NEW INFORMATION ON COMET HALLEY AS DEPICTED BY GIOTTO DI BONDONE AND OTHER WESTERN ARTISTS

Roberta J.M. Olson[1] and Jay M. Pasachoff [2]

1) Art Department, Wheaton College, Norton, Massachusetts, U.S.A.
2) Hopkins Observatory, Williamstown, Massachusetts, U.S.A.

ABSTRACT

Artists' depictions of comets provide the only visual evidence of historical comets, most notably of Halley's Comet. We discuss the visual evidence of Comet Halley at several passages (684, 1066, 1145, 1222, 1301, 1456, 1531, 1682, 1759 and 1835) and compare these with descriptions and modern images. We also include our own images made with the Canada-France-Hawaii Telescope. Since it was first recognized that Giotto di Bondone painted a comet in place of the Star of Bethlehem and suggested that this was a portrait of the 1301 apparition of Comet Halley [R.J.M. Olson, Scientific American, May 1979, 160-170], a great deal of new information has come to light. We present the textual, visual, and astronomical evidence to support the theory that when Giotto painted his comet in the Scrovegni Chapel he was reflecting his viewing of Comet Halley in 1301.

Keywords: Comet Halley, Art, Historical, Giotto

1. INTRODUCTION

Artists' depictions of comets provide the only **visual** evidence of historical comets, most notably Halley's Comet, before the advent of astronomical photography in the later nineteenth century. As such, they can furnish unique historical information about past apparitions that supplements astronomical observations and texts. They also reveal contemporary attitudes toward celestial phenomena and reflect current scientific thought.

2. DISCUSSION

2.1. Halley's Comet--684 A.D.

Perihelion: October 2
Closest to Earth: September 7 -- 39 million km

While this stylized, linear woodcut purports to record the 684 A.D. apparition of P/Halley, the prickly form from 1493 is one of many related ones sprinkled throughout the text. Thus the pictures merely provide visual punctuation for the chronicle. The illustration is significant because it calls our attention to the fact that the apparition was recorded in Europe in one of the sources used by the compiler of the later *Nuremberg Chronicles*. Chinese records also briefly report the apparition.

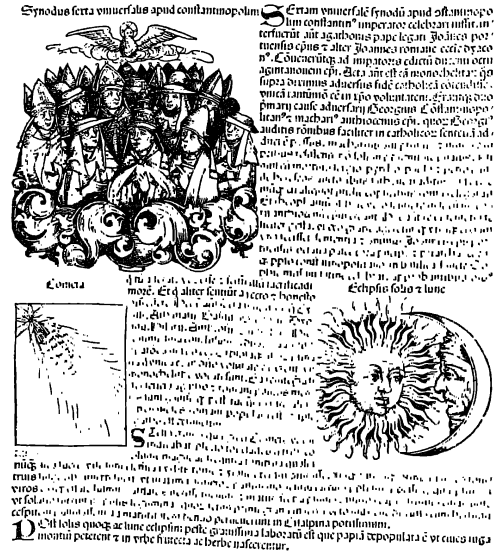

Fig. 1. *Halley's Comet of A.D. 684*, from Hartmann Schedel, *The Nuremberg Chronicles*, 1493.

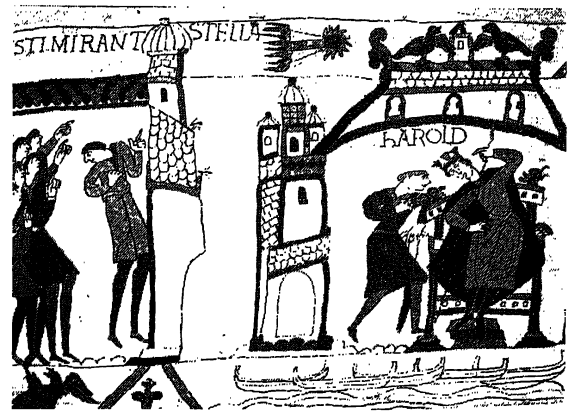

Fig. 2. *Halley's Comet of 1066*, detail of the Bayeux Tapestry, 1073-83. Bayeux Town Hall.

Proc. 20th ESLAB Symposium on the Exploration of Halley's Comet, Heidelberg, 27–31 October 1986, ESA SP-250 (December 1986)

2.2. Halley's Comet--1066
Perihelion: March 20
Closest to Earth: April 24 -- 16 million km

The Chinese recorded this apparition as having a broom-like vapor. A brief report in the *Koryo-sa*, a Korean observation, describes it as being as large as the moon, which Western sources also note (either because of a common source, similar rhetorical judgments, or as absolute judgments of its size). The cathedral archives at Viterbo, Italy, record it as having a tail streaming like smoke up to nearly half the sky. Other Western sources describe it in such rhetorical phrases as "a torch of the sun" or a "flaming beam" -- language that parallels the Romanesque stylizations of the Tapestry. These flattened and simplified cartoon-like forms endow the image with a symbolic power worthy of the accompanying inscription: *Isti mirant stellā* ("they are in awe of the star"). The comet, resembling a primitive rocket ship, does reveal its anatomical parts, albeit stylized: the coma, center of condensation, plasma tail, etc.

