they can be considered as evidence for a young system, and hence for a young earth.

Introduction

Though analysis of the data is still continuing, a brief look at the 1973-74 winter phenomenon, comet Kohoutek, seems appropriate. No comet since Ikeya-Seki in 1965 has received the publicity which welcomed Kohoutek. Of course a unique study of the comet was possible since the comet arrived at the same time as the Skylab 3 trip.

Extreme predictions were made. Following are only three representative statements:

Kohoutek is believed to be a piece of debris left over from the birth of the solar system. The pictures hopefully will reveal many of the chemical elements of the comet and thus provide clues to the early history of the sun and planets, believed to have been formed 4.6 billion years ago.¹

It is very probably a new comet and so the determination of the orbit is very important. If it is a new comet it should leave some information not only about comets, but about the origin of the solar system.²

All through the space program, we've been looking for a Rosetta stone—what is the primordial material out of which the solar system is made? We looked for it on the moon and we didn't find it; we found other things instead. Now we're down to our last chance—the comets.³

Kohoutek is just one of many comets which have been observed over the years. Halley's comet, named for the man who first plotted an approximate orbit for it and who predicted its return in 1758, is probably the most well-known. Chinese observations of this comet date back almost two thousand years.

Biela's comet was first discovered in 1826. On its third return, in 1846, its nucleus split into two cores. These reappeared in 1852 but, on subsequent expected returns, only bright meteor showers were observed. Today, due to orbital perturbations, no trace remains of Biela's comet.

Encke's comet, however, has returned many times since its discovery by Pons in 1818. This comet is distinguished by having the smallest known period of any comet, 3.3 years.

For years, comets were little understood objects which were greatly feared. They were believed to represent evil spirits and were connected with human tragedies. John Maplet set forth the common belief in *The Diall of Destiny* in 1581:

These Comets doe prognosticate Warre, Commotions, sturres, stryfes; Treasons, and such like, because yt in the tyme of their Generation and continuance, exceeding heate ruleth and boyleth in men, which Incenseth and sturreth forwards thereto, the bodyes and myndes of men. And besides this, it signifieth more especially the death of Princes and Noble Personages, for that the Ayre which then is more grosse and viscourse through the corrupted matter of ye Comet, is not so wholesome for delicate and delicious Persons, as for the lusty and course Constitution of the bodyes & appetites of Labourers and Husbandmen.⁴

Even with Kohoutek, we have had a continuance of such superstitious belief. A group of young adults, all members of the controversial "Children of God" sect, carried signs in front of the United Nations building in New York to indicate that the United States would be destroyed in 40 days, by January 31, 1974.

According to the leader of the sect, David Berg, comet Kohoutek was a sign of this destruction.⁵ Astrologers have also predicted that the visit of Kohoutek is a bad sign for President Nixon.⁶

*Peter A. Steveson is the Chairman of the Bible Department, Bob Jones Academy, Greenville, South Carolina 29614.

The *Catalogue of Cometary Orbits*, published by the British Astronomical Association (1961) lists only 566 individual comets known at that date. These included 94 short-period comets, 40 of which had one apparition only; 117 long-period comets; 290 comets with parabolic orbits, i.e., insufficient observation to allow a more accurate orbital determination; and 65 comets with hyperbolic orbits, i.e., in the process of being ejected from the solar system.⁷

Some General Details on Comets

The mass and size of comets vary widely. Because of the gaseous nature of the coma, it is not possible to observe a comet directly. However, an upper limit to cometary masses may be set by the fact that comets do not exert any measurable gravitational influence on even the minor planets, while the comets themselves may be perturbed substantially.

