

*Indian Surveys for the year 1879-80.*

In India the progress of geographical science is ever active. Besides the laborious and minutely accurate operations of triangulation, topography, and revenue survey, required to complete a first survey of our Indian empire, these are supplemented by surveys carried on by either European or native agencies, under circumstances of far greater difficulty in the mountainous tracts which hem in India on all sides, where the presence of savage and hostile tribes not amenable to our rule and influence makes the surveyor's task one of the greatest difficulty.

The principal triangulation is fast approaching completion. During the season 1879-80 the chain of triangles between Cape Comorin and Madras, which has been for some years in progress, was completed, so that the principal triangulation may now be considered to be wholly finished in Southern India. In Northern India only a small portion of a single chain of triangles remains for execution, which will be probably completed within the next few months, and then the whole of the principal triangulation of the regions between Afghanistan and Burma will be finished. The extension of the Eastern Frontier Series as far as Bangkok in Siam has been carried to within a short distance of that town, but the unhealthiness of the district unhappily proved fatal to Mr. H. Beverley, a surveyor of long and valued experience.

In Afghanistan the resumption of hostilities in the latter part of 1879 led to the formation of two field survey parties, one under Major R. G. Woodthorpe, R.E., to proceed via the Kurram and Shutargardan to join General Sir F. Roberts' column, and the other under Captain Holdich, R.E., to join General Bright's column by way of Peshawur and Jalalabad. A timely halt near the summit of the Shutargardan Pass enabled Major Woodthorpe to ascend a neighbouring hill, and connect the triangulation of the Kurram Valley with that of the Logar and Kabul valleys, which now form a continuous series from Thull round via Kabul to Jalalabad. The out-turn of work in Northern Afghanistan comprises surveys of a large extent of the Zaimukht country west of Kohat, of the Logar Valley, Kohistan, and Koh Daman, besides several points on the Paghman, Altimor, Deh-i-Sabz, and Karkatcha ranges, and detailed surveys of the country between Gundamak and Kabul. Very acceptable aid was rendered by the native sub-surveyors, one Munshi having carried on the mapping of the Sherpur cantonments and of the country round it during the actual progress of the investment, and having continued to work through the city and surrounding districts immediately the siege was raised, and before it would have been possible for any European to have been so employed. The same man also undertook an exploration up the Kunar river into Kafiristan, travelling as a native doctor, and there is every reason to suppose he could have succeeded in reaching Kafiristan (for he was never suspected at any time) had it not been for an unfortunate and unexpected rising of the tribes in the vicinity.

The operations in Southern Afghanistan comprised surveys and reconnaissances of Candahar and the surrounding country, of the Argastan Valley, the Kadanai Plain, and adjoining localities, by Lieutenant St. G. C. Gore, R.E.; while Major E. P. Leach, V.C., contributed reconnaissances of the Argandab and Khakrez valleys, and the determination of various peaks and passes leading from the Argandab basin into the Hazara country. Unfortunately the whole of this material, together with some valuable notes concerning the Hazara tribes and country, was lost during the retreat from Maiwand and the subsequent evacuation of the Candahar cantonment. Efforts have, however, been made to replace these documents by fresh surveys, and these have been fairly successful. General Stewart's march from Candahar on Kabul via Ghazni enabled Lieutenant Gore to accomplish a most useful piece of survey work through the Khushk-l-Rud and northern portion of the Tarnak Valley, and on north-

wards through the Ghazni Valley and over the Sher-i-Jana Pass into Wardak. As this furnishes a connection between the surveys in Northern and Southern Afghanistan, besides the position of several important places on the route and a copious list of heights, it will prove a material and most welcome contribution to our geographical knowledge.

In Beluchistan a rough reconnaissance was effected of the country situated within the triangle formed by Quetta, Thal, Chotiali, and Sibi; it is more or less incomplete, as the country was in an unsettled state, but around Sibi, Dadur, and a portion of the lower Bolan, a fair amount of good topography has been obtained. The combined operations in Northern and Southern Afghanistan and in Beluchistan furnish a total area of about 16,000 square miles of new geography.

A satisfactory attempt to determine the position of the head-waters of the Irrawaddy river was made by Captain J. E. Sandeman through the agency of a native surveyor, who was taught the use of the compass, to pace, and to observe double altitudes of stars with the sextant. This intelligent traveller succeeded in ascending the river as far as Mo-gung-poon, near which the river forks into two main branches, called Malee and Mehka respectively, the western one rising at a reputed distance of from six to eight days' journey, in a district bounded by snow-clad hills. A sketch map compiled from this explorer's note-book shows a remarkable agreement with the map compiled by Lieutenant R. Wilcox in 1828, and leaves little room for doubt that the claim of that enterprising traveller to have discovered the principal source of the Irrawaddy is good. There still remains, however, an eastern branch of the Mehka which awaits exploration, and which according to native information is derived from a very large lake called Nungsa in the territory inhabited by Chinese Shans.

On the extreme north-western frontier of British India, about Gilgit, some interesting triangulation has been done by Colonel H. C. B. Tanner in continuation of his previous season's work. This is one of the most mountainous regions of the globe, and the number of peaks this officer has succeeded in fixing amid difficulties of no ordinary kind, will help materially to clear up the drainage and orography of an important tract which marks the convergence of the Hindu Kush and Himalaya systems towards the mountain mass of Pamir. Colonel Tanner has determined, among other peaks, the position of two snow-capped summits beyond Chitral, and one north-west of Sarhadd, in the basin of the Oxus. He also furnishes an interesting description of the nature of the water-parting between the Indus and Gilgit rivers, the northern slope of which he surveyed, and of the celebrated mountain Nangaparbat, which, after a perilous journey, he succeeded in approaching from the northern side. The scene he describes as probably the most magnificent snow view on the globe. Standing on the brink of a tremendous precipice 16,000 feet in height, which rises sheer and unbroken from the forests and vineyards of Gor, at an immense depth below, he beheld the huge mountain, exhibiting a slope of very nearly 24,000 feet (vertical measurement), with its glaciers, snow-fields, ice-cliffs, and jagged needles of naked rock extending from the very summit down to the Indus, which flows in a deep and gloomy channel at its base. Colonel Tanner was enabled to fix Tirich Mir (to which his preliminary calculations assign a height of 24,000 or 25,000 feet), a peak on the southern slopes of the Hindu Kush north-west of Chitral, as well as a remarkable double peak of nearly the same height, about 10 miles south-east of Varg, in the Oxus valley. Not the least important of Colonel Tanner's researches consist in a rich botanical collection, and a series of notes on the *flora* of this region.

The systematic observation of the tides for determining the rise and fall at the principal ports along the coasts of India has been extended, so that there are now no less than fourteen ports, comprising such places as Aden, Kurrachee, Bombay, and Rangoon, as well as harbours of minor note, where this valuable aid to navigation is available in the form of printed handbooks.