did not reach Khava on the east or the Gizarud on the south, but that when he stood on the rolling hills of the Kuh-i-Daud, south of Harsin, which he describes exactly, and asked his guides what the place was called, they waved their hands eastward in the vague Persian way and said, "There is Khava," though as a matter of fact the plain is nearly a day's journey farther east. The fixing of localities is indeed one of the most difficult things in nomad country with no settled villages.

Professor Minorsky has kindly sent me the following comment on the name Dukkan Daud = the Shop of David (p. 499): "There is a more celebrated place of that name south of Saripul. Both are certainly supposed to be David's workshops where he fabricated his famous coats of mail (Quran xxi, 78; xxxiv, 11). The place must certainly be connected with the Ali Ilahi cult."

[*We regret that we have not been able to reproduce for this number the sketch-map which Miss Stark made to illustrate her paper. It is however available for students in the Society's collection, and we hope that it may be reproduced in a later number to accompany a further paper by the author.*—ED. *G.J.*]

THE HABITABILITY OF CHINESE TURKISTAN

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AT a period when Nature has shown herself so lavish that the world is glutted with foodstuffs, it may be almost perverse to discuss the possibilities of the empty places of the universe; but population continues to increase, and lean years follow fat ones. These empty places must therefore be a subject of speculation, and it is proposed to consider briefly to what extent the province of Sinkiang, which embraces all Central Asia now in Chinese hands, can support future generations.

Politically this province comprises three geographically distinct regions: 1. The so-called Tarim Basin between the Tien Shan and Kunlun ranges, which is at once the most populous and the oldest inhabited of the three. 2. The plain north of the Tien Shan. 3. The Altai area, between the Great Altai range and the Irtish river. The Ili valley and the Turfan depression are isolated tracts which do not call for separate discussion.

The population of the province consists of nomads and settled cultivators. It is the latter who predominate, and the means of subsistence from agriculture are greater than from pastoral pursuits; and as the Tarim Basin is the most promising part of the province, it is well to consider it first. Agriculture in the Tarim Basin or Kashgaria (a more convenient name) depends wholly on irrigation, and I have nowhere seen south of the Tien Shan, either on the plain or in the hills, a single piece of unirrigated ground under crops. The present population of Sinkiang is between 5 and 6 millions, and that south of the Tien Shan certainly well over 4 millions. Professor Penck's estimate (see *G.J.*, vol. 76, p. 484) requires revision. The estimate as now given is based

partly on observation, but chiefly as the considered opinion of the late Governor and the chief officials at Urumchi, and may be regarded as a conservative one.

To enable any clue of the capabilities of the Tarim Basin to support a larger population its irrigation must be considered, for on irrigation depends the life of the people. Unfortunately, Turki methods of irrigation are singularly bad. The season is from May to September, and during the rest of the year, when the water is low, or frozen, the fields are flooded to soften them, though even this is not the universal practice.

Sketch-map of part of Chinese Turkistan

Any one who has observed methods of irrigation in other parts of the world where water is scanty or the congestion great will be unfavourably impressed by even a casual glance at Turki irrigation. To begin with, there is no system at all. It is true that there are local functionaries in charge of the water supply, but there is no co-ordinated arrangement whatever. The original canalization is uneconomical and inadequate, and the distribution of the water is unequal and uncertain; and in addition the cultivator himself wastes his water. Thus, from the moment the supply in the river is tapped, much avoidable loss, apart from sepage, is incurred. The whole irrigation is bad from beginning to end.

The Turki farmer has a perennial grievance on the subject, but he cannot, in face of the supineness of the administration, do much himself. The problem is too great for the individual, and every distinct irrigable area requires overhauling and replanning: not an expensive task at all, but one requiring skill, enterprise, and intelligence, very rare qualities in Turkistan and especially in the yamens. For instance, in the Kashgar area there are five civil districts depending on the Kashgar river and its affluents, and the irrigation, instead of being under one authority with a consolidated system, is all parcelled out with deplorable results, the water reaching some fields in excess, others very much in defect.

Moreover the wasteful habits of the Turki cultivator call for comment. No Turki ever irrigates his fields at night, not even in places where there is a water shortage, and those who know the countries where the tenants spend the nights watering their fields as being the only means of ensuring enough irrigation, will realize then one-half to one-third of all the water runs to waste throughout the irrigable year. The swamps that accumulate round a village, and the failure to save water in tanks or *bunds*, illustrate the lackadaisical ways of the Turki. The reason of this disregard for water will be discussed later, but the point here emphasized is that in the chief settled areas of Turkistan half the canal water is wasted, so that with proper economy double the population could be supported with the existing supply.

