INSTITUTE OF CURRENT WORLD AFFAIRS

ATW-20:

Kohoutek Is Coming!

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Dear Mr. Nolte:

Our planet earth is about to be visited by a ghost. The name of the visitor is "1973f" or "Kohoutek," and it is a great comet, perhaps the greatest of the century.

Comets have been called the ghosts of the solar system because they are so insubstantial relative to their size and brightness. Percival Lowell called them "bagfuls of nothing," and, in fact, their most eye-catching features -- great tails of enormous length and brilliance -- seem to be nothing more than tenuous streamers of gas excited to luminescence by the radiation of the sun.

The great comet now rushing at us from the far corners of space was discovered on March 7th of this year by Dr. Lubos Kohoutek of the Hamburg Observatory in Bergedorf, West Germany. It showed up on a photographic plate as a faint, diffuse object with no tail in the constellation of Hydra. Subsequent observations made possible the calculation of the orbit of this body. We now know that it will reach perihelion, its closest approach to the sun, on December 24th, and it should be spectacularly visible to the naked eye for about six weeks before and after that date.

The word "comet" comes from the Greek "hairy star." Comets are members of the solar system. Like planets they revolve in orbits around the sun. But these two families of solar objects have little in common. Planets travel in elliptical orbits of low eccentricity (that is, almost circular) that are mostly in the same plane. Comets move in highly eccentric orbits (cigar-shaped) in all planes or in open curves (parabolas) that bring them around the sun only once, after which they disappear forever back to the cold and distant reaches from which they came.

When a comet is far from the sun, it moves relatively slowly, gives off no light, and probably exists as a chunk of ice and dust some tens of kilometers in diameter. As it approaches the sun, it speeds up and becomes active. First its frozen gases begin to evaporate, forming a nebulous halo or coma around the nucleus of particulate matter. Sunlight reflected from the solid particles in the nucleus makes the approaching comet visible to telescopes on earth. The coma soon begins to glow, much like a giant fluorescent light, as the sun's energy excites the molecules of gases. Then, as the comet nears the orbit of Mars, always accelerating in its fall toward the sun, it begins to develop its tail. Material passes from the nucleus to the coma to the tail and streams out into space. The tail may grow at the rate of a million kilometers a day until it is hundreds of millions of kilometers long, or more than the distance of the earth to the sun. It always points away from the sun, which is the source of all the comet's energy.

When the earth is in a favorable position for observation of a great comet dashing toward its rendezvous with the sun, dwellers on the

earth may see some remarkable sights. Over a period of weeks the new light in the sky becomes steadily brighter, outshining all the stars, becoming brighter even than Venus, so bright that it may remain fully visible in daytime. At night, the huge tail may cover a third or more of the sky, changing form over a period of hours.

Kohoutek's Comet is gigantic. Many large comets are not discovered until they are within a very few months of perihelion. Comet Kohoutek, visible nine months away from its closest approach to the sun, could not have been seen at that distance were it not unusually large. It should become visible to the naked eye sometime in mid-November, when it will be in the morning sky before sunrise. It will increase in brightness daily, reaching the brightness of Sirius about mid-December. During Christmas week, much brighter and moving very fast, it will make its perihelion pass behind the sun and emerge in the evening sky after sunset. Its tail, still pointing away from the sun, will now be leading the head on the return journey. The comet should be most spectacular in the middle of January, and will come closest to earth on the 15th of that month. It will be seen as well in the northern hemisphere as in the southern.

What impact this apparition will have on the world we will know soon enough. In the past, great comets have inspired awe and terror among men and have often been taken as omens of disaster, particularly of the deaths of leaders. "When beggars die, there are no comets seen/ The heavens themselves blaze forth the death of princes," wrote Shakespeare in Henry VI. The comet of A.D. 453 heralded the death of Attila and that of A.D. 435 the death of the Emperor Valentinian. In 79 A.D.

the Emperor Vespasian, in good health, refused to be intimidated by the appearance of a comet. "This hairy star," he declared, "does not concern me. It menaces rather the king of the Parthians, for he is hairy and I am bald." But Vespasian died soon afterward. The belief in the association between the death of the great and the appearance of blazing stars in the heavens was so strong that some ancient chroniclers seem to have recorded comets that were never seen, such as the comet of 814 that was supposed to have announced the impending death of Charlemagne.