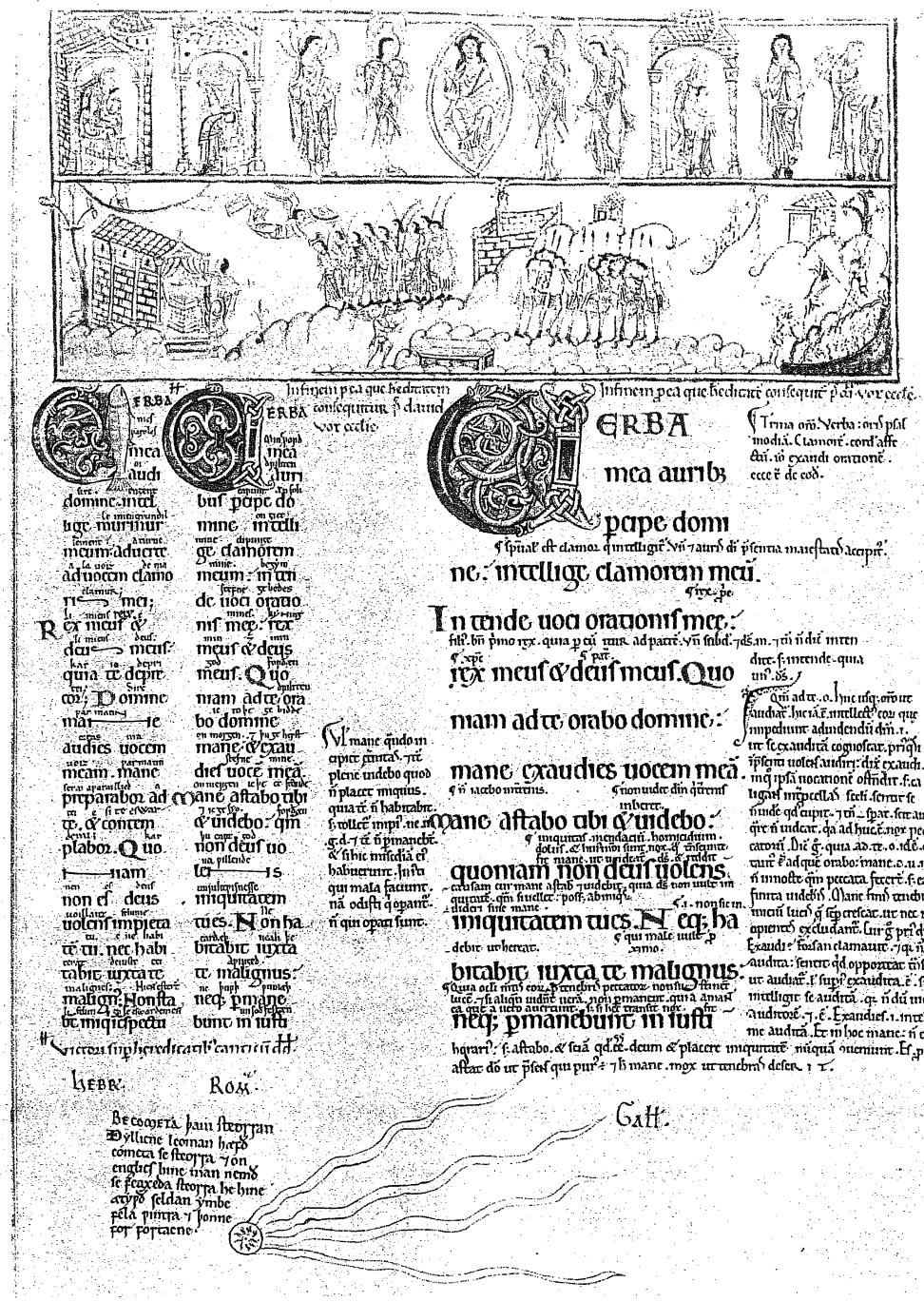

Fig. 3. Eadwine, *The 1145 Apparition of Halley's Comet*, *The Eadwine (Canterbury) Psalter*, Fol. 10r. Cambridge, Trinity College Library.

2.3. Halley's Comet--1145 A.D.
Perihelion: April 18

Halley's Comet of 1145 is shown in this stylized marginal drawing by the monk Eadwine. Even though it is a line drawing, there is an attempt to show a head (including a nine-ray center of condensation) and some structure in the tail. In April 1986, Comet Halley exhibited a fan tail similar to Eadwine's line drawing.

2.4. Halley's Comet--1222
Perihelion: September 28
Closest to Earth: September 6 -- 46 million km

During a century rich in comet apparitions, P/Halley was probably seen by European observers in August and remained visible until 8 October. A fairly recent theory was put forth that the 1222 apparition of P/Halley is depicted in a newly discovered fresco fragment of about 1250 signed by an otherwise unknown artist Grixopolus (Ref. 1). The fresco is in the Palazzo della Ragione in Mantua. It has been suggested that the anemonelike structure to the left of the partriarch Jacob is Halley's Comet. Both Jacob and Isaac hold pieces of drapery containing little children who symbolize the tribes of Israel. Unfortunately, the fresco is too fragmentary to determine the subject of what must have been a large original cycle, and thus the context and meaning of this so-called "comet" has been lost. The supposed tail of this "comet," however, strongly resembles a form to the right of Isaac that looks like the trunk of a stylized tree, and thus raises some questions as to whether it is, in fact, really a comet. If it is indeed a comet, it is interesting to note the following passage not mentioned by Datei: A prophecy of Balaam fulfilled by Christ's birth is recorded by Moses in Numbers 24:17. It reads (in the New English Bible): "A star shall come forth out of Jacob, a comet arise from Israel."

2.5. and 2.6. Halley's Comet--1301
Perihelion: October 25
Closest to Earth: September 23 -- 27 million km

The appearance of P/Halley was recorded in Europe by several individuals, including the eminent historian Giovanni Villani, who describes the *stella comata* that appeared in September as having "great trails of fumes behind." According to him, the Comet remained visible until January 1302, although it is generally agreed that the Comet remained visible from at least 16 September to about 1 November. It seems impossible that anyone alive at this time would have failed to see this impressive comet.

