Lack of a universal length standard was a problem which plagued early geodesists (and still affects modern interpretation of early efforts). In the late 1700's two Frenchmen, Delambre & Mechain, were charged with determining, as precisely as possible, earth's arc distance from the equator to the north pole. Upon completion of the survey, that distance was set to be exactly 10,000,000 meters and is the length standard still used worldwide. (True, replication of that distance has undergone redefinition and modernization, but a geodetic survey provided the original definition.)

Since the early 1800's there have been numerous determinations of earth's size and shape. If the earth were truly a homogeneous rotating fluid as postulated by Newton, one would expect answers for earth's size and shape to agree better than they do. However, since the internal distribution of mass within the earth is not uniform, a "best fitting" ellipsoid in one part of the world will not necessarily be "best fitting" elsewhere. The theory of least squares was developed by Legendre (and first published in 1806) in an effort to find the best mathematical ellipsoid to represent earth's size and shape.

An important point too is that determining a "best fit" ellipsoid requires finding two ellipse parameters. Early determinations assumed a spherical earth with one radius but, starting with the results of the Cassini's, determining a measure of flattening became standard. The commonly accepted value for flattening is about 1:300 and a negative value (as obtained by the Cassini's) indicated a prolate ellipsoid instead of an oblate one.

Table 1 lists some early determinations of the earth's size and shape while Table 2 shows several more recent ellipsoids and the area where they were used. With the advent of satellite triangulation, doppler positioning, and global positioning system (GPS) surveying, it became possible to determine earth's size and shape much more precisely. And, modern ellipsoid models of the earth are applicable to the entire earth rather than restricted to a continental land mass (part of the difference between a regional datum and a global datum). An extensive description of recent ellipsoids is given in a Defense Mapping Agency Technical Report, "Department of Defense World Geodetic System 1984 - Its Definition and Relationships with Local Geodetic Systems".

In the United States the Clarke Spheroid of 1866 was adopted as the basis of the New England Datum in 1879 and used subsequently for the U.S. Standard Datum (1901), the North American Datum (1913), and the North American Datum of 1927. However, the North American Datum of 1983 (NAD 83) uses the Geodetic Reference System 1980 ellipsoid which was adopted by the XVII General Assembly of the International Union of Geodesy & Geophysics meeting in Canberra, Australia, in December 1979.

Note: The WGS 84 ellipsoid defined by the DMA and the GRS 1980 ellipsoid used for the NAD 83 are very nearly identical and can be used interchangeably. But X/Y/Z WGS84 coordinates may differ from NAD8 X/Y/Z's by a meter or more.