

being too rough to measure correctly a sufficiently long base for the work—and a subsidiary base was interpolated at the raudal Alto. Later subsidiary check bases were interpolated at Punta Capuchino and Laguna de la Guaya; more, possibly, by good fortune than by good guidance, these checks worked out with wonderful accuracy.

The river work was done by prismatic compass and time survey, and is necessarily somewhat inaccurate, the varying strength of the current and the somewhat intermittent work of the paddlers making it extremely difficult to gauge with any degree of accuracy the real distance travelled. The compass also seems to have been affected by the ironstone, as was the case on land. The points fixed astronomically were—

*Caicara*.—Latitude by meridian altitude of sun,  $7^{\circ} 43' N.$ ; longitude by morning sights (sun),  $66^{\circ} 32' W.$

*Lajitas*.—Latitude by meridian altitude of sun,  $66^{\circ} 55' 8'' N.$ ; longitude by chronometer and four altitudes of Aldebaran,  $66^{\circ} 15' 18'' W.$

*Randal Alto*.—Latitude by sun,  $6^{\circ} 31' 30'' N.$ ; longitude by chronometer and sun,  $66^{\circ} 16' 8'' W.$

*Mouth of Cuchivero*.—Longitude by chronometer and altitude of Procyon, *Punta Capuchino*.—Latitude by sun meridian,  $7^{\circ} 39' 32'' N.$

*Mouth of Tortuga*.—Latitude by sun meridian,  $7^{\circ} 16' N.$ ; longitude by morning sun and chronometer,  $66^{\circ} 56' 16'' W., 66^{\circ} 13' 40'' W.$

Owing to want of practice and experience in astronomical work, I am very doubtful as to the correctness of any of these observations, and, in placing these points on the map, have usually preferred to rely on the mechanical accuracy of the plane-table rather than on the more dubious results of inexperienced astronomical observation. The factors from which these results were obtained are attached hereto—at least, such as remain in my possession. Unfortunately, owing to the capsizing of a canoe in the Tortuga, the remainder were lost, though luckily the results of the calculations had been already committed to the map.

The entire work was completed under circumstances of considerable difficulty, as, except in the savannah country, the stars were rarely visible through the dense forest trees; all night work was rendered inaccurate, owing to the constant heavy dews, which dimmed the sextant glasses before contact could be obtained, and the continual interruption of work caused by the unbearable irritation from the bites of thousands of mosquitoes and other troublesome insects. I do not, therefore, claim that this is a complete and correct survey, but consider that it is nearly so, and much more accurate than any of the antique existing maps.

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## THE PROCEEDINGS OF THE PAMIR BOUNDARY COMMISSION.

THE report on the Commission for delimitating the Russo-Afghan Boundary on the Pamirs has at length been given to the public. This commission left India in June, 1895, and returned in October of the same year, so that the report is about three years old.

It contains an account, by Major-General M. G. Gerard, of the arrangements preliminary to delimitation, and of his journey subsequent to the completion of the boundary through Russian Central Asia to Europe. The narrative of proceedings during delimitation has been

