Sibi route. In conclusion, he said he felt he was only expressing the sense of the Meeting in saying that they were deeply indebted to Sir Richard Temple for the lucid and interesting account he had given of one of the most important works that has ever been undertaken in India.

General Sir HENRY THUILLIER expressed a hope that the labours of the engineers in surveying and mapping the country on either side of the line of the railway, might be brought into practical use for the rectification of the existing map. Both geographically and topographically, extensive materials had now been gleaned for the improvement and reconstruction of the map of Afghanistan.

The PRESIDENT, in his closing remarks, said that in listening to the description of the new railway, and of the difficulties of the old military roads which have passed for thousands of years through the Bolan Pass and over the Khoja Amran, he could not but think of the fearful sufferings and mortality of the animal transport in the last advance of the British troops. The loss of beasts of burden during the late war (he believed 25,000 camels had died) was such as to seriously interfere with the means of commercial transport. No person has ever had to contend with the difficulties and hardships of travel in this mountainous region without retaining a vivid recollection of the sufferings he had endured. The utilisation of the fertile tracts of the interior, which have never been turned to profit, would justify the railway from a commercial point of view. As to its military importance, that was a question which would afterwards have to be decided. He could not sit down without referring to the historical interest which this portion of Afghanistan possesses. When the advance of the British troops was made into this country, many must have been led to refresh their memories by turning to the history of Alexander the Great, who entered India by the Khaibar Pass and the northern route, and on his return to Persia, dividing his army into two parts, he led one division himself through Beluchistan, the other marching through the Bolan Pass and over the Khoja Amran, operations which resulted in the loss of three-fourths of those two armies. In conclusion, he would invite the Meeting to join in expressing their thanks to Sir Richard Temple for his instructive lecture.

Notes on the Country between Candahar and Girishk.

By Captain R. BEAVAN, F.R.G.S. and C.M.Z.S., Bengal Staff Corps, Assistant-Superintendent, Survey of India.

THERE is not much interest, in a purely geographical point of view, in the route between Candahar and the fort of Girishk on the right bank of the River Helmund. But it is of great importance as a military position, lying as it does at the extremity of the vast mountain masses that break up the whole of the country between the rivers Helmund and the Arghesan into a troubled sea of rock, hardly practicable even for pedestrians, and forming a complete obstacle to the movement of large bodies of men with military impedimenta.

Skirting the route, to the south, lies the great sandy desert, equally impassable to troops, and thus the tract I now describe forms practically the sole military passage between the east and the west, between India on the one hand and Persia and Turkistan on the other. It is, in fact, for armies what the Suez Canal is for ships. Certainly there are

other entrances to India, such as the routes viâ Chitral and viâ Bamian, but these are, so to speak, back entrances, and involve crossing mountain passes of 12,000 feet and upwards. A formidable army of invasion would necessarily have to traverse the road from Girishk to Candahar. The simple fact that natives of the country travelling from Kabul to Herat or *vice versâ* will go by preference round by Candahar, and that this, though apparently circuitous, is considered the regular route, proves that the other routes are difficult and uncertain.

The narrow strip of plain which this route traverses forms then the interval between the desert, on the one hand, and the hilly country on the other. The desert rolls up in undulating sandhills from the far south. It is traversed and inhabited by nomadic tribes, who graze their camels and flocks on the scanty herbage, and who live in tabernacles of black blanketing, and relieve the dull monotony of such an existence by raids and fights with each other, and with their neighbours. Water is to be found, they say, throughout the desert in certain places, but it would be risky for any one who had not been born and bred there to attempt to travel through it.

The sand is bounded by the rivers Argandab and Dori, the thin line of running water seeming as if it had some magic influence in restraining the overflow of the sand. It is just the reverse of the phenomena of the sea-shore. There the narrow belt of sand appears to impose a limit to the inroads of the waves. Here a thread of running water seems to say "thus far" to the encroaching sand dunes. To the north are the mountains, bare and rugged, not a sign of verdure anywhere about them, not an indication of moisture. The ridges run nearly parallel to each other, with a general direction from north-east to south-west.