"Old men and comets," wrote Jonathan Swift, "have been reverenced for the same reason: their long beards and pretences to foretell future events." As omens of tribulation, comets approaching perihelion show good correlation with earthly wars and other misfortunes. Halley's Comet in A.D. 66 was probably the "sword of fire" described by the Jewish historian Josephus as hanging over Jerusalem not long before the destruction of that city by Titus. Halley's Comet was also in the sky at the time of the Battle of Hastings and again in 1456, three years after the fall of Constantinople to the Turks, when its appearance filled Christian Europe with dread. The Pope ordered prayers to be said, and the common prayer of the day was: "Lord, deliver us from the devil, the Turk, and the Comet!" A brilliant comet of 1528 again kindled fear in the population of Europe. Of it, wrote Ambroise Paré, the father of French surgery, "This comet was so horrible, so frightful, and it produced such great terror in the vulgar, that some died of fear and others fell sick. It appeared to be of excessive length and was the color of blood."

In Boston in 1680, Increase Mather used the occasion of a comet's

appearance to preach a rousing sermon titled, "Heaven's Alarm to the World." He took as his text a line from Revelation (8:10): "And the third angel sounded and there fell a great star from heaven, burning as it were a lamp. . . ." After describing various signs of doom that can be read in the sky, Mather told his listeners:

> God in his Providence doth so order, as that sometimes Blazing Stars are seen in heaven. Such Stars are called Comets for the stream like long Hair, which useth to attend them. Such a Star is Prodigious and a Fearful Sight . . . . These Fearful Sights are many times Presages of those things which make way for great Changes and Calamityes to come upon the World. . . . Such Signs are frequently portentous of those Judgements, which cause Want and Scarcity: e.g., of sore Droughts and Blastings and the multiplication of noxious Creatures that destroy the Fruits of the Earth. . . . Such Sights are Heaven's Alarm to a sinful World, to give notice that God hath bent his bow and made his Arrows ready and that if Sinners turn not, the Arrows of Pestilence and Death shall fall down upon them speedily.

Mather recounted to the congregation a long series of historical disasters heralded by Blazing Stars. He then exhorted them:

> As for the Sign in heaven now appearing (which hath occasioned me to speak this Word at this time) what Calamityes may be portended thereby, which of the Judgements mentioned or whether all of them be not thereby presaged I shall not say, but leave it unto God and Time to discover. . . . Let us admire the Clemency of that God, who before He smites us, causeth such Signs in Heaven, that so He might awaken us out of our security. . . . And let us not make ourselves secure by saying or thinking that the Lord by such fearful Sights speaks to others onely and not unto Us. As Vespasian, the Emperor, when there was a long hairy Comet seen, he did but deride at it and make a Joke of it, saying that it concerned the Parthians that wore long hair and not him who was bald, but within a year Vespasian himself (and not the Parthian) dyed . . . . Let us then prepare for Trouble. We should onely expect it; but so expect it as to prepare for it. Certainly we have reason so to do. If there had been no Blazing Star, yet upon other accounts, we have cause to expect and prepare for another Day of Trouble which seems to be hastening upon thee, O NEW ENGLAND, and upon thee, O BOSTON.

Superstitious beliefs about comets gave way gradually to factual knowledge. Ancients thought comets moved about in the earth's atmospere, where they could exert evil influences on the world. Disproof of this idea did not come until 1577 when the Danish astronomer Tycho Brahe found by careful measurement that the brilliant comet of that year did not differ in apparent position when viewed from his observatory at Hven in the Baltic Sea or from Prague, some 400 miles to the south. He was able to infer from this observation that the comet was far more distant than the moon.

