CANADA

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The Dominion of Canada was established in 1867 by the union of New Brunswick and Nova Scotia with the Provinces of Canada. The Statute of Westminster of 1931 removed the U.K. Parliament authority over the dominions and the constitution was patriated to Canada in 1982. The original geodetic surveys of Canada were computed on the Bessel 1841 ellipsoid. In 1880, when the U.S. Coast & Geodetic Survey chose to adopt the ellipsoid that had been published by Colonel A. R. Clarke of the *British Royal Engineers* in 1866 for North America, it was only logical for Canada to adopt the same ellipsoid. The original first-order geodetic networks included only a few networks in Canada. With a few second-order networks, they were adjusted between 1927 and 1932 to produce the original system of coordinates known as NAD27. Southern Quebec, Ontario, and the southern boundary of the Western provinces were included. Subsequently, first-order arcs were extended northwards from stations in the original figures and were adjusted while holding the original stations fixed.

This practice was the same as used in the U. S. and Mexico with respect to new observations made after the original datum adjustment. The North American Datum of 1927 was a spectacular achievement in geodesy *at the time*. In certain cases, local datums were later computed for optimum accuracy at the expense of overall continuity. Some of the major readjustments included: the Prince Edward Island free adjustment of 1968, the 1971 Newfoundland adjustment, the 1972 Nova Scotia readjustment, the Southern Ontario adjustment of 1974, the Northwestern Ontario adjustment of 1974 and the Southern Quebec adjustment of 1978.

With the advent of the Transit satellite system, the Maritime Scientific Adjustment (MSA) was developed in 1971. The Canadian Council on Surveying and Mapping adopted a resolution (23 June 1975) that the Geodetic Survey of Canada (now Geomatics Canada) should make an adjustment in 1977 of the primary horizontal control net of Canada on the NAD1927. Only the Maritime Provinces are still on the Average Terrestrial System (ATS 77), and they have not yet moved to NAD83 or WGS84.

Early one-inch maps of Canada (one inch equals one statute mile) by the Geological Survey of Canada as of 1844 were based on the polyconic projection until the Army replaced it with the 1932 Lambert Conformal Conics that included the Maritime Zones and the Eastern Zones. Although the U.S. military was using the World Polyconic Grid system in U.S. Survey yards (3600/3937), the Lambert projection sheets of the Canadian Army were gridded in International yards (1 inch = 2.54 cm.). On the other hand, Topographical Surveys, part of the Department of the Interior, published one sheet in 1926 on the polyconic projection, and from 1927 on used the Deville-Peters 1924 Transverse Mercator (Gauss) projection with 8 degree zones for the National Topographic Series (NTS).

There was a lively discussion (and correspondence) for years between the two mapping organizations that centered on the relative merits of aesthetics versus convenience for artillery fire control. On sheets of the NTS that were of use to the military, the Army added a 1000-yard rectangular grid overprint based on the Army Lambert systems. That was called the "British Grid," a system introduced in England in 1919 and adopted by many Commonwealth countries. Later changed to the "Modified British Grid," it was also overprinted on many existing Army one-inch maps cast on the polyconic projection. The "Modified British Grid" did not have the failing that numerical references would repeat themselves every 10,000 yards, but would continue differently until 100,000 yards, a decided safety advantage to avoid calling "friendly" artillery fire onto your own positions. The Canadian Lambert projection grids continued in use until the one-inch series was converted by the Army Survey Establishment to 1:50,000 scale maps in 1948 with the UTM grid system and the associated Military Grid Reference System (MGRS).

In 1945, a special Lambert Conformal Conic projection was established for Prince Edward Island and later changed to an oblique double stereographic in 1959 along with a separate stereographic zone for New Brunswick. Some time after World War II, probably also in 1959, five 3-degree wide Gauss-Krüger Transverse Mercator belts were established for eastern Canada, but seem to have been actually used only for a couple belts covering Nova Scotia. These two belts (zones 4 and 5) were used with the millions digit of the False Easting being equal to the zone number. Although this convention is not uncommon throughout the world, this is the only such usage known with respect to False Eastings for North America.

The grid systems established

in 1959 for the Maritime Provinces were later documented (1970's) in a series of publications from the University of New Brunswick which are among the most elegant ever written for the computational use by geodetic surveyors and mappers. These documents are genuine "how to" books and not just math proofs. Those readers that are interested in the topics of this column are strongly urged to obtain copies of this series by Thompson, Krakiwsky, *et. al.*

As the Provinces move towards the adoption of NAD83, a change in grid systems is inevitable. Current plans for New Brunswick are to retain the Oblique Double Stereographic, but the False Easting will be changed to 3500 Km and the False Northing will be changed to 4500 Km. All other constants will remain the same, excepting the ellipsoid. The Province of Quebec will use the "Modified Transverse Mercator" (MTM) with eight zones of 3° (2 to 10 from east to west), for example; zone 7 has a central meridian of 70° 30' W. The scale factor at origin is 0.9999 and the False Easting is 304800 meters for all zones. All other provinces seem to be content with the NAD83 UTM (for now). Surprisingly, not a single Province seems interested (or is aware of) in changing the ellipsoid parameters to simplify the sea-level reduction for GIS/survey applications as done by Minnesota, Wisconsin and Colombia. The Canadian national government and some provinces have gotten commercial in their support (for a price) of transforming to NAD83. The software to convert Latitude & Longitude between the NAD27 and the NAD83 is available for a couple hundred dollars, the geoid software is available for several hundred dollars more. The Canadian government also offers a GPS correction service for a price.