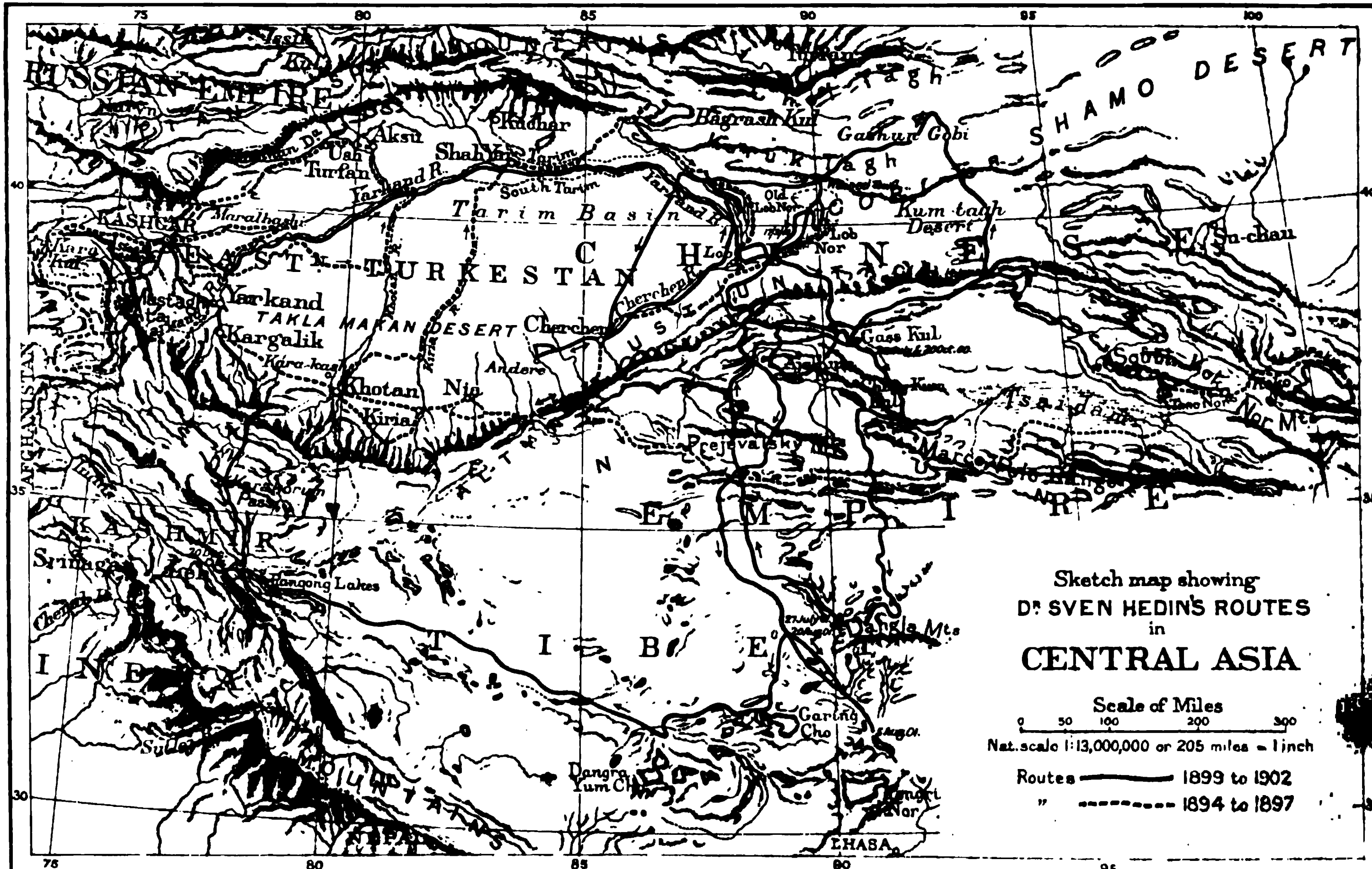
SUMMARY OF THE RESULTS OF DR. SVEN HEDIN'S LATEST JOURNEY IN CENTRAL ASIA (1899–1902).

