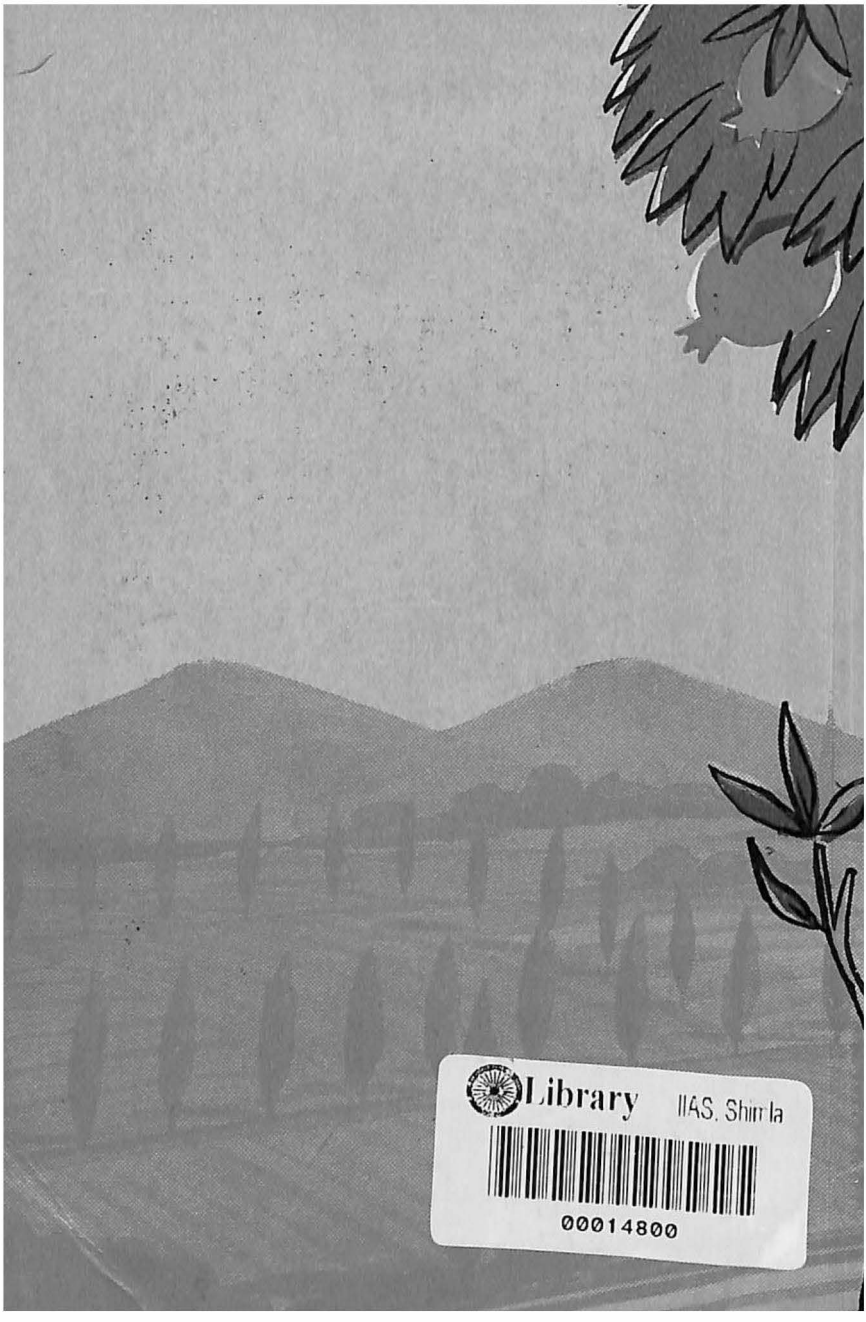

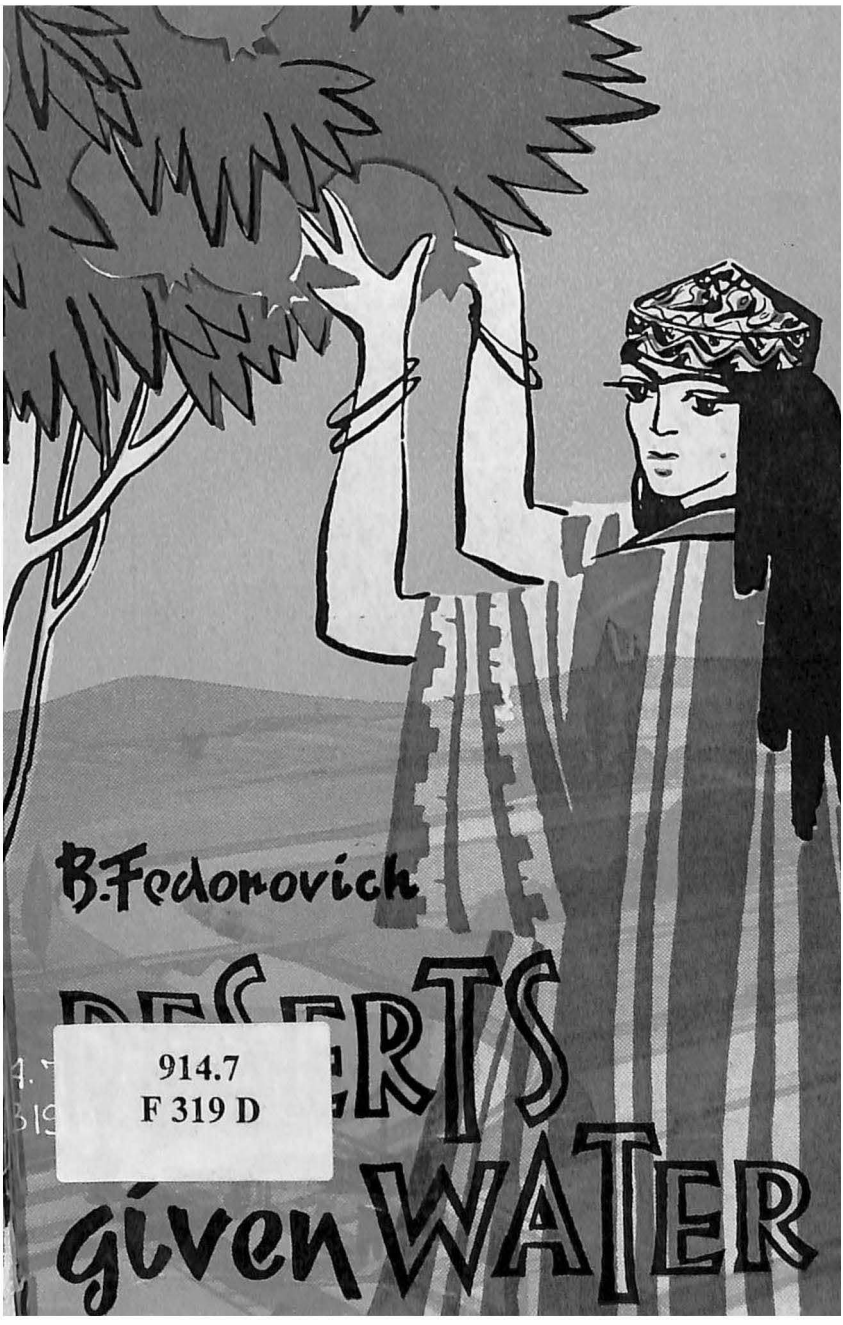

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DESERTS given WATER

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Б. А. Федорович

НАПОЕННАЯ ЗЕМЛЯ

CONTENTS

THE FUTURE OF CENTRAL ASIA'S DESERTS

BY WAY OF A FOREWORD

You will hardly find anyone in the world who hasn't a love of nature with its infinite variety of shapes and colours, its constant changes and rejuvenations, its great age and its agelessness, its wealth of life and movement. The mysteries of nature are fathomless, its every manifestation amazing, and there is nothing to compare with its grandeur and simplicity. . . .

Try to recall the best moments of your life and you will find that they are associated with nature in one way or another. Man is uplifted by nature. Distance calls and lures one on to perform the most daring feats. A ray of sunshine awakens joy and a cool breeze dispels weariness. Contact with nature heals sorrows, ennobles one's soul, gives one hope and sharpens one's wits. Helmholtz—one of the most gifted of physicists—used to say that his greatest discoveries were made not in the laboratory, not in a library chair nor at his desk, but during walks in the forest.

Man's whole life is tied up with and is dependent upon nature. Even a townsman, locked behind his four walls, cannot divorce himself from nature for a single moment: the food he eats is what the soil has yielded, the house he builds is of stone and other materials obtained from the ground, the metal which he works is taken

from the depths of the earth, his electric light comes from dammed rivers, the paper he writes on is made of trees that grow in the forests, the clothes he wears are woven from the threads of cotton, silk or wool given us by animals or grown in fields and plantations.

As a rule, nature pays generously for the labour spent on its development. Life-giving rains and the sun's warm rays reward the farmer with abundant crops. But nature is far from being man's loving mother in everything and at all times. Not infrequently it turns into a cruel stepmother: crops will perish in the scorching rays of the sun and in dry winds, or incessant rains will make gathering the harvest impossible; there will be no water for the fields, or violent floods will inundate everything and choke the ploughfields and orchards with rocks and silt. Vast landslides are not an infrequent occurrence in areas where there is too much rain, while in dry regions the irrigated crops perish from the salts emerging from the soil. And then there are the earthquakes destroying towns and villages, roads and canals, bringing death to hundreds of thousands.

Even today man is apt to fall victim to nature's whims. It is not surprising, therefore, that early man worshipped nature, feeling insignificant in the face of its awesome forces.

But we cannot reconcile ourselves to the inconstancy of nature or to its everlasting whims. Floods caused by such rivers as the Hwang Ho or Ganges are so disastrous that men had to seek ways to master these gigantic streams. The water and silt of these rivers are an inexhaustible source of wealth which for many thousands of years has supported millions of people. So far, however, men have tried to snatch for themselves no more than a particle of this life-giving wealth. Does this mean that these. the greatest of rivers, cannot be tamed?

The time has surely come for man to master them. Must people really go short of food because the scraps they raise fail to meet the demand? Is there no spare land suitable for cultivation, or have the rivers that could be used for irrigation all dried up? Is it not possible to make the old fields yield far greater crops? Is there a limit to what a people freed from economic bondage, an independent state equipped with the achievements of advanced science and engineering, might venture to undertake?

I. V. Michurin, the famous Russian naturalist and plant breeder, said: "We cannot wait for favours from nature, we must wrest them from her." These words express the gist of the attitude taken by millions of Michurin's countrymen.

In pre-revolutionary days, Russia was a country of destitute, illiterate peasantry, a country whose industry was utterly inadequate for its needs.

After the Great October Revolution, reorganization and reconstruction was commenced on a gigantic scale, old conceptions broken and rooted out—work never before undertaken in the history of the world. The new socialist attitude to nature was given earnest consideration and it became clear that a system of enriching and improving nature should be substituted for the old way of plundering and destroying. Mankind had for too long been treating nature unreasonably, chopping down woods haphazardly, tilling hillsides on which deep gorges soon developed, destroying the green growth in the deserts, thus causing the sands to shift, and making the poorly fertilized soil grow barren.

The problem of enriching and improving the nature was far from simple, but the forty years of creative effort put in by collective farmers, workmen, agronomists, engineers and scientists have already produced con-

siderable results. Striking changes have taken place in the life of the formerly backward peoples of Central Asia to whom the cultivation of deserts has brought prosperity and culture.

There was a time when rice crops did not yield more than fourteen bushels per acre—a harvest considered normal in some countries even now. But in the Soviet Union, as the newspaper *Vechernaya Moskva* said in October 1956, "245 bushels of rice have been gathered from each of the 1,853 acres belonging to the Stalin Collective Farm in Gurlen District, Khoresm Region."

Cotton has been cultivated in Central Asia since time immemorial. In 1913 it yielded an average of 260 pounds of raw cotton per acre, in 1928 it was 668 pounds, and now the state quota of 2,225-2,492 pounds is being overfulfilled by many of the collective farms, while the foremost ones gather as much as 5.340 to 7,120 pounds per acre.

But how could such results be achieved in desert regions where no agricultural plant could grow unless it was watered? What is the purpose of developing dead, sun-scorched deserts with dogged perseverance for forty years in a country like the Soviet Union with its immense tracts of virgin steppeland that remained untilled till 1954? Do such endeavours to remake nature really pay?

We shall try to touch upon all these questions in this book. We shall speak about the deserts of Central Asia and ways of developing them, about our chances in the struggle with nature and the gain from remaking it. We shall speak of what we have done already and what we are hoping to do in the future.

WHY DEVELOP DROUGHTY REGIONS?

The development of deserts and semi-deserts entails great expenditure of labour. Deserts are called "God-forsaken" regions where everything is killed and burnt by the sun. So why stand up against nature? It is so much easier to work lands where the farmer's only worry is ploughing, sowing and harvesting, as in the Russian steppes, and yet the deserts and the droughty regions adjoining them are being developed so persistently. Can it be that the globe is overpopulated, with no vacant space remaining at all?

No, our planet is far from that. Neither in the U.S.S.R. nor in Canada has the whole of the podzol zone been cultivated yet. Granted that forests essential for the needs of these two countries now take up that zone, that not all these areas are cultivable, that the soil requires painstaking attention and the climate is rigorous—still that is a good reserve for the future. There are also the tropical savannahs and the extensive jungles in equatorial Africa and South America with their eternal summer which have never been tilled. All these lands will be inherited by our great-grandchildren and their children in a practically untouched state.

But then why did man, even at the dawn of civilization, try to develop the droughty lands which would appear to be the most difficult to till, and why does he so stubbornly continue that effort? Because the sky above the deserts is cloudless throughout the long summer. Indeed, nowhere in the world does the soil receive such a wealth of sunlight and warmth as in deserts and droughty regions. In the deserts of Central Asia, where the climate is markedly continental, the summer heat of 104°-110° F gives way to a cold of −4°-13° F in winter. Therefore, evergreen plants cannot grow here, but the abundance of sunlight and warmth in summer makes it

possible to cultivate annual crops, which require the greatest warmth. The desert soil contains alkaline substances essential for plant life; what is more, these substances are not lixiviated in these conditions as they are in regions of high moisture content, but under the influence of the hot sunrays they rise to the surface together with the moisture and render the soil potentially fertile. The only problem is water. The Turkmen who live in the south-western part of the Central Asian deserts say that a drop of water is worth a diamond. Give the desert water and you'll get the best crops in the world.

Skill is required in cultivating desert soil, watering the plants in time and in due measure, protecting the soil from salinity, improving its structure and consistency, maintaining the irrigation canals and drainage system, and fighting the winds which bring excessive heat and dryness and bury the fields in sand. But then, the effort is lavishly rewarded.

In northern countries the trees show a branch growth of from two to four inches a year, while in watered deserts some trees grow as much as three or even 6.5 feet a year. In temperate climates grass is usually cut but once a year, while alfalfa grown in the oases is cut four or six times a year, each harvest bringing in far more hay than in northern countries and providing a more nourishing fodder as well. In Central Asia an acre of alfalfa yields as much as 24,000 pounds of hay with a protein content of from 12 to 16 per cent. Sugar-beet may be grown in any climate, but nowhere is it as abundant and rich in sugar as in desert oases. Grapes are grown in various parts of the world; viticulture has long been in existence in Germany and today it has been made possible even in the rigorous climate of Moscow Region, but the sweetest grapes are those grown in droughty regions.

All these examples supply the answer why the devel-

opment of desert lands is one of the primary problems to be solved in achieving abundance.

The development of deserts and semi-deserts calls for a great outlay of money and labour to build an irrigation and drainage system. Irrigation on a major scale could not have been achieved in the days when the only tools were a mattock and a wooden plough with a cast-iron share, and the only driving power, the muscles of men and their camels, horses and donkeys.

More and more machinery is being used in the construction of irrigation and drainage systems and in tilling, with the result that labour productivity is greatly increased and the work itself made much easier. Crop yields have increased immeasurably due to the combined efforts of plant breeders, agronomists and farmers, and this makes the prospects of arid land development in the U.S.S.R. brighter still.

The future of arid lands in other countries need not be less promising. The whole solution hinges on the date of the great changes. A lot has been accomplished in the forty years since the people took the reins of government into their own hands in the Soviet Union. The Chinese people did not win their freedom until 1949, but even so they have achieved much. In China, of course, attention has been concentrated mainly not on the deserts but on those droughty and more populous regions where irrigation farming has been in existence for many thousands of years. Until now, farming and the very lives of the people in these regions, watered by great rivers, have been ruled by the elements. The rivers challenged man too often and flooded vast areas. Therefore, the problem today is to harness those rivers. However, plans are also being made for the large-scale development of inland deserts.

In Egypt, the first undertaking of the young state which had thrown off the shackles of colonialism, was to

irrigate the deserts with the waters of the Nile. The cultural life of the Egyptian people is concentrated on a narrow strip of land which comprises but four per cent of the country's territory. This narrow valley, hemmed in by the vast parched desert, has been tilled for over ten thousand years. Year after year and day after day the Nile carries its hundred cubic feet of water per second through the desert and discharges it into the Mediterranean Sea. And yet an overwhelming majority of Egyptian peasants are obliged to eke out an existence on tiny plots of land. In the days of England's supremacy, two and a half million peasant families of Egypt were entirely deprived of land. Approximately one and a half million peasant families each owned an average of 0.3 feddans (0.3 acres). Peasant-fellahs, comprising 72.2 per cent of the landowners, held 13.3 per cent of Egypt's total arable land, while a small group of landlords, comprising a mere 0.4 per cent, owned as much as 36.7 per cent of the land. It should also be mentioned that until recently the total arable territory in Egypt amounted to only 6.175,000 acres, with a population of 20,700,000 (according to 1952 data).

But there is no doubt that the liberated Egyptian people will be able to utilize their natural resources differently. They will no longer let the waters of the Nile continue flowing away into the sea, but will instead send every drop of it into the fields. The possibility of achieving lasting changes in the nature of his country has now been realized by every Egyptian. And if Egypt is not threatened by any new attacks, the people who have learnt the meaning of liberty will utilize the wealth of the Nile's sacred waters in a new manner and will never again know misery or want.

India, with its enormous precipitation incidence, its soil more fertile than the Sahara sands, and its two or three crops a year, is no poorer than Egypt in natural

resources. And the problems of remaking nature in India are more varied with considerably greater prospects.

On the Deccan plateau, where rivers flow only in the monsoon season, the rain deposit is so great during that period that this water supply could well be used for irrigation purposes. But in parts where not only the level land but also the slopes are cultivated, these tropical rains cause irreparable damage to the crops, washing away layers of soil from the plateau. Combating soil erosion—an extremely laborious undertaking—is what is now facing the liberated Indian people. The experience of Chinese and Indonesian peasants, who for many centuries have been engaged in terrace farming, could help here.

When the people of India are ready to undertake the making over of Deccan's nature, they will have all the modern machinery they need at their disposal. Although the job of levelling the fields is going to be an extremely difficult one, in conditions of tropical rains it is the only way to preserve the fertility of the soil for the generations to come.

In north-western India and partly in Pakistan, east of the Indus, lies the Great Indian Tar desert. A considerable part of it is covered by sand dunes. Since time immemorial this region has been used for pastures, and a great part of it will continue to be used as such for a long time to come. However, there are spacious plains bordering on this desert whose relief and soil admit their cultivation suitability. But this desert, like the Kara Kum, has a moisture deposit of only four inches a year, which is 16 or 17 times less than in either Calcutta or Bombay. No field-crop could grow and yield a harvest in these conditions. And yet, to the west of the Tar desert, the Indus carries its mighty waters away into the ocean. This tumultuous and yet unconquered river senselessly pours away two and a half times more water than does the Amu Darya, which is the largest waterway in Cen-

tral Asia. The time has surely come to turn the waters of the Indus to better use. One should not lose sight of the fact that the Indus is one of the most silty rivers in the world. The annual quantity of silt, this unsurpassed fertilizer, borne away into the ocean amounts to 450 million tons. In the course of geological epochs, the waters and silt deposits of the Indus formed a vast sandy plain, but the winds have disintegrated it into the Tar desert. But if the same waters and silt deposits were taken under control they could transform great stretches of the desert into fertile plains; to achieve this the silty waters would have to be turned into the lower regions of the desert. This method has been put to the test in Central Asia and there is no doubt it could also be advantageously and widely adopted in the Tar desert. The work would take years and require great effort, but it would be an achievement which would live through the ages.

The north-eastern part of India is watered by the numerous rivers of the Ganges and the Brahmaputra basins. For many thousands of years these waters have been providing the peoples of India with a living, and yet how often these same waters turned into raging elemental forces and reduced the people to mere slaves. In the flood of 1950 for instance, over five thousand villages were inundated. But great are the people of this great country and they will certainly find a way to restrain this elemental force as well.

There are no ready-made instructions for remaking nature. Different methods may have to be applied in each country, in every region, but all would have a common aim—to conquer nature and direct all its forces toward the building up of universal prosperity. And perhaps, from this point of view, the reader would be interested to learn what methods are being adopted in the Soviet Union to remake the nature of desert lands.

LIFE IN THE DESERTS OF CENTRAL ASIA—PAST AND PRESENT

EARLY HISTORY

The dawn of civilization saw the birth of agriculture in Central Asia. Eight and a half miles east of Ashkhabad, on a level tract below the hills, lie the ruins of the ancient town of Anau. The attention of archaeologists has for some time been directed to the two hills near the ruins. Excavations have elicited that one of the earliest civilizations had been developing on the narrow strip of land hemmed in by the Kara Kum desert on one side and the barren Kopet-Dag ridge on the other, in those ancient times when in Europe men still dwelt in tree tops and caves, and lived by hunting, fishing and gathering wild fruit.

