

## THE REPUBLIC OF TRINIDAD AND TOBAGO

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Trinidad and Tobago was originally populated by the Igneri, a relatively peaceful Arawak subgroup, and by the cannibal Caraiibes. Trinidad was discovered by Columbus in 1498, the Spaniards established a colony on the island in 1577, but Sir Walter Raleigh destroyed it in 1595. Occupied by the British in 1797, Trinidad was formally established as a colony in 1899 and was a member of the West Indies Federation from 1958-1962.

Tobago, in contrast, was not colonized by Spain; it has had a most varied history, and experienced a remarkable 31 changes of possession before finally being recaptured by the British in 1803. The first oil deposits on the island were discovered in 1866, by 1908 crude oil production began, and in 1912 the first oil refinery was established. The first international boundary treaty between two sovereign nations that divided the mineral resources of the ocean bottom was signed by Venezuela and the United Kingdom in 1942. Both Trinidad and Tobago, and Venezuela are parties to the Geneva Convention on the Continental Shelf. In 1954, marine drilling began off the West coast of the island in the Gulf of Paria.

The Republic of Trinidad and Tobago became an independent state in 1962. In 1968, petroleum discoveries off the East coast propelled Trinidad to the enviable status of the wealthiest nation in the Caribbean. The highest point in the Republic is El Cerro del Aripo, at 940 m (3084 ft.). The island of Trinidad is mostly low plains with some hills and low mountains in the north; while the island of Tobago is also

low in the southern part and hilly to its north. My children and I found the shallow coral reefs to the south of Tobago to be spectacular!

In 1787, the Spanish Governor of Trinidad signed the first Instructions for Surveyors. The last sentence reads: "All which shall be faithfully and punctually observed, as has been provided in these instructions, of which an attested copy, under my hand, is to be given to every surveyor, making him sign at the bottom of this original a receipt, **in order to convict him as necessary** (*emphasis added*)."  
(Signed) PEDRO DE IBARRARTE.

The first triangulation of Trinidad was carried out from 1900 to 1903 by E.R. Smart, M.A., with third-order extensions carried out until discontinued in 1911. The Orange Grove Base Line was first laid out and then measured three times with a Gurley 300 ft. steel tape. The tape was certified at the U.S. National Bureau of Standards. The mean distance was 8,085.034 ft. (~2,464 m). The triangulation was then carried westwards to Battery, Port of Spain, the Longitude of which had been accurately determined by telegraph by LCDR. Green, U.S.N., in 1883 at Orange Grove Meridian where  $\phi = 10^{\circ} 37' 33.412''$  N,  $\lambda = 61^{\circ} 22' 30.920''$  W. The triangulation then proceeded southwards to the Harmony Hall Base Line; a discrepancy being computed through the unadjusted triangulation of 8.4 inches was equal to nearly  $1/11,500^{\text{th}}$  part of the Harmony Hall Base. Latitude was determined at both bases by meridian altitudes of North and South stars, and the results showed reasonable agreement. Azimuth was also determined at both bases by observation of circumpolar stars at and near elongation. The adjustment of the triangulation of Trinidad was carried out by the usual approximate methods.

The triangulation of Tobago was

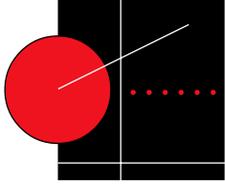
carried out by Capt. G.M. Latham, R.E., and a party of the Royal Engineers in 1923. A base with a mean distance of 2,162.3741 ft. (*sic*) (~659 m) was determined from three measurements with the Trinidad Base Measurement Apparatus. The main net of the Tobago triangulation was adjusted by the method of least squares.

"In 1925, on the advice of the Colonial Survey Committee, it was decided to adopt the Cassini Projection for Trinidad maps. A suitable sheet system based on a grid for the whole island has been evolved. The projection used for both Trinidad and Tobago is the Cassini, Clarke (1858) Spheroid. In Trinidad, the Standard Meridian is Long.  $61^{\circ} 20' 00''$  and the point of Origin is situated as Lat.  $10^{\circ} 26' 30''$  on that meridian, the Rectangular Coordinates of this point for convenience are called N. 325,000 links and E. 430,000 links. In Tobago, the Standard Meridian is Long.  $60^{\circ} 41' 09.632''$  W and the point of Origin (Mount Dillon, Trig Sta. L.) is situated as Lat.  $11^{\circ} 15' 07.843''$  N on that meridian, the Rectangular Coordinates of this point for convenience are called N. 180,000 links and E. 187,500 links. —o0o— Brigadier H. St. J. Winterbotham, C.M.G., D.S.O., 15 October 1930." Note that 8,000 links = 1 mile, and 1 meter = 4.971014137 links. Also, for the Clarke 1858 ellipsoid as used in Trinidad and Tobago:  $a = 6,378,293.6$  meters and  $1/f = 294.26$ . The origin of the Old Trinidad Datum of 1903 is defined at the Harbour (*sic*) Master's Flagstaff where:  $\Phi_0 = 10^{\circ} 38' 39.02''$  North,  $\Lambda_0 = 61^{\circ} 30' 38.00''$  West of Greenwich, and the corresponding Cassini-Soldner Grid coordinates are: N.436,366.91 links, E.333,604.30 links.