The close approach of the Comet to the Earth and the spectacular nature of its apparition may partially explain why this is the first apparition of Halley's Comet, or of any other comet for that matter, to have inspired a visually convincing portrait of a particular comet. While the time was artistically and intellectually ripe for such an accomplishment, it took the proclivities of Giotto di Bondone, the Florentine pioneer of naturalism, to observe the naked-eye apparition, translate his sensual experience into this image, and thus shatter the schematic artistic conventions for representing comets, one of Nature's grandest icons.

Giotto painted his comet in place of the customary Star of Bethlehem/Epiphany in the *Adoration of the Magi* scene in the Scrovegni Chapel in Padua about 1303-1305, as part of an ambitious cycle narrating the events of the story of Joachim and Anna, the life of the Virgin Mary, and the infancy, mission, passion, and resurrection of Christ. This in no way implies that Giotto or anyone else believed or believes that Halley's Comet was the Star of Bethlehem/Epiphany, as some individuals have misinterpreted the theory.

Fig. 4. Grixopolus, *Fragment of a Cycle with Jacob and Isaac*, c.1250, fresco. Mantua, Palazzo della Ragione.

The Star of Bethlehem is usually depicted as a tiny stylized star, often with rays descending from it that point to the Christ Child to signify God's blessing of the event (Fig. 6A). (To further complicate the matter, in the Birth of Christ story in the *Apocrypha*, two different stars or lights are indicated -- one for the Nativity and a separate one for the Adoration of the Magi -- but usually both are shown as conventionalized stars.)

A visual tradition for representing the Star of Bethlehem/Epiphany as an unusual star existed in Italy before Giotto, as seen in an eleventh-century manuscript page with its bizarre heavenly configuration (Fig. 6B) or in a thirteenth-century manuscript (Fig. 6C). The "star" in the earlier manuscript is too stylized to determine its exact nature (although it may be meant to signify a nova), while the thirteenth-century example is more standard, with its three symmetrical groups of blessing rays that issue from a conventional eight-point star. Another variant of the unusual star is found in Figure 6D, proving that the phenomenon is not restricted to one region of Italy. It is clear that these representations all contain a distinctive star, but that, significantly, none of them depict a form that everyone would identify as a comet.

Fig. 5. Giotto, *The Adoration of the Magi*, 1303-1305, fresco, 78 3/4 by 72 3/4 in. Padua, The Scrovegni Chapel.

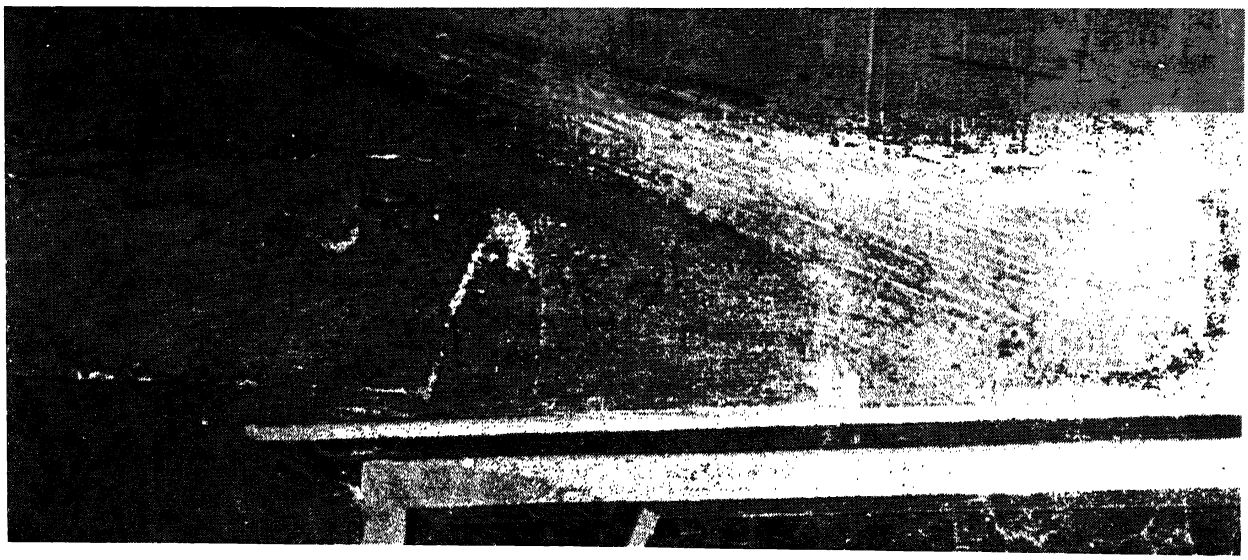

Fig. 6. Giotto, *Halley's Comet of 1301*, detail of Fig. 5.

Fig. 6A. Duccio, detail from the *Maesta: Nativity*, tempera on panel, 1308-11. Washington D.C., The National Gallery of Art.

Fig. 6B. *Initial with the Adoration of the Magi from the Gradual of St. Stefano*, 11th. c. Rome, Biblioteca Angelica.

Fig. 6C. *Adoration of the Magi*, Codex 541, 13th c. Padua, Biblioteca del Seminario Vescovile.

Fig. 6D. Attributed to Giovanni da Bologna, *Adoration of the Shepherds*, 14th c. Whereabouts unknown.

By contrast, Giotto's fresco contains the first unambiguous representation of a comet in an episode from the Infancy of Christ cycle. Moreover, Giotto's revolutionary, large comet is more or less anatomically correct; that is, it shows the head and tail of the comet as it would have appeared to the naked eye. It is thus viscerally convincing.