Ancient history is still unable to guarantee the accuracy of its dates. But the summation of existing tools and utensils used by primitive man affords an accurate determination of the sequence of events and cycles of civilizations. The fact is quite indisputable that Anau was at least one of the first homes if not the birthplace of agriculture, cattle breeding and handicrafts. There, earlier than in many other regions, man made his first attempts to cultivate wheat and barley, tame animals and weave cloth. It was evidently from this part of Central Asia that wheat found its way into the steppes of the Ukraine and, at a much later period, penetrated into

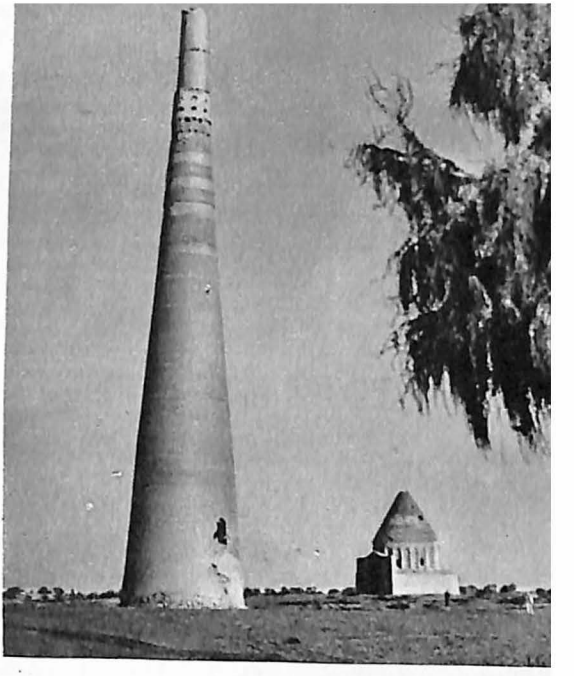
the countries of Europe. Excavations at Anau have proved that even in the Stone Age men did not live solely by hunting and gathering wild fruit, but also sowed crops, which in Anau they seem to have been doing even before they had tamed the animals.

It is obvious that men inhabiting the desert and its oases had been able to find all that was essential for their existence at a much earlier period than those inhabiting the temperate zones. The climate then was not substantially different from what it is now, proving that mankind in all stages of development had no fear of the deserts so long as water was to be had in them. But since crops will only grow in such parts of the desert where the soil is provided with moisture to an incomparably greater degree than that brought by rains and snow, the question arises, where did the early man sow his grain?

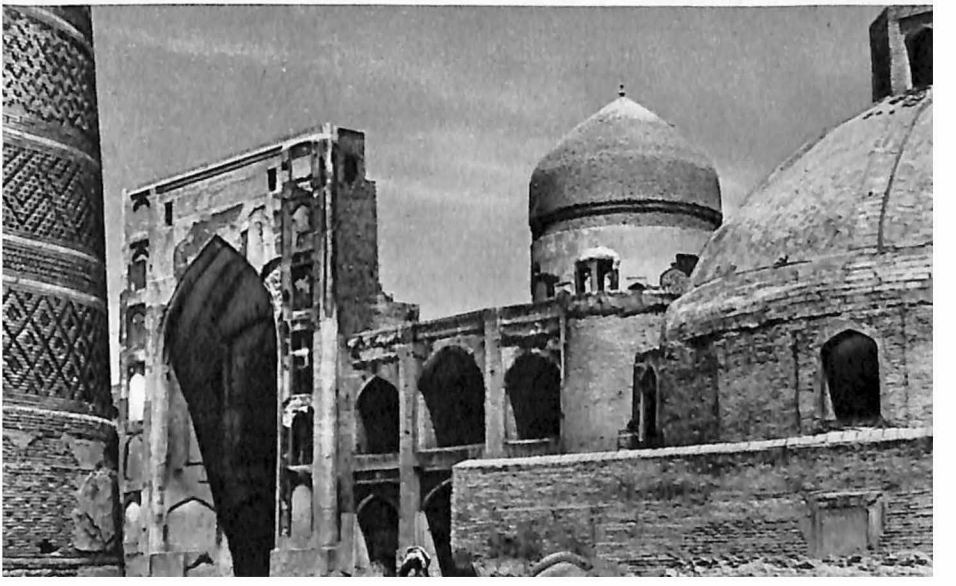
To begin with, these must have been naturally flooded areas. A man would settle close to a brook or a stream, gather in the wild cereals, and as he threshed them close to his tent he certainly could not help dropping a few grains on the ground. Later he'd notice that his spontaneous crops would only take root in soils of the highest moisture content. Little by little he would learn to weed out the patches where these crops were growing and, eventually, come to sow the seeds himself. The necessity of digging up edible roots had taught him to loosen up the soil, and with time he became convinced that everything grew faster and better on land that had been tilled.

Over the course of many centuries mankind utilized only those areas which were naturally irriguous. Up to now a so-called "bulak" agriculture exists in central Kazakhstan around the "bulaks" or brooks which flow from beneath granite rocks, and water the adjoining

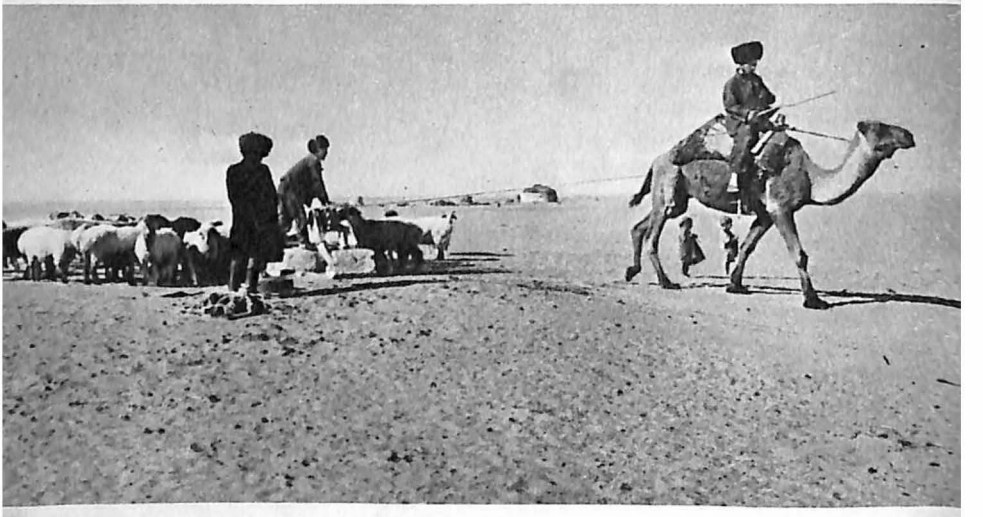
Ancient culture has left many memorials in the deserts of Central Asia. This minaret which is 203 ft. high was built in 1011 in Kunya-Urgench, a town in the ancient kingdom of Khorezm situated in the lower reaches of the Amu Darya. The river changed its course in 1578 and the town was left in a waterless desert



Architecture was also highly developed in Bukhara, an ancient kingdom adjoining Khorezm. And here, too, there was shortage of water



This is a "chigir," an installation which in the old days used to bring water to the fields



Wells are deep in the deserts. In Turkmenistan the practice over many centuries was to use camels to draw the water

parts of the valley. It is evident that this "bulak" agriculture goes back to the earliest civilizations known.

Only an insignificant part of the desert, however, is cultivated in this manner. Man made far wider use of the riversides. The rivers flowing through the deserts carry great quantities of silt down from the mountains. As they traverse the deserts the waters sustain heavy seepage and evaporation losses, and far from deepening their channels towards the mouth, they choke them up with silt and sand, resulting in overflow. The soil becomes so saturated with flood waters that it remains moist until autumn. Fresh water silt, alluvium, is a high-bearing soil which yields abundant crops even with the most primitive of tillage methods. This is the reason why the flooded areas were the cradle of agriculture in the desert.

To this day there are certain regions in lower Amu-Darya where the population only cultivate riverside areas subject to flooding, or territories with close subsoil waters, where no artificial irrigation is needed. This is the so-called "kair" farming which, together with the "bulak" farming, is a heritage passed down from the most remote epochs.

The "kair" farmers often had to safeguard their crops from too high a flood by building dikes around their fields and draining off the surplus water, which was then directed into other arid plots. Thus they learned to control the water and acquired the practice of artificial irrigation which enabled them to develop new tracts of land, extend the areas of natural oases and create new, artificial ones.

Irrigating the deserts, which originated in the dawn of civilization, played a tremendous part in the advancement of culture. This battle with nature made men join

forces, developed their capabilities, taught them labour efficiency and helped to promote civilization.

Blindly, the forces of nature
Over the deserts held sway.
Alone, to combat them,
Man entered the fray....

Thousands of years went by. Fields, artificially irrigated, spread out farther and farther. Spacious oases began to appear close to the rivers, where once there had been an impassable wilderness of woods and jungle, reeds and rushes, inhabited by tigers and wild boars. The people had to fight the wild beasts as well as the desert sands, and this battle they fought long and doggedly. Only recently the tiger seems to have been exterminated in the lower reaches of the Amu-Darya. As for the wild boars, which to this day inhabit the thick rushes of the delta, they still devour no small percentage of the crops on the outskirts of the oases. As much as 20 pounds of rice is sometimes found in the stomach of a killed wild boar.

A small clan or family group could only undertake the cultivation of a brook-watered plot of land, or a piece of the flooded area, and root out some trees or reeds to clear a small space, but it had taken thousands of people joined in organized labour to master the great rivers and irrigate large tracts of land. This is why social culture was on a high level in ancient times in the valleys of the great rivers which cross the deserts. Complex forms of social organization were conceived and developed there and the first powerful kingdoms came into being.

Many centuries have passed since then. Kingdoms and peoples have disappeared. And yet the life-giving sources in the deserts have on the whole remained the same. Cattle breeding was still the main occupation in the arid regions, while farming in conditions of close

sub-soil waters and surface waters of a temporary nature always played a secondary part in the life of the desert. But wherever men found permanent sources of water, such as in the riverside areas, they steadily fought for and wrested from the desert more and more land, turning it into gardens and fields.

FARMING IN THE DESERT WITH LOCAL WATER SUPPLIES

One day in early summer, an expedition of which the author was a member made its way up the dried river-bed of the Western Uzboi in Turkmenistan. Empty spaces lay all around us. We came to a spot where a great length of the river-bed was covered with fresh silt deposit brought down the large ravine cut in the slope of a nearby hill. It seemed curious that the slabs of silt, already dried to a crust and cracked on top, were turned upside down here and there, with a chequer-board regularity in the design. We wondered who could have wanted to play this queer game. The puzzle was solved for us when we came up close to the very first slab. Some 6 inches deep in the still wet silt we saw young melon shoots.

We came back early in the autumn. Having made our arrangements with the head of the caravan as to where we should meet that night, we went our different ways as usual. The routes we chose that day happened to be long ones and it was quite dark when we sighted the friendly light of the camp on a rise ahead of us. When we got there the workmen welcomed us with somewhat exaggerated ceremony and led us to the central tent. But what a surprise awaited us! A mount of twenty or thirty huge melons lay heaped in the middle of the floor. Some of them weighed as much as 33 pounds each. Altogether there were sixteen kinds of melons of the most varied hues and shapes. Even the most critical connoisseurs could find no fault with either their taste or fragrance,

although we kept debating for many a day to follow about which variety was the best. At that time I noted down the names of ten varieties out of the sixteen. A few years later I came across a monograph describing 132 sorts of melons grown in Central Asia, but I found only four names included of the ten I had noted down. There are obviously even more varieties than those accounted for by the author of the monograph.

Those melons, which had grown in the silt brought from the ravines and which had never been watered, could not be compared in flavour to those grown in the oases. Small wonder then that the whole village, owners of the melon fields, came out in a body to gather them in. Huge slices of golden melon lay drying in the sun. Besides being a delicacy, it constitutes an essential food product for the people there.

It should be mentioned that melons play a big part in the economy of Central Asia and Kazakhstan deserts and oases. They grow in irrigated fields, or in conditions of close sub-soil waters, or even in unwatered ground. If you add to this the fact that melons can withstand a great degree of salinity in the soil and are also used as a crop rotation culture which destroys annual weeds, then the reason why this plant is valued so highly becomes perfectly clear.

In 1947, travelling in the expedition's car, we drove through the Kara Kum desert north-east of the Aral Sea. The levelled strip of road narrowed gradually, and tall humps of sand, either partly overgrown or completely bare of growth, hemmed in the road closer and closer. The going was difficult for the sands became ever looser.

We wondered if we'd be able to go on. It seemed as if these tall ridges were about to interlock and we would be stranded in the arid, parched desert.

Suddenly, around a turning, we sighted a plot of ground covered with lush green grass. This looked ex-

traordinary amid the gleaming white sands with their sun-scorched, meagre, greyish-yellow growth. It appeared that one of the collective farms had this piece of land under crop. Beyond a dense wall of maize stretched millet and melon fields. But it puzzled us how all this could have been grown in the desert, and also how soil as dry as this could have produced such heavy, rich clusters of millet and such powerful stalks of maize. The answer lay in a 10-feet-deep trench which ran along one side of the field; sub-soil water seeped through the sand into this trench, 656 feet in length, gradually draining into a reservoir which was fitted with a wheel of a 20-feet diameter, made of light slim poles and equipped with metal pitchers. This wheel was set in motion with the aid of a winch and a second toothed wooden wheel placed horizontally to it; it scooped up the water and poured it into a trough. The device is called the "chigir" and is one of the most ancient types of hydrotechnical contraptions.

In the old days they were very much in use in practically all the oases, numbering thousands in the lower Amu-Darya alone. The creaking of the "chigirs" sounded through the desert like the mournful song of oppressed slavery. Camels, horses or donkeys hauled the water up on to the fields, and the cost of maintaining these animals weighed heavily upon the small landowners. Procuring fodder was a problem but they had to procure it at any cost, for otherwise they would have no means of watering their fields and would themselves die a hungry death. And so they were compelled to allocate a considerable portion of their arable land for fodder crops.

Today the irrigation system has been completely rebuilt and gravity flow canals are now bringing the water into the fields. However, in deserts where there is plenty of fodder for the camels and where the animals require hardly any care while water is worth its weight in gold,

these "chigirs" are still found useful and necessary. They are also quite a frequent sight in the northern part of the desert regions where the sub-soil waters are fresh and 6.5 to 13 feet below the surface; occasionally they are seen, too, in household plots.

The largest of the Caspian Sea's gulfs is the Kara-Bogaz-Gol, separated from the sea by a narrow spur of coarse-grained cockle-shell sand. The waters of the blue Caspian Sea are salty, and the leaden-grey waters of the gulf look like a thick saline solution. You should imagine that the water in the sand of this low spur would be just as salty but when you had spaded it up and tasted it you found it was perfectly sweet. All you had to be careful of was not to destroy the thin (half-inch thick) lining of clay, as otherwise the sea water would seep in at once. This layer of fresh water was formed from rains and melting snows and also the condensation of hot air vapours which had cooled in the porous sand. The question was how to make this moisture serve agriculture. A "chigir" couldn't be installed there—fresh water would instantly mix with the salt. The layer of fresh water was too deep for annual plants. The solution found was quite simple: wide trenches—a metre deep and with sloping walls—were built in the sand. The seeds were planted in this sand, moist with the capillary rise of sub-soil waters. And these trenches yielded splendid crops of water-melons, melons, tomatoes and other vegetables, grown without watering. The same method was used in viticulture.

Trench agriculture, first attempted in the early 1930's, produces splendid results and is adopted wherever the sub-soil waters are either fresh or slightly salty and are not more than 6-8 feet below the surface.

In the Muyun Kum desert in South Kazakhstan, as well as in some other parts of Central Asia, where the winds have long since dented the sands with deep and

spacious hollows, and where the soil is washed clear of salts by the fresh water flowing abundantly from the mountains, seeds are planted in these natural hollows and no special trenches have to be dug. In certain regions these hollows were used as sowing ground by nomads; today they are fully utilized for melon and millet cultivation and produce abundant crops.

In parts where sub-soil waters lie far beneath the surface we now employ wind turbines and sometimes mechanized irrigation, whereas once these waters were not utilized at all.

In clayey deserts, where the sub-soil waters are meagre or too deep, it has long been the practice to use temporary surface waters, not as primitively as on the Uzboi, but by the construction of small earthen dams and irrigation ditches. In Northern Aral regions, early varieties of barley, wheat and millet covering large fields are watered with the melting snows which flow down the dried-up ravines into reservoirs.

Experimental stations, located in different parts of the desert, are perfecting the different types of desert agriculture and evolving new varieties of field-crops of a greater resistance and yield to suit the local conditions.

TUNNEL IRRIGATION

No streams flow through the valleys of the desert mountains, but occasionally a cloud-burst in the mountains would send torrents of water, rushing down impetuously, to flood the ravines. From a mile away one could hear the roaring of the stream above, as the waters bore down the rocks, but on nearing the river-bed it would be found perfectly dry. All that volume of water rushing down in a tumultuous stream vanished entirely into the conical thickness of broken rock deposit, or

"mountain rubbish." But this water was neither lost nor wasted, for men have long learnt how to put it to use.

In a dry and narrow gorge, some distance away from the river-bed, out of reach of the flooding water, they dug a ditch, which would then become a tunnel leading towards the upper reaches of the gorge. The tunnel would be not more than 20 inches in width and about 40 inches high. Work was hard in this cramped space and, besides digging, they had to reinforce the walls with timber or stone slabs as they went along. One man would do the digging and another, on all fours, would carry away the earth in a leather bag hitched onto his back. But this could not be kept up for long, so when they had gone on for some 65 or 100 feet, they would come out on the surface and dig a well at the point of its continuation. Starting from the bottom of the well, they worked backwards until they had joined up with their unfinished tunnel, after which they would continue its original direction from the bottom of the well for another 65 or 100 feet, come out on the surface and dig a well again, continuing the process for the desired length. Each subsequent well would be deeper than the last, and the tunnel would cut deeper and deeper into the deposit of rubble, pebbles and clay. Thus they would dig on until they got to the sub-river-bed waters. Though surface waters may only stream down the gorge a few days a year, sub-river-bed waters are ever-present in the thick pebbly strata. Once the tunnel was completed, this water could be directed into the fields, keeping them supplied with moisture for a whole year.

A tremendous amount of labour had to be put into the construction of these tunnels. In Iran, for instance, the average length of each tunnel comprises 18.5 miles. Excavations, including the depth of the numberless wells, would sum up to approximately 62 miles, requiring as much as 170,000 man-days of back-breaking labour. And

yet the result would be a little stream capable of watering only a few acres. The digging of these tunnels took years to accomplish. Some of the wells measure to a depth of 330 feet. But not infrequently the water supply would give out in a few years' time, and all this effort would be wasted. Sometimes, too, the stream would be slightly salty, and as a result the soil watered with it would be covered with a thin white film of salt. But, whatever the obstacles, persevering labour would overcome them. In Iran, they do not always sow their millet and wheat directly, but transplant it like vegetable seedlings. And this soil, literally watered with sweat, rewards the desert farmer with magnificent crops.

Tunnels such as the above are numerous in the deep valleys of West China. Hundreds and thousands of them are responsible for the existence of large oases on the slopes of the Tarim depression, in the Liuchung hollow and elsewhere.

There are many ancient tunnels, bringing water to whole oases, in Central Asia, too, particularly at the foot of the Kopet-Dag. In recent years, artesian wells have been bored to direct pressure waters of deeper horizons into the tunnels to guarantee a water supply and, what is more, to increase its abundance. We prefer to bore deep artesian wells rather than dig new tunnels. Wherever internal water pressure is insufficient we take recourse to pumps with wind motors. The expense involved is considerably less than the cost of digging tunnels.

GRAVITY FLOW CANALS

The cultivation of only small plots of land is possible in conditions of total absence of irrigation, or irrigation by means of temporary surface waters or sub-soil waters. Minor oases owe their existence to the tunnels, but the chief source of water supply in the deserts comes

from the rivers which flow through the sands in transit from other, usually mountainous, regions. These rivers do not form deep beds or valleys in the desert, but on the contrary, with silt deposited so forcibly in their beds, their course often lies over swelling sand banks and for that reason they have to be hemmed in with dikes. This is a very useful feature, though, for directing the water into gravity flow canals, which are, in fact, responsible for the creation of all the greatest oases in the desert.

However, a good harvest does not rest alone upon the combination of fertile desert soil, plenty of sunlight and warmth and the presence of canal water. These are merely favourable conditions in which, with hard work and perseverance, man might gather in a rich harvest. Labour was particularly hard in Central Asia in the old days of crude farming implements. In order to grow wheat on irrigated soil, it was essential to "wash down" the area properly in the autumn, watering it hard before sowing. The soil could be tilled only after the salts had seeped deep into the ground and the surface had become reasonably dry. It was a good thing if animals were obtainable to pull the ploughs, but more often than not the work had to be done by hand, with a heavy mattock or an oval-shaped spade. After the seeds were planted the earth had to be stamped down to protect it from drying or being blown away by winter winds. The following spring when the crops would fast begin to grow, they had to be given several waterings, an operation requiring great care lest the soil split and break the wheat roots apart, and that an air-proof crust should not be formed on the surface.

