

Grids & Datums

REPUBLIC OF CUBA

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

"It's thought that humans first cruised from South America to Cuba around 3500 BC. Primarily fishers and hunter-gatherers, these original inhabitants were later joined by the agriculturalist Taino, a branch of the Arawak Indians. Christopher Columbus sighted Cuba on 27 October 1492, and by 1514, Diego Velázquez de Cuéllar had conquered the island for the Spanish crown and founded seven settlements. When captured Taino Chief and resistance fighter Hatuey was condemned to die at the stake, he refused baptism, saying that he never wanted to see another Spaniard again, not even in heaven. Cattle ranching quickly became the mainstay of the Cuban economy. Large estates were established on the island under the encomienda system, enslaving the Indians under the pretext of offering instruction in Christianity. By 1542, when the system was abolished, only around 5000 Indians (of an estimated 100,000 half a century before) survived. Undaunted, the Spanish imported African slaves as replacements. Unlike in the North American slave trade, Cuba's African slaves retained their tribal groupings, and certain aspects of their culture endure" (*Super CubaTravel*, 2010). "Father Bartolomé de Las Casas was in Cuba 1511-1512, and it was probably his observations there of the abuse and decimation of the native Caribs (who had only

1500. In the 17th century, an improved map of Cuba was compiled by Gerhardus Mercator. In the middle 1800s, the Spanish Army produced a topographic map of the island called "Mapa de Vivas." The U.S. Army Map Service Inter American Geodetic Survey (IAGS) established an office in Cuba in 1947. The *Instituto Cartográfico Nacional (ICN)* was designated as the national agency to collaborate with the IAGS in the cartographic plan (*MAPPLAN*). In the first eight to ten years of cooperative work the operations consisted of establishing a geodetic network covering the entire territory as well as the installation of 10 tide gauges in selected locations. Aerial photography was flown in 1956, and 100% Cuban coverage of topographic maps at 1:50,000 scale was completed in 1960 in cooperation with the IAGS (*IAGS Report (in Spanish) by Army Map Service, ca. 1960*).

"In 1912 Washington Hydrographic Office executed astrogeodetic determinations on 23 stations located in the whole contour of the Cuban coast. Two decades later, in the frame of the program for navigation aids, the U.S. Navy Hydrographic Office carried out oceanographic works as well as third and fourth order triangulation of the Cuban coast and keys, in order to obtain the astrogeodetic coordinates of a great number of sites"

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a short time before dispossessed the Arawaks) that launched him on his career as 'Apostle of the Indians'" (*Boundaries, Possessions, and Conflicts*, 1938). Thanks to *InfoPlease*, 2010, "In the early 1800s, Cuba's sugarcane industry boomed, requiring massive numbers of black slaves. A simmering independence movement turned into open warfare from 1867 to 1878. Slavery was abolished in 1886. In 1895, the poet José Martí led the struggle that finally ended Spanish rule, thanks largely to U.S. intervention in 1898 after the sinking of the battleship *Maine* in Havana harbor." The Spanish-American War had begun, and Teddy Roosevelt prevailed at the Battle of San Juan Hill, including my grandfather, Gaston Mandeville Mugnier of the *Louisiana Regulars*, although I think he was stuck in Florida tending Teddy's horses In 1959, Fidel Castro completed a successful revolution and deposed the Batista regime to form the closed communist society extant to this day.

The island of Cuba is slightly smaller than Pennsylvania and is the largest country in the Caribbean. With a coastline of 3,735 km, the terrain is mostly flat with rugged hills and mountains in the southeast; the lowest point is the Caribbean Sea (0 m), and the highest point is Pico Turquino (1,970 m) (personal communication, Dr. Ernesto Rodriguez Roche 2010, Havana Cuba). The only land boundary is with the U.S. Naval Base at Guantanamo Bay (29 km) (*World FactBook*, 2010).

The first map known of Cuba was produced by Juan de la Cosa in

(*Roche & García, FIG Congress 2010, Sidney, Australia*). SHORAN surveys between the Florida Keys and Cuba were executed in 1950, allowing the IAGS to extend the North American Datum of 1927 (NAD 27) into Cuba. The NAD 27 origin is at station Meades Ranch in Kansas 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.

"Between 1951 and 1953 aerial-electronic missions were repeated, applying the High Precision Range (HIRAN) trilateration method. The selected stations were linked to the fundamental triangulation network. After the campaign was over and a common adjustment by the parametric method performed, all the stations were referred to the NAD 27. It was considered that a relative precision of 1:113,000 was achieved. Up to 1958, the basic network was constituted by 87 stations, while another 181 stations belonged to other types of networks.

"The astrogeodetic network modernization was carried out on 1970-1973. The new network covered the whole Cuban territory, ..., being conformed (*sic - Ed.*) by 237 first order triangulation stations, 15 lineal bases, and 28 Laplace stations. After the densification task was finished, 490 and 1,903 of second and third (*order - Ed.*) stations respectively were established." (*Roche & García, Ibid.*). The short arc approach was pioneered by the late Dr. Duane C. Brown, Honorary

Member of the ASPRS – and he is generally regarded as the Father of Analytical Photogrammetry.

A GPS campaign was carried out in 1998, and some additional GPS densification was performed in the vicinity of Havana in 2001. Although transformation parameters were developed between the modernized astrogeodetic system (NAD 27) and WGS 84, efforts are planned to establish a cutting-edge system of reference stations similar to the National Continuously Operating Reference System (CORS) of the United States. The 7-parameter transformation is reported to be a Coordinate Frame Rotation from NAD27 to WGS 84: $DX = +2.478$ m, $DY = +149.752$ m, $DZ = +197.726$ m, $Rx = -0.526356$, $Ry = -0.497970$, $Rz = +0.500831$, $\delta s = +0.6852386$, where the rotations are in arc seconds and the scalar exponent is parts per million (*ibid.*, Dr. Ernesto Rodriguez Roche 2010). The accuracy is reputed to be good to a meter. A test point offered by Mr. Pablo Velazco Villares from the "PROJ mailing list" is from NAD 27: $\phi = 20^{\circ} 22' 16.1900''$ N, $\lambda = -76^{\circ} 38' 28.0824''$ W to WGS 84: $\phi = 20^{\circ} 22' 17.8949''$ N, $\lambda = -76^{\circ} 38' 27.1732''$ W.



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