The yield of crops in Turkistan is poor. The return for wheat is on an average of 12. At Charkhliq (Lop Nor) it is 15; at Aqsu and Uch Turfan 10 to 12; at Bai (a cold place) 8 to 10. In England the highest yield is 19·9; in Germany 18·8; in Denmark 30·4; and in parts of India, with good seed, nearly that of England and the Continent.[1] The yield of maize, barley, and rice is also very low, and the grains, particularly of maize and rice, small and ill-formed.

These indifferent harvests are due to want of fresh seed and bad husbandry. The same seed is sown year by year on the same ground. The weeding of the fields is perfunctory and slovenly, and often neglected. The rice crop is particularly badly tended, in spite of the fact that there is an unsatisfied demand for rice which is exported to all parts of the province and fetches very good prices. The seed is never sown in nurseries and then transplanted into the fields, and regularly weeded and watered, but it is flung anyhow into the fields and only weeded once.

The slovenliness of the Turki reacts on the soil in such habits as not cutting down the maize but merely taking off the heads and leaving the stalks for winter fodder for animals. Then, again, the young wheat is deliberately twice eaten down by sheep. This is said to increase the yield when the corn is finally allowed to grow, but there is loss caused by the animals trampling down the young shoots. The Turki keeps fewer domestic animals than the native of India, but he does not use all their manure for fuel, although the manure available is inadequate. Horse dung is the most abundant, and it is singular that in Sinkiang it is the most valuable, as it enriches the soil in a way unknown in other countries. The dryness of the climate and the failure to store manure

[1]The amounts for England, Germany, and Denmark are given in cwts. as the highest average yield per acre, from the Ministry of Agriculture's Official Report, 28 February 1924. The yields in Turkistan are in return to the seed sown.

properly prevents a supply of "short" or well-rotted dung. A great deal turns on the manure pit, and the introduction of this manure pit into the Gurgaon district for the Eastern Punjab (see F. L. Brayne, 'Rural Reconstruction in India: The Gurgaon Experiment') was a remarkable success. In one or two places I have seen these pits in Turkistan, but they are very rare. If the available manure were properly collected and stored, the increase in the harvest would be great, and the shortage now complained of would be largely adjusted.

The poverty of the soil is not often a factor in production, as generally speaking the soil in Turkistan varies little and is very good. Sir Aurel Stein records that the whole of the Taklamakan desert is potentially cultivable. There are, of course, throughout the settled areas sandy tracts where cultivation is poor. The usual loess soil benefits by a top dressing of sand which prevents it from setting into a cake of hard clay after irrigation; and so small heaps of sand are commonly seen on the fields before ploughing.

The Turki often over-irrigates, and although he understands the rotation of crops, is very lazy about it. Perhaps he should be described not so much as a bad farmer as an uninterested one, without that keen absorption in the land which is often a pleasing trait of the Indian peasant. The reason for this languidness in farming and the unsatisfactory system of water supply lies in the lack of incentive. Generally speaking the Turki can grow, under the present hugger-mugger agricultural system, more than enough for his personal use and for marketing, so there is no inducement to greater efforts. After all, his attitude is natural enough, and so it is that the farming standard is in all respects low. When it is realized why there is this lack of agricultural enterprise, it will be possible to estimate the agricultural possibilities of the country, for this low standard has nothing whatever to do with bad soil, defective water, or uncertain climate, but solely with the farmer himself.

It is safe to say that proper irrigation will double the yield. Good farming will add 50 per cent. to this double yield, so that the average settled areas should treble their returns. This is a conservative estimate, as the land adjoining these settled areas and not now irrigated would come under the plough by the introduction of a good system, and thus the population of the settled areas of Sinkiang could be increased to 12 millions.

Professor Penck (*op. cit.*, p. 484) gives 5000 square miles as a rough estimate of the cultivated areas of Southern Sinkiang, based on Sir Aurel Stein's maps of the Tarim Basin. But this requires some adjustment. To begin with, much cultivation is unmapped, notably the fertile district north of Aqsu. Then again, the maps are thirty years old, and allowance must be made for the increase of the areas shown, opening of new ground in areas mapped, and for cultivation both new and old on wholly unmapped tracts. It is quite safe to double this estimate. Very little land has gone out of cultivation, whilst in some cases, *e.g.* along the left of the Yarkand river from Yarkand city almost up to Maralbashi, what is shown on the map as a scantily settled tract is now a belt of fertile land with busy bazaars.