After that came the harvesting: wielding a scythe, tortured by the scorching sun, watching keenly that no single grain should be lost—that is, of course, if the crop had been saved from the birds and the wild boars.

Threshing was a simple procedure: a clearing was watered and stamped down, dried hard by the sun, a pole was stuck into the centre to which a couple of blindfolded mules were tied, secured by a stick, and children would be charged with chasing the mules round all day over the unthreshed wheat spread round the pole. By evening the job would have been finished by the mules' hoofs, but it would hardly amount to much. And to think of the quantity of grain left in the wheat-ears and stamped into the ground!

Other crops are planted, too, requiring much more care. Wheat provides food for the people but not animal fodder, and therefore it is necessary to sow sorghum, a fodder crop. Like maize, it grows to a height of 10 feet. The stalk has a sweetish taste, and both children and grown-ups are fond of chewing it when freshly cut; the stalks serve for fuel when dry, and the leaves provide all the animals with rich fodder. Sorghum is therefore frequently sown in the summer in fields from which wheat had been gathered, and the seeds are planted thickly, suitable for fodder harvesting. Some varieties of sorghum are crowned with spreading tassels, 8 to 10 inches in length, while in others the stalk terminates in a thick cluster the size of a fist, containing several thousand white round seeds, resembling pearl-barley in appearance. One acre of sorghum yields from 28 to 42.5 bushels of grain, which is 2,000 or 2,500 times the amount sown.

A porridge of unground sorghum would remain hard even after several hours of cooking, but if ground, it makes a good white flour. A freshly baked flatcake of sorghum flour can hardly be distinguished from one of wheat flour by the taste of it, but the moment it grows stale it becomes very hard. This drawback, however, is not so very great when weighed against the fact that sorghum brings in a much higher crop than wheat and

also provides the animals with rich fodder. The people of the desert, therefore, are keen on planting this crop although it requires more watering than wheat, ripening as it does only in November.

Cotton requires even greater care because its growth is slow, and while the bush is still small the soil beneath it dries quickly and has to be earthed up after each watering. Four, six or even eight waterings are necessary. Cotton has to be picked as it becomes ripe, and this period lasts from September until the end of December.

But the hardest work has to be done in winter. Canals, which in the winter months are free of water, have to be cleared of superfluous silt and sand, deepened and straightened, and a certain number of new canals dug to replace the old wherever the banks have grown excessively high as a result of often repeated clearing. In the old days each family, consumers of Amu-Darya's waters, had to assign an able-bodied representative to repair and clear the canals for as long as two or two and a half months every winter.

Manure is hardly used as a soil fertilizer in the desert for it is mostly used for fuel. River silt serves as superb fertilizer, but if a canal discharges too much fine silt it turns into a hard crust when dry and kills the plants. If, on the other hand, it brings too much sand, it ruins the soil's moisture retaining ability and makes it liable to dispersal by the wind. If a soil is too well washed it loses its very essential potassium chloride. And it's up to the farmer himself to improve on his soil content. He adds sand to some of his fields, strews clay over others before watering, or carts quantities of earth from the roads, remnants of mud cottages and tumbledown walls—in a word, any man-made earthen structures to which the potassium chloride is more intensively drawn under the influence of the sunrays. The farmer would have to bring approximately 40 to 60 cartloads for

one acre of land and spread it evenly over the surface.

The above is an illustration of what the cultivation of artificially irrigated soil involved before machinery came to the farmer's aid.

Apart from striving to obtain richer harvests from the deserts, the Soviet government has done a great deal to ease the lot of the workmen by mechanizing tillage, watering, earthing up and also canal dredging.

LIFE WITHOUT OVERLORDS

ON LIBERATED LAND

The Great October Revolution eradicated exploitation and liquidated every class of exploiters and oppressors. The Soviet government's first act in Central Asia was to issue a decree whereby land and water were nationalized, for exploitation of the working people could not have been eradicated until ownership of land and water had been wrenched away from the local feudal lords and nobility.

And we who were but slaves, whose eyes were
dim and glum,
Threw out our chests, we saw a light before us.
And with our heads held high, together
we marched on,
Led into battle by our Russian elder brothers....

The dethroned masters put up a furious resistance. For many years the towns and villages of Central Asia were subjected to attacks by "basmatch" counter-revolutionary bands. But, notwithstanding, new life found its way into each household, into every village, it penetrated into every field and every heart, it regenerated the souls of men and transfigured the deserts.

The people had built the canals, yet the emirs and nobles had always strived to get a greater share of water for their own private plots. Whoever was in power built ditches to detour the water from the canals, with utter

disregard for everything except his own convenience. In consequence, much of the water was lost in the maze of irrigation canals and ditches, and the fields actually received but a quarter of the volume released by the river. Water was at a premium and yet it was being wasted. There was insufficient arable land, and yet huge tracts of it were written off, shrouded in white alkaline deposits. It was high time the tangled mesh of canals and ditches were put in order.

Tsarist Russia had been using Central Asia as its cotton growing ground for sixty years, but the cotton plantations of Central Asia and Transcaucasia satisfied only half the country's total requirements, and therefore as much again had to be bought abroad at three times the price. Cotton was therefore an expensive item and millions of peasants had to wear home-spun clothes, unable to afford factory-made cloth.

The young Soviet state was determined to produce sufficient domestic cotton to satisfy everyone's needs, and to achieve this, the area of irrigated fields had to be greatly expanded.

The 1920's and 1930's were the years when the country set out to extend the desert oases, to reconstruct the irrigation system entirely and to accomplish unheard-of, gigantic construction projects.

Fine is our cotton with a staple long,
White, pure and silvery like early snow.
Our Zeravshan gives us our wheat,
It's bright like gold, it's rich and sweet.
Our orchards multiply our wealth for us,
And the varieties of fruit we grow!
They're glistening like gems amid the branches,
Figs, peaches, apricots, pistachios,
Pears, apples, cherries, it's a busy time,
To pick, and cart, and dry them all!

Our wizard Rizamat, he tends the vines,
He learnt to speak their tongue, he takes a pride
In growing new varieties each year
Of heavy clusters, golden, clear....
The taste of melons, luscious and ripe,
Is sweet enough to bring the dead to life!

The above was included in a letter the people of Uzbekistan addressed to the 18th Congress of the Communist Party in 1939.

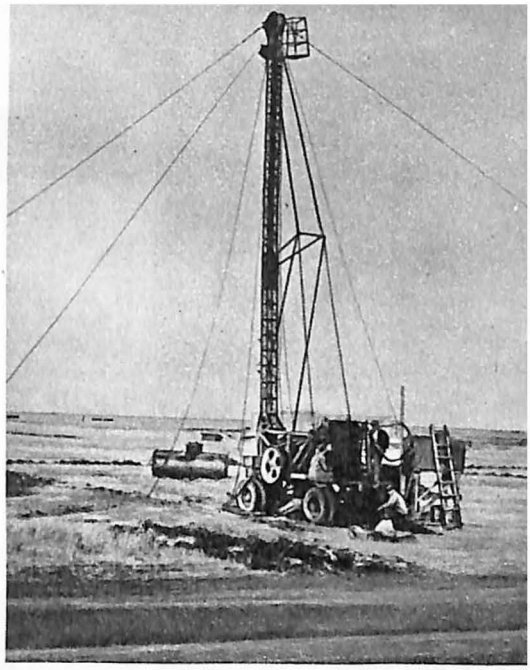
It would seem that the soil and the water are no different from what they were centuries ago—yet why do the people now sing at their work, why have the fields become more spacious and better watered, why do they yield harvests unheard of before?

The reorganization of our entire economy on socialist lines and, in particular, the wisely planned desert reclamation, is responsible for these changes.

The fields have quite a different appearance now. In the old days, before collective farms had been formed, one would look down from an aeroplane and see a poor patch-work quilt spread out below: little scraps of cultivated soil of the most whimsical contours, solitary huts, a maze of ditches, and ancient neglected canals. Those patches of fields seemed hopelessly cluttered. But today one sees thousands of tractors working these reshaped fields divided into regular plots cut with canals of a taut-wire straightness. There is plenty of room now to operate the tractors, ploughs, cultivators and the latest cotton-picking machines.

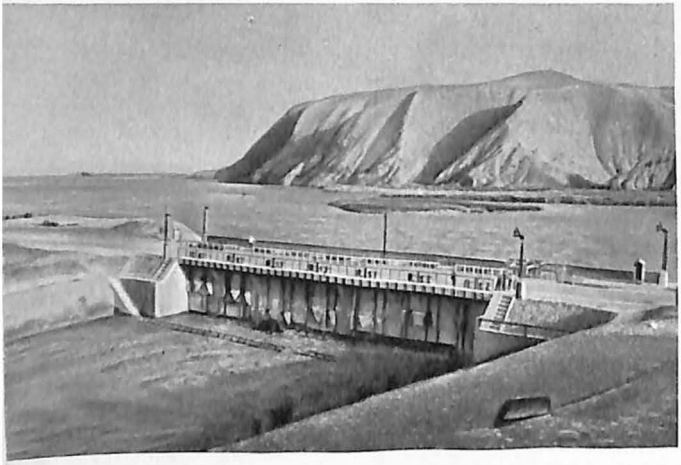
The reshaping of these fields entailed tremendous effort. Formerly each patch was levelled independently of the one adjoining it, all were on a different plane and each was watered with its own individual ditch. This necessitated bringing all the fields to one level and cutting a new irrigation system.

A quick way to sink artesian wells is by using drills mounted on trucks



Self-spilling artesian wells such as this, drilled in the Kyzyl Kum desert, help to develop new lands

The Ferghana canal. This and many others have been built in the deserts by popular endeavour



The Vakhsh main canal—one of the first-born of Soviet hydromechanics

The Kairak Kum reservoir

Formerly, the most popular method of watering the fields was by flooding them entirely. The field would be turned virtually into a lake and for a long time the plants would remain under water. Upon drying, the soil became armour-clad in a water-proof and air-tight crust which split into pieces and tore apart the roots of plants. This method of watering caused a great waste of water and a fast-growing alkali content in the soil.

Today we have machinery to groove a perfect design of shallow irrigation ditches in our fields, along which the water flows slowly. And on the narrow beds, separated by these water-filled furrows, lush crops ripen in soil free from any crust formation. Watering is done more frequently now, but the water is meted out carefully according to precise calculations and therefore the volume required has dropped considerably.

Orchards, vineyards, cotton plantations, fields of alfalfa for which Central Asia is famous, oil-bearing plants such as the sesame, safflower, and peanuts, fields of "mash"—a plant of the bean family which makes tasty and nourishing broths and pilau, plantations of marvellous tobaccos, kenaf, sugar-beet and fields of superb melons now cover three times the area they occupied thirty or forty years ago.

This increase deserves some thought. In a comparatively short space of time, we have succeeded in wresting from the deserts an area which is almost double the total territory cultivated over the course of at least five or six millenniums.

To keep these fields supplied with moisture, we have built a vast new network of canals. In Uzbekistan alone, to say nothing of Turkmenistan, Tajikistan and Kazakhstan, the length of these canals measures over 74 thousand miles. If all of this network of Uzbekistan's "blood vessels" were stretched out in a line, it would go around the equator three times.

An end had been put to the old, exhausting "slave-labour" method of clearing the canals with men standing knee-deep in mud in the winter with a mattock for their only tool. Powerful dredgers and silt pumps have released thousands of people from this strenuous work. Pumps keep dredging the specially built sediment basins of superfluous silt, preventing it from entering the canals. These are built at an incline so they do not get choked up by the fine silt which percolates into the fields. Ninety per cent of the work connected with clearing the main canals has been mechanized, while that of building and repair has been mechanized fully.

Many novel and wonderful varieties of plants are now yielded by the soil of the oases—nourished, watered and cultivated in the new way.

The collective farms of Central Asia obtain immense quantities of silkworm cocoons. For example, in Uzbekistan alone the 1956 showings of this valuable raw material amounted to 14,600 tons.

Formerly, sugar-beet was merely grown in household plots here and there and only used in home-made apple jam. Today, in the irrigated lands of Kazakhstan, Kirghizia and Uzbekistan, there are boundless sugar-beet plantations, with a chain of sugar refineries built close by providing the country with vast supplies of sugar. And yet a mere thirty years ago, sugar was considered a rarity and a luxury in these parts.

The greatest success of all has been achieved by the cotton planters, but we shall speak of that later.

CONSTRUCTION PROJECTS

In the spring of 1939, fourteen thousand members of collective farms of the Ferghana valley, situated in the Tien Shan mountain region of the Uzbek, Tajik and Kirghiz republics, set out to build the Lyagan canal. This

marked the first offensive against the desert. In an extraordinarily short space of time—a total of fifteen days—the 20-mile-long canal was completed. It had taken the tsarist government eleven years to build a canal of the same length in the adjoining Hungry Steppe region. There was a shortage of canal-building machinery in the Soviet Union, but the joint efforts of thousands of farmers made up for it.

News of this canal having been built by popular endeavour instantly spread throughout the country. And in all the republics of the desert or arid zone, collective farms picked up this initiative and gradually won away from the deserts thousands of acres of land, feeding them with water brought by canals which they built in incredibly short periods.

The construction of the Great Ferghana Canal, which was to cater for the whole of Southern Ferghana, was commenced on August 1st, 1939. And fifty days later, the completion of this new project was celebrated by the builders—160,000 farmers of the Uzbek, Kirghiz and Tajik republics. In 1940 the farmers of Tajikistan added 49 miles to the length of the canal.

Thus this new river was born—for what else could one call this waterway which is 217.3 miles long and from 82 to 100 feet wide? A total of 565 million cubic feet of earth was excavated and 400 irrigation canals and ditches built.

The farmers—Uzbeks, Russians, Kirghiz and Tajiks—demonstrated to the world at large that in a socialist state, work had indeed become a "matter of honour, glory, valour and heroism."

Although eighty small rivers come flowing down from the mountains to provide the fertile Ferghana valley with water, they fall short of the requirements because two of the largest rivers—the Narin and Kara Darya

which, merging, become the Syr Darya—cut too deeply into the soil and cannot be utilized for irrigation purposes.

Construction of first the southern and then the northern Ferghana canals opened up prospects of putting the entire area to use, and since then the oases of the Ferghana valley have been growing steadily.

The Ural-Kushum canal in the lower reaches of the Ural River was built in 1939, and the waters provided us with a 247,000-acre water-meadow and brought 12,500 acres of land under irrigation.

In 1940 the construction of the vast Katta-Kurgan reservoir in Bukhara Region of Uzbekistan was undertaken by over 100,000 farmers. The Zeravshan, a large river which takes its source from the eternal snows and glaciers, has for a long time been relied upon to supply an area of 988,000 acres with water. This river, it would have seemed, could not have taken on a single extra acre to water. But the Zeravshan is apt to overflow at a season when the fields do not need water, and so it spreads through the deserts, almost as far as the Amu Darya, doing no good to anyone. It was with a view to utilizing this "wild water" that the construction of the great reservoir "Uzbek Sea" was undertaken. Millions of cubic feet of water are now collected in this "sea" and used for the irrigation of thousands of acres of fields and orchards.

The construction of reservoirs and irrigation systems on this unheard-of scale was interrupted by the treacherous Nazi attack on the Soviet Union. Although the front lines were far from the deserts, these deserts, too, fought hard for victory. In November 1942, the hardest days of war, when the enemy had come as far as the Volga and Stalingrad was reduced to a pile of ruins, the day before the Soviet Armies began their advance at the Stalingrad front, Stalin endorsed the resolution to build a dam

and a hydropower station on the Syr Darya by the Farkhad rocks. This dam, which is the largest in Central Asia, raised the level of the river by 65 feet. The water comes to the turbines by way of a 8.7-mile-long canal and produces energy which not only serves the factories and works but also sets the farming machinery in motion.

This was the dawn of a new era in irrigation, when various powerful machines came to take the place of the muscle power of man.

COTTON PLANTING

The peoples of Central Asia have for many centuries been growing their local greyish varieties of cotton, but in the 1880's American cotton began to supplant it in the market. The Soviet government at the very outset took steps to acclimatize the highest sorts of American cotton—upland cotton and certain others, as well as the long-stapled Egyptian Sea Island variety, which, though requiring considerably more sunlight, produces a much longer staple.

Selection was then taken up on a major scale—a struggle for higher resistance, increase of staple-bearing pods, earlier ripening and maximum crop capacity. This work was participated in by the Tashkent Scientific Research Institute of Cotton Planting, experimental and selection stations and bases, state and collective farm laboratories and thousands of rank-and-file cotton growers. The new varieties of cotton, cultivated as a result of this combined effort, resemble neither the American nor the African varieties, nor their own Asiatic ancestors. They are completely new species and the Soviet cotton experts cultivating them have set many a world record in crop capacity.

The slogan of the First Five-Year Plan (1928-1932) in the Central Asian republics was the fight for the

U.S.S.R.'s cotton independence. As early as 1932 the area of cotton plantations more than doubled that of 1928, and increased two and a half times as compared to 1915, while in Kazakhstan it was increased by more than five times.

In pre-revolutionary days Russia received an average of 258 pounds of cotton per acre. By 1928-1932 cotton crops averaged 667.5 pounds in artificially irrigated areas, as compared to Egypt's 400 pounds and India's 80 pounds. Thus within the first five-year plan period we won our cotton independence.

In those days a crop yield of 667.5 pounds required no mean effort, but today the figure actually seems funny to us. The 2,670 pounds per acre which were first achieved in the years of the first five-year plan as unheard-of individual attainments are even below a good average in many of our state and collective farms today. The report to the Jubilee Session of the Uzbek Supreme Soviet of January 16th, 1950, on the republic's 25th anniversary, stated: "Many of our collective farms, thousands of field teams and brigades obtain 2,670 to 3,560 pounds of cotton per acre. Our country has outstripped Egypt and India by far in cotton crop capacity and has left America behind."

As mentioned earlier, in order to increase yields of cotton and other crops, we were obliged to reconstruct the whole irrigation system and to reshape and enlarge our fields and plantations considerably. But even after this, fields of 5 or 10 acres did not allow our vast fleet of agricultural machines to operate to full capacity.

The experience of leading state and collective farm workers proved all the advantages of watering large tracts of land with temporary irrigators—built just for the season—rather than permanent canals. Dikes, formed of silt dug up when clearing the canals, gradually rise on either side of the canal, and as they grow over with

weeds they take up more and more space and push back the acreage under crop. But if the canals were covered up, the area levelled and planted across the whole width of it, and a temporary network of shallow irrigation ditches cut—the field would become utterly transfigured. Weeds and vermin would disappear, and machines would do their work efficiently, without injuring the plants.

In view of these considerations, we had to reshape the fields once again. In 1950 the Council of Ministers of the U.S.S.R. issued an order for the fields to be reshaped in the artificially irrigated regions and the plots increased by 50 to 100 acres each. Although vast excavations were entailed in this, they were worth it for we could now mechanize our farming completely.

Picking had always been the most labour-taking procedure in cotton growing. As far back as 1950 the Tashkent Farm Machinery Works put out the first thousand highly efficient Soviet cotton-picking machines, and though most of the work is done by machines now, cotton picking still remains a highly toilsome job.

At present there is a marked increase in the number of farming machines despatched to the cotton planting state and collective farms, as well as in the quantity of phosphoric and nitrogen fertilizer delivered to the plantations.

In addition to the struggle for higher cotton crop capacity, the acreage under crop is being continually increased. In the course of five years (1955-1959) it is planned to win away from the desert and irrigate 1,482,000 acres of cotton planting area in the republic of Uzbekistan alone.

Cotton production in Uzbekistan showed a 70 per cent increase in 14 years, i.e., 1940-1953, but what we plan to do now is step up production by 75 per cent in 5 years—in other words, at three times the rate.

In 1956, after the adoption of the new technique of planting cotton by the square-pocket and the rectangular-pocket narrow-row methods, 4,840 pounds of cotton were picked from every single one of the 3,211,000 acres covering the cotton plantations of Uzbekistan. It should be mentioned that an average crop of 3,115 pounds per acre was gathered in Denau District of Surkhan Darya Region, and 3,380 pounds per acre in Orjonikidze District of Tashkent Region. Single collective farms had even better showings, as for example the Khrushchov Collective Farm in Kitab District which gathered as much as 3,740 pounds.

As a token of these achievements the Uzbek Republic was awarded the highest merit of the U.S.S.R.—the Order of Lenin.

That same year, 1956, even better showings were achieved by the Tajik Republic—an average of 2,490 pounds per acre of medium-stapled cotton, and 1,960 pounds per acre of long-stapled cotton. This republic was also awarded the Order of Lenin.

The Turkmen republic received a similar award for achievements in all branches of economy, cotton planting in particular.

To sum up, the average cotton crop capacity in the U.S.S.R. in 1956 was three times that of the U.S.A., twice that of Egypt and almost seven times that of India.

NEW ECONOMY—NEW PEOPLE

Who are the people who are conquering and reshaping the deserts? They are the former slaves and labourers and their children, people deprived of all rights and privileges in tsarist days.

The Soviet society gave liberty and security to these downtrodden and oppressed people and made them com-

petent citizens of a country which has done away with all class and racial privileges and has raised man's valour in work above all else.

They are still the same people, and yet under these new conditions they have become quite different.

In the year 1925 our Party decreed: "Industrial enterprises to be founded in the Soviet republics of the East to serve as bases for uniting the peasantry with the working class." And the reorganization of the economy of these regions on socialist lines was based upon this decree.