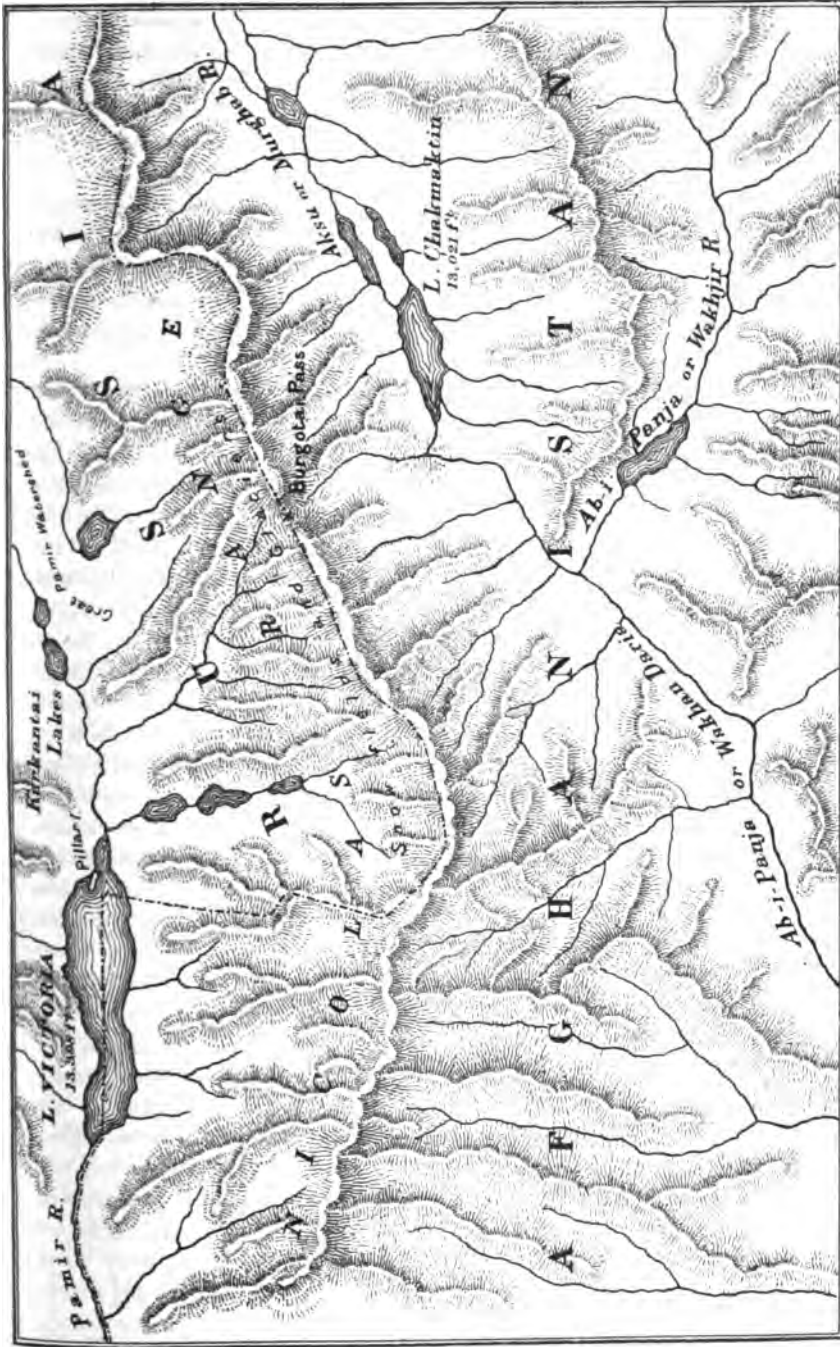
written by Colonel Holdich, R.E., together with the historical and geographical notes of the Pamir region. The survey report is by Lieut.-Colonel Wahab, R.E., and the natural history section by Surgeon-Captain A. W. Alcock. The last is both interesting and valuable, and (in common with the rest of the report) is excellently well illustrated; but it is to the geographical sections of the report that we wish to call attention at present, as they appear to throw fresh light on certain debatable points in Central Asian geography, and to clear away the mists that have hung so long around the sources of the Oxus.

The first pillar of the boundary was set up at the eastern end of Lake Victoria, and this point was selected, together with one near the end of the demarcated line, for comparison between the Russian and English values in latitude, longitude, and altitude, to serve as the datum, or basis, for all the surrounding survey. The results of the comparison are given by Colonel Wahab, and they are certainly satisfactory; for they exhibit no divergence of opinion whatever as regards longitude; only a small one in latitude; and none to speak of in altitude. In fact, the Russian mapping of these regions is entirely in harmony with the Indian mapping, and it may safely be assumed in future that Russian values are practically identical with our own. The longitude agreement is of special interest when we consider how it was obtained. Direct geodetic triangulation connects the western shores of the Caspian sea with Greenwich—some 2200 miles—across the intervening states of Europe. Here for the present it ends, and the Russian longitudes of their Central Asian possessions to the east of the Caspian depend upon telegraphic determinations only. For about another 1000 miles from the Caspian to their military post of Osh the telegraph is thus responsible, and Osh was, two years ago, the nearest point so fixed relatively to the scene of demarcation on the Pamirs. From Osh to the boundary-line (about 80 miles) the longitude values were brought down by chronometric deduction, a very fine battery of chronometers being carried in circuits till it touched the field of operations.

On the English side, the longitude of India is derived from Greenwich by telegraphic determinations, and the longitude of the Lake Victoria pillar was derived from India by direct triangulation, which was carried from Gilgit across the Hindu Kush into the Pamirs. Although it was improbable in either case that any large absolute error should exist, it was quite possible that a difference might have been found on comparison of final results, which would be appreciable on the scale of mapping. It was, therefore, a matter of congratulation that the accordance should be as absolute as it proved to be when that comparison was made. Latitude was, of course, determined on the spot by means of astronomical observations; but the Indian Survey determination was additionally fortified by the value derived from triangulation, which agreed absolutely with the astronomical deduction. In altitude, again,

there was little to adjust between the trigonometrical values and the barometric determinations of both Russian and English surveyors. We may safely assume that the Pamir altitudes are now definitely fixed.

