THE EARLIEST DOCUMENTED TORNADO IN THE AMERICAS

Tlatelolco, August 1521

by Oscar Velasco Fuentes

On the eve of the fall of the so-called Aztec empire a tornado swept around the besieged capital—seemingly a rare omen, except that records document subsequent tornadoes in Mexico City.

The Basin of Mexico, artificially drained since the seventeenth century, was originally a closed hydrological basin. The lacustrine plain has an average altitude of 2240 m and is surrounded by elevated volcanic ranges (3000–5500 m) on the east, south, and west and by low discontinuous ranges on the north (see, e.g., Sanders 1976). The basin’s high altitude combines with a tropical location (19.5°N) to produce a temperate climate with rainy summers and dry winters. This rain regime seems to have prevailed during the whole historic period despite the relatively large fluctuations in the total annual precipitation (see Jáuregui Ostos 2000; O’Hara and Metcalfe 1997; Therrell et al. 2006).

At the dawn of the sixteenth century the Basin of Mexico was occupied by a chain of shallow lakes and inhabited by Nahuatl-speaking peoples distributed in dozens of altepetl. Literally meaning “water(s) and mountain(s)”, “altepetl” can be understood as city-state although the equivalence is not exact (Lockhart 2004). Estimations of the total population in the Basin range from 800,000 to 1.2 million people, with one quarter of them living in the twin altepetl of Tenochtitlan-Tlatelolco (Sanders 1992). These were founded in the first half of the fourteenth century in two small islands in the western side of the central lake, Texcoco. Drought conditions prevailed at that time, but the climate soon became wetter and the Tenochca (or Mexica) and Tlatelolca flourished under relatively moist conditions (O’Hara and Metcalfe 1997). Two centuries of development and draining works transformed the two islands into a single one of about 6 km in north–south direction and 4 km in east–west direction (see Fig. 1).

The Nahuas, like nearly all early civilizations with an economy based on agriculture, were meticulous observers of astronomical and meteorological
phenomena. Their achievements in observing the motion of celestial bodies, though not as impressive as those of the Maya, are well documented (see, e.g., Aveni 2001). The surviving pictorial manuscripts also give evidence of a careful register of meteorological phenomena such as rains, winds, and storms (e.g., Therrell et al. 2004). The start and end of the rainy season were milestones in their civic–religious calendar. Indeed, two of the most important deities in the Nahua pantheon were related to meteorological phenomena: Tlaloc (He Who Has Earth) was their god of rain, thunder, and lightning and Quetzalcoatl (Plumed Serpent) their god of wind and eddies (Sahagún et al. 1997).

In this respect the Nahuas were in tune with other Mesoamerican civilizations. In the whole region the cult of the Rain God goes back to the earliest of times. Thus, the Maya of Yucatan worshiped him under the name of Chaac, the Mixteca of Oaxaca worshiped him as Dzahui, and the Totonaca of Veracruz as Tajin. The cult of the Wind God, usually represented as a plumed serpent, was just as widely extended and deeply rooted: the Maya of Yucatan venerated him as Kukulcan, the Mixteca of Oaxaca as Lord 9 Ehecatl, and the Maya of Guatemala as Qucumatz (see, e.g., Jansen 1997).

The Nahuas were well aware of the close relation that exists between the mountains and the rain in central Mexico: on top of the mountains surrounding the Basin of Mexico the clouds gather and rain is produced. Hence they considered the mountains to be rain gods, the Tlaloque, attendants of Tlaloc. In consequence, they built temples on top of the major mountains around the basin and conceived of the pyramids within the city as ceremonial mountains (Broda 1997).