The great peculiarity of this country is that only the upper portions of the hills are exposed above ground. The whole country, including the lateral valleys, appears to have been filled up, at a date subsequent to the elevation of the hills, with a deposit of rubble, waterworn boulders, and pebbles, with hardly sufficient soil to hold them together. The elevation at this part of the country is over 3000 feet, but the same peculiarity is observable throughout Beluchistan down to the bottom of the Bolan Pass, at an elevation of some 600 feet only. Everywhere we find parallel ranges of rock, with flat open valleys between formed entirely of boulders and shingle, barren in appearance and exasperating in effect.

This deposit, though apparently level, in reality slopes considerably upwards from the rivers to the base of the hills, and in the valleys it has also a good slope in the direction of their length. Attention to this fact will enable us to understand better the peculiar system of irrigation, by means of the "karez," or underground aqueduct, which is so constantly made use of in this country.

The soil being naturally open and porous, composed as I before noted, of waterworn stones imbedded in a sandy soil, which, however, having a large admixture of lime, hardens at a short distance below the surface into an impermeable conglomerate, it is easy to understand how flowing water may in many places be found 20 or 30 feet from the surface, while on the surface itself for miles round there is nothing but an arid plain. The water thus found is led gradually towards the surface through the karez. A series of wells are dug at intervals of 15 to 25 yards, and connected below by an underground passage, through which the water runs till at last it reaches the surface and is utilised for irrigating the fields. In this manner the low-lying parts of the valleys are cultivated, partly by karez water and partly by irrigation canals taken from the rivers. The two rivers of this district are the Helmund and the Argandab. The latter receives the Dori, Tarnak, and Arghesan, but neither of these contribute a large supply of water.

The minor affluents of these rivers, as shown on the maps, are deceptive. The largest for instance, of these, taking the drainage of the Khakrez Valley, and emerging from among the hills at Khushk-i-Nakhud, contains only a little water in some parts of its course. The others are merely surface-drainage courses, extending a short distance from the hills and then lost altogether, and only carrying a little water after heavy rain. At the junction of the two rivers is the fort of Kala Bist, and from this point along the banks of the Helmund to a considerable distance above Girishk, are scattered the remains of numerous forts and entrenchments, showing the importance that has always attached to the defence of this part of the Helmund River. This district presents a rich and almost unexplored field for archæological research, and will doubtless some day well repay a careful exploration, whenever the state of the country will permit of its being traversed by unofficial explorers. Girishk itself is simply a fort, commanding the Herat road; there is no town near it, but the whole of the Helmund Valley is full of small scattered villages and hamlets, with gardens, trees, and fields. Under a settled government a great deal might be made of this fertile strip of land along the rivers, as also of that along the Argandab; at present they are liable to be pillaged by every body of troops that may chance to traverse the land. For example, just before our arrival, they had been visited by Mir Afzul Khan, the ex-governor of Candahar, who retired with a mob of cavalry towards Herat as soon as our troops made their appearance. The inhabitants, therefore, are well used to being raided upon, and in consequence they only grow sufficient for their own requirements from one harvest to another. They did not understand at first our plan of paying for what we required; but even when they saw we meant it, they could not supply us very liberally, as they had simply nothing to give us but what was put by as food for themselves and their families for the next five or six months till harvest time.

The position of Girishk on the old maps is very fairly accurate. I make the latitude of the fort 31° 47′ 24″, and the height 3050 feet above sea-level. I was not able to visit any of the hill-tops in the neighbourhood, but I fixed the position of a number of distant peaks with reference to Girishk. Beyond the river, the ground rises gradually. To the north-west, by the Herat road, the country is mountainous, and again towards the north-east by the Upper Helmund; but in a northerly direction it appears quite open and level as far as the eye can see, the only exception being that on very clear mornings after rain a few snowy peaks can be seen, just showing their tops above the horizon. I have secured bearings to some of these, but failed in recognising them from more than one point, and can consequently form no idea of their actual distance.