Giotto's brushstrokes have effectively captured the nature of a comet's composition, including the coma as well as the center of condensation. He has accomplished this by building up layers of red, yellow, and gold pigment in the comet's head. It is interesting to note that beneath the glowing center of condensation and reaching out into the coma are traces of an eight-point gilt star. This configuration may be either a *pentimento*, a first more conservative, traditional idea for the Star that the artist later converted into a comet, or may be an integral part of his visualization of the ever-changing center of condensation and the coma. (Comets have frequently been described as having a star-like head.) One scholar has claimed to discern 24 symmetrical rays within the head and 12 golden rays within the tail (which, on the contrary, seems to have between 12 and 15 irregularly spaced rays, some of which are so faint as to put them into question). The coma appears to be very complex, made up of several layers of paint. At the base is an orange-yellow circular form. On top of that one finds red flame-like points arranged in a circle; it is impossible to determine their number because of the overlapping manner in which Giotto painted them and the condition of the fresco. At the center is a fuzzy orange circular form that covers up part of the eight-point gilt star with a diffuse haze, thus unifying the comet's luminescent head. The whole area is pierced by gold striations, some of which are incised, applied like the spokes of a wheel. (They too are only partially preserved.) These striations also streak through the red-orange tail in an indeterminate number, helping to create the scintillating effect of the comet's jets and streamers. Figures 6E and 6F show, for comparison, the Comet's 1986 passage. Fig. 6E, taken over three months before perihelion, contrasts the diffuse structure in cyanogen with the peaked structure of the continuum. Fig. 6F shows Halley with its tail at a maximum as seen from Earth, six weeks after perihelion.

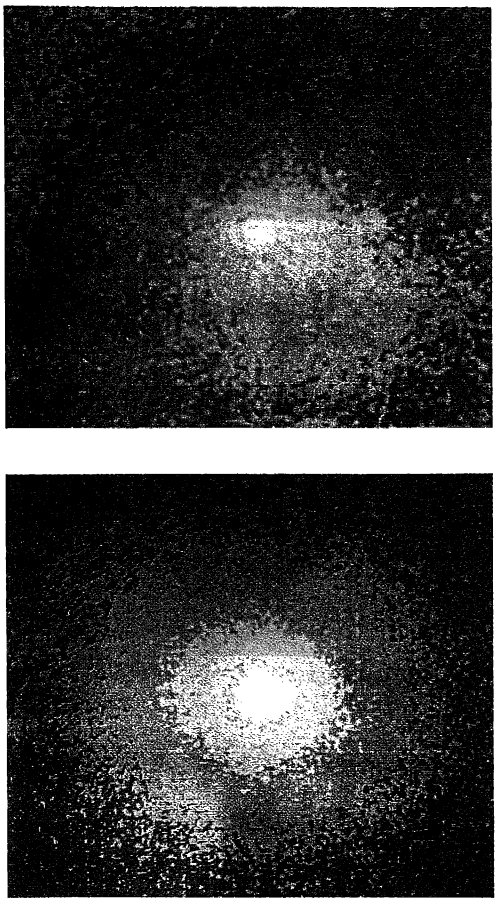

Fig. 6E. Photon counting images of P/Halley, October 1985, at the Canada-France-Hawaii Telescope by C.T. Hua, J.M. Pasachoff, B. Grundseth, and E. Ladd.

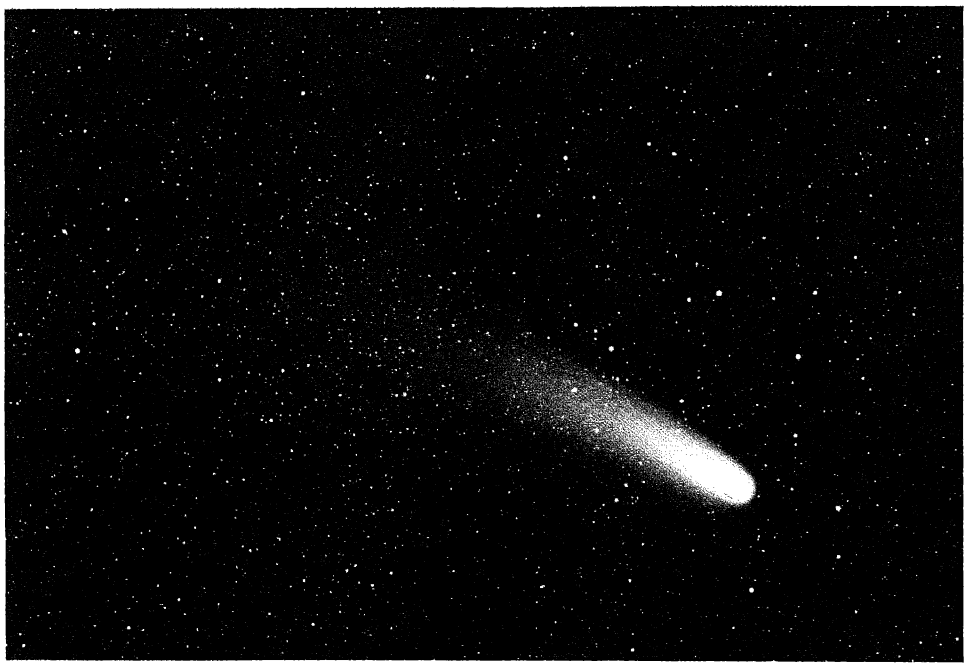

Fig. 6F. Image of Halley in March 1986. Photo by A. Fujii.

The image's immediacy is heightened by Giotto's method of painting the sweeping arc of the tail. It fades out at the left of the scene in an illusionistic manner behind the scene's painted architectural border (a device used frequently by Giotto in this fresco series to connote movement and space, and to propel the viewer's eye in the narrative), just as in nature the frozen gases and interstellar dust activated by solar radiation and solar winds diminish as they are further removed from the nucleus. Giotto's technique thus successfully imparts both depth and the dynamic impression of the comet's passage across the sky that contemporaries would have seen in the naked-eye apparition of P/Halley in 1301.

