

Grids & Datums

KINGDOM OF NEPAL

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

“Nepal has been a kingdom for at least 1,500 years. During most of that period, the Kathmandu Valley has been Nepal’s political, economic, and cultural center. The valley’s fertile soil supported thriving village farming communities, and its location along trans-Himalayan trade routes allowed merchants and rulers alike to profit. Since the fourth century, the people of the Kathmandu Valley have developed a unique variant of South Asian civilization based on Buddhism and Hinduism but influenced as well by the cultures of local Newar citizens and neighboring Tibetans. One of the major themes in the history of Nepal has been the transmission of influences from both the north and the south into an original culture. During its entire history, Nepal has been able to continue this process while remaining independent. The long-term trend in Nepal has been the gradual development of multiple centers of power and civilization and their progressive incorporation into a varied but eventually united nation. The Licchavi (4th to 8th centuries) and Malla (12th to 18th) kings may have claimed that they were overlords of the area that is present-day Nepal, but rarely did their effective influence extend far beyond the Kathmandu Valley. By the sixteenth century, there were dozens of kingdoms in the smaller valleys and hills throughout the Himalayan region. It was the destiny of Gorkha, one of these small kingdoms, to conquer its neighbors and finally unite the entire nation in the late eighteenth century. The energy generated from this union drove the armies of Nepal to conquer territories far to the west and to the east, as well as to challenge the Chinese in Tibet and the British in India. Wars with these huge empires checked Nepalese ambitions, however, and fixed the boundaries of the mountain kingdom. Nepal in the late twentieth century was still surrounded by giants and still in the process of integrating its many localized economies and cultures into a nation state based on the ancient center of the Kathmandu Valley. Nepal took a fateful turn in the mid-nineteenth century when its prime ministers, theoretically administrators in service to the king, usurped complete control of the government and reduced the kings to puppets. By the 1850s, a dynasty of prime ministers called Rana had imposed upon the country a dictatorship that would last about 100 years. The Ranas distrusted both their own people and foreigners – in short, anyone who could challenge their own power and change their position. As the rest of the world underwent modernization, Nepal remained a medieval nation, based on the exploitation of peasants and some trade revenues and dominated by a tradition-bound aristocracy that had little interest in modern science or technology. After the revolt against the Ranas in 1950, Nepal struggled to overcome its long legacy of underdevelopment and to incorporate its varied population into a single nation. One of the early casualties of this process was party-based democracy. Although political parties were crucial in the revolution that overthrew Rana rule, their constant wrangling

conflicted with the monarchy’s views of its own dignity and with the interests of the army. Instead of condoning or encouraging a multiparty democracy, King Mahendra Bir Bikram Shah Dev launched a coup in late 1960 against Bishweshwar Prasad (B.P.) Koirala’s popularly elected government and set up a system of indirect elections that created a consultative democracy. The system served as a sounding board for public opinion and as a tool for economic development without exercising effective political power. Nepal remained until 1990 one of the few nations in the world where the king, wielding absolute authority and embodying sacred tradition, attempted to lead his country towards the twenty-first century” (*Country Study, Library of Congress, 1991*).

Slightly larger than Arkansas, the terrain is comprised of Tarai or flat river plain of the Ganges in the south, central hill region, and rugged Himalayas in the north. The lowest point is Kanchan Kalan (70 m); the highest point is Mount Everest (8,850 m – the highest point in Asia). Nepal is bordered by China (1,236 km) (*PE&RS, May 2000*) and by India (1,690 km) (*World Factbook, 2013*).

The first survey of Nepal was conducted by the Survey of India (SOI) in 1924. The first mapping was issued by the British Military Survey and later by SOI in 1927, which was compiled from plane-table and alidade surveys with a 500-foot contour interval. The Colombo Plan of 1950 resulted in SOI surveys and mapping of the country for 10 years. During that time, Muneendra Kumar was a Survey Officer with the SOI and led triangulation parties into the mountains of Nepal. He later retired from the SOI, immigrated to the United States and received his doctorate in Geodesy under Prof. Ivan I. Mueller at The Ohio State University. After serving as Chief of Vertical Control Surveys at the U.S. National Geodetic Survey when we first started our personal friendship in 1977, he transferred to the National Imagery and Mapping Agency and finally retired as Chief Geodesist from the National Geospatial-Intelligence Agency. While working his triangulation party in Nepal, Dr. Kumar once walked 5,000 kilometers in one year!

