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REPORT

SUBJECT The Institute of Water Economy and Hydraulics of the Academy of Science of the Uzbek SSR/Irrigation and Development of Golodnaya Steppe

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two pamphlets in English published in the Soviet Union. The first one, published in Tashkent by the Academy of Science, is entitled "The Institute of Water Economy and Hydraulics of the Academy of Science of the Uzbek SSR." It covers the following problems that the Institute is solving and the important results achieved:

Problem 1. Scientific Principles Underlying the Complex Utilization of Water Resources in Uzbekistan

Problem 2. Irrigation and Reclamation

Problem 3. Study of the River Bed Courses, Water Intake Structures and Hydraulics of Structures

Problem 4. Calculating Methods and Construction of the Hydraulic Structures

Problem 5. Mechanization and Industrial Methods in Hydraulic Construction

Problem 6. Hydraulic Machinery and Apparatus - UNCLASSIFIED

The second pamphlet, published in Moscow in 1961 by the Ministry of Agriculture, is entitled Irrigation and Development of Golodnaya Steppe. It covers the following subjects:

Natural Conditions of the Golodnaya Steppe

Short Description of Irrigation Development

Present Economy

Construction, Project Planning and Research Organizations

Engineering Scheme of Irrigation

Irrigation and Drainage Network

Communication Lines

Proposed Agricultural Development

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Quantities, Plant and Equipment

Construction Cost - UNCLASSIFIED]

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THE INSTITUTE OF WATER ECONOMY AND HYDRAULICS

OF THE ACADEMY OF SCIENCE OF THE UZBEK SSR

ACADEMY OF SCIENCE OF THE UzSSR

INSTITUTE OF WATER ECONOMY AND HYDRAULICS

THE INSTITUTE OF WATER ECONOMY AND HYDRAULICS OF THE ACADEMY OF SCIENCE OF THE UZBEK SSR

PUBLISHED BY THE ACADEMY OF SCIENCE OF THE UzSSR

TASHKENT·1961

Fig. 1. The Institute of Water Economy and Hydraulics of the Academy of Science of the Uzbek SSR.

The Institute was founded in 1925 under the name of the Central Asian Scientific Research Irrigation Institute to provide the irrigation engineering of Central Asia with tasks for the experimental part of the research work.

The scope of the scientific research work in water economy was greatly enlarged after the Academy of Science in Uzbekistan was established in 1943. At present the work of the Institute involves all the problems dealing with the study and utilization of water resources, construction and maintenance of water diversion works, hydraulic structures, irrigation and drainage systems.

The Institute serves all the water organizations and at the same time carries out theoretical and experimental work in all branches of hydraulics and reclamation.

The Institute is composed of the following departments and laboratories:

1. Department of Hydrology and Water Resources,
2. Department of Complex Problems and Water Power Engineering,
3. Irrigation and Reclamation Department,
4. River Beds Department,
5. Laboratory of Intake Structures,

6. Laboratory of Structure Hydraulics,
7. Experimental Wave Action Laboratory,
8. Soil Science and Soil Mechanics Laboratory,
9. Department of Hydraulic Structures and Seepage Flow,
10. Laboratory of Building Materials,
11. Mechanization Department,
12. Laboratory of Prefabricated Reinforced Concrete Structures,
13. Laboratory of Hydraulic Machinery,
14. Laboratory of Water Gauge Sets.

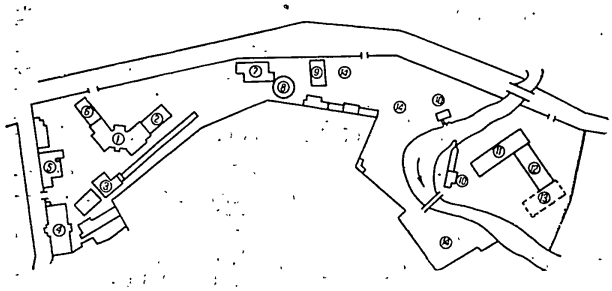

Fig. 2. A Plan of the Institute:
1 — main building; *2* — the Laboratory of Intake Structures; *3* — Experimental Wave Action Laboratory; *4* — Laboratory of Building Materials, Soil Mechanics, Analytical and others; *5* — Experimental Mechanical Work-Shop of precision instruments; *6* — Laboratory Water Gauge Sets; *7* — Laboratory of Prefabricated Structures; *8* — Calibrating Station; *9* — Laboratory of Hydraulic Machinery; *10* — Pumping Station; *11* — Laboratory of River Beds; *12* — Laboratory of Soil Science, Seepage Flow and other departments; *13* — Building of the Laboratory of Hydraulics and Hydromechanics now being designed; *14* — Experimental Models.

PROBLEMS THE INSTITUTE IS SOLVING AND THE IMPORTANT RESULTS ACHIEVED

Problem 1. Scientific principles underlying the complex utilization of water resources in Uzbekistan

The Department of Hydrology and Water Resources carries out research work on the problems of water resources and flow formation, it studies the river flow regimes, works out the methods for hydrological estimations and solves questions of water balance of irrigated areas.

On the basis of the studies of the Central Asian rivers flow and observing their regime fluctuations the rules for flow control are derived and the main characteristics established. This brought about the further development of methods for approximate determination of river flow characteristics for the unexplored regions of Central Asia.

The role of various sources of river water supply is made clear and it was ascertained that it is not glacier but snow that plays the leading part.

The research work is going on the problem of water losses from the water table of reservoirs on the territory of Uzbekistan. The estimation of the Sir-Darya river water balance is drawn up on the section just above the Chardar Reservoir for further necessary construction of water power and irrigation works.

Water power cadastre of the rivers of Uzbekistan and surrounding regions is being completed.

The Department of Complex Problems and Water Power Engineering works on the questions of complex utilization of surface and underground water resources in the national economy of Uzbekistan (in the first place for irrigation needs, water supply and water power), bringing out the basic points and methods for drawing up schemes for complex utilization of the Central Asian rivers and dealing also with control and regulation problems of river flow along with water power estimations.

This Department derived a method for drawing up schemes for the purpose of pump irrigationw ith complex utilization of water resources.

In accordance with the newly obtained experimental data a plan-scheme for the development of irrigation along the mean flow of the Amu-Darya river is in preparation; in the valleys of the Zeravshan and Kashka-Darya rivers pumping irrigation and gravity flow irrigation zones are set up together with the techno-economical reasons and a plan-scheme for subdividing the territory into zones is worked out.

Problem 2. Irrigation and Reclamation

The Department of Irrigation and Reclamation works on the following general problems: technique and machinery for irrigation of agricultural crops, control of canal silting and its overgrowing, reduction of the maintenance costs, on reclamation problems of saline soils by means of horizontal surface and underground drainage and vertical drills.

Fig. 3. A field irrigated by long furrows.

This Department introduces: a method of estimating the elements for furrow irrigation, sprinkling of cotton plants, devices for increasing the labour efficiency — such as pipes, siphons (rubber tubes), portable pipelines; methods for designing

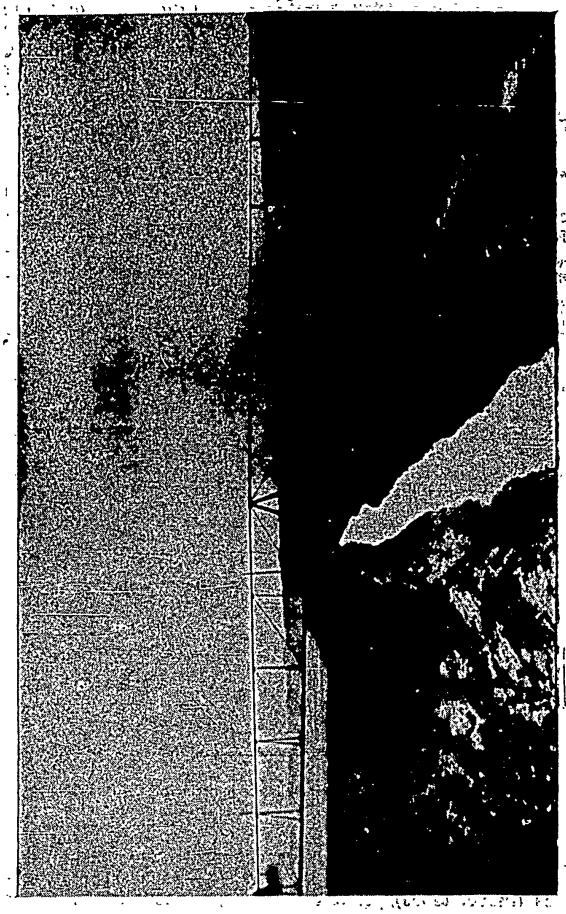

Fig. 4. Irrigation by sprinkling.

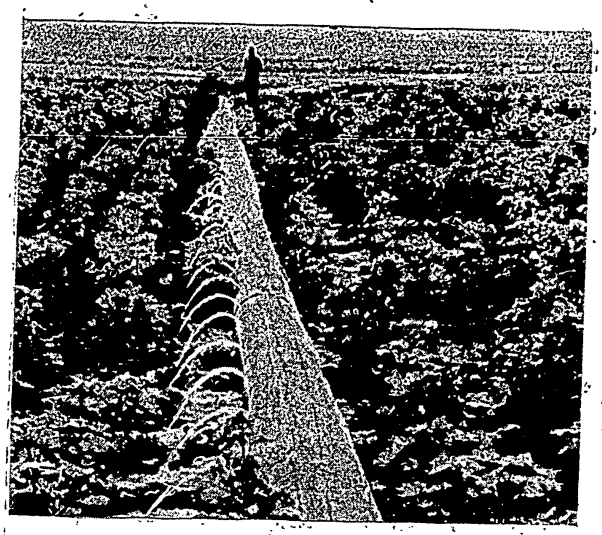

Fig. 5. Portable pipeline.

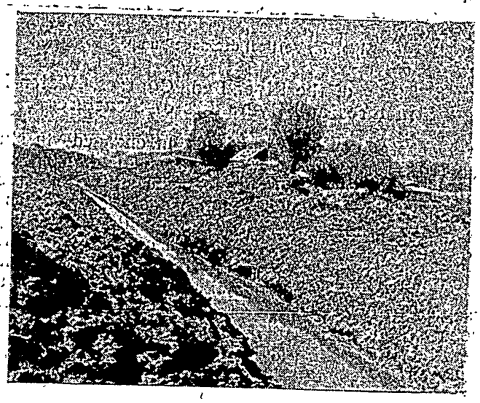

Fig. 6. Horizontal open drain.

and practical execution of levelling as well as extention of irrigated areas; the Department also worked out methods of estimation and construction of vertical drainage; it derived a method for estimating the horizontal drainage by water balance equalization and construction of temporary drains.

Fig. 7. Vertical drainage pump.

Problem 3. Study of the River Bed Courses, Water Intake Structures and Hydraulics of Structures

The Department of River Beds in engaged in studying the rivers of Central Asia with the aim of drawing up methods to regulate river beds, to estimate silting process and washing of upstreams and downstreams of headworks as well as to estimate the scouring of beds along the great length in dams downstreams; in is occupied in compiling the methods for estimating the ice regime on river sections adjoining the headworks and determining the time of the reservoirs silting. Analyses of turbulent flow patterns carrying sediment are conducted.

