The Republic of Mauritius

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This month's topic features the Republic of Mauritius, an island nation in the Indian Ocean that includes Rodrigues Island , the Agalega Islands, and the Cargados Carajos Shoals (Saint Brandon). Discovered by the Portuguese in the early 16th century, Mauritius was occupied by the Dutch from 1598-1710, and was held by the French from 1715 until 1810 when it was captured by the British. Mauritius was formally ceded to the United Kingdom in 1814. It became independent in 1968, and became a republic in 1992. This nation has a land area of 1,850 square kilometers, which is almost 11 times the size of Washington, DC.

The first triangulation was carried out by the astronomer, Monsieur L'Abbe La Caille (literally "Mister Abbot of the Quail"), when he was sent to the island by the French East India Company in 1753. He observed the position of his observatory (Mabile's house), which was situated 4,730 feet east and 2,610 feet north of the Port Louis Time Ball, as: Φ_o = 20° 09' 42 South, Λ_o = 55° 08' 15" East of Paris. He determined the summit of Le Pouce as one of approximately 90 stations. Note that "Le Pouce" literally means "the thumb" in English, which is an apropos description of its shape! I guess that the Grid system used by Lacaille (modern spelling) was based on the Bonne projection, which was in vogue with the French at that time. Unfortunately, the records of Lacaille's survey did not survive the ravages of time.

In 1874, Lord Lindsay led an expedition to Mauritius to observe the transit of Venus across the local meridian. The purpose was to observe a network of precisely determined longitudes in the Indian Ocean. The points on Mauritius included Belmont (primary), Pamplemousses, and Solitude. Others in the network were the island of Rodrigues and the French islands of Réunion and St. Paul. Interestingly, the datum origin in Egypt (different British network and decade) is still named "Venus."

In 1876, the Surveyor General of the Colony of Mauritius, M. Connal, published coordinates of the second triangulation and used the Datum origin as Le Pouce, where: Φ_o = 20° 11' 49.156" South, Λ_o = 57° 31' 39.60" East of Greenwich. The ellipsoid of reference was the Bessel 1841 where the semi-major axis (a) = 6,377,397.155 meters and the reciprocal of flattening ($^1/_f$) = 299.1528128. This point was also the projection origin of the first Cassini-Soldner Grid System of Mauritius, and was used with a quadrant system (north-south, east-west), rather than with the more "modern" False Eastings and False Northings.

In 1902, Captain Harrison of the British Colonial Survey Section produced a series of "1 inch" (to the mile) maps also using Le Pouce as the origin, but based on the Clarke 1858 ellipsoid. Harrison's mapping, presumably also using the Cassini-Soldner Grid, was based on two networks of triangulation that were never connected to form a consistent system. The basis of all subsequent control and mapping prior to the 1990s was based on yet another survey.

In 1934, Captain V. E. H. Sanceau, R.E., performed the re-triangulation of Mauritius. He originally intended to use Connal's work as the basis of his survey in that "more complete records existed than of the work of the Colonial Survey Section." Eventually, only the latitude and longitude of Le Pouce and the azimuth Le Pouce – Corps de Garde (Lacaille's Rock) were retained. The only additional points originally used in Connal's survey that were occupied by Sanceau were: Signal Mountain, Lagrave (the grave), Montagne Blanche (white mountain), Nouvelle Decouverte (new discovery), Montagne Cocotte (chuck-chuck or hen mountain), Montagne Bambou (bamboo mountain), and the West Peak of the Fayence Mountains. The new triangulation of Mauritius established the Le Pouce Datum of 1934 with an origin of: Φ_o = 20° 11' 42.25" South, Λ_o = 57° 31' 18.58" East of Greenwich. The ellipsoid of reference was the Clarke 1880, where a = 6,378,249.145 meters and $^1/_f$ = 293.465. Sanceau's triangulation also established a new Grid based on the Lambert Conical Orthomorphic (Conformal Conic) where the scale factor at origin was 1.0 (tangent conic), and the False Easting (FE) and False Northing (FN) were 3,500,000 feet each. The unit of measure was the yard, where 1 meter = 1.09362311 yards. Captain Sanceau also produced ***The 1" Topographical Map***.

