

Grids & Datums

REPUBLIC OF MOLDOVA

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

"The history of the Republic of Moldova is the history of two different regions that have been joined into one country, but not into one nation: Bessarabia and Transnistria. Bessarabia, the land between the Prut and Nistru rivers, is predominantly ethnic Romanian in population and constitutes the eastern half of a region historically known as Moldova or Moldavia (the Soviet-era Russian name). Transnistria is the Romanian-language name for the land on the east bank of the Nistru River; the majority of the population there is Slavic -- ethnic Ukrainians and Russians -- although Romanians are the single largest ethnic group there. To a great extent, Moldova's history has been shaped by the foreigners who came to stay and by those who merely passed through, including Greek colonists, invading Turks and Tatars, officials of the Russian Empire, German and Bulgarian colonists, communist apparatchiks from the Soviet Union, soldiers from Nazi Germany, Romanian conationalists, and twentieth-century Russian and Ukrainian immigrants. Each group has left its own legacy, sometimes cultural and sometimes political, and often unwelcome. Moldova's communist overlords, the most recent 'foreigners,' created the public life that exists in Moldova today. Independence has brought about changes in this public life, but often only on the surface. What further changes Moldova makes will depend partly on how much time it has before the next group of 'foreigners' comes to call. Moldova's Latin origins can be traced to the period of Roman occupation of nearby Dacia (in present-day Romania, Bulgaria, and Serbia), ca. A.D. 105-270, when a culture was formed from the intermingling of Roman colonists and the local population. After the Roman Empire and its influence waned and its troops left the region in A.D. 271, a number of groups passed through the area, often violently: Huns, Ostrogoths, and Antes (who were Slavs). The Bulgarian Empire, the Magyars, the Pechenegs, and the Golden Horde (Mongols) also held sway temporarily. In the thirteenth century, Hungary expanded into the area and established a line of fortifications in Moldova near the Siretul River (in present-day Romania) and beyond. The region came under Hungarian suzerainty until an independent Moldovan principality was established by Prince Bogdan in 1349. Originally called Bogdania, the principality stretched from the Carpathian Mountains to the Nistru River and was later renamed Moldova, after the Moldova River in present-day Romania. During the second half of the fifteenth century, all of southeastern Europe came under increasing pressure from the Ottoman Empire, and despite significant military victories by Stephen the Great (Stefan cel Mare, 1457-1504), Moldova succumbed to Ottoman power in 1512 and was a tributary state of the empire for the next 300 years. In addition to paying tribute to the Ottoman Empire and later acceding to the selection of local rulers by

Ottoman authorities, Moldova suffered repeated invasions by Turks, Crimean Tatars, and Russians. In 1792 the Treaty of Iasi forced the Ottoman Empire to cede all of its holdings in what is now Transnistria to the Russian Empire. An expanded Bessarabia was annexed by, and incorporated into, the Russian Empire following the Russo-Turkish War of 1806-12 according to the terms of the Treaty of Bucharest of 1812. Moldovan territory west of the Prut River was united with Walachia. And in the same year, Alexandru Ioan Cuza was elected prince of Walachia and the part of Moldova that lay west of the Prut River, laying the foundations of modern Romania. These two regions were united in 1861" (*Library of Congress Country Studies, 1995*). "Moldova was incorporated into the Soviet Union at the close of World War II. Although the country has been independent from the USSR since 1991, Russian forces have remained on Moldovan territory east of the Dniester River supporting a Transnistrian separatist region with a Slavic majority population of mostly Ukrainians and Russians" (*World Factbook, 2013*).

Slightly larger than Maryland, Moldova is bordered by Romania (450 km) (*PE&RS, May 2001*) and Ukraine (940 km) (*PE&RS, June 2004*). Moldova's terrain is comprised of rolling steppe with a gradual slope to the Black Sea; the lowest point is the Dniester (2 m) and the highest point is Dealul Bălănești (430 m) (*NGA GeoNames Server*).

"The triangulation consisted of a net of the first order, supplemented by auxiliary nets of the second- and third-orders. In respect of the Moldavian district, the Dobrudzha, and Muntenia as far as the meridian of Zimnicea, was calculated on Bessel's ellipsoid (*where $a = 6,377,397.155$ m, $1/f = 299.1528128$ - Ed.*); whereas for computing the triangulation westwards of this meridian, Clarke's ellipsoid of 1880 (*where $a = 6,378,249.145$ m, $1/f = 293.465$ - Ed.*) was employed" (*Memorandum on the General State of Geodetic Work in Romania - Brief Historical Review, by General Radu Bodnărescu and Colonel Virgil Joan, translated by the U.S. Army Map Service, RHO/AMS Memo 318, 7 October 1960*). "The geocentric datum shift parameters from the local datum to the WGS84 datum were computed using control points coordinates scaled from both the old and from the modern maps, in vicinities near the zone centers" (*Rectification of the Romanian 1:75,000 map Series, Prior to World War I, Timár, G. and Mugnier, C., Acta Geod. Geoph. Hung., Vol. 45(1), pp. 89-96 (2010) DOI: 10.1556/AGeod.45.2010.1.13*).

"One side of the Russian triangulation for Bessarabia was taken as the basis for calculating the Moldavian triangulation. This had been taken as far as one side of the Austrian triangulation in Bukovina. Simultaneously, i.e., in 1874, an Austrian and a Romanian officer surveyed the difference in longitude between Iași and Czernowitz. The triangulation

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work was continued southwards, without attempting to fit in with a side of the Austrian or Russian triangulation, and without measurement of a geodetic baseline" (*ibid. Bodnărescu and Joan*).