The River Bed Department carries out laboratory and field research work for a series of large hydraulic projects (Farhad,

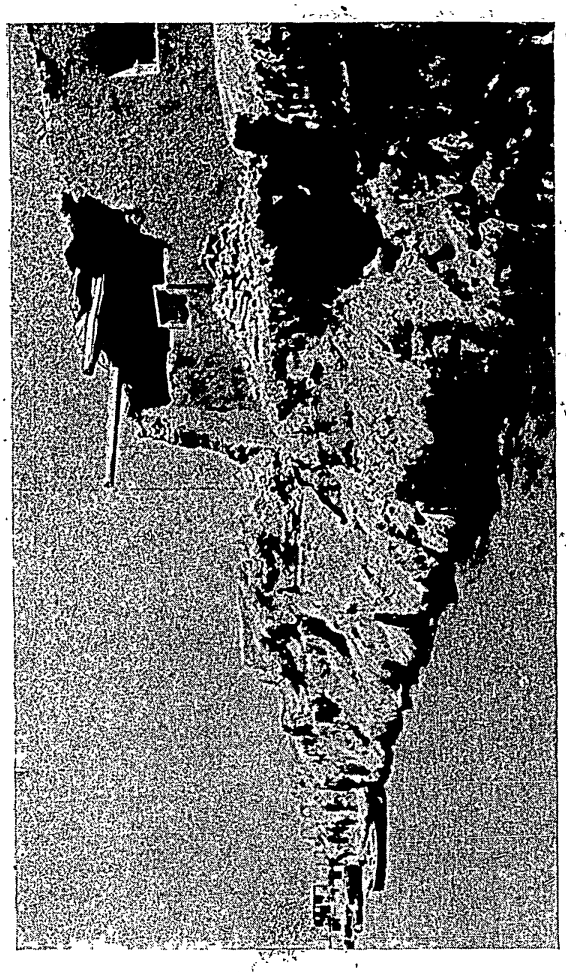

Fig. 8. Scouring of the Amu-Darya river bank (Daigish).

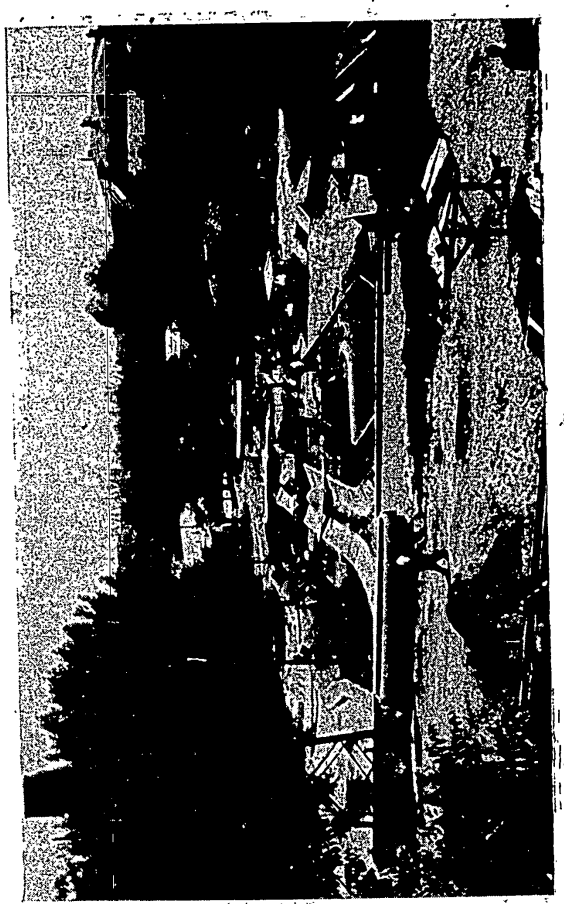

Fig. 9. General view of river bed models site in summer.

Kairak-Kum Dams on the Sir-Darya river, Kampir-Ravat and Gazalkent Dams). The methodical part of the main silting problems of the work is completed and the reasons for rapid silting (twice as much thas has been expected) of Farhad and Kairak-Kum reservoirs were elucidated. It was determined that in estimating the silting process period one should take in consideration also the effect of wind wave action on the reservoir banks and some other factors.

The Laboratory of Intake Structures is busy with methods of further improvement of intake structures on the Central Asian rivers with appliances controlling the entrance of sediments into the irrigation and power station canals.

The Laboratory together with the designing institutes has completed the scheme of an intake works of Fergana type which permits the draw of water for the canals with the least amount of sediments.

The operation of this type of intake works based on the principle of utilization of a lateral flow circulation, possesses the following characteristics.

The intake process takes place from a curved flow at a concavity of the river bank. Intake works dams consist of curvilinear approach channel gate dam, intake sill adjoining the dam at the concave bank. In most cases the river headworks in Central Asia are built according to this type.

The Laboratory of Intake Structures has worked out the theory and a calculation method for silting basins, curvilinear sand traps and silt-discharge canal capacity.

In the **Laboratory of Structure Hydraulics** questions connected with energy absorption in the downstreams of headworks are studied, research work is carried out on the question of disturbed and pulsating flow as well as on methods of the hydraulic modelling.

The elaboration of a method for the depth calculation of local scouring beyond the headworks which is of great importance for correct evaluation of possible scouring, as well as designing and calculation of tower and siphon spillways were accomplished by the Laboratory.

The main problems with which the **Experimental Wave Action Laboratory** is concerned consist in active and passive control measures for protecting the slopes of earth dams and reservoir embankments from wave action. The Laboratory plans to study wind and wave regimes of reservoirs, fixing the wave load standards more accurately. The Laboratory is also busy with the testing of large-scale models of various types of strengthening in order to choose the best solution and finally the Laboratory is engaged in making a detailed study of cal-

Fig. 10. The Kuliuk headworks model.

culating methods. Visual observation is set on the experimental sections of reservoirs. For example observations on conditions of strengthening the Katta-Kurgan Dam slopes were conducted, and the values of wave height vs. wind velocity were determined.

A laboratory with two wave flumes 16 *m* and 80 *m* long, respectively, will be completed in 1961. The height of the waves in these flumes will reach 1,7 *m*.

Problem 4. Calculating Methods and Construction of the Hydraulic Structures

The **Department of Hydraulic Structures** and the **Laboratory of Soil Science** carry on research work on the structural properties of loess soils used as building material in the majority of earth structures in Central Asia. The calculating methods of designing and erection of earth hydraulic works are being studied. The Laboratory of Soil Science conducted research work on structural properties of loess soils: common, saline and loose settling soils. The results of these tests make it possible to apply soils containing 10% of salt for important earth constructions and in some cases it is even possible to apply soils containing as much as 15% instead of the usual 3% of salt fixed by State Standards.

Methods for fixing the bed settling for embankment and dam construction are also completed by the Laboratory and recommendations are given for foundation treatment in loose settling soils. This helps to determine more accurately the necessary volume of supplementary work due to foundation settlement and garantees to a greater degree the safety of the construction. The Laboratory has provided methods for designing, constructing and maintenance of canals in highly loose settling soils.

The Department of Hydraulic Structures studies questions of deformations of earth dams (among these are the dams constructed by filling the water with soil), the consolidation process and stability of canal slopes in saturated loess soil are also studied; simplified methods of percolation calculation in structures taking in account all volume seepage are worked out (among these drops-chutes, water outlets, aqueducts and cantilever spillways.)

The Laboratory of Building Materials is engaged in finding new as well as local materials for water works problems, choosing right concrete proportions and testing their properties for application in irrigation construction.

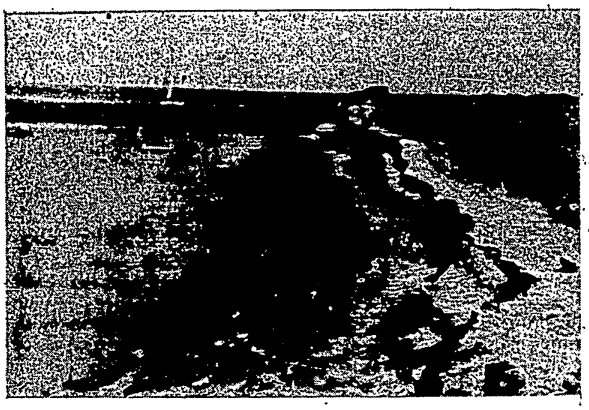

Fig. 11. Cracks in settling loess soils as a result of wetting.

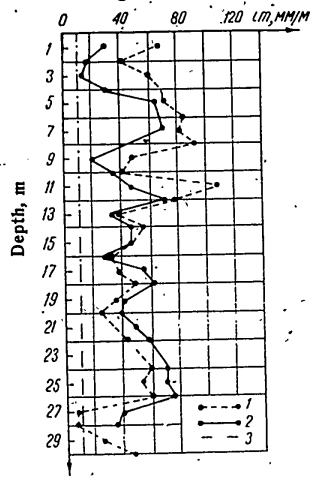

Fig. 12. Diagram of value variations of relative depth settlment in loess soils.

The Laboratory is also busy with studying of earth canal lining materials and coverings in order to protect concrete from abrasion. Technology of preparation and placing of cold-mixed asphalt materials was likewise completed. General characteristics of plastic concrete containing furfurol acetone monomer „FA" with required abrasion resistance were obtained

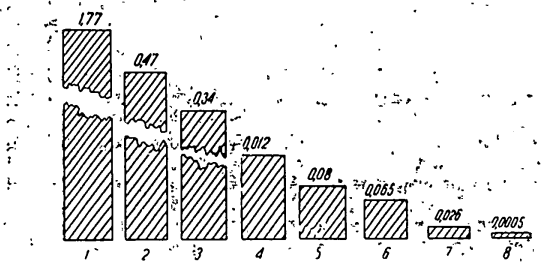

Fig. 13. Abrasion resistance of lining materials (kilograms per square meter per hour) determined by a special device designed in the Institute.

as a result of research work. Properties of reinforced gunite were studied so as to apply it as a lining material for pressure hydraulic structures, research work is going on making gunite more plastic and using it as an anti-seepage canal lining.

Problem 5. **Mechanization and Industrial Methods in Hydraulic Construction**

In the **Mechanization Department for Water Works** beside testing of irrigation machinery and improving their service and methods of advanced mechanized processing they design new machines for building and maintenance services in irrigation systems.

Field testing of a floating mower for cleaning canals from vegetation designed by the Institute was carried out and a special machine has been designed for cleaning laterals from vegetation and silt deposits.