Taking 1925 as a comparison, industry in Turkmenistan had increased 13 times by 1950 and more than 17 times by 1957. Industry's share in the republic's economy amounts to 70 per cent, despite the strides being made in agriculture and the fact that karakul sheep livestock has grown five times in the interim.

Turkmenistan, with a total population of 1,400,000, is the most thinly populated of all the republics in Central Asia. Farming is its chief occupation. The fine-stapled cotton crop grown in this republic in 1956 would make 165 million yards of materials such as voile, cambric, taffeta, crêpe voile, etc. State deliveries of karakul skins alone amounted to 940,000 pieces in that one year.

Industry is growing constantly in this republic. Turkmenistan has taken third place in the Soviet Union in oil output, and in 1956 supplied the country with 3,500,000 tons of "black gold." It would have taken 5,000 freight trains to export this oil by rail.

Turkmenistan boasts of industrial enterprises such as oil refineries, chemical plants, building material works and textile mills, sewing and knitted goods factories, printing and publishing houses, glass works, etc. By 1950, 352 major enterprises had been founded or completely reconstructed in the republic.

A happy and prosperous life and free creative labour in the family of sister republics have basically altered the mentality of the Turkmenian people. Where formerly less than one per cent of the population could read and write, compulsory secondary school education is now in practice. The eleven schools of old have grown into 1,230, numbering 225,000 pupils, i.e., a sixth of the entire population. Approximately 10,000 students attend the six higher schools and the 30 specialized secondary schools. To this must be added a chain of evening schools for adults and a variety of special courses. The Turkmenian branch of the U.S.S.R. Academy of Sciences was augmented and reorganized in 1951 into the Academy of Sciences of the Turkmenian S.S.R. The republic numbers 15,500 diplomaed specialists among its ranks.

The front-ranking cotton planters of Turkmenistan—the U.S.S.R.'s chief source of fine-staple cotton—and the cattle breeders comprise over 5,000 men and women decorated with badges of honour and some 200 Heroes of Socialist Labour.

The country's cultural assets include: 561 libraries, 373 town and 850 collective farm clubs, over 500 reading rooms, 53 Houses of Culture, a national theatre of drama, an opera and ballet theatre and a philharmonic society, 66 newspapers and 13 periodicals in Turkmenian and Russian.

There is an old Turkmenian saying that a woman's path lies from the home to the water well. Today's Turkmenian women play an active part in all fields of the country's economic and cultural life. Among these women, who used to be compelled to hold a "veil of silence" always pressed to their lips, there were, according to 1950 data, 25 Heroes of Socialist Labour, 130 chairmen and vice-chairmen of collective farms, 600 foremen of field teams and 10,000 team leaders. The country, where until quite recently, a woman was con-

sidered less than a human being, now takes a pride in her women scientists, her 72 delegates to the Supreme Soviet of the republic and about 3,500 delegates to the local Soviets. The Turkmenian people who have done away with backwardness and poverty for ever now sing their proud song:

In the Soviet Union, equal among equals,
The people of Turkmenistan are happy and free.

Yesterday, the people used to say: "Water streams across the master's land, a dusty road winds through the beggar's," or "the river has no water to spare the poor man, the mountains have no shade to spare him." Today they say: "The desert will become a garden if we tackle the job together."

The first Uzbek girls to attend the Central Asiatic University in Tashkent in the 1930's would sometimes bring their *paranjahs* along to class with them and wear the black hair-nets over their faces on their way home. Such was the custom, such were the orders of their elders. A girl walking home with an uncovered face ran the risk of being hit with a stone or a lump of mud thrown furtively and accompanied with foul abuse and frightening curses. Such was the Sharia—a law that knew no mercy. It reduced the woman to a poor thing deprived of all rights, a being over whom a man had almost as much right as over an inanimate object or an animal. The Sharia legalized not only the right of ownership over land and water, it also gave the masters a right to lease out arable lands, water sources, animals and farming implements against four-fifths of the lessee's crop. Almost three quarters of the cotton growers were landless farmhands. Taking advantage of the Sharia, the Emir of Bukhara, who ruled a considerable part of Uzbekistan and Tajikistan before the Great October Revolution, officially established 55 types of taxes, collected sepa-

rately for the use of land, water, roads and bridges, for living in a hut, for a smoking chimney, for having a child, owning an animal, going to market, etc.

The peoples of Central Asia had to wage a desperate battle against the counter-revolutionary "basmatch" bands, the Whiteguards and the intervention forces in order to establish Soviet rule, and to assist the people in their struggle the government commissioned such leaders as M. V. Frunze and V. V. Kuibyshev to command posts in Central Asia.

Great changes have also taken place in the life of the people of Uzbekistan. Towns and villages have assumed a new guise. The mud huts of former days are giving way to new modern buildings. Powerful enterprises have sprung up in what had once been a colony, and now the textile works in Tashkent and Ferghana, the Chirchik Electrochemical Plant, the Margelan Silk Mill, the Uzbek Metal Works, the Tashkent Plant of Agricultural Machine Building and hundreds of other plants, equipped with the latest machinery, are forging riches for the people of Uzbekistan. The cotton plantations have grown to three times their former area, and in addition to the old, they are now being watered by twenty new canals, among them the pride of the Uzbeks—the Great Ferghana Canal, flowing in the shade of wide-spreading trees. The Uzbek people reap untold wealth from their cotton, fruit, vines and sheep.

In 1914-1915 there were about 3,000 pupils attending the village schools in the whole of Uzbekistan, whereas in 1954 over a million children were enrolled in the elementary and secondary schools, the number of which exceeded five thousand. Thirty-five higher schools, a hundred technical schools, the Academy of Sciences and numerous research institutes assist the development of science and culture of the Uzbek people. Their cultural needs are looked after by 26 theatres, about a thousand

cinemas, a great number of clubs and Palaces of Culture, over 3,000 libraries, many museums, and 210 newspapers and periodicals.

Prior to 1917 a mere 7 or 8 per cent of Kazakhstan's entire population could read and write, and for the most part they were Russians living in the towns. Today Kazakhstan is a civilized country with 27 higher schools of its own where formerly there were none, with an Academy of Sciences and many scientific-research institutes employing over 4,000 workers in various fields of science. In 1913, with the exception of the primary two-year schools, there were only 53 schools in all Kazakhstan, whereas now, with a total population of 3,500,000, its 9,000 secondary schools employ 65,000 teachers and number 1,203,000 pupils. In addition there are numerous specialized secondary schools.

There were but 196 physicians in Kazakhstan in 1914 and one hospital bed for every 2,500 people. Plague, leprosy, anthrax, cholera, smallpox, malaria, tuberculosis, typhus and syphilis kept the mortality rate high. There was little a village doctor could do when he had charge of a district with a 125-mile radius and his only means of transportation was a horse. By 1951 Kazakhstan had a staff of 6,157 physicians.

The former scourges of a Kazakh village—epidemics and social diseases—are liquidated.

The new opera houses of the Kazakh and Uzbek State Operas, which opened in Alma-Ata in 1941 and Tashkent in 1947, are splendid memorials to our epoch.

Even as recently as 1925 there was hardly a university educated man among the native population of Central Asia. But now Academies of Sciences have been founded in all the republics of Central Asia and in Kazakhstan, staffed to a considerable extent with local scientists.

The local, native intelligentsia, highly educated and cultured, have risen from the common ranks and they hold dear the interests of the people. They cultivate and develop science, disseminate knowledge, acquaint the people with the greatest achievements in science and art of the world in general, and create their own original art—socialist in content and national in form.

The theatres of Kazakhstan and Central Asia stage plays by Molière and Shakespeare, Ostrovsky and Gorky, as well as those by native playwrights on themes historical and modern, and they are acted in the Uzbek, Kazakh, Uigur, Turkmenian, Kirghiz, Tajik and other languages. The works of the classics of all times and countries, as well as Soviet literature, are being published in the languages of the peoples of Central Asia and Kazakhstan. Hundreds and thousands of people—sons of the deserts—are working in all branches of technology, science and art.

ARID REGIONS IN THE U.S.S.R.

IN FORMER NOMAD LAND—THE DESERTS OF CENTRAL AND WESTERN KAZAKHSTAN

The desert is the home of cattle breeding. It has been so for many years, and will remain so to a certain extent. But whereas deserts once were used merely for cattle breeding, now they are the sites of gigantic industrial centres, founded in the years of Soviet rule.

To get to Verny (now Alma-Ata, the capital of Kazakhstan) in pre-revolutionary days, one had to cross 435 miles by cart from the railway station along a dusty, broken and never repaired dirt road. Uninhabited Kirghiz steppes stretched for six hundred miles north of Verny. Occasionally a dare-devil explorer would make his way into the wilds in search of useful minerals. He would bring back samples of ore and show them to the merchants and manufacturers, but no one would take the risk of investing their money in a project, to reach which one was liable to spend long weeks stranded in the waterless and roadless steppe. Other, better organized attempts were made to explore into this mineral wealth, but private means were soon exhausted in research and the site was abandoned. Some foreign firms spent eleven years trying to prospect Jezkazgan for copper ore, but they only succeeded in revealing an infinitesimal fraction of the area's untold wealth.

Today, we find the region north of Alma-Ata given over to large-scale industrial enterprises. The Balkhash Copper Works, a colossal metallurgical plant rearing proudly amid the unexplored deserts of old, adorns the shore of the turquoise-blue Lake Balkhash, framed in red granite rocks on the north and a yellow expanse of sands on the south. A town with beautiful buildings and a splendid bathing beach grew up close to this plant, and though it is located in a parched desert with but a straggling growth of wormwood, the people have succeeded in cultivating a large park and an experimental station which produces splendid vegetables.

Karsakpai, Jezkazgan and Kounrad are the names of places which until 1930 were only known to a few nomads, but now they are large industrial centres, mining copper and other metals. The deserts of Central Kazakhstan proved to be the richest storehouses of various non-ferrous metals, as well as of vast coal deposits.

A resolution was passed in 1931 to make Karaganda the third largest coal basin in the U.S.S.R. When, ten years later, the enemy had temporarily occupied the Donets basin, which was the country's chief "coal store," the furnaces of Soviet plants received an uninterrupted supply of Karaganda coal.

This region, hundreds of miles away from any means of transportation, was inaccessible until railway lines were laid across the boundless steppes and deserts. In 1929 the Turkestan-Siberian main line connected Alma-Ata with the Tashkent railroad, crossed the whole of Southern and Eastern Kazakhstan as far as Semipalatinsk and proceeded to tie up with the Siberian main line. In 1936 a railway line was built from Petropavlovsk to Karaganda, then to Balkhash and Karsakpai and Jezkazgan, and in 1939 the Akmolinsk-Kartaly line was built according to high-speed methods. The largest metal and coal mining districts of Central Kazakhstan were

Today many of the collective farms have their own hydro-electric power stations which allow them to mechanize much of the work. This station caters to five collective farms in Tashlak District, Ferghana Region

In the Soviet Union the whole process of cotton planting is now mechanized. This picture was taken at the Khrushchov Collective Farm, Kulyab District, Tajikistan

Furrow-watering has now taken the place of field-watering which was very uneconomical and tended to alkalify the soil. The Fifth Anniversary of the Uzbekistan Collective Farm, Tashkent Region, uses a special pipeline for the purpose.

now connected by rail with the rest of the country.

With every year more and more mineral wealth is discovered in Kazakhstan by geological research parties.

Formerly, Nikopol on the Dnieper and Chiatury in Georgia were the world's suppliers of manganese. Rich manganese deposits have now been found in Mangyshlak in Central Kazakhstan and are already being exploited.

Phosphate—the best soil fertilizer—had to be imported from Algiers until 1933 when the Khibini Mining and Chemical Works was founded in the far north of the U.S.S.R., supplying the Soviet Union and other European countries with this fertilizer. Moreover, a short while ago vast deposits of phosphorite were found in the Kazakhstan deserts, in the Karatau mountains, so the trouble of bringing superphosphate to the plantations of Central Asia all the way from the Arctic Circle will now be obviated. Superphosphate fertilizer is being produced by plants situated close to the mines in the Karatau mountain range.

Subterranean stores of oil were found long ago in the Caspian lowlands, in the lower reaches of the Emba amid salt marshes which had emerged from the Caspian Sea only a short while ago (less than 10,000 years ago), according to geological standards. The first oil well was drilled here in 1892, but since guesswork played a large part in the first attempts, the cost price proved too high, and then the cost of exporting the oil from the then unapproachable wilderness proved higher still, so by 1917 only the Dossor oil-fields were being exploited in the main.

The "Embaneft" trust was established in 1920. Since then hundreds of oil-fields have become known, many of which are being exploited on a wide scale. Comfortable cottages of white plaster have now been built to house the workmen in the Emba's new oil-fields.

"Black gold" comes flowing through the oil pipes, supplying the country's tractors, motor-cars and aeroplanes with fuel. The Guryev-Kandagach railway now connects the Emba oil-fields with the Caspian Sea and the railway system of the East. A new railway is being built to connect the Emba with Astrakhan, in other words with the rest of the country—with the Central regions via Saratov, and with the south-west via Kizlar.

The oil-fields of Aktyubinsk Region connect the rich Emba stores with the "Second Baku"—a colossal new oil-field which covers Bashkiria and the whole of the Volga country.

Vast deposits of various salts have been discovered and are being worked in the Caspian lowlands. A prospecting hole was drilled through a 1.2-mile thickness of salt without reaching the bottom of the layer. The local stores of common salt are such that they could take care of the whole world for millenniums to come. Impressive layers of various boric salts have been found there too, and it is interesting to note that these discoveries were first arrived at by our scientists drawing theoretical rather than practical conclusions. These regions have also yielded generous deposits of potassium salts.

The conquest of the desert, the discovery and development of every new deposit, could become a never-ending story. The Soviet people are fast reclaiming their deserts. New towns are springing up around the industrial centres. The construction of the Temir-Tau Works—the first-born of ferrous metallurgy—was started during the Second World War in Central Kazakhstan, and within five years it developed into a large, civilized city.

The absence of water for irrigating the fields made it difficult to keep the industrial centres supplied with fresh vegetables and fruit. But that was only in the beginning,

when Kazakhstan's mineral wealth was first being worked; today the towns are surrounded with reservoirs and model farms catering to the needs of the population. Not long ago, a workman of Karaganda attempting to grow potatoes in his garden reaped, in the best of cases, only as much as he had planted, and the potatoes he dug up were the size of nuts. Now the large Samarkand reservoir, built close to the town, supplies the state farm fields with water, and Karaganda is well provided with vegetables, berries and fruit.

Research workers sought long and vainly for a method of bringing water to the Jezkazgan Copper Works. Surface waters were insufficient, and attempts to locate artesian waters failed. Limestone, which could have been water-bearing, proved solid and dry in all the concave folds (synclines). Finally one geologist proposed drilling a most unpromising-looking spot in the centre of a convex (anticlinal) fold, and he was found right in his calculations. That was exactly where the limestone showed cracks: the process of dissolution had gradually hollowed out an intricate maze of caves and corridors, which were brimming with fresh water. In other regions, too, fresh artesian waters were located.

One of the most urgent problems to be solved in Central Kazakhstan is the expansion of the old and development of the new arable lands. We have the means to accomplish this. The sub-river-bed waters in the valleys have not yet been utilized. The vast stores of artesian waters are not being exploited in full. There is no irrigation system leading from the western part of the freshwater Lake Balkhash and the Ishim River. It is conceivable that part of the Irtish waters could be detoured to provide for Karaganda, Karsakpai and Jezkazgan districts. All these problems remain to be solved in the more or less near future.

To the south-east of Central Kazakhstan's hilly district and south of Lake Balkhash, stretch the sands of Sary-Ishik-Otrau. This name, however, only exists on maps, and its origin remains unknown to both the scientists and the Kazakh people themselves. The old Kazakh name—"Jetysu" or the "land of seven rivers"—referred not so much to this desert as to the hills surrounding it—the Tarbagatai, Jungarian Alatau, Trans-Ili Alatau—and to the fertile regions below. For this reason the people prefer to call the desert the Sands of Southern Balkhash or the Balkhash-Alakul depression.

Only four of the seven rivers reach Lake Balkhash: they are the abundant Ili, and the much poorer Karatal, Ak-Su and Lepsa. They all take their source in the snow-clad mountain tops of the Tien Shan range.

If one scooped up some of the cloudy water from any one of these rivers and allowed it to settle, there would be a surprising amount of sand precipitated to the bottom. The whole of the vast desert of Sary-Ishik-Otrau is the result of the rivers' age-old work of eroding mountains and silting up plains. Therefore the presence of numerous dry river-beds, choked with sand and abandoned by the rivers, is quite easy to understand.

At the foot of these hills there are fertile fields and large settlements of Russians, Kazakhs, Uigurs and Koreans. It must have been a painstaking job to irrigate these lands and turn the arid deserts into lush fields and gardens. The rice crop obtained here is tremendous. However, too much valuable water is being borne away by the rivers into the deserts.

Cattle graze on mountain pastures all summer, and only come down into the plain for the winter. Alma-Ata Region pastures its flocks of sheep in the snowless ravines of Karoi and Bozoi, but the sands south of Bal-

khash are not being fully utilized, particularly in the interior of the desert.

The river valleys, whose principal inhabitants only 20 or 30 years ago were wild boars, tigers and swarms of mosquitoes which made the water-meadows impossible to use in summer, have hardly been explored yet. The flood lands of the River Ili wind in a long green ribbon, yet along the whole of the river's course there are only three or four lots of irrigated fields. The Ili basin is mostly used for the breeding of a guest from abroad, the ondatra, a muskrat with a strong, thick and beautiful fur. It multiplied so quickly in the reed growths of Lake Balkhash that within a few years it became one of the most profitable of hunting trophies.

Saksaul planting is a new branch of economy in this area. The artificial breeding of fish in Lake Balkhash is increasing with every year.

A plan is under consideration to irrigate thousands of acres of land with the waters of the Ili, and to cultivate them for rice. This task is far from simple, however. First, the sub-soil water level is extremely high, so the soil would immediately alkalify once irrigation was accomplished, and the region would be extremely difficult to drain because the sub-soil waters are underpinned by the lake. Second, there is little flat land here suitable for irrigating in large tracts.

It would seem that in order to cultivate these regions thoroughly on a major scale, it would first be necessary to dike in a large area in the river's upper reaches by means of hydromonitors and suction dredges, and build a spillway dam. This hedged-in area would then have to be flooded with river waters until such time as silt deposits evened out the surface. After that the weir opening would be lowered and the levelled plain completely drained. Then the waters of the Ili would have to be directed into the next and lower area, also surrounded by

a dike, and, continuing in this manner, the large humped desert could be remade into a level oasis.

But it goes without saying that we shall have to work up gradually to the fulfilment of this plan, after all the main tracts of land suitable for cultivation have been irrigated.

The first step, however, has already been made in this direction. In the Ili valley, below the Iliisk village 37 miles north of Alma-Ata, research has now been completed, and construction of the first dam across this river will be started soon, enabling the building of a hydropower station and the redirection of part of the Ili waters into the fields.

We are firmly convinced that the Balkhash deserts will be brought under irrigation eventually, because there is no such land that could not be turned to the benefit of mankind in the capable hands of the Soviet government.

THE HUNGRY STEPPE

We travelled by plane one day from Charjou to Tashkent, the capital of Uzbekistan. The Nuratin mountains looked strikingly picturesque from above. The grey of the rocks was mottled with a close network of gorges, starting with barely noticeable threads and ending with deep and narrow crevices slashing the mountains apart. This chaos of rock was interrupted here and there with green winding valleys glistening with narrow silvery streams, cut with white ribbons of roads, dark rectangles of orchards, uniform vegetable patches and with trim little houses nestling in the shade of thick, dark-leaved elms and Lombardy poplars.

But as soon as we left the mountains behind us, all trace of verdure disappeared and a dead, flat desert stretched below. It began with a chain of white and grey

salt marshes, spotted with the bright pink blots of dry salt-lakes. Then it expanded into a flat, yellow-grey sea of sand. No matter how hard you strained your eyes you could see neither a shrub nor a gully, and only very, very rarely you'd catch sight of a tiny footworn path or a few circular marks in the sand where once some nomad tents had stood.

The Hungry Steppe! One could hardly imagine a more desolate spot, and yet once the channels of the Syr-Darya had coursed through it. But the river had receded far and the dust brought from the desert plain of Kyzyl Kum gradually formed a thick loess, burying beneath it all trace of the river's work. In the spring the Hungry Steppe is thickly carpeted with grasses and flowers, but for the remaining ten months of the year it lies scorched and dead.

But suddenly the scene below underwent a complete change. A wall of Lombardy poplars and a straight, wide ribbon of highway cut across the Hungry Steppe and beyond that line began what seemed to be a totally different world. We saw rows of trees planted along the perfectly drawn silvery lines of canals, the precision of which could only have been achieved by means of machines. We flew over thousands of acres of cotton plantations, chequered squares of orchards and vivid carpets of alfalfa.

And as you gazed down upon this you were impressed anew with the splendour of the country where socialism had triumphed! You saw an example of what a people conquering and remaking nature could achieve! The Hungry Steppe turned into a fertile land! The first state farm here was called the "Pakhta-Aral" which means a "Cotton Island," and it was indeed the first cotton island cultivated in the middle of the desert. But today—25 years later—the name "Pakhta-Dengiz" or "Cotton Sea" would be more apt.

But who and when had brought this miracle to pass?