"Bucharest (1920) (code BUC), Militari (east end of base) $\Phi_0 = 44^\circ 26' 07.2823''$ N, $\Lambda_0 = 26^\circ 01' 00.2060''$ E, $\alpha_0 = 96^\circ 43' 22.8''$ to Ciorogârla (west end of base) from south. International ellipsoid. Position determined from West Pillar of the Military Observatory (Observatorul Militar Astronomic din Dealul Piscului). Also called New Romanian. Reference: Vornetvure Zum Planheft Sudosteuropa Nordlicher Teil Rumienien.

"Constanta (code COS), Minaret of the Main mosque in Constanta (Kyustendyhi) (Kyustendja), $\Phi_0 = 44^\circ 10' 31''$ N, $\Lambda_0 = 28^\circ 39' 30.55''$ E, $\alpha_0 = 305^\circ 15' 01.7''$ East Pyramid to West Pyramid of the Kyustendyi Base, Walbeck. That came out of the Zapiski vol. 43.

"Observatorul Militar Astronomic din Dealul Piscului, Bucuresti (code OAR), $\Phi_0 = 44^\circ 24' 34.20''$ N $\pm 0.06''$ (1895), $\Lambda_0 = 26^\circ 06' 44.98''$ E $\pm 0.075''$ (1900.7), $\alpha_0 = 127^\circ 01' 53.005''$ (1895) to Cotroceni. The latitude error value of $\pm 0.06''$ came from 'Determinari Astronomice,' Institutul Geografic Militar, Romania. The same latitude value but $\pm 0.04''$ was published by Dragomir, General-locotenent ing., Vasile, Rotaru, Colonel dr. ing. Marian, Mărturii Geodezice, Bucuresti, 1986, pg. 151. The astro position was transferred geodetically to Bucharest (BUC).

"Old Romanian (code ORU), Bucharest Meridian, $\Phi_0 = 44^\circ 26' 06.63''$ N $\pm 0.04''$ (1899), $\Lambda_0 = 23^\circ 46' 32.00''$ E of Paris, $\alpha_0 = 26^\circ 16' 45.95''$ E, Clarke 1880. Used on old maps, pre WW II, at 1:20,000 and 1:100,000. Taken from a Planheft, possibly the one listed above for BUC.

"Saint Anna (code STD), at South Base Point of Arad Base, $\Phi_0 = 46^\circ 18' 47.63''$ N, $\Lambda_0 = 39^\circ 06' 54.19''$ E. of Ferro, $\alpha_0 = 21^\circ 27' 08.17''$ E. of Greenwich. Zach ellipsoid ($a = 6,376,480$, $1/f = 310$). Derived geodetically from Vienna. Probable reference is Positionen Rechnungen für die neue Special Karte der Monarchie, 1887 Vol. I, Part 1 and 2" (John W. Hager, Personal Communication, March 2013).

"The Austrian military geographic survey invested a tremendous work into the geodetic and cartographic works in parts of Old Romania, mainly in two waves. First in the second half of the 18th century in the frame of the First Military Survey, then during the Crimean

War in Oltenia, Muntenia and Northern Dobrogea, developing a full first-order triangulation net from the Transylvanian border to the Danube and the Black Sea. The network was on the Walbeck ellipsoid and its Molodensky-type displacement parameters are: $dX = +1317$ m; $dY = +73$ m; $dZ = +357$ m, the error of these figures is under 20 meters. The low error shows that the network was very precise at the time of the survey. The Austrian work in the Danube Principalities preceded the main part of the Second Military Survey in Transylvania (or connected to it), perhaps giving a good training opportunity also for that measurement" (*Habsburg geodetic and cartographic activities in the Old Romania, Gábor Timár, Dept. of Geophysics and Space Sciences, Eötvös University, H-1117 Budapest, Pázmány Péter sétány 1/a, Hungary*).

System 42 of the Soviet era represents a significant volume of geodetic control for Moldova in which the origin point is at Pulkovo Observatory where: $\Phi_0 = 59^\circ 46' 18.55''$ North, $\Lambda_0 = 30^\circ 19' 42.09''$ East of Greenwich. The defining azimuth at the point of origin to Signal A is: $\alpha_0 = 317^\circ 02' 50.62''$. System 42 is referenced to the Krassovsky 1940 ellipsoid where $a = 6,378,245.0$ meters, and $1/f = 298.3$. The 7 – parameter transformation from System 42 to the European Terrestrial Reference Frame 1989 locally referred to as MOLDREF89 is: $\Delta X = -617.880$ m, $\Delta Y = -253.456$ m, $\Delta Z = -315.690$ m, $R_1 = 5.79748''$, $R_2 = -2.44443''$, $R_3 = -5.1534''$, $\delta s = -13.51806$ (*Development of new geodetic infrastructure in Republic of Moldova, V. Chiriac, et al, EUREF 2011, Chisinau, 25028 May 2011*). MOLDPOS is the national real-time kinematic GPS network, and the country has implemented a first-order gravity network enforced by three absolute gravity stations and a national quasigeoid. (Regional quasigeoid solution for the Moldova area from GPS levelling data, A. Marchenko, I. Monin)

The Transversal Mercator for Moldova (TMM) is used for large-scale mapping and has a central meridian $\lambda_0 = 28^\circ 24'$ E, $m_0 = 0.99994$. No information is offered for a False Easting, but it may be 500 km since UTM is their adopted standard for small-scales.



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