For horizontal underground drainage 2,5—3,5 *m* deep the Mechanization Department together with Glavgolodnostepstroy (Hunger-Steppe Design Institute) constructed a drainlayer. This machine prepares trenches, lays drains 500 *mm* long and

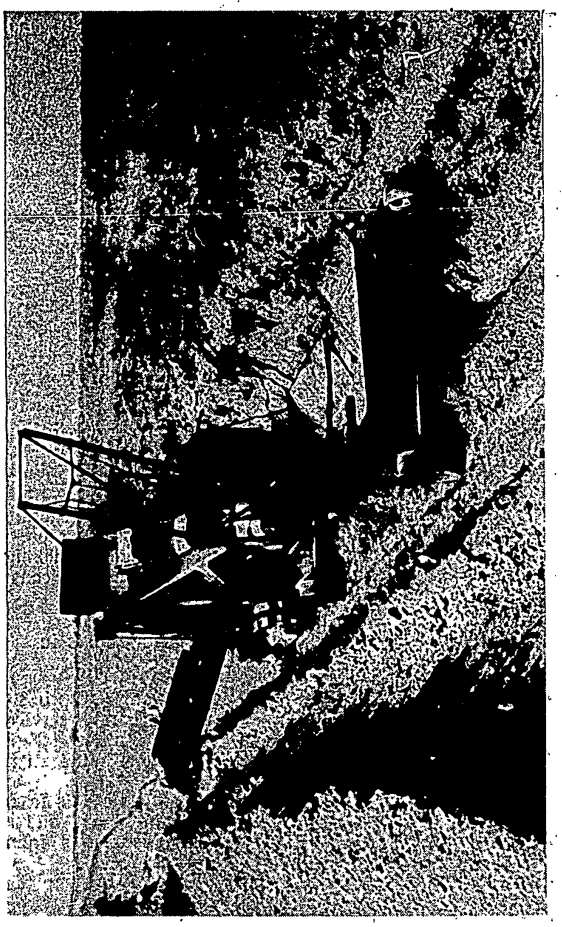

Fig. 14. Drainlayer of D. 251 type for the construction of underground horizontal drains 3,5 *m* deep.

covers them with gravel. The effiency of the machine attains 250 linear meters per shift.

The **Laboratory of prefabricated Reinforced Concrete Structures** is engaged in improving prefabricated concrete and reinforced concrete structures and canal linings; besides that it is busy in creating new thin-walled prefabricated structures.

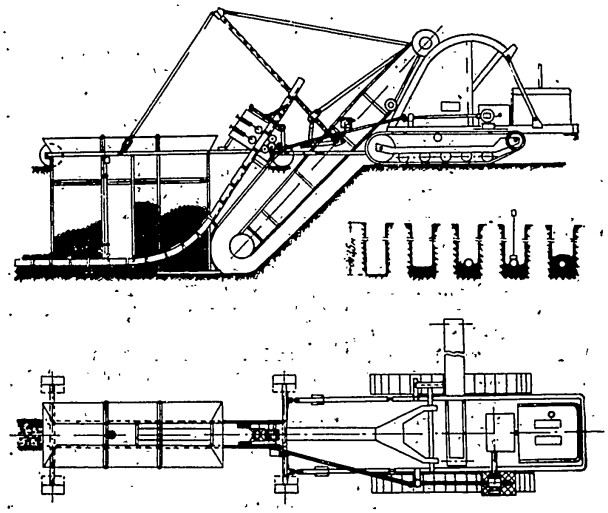

Fig. 15. Diagram of drainlayer operation.

For manufacturing in situ the prefabricated parts the Laboratory has planned experimental stations with stand-basins adjustable for working in specific climatic conditions of Central Asia.

The Laboratory discovered the possibility of reducing the thickness of reinforced concrete linings from 12 *cm* to 6 *cm* for main canals and in canals where water discharge runs from 0,2 to 20 cubic meters per second. The practice of using prefabricated concrete linings 5—8 *cm* thick rather than those of reinforced concrete has been proved to be more economical.

Fig. 16. Experimental station with stand-basins for manufacturing the prefabricated parts of the structures in situ.

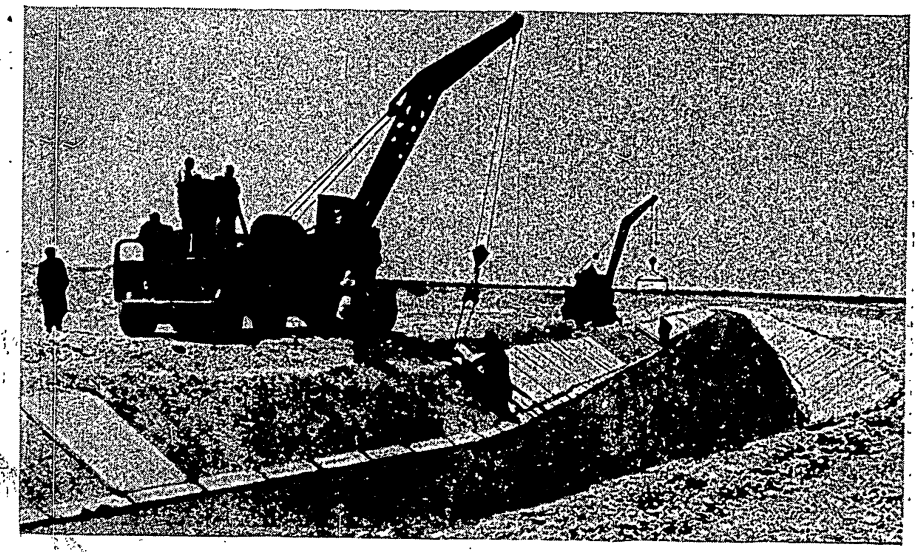

Fig. 17. Placing prefabricated concrete lining on the main canal during operation period.

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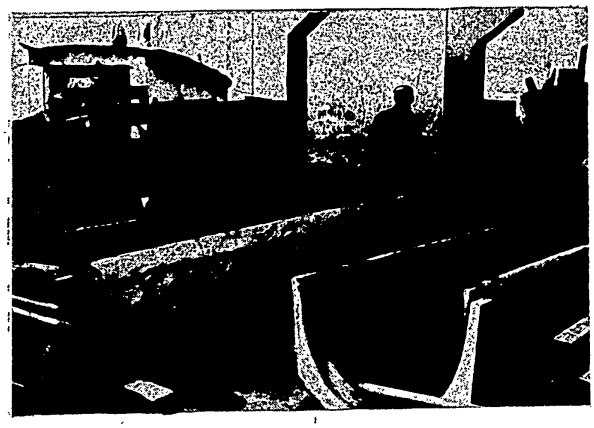

Fig. 18. Reinforced cement flume 9 *m* long with the capacity of 0,5 cubic meter per second.

Fig. 19. Prefabricated reinforced cement gate-regulator with 3,4 *m* span for the capacity of 0,8 cubic meter per second.

New reinforced cement slabs 2 *cm* thick were recommended for lining ditches in small farming network. The Laboratory worked out a scheme and a technology of producing the reinforced cement flumes of parabolic shape which are twice as economical as reinforced concrete. The dimensions of a flume are: 6 to 9 *m* long, 60 *cm* high and 80 *cm* wide in its upper part, its capacity being 0,5 cubic meter per second.

For minor networks the Laboratory has worked out prefabricated hydraulic structures of an economical shape. They consist of ribbed slabs and panels which are prepared as flat reinforced cement details receiving prefabricated ironconcrete ribbs.

Problem 6. **Hydraulic Machinery and Apparatus**

The **Laboratory of Hydraulic Machinery** studies serving conditions of water-hoisting machines for water economy of the Republic and questions of their rational utilization.

Propeller pumps of small capacity for pumping irrigation of Horezm and Kara-Kalpakia regions, shaft pumps for vertical drainage and for utilization of ground waters for irrigation purposes as well as cord and band pumps for pasture watering were created by the Laboratory.

This Laboratory is also busy with methods of choosing pumps for zonal pumping irrigation and for vertical drainage; estimation of hydraulic ram effect in pressure pipelines, theory of operation process in the cord and band water hoisting devices as well as the theory of vacuumless charging of propeller pumps.

The problems of the **Laboratory of Water Gauging Devices** consist in creating of new types of water gauge sets (tubular and surface gauge), automatic apparatus for recording and controlling irrigation water (hydrometers, distant transmitters, discharge indicators, discharge recorders, flow meters, etc.), and making use of the advantages of automatic and telemechanic inventions to solve these problems.

Besides that the Laboratory calibrates water gauging devices for all irrigation systems of Uzbekistan.

Among the recommended types are the following water gauges and automatic equipment designed by the Laboratory itself: an open gate regulator for collecting farm allocation water where the water discharge capacity reaches 2,5 cubic meters per second; tubular water gauge whose discharge water capacity reaches 1,5 cubic meters per second; surface water gauge-regulator to be applied in the farming whose water ca-

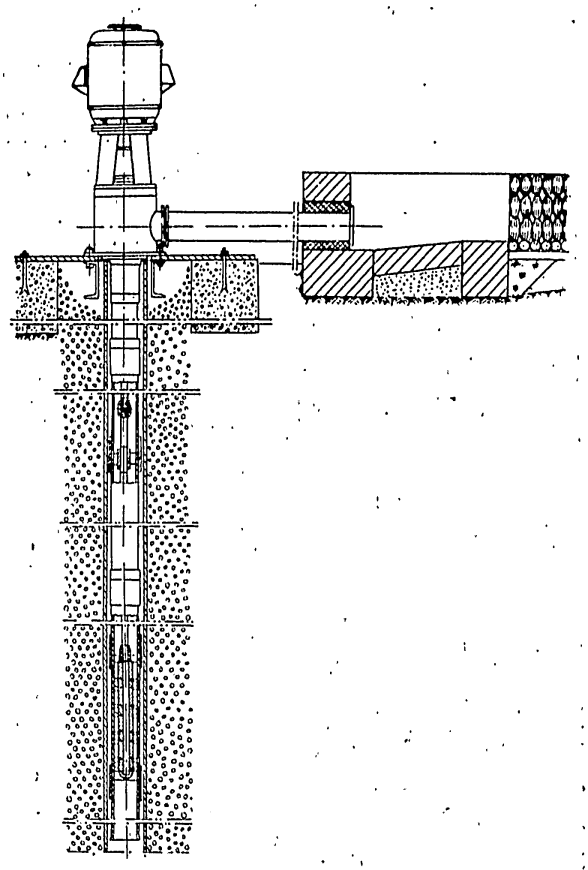

Fig. 20. Shaft propeller pump ВП-8 for vertical drainage and utilization of underground water for irrigation purposes.

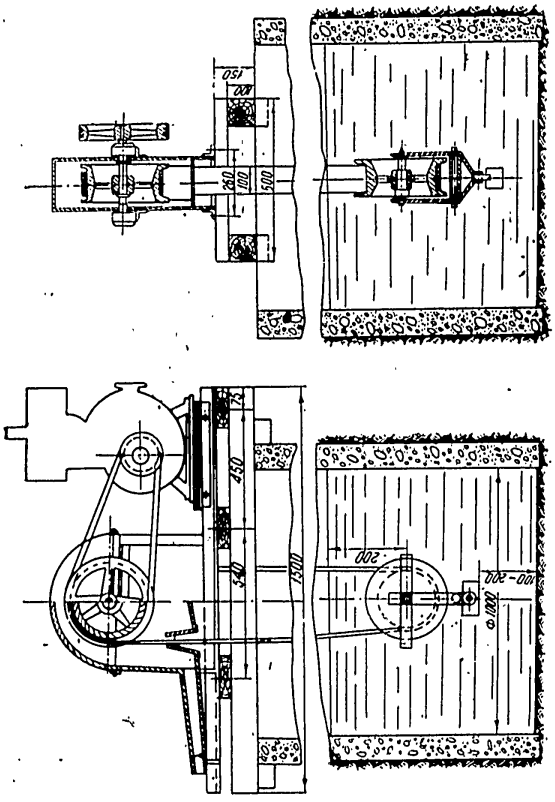

Fig. 21. Diagram of a band water-hoisting device of JI-100 SANIIRI type.