No contemporary description provides this kind of veracity, strongly suggesting that Giotto's image could not have been rendered without careful firsthand observation. Giotto's magnificent comet dominates the Adoration scene. Because he included a historical comet, which his viewers would have also seen, he enhanced the contemporary impact of his painting and encouraged his viewers to identify with the strong emotion and significance of the scene. For they, like the Magi, had recently witnessed the awesome celestial event, the unforgettable apparition of P/Halley in 1301.

The strong red coloration of Giotto's comet may be partially due to the flaking tempera pigments and red bole adhesive. The comet image, like many elements in the Scrovegni Chapel (especially those painted with non-watersoluble pigments like ultramarine blue), has lost pigmentation in a number of areas. For instance, the dark areas at the end of the tail and the area to the right of the coma seem to be affected. Dark tonalities also appear throughout the background where the blue pigment has deteriorated. But the color red was certainly also an important ingredient in Giotto's original palette. It is significant that many historical comets, including Halley's, have been described with a red cast.

By including the bushy-tailed comet in this Adoration Scene, Giotto was true to his humanistic *modus operandi* demonstrated most tightly in the Scrovegni Chapel. That is, in each scene of the fresco cycle he painted one or two familiar objects with such veracity that his audience could immediately associate with their tangibility. Furthermore, each of these objects usually had a profound symbolic dimension.

So too with the comet. By painting his comet, inspired by his experience of P/Halley 1301, in place of the more conventional Star of Bethlehem/Epiphany, Giotto married his naturalistic observations with an arcane literary/theological tradition dating back to the time of the Church Fathers Origen, so popular in the Renaissance in Florence and elsewhere in Italy for his combination of pagan and Christian ideas, and John of Damascus. Matthew is the only Evangelist who mentions a star leading the Magi to the Christ Child, but he gives no details and certainly does not call it a comet:

> For we have seen his star in the east, and come to worship him... And lo, the star, which they saw in the east, went before them, till it came and stood once where the young child was. When they saw the star, they rejoiced with exceeding joy. (Matthew: 2:2; 2:9-10)

It is only Origen who blatantly states that the star is a comet:

> The star that was seen in the east was considered to have been a new star.... such comets or those meteors [comets and meteors were not then differentiated] which resemble beams of wood or beards or wine jars.... we have read in the *Treatise on Comets* by Chaeremon the Stoic, that on some occasions also, when **good** was to happen comets made their appearance.... If then, at the commencement of new dynasties... there arises a comet... why should it be a matter of wonder that at the birth of Him who was to introduce a new doctrine to the human race... a star should have arisen? (*Against Celsus*, I, 59)

Later, John of Damascus, an influential Byzantine dogmatician, discussed the Star of Bethlehem/Epiphany as a new star, but in a manner so that the reader would think it a comet:

> It often happens that comets arise. These ... are not any of the stars that were made at the beginning, but are formed at the same time by divine command and again dissolved. And so not even the star which the Magi saw.... is of the number of those that [were] made in the beginning. And this is evidently the case because sometimes its course was from the east to west, and sometimes from north to south. At one moment is was hidden, and at the next it was revealed; which is quite out of harmony with the nature of the stars. (*Exact Exposition of the Orthodox Faith*, II, 7)

The Church Fathers would have been read throughout Italy and thus their influence cannot really be localized to a specific region. The New Testament *Apocrypha*, which were frequently more popular than the Bible during the Middle Ages and the Renaissance, were written to embellish the canonical books of the Bible, especially the four Gospels, which say little about the infancy, childhood, and early manhood of Christ. Their embroideries seem to have influenced the entire iconographic program of Giotto's Scrovegni Chapel.

One of the two oldest apocryphal books, which are the basis for all the others, the Protevangelium of James describes the strange new star in language only befitting a comet:

> For we have seen his star in the east.... We saw an extraordinary large star shining among the stars of heaven, and so out-shined all other stars, as that they became not visible, and we knew thereby that a great king was born in Israel, and therefore we are come to worship him.... So the wise men went forth, and behold, the star which they saw in the east went before them, till it came and stood over the cave where the young child was with Mary his mother. (XV:2-9)

One of the later *Apocrypha*, The Evangelist of the Infancy of Christ, has expanded on the earlier account:

> ... L'abbiamo appreso dal segno della stella, --c'è apparsa infatti più folgorante del sole! -- sul cui folgore nessuno mai ha potuto dir nulla. Questa stella, ch'è sorta, significa che regerà la stirpe di Dio nello splendore del giorno. E non girava nel centro del cielo come sogliono le stelle che son fisse e anche i pianeti, che quantanque osservino un certo corso di tempo.... sempre son dette essere erranti i questa sola non è punto errante. Giacchè tutto il polo cioè il cielo ci sembrava non poterla contenere nella sua grandezza. Ma neppune il sole poté oscurarla con lo splendore della sua luce come le altre stelle. Anzi lo stesso sole divenne più fiacco alla vista dello splendore della sua venuta. Giacchè questa stella è la parola di Dio.... E la parola di Dio, Dio [è] ineffabile. Come ineffabile [è] questa stella. Ed essa ci fu compagna per la via che abbiamo fatto venendo a Cristo. (94)

(The important ideas concerning the Star in this passage, which has not been translated into English, are: (1) it is more splendid than the sun; (2) not like fixed stars and planets; (3) it is very large; and (4) it is a sign, the word of God, ineffable.)

Another book of the *Apocrypha*, Pseudo-Matthew, has also been suggested as a source, but it must be discounted for Giotto in that it recounts that the Christ Child was supposedly two years old at the time of the Magi's visit.