Soon after the Revolution the Soviet government entered upon large-scale research and construction in these parts. Soil scientists and agriculturists found ways of combating salt accumulation in the soil, adopted new methods of watering, and cleansed the soil of detrimental content. These lands, irrigated with newly built canals, number several large state farms and over a hundred collective farms. In 1939 we had a fleet of 800 powerful tractors working these fields. By then the area of irrigated land in the Hungry Steppe was seven times larger than in 1914.

In 1940, by the popular endeavour of adjoining Kazakh and Uzbek collective farmers, a new network of canals was cut according to high-speed methods [named Kirov canal and Tugai (flood land) branches], irrigating thousands of acres of land.

When, in 1947, the Uzbekistan collective farm workers completed construction of the Farkhad dam on the Syr Darya, we were enabled to advance upon the desert in a wider front. Thousands of Uzbekistan's Y.C.L. members, boys and girls, responded to the call of the Party and came to the Hungry Steppe from all over the republic to make it what it is now. They had to start from scratch: building houses, tilling the desert's virgin soil and turning it into cotton plantations, laying roads and planting orchards, building schools and clubs, cinemas and children's institutions. The style of architecture was quite modern, the spacious buildings of the new collective farms in no way resembling the low mud hovels of old. The Y.C.L. may well be proud of conquering the Hungry Steppe.

A further and final advance upon the Hungry Steppe is ahead. Nearly 750,000 acres are to be irrigated in the near future, and 247,000 at a later date. And then the

only reminder of the Hungry Steppe's past will be its name, which will throw its splendid present into ever sharper relief.

FERGHANA—THE JEWEL OF UZBEKISTAN

To the east of the Hungry Steppe and south-east of Tashkent lies the great Ferghana valley.

Early in the morning, while the air is still crystal clear, one can see a marvellous picture of distant roseate snow-clad mountains, gleaming in the rays of the rising sun.

The mountains surrounding the Ferghana valley protect this beautiful country from inclement weather and cold winds. The sky is always blue, the air dry and warm, even in the winter.

The Syr Darya, a wide and fast river, carries its mighty stream through the very centre of the Ferghana depression, but its shores are bleak desert sands scorched by the sun. Eighty other streams and rivers flow down from the glaciers and eternal snows to quench the thirst of the desert. A number of them—the Sokh, Isfara, Isfairam, Shakhimardan and others—are quite generous streams, but once they reach the plain they fan out into numerous canals and channels which water the soil of the oases. Hundreds of villages and some ten large towns benefit by the green shade of these oases, merged into one great Ferghana oasis. And for this reason none of the rivers manage to bring a single drop of water as far as the Syr Darya, flowing its solitary course through the desert.

Except for the Syr Darya the streams and rivers flowing down into the Ferghana valley have been used for thousands of years to water orchards, vineyards, cotton plantations and fields of alfalfa. In the springtime, the heady fragrance of the flowering almond, apple, pear,

peach and apricot trees is enough to make one dizzy. Could better varieties of grapes be found anywhere? Could pomegranates be tastier or figs sweeter? And where, in what other country, are the roads so thickly lined with apricot trees, planted there especially for the traveller's convenience?

However, Ferghana was once rather cramped. Although the population was then much more sparse than at present, there was a shortage of arable land. The rich owned the water. They flooded their own fields and left the parched acres to the poor. Both in the days of the khans and the Russian tsars, Ferghana numbered a great many destitute peasants who were obliged to hire out as farmhands.

Warfare and strife accompanied the inauguration of Soviet rule in the Ferghana valley. Medieval darkness and fanaticism refused to give up their hold and bore down upon people in a "holy war." There were cases when an entire village population was massacred by the "basmatch" bands because its men had gone off to join the Red Army. Hundreds of women paid with their lives for daring to discard their veil. But when the people had taken the reins of power in their own hands, the vista of a new life unfolded before their eyes.

The irrigation system was completely rebuilt, thus making it possible to provide for double the territory with the same volume of water.

There is an ancient legend woven round Farkhad, a valiant youth, who to do the beautiful Shirin's bidding tried to turn the river into the desert in order to quench the thirst of the arid lands. This legend embodies the people's dreams of remaking the nature of their homeland. And now these liberated people have resolved to turn the course of the Syr Darya to water the soil of Ferghana and the adjoining Hungry Steppe. The Farkhad dam, feeding the hydropower station and the irriga-

tion canals, built by the workmen of Central Asia at the very entrance into the Ferghana valley, personifies the might of man, his mastery over the blind forces of nature, and the ancient legend which says that Ferghana is the place where Paradise had once been, has now become reality.

The towns and villages have altered beyond recognition. Where once there was a small, dusty village, Assake, there now stands the new town of Leninsk. The streets of this town, which is the youngest in Ferghana, are already thickly lined with poplars, maples and elms.

All the land in the valley, divided into rectangles, has been cultivated with extraordinary affection, wisdom and care. Rows of trees have been planted along every road, every irrigation ditch or balk—they are either spreading apricot trees or thick-trunked mulberry trees with their branches chopped off and used to feed the silkworms. The old mud houses are now giving way to new well-designed brick cottages, varied in style. Every village can now boast of a club, cinema, school, hospital and library. Electricity has been supplied and, moreover, gas has been put in into quite a number of collective farms during recent years.

Agriculture and industry exist in close proximity in the Ferghana valley. This is the Central Asiatic "coal store" besides being the birthplace of various ores and oil. The lacy open-work of derricks, brimstone mines and other pits, gigantic metallurgical and machine-building plants, cement and cotton mills alternate with shady fruit gardens or great stretches of plantations producing the best varieties of cotton.

Ferghana's population is equal to that of the most densely populated parts of the world, having as many as 1,036 people per square mile.

But the barren desert is like a worm-hole in the very heart of this beautiful land, a worm-hole encircled by

an emerald necklace of flowering orchards and lush fields.

The valley is well protected by the mountains except for a narrow opening in the west, and the hot breath of the Kyzyl Kum desert and the Hungry Steppe comes tearing in through this doorway. The wind whips up the river sand and drifts it into single shifting sand dunes, piling them afterwards into long, narrow ridges stretched into a straight line. And as a result the shifting sands of the Syr Darya bury the fields beneath their dark-grey pall.

In addition to the sands, the desert sends its dry winds into the valley, raising the temperature to 107.5-115° F. Moisture content in the desert air is only about 20 per cent even in summer, but the dry winds carry as little as six per cent. This has a disastrous effect on the thin, broad leaves of the cotton plant. They shrivel and fall, the wind whisks them away and reduces them to powder. The spring dry winds—called "garmsili"—are particularly dangerous, since they blow at the time when cotton plants are first showing their tender shoots. Where fields are ineffectually protected by trees, the dry winds, besides scorching the young cotton shoots, are sometimes liable to blow the very seeds out of the ground and carry them away together with the fertilized soil. In June 1948, 124,000 acres of cotton perished from the dry wind in Western Ferghana. It made repeated planting necessary, and the cotton was a whole month late that year, with a yield just half of the normal.

The time has come to start a decisive battle against the desert in Ferghana. In 1947-1950, several institutes of the Academy of Sciences of the Uzbek S.S.R. made a comprehensive study of this problem. Based on their conclusions, various projects are now being brought into execution: the rivers' cloudy waters are being drained

into diked pebble-lined plots which will eventually be covered with a layer of fertile silt; alkalized tracts are being cleansed with water, salt marshes remade into fields and plantations; young groves of trees are beginning to appear in place of the piled sand ridges; the Kairak Kum reservoir at the entrance of the Ferghana valley is now under construction. It will moisten the dry desert winds and render them innocuous to plant life. In a few years the barren desert in the heart of the Ferghana will disappear forever.

MAN—THE MASTER OF NATURE

CLIMATE REMODELLING

What is the future we have in mind for our desert lands? Do we want to turn all the deserts into orchards and fields? To what extent are we planning to change their hot dry climate?

A considerable portion of the deserts will eventually be turned into green gardens, but our water sources are limited and therefore we shall have to look after our best lands first, rather than our deserts and plateaux.

As for the desert climate, we find it quite an asset in many respects.

Though the summer of 1947 was moderate in Central Asia, with cloudiness and rains and no superfluous heat, it resulted in our cotton, which requires a temperature of almost 57.2° F for sprouting and immense warmth for ripening, having to be replanted in some areas that "cold" year. In the beginning of November, when picking is usually coming to a close, the plants still showed many green, unripened pods, and the frost might have killed much of the harvest had it not been for the long and warm autumn which alone saved the situation. In other words, the desert's abundance of warmth and sunlight is an asset unless combined with excessive dry winds.

Plenty of warmth is particularly essential for the cultivation of the long-stapled varieties of cotton. The sum total of the average day-time temperatures during the

whole period of growth must be not less than 7,232° F. Only the extreme south of Central Asia can provide these conditions, whereas in other regions we are obliged to plant less capricious varieties which yield a shorter, and correspondingly a less valuable, staple.

At present our cotton growing regions extend as far north as the southern shores of the Aral Sea and the town of Turkestan. There are large areas suitable for cotton planting in the region of Kyzyl Orda, but the summer there is too short.

Although we grow rice in Kuban, cotton in the Southern Ukraine and Moldavia, and sugar-beet even as far north as Leningrad, yet in irrigated desert lands, under the direct rays of the sun and a constantly cloudless sky, these plants yield a much richer crop and are of a finer quality. Cloud increase over the desert would only interfere with the ripening of cotton and many other warmth-loving plants, for what they need is direct sunrays. It follows that the desert's heat and dryness in certain conditions are conducive to wealth rather than disaster. Therefore, what we want least of all is bringing down the temperature in the deserts. Once we have brought water to these regions, so rich in sunlight and warmth, we shall be able to reap good harvests of heat-loving crops.

Therefore, abundant sunlight and lengthy summer heat are not deficiencies in the desert climate but, on the contrary, its most valuable assets. However, if we are to dwell on the climate's drawbacks, we should mention its irregularity. And yet regularity is not always to the good either. In the deserts of Kazakhstan or Mongolia, for instance, precipitation is more or less equal throughout the year, causing an insufficiency of moisture in the spring—the season so important in plant development. At the same time, in the deserts of Central Asia as well as in all the arid lands bordering on the Mediterranean Sea,

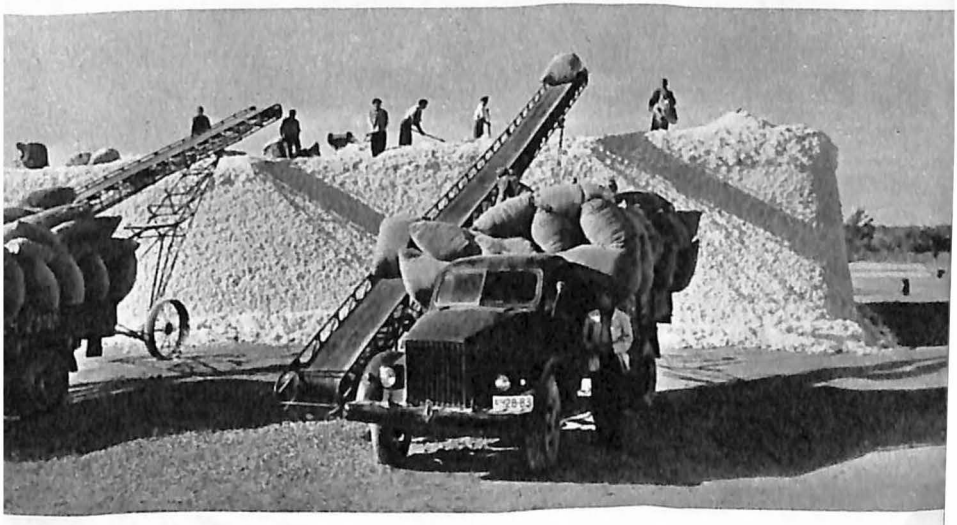
maximum precipitation takes place in the spring and therefore vegetation is more varied and rich.

However, climate irregularity in its other aspects may indeed be classed as a great drawback. That same cotton, for example, could be yielding a far better crop if its vegetation period were longer and the hot summer did not give way to winter so soon. For the winters in the deserts of Central Asia are so rigorous that not all plants, especially cultivated ones, can weather them.

What is particularly detrimental to natural plant life is the lack of regularity in the climate from year to year. In contrast to artificially irrigated farming, which is hardly affected by rains and their seasons, desert pastures are entirely dependent on them. If the climate were the same year after year and these pastures could be relied upon to yield a steady crop, they could be used to maximum capacity according to annual plan. But in the deserts, one year is quite unlike the next, and this affects our cattle breeding unfavourably.

A fearsome evil of the deserts is the excessive dryness of the air which generates dry winds. The question arises: could we do away with this excessive dryness without at the same time increasing cloudiness, inasmuch as these phenomena are bound in reciprocity? The answer to this is found in the existing oases. They are supplied with water and planted with verdure, but we have observed no direct dependence between this man-made heightened moistening of the ground layer of air, and cloudiness. The explanation is simple. While the average moisture content of desert air is equal to 20 per cent in the daytime in summer, it is about 30 or 40 per cent in the oases, whereas in order to create cloudiness the atmosphere must have at least a 90, if not a 100 per cent moisture content. It follows that we could safely increase moisture content in the oases' air, and

Cotton picking, the most labour-taking procedure, has also been mechanized. The picture shows Soviet-built machines doing the picking at the Progress Collective Farm, Ilyich District, South Kazakhstan Region



A cotton dump in Samarkand Region

The Shakhrinau State Farm, Tajikistan, produces splendid grapes and apples

even more so in that of the deserts, by 20 or even 30 per cent. The most cruel of dry winds would be eradicated entirely, while cloudiness would only be increased to a barely perceptible degree, with the exception of submontane and mountainous regions.

When confronted with a mountain ridge, air begins to rise upwards, cooling and forming clouds, whereupon the moisture contained therein falls in the shape of rain, sleet or snow and feeds the mountain rivers. In Central Asia and Kazakhstan, the mountain chains and the direction of the rivers' courses are placed in such a way that if moisture content were increased in the deserts and oases, this same moisture would be redeemed to a considerable extent through the rivers coming down from the mountains, and would once again be used for irrigating the fields.

Increasing moisture content in the ground layer of air would be a worthwhile undertaking and one possible to achieve. To a certain extent, we should also be able to increase moisture content in greater and more distant atmospheric masses. There are different ways of tackling this problem. The easiest methods, such as snow retention, were tried first. Now we are undertaking more complicated and effective means for the most satisfactory remodelling of nature, such as: protective afforestation, construction of a network of reservoirs, regular watering, flooding, etc.

The abolition of frost, of course, would make a tremendous change, but the conversion of our deserts into frostless subtropics is something that could not be realized. Therefore, all we can do is struggle for a longer vegetation period, or, in other words, combat the late spring and early autumn frosts. Methods such as smoke screening are being expertly employed.

FIGHTING THE BREATH OF THE DESERT

Droughts, dry winds and black dust storms are the frightful scourges of farming in the arid lands.

In 1946, following the country's victory in the Great Patriotic War, an elemental calamity descended upon it. Drought struck at 21 of our regions—the whole territory from Voronezh to the Caucasus, and trom the Ukraine to the Urals. I happened to drive through those parts that summer. There was never a cloud in the sky, the hot sun was dazzling, but this brightness gladdened no one, for there had not been a single rainfall since early spring. The fields stretched stark and scorched. Wheat and millet stalks were only about six inches tall, and they were so straggling that at first sight they were unrecognizable. And the further south we drove the more depressing was the scene of devastation worked by this sudden calamity.

The Soviet Union, however, bore this new trial with fortitude even though its war wounds were still far from healed. For a whole year the government so generously supported the population of the famine-stricken regions with food and fodder that not only did the people know no shortage, but they actually managed to sow more corn in the spring of 1947 than they had done in 1946. And there were no losses in livestock.

That same summer I happened to visit the Salsk steppes in North Caucasia. The land is rich, but drought is a very frequent occurrence there. As early as 1937-1939, shelter planting was first attempted to protect the fields from the disastrous dry winds from the East, and the year I was there, though the trees were only 7 or 8 years old, these rows of wild, spreading apricot, saved the harvest. Under the protection of this young forest which had held back great quantities of snow in the winter, the collective farmers managed to reap from 23 to 29 bushels of wheat per acre in spite of the cruel drought.

At the time, there were similar experimental shelter belts in the steppes of the Kuban, Crimea and Ukraine, and they stood the test superbly everywhere. Fighting droughts by means of protective plantings was elaborated by the well-known Russian scientists V. V. Dokuchayev and P. A. Kostychev, initiators of soil science and scientific agriculture.

In 1948, on the basis of past experience, protective afforestation was undertaken on a major scale throughout all the steppes and semi-steppes in the southern European part of the Soviet Union. And now, driving down the Moscow-Simferopol highway, one sees these gay green rows of curly young trees everywhere. Though they were only 3 or 4 years old at the time, they had taken so well that they were already a help in retaining snows in the fields, thus providing the soil with the necessary moisture. And by now these green walls have risen sufficiently high to slacken the force of the wind, as a result of which the dryness of the ground layer of air has been moderated substantially. Droughts and dry winds present no danger to the fields sheltered by these trees.

What of the black dust storms? Just one instance should be enough: in the Salsk steppes, the extreme eastern line of protective plantings absorbed the main force of the wind, and after several black dust storms, the trees stood 6 or 10 feet deep in the black soil which had drifted against them in the wind.

In the North-Western Caspian area, in Bashkiria, North Kazakhstan and the Altai steppes, the tilled soil, in which the seeds have not yet sprouted or the shoots have not gained strength, is frequently so dried out by the spring winds that the top layer of black soil (2-4 inches deep) is completely blown away, and sowing has to be done all over again. The growing barriers of trees are now protecting the fields from this calamity.

The time has come to plant similar shelter belts in

those regions of Kazakhstan and Altai where the virgin soil was never tilled until 1954, and where snow retention is still achieved by screening the fields with stalks of sunflower and maize, left uncut for the winter.

We are now speaking of combating soil dispersion, drought, and dry winds in the steppes—which are some 300 or 600 miles away from the deserts—but could the breath of the desert be fought in its very heart, in Bukhara for example? There is hardly any snowfall there, and no pools of melted water are formed in the fields, for even if snow does fall it evaporates within a few days.

But nevertheless it is essential and feasible to fight the dry winds in the oases wrested from the deserts, and our Soviet people are already waging a winning battle against this scourge.

In Uzbekistan the dry winds cause an average loss in cotton crops of over 25 per cent, and matters are more or less the same in the other Central Asian republics and in Kazakhstan. But, considering that 90 per cent of all the cotton produced in the U.S.S.R. is grown in these republics, it can be fully appreciated how calamitous the dry winds are.

The deserts and oases are quite dissimilar in climate. Although they receive the same wealth of sunlight and the same amount of atmospheric precipitations and the blue sky above is as cloudless, yet for some reason the crowns of the elms growing in the oases spread out in huge green canopies, while those of the same trees planted in the middle of the desert close to a water well and given generous waterings, are much poorer and have the leaves half as big. The explanation of this is that man, watering the soil of the oases at regular intervals, causes a change in the moisture content of the ground layer of air. To protect plants from dry winds, the soil of the oases should be moistened even more often. It would be possible, of course, to build more reservoirs and

water the fields at more frequent intervals, but this measure would not be beneficial. Crop capacity drops rather than rises with excessive watering of the fields, preventing as it does the access of air to the roots and, what is more, alkalifying the soil. Large reservoirs would only deprive the fields of water and take up too much room.

But then what could be done to moisten the air of the oases if neither reservoirs nor flooding of the fields are capable of solving the problem? It appears that tree-planting is the best solution.

The water in the lakes and rivers evaporates from one plane—the surface. But trees have thousands of small planes—their leaves—to transpire moisture and, moreover, each leaf exhales it on both sides. A tree with a spreading crown of, say, a hundred square feet evaporates far more moisture than does the surface of a reservoir of the same area. Willows, poplars, black poplars, alders and eucalypti are particularly notable for the amount of moisture they transpire.

It follows, therefore, that the more trees there are in the oases the higher the air's moisture content and the milder the effect of dry winds.

The number of trees grown in the Ferghana is insufficient, of course. On an average, plantings take up as little as 3 per cent of the oases' area (excluding the territory occupied by villages and towns).

The people of Uzbekistan are advancing on the desert in a wide front and are systematically fighting these disastrous dry winds. A barrier of trees is built in the narrow bottleneck of the Ferghana valley and across all its western territory. The trees are planted crosswise to the direction of the wind. Every belt consists of five strips, each 200 feet in breadth. When the wind is confronted with a line of trees it only recovers its velocity after 1,000-1,500 feet, a distance which is approximately 30 times the height of the trees. The wind slackens its

speed not only after it has passed the trees but also before it strikes the barrier. These wide belts are sometimes combined with others which have only one or two rows of trees but are planted at close intervals of 1,000 or 1,200 feet. Shelter belts planted along all the canals, around the fields and by the sides of roads should increase the afforestation of the oases by 6 or 7 per cent.

The choice of trees includes Lombardy poplars and platans for their valuable wood, and oaks, useful as a basis for the development of the Central Asian oak bombycid, which produces a stronger fibre than ordinary silk. More mulbevry trees have been planted which are essential for further development of silkworm breeding—traditional with Central Asia. Silver-berry is considered a good tree for regions with a poor water supply. Fruit trees comprise one-third of the total planted area. They are not tall enough to provide any great protection from the dry winds, and they themselves have to be sheltered from the wind, but they serve very well as transpirators and air moisteners, besides bearing delicious fruit.