The first SOI surveys in the Kingdom of Nepal were referenced to the Indian Datum of 1916 where the origin is a station Kalianpur Hill where: $\Phi_0 = 24^\circ 07' 11.26''$ N, $\Lambda_0 = 77^\circ 39' 17.57''$ East of Greenwich, and the ellipsoid of reference is the Everest 1830, where: $a = 6,974,310.600$ Indian Yards, and $1/f = 300.8017$, $\xi = -0.29''$, $\eta = +2.87''$, $N = 0$ m. A Czechoslovakian team observed 7 Laplace (Astro) stations with 14 azimuth stations in 1977 through the assistance of the United Nations Development Program.

“Between 1982 and 1985 soldiers from the Military Survey branch of the Royal Engineers undertook a major project in Nepal. The aim was to establish a first order geodetic network – a series of precisely coordinated trigonometrical points across the whole country – on which future lower order surveys and mapping could be based.

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The project, which was called Exercise High Trig, was carried out in conjunction with the Nepal Survey Department. A total of 14 Doppler points were fixed, ... a further agreement was to provide a comprehensive network of gravity observations.

"In the first year work started in the east of the country with the project headquarters situated in the British Gurkha cantonment at Dharan. A total of 16 survey stations were occupied in the first year and the distances and angles between them were measured.

"In the second year, work continued westward through the central region. The headquarters was now located in Maya House, Kathmandu, a fairly palatial accommodation hired through the British Embassy. Eventually this was supplemented by a tented advance camp at Pokhara in the Annapurna region. We capitalized on the groundwork of the previous year, and blessed by excellent weather, progress was rapid and more work was achieved than expected. In all, 36 stations were occupied, four of these being re-occupations of the previous year's stations in order to tie together the two pieces of work. The project was completed during the 1984/85 season, finishing in the 'far west' of the country" (*Himalayan Survey, Captain F.S. Spence, R.E., The Geographical Journal, Vol. 153, No. 2, July 1987, PP. 223 – 230*).

The Nepal Datum of 1981 origin is at Station 12/157 Nagarkot where: $\Phi_0 = 27^\circ 41' 31.04''$ N, $\Lambda_0 = 85^\circ 31' 20.23''$ East of Greenwich, and the ellipsoid of reference is the Everest 1830, where: $a = 6,377,276.345$ m, and $1/f = 300.8017$,

$\xi = -37.03''$, $\eta = -21.57''$, $N = 0$ m., in which the deflections of the vertical are derived from an astronomical position observed by the Czechoslovak Geodetic Institute (*The Geodetic Survey of Nepal*

1981-84, Directorate of Military Survey, UK, November 1985).

The University of Colorado and the Massachusetts Institute of Technology established a precise GPS network in Nepal during 1991. The classical origin point at Nagarkot on the WGS84 Datum is: $\Phi_0 = 27^\circ 41' 33.778''$, $\Lambda_0 = 85^\circ 31' 16.384''$.

"The topographical maps of Nepal are prepared and published in two parts: one of the Eastern Nepal and other of the Western Nepal. In both cases the ground controls for the topographical map preparation were established by GPS technique. Since the maps thus prepared have to be based on Everest Ellipsoid 1830, Nepal Datum the GPS established ground control points had to be transformed from WGS-84 to Everest Ellipsoid 1830.

"In the process of the determination of the transformation parameter (the common points between the reference frame *i.e.* WGS-84 and Everest 1830) first order points based on Nepal datum, Everest 1830, only 11 points were used as the common points.

"The values of the transformation (**WGS-84 to Local**) parameters are as follows: $\Delta X = -293.17$ m, $\Delta Y = -726.18$ m, $\Delta Z = -245.36$ m. ... 1-sigma accuracy of the determination of transformation parameter is 0.26 m" (*Study of Geodetic datum of Nepal, China and Pakistan (sic - Ed.) and its transformation to World Geodetic System, Niraj Manandhar, Nepalese Journal on Geoinformatics – 10, 2068*).



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