By Dr. SVEN HEDIN.

THE geographical regions which were the principal objects of exploration during my journey in Central Asia in 1899–1902 are indicated on the accompanying map. It will be seen that I endeavoured to avoid travelling over again routes where other explorers had been before me.

1. *The River Tarim from the Environs of Yarkand to its Lower Extremity.* —This river has been mapped on about one hundred sheets, on the scale of 1 : 35,000, large enough to display all the characteristics and changing features of the stream. The alluvial deposits, which have been laid down in the bed of the river since the current dwindled, as well as every accumulation of mud and every sandbank, have all been indicated. So also have every angle and curve of the bed which the stream has now abandoned; and wherever it has been possible to do so, I have noted the *time* at which these desertions took place. I have ascertained that throughout the whole of its course the stream shows a tendency to shift its bed to the right, that is, to the south. It is especially on that side, namely, the right, that the main stream sheds off its numerous arms or secondary channels, and it is a very common occurrence for the river to follow, for longer or shorter distances, first one and then another of these auxiliary arms. The tendency increases in frequency the nearer the river approaches its terminus, and is most extensively developed immediately before the terminus, where, instead of emptying into the ancient lake of Lop-nor, it now goes on past it and forms the lake of Kara-Koshun, farther to the south.

Throughout the journey I was accompanied by native hunters and shepherds; but as soon as each man's local knowledge came to an end he was dismissed and another guide engaged in his place. Every name given to the stream was recorded, every channel mapped, and the diverse characteristics of the country adjacent to the banks, the graves of saints, the towns, the shepherds' camps, the fords that connect the highways on each side of the river, the lagoons and lateral lakes, the boundaries of the sand-deserts, and so forth—all were noted and plotted out on the sheets of the map. In this way I gathered a mass of material for a minutely detailed monograph upon the course of the Tarim, and the conditions which characterize this the greatest river in Central Asia. In fact, the map is so detailed that with its help it would be possible to construct a profile of the river-bed, at all events to form a clear conception of its structural formation. A number of astronomical positions were determined for the purpose of fixing and controlling the longitude and latitude. Every day, or at least every



Sketch map showing
Dr. SVEN HEDIN'S ROUTES
in
CENTRAL ASIA
Scale of Miles
0 50 100 200 300
Nat. scale 1:13,000,000 or 205 miles = 1 inch
Routes 1899 to 1902
" 1894 to 1897
RUSSIAN EMPIRE
SHAMO DESERT
Gashun Gobi
Bagrash Kul
Kuruk Tagh
Aksu
Kuchar
Shah Yar
Uch Turfan
Yarkand R.
South Tarim
Tarim Basin
KASHGAR
Maralbashi
EAST TURKESTAN
CHINESE
Yarkand
TAKLA MAKAN DESERT
Kargalik
Cherchen
Andere
Khotan
Nia
Kiria
Lob Nor
Old Lob Nor
Kum tagh Desert
Su-chau
Gass Kul
Tsaidam
Prejevalsky
Nor Mts.
Karakorum Pass
KASHMIR
Srinagar
Leh
Pangong Lakes
TIBET
INDIA
Dangla Mts.
Garing Cho
Dangra Yum Cho
Tengri Nor
LHASA
Sutlej
MOUNTAINS
NEPAL
AFGHANISTAN
75
80
85
90
95
100
40
35
30

second day, the volume of the stream was measured; it was found to vary very considerably during the course of the journey. This, however, is neither the place nor the time to dwell upon the causes of this changeability in the levels of the river. Indeed, throughout the whole of its course the conditions of the Tarim are more complicated than would be presupposed, and not a year passes without the channel undergoing very considerable changes.

