

**International Fund for Saving the Aral Sea
Executive Committee**



ARAL: the history of dying sea



Dushanbe - 2003

U. ASHIRBEKOV, I. ZONN

*To 10-th anniversary of IFAS and Dushanbe
International Forum of fresh water*

**ARAL:
THE HISTORY OF DYING SEA**

Dushanbe - 2003

ББК 26.3+26.82+28.081+2689(2)

A - 98

Ashirbekov U.A., Zonn I.S.

Aral: The History of Dying Sea. Dushanbe, 2003.-86 c.

This book gives a brief description of the Aral sea till 1960 when the sea started dying out. For the first time it presents the chronology of studying, development and attempts of conservation and reha-bilitation of the Aral sea. Shown is the participation of the world society in cooperation related to envi-ronmental catastrophe.

© Ashirbekov U.A., Zonn I.S.

It is issued by the decision of IFAS
Executive Committee.

Under the general edition of
Aslov S.M. - Chairman of IFAS Executive Committee

Composer: Gaybullaev H.G.

Editor: Jamshedov P.

The edition is carried out by the financial support of the
«Natural Resource Management» Project (NRMP) and the USA
Agency on International Development (USAID)



***«Who does not have past, that does not have future»
Popular wisdom***

INTRODUCTION

For the last decades the problem of Aral doesn't come off the pages of mass media. New works appear refreshing new aspects of "life" of drying sea, it's actively discussed on national and international levels.

Ten years ago five new independent states of central Asia - Kazakh Republic, Kyrgyz Republic, Republic of Tajikistan, Turkmenistan and Republic of Uzbekistan united its efforts for creation of Interstate Coordination Water Commission. This unique organ of Interstate water division upon conditions of water resources deficit in reservoir of Aral sea did a lot and still does for improvement of stability of ecological situation.

This year a decade is celebrated since the Agreement was signed for united actions for salvation of Aral sea and pre-Aral problems, ecological improvement and support for social-economic development of Aral sea.

At the same time a decade ago the International Fund for saving the Aral was established.

To this date the authors decided to dedicate this small book, chronologically enlighten the history of studying and development of Aral basin.

ARAL, WHICH WE HAVE LOST

The name " Aral sea " - from a word " aral " - island, is called because of the vast basin that lies as an island among the waterless deserts of Turansk lowland.

In old Russian sources it was called as Blue Sea. V. V. Bartold marks that the district in delta of Amu Darya called as "Aralan" - was an island between sleeves of the river, from here there is a name " the sea of Aral ".

In northern deserted part of Central Asia, within the borders of Uzbekistan and Kazakhstan, the Aral Sea, which up to 1960 covered the area of 68 thousand km² at volume of 1000 km³ of water.

With these sizes the Aral sea occupied the second place in the world among intercontinental source less lakes after the Caspian sea and fourth place among lakes after the Caspian sea (former USSR, Iran), lake Top (Canada, USA), lake Victoria (Tanzania, Kenya, Uganda), that's why people call it a sea.

Geologically the Aral sea is young. The absolute age equals to 139±12 thousand years. During неогеновый period as a result of powerful тектонических movements in the territory of Central Asia, three deep hollows - Aral, Khorezm and Sarikamish were generated in the center of Tirannsk valley. At the same time the predecessor of Amu Darya - flew through the centre of Karakum on west in Caspian (Hvalinsk) sea. About 70 thousand years ago it has turned to north and, having cut deep gorge in area of Tuya-Muya, has reached the Khorezm hollow, where the extensive lake was formed. With current of time, as a result of deflection of huge amount of, was brought and transformed into the flat plain which has been cut up by canals.

In late Pleistocene (10-12 thousand years ago) Amu Darya (Jeihun) has turned to west and has reached Sarikamish hollow, having transformed it to a lake. About 4 thousand years ago Amu Darya has turned to north and has begun to flow in a huge Aral hollow, into which Syr Darya already ran. Before, instead of the Aral hollow the extensive plain with the dismembered relief bordered in west by Ustyurt, in north - by Aral heights, in east -by desert Betpak-Dala and mountain range of Kratau, in the south - by deserts Karakum and Kizilkum.