The most important source of information about the Nahuas around the time of the conquest is the Historia General de las Cosas de Nueva España, also known as the Florentine Codex because the original manuscript is kept at the Biblioteca Medicea Laurenziana in Florence, Italy. It is the result of over 30 years of work by Franciscan Friar Bernardino de Sahagún and his team of Nahua assistants: the Spanish–Latin–Nahuatl grammarians Antonio Valeriano, Martín Jacobita, Alonso Vegerano, and Pedro de San Buenaventura and the copyists Diego Degrado and Mateo Severino (Sahagún 1981). The Florentine Codex, divided into 12 books, is an encyclopedic compilation of texts in Nahuatl and Spanish (Fig. 2) dealing with all aspects of Nahua culture and life, from social structure and religious matters to natural history. The Nahuatl text, written between 1547 and 1569 by the grammarians, is based on native documents and interviews with elders of high status from three altepetl in the basin (Tenochtitlan, Tlatelolco, and Tepepelo). The Spanish text was dictated by Sahagún to his assistants around 1578–79. It is sometimes a literal translation and sometimes a paraphrase of the Nahuatl text. Book XII, the only one fully devoted to historical matters, is an account of the Spanish conquest of Mexico (1519–21). In the introduction Sahagún explains that this book “was written at a time when those who took part in the conquest itself were alive, and those who gave this account were important people of good judgement who are considered certain to have told the entire truth.” According to Lockhart (2004), the second half of Book XII (chapters 20 to 41) faithfully represents the local view of the events, closely resting on oral tradition and probably on pictorial documents too. As for factual accuracy, Book XII is not very different from the two major Spanish sources, namely Hernán Cortés’ (2001) Cartas de Relación to the emperor Charles V and Bernal Díaz del Castillo’s (1963) Historia Verdadera de la Conquista de la Nueva España.
A chronology of events, consistent with both Nahua and Spanish sources, is briefly sketched here. In November 1519 Cortés and his army were received peacefully in Tenochtitlan by Montezuma, the Mexica ruler. The Spanish army was forcibly expelled in June 1520 after Pedro de Alvarado, one of Cortés’ captains, massacred the local population during the celebration of Huitzilopochtli, the chief god of Tenochtitlan. Cortés spent the following months preparing his return by forging alliances with the enemies of the Mexica, conquering the altepetl that refused to cooperate with him, and building brigantines for the assault of the island city. Meanwhile, Tenochtitlan-Tlatelolco endured a smallpox epidemic that decimated the local population. Since one of the victims was Montezuma’s successor, a new ruler was elected to organize the defense: Cuauhtemoc. The siege started in late May 1521, when Cortés sent divisions to three altepetl on the lake shore: Tacuba in the west, Coyoacan in the southwest, and Iztapalapa in the southeast. After two months of bloody battles Cortés’ army occupied the southern part of the island (Tenochtitlan) and the Mexica took refuge in the northern part (Tlatelolco), where they and the Tlatelolca resisted for two more weeks. Finally, the city fell on 13 August 1521. As is customary, this date is given in the Julian calendar current at the time; in our calendar the date of the fall is 23 August 1521.

THE TORNADO OF Tlatelolco. Chapter 39 of Book XII (Fig. 2) begins with a description of a meteorological phenomenon observed by the Mexica and Tlatelolca in the final days of the siege. Figure 3 shows a transcription of the relevant passage of the Nahua text accompanied by the English translation...
of Anderson and Dibble (Sahagún 1965). A clear understanding of the nature of the phenomenon depends on the words highlighted in the Nahuatl text: ecamalacotl and ecatepoztli (since the spelling in the Florentine Codex is not uniform, here we use the standard spelling of these words). The meaning of the former word is undisputed: ecamalacotl has the roots ehecatl (wind) and malacatl (spindle). Spanish translations, starting with Sahagún’s, use any of two synonymous words: torbellino or remolino. English translations, either of Sahagún’s paraphrase or the Nahuatl text, use “whirlwind.”