A lower mass limit is set from the rate of loss of mass at perihelion. This mass loss occurs at a rate on the order of 100 tons/sec, equalling a total mass loss on the order of 10^{13} gr. for a single passage. Total cometary masses thus are estimated to be between 10^{15} and 10^{17} gr.⁸

The size of the nucleus is given an upper limit from the fact that, in the case where comets have transited the face of the sun, they could not be seen. Thus the diameter must be less than 70 km. The average diameter of the cometary nucleus is estimated to be about 1 km.⁹

Spectrographic analysis of comas and tails has been conducted. A number of common substances are usually present, including the hydroxyl (OH) and imino (NH) groups, cyanogen (CN), various hydrocarbons (CH, CH₂, C₂, C₃) and other radicals (CH⁺, CO⁺, N₂⁺). Traces of many metallic elements have been observed (Fe, Ni, Cr, Cu, K, Na, Ca, Mg) in the heads of sun-grazing comets. The "forbidden lines" of O I have been observed in some comets. Observation of Kohoutek indicates the presence of methyl cyanide and hydrogen cyanide, never before observed in any comet.¹⁰

The most spectacular part of a comet, the tail, is actually nothing more than a good vacuum, with a density estimated to be 10^{-20} that of air, i.e., one molecule/cc, about that of empty space. A comet's nucleus is heated as it nears the sun, causing dissociation and ionization processes to take place. Solar radiation pressure drives the molecular particles radially away from the sun. Some scientists have suggested that solar corpuscular radiation, or the ejection of high-velocity particles from the sun, may be an important factor in tail formation.¹¹

Long straight tails, which normally are associated with comets, are formed by the above

repulsive forces on the lighter molecular particles. Curved tails, which also occur in comets, are due to the combination of attractive gravitational forces on the heavier particles and the repulsive forces, with the centrifugal force of orbital motion and, perhaps, interplanetary magnetic fields also acting upon the tail.¹²

Analysis of the orbits of known comets has shown the definite influence of planets upon them. The distribution of cometary nodal distances shows a large number near Jupiter's orbit.¹³

An interesting example of a significant perturbation is found in Comet Oterma. During 1936-39, this comet made a prolonged close approach to Jupiter. As a result of this, the period of its orbit was reduced from 18 to 7.9 years. During 1962-64, however, the comet again approached Jupiter, within 0.1 astronomical unit, and the orbit was enlarged again to a period of 19.2 years.¹⁴

Problem: Origin of Comets

The origin of comets has long puzzled astronomers. Currently, Jan Oort has suggested that comets were formed in the same general region as the planets; and, then, were set into large elliptical orbits through planetary perturbations. This idea is favored by the majority of astronomers.

Oort cites statistical investigations by Fayet (1910) and van Woerkom (1948) which show that approximately half of all comets thus formed would be ejected from the solar system, while the other half would be set into elliptical orbits with aphelion distance on the order of 10,000 astronomical units, and periods of about 40,000 years.¹⁵

From such a reservoir, estimated by Oort to be on the order of 10^{11} comets, perturbations by passing stars and planetary perturbations may have caused some comets to assume short-period orbits.

Many other proposals of cometary origin have also been developed. Oort himself has suggested that "the occurrence which gave birth to the belt of asteroids formed, in addition, a large number of fragments moving in unstable orbits . . . a number of the small condensations suffered large perturbations, bringing them into orbits of considerable eccentricity."¹⁶

Some have suggested that Jupiter or one of its moons has ejected planetary mass into cometary orbit. Whipple points out that this seems to violate the physical conditions necessary for an icy comet structure.¹⁷ Lyttleton also comments that the orbits of the long-period comets show no relation to Jupiter.¹⁸

R. A. Lyttleton has developed what is probably the second most commonly held speculation of cometary origin. He has proposed a process of accretion from interstellar dust clouds.¹⁹ Abell, however, has pointed out that, if comets were interstellar objects, there should be a preponderance of them approaching the solar system from the direction of Hercules due to solar motion.²⁰ Moreover, there is no known case of a comet approaching on a hyperbolic orbit as would be true if it came from interstellar space.²¹

Possible Biblical References to Comets

Comets are of only minor importance in the Bible. Of course, they can be included in the reference in Genesis 1:14 where the "lights in the firmament of the heaven" are said to "be for signs . . ." The word "sign," *'ot*, is used 80 times in the Old Testament. Regularly, it indicates a religious symbol, a mark with spiritual significance.