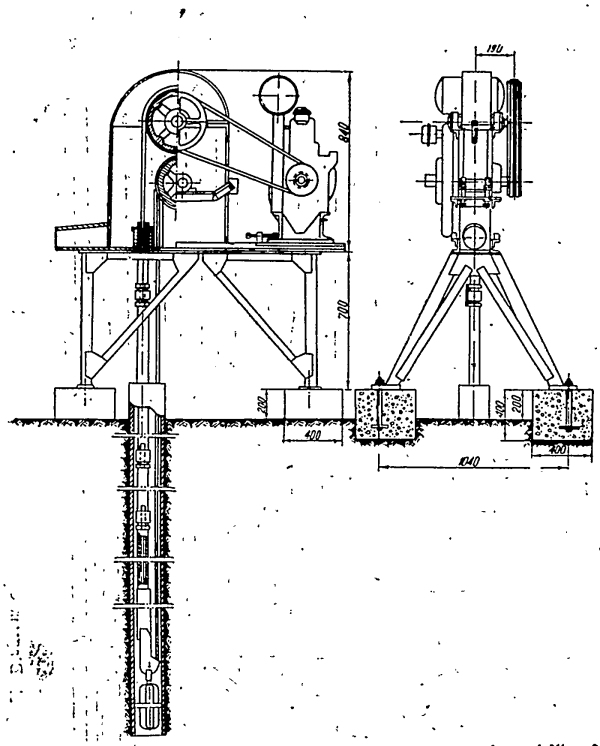

Fig. 22. Cord water-hoisting device 8CD for hoisting water from drills of small diameter located on pastures. Its capacity being 1,5–2,5 litres per second; the height of hoisting—30 *m*.

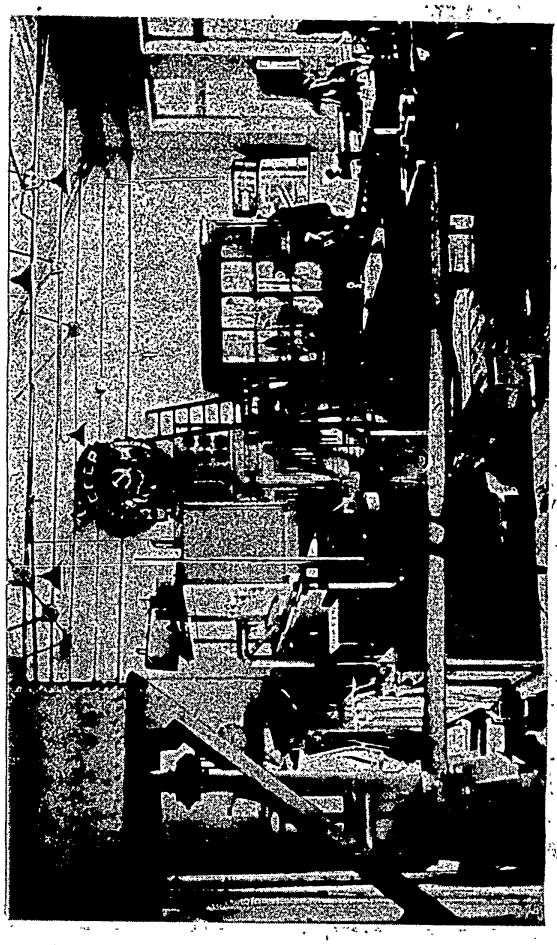

Fig. 23. Laboratory of Water Gauge Sets.

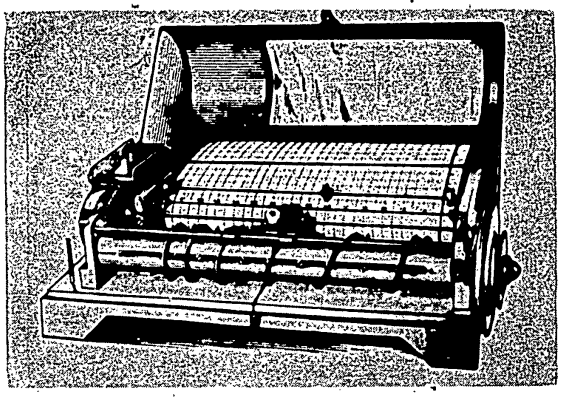

Fig. 24. Level-discharge recorder.

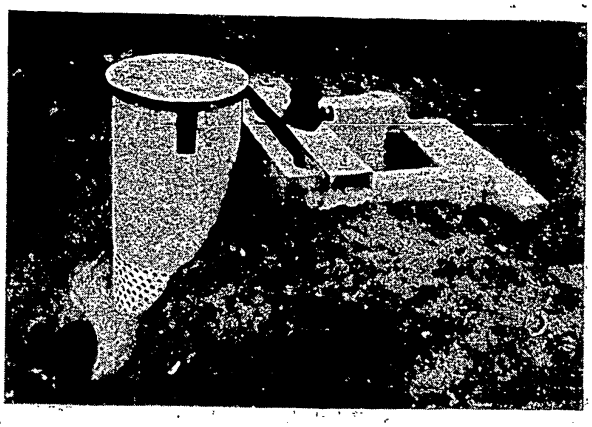

Fig. 25. Water gauge attached to open regulator.

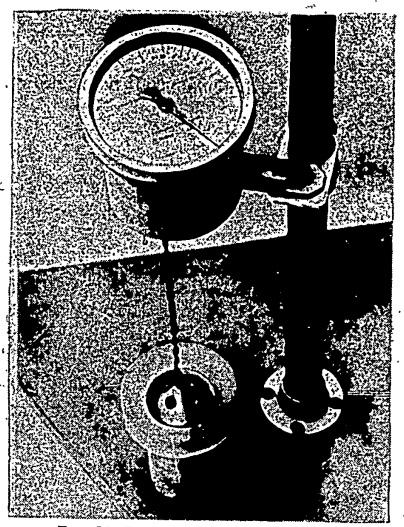

Fig. 26. Dynamic discharge recorder.

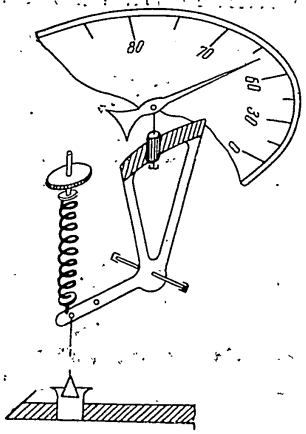

Fig. 27. Diagram of the dynamic discharge recorder.

pacity runs to 250 litres per second; dynamic discharge indicator which operates on water level difference, indicating discharge capacity per second; dynamic and rotary flow recorders indicating the supply of water during a definite period. Gates that are used for upstream sections such as those of Finke and Neyrpik type are being studied.

Over 10000 water gauging devices constructed by the Institute are in operation on the irrigation systems of the Central Asian Republics.

* * *

While carrying out scientific research work the Institute of Water Economy and Hydraulics is engaged at the same time in summarizing and propagating advanced experience, gathered at home and abroad, with the use of technic achievements in water economy, introduces them into service and is busy in educating scientific workers.

The Institute takes an active part in scientific congresses and conferences on hydraulic engineering and reclamation problems.

The scientific achievements of the Institute are published as books, proceedings and special editions by the Institute or in journals of the Uzbek Academy of Science: „Известия" и Доклады АН УзССР and other scientific journals which deal with hydraulic engineering such as „Гидротехника и мелиорация", „Гидротехническое строительство" etc.

Chief editor

corr. member of the Academy of Science of the UzSSR
R. A. ALIMOV

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Академия наук Узбекской ССР**

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The USSR National Committee on Irrigation and Drainage

IRRIGATION AND DEVELOPMENT OF GOLODNAYA STEPPE

Moscow, 1961

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IRRIGATION AND DEVELOPMENT OF GOLODNAYA STEPPE

Moscow, 1961

The report is compiled by engineer Girshkan S.A. by the materials of the Institute "Sredazgiprovodkhlopok" and Glavgolodnostepstroi

Irrigation and development of the Golodnaya Steppe began 90 years ago and the irrigated area in 1917 was 34 thous.ha.

During the first ten years of the Socialist Development Programme, V.I. Lenin paid considerable attention to the irrigation in the Southern republics, to utilize the rich natural resources of the Golodnaya Steppe and its advantageous proximity to neighbouring industrial centres, power and water resources and favourable topographical conditions, to develop this area into one of the main locations for cotton growing in the Soviet Union, although faced with rather difficult soil and land reclamation problems.

Since 1917, under the Soviet Regime the irrigated area in the Golodnaya Steppe has been steadily increasing and now amounts to 250 thous.ha.

Development of industry in our country has been stepped up and provided civil engineering projects with various types of powerful machinery for speedier fulfilment of the development programme in this area. The general practice for development of virgin lands is by state farms. Complex mechanization too has been introduced into the realisation of the Soviet Agricultural Programme. The Government expects in the nearest future a three-fold increase in the acreage irrigated here, by their decision to exploit the above facilities for the intensified development and irrigation of the Golodnaya Steppe.

Natural Conditions

The Golodnaya Steppe is the name given to the vast plain in the lower section of the middle reaches of the Syr-Darya River and bordered on the north-east and east by the Syr-Darya River, on the north-west and west by the sandy desert Kara-Kum and on the south by the foothills of the Turkestan ridge. Within these limits the total area of the Golodnaya Steppe is over 1 mill.ha.

The mean annual temperature in this vast area is 14°C; the sum total of temperatures for the frostless period is 4,700°C; number of days with average daily temperatures above 14°C exceeds 200. The annual precipitation is about 250 mm, its distribution through the seasons being typical of that for semi-deserts of Middle Asia. Evaporation is 1,200 to 1,700 mm.

The plain has a flat gradient from south-east to north-west, the gradient being 0.0002 to 0.0005. In the south nearing the foothills the gradient is 0.003 to 0.005.

The Golodnaya Steppe soil strata were formed under the effect of waste from "Says" of the Turkestan ridge, sand and pebble deposits of the Chatkal ridge rivers (Chirchik & Angren) to say nothing of silt run-off of the Syr-Darya which is the main water artery.

Surface horizons are mainly composed of loam, banded in the southern part with pebble and rubble, in the central part with clay and sand, and in the northern, eastern and south-western parts with loam and sandy loam overlying old debris of the Syr-Darya.

The occurrence and mineralization of ground water requiring land reclamation are determined with the whole complex of geomorphological and hydrogeological conditions.

The Southern part occupied with grey soils (sierozem) is characterized by natural drainage and stability of ground water. It does not need special reclamation arrangements.