The height of Lake Victoria was trigonometrically fixed at 13,390 feet above the sea, a result which is in agreement with the barometrical determinations of the Russians, and which differs from Captain Trotter's value (determined during the progress of the Forsyth Mission) by 560 feet. Trotter makes the altitude too great. His observations were made in the unsettled spring weather, when single barometric determinations are of little value. It is curious that Wood should make its altitude 15,600 feet in mid-winter by hypsometer observations. Lake Victoria is only 400 feet higher than Lake Chakmaktin (the "Gazkul" of the Little Pamir), and about 500 feet below the watershed of the Great Pamir. One principal source of the lake is an affluent 14 miles long which rises in the northern slopes of the valley, not far from the pass across the watershed leading eastwards to Jarti Gumbaz. This affluent, known as the Yangi Diwan, flows through two small lakes, each about half a mile square, lying close under the saddle of the watershed. The mountains enclosing the lake run to 5000 and 6000 feet above the water-level on the south, where they culminate in the vast glacial system of the Nicolas range dividing the Great and Little Pamirs; and to about 4000 feet on the north. There is another system of lakes which drain into Victoria, hidden in the northern slopes of the Nicolas range, through which immense volumes of glacial water pass down. There is, however, strong evidence that Lake Victoria is gradually silting up, and that it will in process of time cease to exist in its present form. Neither Lake Victoria, which long held its own as the reputed source of the Oxus, nor Lake Chakmaktin, which was for years its great rival as the source of the Aksu, can properly be called a source at all. Both of them appear to be but incidents in the construction of the water-channels of the Pamir river and the Aksu respectively. Of both of them it is said that they are fed by warm springs, but in neither case are these springs sufficiently apparent to justify the supposition that the lakes, rather than the glacial streams which feed them, are the fountain-head of the rivers to which they belong. There are several lakes above the level of Victoria, any one of which (except for the accident of size) might apparently claim equally with Victoria to represent a source. The confirmation of the upper drainage of the Chakmaktin is peculiar. Early explorers represented the lake as having two outlets—one eastward to the Aksu, and the other westward to the Ab-i-Panja. Later explorers maintained that the lake drained only to the eastward, and that it was the source of the Aksu-Murghab river only. Neither view is entirely correct, though the former perhaps more nearly approaches the truth than the latter; for the headwaters of the Aksu, which originate in the glaciers of the Nicolas range (which,



SKETCH OF SOURCES OF THE OXUS RIVER.  
 Scale about 8 miles = 1 inch.

it must be remembered, equally feed Lake Victoria on the north), divide into two streams close to the western shores of Chakmaktin, part flowing into the lake and passing out again into the Aksu, and part flowing westward into the Ab-i-Panja. This division of the drainage occurs in the marshy swamps which border the lake, and was unobserved till the complete drainage system was followed out in detail by the topographer. Thus the source of the Pamir river, and the source of the Aksu-Murghab, as well as the chief source of the Ab-i-Panja are all found together in that elevated region of snowfields and glaciers which forms the summit of the Nicolas range—the dividing watershed between the Great and Little Pamirs. Surely, then, the true source of the Oxus lies amid these glaciers; for no single affluent can compete with these three combined.

Another point of interest in the geographical researches of the boundary commission was the determination of the position of the highest peak north of the Himalaya. It will be remembered that the Sarikol range is the great meridional watershed which stretches northward from the head of the Tagdumbask Pamir, dividing the waters of the Oxus from those of the Tarim basin. This is the range that represents the Taurus of classical authors, and the Bolor of mediæval geography. East of this watershed is a high and rugged range, running approximately parallel to it, but topping the Sarikol in altitude, through the mighty gorges of which the eastern Sarikol drainage passes to the Kashgar plains. This range has been variously named by successive travellers. As a comprehensive name for the whole of it, perhaps "Kashgar" is the most appropriate. On it are the highest peaks of this northern region; but which of them claims pre-eminence in altitude is a question which Russian surveyors have yet to determine. The most northern of these peaks is in lat.  $38^{\circ} 35'$ , and this is the one which was probably observed by Trotter from the Kashgar plain and called Tagharma. Trotter determined its height to be 25,000 feet. The same peak was seen by Ney Elias, and named by him Mount Dufferin. The Russian maps, however, call it "Kangur," and this is the name it will be known by in future. Trotter assigns a position for the peak which throws some doubt on his observations, but there is no doubt that the Russian position (which differs largely from Trotter in longitude) is correct, though its altitude has not yet been determined. Trotter's height (25,000 feet) has been applied to another peak further south, which is called Mustagh Ata both by Russians and by the great explorer Sven Hedin, who ascended it. Mustagh Ata, however, now falls within the Indian triangulation system. It has been well fixed, and its height ascertained by direct observation. It is a broad, bold mountain, with a magnificent glittering dome of snow for its highest summit, whilst other more sharply defined pinnacles of less altitude support the dome on either side. The

height of the dome is 23,480 feet, and the height of an outlying pinnacle 22,780 feet. It will be a matter of interest to learn, when the Russian trigonometrical survey closes on the boundary, whether Kangur or Mustagh Ata is to rank as the highest mountain north of the Himalaya.