According to John W. Hagar, "In 1942 the Coast & Geodetic Survey put out Tables for Computation of Plane Coordinates on Lambert Grid: Trinidad. I would guess that these

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were part of the general contingency planning of WW II. Anyway, they are Lambert, Clarke 1866, yard, latitude of origin = 10° 25' north (lower standard parallel = 10° 10' north, upper standard parallel = 10° 40' north), longitude of origin = 61° 30' west, scale factor = 0.99999054, FE = 120,000 yards. I don't have a false northing but cannot conceive of a U.S. military grid without same. Never saw any maps or coordinates on this system."

Just across the Gulf of Paria, Ing. Dr. Adolfo C. Romero initiated the redefinition of classical triangulation for the northern expanses of the South American continent. The small Venezuelan town of La Canoa, just a few hundred miles from Trinidad was used as the origin of the Provisional South American Datum of 1956 (PSAD 56) where:  $\phi = 08^{\circ} 34' 17.170''$  N,  $\lambda = 63^{\circ} 51' 34.880''$  W. The ellipsoid of reference is the International (Hayford 1909 or Madrid 1924) where  $a = 6,378,388$  meters and  $1/f = 297$ . Earlier work in Venezuela had made connections to the island of Trinidad through the assistance of the Inter American Geodetic Survey (IAGS), and classical triangulation on the Loma Quintana Datum of 1911 was extant across the Gulf of Paria. The PSAD 56 coordinates were subsequently also carried over to Trinidad through the redefinition by Dr. Romero, the IAGS and the U.S. Army Map Service.

The basic triangulation net of Trinidad and Tobago began to be re-observed and adjusted by approximate methods in 1963-1965. The U.S. Army Topographic Command accomplished a subsequent simultaneous least-squares adjustment of triangulation and traverse through the "USHER" computer program for horizontal control surveys using the Variation of Coordinates method. This is known as the Naparima Datum of 1972. The point of origin is station Naparima Hill where:  $\phi = 10^{\circ} 16' 44.8600''$  N,  $\lambda = 61^{\circ} 27' 34.6200''$  W, and the ellipsoid of reference is the International. When I visited Trinidad, I inquired where exactly the station on Naparima Hill was located. I was told that it was about 20 meters past the cliff face in thin air. It seems that there was a rock quarry on the western face of the hill, and the station was blasted away shortly after the last observation period in the early 1960s. For comparison, the Trinidad Datum of 1903 coordinates for Naparima are:  $\phi = 10^{\circ} 16' 37.737''$  N,  $\lambda = 61^{\circ} 27' 31.489''$  W, H = 586 ft. Although the UTM Grid was adopted for use with the new Datum, local use of the Cassini Grids on the former Datum continued for various applications. These applications included the contractual description of offshore petroleum concessions ("Lease Blocks") and reporting regulations. As of 1999, the Cassini-Soldner Grid of Trinidad on the Old Trinidad Datum of 1903 was alive and well in the "oil patch."

In 1996, the U.S. National Geodetic Survey (NGS) made GPS observations of many countries in the Caribbean. Observations on the island of Trinidad included two points

that happened to be on both the Old Trinidad Datum of 1903 and on the Naparima Datum of 1972. Thanks to David Doyle of NGS, I received the WGS84 coordinates of all stations observed. I performed a simple three-parameter analysis of those two points and derived the following relations: From Old Trinidad 1903 To WGS 84,  $\Delta X = -33.250$  m,  $\Delta Y = +232.675$  m,  $\Delta Z = +484.542$  m, the fit was good to about 2 meters in each component for the two points computed. From Naparima 1972 To WGS 84,  $\Delta X = +0.332$  meters,  $\Delta Y = +369.359$  meters,  $\Delta Z = +172.897$  meters, and the fit was good to better than a meter in each component for the two points computed.

In 1986 I was retained to study the relations of the various Grids and Datums of the area, and I traveled to the islands and mainland to research the original data. In 1987 I was invited to present the results of my analysis and development of the 7-parameter Bursa-Wolf Datum Shift relations of all coordinate systems in the Republic of Venezuela and the Republic of Trinidad and Tobago to the Minister of External Affairs (Secretary of State) in Port of Spain. A new International Boundary Treaty was subsequently signed and ratified by both republics. The defining Datum in the Treaty was the PSAD 56. Next month I'll write on Venezuela and I shall list the various transformations among all four of the classical Datums of the region that includes Trinidad and Tobago.

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