The subject of barometrical heights will I think repay a careful reconsideration. The formula usually recommended for travellers is based upon barometric differences between two stations, the height of one being known, and the observations being made simultaneously or nearly so. The result, however, is affected considerably by the temperature of what is called the "intervening stratum of air." Now, in the elevated plateaus of Central Asia it is difficult to assign even an approximate value to this element. It cannot be represented by the mean of the observed surface temperatures, for the reason that this latter has often an excessive daily range, on account of the great heat of the sun's rays in the daytime, and the excessive radiation at night. For example, near Quetta in the winter the thermometer may read 15° in the early morning, and 55° a few hours later. It would be, I think, very useful if tables could be compiled in a convenient form by which absolute heights could be deduced for the use of travellers in Central Asia. Such tables would of course involve a large amount of work, and could only be compiled from actual records extending over a long period, and embracing such latitudes as would be required in practice. I therefore take the present opportunity of suggesting the subject in the hope that some one among the members of the British Association, who may have the time and the means at his disposal, may be induced to take the matter in hand, and thereby earn the thanks of future explorers. I append a memorandum * showing what tables would, I think, be found

* Table I.—Giving B = the normal barometric reading at sea-level, corresponding to different latitudes on different dates, taken for a given time of day (say 10 A.M.).

T, the normal mean temperature, for the same date.

Table II.—Correction for hourly variations to reduce the readings of aneroid on certain dates to the given hour (say 10 A.M.).

Table III.—Approximate heights above sea-level, corresponding to barometric readings, referred to different values of B, Table I.

Table IV.—Normal temperature from Table I. corrected for approximate height above sea-level.

Table V.—Correction to approximate height on account of difference between

desirable. I may mention here that the aneroid barometers by Messrs. Troughton and Simms, as used in the survey of India, have proved very reliable, and not liable to sudden changes of index error under very severe changes of altitude. It is of course necessary to test them occasionally by boiling-point observations.

Visit to Skyring Water, Straits of Magellan.

By R. W. Coppinger, H.M.S. *Alert*.

Since the original exploration of Otway and Skyring Waters made by Fitzroy in the year 1829, no reliable information, that I am aware of, was obtained regarding these interior waters until November 1877, when the Chilian gunboat *Magellanes* visited them, and made a stay of three weeks in Skyring Water, during which time her boats were employed in effecting a partial survey of its shores. One result of her survey was to show that Skyring Water greatly exceeds the dimensions assigned to it in our latest Admiralty chart (No. 554), and that its western extremity—as laid down from an eye-sketch—is in about 73° 20′ W. long., which gives to Skyring Water a length from east to west of 64 miles, i. e. pushing its western limit 32 miles further to the westward than our Admiralty chart would indicate. Strangely enough, Fitzroy's old chart coincides very fairly with that of the more detailed survey since made by the

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the actual temperature at place of observation and normal temperature from Table IV.

The method of computation with the aid of these tables would be as follows:—

Let aneroid reading = b,

Correction for index error of aneroid = c,

Correction for time of observation from Table II. = d;

Then true barometer height for the standard time on the day of observation = $b + c + d = B'$.

Normal barometric height at sea-level for the same day and the same hour = B.

Then with B and B′ find from Table III. approximate height of place of observation = H.

From Table I. take normal mean temperature at sea-level for day of observation T.

By Table IV. reduce this to normal temperature at place of observation T′.

Mean temperature for the day at place of observation t.

Then with the difference of T and t enter Table V. for a correction to be applied to H to give absolute height above sea-level, affected only by temporary or abnormal variations of pressure. These variations are not large in amount, nor frequent, in the interior of the continent, and a series of observations would give a good mean value, while if comparison could afterwards be made with readings at some point the height of which was known, and which was not too far distant, the error due to this cause might be eliminated. It is not always possible for a traveller to read his aneroid at a particular hour of the day or night, hence it is necessary to have the means of reducing his readings to one standard time. The observer can find his mean temperature (t) of the day for himself, either by keeping a record of maximum and minimum daily temperatures, or by accepting the temperature at a certain hour as the mean. This hour will, of course, vary with the seasons, but is easily determinable by experiment.