Perhaps the most interesting of all the investigations connected with the Pamir boundary is that which traced out the ancient lines of communication with India. Those routes which lead directly from the Pamirs towards Chitral, Gilgit, and Kashmir have never yet been traversed by any military invading force moving southwards; neither have they been used by any of the countless irruptive hordes of Central Asia, seeking new countries and thirsting for the wealth of Hindustan, who have from time to time left the north-west borderlands of China and poured over the boundaries of India. The course of these irruptions can still be faintly traced in history, or be gathered from modern ethnographical evidence. This subject is dealt with in the historical section of the report, which points out that the only travellers through these most inhospitable regions who have left any authentic record behind them are the early Buddhist pilgrims, who made their way either alone or in small parties by the most direct route, in quest of the great centres of their faith which existed between the Hindu Kush and the Peshawar valley, east of the country of the Kafirs. Chitral, Dir, Gilgit, Darél (an almost unexplored district), and Swat were all under the influence of Buddhism till late in the Middle Ages.

These Chinese pilgrims, who set out from Northern China as scholars and returned as missionaries, seem to have explored every route in existence which led to the great Buddhist cities in Swat and the Kabul river valley. Fa Hian, who started about the year 400 A.D. from Kansu, crossed the desert of Gobi to Khotan. There he found a flourishing Buddhist community. From this point his route has been much discussed, but the topography of the districts between Khotan and India appears to decide it. He journeyed twenty-five days towards the country of Tseuho (rightly conjectured to be the Yarkand district), from which he says there is a caravan route due south into the mountain region of Tsungling. After a month he reached the country Kiesha, in the Tsungling mountains. Another month across these mountains brought him to Toli, which has been identified with the valley of Darél, south of Gilgit. After fifteen days' further advance towards the south-west, he struck the Indus, and, crossing it, he reached the kingdom of Udyana. If we accept Tseuho as identified with Yarkand, and Toli with Darél, there exists but one possible caravan route "southwards," by which Fa Hian could have travelled. This is the route which traverses the Hindu Kush by the Baroghél pass, the Baroghél having been a recognized caravan route through all ages. And there is no *known* route into Darél from the north, except that which passes through the Gilgit

valley. But where is Kiesha? It seems possible that Kiesha, "in the centre of the Tsungling mountains," may have been Chitral, which is called also Kashkar. There is interesting evidence that Chitral was once Buddhist, and Fa Hian's graphic description of the place tallies well with what we now know of it. There is also the probability that so earnest a pilgrim as Fa Hian would endeavour to visit all Buddhist places that he could compass on his pilgrimage. After leaving Kiesha, he continued to wander amongst the mountains for a month, and he followed a road "where there is snow both in winter and summer;" where there are "poison dragons who spit poison; winds, rain, drifting sand, and gravel stones," and the people of that land are called "snowy mountain men." A climate such as this implies that his wanderings kept him in the northern hills and amongst high altitudes, and the topography of the country indicates that he followed the route to Gilgit, subsequently made famous by the march of Kelly's relief force. There are many evidences of the former vitality of Buddhism at Gilgit, especially about the narrow defiles and "durras" which lead to Darél. There are the remains of a stupa at Hunzil (about 10 miles from Gilgit), as well as rock-cut figures and inscriptions. About Darél itself we unfortunately know very little beyond what is contained in the report of a native surveyor, who traversed it in 1876. He describes its fertility and the growth of vines in the valley, but says nothing about Buddhist evidences. From Darél, Fa Hian's graphic description of the next fifteen days' journey along the Sintu-ho (Sindhu, or Indus), till he reaches the Udyana plains, leaves little doubt about the position of his final entry into India. Sung Yun, in 518 A.D., seems to have followed the same route. Hinen Tsiang, in 630 A.D., followed the trade route from Northern China to Tashkent and India, and returned *viâ* the Pamirs.

Incidentally, the limits of the ancient kingdom of "Bolor" are traced out on the historical notes of the report; and there are references to the ancient Christian communities of Asia, and the survival amongst the Sarikolis and Kirghiz of fragments of Christian ritual in their ceremonies of to-day.

The grass highland valleys of the Pamirs are described, and the passes connecting them; but there is not much more to be said than has already been said by former travellers about the physical appearance of that elevated tableland. It has its picturesque aspects during the short summer season; but the empty desolation of those snow-covered wastes for the rest of the year drives even the hardy Kirghiz nomads to lower altitudes and more hospitable climes. They are occasionally visited by huntsmen in search of *Ovis Poli*, but are more usually left in silent desolation to the cold sweep of winter storms and the fierce grip of winter cold.