

Grids & Datums

UNITED MEXICAN STATES

by Clifford J. Mugnier, C.P., C.M.S.

“Archaeological evidence testifies to the presence of early hunters and gatherers in Mexico around 10,000 to 8000 *B.C.* During the next few thousand years, humans domesticated indigenous plants, such as corn, squash, and beans. With a constant food supply assured, people became permanent settlers. Leisure time became available and was used for developing technical and cultural skills. Villages appeared as the number of people and food supplies increased. By 1500 *B.C.*, the early inhabitants were producing handmade clay figurines and sophisticated clayware. Between 200 *B.C.* and *A.D.* 900, Mesoamerica was the scene of highly developed civilizations. Archaeologists have designated this Classic Period as the Golden Age of Mexico. This era was a time when the arts and sciences reached their apex, when a writing system developed, and when a sophisticated mathematical system permitted the accurate recording of time. Religion was polytheistic, revering the forces of nature in the gods of rain, water, the sun, and the moon. The most important deity was Quetzalcóatl, the feathered serpent and the essence of life, from whom all knowledge derived.

(the Aztec language), and perhaps what was most important, Cortés unwittingly had the advantage of the legend of Quetzalcóatl, in which the Aztec are said to have believed that a white god would arrive in ships from the east in 1519 and destroy the native civilizations. Unwilling to confront the mysterious arrival whom he considered a god, the Aztec emperor, Moctezuma II (Anglicized as Montezuma), initially welcomed the Spanish party to the capital in November 1519. Montezuma soon was arrested, and the Spanish took control of Tenochtitlán. The Aztec chieftains staged a revolt, however, and the Spanish were forced to retreat to the east. The Spanish recruited new troops while a smallpox epidemic raged through Tenochtitlán, killing much of the population, possibly including Montezuma. By the summer of 1521, the Spanish were ready to assault the city. The battle raged for three weeks, with the superior firepower of the Spanish eventually proving decisive. The last emperor, Cuauhtémoc, was captured and killed. In the nineteenth century, the legend of Cuauhtémoc would be revived, and the last Aztec emperor would be considered a symbol

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Metals came into use only by the end of the period, but despite this handicap, impressive architectural structures in the pyramids at Teotihuacán near Mexico City, the Pyramid of the Niches at El Tajín in the state of Veracruz, and the Temple of the Sun at Palenque in present-day Chiapas were built and survive to this day. The last nomadic arrivals in the Valley of Mexico were the Mexica, more commonly known as the Aztec. Although recent linguistic and archaeological work suggests the Aztec may have come from northwest Mexico, their origins are obscure.

“According to legend, the Aztec came from Aztlán, a mythical place to the north of the Valley of Mexico around *A.D.* 1100. Lured by stories of the riches of the Aztec, a Spanish adventurer, Hernán (sometimes referred to as Fernando or Hernando) Cortés, assembled a fleet of eleven ships, ammunition, and over 700 men and in 1519 set sail from Cuba to Mexico. The party landed near present-day Veracruz in eastern Mexico and started its march inland. Superior firepower, resentment against the Aztec by conquered tribes in eastern Mexico, and considerable luck all aided the Spanish in their conquest of the Aztec. The Aztec and their allies had never seen horses or guns, the Spanish had interpreters who could speak Spanish, Maya, and Náhuatl

of honor and courage, the first Mexican national hero.

“The eleven-year (1810-21) period of civil war that marked the Mexican wars of independence was largely a byproduct of the crisis and breakdown of Spanish royal political authority throughout the American colonies. A successful independence movement in the United States had demonstrated the feasibility of a republican alternative to the European crown” (*Country Studies, Library of Congress, 2012*).

Slightly less than three times the size of Texas, Mexico is bordered by Belize (250 km) (*PE&RS, March 2009*), Guatemala (962 km) (*PE&RS, July 2008*), and the United States (3,141 km). The lowest point is Laguna Salada (–10 m), and the highest point is Volcán Pico de Orizaba (5,700 m). “According to tradition, Francisco Gonzalez Bocanegra, an accomplished poet, was uninterested in submitting lyrics to a national anthem contest; his fiancée locked him in a room and refused to release him until the lyrics were completed” for the National Anthem of Mexico (*World Factbook, 2012*).