Having thus discussed the cultivated parts of the Tarim Basin we must consider how much more of this immense area is available for human settlement.

Professor Penck (*op. cit.*, p. 486) rightly discards the habitable estimate of 75 inhabitants to 1 square mile as being much too low, and would raise it to 225. This estimate approaches that given in M. L. Darling's 'Rusticus loquitur,' p. 84, where a family of five, growing wheat, maize, and sugar-cane, can be supported in comfort on 13 acres of "barani" or non-irrigated land. (It must be remembered that there is agriculturally speaking no rainfall in Southern Sinkiang.) P. 199 (*op. cit.*) gives an estimate of five persons on 9 acres if water were sufficient; except for the sugar-cane, the resemblance of the Punjab to Kashgaria makes this valuable corroborative evidence, and allowing for difference of yield and season 250 persons per square mile is admissible for Turkistan, especially as the Sart has additional food supplies in cheap meat and in the oleaster (Trebizond date), while the lack of ghi is balanced by the linseed oil he consumes.

I confess to being unable to follow Professor Penck's estimate of the amount of cultivated land along the Tarim (p. 486), as it seems to me that this vast river would lend itself to a scientific system of irrigation and that the lagoons, back-waters, swamps, and minor branches would all appropriately disappear when the water is brought under control. Take, for instance, the village of Qaratai (Stein's Map No. 25, D.4), a Loplik village in south-east Sinkiang. In former times before the water from the Tarim flowed into the Yangi Darya this village was conspicuous for its fertility, so much so that 80 lbs. of wheat sold for sixpence. The land about it is irrigable and cultivable, and the same applies throughout the course of the river from Kurla to Charkhliq. Where now exists a shortage of water, scanty crops, dying pasture, and dwindling herds, there could be made by proper canalization a smiling area. I cannot believe that proper canalization of the Tarim together with the Konche Darya is only going to increase the cultivated area by 1000 square miles, which is little more than that irrigated by the comparatively insignificant Keriya river. But perhaps I have misunderstood the figures.

Bearing in mind how the face of the Punjab has been changed by successful canalization I think it difficult to limit the habitable possibilities of Kashgaria if scientific methods accompanied a development caused by pressure of population. In the Lyallpur district of the Punjab the population rose from 30,000 in 1891 to 979,000 in 1921. There is as good soil and abundant rivers in Sinkiang as in the Punjab, but without the irregular climate and ubiquitous pests. In this dry rainless region conditions of life are far better. In the Eastern Punjab the tenant is well enough fed, not badly clothed, but miserably housed. His dwellings are rat-ridden and vermin-infested (Darling, *op. cit.*, p. 346). Contrast this with the roomy comfortable houses of even the poorer Turkis, where flies are seasonal and vermin and rats unknown. These happy conditions materially act in extending settlements and supporting a healthy population.

Professor Penck hazards (*op. cit.*, p. 486) 40 millions as the maximum population for Central Asia, the limits of which he does not define. I should multiply this by four for the Tarim Basin alone. And I cannot agree with his view of the low standard of life in Central Asia. If the standard of life is judged by a full belly, warm clothes, and fat children, then the standard is very high. In India during the cold weather warm clothes are rare, but there is not a Turki

in the land who has not a warm wadded coat. Standards of life are deceptive, for in India the peasant spends his money wildly and wastefully at certain times, whereas the Turki puts food and clothes before family, religion, ambition, education, or whatever sways the desires and opens the purse of mankind. It is comfort, first and last, that appeals to the Sart, and for that reason he will not tolerate conditions under which the Indian peasant lives contentedly, even though he could change them if he wished.