A large number of photographs were taken all through the journey; meteorological observations were recorded three times every day; and the self-registering instruments used for this purpose were employed throughout the whole of the day.

2. *The Desert between the Lower Tarim and the Cherchen-daria.*—This

CAMP IN TIBET.

part of the desert of Gobi, which had never been visited before, was crossed from Karaul to Tatran (north of Cherchen), and proved to possess an entirely different conformation from the desert of Takla-Makan. The sand, which is heaped up in dunes that go to over 300 feet in altitude, is not continuous, but is interrupted by tracts of perfectly level soil entirely destitute of sand. In the southern parts of the desert small patches of tamarisk and *kamish* (reeds) were met with occasionally, and in such localities water can be obtained by digging down to 6 or 7 feet in depth.

3. *The Region between Cherchen and Andereh.*—This consists of a narrow strip of *tograk* (poplar) forest and steppe, lying between two sand-deserts on the way from Cherchen to Keriya. The more southerly

of these deserts is of no great extent. The region itself is watered by certain of the streams which flow out of the Kwen-lun mountains.

4. *The Lower Course of the Cherchen-daria.*—The regions on both sides of this river were explored, and it was ascertained that the Cherchen-daria also shifts and changes its bed.

5. *The Lower Course of the Tarim between Yanghi-kull and Kara-koshun.*—This part of the course of the Tarim is the most intricate and the most difficult to disentangle of any section of the entire system; accordingly I devoted several independent excursions to its exploration. For example, I was at work there in February, 1900, in the end of April, and the beginning of May, 1900, and again in June of the same year, and each time I adopted a new route and travelled along different branches of the river, all of which were mapped. The contours here are so flat that the stream is subject to the greatest changes, and the current is continually seeking out new channels. At my last visit the little settlements, which have grown up on the banks of the river since the Chinese created the Lop region a separate administrative district, were in danger of being deserted by the stream, and the inhabitants were considering the advisability of building dams to retain the water. How far they will be successful in this the future will determine, but probability is against them.

The tendency of the Tarim to form lateral or marginal lakes begins as high up as Yanghi-kull, where I had my headquarters from December, 1899, to May, 1900, as well as an observation station, at which my self-registering instruments were uninterruptedly at work. Between Yanghi-kull and Arghan the right bank of the river is accompanied by a chain of long lakes bordered by sterile sands, with sand-dunes as much as 300 feet or more in height. The lakes are elongated, and stretch from north-north-east to south-south-west, and are in every instance continued by a series of depressions, penetrating into the heart of the thick masses of sand. These depressions, which the natives call *bayir*, consist of a clay soil without a particle of intermingled sand, and except for a few sparse patches of *kamish* and tamarisks close beside the Cherchen-daria, are absolutely barren. The discussion as to the origin and construction of these depressions must be reserved for another occasion. An east-west vertical section cut through the heart of the Cherchen-Desert would reveal a serrated profile something like the subjoined diagram. In other

words, the sand-dunes turn their steep sides towards the west, whereas on the east they mount up more gradually and by a step-like formation to the summit, which is usually 300 to 350 feet above the general level. This arrangement can only be due to one cause—winds from the east.

The greater part of the lakes which thus accompany the right bank of the Tarim were mapped and sounded during the summer of 1900.

It is impossible here to enter into fuller details with regard to the

BOGTSANG-TSANGPO.

labyrinth of lakes, marshes, and collateral river arms which constitute the changeable delta of the Tarim. In fact, it would be labour in vain to attempt to do so without a general map, and a general map can only be constructed when the cartographical material which I have brought home has been digested, a task that will require at least three years for its completion.

The lakes which I mapped on the occasion of my first journey—Avullu-kull, Kara-kull, etc.—still remain of the same dimensions and keep the same positions; but a number of fresh lakes have been formed in the same region. In fact, the lower Tarim seems disposed to change its course entirely.