The increase in the cotton yield will be well worth the loss of 7 per cent of the territory taken up by shelter belts. Moreover, Central Asia has to import its building timber at present, and it also has an insufficiency of wood fuel.

Meanwhile, in the oases of Central Asia, with close sub-soil waters and hot sunrays during the whole vegetation period, i.e., from March to October or even November, the trees are growing very fast. They will have to be thinned out in their 7th or 8th year and then again in their 15th or 16th year, which will provide the country with a large quantity of fuel. In 25 or 30 years' time, one acre of fast-growing trees will produce nearly 22,000 cubic feet of wood. Central Asia will then be amply provided with its own building timber and fuel, a bit of "extra" profit from the oases immune to dry winds.

But what are the prospects for those oases which are not surrounded by mountains, like the Ferghana, or lying in the submontane regions, but are right in the middle of a desert? Could we succeed in sheltering them from the dry winds? The answer to this question is not in the negative either. These oases have fewer trees by far than the Ferghana, e. g., on an average the plantings in Uzbekistan's oases take up as little as 0.1 to one per cent of their territory, and though the dry winds are at their most frequent there, in the summer the wind rarely attains the same force in these open spaces as it does in the Ferghana valley bottleneck. The oases in the centre of the desert would have to be edged all round with a wide belt of shelter plantings. In this case the trees would be planted both against and along the direction of the wind, forming checks a half mile long (crosswise to the wind) and nearly 1,000 feet wide. In other words, from whatever direction the dry wind might blow it would be held up by a maze of trees.

COMBATING SOIL SALINITY

When one is travelling by aeroplane over the oases in the lower Amu Darya, one can't help being struck by the grandeur of the work accomplished there. The land still shows traces of the old patch-work type of farming in the different shades of the vast and perfectly tilled tracts of fields. The lines of the new, brimming canals and the motor highways look like taut strings, and the Charjou-Kungrad railway gleams like a ribbon of steel. Well-planned settlements are springing up here and there along this railway.

The aeroplane more than anything else gives one the opportunity of observing with perfect clarity what one would not have noticed when driving along the road and seeing the country disjointedly rather than grasping the

picture as a whole. Looking from above at the vast spaces spreading out below, one is able to draw such conclusions and make such studies as are difficult to achieve in surface observation. That is why geographers, geologists and other workers in research are now finding this method of observation unsurpassed.

And when one looks down on this reshaped country one sees that the area of unused lands is still too large, and that splendidly cultivated fields alternate with waste plots. These latter are either fallow lands, or ancient and now abandoned fields, or pools of fresh, clear blue water, or cloudy yellow ponds into which superfluous flood water is drained. Salt-lakes appear as strange mauve stains edged with white. Moist salt marshes stand out in greyish-brown blotches here and there; malignant, bloated salt marshes look like patches of white snow. The latter have been done away with to a considerable extent, but we can hardly reconcile ourselves to their existence at all in our present-day conditions.

The question arises: how did these salt marshes come into being amid this wealth of fresh water in the green oasis? All this is a heritage of the past, blemishes not yet liquidated of a plundering and careless attitude towards nature, when, in their struggle for water and their strivings to bring as much of it as possible into their own fields, men gave no thought to the consequences. And yet the desert climate calls for a particularly thoughtful attitude towards nature. The dryness of the air is extreme here, and wherever sub-soil waters are no deeper than five feet, they are subject to intensive evaporation. They contain no great quantity of salts, but in the process of evaporation the vapour of the chemically pure water goes off into the air, while all the salts remain on the surface and gradually render the soil saline.

The greater the development of oases and the harder the fields are watered, the more abundant are the sub-

soil waters, their level rising ever nearer the surface and causing a subsequent increase in soil alkalization.

Until a few years ago, salt marshes covered 2.5 million acres of formerly irrigated territory in Central Asia. Nothing but saltwort would grow in these fields, and with every year the salt marshes swallowed up more and more territory, threatening to destroy the crops entirely. And in this respect the Central Asian oases present no exception.

During the years of England's dominion over her colonies, intensive soil alkalization was allowed: in Egypt, salt marshes paralyzed 2.5 million acres of irrigated land, and in Pakistan and India the same thing happened to 5 and 6 million acres respectively. As far back as the 1930's the alkalized area in the United States of America measured as much as 7.5 to 8.7 million acres.

This disease was not easy to fight. Research work was carried out by our soil scientists, irrigation engineers and agronomists in different conditions and in various parts of the country. This investigation showed that a third of the main canal water supply was harmfully infiltrated into the soil. Minor irrigation ditches showed an even greater loss. The cause was traced back to the time when fields were flooded entirely without rhyme or reason. Prior to flooding, the sub-soil waters in the Hungry Steppe lay 50 feet below the surface, but inefficient watering raised their level to 3-6.5 feet below the surface. At this depth, excessive watering and the capillary rise of water inevitably brought about soil alkalization.

The industrialization of the country made it possible to provide the state and collective farms with thousands of tractors and completely mechanize the cultivation of irrigated fields. Row-planting, furrow-cutting and furrow-watering are now done by machines. Adequate irrigation now requires considerably less water than it once did. As a result, evaporation is not so intensive, sub-soil waters

do not rise unduly, and no further alkalization of the soil is taking place.

But this was only the first stage in our fight against soil alkalization. There remained vast tracts of alkalized soil to be reclaimed. To achieve this we watered the fields lavishly or flooded them to a depth of 12-15.5 inches in the autumn, after the heat had passed. During the course of the winter, when evaporation is at its lowest, this water gradually seeped into the ground together with the salts. But sub-soil waters are practically motionless: horizontally, their movement is extremely slow. Therefore, the salts which had seeped through and the excessive sub-soil waters had to be drained off. In the old days every available hollow and depression or the outer rim of the oases was used for the purpose. Today we are adopting specially constructed drainage systems on a wider and wider scale.

One system of canals—irrigation canals—is built on dikes above field level and serves as the arteries, as it were, bringing fresh water to the acreage under crop. Another system—drainage canals—resembles veins, inasmuch as it serves to cleanse the organism of the oasis of waters which percolated through the soil and became alkalized, presenting a waste product of its vital activity. These drainage canals are laid below the level of sub-soil waters, which seep into these canals and flow away far beyond the bounds of the irrigated fields.

In recent years we have begun to use vertical drainage in our oases, doing away with the need of building deep drainage canals. This method requires wells to be bored and equipped with wind motors. The sub-soil, usually saltish, waters are pumped up and turned off from the oases along shallow drainage ditches. The choice of method, however, depends entirely on local conditions.

A great variety of methods is used in an effort to recondition the old alkalized fields. It appears that in this

matter, trees once again are the best solution. Plantings by the front-ranking Pakhta-Aral State Farm, which was thirty years old in 1954, proved that trees were much more successful in bringing down the level of sub-soil waters than drainage canals. The trees, planted in ditches dug in the salt marshes, thrived beautifully. The level of sub-soil waters dropped quickly, salts no longer fed the salt marshes, and if these tree-drained plots were capably washed out in the autumn, they could be restored and once more made available for tillage. It must be borne in mind that these tree plantings alone cannot cope with the job unless natural conditions are favourable, i.e., the area is inclined and the soil permeable to water, causing more intensive movement of sub-soil waters. In flat areas it is essential to combine plantings with drainage canals.

The existing oases possess ample reserves of land suitable for irrigation. These areas have been doubled since the Revolution, but even now in some of the oases only a quarter of the territory is being put to use. Therefore, we should make every effort to utilize the more easily developed plots of land within the old oases, besides creating new ones. The approach to this is not so much a struggle for new sources of water as one for greater efficiency and water economy. "The art of irrigating is the art of draining," said Academician D. I. Shcherbakov, the explorer of Central Asia and follower of the Academician A. Y. Fersman.

In the lower reaches of the Amu Darya it is possible to plan the drainage system in such a way that the waters could be used a second time for irrigation. To accomplish this, in regions where the drainage waters are sufficiently fresh, they could be pumped up by wind motors and directed back into the fields. On the other hand, in regions where the sub-soil waters are salty and unfit for use, they could be concentrated in large main

drainage canals on the outskirts of the oases and turned into the Sarykamysh depression, directing them into the dried-up river-bed of the Kunya Darya (Daryalyk). The flow of these waters could then be used for the generation of electric power. A system of evaporation basins might also be built in the Sarykamysh depression for subsequent extraction of various salts.

Until now, when developing desert lands, the construction of an irrigation system took precedence over everything. Today our main forces should be directed towards the construction of a drainage system. Pursuit of this policy would, within a few years, permit the fertile oases of the Ferghana, Zeravshan, Murgab and other regions in Central Asia to develop hundreds of thousands of acres of land suitable for cotton planting within their own precincts.

COMBATING MUD AND ROCK STREAMS

Vegetation has for centuries been desperately struggling for mastery over the mountain slopes. A seed would sprout in the crevice of a rock, but a hurtling stone would break the young shoot, snow would crush it down and rain waters wash the soil away from its roots. Only in rare cases would the shoots grow into crooked little trees. But screened by these little trees other seeds found it easier to take root. And in this manner forests gradually come to grow on the mountain slopes. But many centuries go by before the roots of grasses and trees bind the scattered stones, and rocks grow a covering of soil.

Man in his search for fuel chopped down trees, and in his struggle for existence tilled small plots of ground down the desert-bordering mountain-sides, the only places where cereals could be grown without artificial

irrigation. But torrents of rain would wash away the soil that had just been ploughed and planted, and strip the rocks bare once more. And gradually, the wooded mountain-sides became slopes of scattered stone again. After one of the heavier rainfalls, a stream of mud and stone-bearing water would come rushing down madly, dragging broken rock, stones and huge boulders, roaring and thundering into the plain, flooding the fields and gardens with muddy water, cluttering them up with stones and depriving man of home and land.

According to the data compiled by one of the well-known Soviet meliorators, F. K. Kocherga, during the period of 3rd-7th May, 1927, in the Uzbek part of the Ferghana valley siles, or rock streams, washed away and damaged nearly 13,000 acres of crops, destroyed 247 buildings and numerous hydraulic structures. In 1931 siles in Uzbekistan buried in stones and washed away the crops from an area of almost 60,000 acres, of which approximately 22,500 acres belonged to the Ferghana valley. In 1934 the total loss caused by these streams amounted to 10 million rubles, and in 1936—following exceptionally hard rains in the mountains—to 22.7 million rubles.

There was a case in the Tajik part of the Ferghana valley in 1946, when a sile, suddenly altering its course, wrecked half the houses in the Kanibadam village and destroyed 25,000 acres of cotton.

Altogether 1,260 instances of disastrous rock streams have been recorded in Central Asia in the past sixty years.

After 1927 a system of fighting these rock streams was introduced in Uzbekistan. Work was carried on in the basins of those mountain rivers and streams which presented the greatest danger to the Ferghana valley, and, as a result, siles became less frequent and destructive in these regions.

In Ferghana, the binding of the first 50,000 acres of mountain slopes more susceptible to rock streams was accomplished by 1940. Supporting protective walls had to be constructed, river- and stream-beds reinforced, snow-slips held back, rain waters retained on the slopes and in river-beds, and slopes stabilized with plantings. Numerous varieties of trees and shrubs and ways of tending them were put to the test. Water had to be collected in hollows where the young trees were planted, and soil had to be grown on to the rocks and watched lest it be washed away.

The plan of remaking Uzbekistan's nature was approved in 1949, according to which 4,396,000 acres of forest were to be grown. Large areas are planted over already; for the most part they cover mountain slopes and will serve as a means of fighting rock streams.

COMBATING ADVANCING SANDS

Sands, easily shifted by the wind, occasionally turn into an awesome and destructive elemental force. It is a well-known fact that senseless plundering of vegetation on sandy soil, even in Western Europe with its moist climate, resulted in the burying of great spaces of cultivated fields and settlements beneath the sands.

In Astrakhan Province, in pre-revolutionary days, the sandy soil suffered such damage at the hands of man that some of the villages had to change their location two or three times. Sands, moving from the north, where excessive cattle grazing had stripped the soil bare, have for years been drifting over the Karakul oasis in Bukhara.

Though the area of sands in Ferghana is not large, yet during 1910-1924, 1,000 acres of irrigated land were buried in just one of its regions. The total loss sustained by the Ferghana valley because of drifting sands added

up to 70 villages and several thousand acres of plantings.

Tsarist Russia gained its hard-earned experience in binding the sands along the Transcaspian and Astrakhan railway lines. But the job we are faced with is even harder, for in addition to the railway lines, we have to bind the sands along canals, round industrial centres and villages, outside and inside of the oases.

When the Transcaspian (now Ashkhabad) railway line was being built across the Kara Kum desert in the 1880's, the engineers decided to use snow-combating wooden shields to hold back the sands. But, whereas snow-drifts would have melted in the spring, the sand piled higher and higher against the defence shields. They had to be rooted up and more planks added to the top, but the mounds of sand stubbornly climbed higher and higher, advancing ever closer on the railway line and threatening to bury it entirely. The line had to be constantly cleared. A team of workmen was attached to every train, which would go as far as the first sand drift and stop, resuming its journey only after the workmen had cleared the way. All traffic stopped as soon as night fell.

The following fact will be a good illustration of the scale assumed by these sand drifts. Two days of wind—the 27th and 28th June, 1897—buried the railway line so deep in sand that it took three squads of the railway battalion, a hundred workmen and a tool train a month to clear the line. And this was not an isolated case.

It fell to the lot of the late Vladimir Afanasyevich Obruchev, a young mining engineer at the time and later the famous explorer and academician—the patriarch of Soviet geology and geography—to be assigned to the construction of the Transcaspian railway immediately upon graduation from the institute. He was quick to grasp that the method then employed to bind the sands

would only lead to disaster. However, his warning was ignored until such time as the futility of the method stood out in its entirety. The very first trial plantings of local desert shrubs in the bare sands, suggested by Obruchev, gave admirable results.

The sands have now been stabilized in regions where they presented the greatest danger. In Ferghana, this toilsome and carefully planned work proved a brilliant success. A green barrier, 68 miles long, protects the Karakul and Bukhara oases from sands which used to drift them over. On the right shore of the Amu Darya, Usty—a sand-stabilization base—has also managed splendidly. By 1949, a total of over 135,000 acres in Uzbekistan and 27,000 in Turkmenistan had been stabilized and fenced in with trees. However, this was merely the beginning. In the last few years vast areas have been planted with saksaul, and still greater undertakings are to follow.

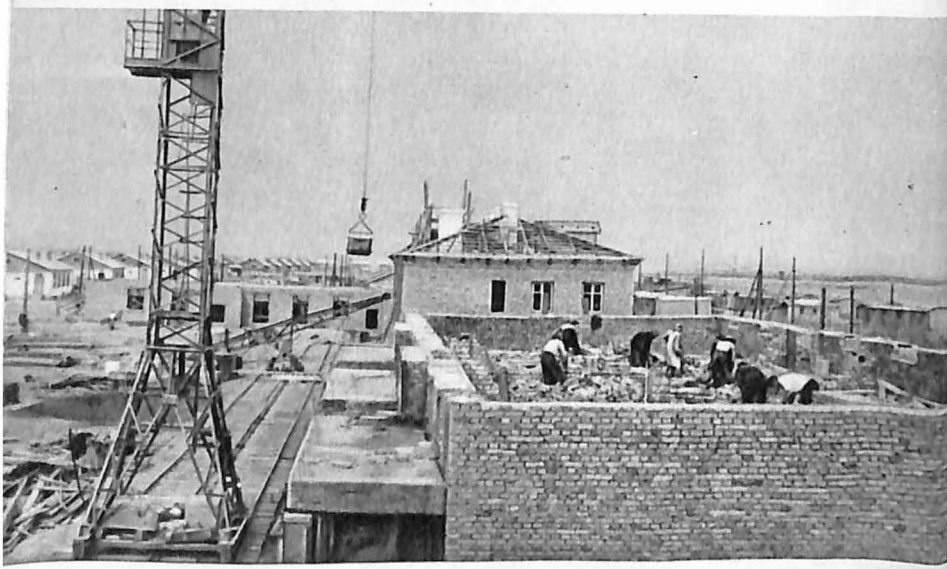
Measures have already been elaborated which make it possible to detain the sands on very large territory. The "Bukhara screen" is one of the most interesting instances.

The century-old irrigated fields of Bukhara and Karakul were being drifted over with shifting sands from the north. People chopped down shrubs and trees for fuel, and cattle devoured the grass; as a result large tracts of heretofore irrigated land, stretching as far north as the foot of the Kyzyl Kum mountains, perished beneath the sands. In certain parts it appeared that the surface soil and the layers of river silt, 33 to 50 feet thick, had been borne away. In consequence a 222,000-acre stretch of shifting sands formed round the oases, and these sands drifted over whole villages, to say nothing of fields.

There was an ancient little town of Vardanzi to the north-east of Bukhara. Houses nestled close to its old

The crop of melons is always rich at the Lenin Collective Farm in Tashkent Region

The new homes of the cotton planters employed on the Kuibyshev State Farm, Stalinabad Region



Homes grow fast in the new town of Yangi-Er which has sprung up in the Hungry Steppe, a barren desert until recently

fortress, and beyond spread an expanse of irrigated fields. But the sands were working their evil deed. By 1931, though the town still existed, to get to it one had to cross 3.5 miles of barren shifting sands which had drifted over all the fields. In 1932 a new canal had to be built, some six miles east of the town, and all the population of Vardanzi moved to the newly irrigated lands, abandoning the old site to its fate. In 1933 the Bukhara sand-stabilizing party undertook the planting of green barriers around the new town and the binding of sands.

In the winter they put rows of Alhagi on the shifting sands with a distance of 5 to 8 feet between the rows depending on the terrain, and to prevent the wind from blowing the Alhagi away, a little sand was sprinkled over it. In the first week of March, when spring came to the desert and the sands were moistened with rain, cuttings of fast-growing shrubs (kandym and salsola) were planted 12 to 16 inches deep in the sand close to the Alhagi belt.

The same spring the cuttings grew to a height of 3.3 feet, blossoming and bearing fruit. In December and January of the following winter, seeds of black saksaul were planted in the natural hollows (this must be done not later than March). But the first trial plantings were a failure. The saksaul seeds, which look like tiny immortelle flowers, have small stiff wings; the wind blew the seeds away and piled them in small heaps, and the rodents fed on this fodder, so thoughtfully provided for them by the wind. As a result, the crop was an exceedingly poor one. Nowadays, the seeds are first passed through special drums where brushes scrape off their wings, leaving the seed itself unimpaired.

In the beginning saksaul was sown by hand or from a camel's back, but now this is done from aeroplanes. Sowing from a height of 65 feet, a vast territory may be

covered with the dewinged seeds plunging hard into the sand.

During the first year saksaul grows to a mere 6 inches; in that period its total strength is directed towards developing a deep and mighty root network. At the age of three, saksaul becomes a thick shrub as much as 3 feet tall, and at five, it reaches 6.5 feet in height. The tree grows to a height of 20 feet by the time it is ten years old, but then its growth stops and its principal function becomes trunk development.

The short-lived but fast-growing shrubs of kandym and salsola have to be chopped down when the saksaul is only 7, so that it may develop properly. But even if this is not done, the shrubs will die anyway by the time the saksaul plant is 10.

The expense of afforestation and tending the plantings is offset to a considerable extent by the wood obtained, and eventually it is covered completely by the saksaul timber.

I happened to see thick forests of saksaul in different parts of the country—from the shores of the Caspian Sea to the China border, from the north of the Aral Sea to Kushka, the southernmost point in the Soviet Union, and I can say with assurance that nowhere did nature rear such splendid saksaul forests as those man-made thickets grown in barren shifting sands, transformed into the green "Bukhara screen."

And yet sub-soil waters here are no less than 40 to 50 feet deep. Then how was it possible to achieve this conquest over nature? The answer is in the sands' moisture distribution. In the natural habitat of saksaul the sands are covered with a layer of turf and contain a certain amount of top soil. This turf layer retains nine-tenths of the rain and snow moisture and the saksaul plant receives only a negligible quantity of it. The Bukhara sands, on the other hand, are entirely free of turf grasses, there

is no desert sedge, and only rarely does one come across blue grass. As a result the saksaul receives the benefit of all the moisture there is. Although the sands are practically motionless, they will remain loose for the next 15 or 17 years, an advantage when it comes to moistening them. These are the reasons why the saksaul forests of the "Bukhara screen" grown by the Soviet meliorators within a space of twenty years are incomparably better than the natural ones.

In consequence of the comprehensive work put in by physicists, geographers, botanists, zoologists, meliorators and construction engineers, we may now undertake with impunity the most complex and intricate of tasks in protecting our fields, industrial enterprises and salt mines from the sands, which, together with the dust, often cause considerable losses in crops, and ruin chemical raw material.

We also make use of shields to hold back the sands for the time required by a plant to take root.

Canal construction in the deserts presented the greatest danger to plant life. The thousands of people and armies of machines employed could not avoid destroying much of the productive top layer of soil. In the process of construction, there appeared a large amount of loosened dry sand which the wind instantly picked up and carried off into the canal.

Today, with floating suction dredges usually employed, a new and reliable method of combating the sands has presented itself. The soil is strongly satiated with water, and as it spreads it forms flat, level plains, which are subject to gradual dispersion as they dry out.