Edmund Halley worked out the problem of the motion of comets in 1705. He used Newton's theory of gravitation to calculate the orbits of 24 bright comets and noted striking similarities in those of 1531, 1607, and 1682. After making all possible comparisons among them, he concluded they were one and the same body, traveling around the sun in a highly eccentric, elliptical orbit with a period of about 77 years. Allowing for the perturbing effect of Jupiter on the comet's motion, he predicted its return at the end of 1758: "Wherefore, if it should return according to our prediction about the year 1758, candid posterity will not refuse to acknowledge that this was first discovered by an Englishman." The comet was sighted telescopically on Christmas Day 1758, sixteen years after Halley's death, and reached perihelion on March 12th of the following year. Its appearances have been recorded all the way back to 240 B.C. Mark Twain was born when it was in the sky in 1835, and he often predicted that he would die in the year of its return. And so he did in 1910. In that year, the earth passed through the tail of Halley's Comet without detectable effect, (good proof of the insubstantiality of comet tails), but cases of insanity

and even suicide were reported as effects of the apparition of this most famous Blazing Star. Its return in 1986 is eagerly awaited, although it may seem pale by comparison with Kohoutek's Comet, which is much bigger.

Halley's demonstration of the periodic return of comets was a great blow to astrologers, who had accorded much significance to these ghostly visitors. A random visitation from space is much more likely to serve as a proper omen than one that comes around like clockwork every so many years. In fact, we now know that only some comets move in orbits that bring them around the sun periodically. Most of these periodic comets seem to have been deflected into elliptical orbits by the perturbing influence of Jupiter -- the most massive body in the solar system next to the sun. They have periods of less than 100 years (some much less) and are often referred to as "Jupiter's Family of Comets." In addition, some returning comets of longer periods are known; they may be associated with the other major planets.

Kepler speculated that the heavens must be as thickly populated with comets as the seas with fish but that only a small proportion of the whole ever becomes visible. And of these many comets, most -- like Kohoutek's -- move in parabolic orbits: open curves that bring them around the sun only once and then send them out to the farthest reaches of the solar system whence they came.

The human urge to assign meaning to spectacular appearances of these one-time visitors finds support in C.J. Jung's concept of synchronicity, which he defined as "a certain curious principle . . . that takes the coincidence of events in space and time as meaning something more than mere chance, namely, a peculiar interdependence of objective events among themselves as well as with the subjective (psychic) states

of the observer or observers." In other words, a prodigious event in the heavens must correlate with something on earth. It is not that a comet causes special events down here -- synchronicity has nothing to do with causality -- but that special events down here and up there are interdependent. The time of a great comet is thus a special time, and the celestial display is merely the outward sign of specialness.

That people have so frequently interpreted such signs in negative ways may simply reflect the pessimism of many people. As Increase Mather put it: "If there had been no Blazing Star, yet upon other accounts, we have cause to expect and prepare for another Day of Trouble." But some observers through the ages have seen in comets great beauty and benignity. Here are the concluding words of two scientific lectures on comets delivered in the Harvard College chapel by John Winthrop, a professor of mathematics and philosophy, in April 1759, as New England watched Halley's Comet retreat from the sun:

> Such grand and unusual appearances tend to rouse mankind, who are apt to fall asleep while all things continue as they were; -- to awaken their attention and to direct it to the supreme governor of the universe; whom they would be in danger of totally forgetting, were nature always to glide along with an uniform tenor. These exotic stars serve to raise in our minds most sublime conceptions of God, and particularly display his exquisite skill.

If Kohoutek's Comet fulfills its promise of providing a once-in-a-century display at the end of the year, visible across the entire earth, it will certainly rouse us from static conceptions and remind us that we live in a dynamic solar system, where sudden and dramatic change is as much the rule as stability. But what in particular it will have to tell us about the nature of our times, we shall have to wait to see.

Sincerely yours, Andrew T. Weil

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Received in New York on September 10, 1973.