In 1943, the United States Army, Office of the Chief of Engineers issued tables on the Mauritius Zone with the FN and FE being 1,166,666.67 yards. It was noted that the "new" FN and FE of the Ordnance Survey maps were equal to 1,000,000 metres on the Blue Grid.

According to D. Ramasawmy, Chief Surveyor:

> During 1962-64 the Directorate of Overseas Surveys (DOS) UK undertook a Tellurometer traverse using most of Captain Sanceau's trigonometric points and at the same time establishing about 60 new additional points. During the period 1967-69 with the assistance of DOS, the control points were increased by a further 80 points. During the same period, a primary level network was established for the island.
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> Formerly, all color maps of Mauritius were produced by DOS and later on, the French Institut Géographique National (IGN) also produced some maps. The scale of these maps were 1:100,000 (one sheet covering the entire island) and 1:25,000 (13 sheets covering the whole island). It was only during the early seventies that the first 1:2,500 maps of the urban

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areas were produced by DOS from 1968 aerial photography. IGN did some 1:2,500 mapping of the North from1973 photography and a portion of the southern part from 1974 photography in 1981. From 1981 onwards most of the 1:2,500 mapping is being done by the Survey Department, Mauritius.

From 11 July 1994 to 16 September 1994, Professor Peter Dare of the University of East London led a group of students for a GPS survey of Mauritius. Seventeen old points were occupied, and the transformation developed by Dare was published as a three-parameter shift from the Mauritius 1994 Datum (WGS 84 ellipsoid) to Le Pouce 1934. Those parameters are: dX = +770.126 meters, dY = –158.383 meters, dZ = +498.232 meters, and the r.m.s. of each component is ±0.250 meters. Dare remarked that the shift components were in "acceptable agreement" with the WGS 72 parameters published by the British Hydrographic Office in 1982. Note that Dare used the "Leica SKI™" software for his students' analysis, and a **left-handed** coordinate system is supported by that software.

In November of 1997, the Chief Surveyor requested assistance from the University of New Orleans with respect to the relation between the Mauritius Datum of 1994 and the Le Pouce Datum of 1934. He also requested software for a new Grid System. Ramasawmy suggested a "UTM projection," with false coordinates of 1,000,000 meters in each component. The "UTM projection" was not used because of my "well-known" disdain for military Grids being used in standard (or especially in "modified") form for civilian applications. Based on my direction, David Fabre, a UNO graduate student, prepared the transformation software for the Republic of Mauritius Oblique Stereographic Grid. Fabre also "volunteered" to perform a geodetic analysis to determine a seven-parameter Bursa-Wolfe datum shift. The seven **(right-handed)** parameters from Mauritius 1994 to Le Pouce 1934 are: dX = –91.824 meters, dY = –292.222 meters, dZ = –115.604 meters, dS = 23.15822 X 10^6, R_x = + 1.01", R_y = –19.74", R_z = –22.14". The residuals with respect to: Latitude = ±0.12 meters, Longitude = ±0.15 meters, height = ±0.50 meters.

As a computational "test point" for the reader, coordinates of Fort George, Martello Tower are provided. For Lindsay's 1874 position: ϕ = 20° 08' 45.92" South, λ = 57° 29' 26.39" East. For Connal's 1876 Cassini-Soldner position: N.18,484 ft., W.12,686 ft. For L. Coghlan's 1877 position: ϕ = 20° 08' 45.92" South, λ = 57° 29' 26.39" East. For C. Sanseau's 1934 position: ϕ = 20° 08' 36.2866" South, λ = 57° 29' 02.1478" East, h = + 11.6 meters. For Dare's 1996 position: ϕ = 20° 08' 47.3129" South, λ = 57° 29' 27.4235" East, h = – 7.4 meters.

The Grid developed by Fabre is based on the Oblique Stereographic Double projection, as similarly used by the Canadians in the Maritime Provinces. The origin of the Mauritius Stereo Grid is at Le Pouce with a scale factor at origin equal to unity, False Easting = 2,000,000 meters, and False Northing = 500,000 meters. The rationale for the disparate numbers for the false origin is that I am a proponent of the U.S. Coast & Geodetic Survey (NGS) preference for a different number of digits in each rectangular component to avoid blunders of reporting. Note that a reason for choosing a stereographic projection is that it is ideally suited for regions that are circular in shape.