It has been suggested that tall-stalked cereals—such as sorghum, maize and kaoliang—should be planted in these plains. Condensed-row planting should be adopted, either in rows with 28-to 60-inch intervals, or in squares of the same dimensions. Already in two months' time

these plants could be substituted for the usual rush screens, serving to protect the plantings of saksaul and other shrubs or cuttings of trees until their roots gained strength. This method of binding the sands is much cheaper than the use of shields. Should these plantings require watering, this could easily be accomplished by means of fire hoses mounted on the floating craft.

A great deal has been achieved in the Soviet Union to transform the parched, arid deserts into the richest of oases, teeming with life. And yet this is by no means the limit beyond which we may not venture, but in fact only the beginning.

Ample man power reserves are what is most needed for faster desert development. A great number of people, however, have for the last few years been engaged in developing vast natural resources, building immense hydropower stations and large industrial centres in the north-eastern regions of the U.S.S.R. People have also moved in great numbers into the regions where fallow lands, covering a territory greater than all the arable lands of France and Italy put together, have been cultivated in the course of the last three years to form the country's new agricultural base.

We shall continue working on our arid lands with their wealth of sunlight, until we have exhausted all available water sources—both surface and sub-soil. But we shall not stop there, for then we shall turn the courses of the distant northern rivers into the desert.

THE FUTURE OF CENTRAL ASIA'S DESERTS

PROSPECTING EXHAUSTED RIVERS

There is a river called Zeravshan in Uzbekistan. Its main source—the River Matcha—comes tearing out from under the huge Zeravshan glacier with a hollow roar, and as it rushes through the valley between two tall mountains—the Turkestan and the Zeravshan—it is joined by numerous small, muddy and boisterous tributaries which also take their source from the glaciers. At the same time the clear waters of the Yagnob Darya River and those of the wondrously beautiful Lake Iskander-Kul join into the Fan Darya which cuts through the Zeravshan mountain ridge. It is, in fact, these two rivers —the Fan Darya and Matcha—which, merging, form the River Zeravshan. As soon as it leaves the mountains behind it, the Zeravshan breaks off into some fifteen streams which water the fertile Samarkand oasis, and then join into one again. During its course the Zeravshan waters the oases of Katta-Kurgan, Kenimekh, Gizhduvan and Bukhara, none of which may claim a single extra drop, because the water is worth its weight in gold down in the lowest, the Karakul, oasis, where all that remains of the Zeravshan is completely absorbed by the fields.

The Kashka Darya, a mountain stream which used to be a tributary of the Zeravshan, can no longer reach that river, let alone water the large Karshi oasis. And there-

fore, due to the water shortage, these fields, instead of cotton, have to be planted with wheat which need only be watered once, and even then only a small part of the land suitable for irrigation is put to use.

Once upon a time there was an ancient kingdom—Merv—in Turkmenistan in the lower reaches of the Murgab River. More than seven centuries have passed since Genghis Khan destroyed this kingdom's capital, but to this day the towers, walls and regally beautiful mosques of ancient Merv rise proudly over the ruins, and the antique reservoir, protected from the scorching rays of the sun by a strong vaulted brick ceiling, is full of fresh, clear water.

Ancient Merv was considered a wealthy kingdom, but in those days only a negligible portion of the Murgab's waters was needed by the people, and the rest was discharged into large lakes and got lost in the reeds. The present Merv-Mari oasis, with its three cities—Mari, Bairam-Ali and Iolotan—its model cotton planting state farm, its seed testing station, factories and hundreds of villages, greatly surpasses the ancient kingdom in wealth.

All the waters carried by the Murgab River are now used for irrigation purposes, as well as those waters collected during the winter in the new chain of recently built reservoirs. Nevertheless, four times the area which could well be cultivated in the Murgab delta remains unirrigated.

To the west of the Murgab, also in Turkmenistan, flows the River Tejen, but it only provides for a tenth part of all the area suitable for cultivation and only for a single watering of wheat at that.

We could considerably supplement this list of rivers drained to the last drop during the summer. In the whole of Central Asia the Amu Darya, the Syr Darya and the Ili are the only rivers not utilized to full capacity,

whereas all the others are being squeezed dry to irrigate the fields.

However, this only happens in the summer, while in winter the same rivers flow idly past the fields. To obviate this wastage, construction of the Katta-Kurgan reservoir was undertaken and the first section completed in 1940. This so-called Uzbek Sea, situated to the south of Katta-Kurgan and to the west of Samarkand, is 5 miles wide and 9.3 miles long. The Zeravshan's winter waters are collected there and in the spring they are channelled into the fields of the Katta-Kurgan, Bukhara and Karakul oases.

The volume of water collected during the winter surpassed the capacity of this reservoir, and so the large saline hollow close to Bukhara was also utilized. This is how the present Tudakul lake originated. This procedure of obtaining additional water supplies has been repeated with the other rivers as well.

Seepage losses of canal waters are considerable. It is therefore proposed to cement the ditches, canals and even the mountain river-beds in many parts of the country. The job will prove an expensive one and, naturally, it will take a number of years to accomplish, but as a result we shall get twice or three times as much water from the "exhausted" rivers and thus double the area of our arable lands.

At the moment the cheapest materials and methods are being sought to make the canal walls waterproof in the simplest possible way.

THE AMU DARYA'S FUTURE

The Amu Darya carries its deep, swift and cloudy waters through the deserts. Great are the oases stretching from Termes, where the river emerges from the mountains, to Chimbai in its lower reaches, but only a

fifth of the water is used for irrigating the fields while the rest discharges into the Aral Sea and there evaporates.

And yet the Amu Darya basin covers vast territory which is suitable for cultivation. A great deal of work was done to reconstruct the chaotically tangled mesh of canals, to build hundreds of new headworks and thousands of water distributors, and now we are confronted with major construction, which will, indeed, be a march against the desert.

The Kara Kum canal, which will go straight across the South-Eastern Kara Kum desert and provide the ever-parched southern oases of Turkmenistan with water, is the first of these offensives, already begun in the middle course of the Amu Darya. The economic expediency of this project has been proved incomparably greater than that of the previously planned Main Turkmenian Canal, which was to have taken its beginning in the lower Amu Darya and crossed completely uninhabited country, whereas existing oases were in dire need of water.

The "dress rehearsal" of the Kara Kum canal construction took place as far back as the early 1930's, when the Bossaga-Kerkin canal near the Soviet-Afghanistan border was enlarged and the waters of the Amu Darya directed along this waterway into the ancient and dry river-bed of the Balkh, continuing along the Kelif Uzboi for a distance of 62 miles. On the strength of this experience, the loss of water in seepage was taken into account, and it was also established that when the current was sluggish the sands were soon choked with silt and became practically waterproof. Methods of binding the sands were also put to the test. In other words, past experience had to help construct a large canal that would cut through the whole of the South-Eastern Kara Kum desert.

The first section of this canal will cover a length of 254.5 miles from the Amu Darya to the town of Mari. This

will bring under irrigation 247,000 acres of new territory in the Mari and Charjou regions for cotton planting, and will water millions of acres of meadow. To speed up construction, work is being carried on from both ends at once—from the Amu Darya and from Mari.

Work is in full sway at present. No storage dam is required on the Amu Darya in view of the site's natural slope, which will send the waters flowing down the length of the canal. The headwater, comprising two reservoirs and a shipping lock, is under construction two miles away from the river. The water will be left to settle in these reservoirs after which the deposit will be washed away by the force of the current and borne back into the river. In other words, the water entering the canal will be free of sand, which is its main load.

To build a waterless canal in the desert is one of the hardest possible jobs. In the north-western part of the Kara Kum canal construction site, where a regular fleet of powerful machines is working in the sands, the conditions are such that there are neither roads, drinking water, nor even water with which to moisten the sand. The sides of the canal refuse to be bound, and the sand, loosened by the machines, falls easy prey to the winds which, as though mocking at the toils of man, hasten to fill in the canal with it once again.

To overcome these hardships another and easier method has been found: the land machines only dig a narrow "pioneer" canal, while the main forces are centred in the south-eastern or Kerki section where suction dredges rather than excavators do the most work, widening and deepening the "pioneer" canal. A string of floating suction dredges starts out from the Amu Darya, pumping up the sand from the bottom and, together with the water, directing it into pipes as they gradually move on. The leader of this fleet is a small flat-bottomed dredge which merely lays a narrow and shallow course. It is

followed by other, more powerful machines which deepen and widen the canal to such an extent that it could stand a stream of 14.120 cu. feet of water per second and serve as a waterway for cargo and passenger vessels.

The former saline hollows of the Kelif Uzboi will be turned into diked-in settling pools for the Amu Darya silt which, when pumped out by dredges, spreads not in heaps but in a smooth layer. Being permeated with water, it may be easily bound with plantings of grass and trees and, if necessary, could be irrigated.

By 1958 it is intended that the waters of the Amu Darya flow across the south-eastern part of the Kara Kum desert and bring moisture to the Mari oasis. Only small irrigation canals will have to be built there, since the main system fed by the waters of the Murgab is already in existence. However, the building of this minor network will require as much effort as the construction of the main canal itself. As a result the ancient Mari (Murgab) oasis will be enlarged by 250,000 acres.

When the principal part of this work has been completed, the construction of the second section will begin, extending the canal to some 93 or 124 miles in length into the arid lands of the lower Tejen. The newly irrigated lands in the Murgab and Tejen deltas will be four times the area of existing fields.

It has been estimated that within a few years the income of the collective farms in deserts developed and irrigated as a result of the canal construction, will be four times their present receipts, and the colossal expenditure involved will be justified in seven years' time. The future paints a picture of spreading cotton plantations, alfalfa and wheat fields, new fruit gardens and vineyards. It is proposed to plant 80 million trees along the shores of the canal and more around the oases.

Eventually the canal may be continued along the foot of the Kopet-Dag towards Ashkhabad, the capital of

the Turkmen S.S.R., and even further to the north-west. Its entire length would then be equal to 565 miles. This would be one of the greatest irrigation canals in the world and it would afford the opportunity of covering the entire southern part of Turkmenistan with lush green fields, fruit gardens and vineyards, and make the republic the country's principal supplier of fine-stapled cotton, or "white gold."

But the dreams of the Turkmen people would not stop at this. When the lands watered by the Kara Kum canal are fully developed, the question will arise once more of irrigating the desert which the Main Turkmenian Canal was to have watered. This includes the south-western part of Turkmenistan and the ancient lower reaches of the Amu Darya between the Khoresm oasis and the Sarykamysh depression. The tentatively proposed development of nearly 2.5 million acres may thus be realized.

The second march on the desert is to be directed against the right shore of the middle stream of the Amu Darya in Uzbekistan, where its waters might be used to irrigate lands in the lower Kashka Darya and lower Zeravshan. This plan, however, requires further research and elaboration. The third march will be the bringing of the lower Amu Darya under irrigation, where the project opens even greater prospects.

Such is the future of the Amu Darya—the deepest and most untamable river in Central Asia. Should there be any water to spare after all three projects have been executed, the Kara Kum canal could be lengthened. This would help to irrigate the clayey soils of the oldest of the northern tributaries of the Amu Darya—the Akcha Darya—and the whole territory of the Amu Darya's old dried-up bed to the west of the existing oasis in its lower reaches.

THE SYR DARYA'S FATE

The second largest river in Central Asia is the Syr Darya, which carries approximately a third of the water of the Amu Darya, and has a less rapid current. The river is formed of numerous tributaries easy to cope with, and therefore the waters of the Syr Darya basin are widely used for irrigation, especially in its upper reaches. Although the Syr Darya waters far greater territory than does the Amu Darya, yet the total area suitable for cultivation is much more than it can cater for.

Irrigation requirements are well satisfied by the character of many Central Asian rivers: mountain snows and ice melt fastest in the summer when fields are in need of water; in winter these rivers carry a comparatively small amount of water and, instead of a brief spring flood, abound in water for the length of the summer months. The character of the Amu Darya is particularly suitable for irrigation. The Syr Darya, for instance, has a stronger spring flood-tide but an inadequate flow towards the final watering season. This makes the building of reservoirs essential to dam up all the water flowing out of watering seasons. The Farkhad dam, built across the Syr Darya in 1947, made it possible to water a part of the Hungry Steppe.

The Kairak Kum reservoir, which will collect the Syr Darya's winter waters, is presently under construction in the extreme west of the Ferghana valley at the entrance of the narrow bottleneck where the winds are particularly fierce. In 1956 filling of the reservoir began. Its capacity will be 176,500 million cubic feet, which is almost that of the famous Aswan reservoir on the Nile. It will cover an area of 231 sq. miles and will play a great part in the battle against dry winds. In the near future it is proposed to bring 1,235,000 acres (including 741,000 in the Hungry Steppe) under irrigation, and at

a later date 250,000 in the same Hungry Steppe and 250,000 in Jizak Region. This desert, where only 32,000 acres were irrigated prior to the Revolution, and 234,500 in 1939 before the major construction projects were undertaken, will be watered to almost 100 per cent.

In 1956 the government issued an order whereby 741,000 acres of land in the Hungry Steppe were to be brought under irrigation. 500,000 acres fall to the share of Uzbekistan and 241,000 to Kazakhstan. At the moment this work is in full sway, and the following are under construction: central and southern main canals, an electric power station, a railway line to Jizak, a network of highways, 932 miles of telephone and telegraph lines, a new regional centre for a population of 100,000 to 150,000, several district centres, 34 new state farms and 23 cotton mills with workers' settlements adjoining. Construction will include numerous concrete hydraulic structures, water distributors, etc. Drainage is given every attention from the outset. The Hungry Steppe collecting main is presently being completed. The measures taken will help to lower sub-soil water level by 16 or 20 inches and will safeguard the soil, to be eventually irrigated, from alkalization. The large, gently sloping Sardoba depression lies practically in the centre of the Hungry Steppe, and with all the territory about it being irrigated, it would be liable to develop into a salt-lake. To prevent the wastage of this area and alkalization of its slopes a powerful pumping station is being built, which will pump the water out and conduct it far beyond the irrigation zone.

Enthusiasm has swept the youth not only of Uzbekistan but also of other regions of the U.S.S.R., and now the young people are streaming into the Hungry Steppe from all ends of the country, eager to win yet another victory over the desert.

The conditions obtaining in the middle and lower reaches of the Syr Darya are peculiar. Why is so much

of its valley as yet undeveloped? Why is there a wilderness of mauve-flowered tamarisk and white-tasselled reed? Why are the cultivated fields so few and traces of quite recent irrigation so many? Why is the valley of this river so thinly populated?

The character of the Syr Darya is mostly responsible for this. In the summer it either threatens to inundate the fields or leaves them waterless, and in the winter floods are quite a frequent occurrence. The lower reaches of the river would be ice-bound while the upper, situated much farther south, would still be enjoying warm weather, and in the event of a late autumn rain or snowfall, the river would overflow in its middle and lower reaches, flooding whole districts and threatening villages and towns with inundation. In the winter of 1949, to save Kyzyl Orda, the people of this town waged battle against the river for a whole month, building up the existing dams considerably, and only this selfless and united endeavour averted the danger of flood.

To control the Syr Darya, more dams should be built besides the already completed Farkhad Dam and the Kairak Kum Dam. A large reservoir would be particularly advantageous in the far north of the Hungry Steppe where winter waters could be collected and used for the left bank Char Darya plain. If a dam were built there, the low-lying part of the plain would never be subjected to flood threat again and its large territory could be turned into irrigated fields.

Should the Kairak Kum and the Char Darya reservoirs prove incapable of holding all the waters of a strong spring flood, the excess could be turned into the ancient dried river-bed of the Syr Darya.

The new dam on the outskirts of Kyzyl Orda will help to put the lower reaches of the river to much more intensive use. Irrigated fields would no longer be affected by insufficient canal water or by floods, and eventually

they could be further increased by 370,000 or 500,000 acres and planted with rice. First and foremost the Kyzyl Orda dam would serve to water the spacious meadows on both sides of the river below the dam. This would help livestock development considerably.

So this is what the future holds for the Syr Darya—the second largest river in Central Asia.

When these projects have been carried out we shall find that there are still vast tracts of land suitable for irrigation in the Syr Darya basin which the river cannot cater for.

The Syr Darya has a great ancient delta which still bears evidence of its old channels—the Inkar Darya, Jana Darya, Kuvan Darya and others. Of these dry channel beds the largest is the Jana Darya, stretching for 248 miles to the south-west towards the lower Amu Darya. All these winding channel beds are situated in a plain, which in its various stages of formation was irrigated in parts at different times. Its total irrigation could only be achieved after the rivers from the far north had their courses turned back.

WILL THE ARAL SEA BE DONE AWAY WITH?

The Aral lake-sea plays quite a large part in our economy. Aralsk, a north-eastern seaport situated close to the railway line, is always alive and busy receiving sea-going barges and steamers loaded with mountains of cotton from the lower Amu Darya, and sending off cargoes of wheat, chemical fertilizers, timber, cement—whatever is necessary to satisfy the requirements of all the lower Amu Darya region.

The largest industrial enterprise in Aralsk is the fish factory. Thirteen varieties of fish are caught in the Aral Sea. Although this shallow lake-sea freezes over in winter, it is well heated in summer and so its productivity

is very high: the annual catch of fish is over 22 pounds per acre.

In the meantime, the waters of the Amu Darya and Syr Darya which feed the Aral Sea are being put to extensive use in field irrigation, and in the years to come will be utilized entirely for this purpose. The Aral Sea will only receive an insignificant portion of their winter flow, but finally this, too, will be directed into the fields. Thus, for the first time in the history of mankind, a whole sea might disappear.

Does this mean that the fate of the Aral Sea is sealed? For if a choice were made between the wealth of the Aral Sea as such and the crops that could be grown in the newly irrigated fields, there could be only one answer. The water used for irrigating the fields would do far more good than the same water retained for the maintenance of the Aral Sea.

However, the fate of the Aral Sea is only sealed insofar as the sea level will be lowered by 16.5 to 23 feet, in other words as much as the improved irrigation of the Syr Darya and Amu Darya deltas calls for. As for the existence of the sea itself, we shall most probably keep it—not for account of the rivers of Central Asia, but by bringing to it the waters of the much more distant northern rivers.

THE DESERT WASTE PLOTS

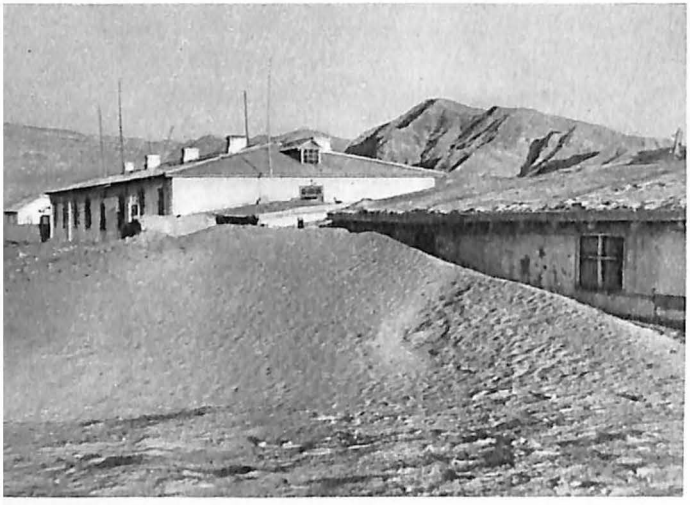
The nature of the deserts depends to a large extent on their distant geological past.

The limestone Ust Urt plateau with its gypsum soils has no resemblance to the levelled isolated remnants of the ancient Central Kazakhstan hills; the Aral eroded sandy plateaux are quite unlike the loess submontane plains.

Even now the economic management of the various re-

New blocks of flats in Ferghana, Uzbekistan

It seemed that no force could arrest these drifting sands



Until recently houses and railways were exposed to drifting sands

gions and, also, the means and sequence in which they are being developed, are all influenced by their geological past.

Where have oases been created before now? Was it on any sort of territory? No, some of the oases were created in loess submontane plains, but the majority in the ancient river deposits, in plains where the rivers had deposited huge layers of silt and the river sands and pebbly beds were covered over with loamy and sandy soil. But in plains where the rivers deposited purer sands, the wind instantly took possession of them, piling them into ridges and dunes, and blowing away all the topsoil. Such is the origin of the fractionally disintegrated sand deserts having no level lands suitable for cultivation, where water is thirstily absorbed by the sands and cannot be retained, and where irrigated farming is extremely difficult to build up. Nor are there any large oases in regions of bedrock foundation. The surface disintegration is more complex here, water supply a greater problem, the top layer of soil is thinner and its content often unfavourable for agriculture.

Vast areas of ancient river plains, or, as geologists call them, alluvial plains, formed of loamy and sandy deposits and possessing the most fertile of soils, are not as yet utilized for irrigated farming. We shall only be able to water them with the rivers of Central Asia by reinforcing all the canals and ditches and adopting the most effective and water-saving type of irrigation—artificial rain. But this undertaking calls for great expenditure, an outlay of labour, cement and vast lengths of piping for permanent installations. Artificial rain is now employed only in suburban vegetable farming, while adoption on a major scale will have to be a matter of the rather far distant future.

And meanwhile, in the next few decades, we shall make use of the waters of Central Asia's rivers to create new oases by means of gravity flow irrigation canals.

We now come to the problem of the remaining deserts, and the waste spots which cover most of their territory.

The infertile gypsum and saline desert soils, which take up a large part of the Ust Urt plateau, for instance, as well as many districts in the Betpak-Dala desert and certain parts round the Aral, will hardly ever be irrigated for farming in large tracts. But even these places do their share: no matter how poor their vegetation, it still provides good sheep and cattle fodder. The wormwood growing there is given to the sheep as a fattening autumn food. Cattle and sheep breeding in the desert is the most profitable and simplest type of occupation possible there.