The meaning of ecatepoztli is less certain. In pre-conquest times tepoztli was the Nahuatl word for copper and, more generally, any workable, nonprecious metal. By extension it was also used to designate objects made of metal, particularly copper axes (Lockhart 1992). So, literally, ecatepoztli means “wind-copper” or “wind-axe.” Anderson and Dibble use “coppery wind” (Sahagún 1965). Lockhart (2004) prefers “wind-axe” and explains that “ecatepoztli was some sort of meteorological phenomenon”. In the analysis of a different text Lockhart et al. (2006) went further toward elucidating the connotations of ecatepoztli: “reference to its rapid motion and appearing out of nowhere point to a tornado, but the meaning is not fully established”. Ecamalacotl and ecatepoztli appear in parallel in another passage of the Florentine Codex, chapter XIV of Book VI. Here Sahagún makes a literal translation of the Nahuatl text and renders those words as torbellino and tempestad infernal, respectively. Anderson and Dibble, for their part, translate them as whirlwind and severe wind (Sahagún 1970).

If we put this together with the other elements in the description, the image of a tornado clearly appears. For there was a heavy storm with a blazing and roaring whirlwind, which emerged as suddenly as it disappeared. Chapter 39 of Book XII goes on to expound that there was no fighting on the day after the storm, and that Tenochtitlan-Tlatelolco fell on the following day. This sets the date of the tornado as 11 (21) August 1521. As for its path, this may be partially deduced from the geographical details given in the Florentine Codex and Sahagún’s 1585 revision of Book XII (see Fig. 4). The latter says that the tornado came from the direction of Tepeyacac (Tepeyac), about 5 km north-northeast of Tlatelolco, and the former says that it circled the enclosure of the Mexica in Coyonacazco, a quarter of Tlatelolco in the northeastern part of the island (Calnek 1972).

A Spanish document of the early colonial period lends further credibility to the Nahuatl account. A few years after the fall of Tenochtitlan, the Spanish crown ordered the elaboration of a description of the land. The work was completed and sent to Spain in 1532. This document is now lost, but some fragments survive in Antonio de Herrera y Tordesillas’ Historia General de los Hechos de los Castellanos en las Islas i Tierra Firme del Mar Oceano (Bustamante 2000). As Herrera recounts events of the year 1531, he presents the following description of the rain in Mexico City: “it rains in the same season and at the same hours (as in the rest of the country), but with a North wind in the afternoons and not in the mornings, and from the morning till the vespur hour the weather is very fair. At the said hour, about a League to the Northward,

Fig. 3. (left) Transcription of the Nahuatl text describing the tornado of Tlatelolco. (right) English translation by Arthur J. O. Anderson and Charles E. Dibble (Sahagún 1965).
over the mountain range of Tepeaquilla (Tepeyac), a very black cloud gathers, and soon after comes to Mexico with mighty airflow and whirlwind. Thus in order to see if it will rain it is enough to look for heavy clouds over the mountain range of Tepeaquilla, because then it is certain there will be rain" (Herrera y Tordesillas 1601, fourth decade, ninth book, sixth chapter). In view of this account we may conclude that the storm and tornado that occurred just before the fall of Tenochtitlan-Tlatelolco was not an exceptional event but an ordinary one occurring at an exceptional moment.

EARLY EUROPEAN DESCRIPTIONS OF TORNADOES AND WATERSPOUTS. Some scholars interpret the tornado of Tlatelolco as being a superstitious construct arising from a desperate situation. According to this view, the Mexica considered the event as a “sign of celestial wrath” (Prescott 1873), a “miraculous tempest excited by their gods” (Brasseur de Bourbourg 1859), or the “final omen that presaged the imminent destruction of the Aztec capital” (León-Portilla 1992). We should notice, however, that the Florentine Codex contains no explicit mention of the meaning or the cause of this particular event. The language used in the description is vivid but factual: the noise and the revolving motion are but defining characteristics of a tornado; as for the fire, it may seem strange now but at that time even educated Europeans invoked this image to describe tornadoes accompanied by lightning. Two well-known accounts, the first one written around the time of the fall of Tenochtitlan and the second one two centuries later, exemplify this. In August 1456 a tornado formed on the Adriatic Sea near Ancona, crossed Italy, and entered the Mediterranean Sea near Pisa. In his Istorie Fiorentine, first published in 1532, Machiavelli described the phenomenon as follows: “This whirlwind, driven by superior forces, whether they were natural or supernatural, broke on itself and fought within itself; and the shattered clouds, now rising towards the sky, now descending towards the earth, crashed together; and then they moved in circles with very great velocity and stirred up ahead of them a wind violent beyond all measure; and in the battling between them appeared frequent blazes and the most brilliant flares” (Machiavelli 1990, p. 270).