Certainly, as we look up into the heavens, whether there be a comet or not, we are reminded that "the glory of God" is being declared. Realizing, though, that comets have often been connected with fearful superstitions, we should heed the admonishment of Jeremiah 10:2, "Be not dismayed at the signs of heaven; for the heathen are dismayed at them."

Unusual activity in the heavens should not cause Christians to be concerned; rather, they should look upon the awesome revelations of power and the infinite variety displayed as evidence of the omnipotence of God.

There are two passages in the Bible in which the appearance of a comet is disputed: (1) I Chronicles 21:16 contains the picture of the angel of the Lord standing "between the earth and the heaven, having a drawn sword in his hand stretched out over Jerusalem." While the long tail of a comet might be interpreted as an angel with a drawn sword, it is highly unlikely that this was the actual case in this passage. The "angel of the Lord" regularly appears in the Old Testament as an actual being.

Further, in v. 27, the angel is commanded by the Lord "and he put up his sword again into the sheath thereof." The whole picture seems to be of a literal judgment executed by the Lord's messenger upon Israel.

(2) In Revelation 8:10, the author tells of that yet future judgment when "there fell a great star from heaven, burning as it were a lamp, and it fell upon the third part of the rivers, and upon the fountains of waters." Commentators seem to be about evenly divided as to whether this should be taken literally or symbolically.

Older writers seem to prefer a symbolic interpretation, with the "star" representing some great

world leader who spreads poisonous doctrine to corrupt the souls of men. More recent authors, however, tend to take this literally and represent a comet or meteor as striking the earth and polluting the water supply of many nations. While it is difficult to visualize the actual happening, there is no doubt but that the Lord is able to judge the nations of the earth in this manner.

The single passage of the Bible which most clearly refers to a comet (though this is disputed by some) is found in Jude 13, where false teachers are described as "wandering stars, to whom is reserved the blackness of darkness for ever." The picture is one of a comet, ejected from our solar system, traversing its hyperbolic orbit through the emptiness of a vast universe.

So, one day, those who have appeared to shine for a brief moment in this life through the promotion of false doctrine will one day experience the unending, lonely torment of hell. Kohoutek, as all comets, should remind us of this sad fact.

Comets and Origin of Solar System

One other question of importance should be discussed. May comets, as scientists have suggested, be used to deduce anything about the origin of the solar system? In the author's opinion, even a direct probe which would allow a detailed analysis of a comet's nucleus would not afford any more than is known already of creation.

Scientists in Project Mohole failed to find the expected depth of sediment covering the ocean floor; and, astronauts failed to find the expected layer of dust covering the moon. Therefore, it seems unlikely that the study of a comet would uncover material to support the evolutionary thinking of scientists.

As a matter of fact, based on what is already known of comets, a recent creation is most logical. Even secular scientists realize that comets have limited lifetimes, as is noted in the following:

The distinguishing feature of a comet is the ability to release relatively large amounts of dust and gas when the nucleus is heated by solar radiation, especially at small distances from the sun. Observationally, this may be translated into a minimum requirement of a more or less diffuse appearance on at least some occasions. The material released is lost to the comet; hence, the lifetimes of comets in the inner solar system must be limited.²²

As the comet begins to approach the Sun through the inner precincts of the solar system and starts developing a tail, it is bound to lose mass irretrievably to the interplanetary substrate. How long can a comet afford to sustain such a loss and avoid complete dis-

integration? . . . an assessment of the amount of mass lost in the course of each orbital cycle discloses that the average lifetime of a comet that approaches the Sun within less than the distance of the Earth is limited to centuries rather than millenia.²³

R. A. Lyttleton has estimated that "probably no short period comet can survive more than about 10,000 years."²⁴ He has concluded:

In the whole age of this system, a comet with average period 100,000 years would make 4.5×10^4 returns to the sun, and if at each one of these it lost only 1/1000th of its mass, through tail-formation and meteor-stream production, the initial mass would have been more than 10^{19} times as great as the present mass—which at a minimum means several times the mass of the sun!²⁵

Thus creationists can use the continuing loss of mass by comets as a strong argument for a recent creation.