Farther to the north gradients become gradually gentler. Underlying soils here consist of fine earth deposits, drainage conditions are not quite favourable. Ground water does not occur deep below the surface though water table is quite stable. Ground water is consumed only for transpiration and evaporation accelerating the process of salinization. Such conditions make it necessary to wash alkali soils in collecting-drainage network.

Still farther to the north, in the central part of the Golodnaya Steppe, inflow of ground water is

low, water table is 5-10 m or even 20 m below the surface. Here it is very important to prevent recharging ground water in the future period of operation. Therefore collecting-drainage networks as well as permanent seepage control in canals are required.

The northern and north-eastern parts within the limits of alluvial deposits of the Syr-Darya River are similar in soil structure to the former parts. The water table is however 1.5 to 2.0 m below the surface. Along with reconstruction of the irrigation network, a new collecting-drainage network will also be required. Investigations indicate that conditions in this region are favourable for vertical drainage.

The above may be generalized as follows.

450 thous.ha of the total area of the Golodnaya Steppe are referred to as the 1-st category, that is the type of lands suitable for development, either not needing any reclamation at the first stage of development or requiring only arrangement of collectors, in some places widely spaced.

375 thous.ha of land referred to as the 2-nd category are less suitable for development. These lands require either rarified collecting-drainage networks or a dense network of collectors.

The rest of the lands (about 200 thous.ha) belong to the category of lands suitable for development only after leaching with suitable drainage-collecting networks.

The portion of the Golodnaya Steppe now under irrigated farming does not exceed 30 per cent, the remaining lands being occupied with pastures or dry crops.

Short Description of Irrigation Development

The first attempts to irrigate the Golodnaya Steppe were made in the seventies of the last century.

In 1908 the irrigated area of the Golodnaya Steppe was 10 thous.ha and in 1917 it was 34 thous.ha. But repacious land utilization and unpractical water use caused rising of the

water table and salinization of arable lands at the earliest stages of irrigation development.

During the infancy of the Soviet Republic the irrigation of the Golodnaya Steppe was evaluated as being very important for the national economy of the country. The decree of the Council of People's Commissars signed by V.I.Lenin on May 17, 1918, provided irrigation of the Golodnaya Steppe for an area of about 500 thous.ha to supply the textile industry with cotton.

By the beginning of the Great Patriotic War the cultivated area of the Golodnaya Steppe had reached 90 thous.ha.

During the War a collecting-drainage network was constructed in the Golodnaya Steppe. This construction and general regulation of water utilization resulted in improving reclamation conditions of the Golodnaya Steppe. Up to the last period collectors and drains in the Golodnaya Steppe were open, and waste water entered them together with ground water. If collectors were not available waste water would recharge ground water and raise the water table. The length of drainage canals in 1958 was as much as 13 m per ha and therefore the water table was lowered by 0.3 m as compared to the 1952 level while the drainage from all the irrigated lands of the Uzbek SSR (about 180 thous.ha) increased for that period from 228 mill.cu.m to 484 mill.cu.m. Water supply per ha decreased during the same period from 13.4 thous.cu.m to 12.4 thous.cu.m. In large farms (Malek, Pakhta-Aral) operation experiments to improve irrigation practices have been broadly developed. In Pakhta-Aral sprinkler irrigation of over 2,000 ha of lands under rotational cotton has been commenced.

Present Economy

In 1960 the irrigated area of the Golodnaya Steppe was 256 thous.ha, 60 per cent of which was under cotton. Irrigated lands are distributed among 22 state farms and 53 collective farms. Benefits derived from these farms equal 83 mill.roubles

per year, about 85 per cent of the income being from cotton growing. Cropped area per one agricultural worker is 2 to 3.6 ha in the Uzbek SSR and 2.6 to 5.1 ha in the Kazakh SSR. In 1959 cotton yields amounted to 24.1 centners per ha in the Uzbek SSR and 26.4 centners per ha in the Kazakh SSR, i.e. higher than the mean figures for the two republics.

The industry of the Golodnaya Steppe is mainly composed of ginneries.

The population of the Golodnaya Steppe is 461.7 thous. of which 326.9 thous. is rural.

The Kirov canal taking water from the downstream of the Farkhad hydropower plant is the main line of the existing irrigation scheme. More than 200 thous.ha are now irrigated by this canal which is designed for 230 cu.m per sec. at the head. Water flows through the canal during 10.5 - 11 months as it is required beyond the cultivation season to meet domestic and industrial needs.

The next in size to the Kirov Canal is the Bayaut Canal, 14.5 km long, with a design discharge at the head 50 cu.m per sec. At present it irrigates about 50 thous.ha with water diverted from the upstream of the Farkhad power plant.

The Begovat Canal, small in size, takes water directly from the tailrace of the Farkhad power plant and commands only about 5 thous.ha.

Reclamation conditions of the irrigated area of the Golodnaya Steppe are now not quite satisfactory, considerable salinization of some soils and high water table being observed there.

Thus, the experience of past years should be taken into consideration in planning and designing future irrigation development. The problem of irrigation and development of the Golodnaya Steppe is to be solved by a large construction organization with application of industrial methods of construction for multi-purpose irrigation and land development.

The construction and economic developments now carried out in three republics (Uzbek, Kazakh and Tadjik) just interest-

ed in the Golodnaya Steppe irrigation are for the first time arranged in the Soviet Union on such a large scale. The realization of the project of the Golodnaya Steppe irrigation is of great significance for national economy.

Construction, Project Planning and Research Organizations

To implement all construction works pertaining to irrigation and development of new lands within the boundaries of the three republics and organizing state farms on newly irrigated lands a Central Board for hydraulic construction and development of the Golodnaya Steppe was formed known as "Glavgolodnostepstroi".

The general designing institute responsible for hydraulic construction and development of the Golodnaya Steppe is the Institute "Sredazgiprovodhlopok". The projects for agricultural, road and power development were worked out by special project planning organizations.

In the Golodnaya Steppe scientific research work is in progress to examine new irrigation practices, various methods of seepage control, new designs of hydraulic structures, etc. These research studies are effected by the Academy of Sciences of the Uzbek SSR (the Institute of Water Problems and Hydrotechnics), the All-Union Institute of Hydrotechnics and Amelioration named after A.N.Kostyakov (VNIIGiM), the Academy of Sciences of the Tadjik SSR (the Institute of Water Problems), Giprovodhoz and other scientific and projecting organizations.

Engineering Scheme of Irrigation

The scheme of the Golodnaya Steppe irrigation is shortly described below. The headworks comprise the dam on the Syr-Darya River with the derivation canal on the left bank of the river, and the right bank canal commanding

50 thous.ha in the Dalverzin Steppe. The discharge capacity of the derivation canal is 500 cu.m per sec.

On the 14-th km of the derivation canal a hydropower plant is erected. About 300 cu.m per sec. of water is diverted from the upstream of the power plant through a regulator, into the Southern Golodnaya Steppe canal. The Southern canal commanding virgin lands of the Golodnaya Steppe will irrigate 354 thous.ha, 290 thous.ha of this being new virgin lands. (The boundary between virgin lands and existing irrigation area of the Golodnaya Steppe runs along the Central collector).

The derivation canal of the Farkhad power plant is equipped with a regulator to deliver 230 thous.cu.m per sec.of water into the Kirov canal. The canal commands 276 thous.ha of the developed zone of the Golodnaya Steppe including 73 thous.ha of the increment of new lands.

32 cu.m per sec. of water of the derivation canal of the Farkhad power plant will be lifted to a height of 170 m to irrigate 39 thous.ha of virgin lands in the Tadjik part of the Golodnaya Steppe.

The Southern Golodnaya Steppe canal flows from east to west, the greater part of it being cut partially below and partially above grade. The Southern canal includes 14.5 km of the Bayaut Canal already under operation which was subsequently widened. The length of the Southern canal is 126 km. It runs through dusty gypseous sandy loam and loam. Water table along the canal route is 2-6 m below the surface. At the 63-rd km the Central branch bifurcates from the Southern canal. It is 20 km long, delivers water into the Right and Left minors and is also used as a flood escape (the Southern canal- Central collector) with designed discharge of 160 cu.m per sec.

The gradients of the canal are 0.00005 from 0 to the 63-rd km, 0.00006 from the 63-rd km to 74-th km and 0.00007 farther to the end. The section is polygonal with slopes 4:1 and 3:1 in the downstream and 3:1 and 2:1 in the upstream. Bottom width is not more than 18 m, the depth is approximately 7.15 m. As the Southern canal runs through the zone where the water table

is rather high, no provision is made for waterproof lining. At some reaches the slopes are planned to be strengthened with fast-sprouting tree planting (willow) to control wave action.

The Central branch is proposed to be lined with concrete from its beginning to the 10-th km.

The Kairak-Kum reservoir (5.5 bill.cu.m full capacity, 2.5 bill.cu.m useful capacity) upstream of the Golodnaya Steppe and the Chardara reservoir (5.7 bill.cu.m full capacity, 4.7 bill.cu.m useful capacity) downstream of the Golodnaya Steppe provide the Golodnaya Steppe irrigation system with 6.5 bill.cu.m of water per year which is enough to irrigate 669 thous.ha.

When development of the total area is accomplished drainage water removed from the territory of the Golodnaya Steppe will amount to 70 cu.m per sec. Water will flow into the Arna-Say depression and the Syr-Darya. The discharge of the largest Central collector to Arna-Say will be 40 cu.m per sec.

Irrigation and Drainage Network

Irrigation and reclamation of the Golodnaya Steppe are planned with due consideration for the following: 1) to increase efficiency of the system, thus raising irrigation capacity of the water taken for irrigation, and to lower the amount of water losses for preventing the danger of salinization; 2) to decrease total water consumption; 3) to provide washing-out saline lands before and in the process of development and to lower water table; 4) to lower labour requirements for irrigation in every way possible; 5) to increase land utilization factor, i.e. to decrease the area under laterals, drains and irrigation facilities.

Canals on newly irrigated areas and partially on old lands are designed and constructed in flumes, with concrete lining or with screens of waterproof materials (including plastic materials or compacted soil), in some cases irrigation canals run in tubes, for example the canal in the Farkhad state farm and many others.

Not less than 15 per cent of the Golodnaya Steppe will be irrigated by sprinkling.

Land levelling is proposed to be effected everywhere.

Broad development of tree plantations is planned to lower water consumption and harmful effect of strong winds and being important for reclamation.

Buried drains and network of collectors are arranged on the lands needing reclamation.

The density of the reclamation network is determined with water table as well as with the extent and type of salinization. To lower the cost great accuracy was necessary when determining the density of the drainage network and the order of priority of cutting the network.

Observations taken at the Zolotoordynsky experimental station in the Golodnaya Steppe during several decades resulted in valuable experience of irrigation agricultural management under hard soil and reclamation conditions. The results of observations are taken into consideration when designing the scheme of the Golodnaya Steppe irrigation and development.

Communication Lines

Main lines of the Golodnaya Steppe under operation before 1956 included the railway section from the Syr-Darya station to the Ursatyevskaya station with a branch to the state farm of Pakhta-Aral and the highway (the Uzbek High Road) from Chinaz to Djizak with the branches to Ura-Tjube and to the Fergana Valley.