On June 1749 a tornado formed on the western coast of Italy, moved inland, and passed over Rome. Boscovich (1749) wrote a detailed account including a census of the damage in Rome, a review of similar events reported in the literature, and a discussion of theories about tornadoes and waterspouts proposed by naturalists of all ages. On the basis of eyewitness accounts Boscovich wrote that the tornado “appeared as a long, dark cloud that went constantly inflaming itself and throwing abundant flares in all directions” (Boscovich 1749, p. 9).

Let us now briefly touch upon two texts that give a fairly accurate description of waterspouts and tornadoes in spite of the providential interpretation which underlies them. These examples have the additional interest of being among the earliest European observations of these vortices in the Americas. During his fourth and last voyage to America, Columbus encountered a waterspout while exploring the coast of Central America. His son Fernando, a 14-year-old member of the crew, later described the episode in the

Fig. 4. (left) Sahagún’s paraphrasic version of 1579 translated into English by Howard F. Cline (Lockhart 2004). (right) Sahagún’s 1585 revision translated into English by Howard F. Cline (Sahagún 1989).
TORNADOES IN MEXICO CITY. A tornado event in what is now the downtown of Mexico City may surprise the modern reader. Indeed, the current view of the scientific community is that tornadoes are exceptional events in Mexico. They are thought to occur only in the northeastern states and along the coastline of the Gulf of Mexico (Goliger and Milford 1998; Berz et al. 2001). An ongoing investigation of documentary sources reveals, however, a different picture. Reviewing books, newspapers, professional journals, and governmental bulletins, we have found records of over 180 tornadoes countrywide in the period 1521–2010. Many more undoubtedly remain to be found in the published literature and also in the rich and varied sources of original, unpublished documents yet to be examined for tornado cases.

Twenty-five of the tornadoes identified thus far occurred in the Basin of Mexico, starting with the tornado of Tlatelolco discussed here and ending with two small tornadoes observed in northwestern Mexico City in April 2008. Furthermore, half of the tornadoes in our catalogue occurred in a narrow stripe, 19°–20°N, that crosses the country from the Pacific Ocean to the Gulf of Mexico. It is still unclear whether the higher incidence in this region, which overlaps the Trans-Mexican Volcanic Belt, arises from the physical conditions being favorable for tornado formation or from the higher population density increasing the chances of tornado sightings. Either way, it is a remarkable statistic because rough terrain is sometimes believed to inhibit the formation of tornadoes (Bosart et al. 2006). A detailed analysis of this developing catalogue of Mexican tornadoes will be published elsewhere (Velasco Fuentes 2010, unpublished manuscript); here we limit ourselves to presenting written and pictorial evidences of tornadoes in Mexico City during the eighteenth and nineteenth centuries.

Antonio Alzate Ramírez, a reputed botanist and zoologist, was also a careful observer of astronomical and meteorological phenomena. His thrice-daily observations of pressure and temperature in Mexico City for the period April–December 1769 were the first systematic series of meteorological data ever published in Mexico. The following is a brief report of a tornado (Alzate Ramírez 1831, vol. 4, p. 389): “On 25 August 1786, at quarter past two in the afternoon, a hose, spout or serpent formed to the north-northwest of this capital. It presented itself for seven minutes either in spiral shape or perpendicular to the horizon. Initially it was dark and later it was whitish.” A few years later he wrote that “spouts, typhons, or water serpents, as they are called here, occur very frequently in this valley: I have seen once, in the month of October, the formation of three at the same time, two to the south and one to the east. ( . . . ) In the present year (1791) a lot of them have formed at a short distance to the Southward of the city.” (Alzate Ramírez 1831, vol. 2, p. 282).