While the *Apocrypha* became the property of the common people and were influential on art and literature, many of their stories were later included in the even more vernacular *The Golden Legend* of Jacobus de Voragine of 1298, which enjoyed a wide circulation. It is significant that his book appeared at nearly the same time Giotto painted his fresco and it has been suggested as the most important source for the

Fig. 6G. Follower of Giotto, *Nativity*, c.1316, fresco. Assisi, San Francesco, Lower Church.

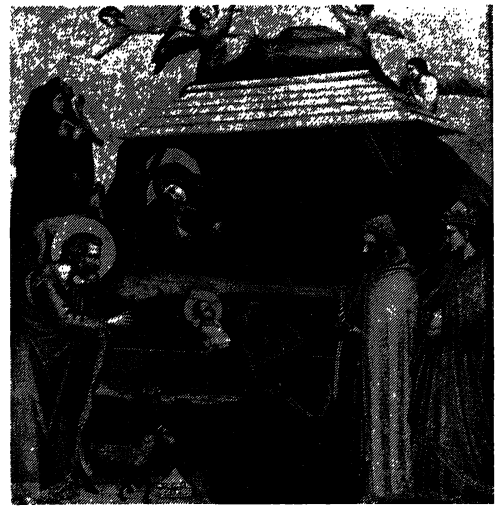

Fig. 6I. Follower of Giotto, *Adoration of the Magi*, tempera on panel. New York, The Metropolitan Museum of Art.

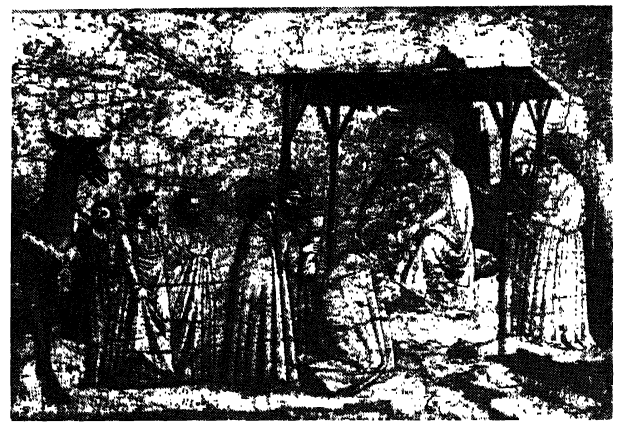

Fig. 6J. Contemporary of Giotto, Copy of *The Adoration of the Magi*, tempera on panel. Whereabouts unknown.

Fig. 6H. Follower of Giotto, *Adoration of the Magi*, c.1316, fresco. Assisi, San Francesco, Lower Church.

Fig. 6K. Jacopo Gradenigo, *Scenes of the Infancy of Christ*, Ms. 78 C.18, Fol. 4r. Berlin, Kupferstichkabinett.

iconography of the chapel. He describes the Star of Bethlehem thusly:

> Now in the night of Christ's birth a star appeared to them, which had the shape of a wondrous child, with a fiery cross upon his head.... As for the nature of the star itself, some think that it was the Holy Ghost who had taken this form in order to guide the Magi. Others think it was an angel who also appeared to the shepherds. Still others, with whom we agree, are of the opinion that it was a heavenly body newly created and that once it had fulfilled its mission, it was absorbed into the matter of the universe... Fulgentius says that this star differed from all others in three things: it was not fixed in the firmament, but hung in the air near the earth; it was so bright that it was visible even in the daytime, eclipsing the light of the sun at noon; and it marched ahead of the Magi like a living person instead of following the circular movement of the stars.

The Epiphany Star (*epi* = above; *phanos* = appearance) certainly owes its ultimate origin to the pagan tradition that the birth of a king was signaled by a comet. And Christ for Christians, was the King of Kings.

Incidentally, Giotto's *Adoration* scene is painted on the south wall of the Scrovegni Chapel in its proper narrative sequence in The Infancy of Christ cycle. If one reads its tail as being foreshortened, as one should, its tail points in a southeastern direction, to the right of the altar wall in the east. (If one reads the image as flat, which one should not, the tail points directly east.) It is thus providential and coincidental that Giotto's Star loosely harmonizes with the biblical and apocryphal accounts which state that the Star came from the east, leading the Magi westward. This fortuitous coincidence is unlike many of the other deliberately calculated foreshadowings and parallels between various scenes in the tightly conceived Scrovegni program, but was probably appreciated by the persons who planned the program.

Giotto was able to paint such a progressive, daring image of the Comet because of the private nature of the Scrovegni Chapel and the nature of the city of Padua. Because it was a family chapel, more artistic and theological license was allowed. In planning the program of the cycle Giotto consulted at least one theological advisor, although his identity is unknown. Furthermore, the Scrovegni Chapel was located in Padua, the university town where Galileo would eventually hold a chair. Already during Giotto's time the university was noted for the study of mathematics, a science that would help transform astrology into astronomy. Thus it was a center for nascent astronomy. Certainly Giotto and/or his patron and his theological advisor had access to some of the latest theories about the heavens.

It has been suggested but not proven that Pietro d'Abano, the Aristotelian medical doctor and astrologer, could have been influential on both Giotto's naturalism and on his specific image of the Comet (Ref. 2). Since Giotto was a Florentine, his naturalistic aesthetic was formed long before his sojourn to paint for Scrovegni and reflects instead the *ambianti* of Florence and Rome. In his *Expositio Problematum Aristotelis Particula*, d'Abano, following Aristotle and Ptolemy, wrote that comets are dry and hot atmospheric exhalations and that:

> Dopo un grande fuoco, la materia perde il colore rosso e si tinge di nero.
> (After a great fire, the material looses its red color and is tinged black.)