In Central Asia, karakul breeding has been developing for several thousands of years. And no matter what perfection is attained in imitation fur production or the artificial wool industry, there is small likelihood that mankind will ever give up the breeding of animals as profitable as the fine-fleeced and karakul sheep. And this being so, the deserts will continue to serve as good bases for cattle and sheep breeding. Stall-feeding of sheep is a much costlier proposition than pasture-feeding, and moreover, it impairs the quality of the wool, particularly that of karakul sheep.

Today, when 86,450,000 acres of virgin and fallow land, previously used as pasturage, have been cultivated, the desert waste spots have gained an even greater importance.

ENRICHING THE SANDS

Sands always have a comparatively high moisture content owing to their ability to absorb and retain not only atmospheric precipitations but also the moisture from the air. Vegetation thrives in these conditions, and therefore the best pasture lands are always found in the deserts.

Nomad tribes, using these pastures sparingly and regularly, did not cause them any great harm. The semi-steppes north of the Caspian Sea suffered most from excessive grazing, for the capitalistic approach to livestock increase was more apparent there than in Central Asia.

The Soviet people put a stop to this plundering of the deserts' natural wealth, and resolved to do everything possible to enrich the sands.

The surface of the sands has been disintegrated by the winds to such an extent that, obviously, it would not occur to us to try and irrigate whole tracts of them. Our plans do not include transformation of the deserts into one vast garden or forest, for we know that the time has not yet come for that, nor the need. But what we are planning to do is irrigate the deserts partially, wherever it is found advisable.

Fresh waters are close to the surface in many of our northern deserts and on the outskirts of some of the southern ones as well. In the old days these spaces were merely used as grazing ground by the nomads, but nowadays our collective farms have learnt a way of cultivating them for fodder grass, and also for millet, sorghum and melons. New varieties of hardy, cold and wind resistant, fruit trees and vines have been raised, which will eventually fill the hollows in the sands and turn them into lush orchards and vineyards. In the Caspian deserts, splendid pine groves have already been grown in such hollows.

In many parts of the desert, the sub-soil waters, though close to the surface, are either saltish or alkaline. Fruit trees and vines will not grow in this soil, but it does produce black saksaul which is a valuable fuel. In pre-revolutionary days saksaul groves were plundered and destroyed, but now the old are being restored in many regions and new ones planted over vast areas, particularly on the edges of oases and around industrial centres.

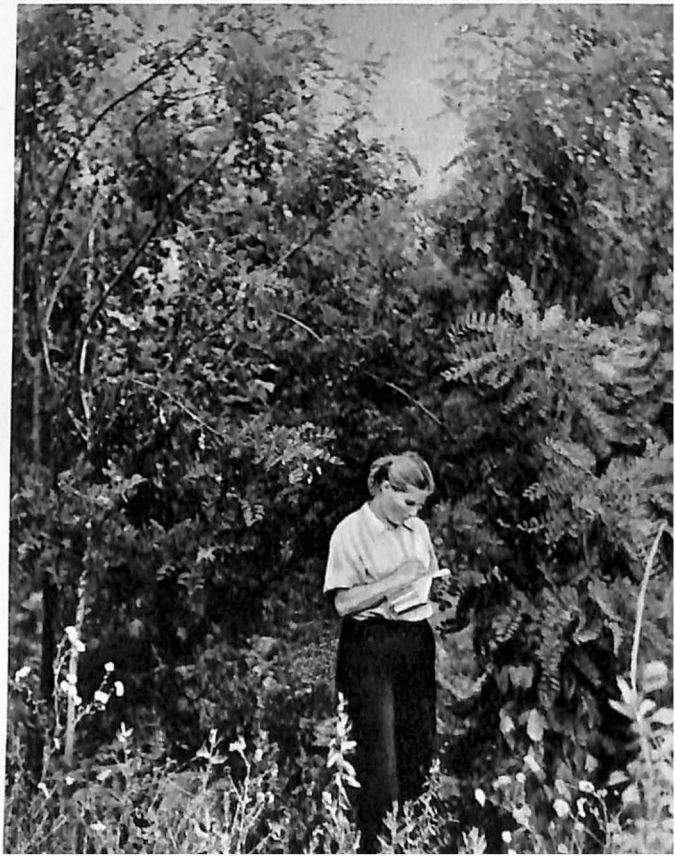
Even in conditions where sub-soil waters are alkaline and deep below the surface, the quality of fodder may be improved by planting valuable grasses in the desert land pastures.

HARNESSING WIND ENERGY

Evpatoria is a seaside resort in the Crimea, well known for its bathing beach and mud baths. It is situated on the shore of the Black Sea, surrounded by arid steppe. Sub-soil waters are salty, and there are no rivers. Artesian wells are the only fresh water source. An old workman, who had for years been drilling water wells there, said that if Evpatoria were turned upside down there would be a regular shower—so closely was it probed with artesian wells. But the whole trouble is that the pressure of sub-soil waters there is not strong enough, and the water has to be pumped up. This is a costly undertaking when done by hand, but then there is the wind—a faint, barely noticeable breeze always blowing either from the sea or from the shore—which, strangely enough, has quite enough energy to work up the water from the wells. Hundreds of sanatoriums, rest homes and private houses in Evpatoria have windpumps installed close by, their manifold wings revolving slowly even when the breeze is at its weakest. Each building has a differently shaped tower crowning it. These towers house the tanks into which the wind pumps the water from the wells.

Similar types of windpumps are to be seen in the Repetek research station in the Kara Kum desert. One of them pumps water from the well into a deep, round, concrete-lined pool, making one think how delightful it would be to dive into this cool water after a day's tramping over burning sands. But this is not the purpose of the pool at all—the water, channelled through pipes, irrigates experimental plantations.

Drifting sands arrested by planting local shrubs and grasses



This 16-feet-tall forest has taken four years to grow on sands levelled and watered

Now this 16-feet-tall forest has taken five years to grow on barren sands which had been neither levelled nor watered

The wells in the Kara Kum and Kyzyl Kum deserts are also equipped with windpumps to provide water for the flocks of karakul sheep. In the lower Volga and Ural thousands of such pumps bring water to the vegetable fields.

It makes one think of the tremendous waste of energy of the winds roaming the deserts, for until now this energy has only been utilized to a negligible degree, whereas it could be doing such useful jobs as pumping water and producing electric power. "Blue coal"—or wind energy—is a great force of the future and, eventually, it will be exploited extensively in the deserts.

TRAPPED SUNLIGHT

There is a peculiar type of bath-house in the Tashkent state observatory. Although there is neither furnace nor chimney, no stores of firewood or coal, there is always plenty of hot water to satisfy the customers. However, as soon as the sun sets, the heating of the water stops. If you walk round this little building, you'll see the "power station" behind it. It consists of a glass frame mounted at a slant on a base. The frame is not large—6.5 feet across at most—and it has flattened water pipes painted black laid against it. The black surface of these pipes absorbs so much of the sun's heat that very soon the water in them becomes hot, and within two hours after sunrise the bath-house is all ready to receive customers. But to what temperature is the water heated, and how often may the bath-house be opened to the public?

I remember we came back to Kyzyl Arvat, the town where our expedition had its headquarters, one cold November day. There was no sun at all in the overcast sky, and dark clouds floated low over the ground. The temperature was 46.4°F, and the wind and the rawness chilled you to the bone. A hot bath was what we wanted

badly after our long trek, but what use could the sun-warmed shower be on this overcast day? But on trying it we found that even in weather like this the water was heated to a temperature of 107.6°F and had to be diluted with cold water.

These sun showers and baths are based on the principle that black absorbs much heat, while the glass, though letting through the sunrays, is a poor heat conductor. In the 1930's K. G. Trofimov, one of the pioneers in utilizing sun energy, made an experiment in Tashkent: he built a black tank, covered it with eight air-separated layers of glass, and filled the tank with water. The temperature he obtained was 437°F. Even in the Moscow suburbs three such sun bath-houses have been built, and in the summer the temperature of the water reaches 122° or 127.5°F. These bath-houses, however, may only function for about a hundred days a year, while in Central Asia it is about three hundred. Firyuza, a summer resort in the mountains close to Ashkhabad, has one of the best sun bath-houses used by Young Pioneers staying in summer camps.

Plans have been drawn up for the construction of model heliobaths and laundries of various sizes, the largest capable of catering for villages with a five thousand population.

But it is not for baths alone that the sun's energy may be used. The Alma-Ata observatory has another sun trap in which no pipes are involved and the wooden frame is smaller still. The whole apparatus resembles a curved mirror, but the glass is not all of one piece, but made of a hundred and fifty tiny flat mirrors. The result is a mass of reflected sunrays focused in one point. If this cluster of sunrays is directed straight at a tank of water, soon it will be boiling turbulently. The Tashkent canning factory has a more efficient industrial installation which employs the sun's energy.

In Tashkent too, a test sun-welding apparatus has been installed in the experimental grounds of the Power Institute of the U.S.S.R. Academy of Sciences. This apparatus has an unusual shape: it looks like the mirror of a huge projector, which revolves automatically and is always turned towards the sun. Focused by this mirror, the sunrays produce a temperature of up to 5,432°F which is, in fact, exactly the temperature required for metal welding. Helio-welding apparatuses could be installed at the mills and construction sites in the desert with great success.

By means of special contrivances, sunrays are also helpful in building up the stores of ice, needed so much in the deserts.

The sun assists, too, in obtaining and dehydrating lake salts, thus providing our factories with valuable raw materials such as: common salt, sulphate, soda, boron, bromine and magnesium.

Sun-traps could be widely used in the deserts and other southern regions. Sun-dryers of fruit, vegetables, grain and cotton; winter heating of the buildings with sunrays stored up since the summer; sun-boilers, ovens and hothouses; sun refrigerators for cooling the buildings in summer; industrial steam and hot dry air obtained for the factories; concentrated sunlight and warmth used for health purposes—this is only a rough and far from comprehensive list of what the energy of the sun could do for us.

In this particular field we find that scientific knowledge has outstripped practical application by far: theoretically everything is clear, all necessary calculations have been made, designs elaborated and the first industrial installations set up. Yet in practice we still make too little use of the sun's energy in our economy and housekeeping. But there is no doubt at all that with every year the sun, trapped in the deserts where there is so much of it, will be of more and more help to man.

This country is subject to frequent dry winds. They originate not only in the deserts but also in the steppes, and must therefore be combated everywhere.

Not infrequently the dry wind blows across the Caspian Sea from the Aral deserts. The observations of hydrologists and climatologists show that the Caspian Sea serves us well in moistening the climate. For every 6.25 miles of its course across this sea, the wind absorbs 2 per cent of moisture, in other words, moisture content will be increased to 40 per cent at the end of this 125-mile journey. But the air of the deserts is so dry that even a huge natural moisture impregnator like the Caspian Sea is not large enough to affect it.

It stands to reason that we should try and remake nature. If we were to irrigate the deserts, turn the depressions and hollows into fresh-water and saltish lakes, and plant them with forests and grasses, the dry winds would become harmless and, even without building up perfectly irrigated farming, the desert lands and pastures would bring in much higher returns. And as the population grew, more and more territory could be allotted to irrigated farming, being the most profitable method of using water and land.

The question arises what parts of the desert should first be irrigated in order to fight the dry winds? Their current and range show that we should begin with the lowlands north of the Caspian Sea.

The problem of watering lands north and north-west of the Caspian Sea could be solved by directing the salt waters of the Black Sea through the Manych—an ancient channel which once united the Black and the Caspian seas. But it would be more expedient to use fresh river waters for the purpose, and the Volga would be the

easiest proposition, answering the requirements perfectly, especially now that the great Kuibyshev hydropower station has been completed and the Kama and Stalingrad hydropower stations are under construction. Colossal tracts of watered and irrigated lands would come into being between the Volga and the Terek and in East Trans-Volga area. Moisture evaporation would to a certain extent disable the dry winds blowing from the south into the Ukraine and Volga country. This would bring about approximately the same moistening effect as if the area of the Caspian Sea were increased by 12 to 15 million acres.

It should be borne in mind, however, that the Caspian Sea depends on the Volga for 80 per cent of its waters. Therefore, a certain drop in sea level is inevitable if the Caspian lands are to be irrigated with the waters of the Volga. Workers in the oil industry could produce figures to prove how great their savings would be if the water level were lowered, for they would have easier access to the rich oil stores presently concealed underwater. But this economy would be one-sided. Supposing the level of the Caspian Sea were lowered by, say, 33 feet: a comparatively small piece of dry land would be added in the vicinity of Baku, whereas vast shallow water stretches would be bared in the north. And that is just where the main fishing regions are, providing the country with great quantities of fish and caviar (an annual average of 312 pounds per acre). But that is not the only drawback. There was a period when the level of the Caspian Sea dropped by as much as 36 feet and even 131 feet, as compared to present-day levels. Instead of the existing shallow water regions in the north, there was a great salt marsh—a powerful base from which the sand, dust and salts were dispersed and carried by the winds. Even now, when the sea level has only dropped by 6.5 feet, the bitter salts forming on the exposed salt

marsh beds are picked up by the dry winds and borne as far as the Penza Region.

It follows that once we start using the waters of the Volga, Terek and Kuma to irrigate the Volga and Caspian Sea lands, we shall have to compensate the Caspian Sea for this loss of water. There are different ways of doing this: we could either take recourse to the Don or the Siberian rivers, but a simpler way would be to utilize the northern rivers turning back some of the tributaries of the Northern Dvina. To achieve this we would have to build dams across them and raise their water level, after which they would flow in the opposite direction, become the Volga's tributaries and thus feed the Caspian Sea. A meeting of scientists, which took place in Astrakhan in the autumn of 1956, unanimously approved this idea and proposed that the project be undertaken as soon as possible.

But even this would not solve all the problems of totally remaking nature in our arid and desert zones. To the north and north-east of the deserts of Central Asia stretch the vast and fertile steppes of Kazakhstan and Western Siberia. And yet this granary of the Soviet Union is far from working to full capacity. The close proximity of the deserts affects it even more strongly than it does the steppes in the European part of the U.S.S.R. Dry winds are frequent visitors to the black soils of Kazakhstan and cause a marked loss in crop yield. And the oases of Central Asia with their irrigation farming require as much protection from the dry winds as the steppes do.

As already mentioned, all the waters of Central Asia's rivers will eventually be used for irrigating the fields. If we could find a cheap and simple way of stabilizing silt deposits, we could treble our existing irrigated lands by means of the same rivers. Even then our deserts would have ample, though as yet

unirrigated, territory suitable for rice and cotton plantations.

It is the dream of the Soviet people to build up irrigated farming in the arid steppes and deserts of Kazakhstan. If we were to find vast sources of fresh water to irrigate both Northern and Western Kazakhstan and the deserts of Central Asia, we would make these lands unrecognizable. New rivers would flow, a network of hydropower stations would spring up and lakes would cover large tracts of the desert. Water, brought into the desert, would help to develop such huge tracts of land that it would take about a hundred million people to operate the required farming machinery. The deserts—watered and irrigated—and the steppes, with nature remade, will eventually be the most important food and raw material bases in the Soviet Union, the source of wealth for generations to come.

You might well ask: could this dream come true, and if so, when? Now these are two entirely different questions. Large-scale watering and irrigation of the deserts is perfectly realizable. Water will be supplied by the Siberian rivers now flowing into the Arctic Ocean. It has been estimated that the volume of water that could be turned off into Kazakhstan and Central Asia would be two or three times that of the Volga. On the whole this idea is not a new one at all. In 1870, almost ninety years ago, Grigory Demchenko, a Kiev engineer, published a book called: *Flooding the Aral-Caspian Depression To Improve the Country's Climate.* The possibility of improving the climate of vast regions, which seemed a fantastic dream, was first put forward in this book.

The 20th century was ushered in hopefully by the progressive world. Many believed that technical progress would automatically solve all social problems. In 1900, thirty years after the publication of his book, Demchenko

—then an old man—had it reprinted, but in a capitalist state his idea could hardly be realized.

Nowadays this seemingly fantastic dream is taking more and more substantial shape. Plans are elaborated, various projects proposed, and keen discussions carried on at meetings of the Geographical Society and different branches of the U.S.S.R. Academy of Sciences, on the pages of magazines, such as *Gidrotekhnicheskoye Stroitelstvo*, *Sibirskiye Ogni*, *Novy Mir* and the periodicals of the geological series, *Izvestiya Akademii Nauk SSSR*.

The question has not yet been decided whether the waters of the Irtysh will be directed into the regions of Central Kazakhstan, towards its main industrial centres —Karaganda, Karsakpai and Jezkazgan. A study of the artesian basins of these regions will give the answer. It may be that in this particular case, deep sub-soil waters could be utilized and the waters of the Irtysh and Ob sent down a 621-mile-long canal, laid at the foot of the hills on the north, to irrigate the recently developed virgin steppes. The population of these steppes is not yet large enough to build up irrigation farming in these vast regions. But when the need arises, the waters of the Irtysh and Ob could be used not only to provide energy for a chain of hydropower stations as is being done at present, but also for irrigation purposes. These rivers, besides watering the fields of Northern Kazakhstan and the south of Western Siberia, could also cater for all the other parts of Central Asia's deserts that are suitable for cultivation.

DESERTS—ADVANCING AND RETREATING

Mankind had so long and so senselessly been squandering the wealth of the deserts, and had disregarded their natural features so blatantly, that the very origin of the deserts began to be ascribed to mankind, according

Salt-marshes with a hard, cracked crust

Soviet soil scientists have found a way to make use of salt-marshes as well

Millet grown in deserts adjoining the lower reaches of the Amu Darya which had never known artificial irrigation

to certain opinions expressed in literature in the second half of the 19th century. "Climate is not a cause but merely one of the conditions in which deserts may be formed. Man is the principal factor in the formation of deserts. Man destroyed his well-being by senselessly utilizing soils and their pristine vegetable growth"—such was the gist of this hypothesis.

According to this theory, mankind from the very beginning did nothing but injure nature. In droughty regions man destroyed trees and shrubs, stamped out grasses with his herds, and laid bare the topsoil which was then dispersed by wind and washed away by rain.

Indeed, in America, where three-quarters of the forests are privately owned, 40 per cent of the woods were destroyed in a space of 30 years—from 1908 to 1938. In a mere three years (1934-1936) six million acres of previously cultivated lands had to be written off. Seventy per cent of the arable lands were impoverished by dispersion and washing away. In Texas, soil dispersion forced so many farmers to abandon their land that the nearby towns, in many cases, were also deserted by their inhabitants.

Conservative scientists in the West consider that this was preordained, that such is the part man is fated to play in the world. Believing capitalist economy to be the most advanced and rational, they arrive at the conclusion that if this economy is not only unable to fight the deserts but even to moderate their growth, and if the deserts are disastrously advancing on all continents, then such is "the law of nature" to which all the zones in the world are subject, regardless of the social conditions prevailing therein and the standard of development of their productive forces.

The authors of this hypothesis have found in it complete justification of the mass plundering of nature, which is particularly intensive in the colonies. The deserts,

they say, are destined to cloak the earth in a shroud of death. The inevitable advance of the deserts will spell the ruination of mankind—grimly prophesy these apologists of colonialism.

The Soviet people live in another world and look at things from another point of view. They know very well that deserts are a phenomenon of the climate. Deserts were in existence many millions of years before man came into the world. It is certainly not one of mankind's callings to give birth to deserts, nor is the plundering of nature necessarily a sequence to man's activity. Even the nomad tribes, carrying on their primitive economy through the ages and continually grazing their stock on desert pastures, did not necessarily destroy the vegetation of the deserts. Rather the contrary, in many parts of the desert the absence of grazing animals causes the formation of a soil crust and an excessive condensation of the sands which disturbs the soil-water exchange and kills vegetation. According to statistics, well-regulated grazing improves the productivity of desert pastures rather than impairs it.

It is true that the deserts of Africa, Australia, South and North America and Southern Asia, in part, are still advancing on those men who are striving to snatch from nature as much as they possibly can, refusing to give it anything in return. But if men assist nature, they receive generous compensation for it.

The socialist system of economy is based not on the plundering of natural resources, but on the contrary, it is based on affection and care for nature, on eagerness to enrich it further. In the Soviet Union, the deserts are rapidly retreating from the onsetting forces of man, and yielding more and more wealth. The Soviet people work the mineral deposits in the deserts and at the same time provide the deserts with reservoirs and gardens. They make use of the desert pastures and wherever necessary they

plant new grasses. Although saksaul growths are exploited, they are also being painstakingly tended and expanded. In Central Asia the sands along the railway lines and around the oases are bound in such a way as they had never been when in their natural state. Millions of trees are being planted around the oases, in barren sands. Lifeless deserts are gradually becoming fertile fields. A sea of cotton spreads over the Hungry Steppe which is becoming a land of plenty. Over vast territory in the U.S.S.R. the deserts are being conquered, developed and enriched. They submit to the will of the Soviet man and retreat before him.

And the day is not far distant when the deserts of all the world will begin to retreat before the great strength of man. People's China is engaged on a large-scale transformation of its arid regions and deserts, and the remaking of nature has been started also by the peoples of India and Egypt. The theory of our planet being overpopulated is shattered by facts. The development of science and new forms of economy show that nature may be remade in such a way that however great the population of the world, untold earthly blessings could be reaped by everyone in abundance, and this is what we are working for.

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