At present the railway section from the Syr-Darya station to the Djizak station, 121 km long (105 km of new route) is completed, while the construction of the railway from Jetty-Say to Chardara is nearing completion. The plan of construction development includes laying main highways (with access roads), 705 km in length, which are to provide easy access to farms and exits to the outer areas.

High voltage transmission lines 1,200 km long are now under construction. Power network will cover all yards, settlements, industrial and operation points over the whole territory of the Golodnaya Steppe.

Main telephone communication lines connecting all yards, field camps and industrial-operation points, to say nothing of settlements, will be as long as 1,100 km.

Main gas pipeline from Bukhara to Tashkent has already crossed the Golodnaya Steppe making real the gasification of settlements of the Golodnaya Steppe. It will require 412 km of gas piping.

The length of water supply piping will be 531 km making it possible to provide the needs of the Golodnaya Steppe population for drinking water. Underground water will be the main source of water supply.

Proposed Agricultural Development

The main agricultural crop in the Golodnaya Steppe is cotton. This was characteristic of the period prior to this great irrigation development and will be the same on attaining the proposed development. The percentage of the state farm sector considerably increases. This is because of the fact that all virgin soils will be developed by state farms, the latter making up 81 per cent of irrigated areas. Forty new state farms will be added to 22 existing ones including 34 cotton state farms and 5 state farms responsible for arranging orchards and vineyards.

Arranging cotton state farms in respect of irrigating and developing the Golodnaya Steppe is given special attention.

A state farm covering 8-10 thous.ha will have a centre. The latter will be a large well-planned settlement with industrial and cultural enterprises. The houses are two-storeyed, the flats are planned on both floors. All the houses are provided with central heating, water, gas and sewerage. The

centre of the state farm will be supplied with electricity, radio and telephone facilities. Provision is also made for aforestation of the entire territory of the centre, 30 sq. m per a person. Each family is given a plot of 200 sq.m with a house. In addition to this each family is also given a plot beyond the central territory of the state farm 550 sq.m in area to grow truck crops, fruit trees and flowers.

Cotton yielding capacity is designed to be 25 centners per hectare at the beginning and 35 centners per hectare for the future.

High level of complex mechanization of operation processes helps to increase the labour productivity in socialist agriculture, resulting in the increase of hectarage cultivated by one worker; i.e. 8 ha for cotton and 18 ha for alfalfa.

As many as 392.7 thous.ha of the new area, or 92 per cent will be sown, including 252.7 thous.ha, which will be under cotton.

In 1959, 307 thous.tons of raw cotton was harvested from the irrigated areas of the Golodnaya Steppe. As a result of irrigating and developing the entire Golodnaya Steppe, the yield of raw cotton over the territory of 669 thous.ha will be 1,300 thous.tons.

Quantities Plant and Equipment

Volume of earth work when constructing irrigation, drainage and road networks, as well as levelling of irrigable areas will amount to 568 mill.cu.m including 201 mill.cu.m while levelling. Volume of concrete and reinforced concrete work will be 2.1 mill.cu.m, including 1.5 mill.cu.m of prefabricated reinforced concrete.

In state farms and industrial yards there will be 1.45 mill.sq.m of living space, 2.8 mill.sq.m of public and other facilities and 8.5 mill.sq.m of plants, factories, workshops and the like.

This great volume of work became reality, as a reliable source of building materials and elements has been established.

Given below are the largest manufacturers:

- Plants producing reinforced concrete articles in towns of Begovat, Yangi-Yer and Chinaz, their total output is 260 thous.cu.m of articles per year. In addition to this 40 thous. cu.m of concrete and reinforced concrete articles are manufactured on yards.
- Plants manufacturing construction materials such as red antimony-concrete and precast silicate-calcite walls.
- Brick factories in towns of Begovat and Khavast.
- Plants producing drainage pipes in the town of Khavast.
- Asphalt concrete plant in the towns of Yangi-Yer and Jetty-Say.

In conformity with the above volumes of work the following number of machines will be required for construction:

excavators	- 750
scrapers	- 1,000
bulldozers	- 1,050
levellers,long wheel base	- 150
tractors, heavy	- 1,450
dump trucks	- 1,900
trucks with flanks	- 1,200
mobile electric plants	- 200

Most of this machinery is already in commission.

Construction Cost

The total construction cost will amount to 1,067 mill.roubles. Hydraulic development requires 392 mill.roubles, agricultural development 528 mill.roubles, 100 mill.roubles for construction of outer communication lines and 47 mill.roubles for construction of industrial enterprises.

Moreover, the state farms will be given 130 mill.roubles for agricultural development other than any kind of construction, namely purchasing agricultural machinery and its like.

Thus, the total cost of all kinds of construction taking into account the expenses for irrigating and developing the areas of the Golodnaya Steppe over the territory of 669 thous. ha together with the new lands will make up 1.2 bill.roubles.

Fig.1 Farkhad dam on Syr-Darya River

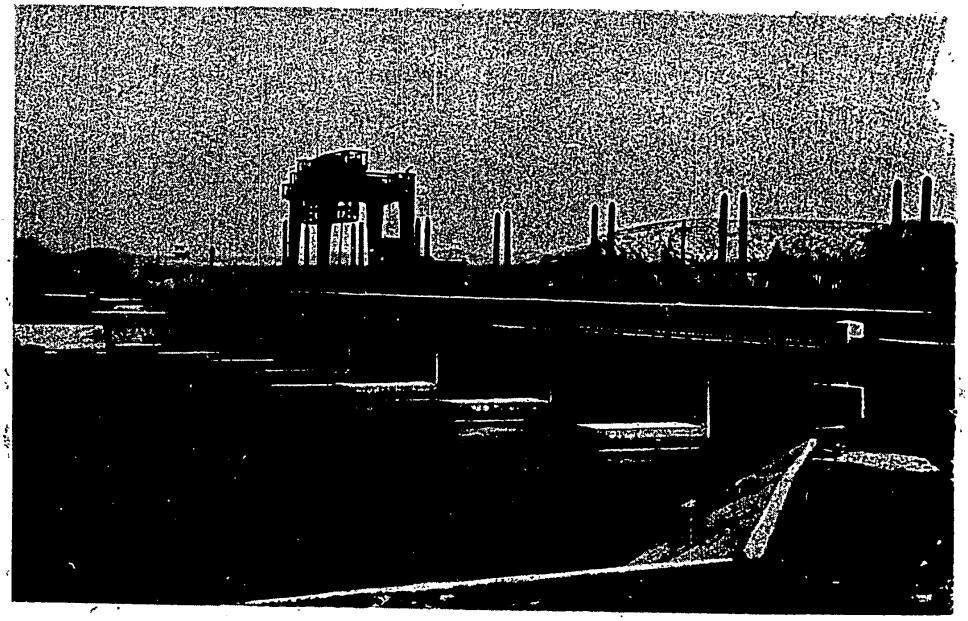

Fig.2 Head regulator of derivation canal of Farkhad hydropower plant, 500 m^3/sec. in discharge

Fig.3 Derivation canal of Farkhad hydropower plant, 500 m^3/sec. in discharge

Fig.4 Farkhad hydropower plant

Fig.5 Reservoir at Farkhad hydropower plant; Southern Golodnaya Steppe canal to the left