“In 1898, the Mexican Geodetic Commission under the direction of Angel Anguiano agreed to collaborate with Canada and the United States to measure the arc of the 98°W meridian comprising some 1,100 km within Mexico. The survey was to encompass some 80,000

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km² and cover parts of the states of Guerrero, Oaxaca, Puebla, Tlaxcala, San Luis Potosí, Veracruz, and Tamaulipas; following the Sierra Madre Oriental and crossing the state of Oaxaca. The arc consisted of 76 vertices and reached heights of 2,500 m above sea level; the lengths of the sides varied from 10 to 130 km. The baselines measured were in Oaxaca, Tecamachalco, Apam, Río Verde and La Cruz. The works were initiated in 1901 and concluded in 1915. The U.S. Coast & Geodetic Survey reported to the International Geodetic Association in Hamburg that the participation of Mexico was of the same quality as that of the Americans” (*translated from INEGI, 1997 – Ed.*). This initial geodetic survey in Mexico was included in the adjustment of the North American Datum of 1927 (NAD27) where the origin is at Meades Ranch, Kansas (and part of the 98°W meridian arc): where: $\Phi_0 = 39^\circ 13' 26.686''$ N, $\Lambda_0 = -98^\circ 32' 30.506''$ W., the reference azimuth to station Waldo is $\alpha_0 = 75^\circ 28' 09.64''$, and the ellipsoid of reference is the Clarke 1866 where $a = 6,378,206.4$ m and $b = 6,356,583.8$ m.

“In the early 1930s most of the Vera Cruz area was covered by 1:100,000 – scale sheets. Aerial surveys had scarcely begun. In 1938 or 1939 the Comisión Geográfico Militar was created (in 1954 to become the Departamento Cartográfico Militar). When the United States Air Force decided to obtain aerial mapping photographs of Mexico in 1942, Mexico agreed, stipulating that it was to receive, among other products, contact prints of all photographs taken. The United States made World Aeronautical Charts (WASs; 1:1,000,000 scale) from it prints; Mexico considered its copies of the photographs to be state secrets, and the prints were not available for civilian use”

(*Topographic Mapping of the Americas, Australia, and New Zealand, Mary Lynette Larsgaard, 1984*).

In July 1953, the Inter-American Geodetic Survey (IAGS) signed an agreement with the Mexican government for a cooperative geodetic survey and mapping program. Geodetic surveys continued to be adjusted to the NAD27 up to 1993. “In close cooperation with the National Geodetic Survey (NGS) and from 1991 onwards, Mexico’s *Instituto Nacional de Estadística Geografía e Informática (INEGI)* has transitioned from the classical , mainly two-dimensional methods to the more accurate three-dimensional GPS-based satellite methodologies” (*GPS High Accuracy Geodetic Networks in Mexico, Tomás Soler, et al, Journal of Surveying Engineering, May 1996*). The seven parameter transformation **from NAD27 to ITRF92**, Epoch 1988.0 is as follows: $\Delta X = -60.2$ m ± 3.8 m, $\Delta Y = +141.5$ m ± 2.2 m, $\Delta Z = +158.2$ m ± 4.4 m, $\delta\epsilon = +1.04'' \pm 0.1''$, $\delta\psi = +0.22'' \pm 0.1''$, $\delta\omega = -1.97'' \pm 0.1''$, $\delta s = -0.13 \times 10^{-6} \pm 0.28$ (*op. cit., Soler, 1996*). Of course, the ellipsoid of reference is the GRS80 where: $a = 6,378,137$ m and $f/f_s = 298.257222101$. Note that Dr. Soler is Chief Technical Officer, Spatial Reference System Division of the U.S. National Geodetic Survey. Now on the ITRF2000, epoch 2004.0; OPUS is now available for all of Mexico.



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