6. *The Position of Lop-nor.*—This interesting problem is now solved. The ancient historical Lop-nor is situated precisely where Baron von Richthofen considered that it had been discovered; but its basin is of course now dried up. On its northern shore I found ruins of towns, settlements, and temples, as well as a number of manuscripts, letters of local origin, and tablets of tamarisk wood written on with Chinese script, and dating from 264 to 465 A.D. Further, I discovered on the same northern shore of the ancient lake unmistakable indications of a great caravan route. With the view of ascertaining definitively and thoroughly the contours of the region, I made in the spring of 1901 precise levellings throughout the whole of the lake basin, and the result showed conclusively that the former Lop-nor and the present

Kara-Koshun lie practically at the same level, and are only separated from one another by an insignificant swelling of the ground. Kara-Koshun, however, shows a decided tendency to return to its former situation—a large lake which took me four days to travel round having been formed to the north of it. This new lake is fed by several new streams issuing out of Kara-Koshun, and carrying a volume of not less then 1060 cubic feet in the second.

7. *The Mountain Chain of Astyn-tagh from the Meridian of Charklik to Anambar-ula.*—This mountain chain was crossed and explored in several different places during the course of the year 1901, and the result of my investigations shows that the chain is a double one, not, as shown on our maps, single.

8. *The Desert of Gobi, west of Sa-chau.*—This was journeyed across from the south to the north in January, 1901. It consists of the following belts or sections: accumulated drift-sand, clay terraces, carved by the wind, and *kamish* steppe. Then follow the low hill ranges which form the eastward continuation of Kurruk-tagh; there again we discovered traces of ancient caravan roads.

9. *Eastern, Central, and Western Tibet.*—This mountainous region of Central Asia was the particular object of my interest during this my

LANDSCAPE IN WESTERN TIBET.

last journey, in that I had made up my mind to explore as much of it as I possibly could. To this end I made several separate excursions into Tibet. Profiting from the experience learned in my former journey through the same region, I deemed it expedient to travel with a smaller

caravan of perfectly fresh animals, and as small a quantity of baggage as might be, and so planned my expeditions that I was always able to go back to my base or principal camp, where the various members of my caravan, human and animal, were, from time to time, able to rest and recruit themselves. In this way I was always able to start with a fresh caravan, thoroughly rested and vigorous. My first expedition was made in the months of July, August, September, and October, 1900. Starting from Mandarlik, beside Gas-nor, I travelled due south as far as 33° 45′ N. lat., thence west, north-west, north, and north-east, until I came back to my starting-point. A large part of the caravan, including one man, perished under the incredible hardships which are incidental to journeying in these lofty regions, destitute as they are of every species of vegetation. On both the out journey and the return, I had an opportunity to cross over the various mountain chains encountered, and clear up the orographical structure of the Kwen-lun and the complicated mountain system of Northern Tibet. The positions of a large number of salt, as well as freshwater, lakes, were determined, and their waters navigated by boat. At the same time I took a number of interesting soundings, the greatest depth measured being 157½ feet. The topographical results of this excursion were embodied in a map of 150 sheets.

My second expedition started from the same base. Its object was to complete the mapping of Northern Tibet, especially of the mountains to the north of Kum-kull. This lake also was sounded. These Tibetan lakes are dangerous to navigate in a small open sailing-boat; to do so is always attended with a considerable amount of peril.

But my principal and longest journey through Tibet began at Charklik on May 17, 1901. The route I selected went first up the valley of the Charklik-su, then on to Kum-kull, and over the Arka-tagh. After that I struck a line between the route followed by Littledale and that followed by Prince Henri of Orleans and Bonvalot, and penetrated southwards as far as 33° 45′ S. lat. There the caravan encamped, whilst, accompanied by two attendants, and in disguise, I made a perilous journey as far as the vicinity of Tengri-nor. There we were closely examined, and compelled to return to the caravan, though the Dalai-Lama's emissaries treated us with the greatest respect and politeness. A second attempt to penetrate south from the same camping-place was frustrated at Sellisy-tso by a force of five hundred horsemen.