It is not so easy to estimate the potential increase in the pastoral areas of Kashgaria, particularly as southern Sinkiang possesses fewer true nomads than does the North, partly because there is less good pasture, and partly because the settled population send their flocks to the uplands, and encroach on the nomads, who find it difficult to secure fresh grazing grounds. There is however the same lack of system and control in the pastures as in the irrigation of the plains, and if the increasing number of nomads and their flocks is to be maintained, some co-ordination of their grazing is necessary. At present these pastures are divided off definitely but not equitably. For instance, the Qirghiz tribes in the Tekes valley urgently need new ground, while the Alaban Qazaqs close to them have more grass land than they need, but resist any intrusion of other flocks. South of the Tien Shan, particularly near Bai and Uch Turfan, the Qirghiz are harassed by Sarts who strive to drive them away, so that in self-defence the nomads are taking to agriculture in the Taushqan and Qarabagh valleys to increase their means of subsistence and to check the encroachment of the Sarts. No one takes any trouble about the rights of the nomads, who are nevertheless of great economic value, as their horses, cattle, and sheep are a source of wealth to the province.

The damage done to forest and pasture by neglect and waste is great and quite unchecked. Many trees are burnt every year by carelessness or laziness, and many are cut down and abandoned, while good pasture land is trampled on and rendered useless for subsequent use, just as many upland valleys are boycotted as being too remote, too cold, or merely inconvenient. There is no reason why this should be, and a little arrangement would remedy the wastefulness and muddle, but it must be remembered that pasture and forest cannot be increased like arable, and much irreparable damage is done. It is a reasonable estimate to treble the number of animals now existing that could be grazed. It is improbable that the interests of the pastoral races and the preservation of the forests will be considered, although especially near the towns of Ili (Kuldja and Chuguchak) the scarcity of wood is greatly felt. The riverine tracts in the Tarim Basin, and also in other parts of the province, support many sheep, and the toghraq forests (*populus balsamifera*) are damaged by lopping off the boughs to let the animals eat the leaves. Thus in many places there are only pollarded or stunted trees; the lack of new and adult ones means an ultimate decrease in pasture, both arboreal and ground. These stretches of toghraq and scrub grazing however are so immense that it will be years before the harm is felt.

North of the Tien Shan, and especially in Dzungaria and in many places in the Ili valley, many crops are produced in unirrigated land, and the wheat so

grown, especially on the low hills between Urumchi and Guchen, is particularly fine, and the opium, barley, and millet markedly good. There is, of course, extensive irrigation, but as there is also abundant rainfall, advantage is taken of it. In the Ili valley especially this is so much the case that whilst in 1928–29 there was a shortage of wheat and barley, in 1930 by planting every available unirrigated upland the harvest was ample, and flour cost less at Ili than anywhere else in the province, to the chagrin and surprise of the profiteers.

The farmers north of the Tien Shan are largely Tungans and Chinese, and are more industrious and intelligent than the Sart. In places, too, the soil is considerably richer with less loess and more humus. The air, too, is more humid. On the other hand, the climate is most unsettled and the crops are often ruined.

It is very difficult to foresee the future of Dzungaria, that great tract extending from the north of the Tien Shan to the Irtish river. After the fertile mountain slopes have been left, the country is thinly populated and largely desert, and it lacks the great rivers that are the salvation of Kashgaria. But far down the Manass river there are many settlements, and the possibilities of irrigation very great. It is however rash to hazard any estimate until the country is better known and more settled. Political conditions have been very unfavourable hitherto, and the fertile districts occupied near the mountains have been so often plundered and their owners murdered that the possibilities of future settlement can hardly be guessed at.

North of the Irtish up to the Great Altai, the only part of Outer Mongolia now in Chinese hands, the settled population is very small but is increasing. Barley and wheat are being grown, the climate is good but harsh in winter, and the future is favourable to extension. The pastures here and to the west, particularly about Chuguchak, are magnificent, and it is wonderful to see these glorious prairies where the flower-decked grass will hide a mounted man. Fine as are the pastures of the Tien Shan, those of the Altai, Saur, and Maili Bar appear even richer, and should be able to support a thriving dairying industry. The larch of the Altai is better grown than the spruce of the Tien Shan, but being remoter it has been less damaged than the latter forests. The Chinese would seem to have every reason to be angry over the way that the rest of Outer Mongolia has been filched from them.

One must bear in mind in concluding this brief account of the habitability of Chinese Central Asia that the skilful use of modern methods of irrigation and agriculture alone can turn this vast empty province into a smiling and populous area. It is possible that the world's needs may never demand this transformation, but it is a feasible one. Perhaps an awakening China, wondering where to settle its surplus millions of people, may have the good sense to call in the science of the West and to develop Sinkiang. There, secure from the annual dread of floods, the industrious Chinese peasant could dwell in contentment to the infinite benefit of himself as well as of his immediate neighbours and of the world at large.