Secondly, the existence of comets with periods as great as 100,000 years can also be used to support a young solar system. For, if the solar system were as old as 4.5×10^9 years, then comets would have been perturbed out of the system long ago.

According to the statistical work referred to above by van Woerkom, approximately half of all comets would be ejected from the solar system under the influence of Jupiter and the other planets. Even if the percentage of comets affected were not this great, if repeated often enough, then a comet's travels through the solar system must surely bring it under planetary influence and convert it into a short-period comet, or eject it from the solar system.

Of particular interest, in this connection, is the fact that the very existence of so many short-periods comets is the major reason for development of the Jovian ejection concept by S. K. Vsekhsviatskii and his associates.

From the comet-density in space, based on the known comets, they estimate that the number of comets in the Jupiter family is about 100,000 larger than could have been captured by the planet during the lifetime of the solar system. Further, "they find the lifetime of the short-period comets to be so brief that Jupiter could not conceivably acquire replacements as fast as the old members of his family wear out."²⁶

From this point, a speculation has been developed which has no observational basis in fact, and which is in contradiction to what astronomers think is known about planetary structure. But the fact still remains that these scientists have recognized the inherent short lifetime of a comet.

A person's faith need not be shaken by the speculations of scientists regarding comets. The observations of secular scientists confirm the teaching of the Bible regarding creation. Clearly, creationists can say with the author of the book of Hebrews: "Through faith we understand that the worlds were framed by the Word of God."

References

- ¹ *The Greenville Piedmont*, December 26, 1973.
- ² *The Greenville News*, December 29, 1973.
- ³ *Time*, special Report/Science, December 17, 1973, p. 95.
- ⁴ Kocher, Paul H. 1953. *Science and religion in Elizabethan England*. The Huntington Library, San Marino, p. 166.
- ⁵ *The Greenville News-Piedmont*, December 30, 1973.
- ⁶ *The Greenville News*, December 12, 1973.
- ⁷ Porter, J. G. 1963. The statistics of comet orbits (in) *The solar system*. Vol. IV. University of Chicago Press, Chicago, p. 551.
- ⁸ Struve, O. and V. Zebergs. 1962. *Astronomy of the 20th century*. The Macmillan Company, New York, p. 163.
- ⁹ *Ibid.*
- ¹⁰ *The Greenville Piedmont*, January 12, 1974.
- ¹¹ Struve and Zebergs, *Op. Cit.*, pp. 162f.
- ¹² Pannekoek, A. 1961. *A history of astronomy*. Interscience Publishers, Inc., New York, p. 424.
- ¹³ Porter, *Op. Cit.*, p. 560.
- ¹⁴ *Ibid.*, p. 570.
- ¹⁵ Oort, Jan H. 1963. Empirical data on the origin of comets (in) *The solar system*. Vol. IV. University of Chicago Press, Chicago, pp. 668f.
- ¹⁶ *Ibid.*, p. 671.
- ¹⁷ Whipple, Fred. 1963. Structure of the cometary nucleus (in) *The solar system*. Vol. IV. University of Chicago Press, Chicago, p. 661.
- ¹⁸ Lyttleton, R. A. 1968. *Mysteries of the solar system*. Clarendon Press, Oxford, p. 146.
- ¹⁹ *Ibid.*, p. 134.
- ²⁰ Abell, George. 1964. *Exploration of the universe*. Holt, Rinehart and Winston, New York, p. 291.
- ²¹ Porter, *Op. Cit.*, p. 555.
- ²² Roemer, Elizabeth. 1963. Comets: Discovery, orbits, astrometric observations (in) *The solar system*. Vol. IV. University of Chicago Press, Chicago, pp. 527f.
- ²³ Kopal, Zdenek. 1973. *The Solar System*. Oxford University Press, London, p. 105.
- ²⁴ Lyttleton, *Op. Cit.*, p. 110.
- ²⁵ *Ibid.*, p. 147.
- ²⁶ Richardson, Robert S. 1967. *Getting acquainted with comets*. McGraw-Hill Book Company, New York, p. 221.