After that I directed my course westwards to Leh, avoiding both Nain Singh's and Littledale's routes. This journey cost me the lives of two men and of almost all my animals. The baggage animals were yaks, which were everywhere placed at my service by command of the Dalai-Lama. The results of this last journey in Tibet are recorded on a map of 370 sheets.

Whilst the survivors of my caravan were resting at Leh during the winter of 1901–2, I took a run down into India, and shall ever retain

a lively recollection of the hospitality and kindness which were shown me by Lord Curzon at Government House. In Bombay, also, I was welcomed as if I had been an old friend by Lord Northcote, and in every city I visited in India the English people vied with one another in their friendly offices towards me. Nor can I withhold the expression of my admiration at the brilliant way in which England has for more than a century administered that vast empire.

In April I broke up from Leh, and, crossing the Karakorum pass, went down to Yarkand; thence, travelling *viâ* Kashgar and the Caspian sea, I returned to Stockholm, where I arrived on June 27, 1902.

The successful issue of this journey, which lasted altogether three years and three days, was in great part owing to the circumstance that

YARKHLEK-SUS PASS.

his Majesty the Emperor of Russia most graciously appointed an escort of four cossacks to attend upon me throughout. Than these I have never had more honest, more capable, or braver men in my service. Whilst I was absent on my excursions I always left my headquarters camp under the charge of one or two of them, and always had my confidence justified by finding everything in perfect order on my return.

My first journey of 1893–97 has been regarded as marking an advance in the knowledge of the geography of Central Asia. The last journey of 1899–1902, from which I have just returned, has yielded results three times as rich as those of the former journey, and in the course of it I have been enabled to lift the veil which for a thousand years had hidden vast stretches of the mountainous and desert regions of the heart of Asia.

My cartographical material extends to no less than 1149 sheets, and if these were arranged end to end in a long row they would stretch over a distance of 1000 feet. This material I hope it will be possible to publish, either with the help of public funds or by private support. It will then constitute a mine of detailed information about certain of the central regions of the great continent which have never before been trodden by any European, and very often by no Asiatic either. This cartographical material is controlled by 114 astronomical determinations of place. For making these I used an alt-azimuth theodolite and three chronometers.

A complete meteorological journal was kept without interruption throughout, in part during my expeditions, in part also, and simultaneously, in my principal fixed camps, where a barograph and a thermograph were in constant operation. The abundant materials thus gathered in are now being worked up by Dr. Nils Ekholm, and will in due time be published, along with the meteorological results of my first journey.

I took also over two thousand photographs, using for this purpose an English camera and English-made plates, and the results leave nothing to be desired.

Anatomical collections of the higher animals were made, including aquatic animals in spirits, and a herbarium was brought together. All these materials will be studied by experts.

The geological profiles of Tibet will be illustrated by some seven hundred rock specimens collected in that region.

I have also brought home a number of archæological treasures from the ruins we discovered in the desert, amongst them several objects of extraordinary interest; and I made, further, a great quantity of sketches, diagrams, and drawings, to illustrate various features appertaining to the provinces of physical geography. In a short *résumé* such as this, it would not be possible even to indicate the great variety of different observations which are embraced under this heading. It must suffice to mention the measurements made in the basin of the Tarim, upon which a vast amount of time was expended, but which supply the essentials for deducing the hydrographic character of that river system.

For the present I have my hands full with the preparation of a popular description of my journey, which will be most copiously illustrated. The scientific results will be published later on in a work especially intended for scientific students.*

* About the high value of the cartographical and other material brought home by Dr. Sven Heden there can be no doubt. It is to be hoped that either through private enterprise or by the liberality of the Swedish Government it will be made available in full detail.—Ed. *G. J.*