Bellinati believes that this brief description accounts for Giotto's powerful comet, not the experience of Halley's Comet in 1301, which no person living in Europe at the time could have failed to see. He also does not account for the technical problems of the fresco which have resulted in its present appearance. His correlation is certainly problematical, especially since d'Abano is not known to have returned to Padua from Paris until 1306, probably too late for an encounter with Giotto. But the suggestion, while a bit chauvinistic and circumstantial, does shed important light on the humanistic ambiance of Padua.

Even more significant for Giotto's image of the Comet is the contemporary theological controversy surrounding the nature of the Star of Bethlehem, already encountered in Voragine's *Golden Legend* of 1298. In the *Prediche del Beato F. Giordano da Rivalto* (born 1260), the churchman wrote that the Star of Bethlehem was not like other stars in the sky, for it did not follow the same path as the other stars. Rather, it was a new star. He specifically states that it was **not** a comet, revealing that the nature of the Star of Bethlehem was a hotly debated topic at the time when Giotto painted his image and that Origen's linkage of that Star with a comet was known.

That fourteenth-century people all over Italy were also very aware of natural phenomena is clear in reading the *Compilatio Cronologia* of Riccobaldo da Ferrara, one of the five contemporary sources to comment on Giotto. Three entries after citing the artist, Riccobaldo mentions an earthquake. A few passages later he discusses a solar eclipse, and near the end he records a comet in June 1314.

Throughout Italy in the popular tradition -- in *presepio* scenes erected in churches and probably *sacra rappresentazione*, which influenced Giotto in the Annunciation scenes, and perhaps others, of the Scrovegni Chapel -- the Star of Bethlehem/ Epiphany was shown as a comet. This is true even today. But it is difficult to trace the exact dates and origins of these practices.

Giotto's blazing comet was such an advanced artistic/scientific statement that it was followed by less than a handful of tiny, timid imitations by his school, but by enough of them to suggest that Giotto's comet had a very special impact. While these diminutive comets echo the literary/theological tradition, they do not preserve Giotto's naturalistic features, definitive proof in itself that Giotto's inspiration was his own experience of a comet and that his model was Halley's Comet of 1301. For example, there are two minuscule, stylized comets in the Lower Church of San Francesco, Assisi, in the Nativity and Adoration of the Magi scenes, painted by followers of Giotto about 1316 (Figs. 6G and 6H). The pigment of the comet in the Adoration has chemically altered so that the form is black and hence difficult to see. (It must be noted that it is especially unusual to represent the Star of the Nativity as a comet; in this case it is accompanied by dominant golden blessing rays from God.) A panel from a larger polyptych by a follower of Giotto contains another stylized mini comet (Fig. 6I). Experts at the Metropolitan Museum of Art think that this comet might be a nineteenth-century addition. *Pentimenti* under the image show that there was once another stylized star in its place, which after a recent inspection **may** have had one thin wispy ray that was longer than the others. The singular nature of Giotto's image is underlined by looking at another fourteenth-century artist's copy of his Adoration scene (Fig. 6J), wherein a stylized comet appears instead of Giotto's naturalistic portrait. A grand but diverse stylized comet also appears in an Infancy of Christ scene in a manuscript by the Paduan Jacopo Gradenigo of around 1399 (Fig. 6K). Here it guides the Magi on their journey, but its head with its stylized eight-point star is found in the middle of the arcing tail encircled by the arms of an angel. Its source is clearly the Infancy Gospel of the *Apocrypha* which states:

> And at the same time there appeared to them an angel in the form of a star which had before been their guide in the journey. (III:3)

Giotto's interest in convincing celestial phenomena was, however, bequeathed to one of his most talented pupils, Taddeo Gaddi, who is recorded to have been partially blinded by an eclipse. A reflection of Taddeo's physical and emotional trauma is found in his fresco scene of the

Annunciation to the Shepherds in Santa Croce, Florence, where an unusual light, synonymous in medieval-Renaissance symbolism with God, permeates the fresco, and one shepherd shades his eyes to gaze up at it in an attempt to penetrate its meaning. The quality of the light and the shepherd's gesture convincingly argue that this preserves Gaddi's autobiographical experience of an eclipse (Ref. 3).

Most recent art historians date the Scrovegni Chapel frescoes, and certainly those of the Infancy of Christ in which the Adoration scene occurs, based on documentary evidence, before the 25 March 1305 consecration of the chapel. The consecration occurred on the feast of the Annunciation, the festival of the Annunciate Virgin, to whom the chapel is dedicated (Refs. 4, 5).

Between 1297 and 1305 there were no other spectacular comets to rival P/Halley in 1301, although one astronomer (Ref. 6) raises the possibility of a second comet in late 1301, based on Pingré's 18th-century reports and Villani (Marsden--Ref. 7--lists only Halley's in 1301). He believes the two may have been conflated. Despite a literary tradition and contemporary trends, Giotto could not have painted his unprecedented portrayal of the Star of Bethlehem as the vivid comet he rendered without experiencing firsthand a spectacular apparition. No written word or visual prototype can explain its revolutionary nature. They can create a context for it, but not the primary nature of the image. The literary tradition and the contemporary zeal for natural phenomena rather created a receptivity in both Giotto and his audience for such a seminal image.

Giotto's comet was surprisingly not equalled in painting until the nineteenth century and not surpassed until the advent of astronomical photography in the late nineteenth century. Giotto's galvanizing image received the highest compliment imaginable when the European Space Agency used the name "Giotto" for their mission to encounter the very comet that Giotto saw 685 years earlier.