José Gómez de la Cortina, an eminent philologist and politician with a keen interest in geography and geology, was the founding president of Mexico’s National Institute (now Society) of Geography and Statistics. On July 1848 he witnessed a multiple-vortex tornado from his house in Tacubaya. At the time this was a small town outside Mexico City; now it is a populous quarter in the western side of the capital (see Fig. 1). Gómez de la Cortina (1895) wrote that early in the afternoon a cloud developed to the southeast of Tacubaya; then, “a little before five, the cloud had grown and started to throw lightning and strong thunder.” After a while “the cloud formed, in its middle, an inverted cone of about half a league in the base, and two smaller ones towards its southern end. ( . . . ) The larger cone as well as the two smaller ones bounced up and down, unceasingly stretching and squeezing. Their vertices tilted notoriously towards the northwest, as if they were attracted by another dense cloud that was fixed in that direction. At about five fifteen of the same afternoon, the color of the middle of the cloud and the base of the hose or pump was almost perfectly black and their ends were dark olive color, which varied in intensity according to the bending and twisting made by the cloud.” Heavy precipitation, including hail stones larger that 25 mm in diameter, ensued as soon as the tornado decayed.
In 1885 Cleofas Almanza, a student at the San Carlos Academy, painted *Tempestad en los Llanos de Aragón* (Fig. 5), which shows a tornado touching down at Sierra de Guadalupe in northern Mexico City. The subject was assigned to him by his teacher José María Velasco, one of Mexico's greatest landscape painters and an active member of the Mexican Society of Natural History. Velasco lived in Villa de Guadalupe from 1874 until his death in 1912 and carefully observed the storms striking the area (Báez Macías 1998). His handwritten notes have been preserved, so we can see how closely Almanza’s painting follows Velasco’s instructions: “In the plains of Hacienda de Aragon a storm is observed to break. A great spout has formed. A man, carrying his fishing instruments, and his wife, carrying a child on her back, hastily run away. A canoe is abandoned on the bank of the small lake that occupies those paddocks, as the man has no time to take it home. The hills of El Chiquihuite and La Corona, which are part of the mountain range of Villa de Guadalupe, are seen in the distance. Great masses of dust are risen almost to the clouds and the trees bend under the mighty impetus of the hurricane” (see Báez Macías 1998).

Almanza’s painting, which is now exhibited at the National Museum of Art in Mexico City, beautifully shows that tornados occur in the Basin of Mexico. Furthermore, it shows a tornado in the same area where, three centuries earlier, the tornado of Tlatelolco was observed to start (Sahagún 1989).

**SUMMARY AND CONCLUSIONS.** We discuss a meteorological phenomenon that occurred in the Basin of Mexico in August 1521. The only known description appears in Book XII of the Florentine Codex, which is an account of the Spanish conquest of Mexico written in Nahuatl in the mid-sixteenth century. According to it, just before the fall of Mexico-Tenochtitlan a heavy storm accompanied by a whirlwind struck the basin. The whirlwind hovered for a while above Tlatelolco, Tenochtitlan’s twin city, before moving to the lake where it disappeared. Analyzing the account in the context of Nahu culture and contrasting it with contemporary European descriptions of tornadoes and waterspouts shows that the described phenomenon was a tornado. Since this event predates the Cambridge tornado of 1521.
1680 (Mather 1856; Ludlum 1970), the tornado of Tlatelolco represents the earliest tornado on record in the Americas. Documentary sources show that severe storms and tornadoes have occurred under the various climatological conditions that have prevailed in the Basin of Mexico throughout the last five centuries (Velasco Fuentes 2010, unpublished manuscript). This is particularly significant because this basin is now the seat of one of the most populous cities in the world. Even a weak tornado could represent a serious threat to life and property in such a densely populated area.

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REFERENCES


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