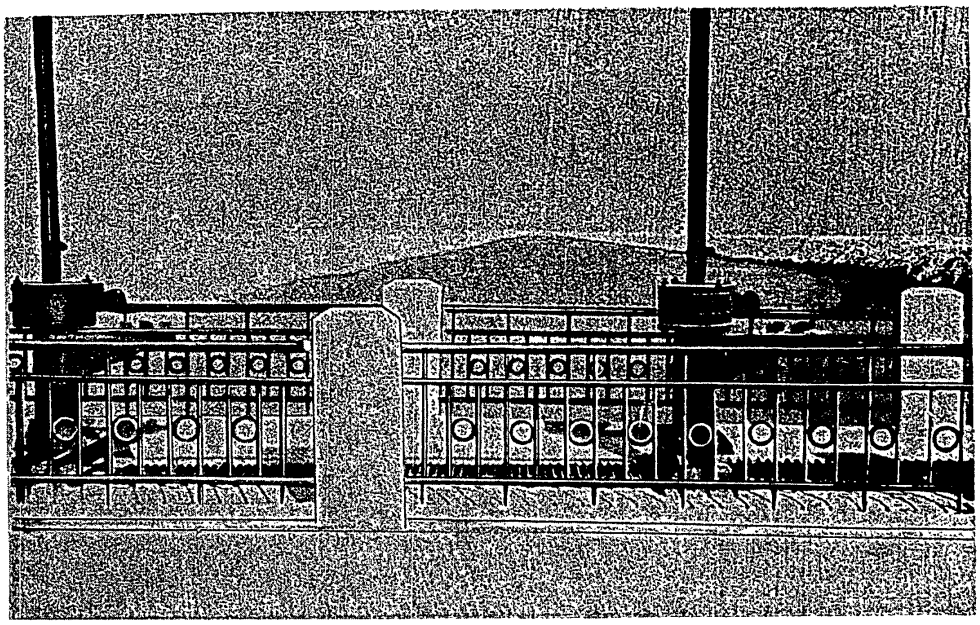

Fig.6 Southern Golodnaya Steppe canal

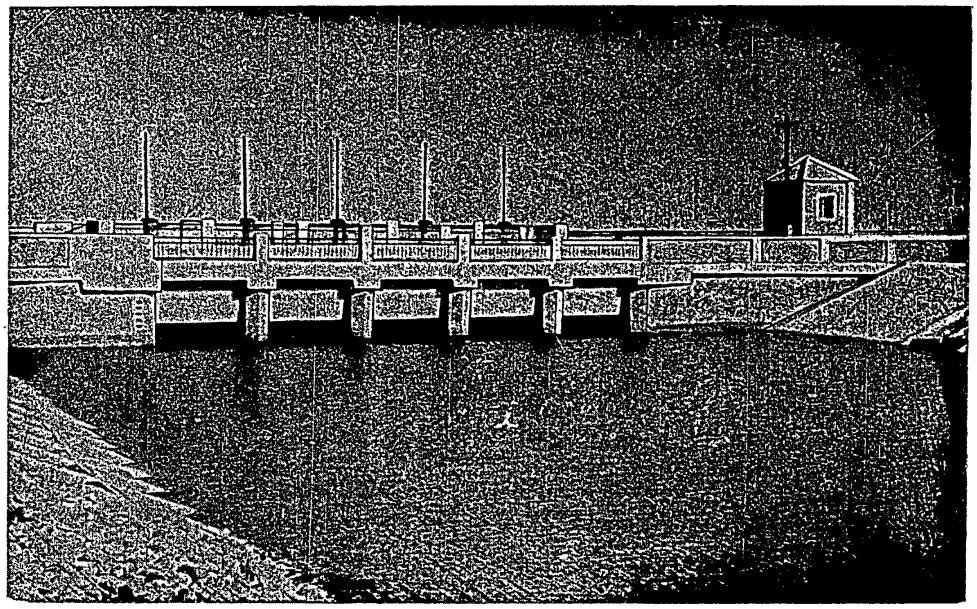

Fig.7 Barrage across Southern Golodnaya Steppe canal

Fig.8 Flumed canal, 300 l/sec. in discharge, state farm No.6

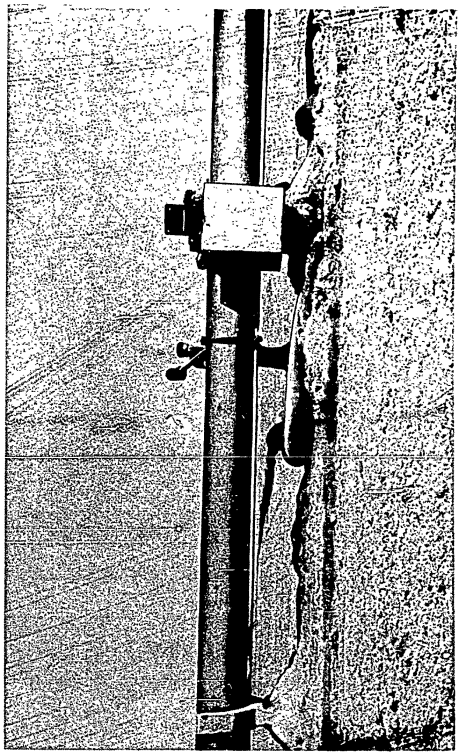

Fig.9 Outlet from R.C. flume to irrigation pipeline

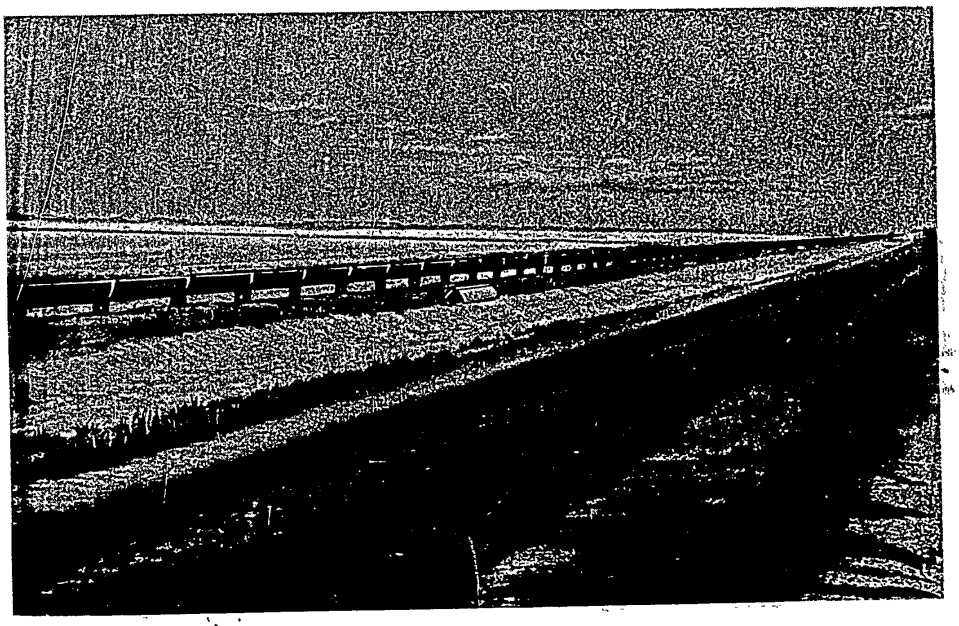

Fig. 10 Flumed distributor, state farm No.6

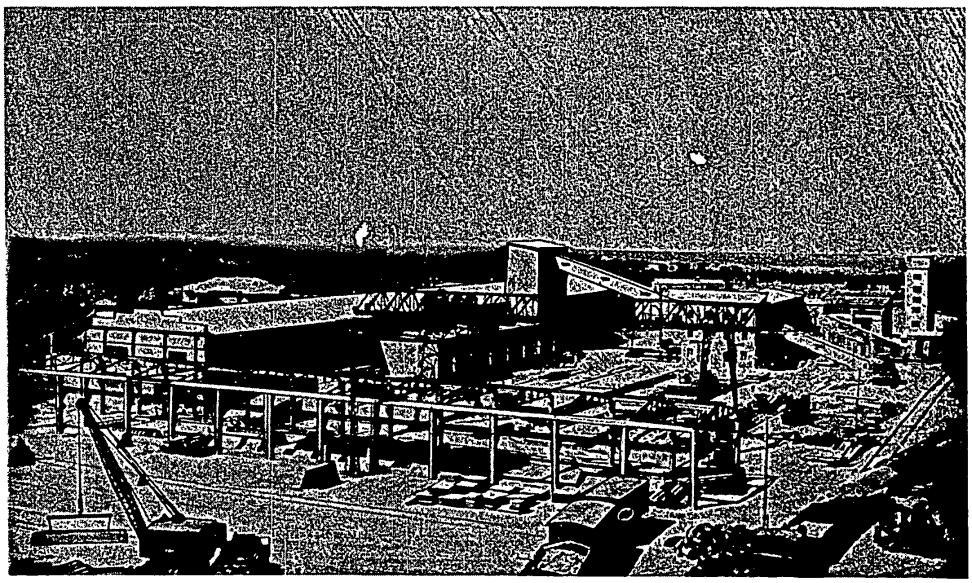

Fig.11 View of precast concrete plant for irrigation works

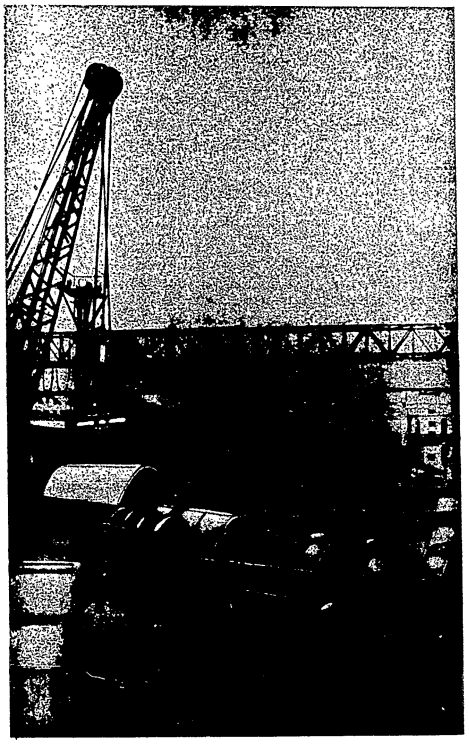

Fig.12 Loading of precast concrete R.C. flume sections

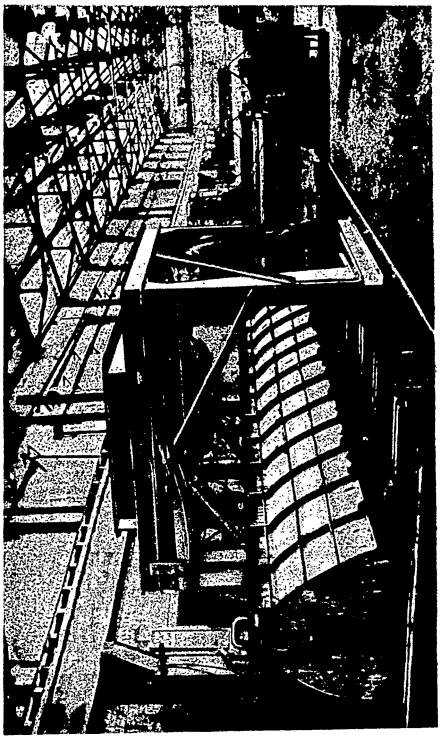

Fig.13 Formwork for R.C. flumes

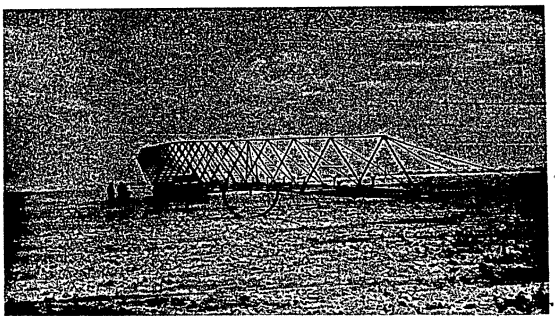

Fig.14 Sprinkler DDA-100M

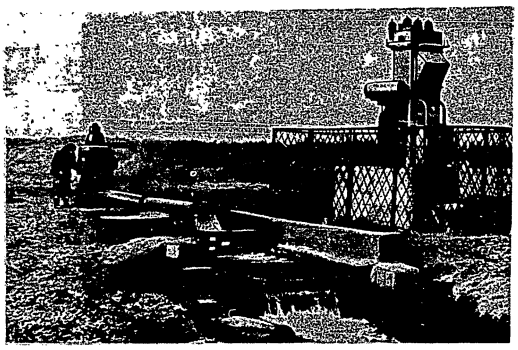

Fig.15 Test plot of vertical drainage on Shuruziak depression within the existing irrigated area