2.7. Halley's Comet--1456
Perihelion: June 9
Closest to Earth: June 19 -- 67 million km

This apparition of P/Halley drew impassioned reactions but also scientific stirrings. Pürbach in Vienna made the first attempts to measure the Comet's parallax. The most detailed observations were made by Paolo dal Pozzo Toscanelli (Fig. 7A) in Florence (from 8 June -- 8 July), who plotted the Comet's passage across the sky. These significant drawings were only rediscovered in 1864 and aided Giovanni Celoria in establishing Halley's orbit with great precision. During its 1456 return, P/Halley's tail reached the remarkable length of 60°. The illustration of this apparition from the *Lucerne Chronicles* (Fig. 7B), an illustrated civic history from c. 1508-13, effectively captures some of the current fears regarding the pernicious effects associated with comets in general as well as red rain (thought today to be the aurora borealis). Only one comet (Halley's) is historically documented for 1456, leading one to conclude that what is represented is Halley's Comet both before and after perihelion, because the tails point in two different directions. This illustration thus preserves evidence of accurate observation before Fracastoro or Apian in the sixteenth century posited that comets' tails always point away from the sun (Ref. 8).

2.8. Halley's Comet--1531
Perihelion: August 26
Closest to Earth: August 14 -- 66 million km

The most accurate observations of P/Halley in 1531 are those of Peter Apian of Bavaria. In fact, Halley used them to demonstrate that the comet he saw in 1682 was identical with that of 1531. Paracelsus in Switzerland and Girolamo Fracastoro in Verona also observed it. Both Apian and Fracastoro noted that a comet's tail always points away from the sun. But it was only in his 1540 treatise that Apian's thought matured. (The fact that comet tails always point away from the sun was known by the Chinese by at least the 7th century A.D. although expressed in a different manner.)

2.9. Halley's Comet--1682
Perihelion: September 15
Closest to Earth: September 1 -- 63 million km

Halley himself observed this apparition from 26 August to 10 September. It was not until 1705 that his theory (that the Comet was the same as that of 1531 and that of 1607) was published in the Philosophical Transactions of the Royal Society (*Astronomicae Cometicae Synopsis*). For this he also relied on observations made by John Flamsteed, Astronomer Royal and Halley's assistant at Greenwich.

Fig. 7A. Paolo Toscanelli, *Halley's Comet of 1456*, Ms. Banco Rari 30, Fol. 251v. Florence, Biblioteca Nazionale.

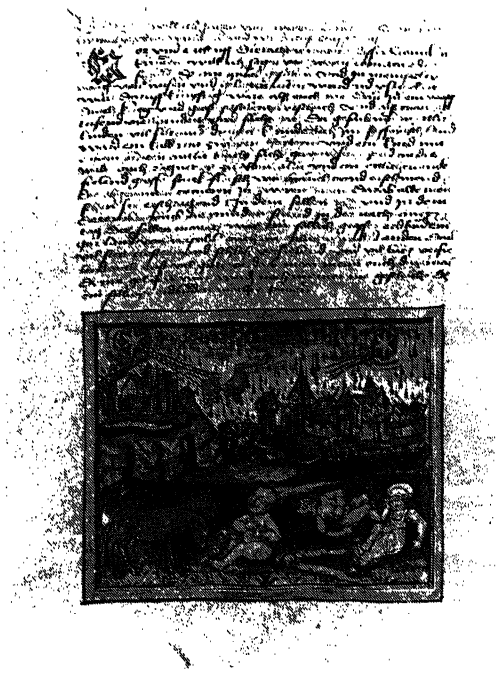

Fig. 7B. Diebold Schilling, *Halley's Comet of 1456, Lucerne Chronicles*, 1508-13. Lucerne, Zentralbibliothek.

PL. I. — PETRUS APIANUS. *Practica auff das .1532. Jar.* Landshut, GEORGIUS APIANUS, (1531). Woodcut: Comet 1531, in August (HALLEY'S comet). (F. VAN ORTROY, No. 17; reduced photostat reproduction).

Fig. 8A. *Halley's Comet of 1531 in the Constellation Leo*, from Petrus Apianus (Apian), *Practica*, 1531.

Fig. 8B. *Halley's Comet of 1531*, detail of a page from Petrus Apianus (Apian), *Astronomicum Caesareum*, 1540.

Fig. 9. *Halley's Comet of 1682 Over Augsburg*, engraving.

Fig. 10. Samuel Scott, *Halley's Comet of 1759 Over the Thames*, oil. Private Collection.

2.10. Halley's Comet--1759-I
Perihelion: March 13
Closest to Earth: April 12 -- 19 million km

1759 saw the verification of Newton's theory of gravitation through its success in Halley's prediction of the return of the Comet. This English painter's nocturnal scene is purported to record the pivotal 1759 apparition hovering over the Thames, with the King's barge in the foreground and Westminster Abbey in the background. Messier observed that, except for a short tail right after perihelion, the Comet was without a tail in 1759. This fact might support the theory that the configuration of the tail in Scott's painting may reflect the conventions of British art for representing comets and meteors. Schmidt (Bull. Am. Astron. Soc. 17, 884, 1985) has concluded on the basis of the object's size, shape, location, brightness, and other evidence that the object pictured is not a comet, and that it may have been a fireball.

2.11. Halley's Comet--1835-III
Perihelion: November 16
Closest to Earth: October 13 -- 28 million km

Painted before the advent of photography, this canvas may contain a reflection of Halley's 1835 apparition. Martin's stupendous comet plunges downward toward the mist-enshrouded cresent moon and the sunset dust-enshrouded sun. Both comet and moon accurately reflect the sun's light, while the comet's tail points correctly in the opposite direction. A coma and center of condensation are clearly evident, while the broad, diaphanous dust tail dominates the image. Other streaks of pigment in the head might be Martin's attempt to show the volatile nature of the comet.

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Fig. 11. John Martin, *The Eve of the Deluge*, 1840, oil. The Collection of H.M. The Queen.

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