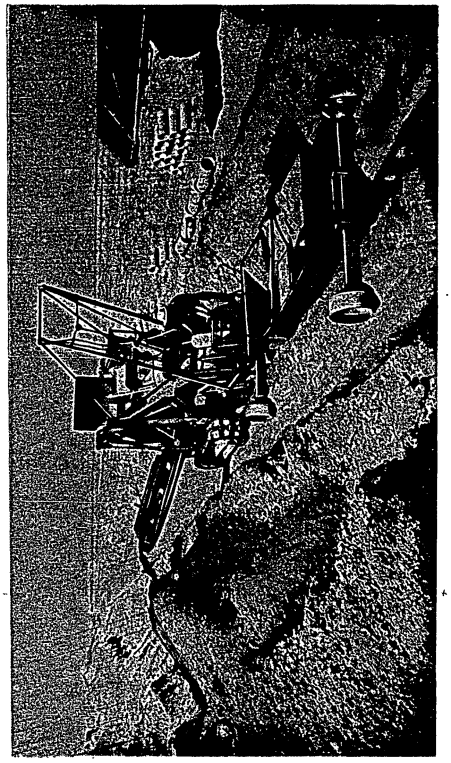

Fig.16 Drainage combine

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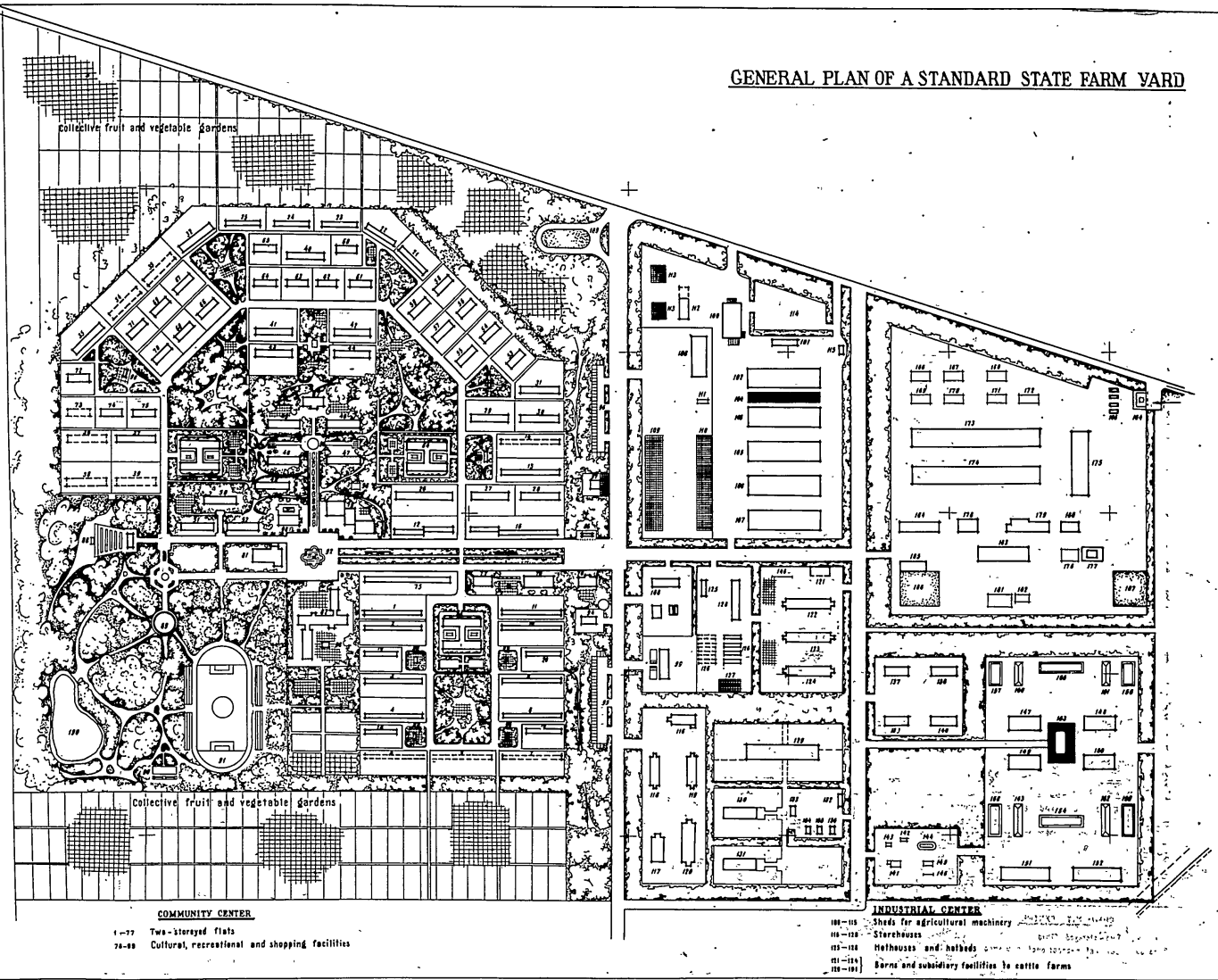
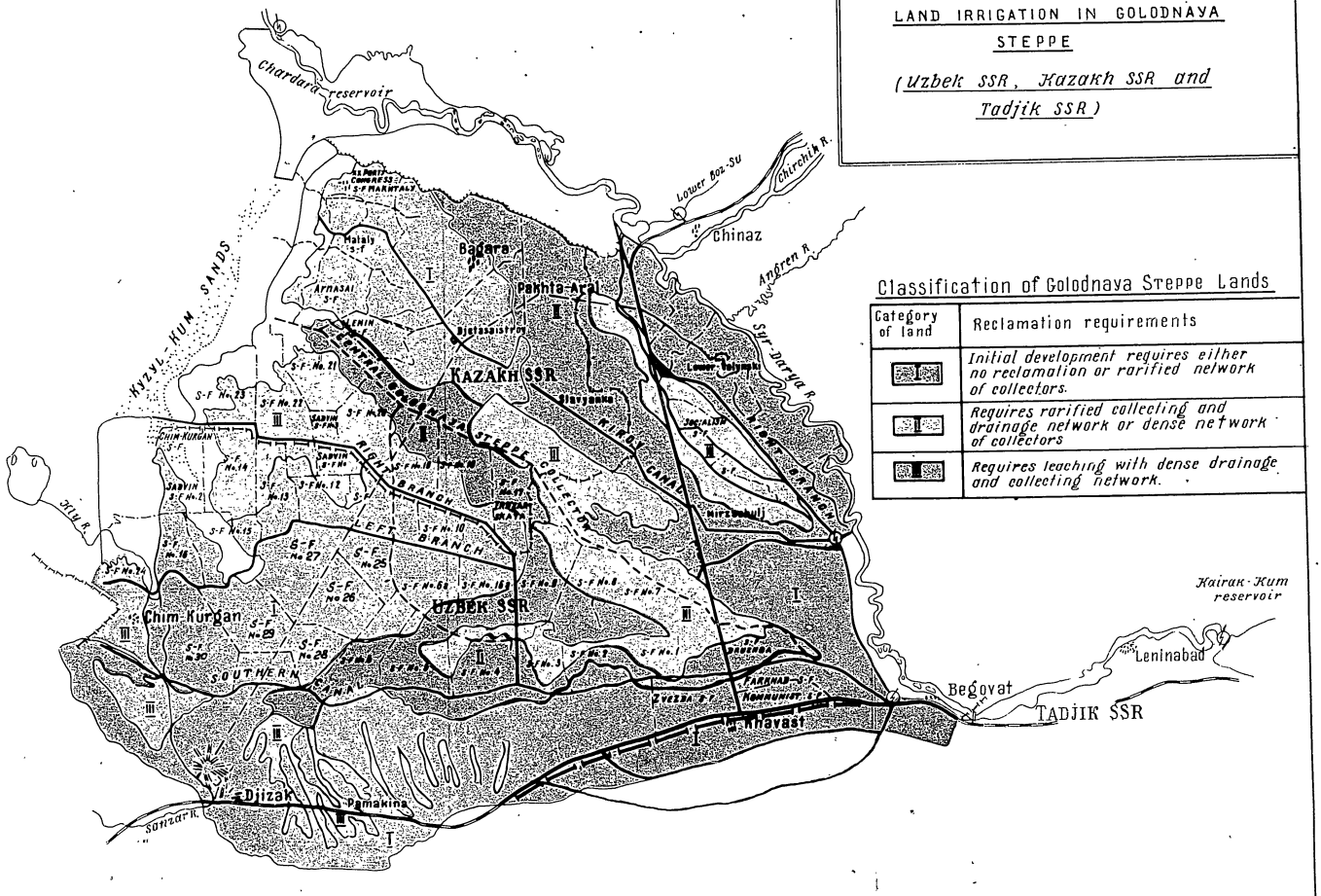
GENERAL PLAN OF A STANDARD STATE FARM YARD



SCHEME OF LAND IRRIGATION IN GOLODNAYA STEPPE

(Uzbek SSR, Kazakh SSR and Tadjik SSR)

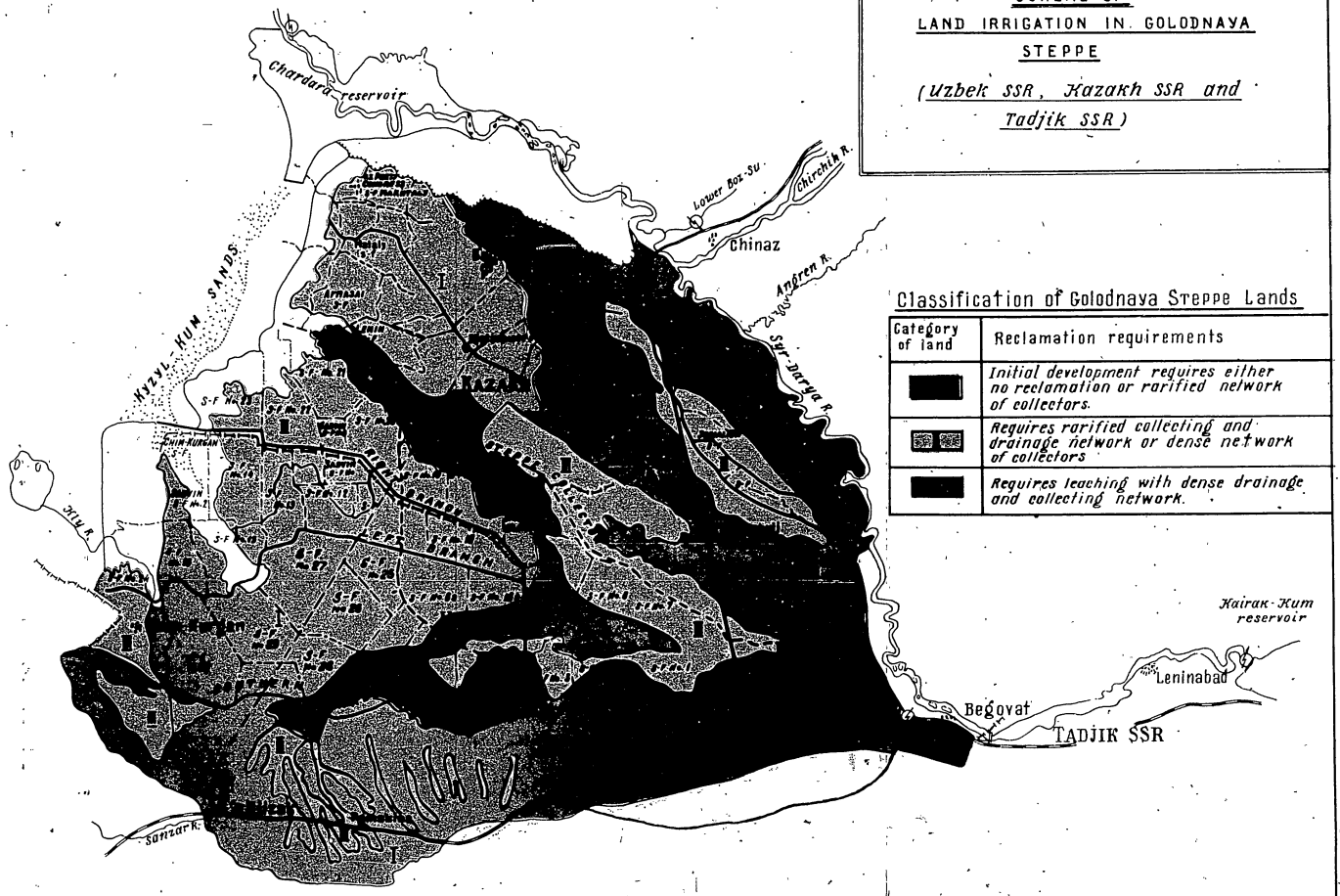


Classification of Golodnaya Steppe Lands

Category of land	Reclamation requirements
I	Initial development requires either no reclamation or rarified network of collectors.
II	Requires rarified collecting and drainage network or dense network of collectors
III	Requires leaching with dense drainage and collecting network.

SCHEME OF LAND IRRIGATION IN GOLODNAYA STEPPE

(Uzbek SSR, Kazakh SSR and Tadjik SSR)



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Category of land	Reclamation requirements
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