The place at a mouth of Amu Darya was called as Aral, and then this name was given to a whole lake. During the Alexander Makendonsky times it was called as Oksysk lake (from the ancient name of Amu Darya - Oks, Oksus). The written notes about it corresponds to IX-XI centuries, when it was called Horesm Lake by the Arabs in the name of the ancient state - Horesm.

The Russian travelers were astonished by an unusual blue waters of the sea, and in the first Russian Atlas XVII in. "The Book of Large drawing" it's named is Dark blue. Only during reforms of Peter I the present name of the sea was ratified.

The mark of a water surface of Aral in natural conditions made 53 m above the level of World ocean, that almost on 80 m is higher than a level of the Caspian sea (fig. 2). Originally, prior to the beginning of decrease of a level in 1960 it had approximately 428 kms in length and 234 kms in width, with the maximal depth 69 m (at marks in 53 m). The volume of water - 1064 km³.

The temperature of water on a surface in the summer is 26... 30 C, in winter - is below 0. The ice during winter can be seen all over the sea. The average salt percentage is 10-11 %, water transparency - up to 25 m. The average salt was in rather narrow limits 9-10%.

Northern coasts in some places are high, in others are low, cut up by deep gulfs, the eastern coasts are low, sandy, with many fine gulfs and islands. The southern coast is formed by delta of the river of Amu Darya. The western coast is fairly cut up and is formed by a precipice Ustyurt in height of 180-200m.

Till 1990 the water area of the sea was divided into two basic, but not equal parts - Large and Small seas connected by a strait Berg.

Continental and drought are the basic features of the climate. In northern parts of region a climate is continental, in southern parts it's subtropical. The average annual amplitudes of temperature of air reach 33-36C. The long hot summer, average July temperature is 26-33C. In the winter cold air mass penetrate here, reducing a general level of temperature. In northern deserts the average January temperature is 10... 15°C, in the south by some places it is above 0°C. The annual quantities of sediments make it 20-120 mm.

The water balance of Aral is developed by the following: the

incoming part - precipitation - 8,7 km³ river drain - 5,5 km³, change of a level - 0,6 m; spending part: evaporation from a water surface -63,8 km³.¹

The Aral is a closed natural sourceless reservoir. But two largest classical rivers of Central Asia - Amu Darya and Sirdarya, which played the important role in trade and political relations of the ancient people flow into the Aral and have such an importance nowadays.

Amu Darya, from the ancient writers Oks, Oksus (greek), Jeihun (Arab). the modern name, the river has received rather recently, in VI c.. The historians assert, that it has taken name from Amul (Amus, Amui, Amu), which lay on a coast of Amu Darya, on a place of present Turkmenabat (ex. Chardjou).

The prominent military figure, scientist - Oriental's, professor, The General A. E. Snesev² wrote: "Amu Darya - "the river of mankind" - it amazed to the same extent the Greeks and Arabs, Chinese and Turkish and for more than three thousand years ago it consequently appeared in the literature of Sanskrit puritans, Alexandre historians and Arabian geographers."³

Amu Darya originates in Tajikistan and Afghanistan. Its length is 2620 km (from other sources 2540 km). It becomes Amu Darya after the merge of Vakhsh rivers, assembling waters of Allai valley and Northern Pamir and Pianj, with the basic inflows Gunit and Bartang, draining a southeast part Pamir range of mountains. From a point of merge its length is - 1400 km.

The basin of Amu Darya includes also rivers of Kafirnigan and Surhandarya, flowing down from southern slopes Gissar Mountains, and river Kunduz, forming a drain within the borders of Afghanistan.

The area of the basin is 465 thousand km², from which only

¹ From the data of A.E.Asarina, on A.A. Sokolov (1986) "The Water: problems on a boundary of XXI of century ". Л., Gidrometeoizdat, 102 p.

² Snesev Andrei Evgenievich (1865-1937). In 1888 has graduated the mathematical faculty of Moscow University, in 1890 - Moscow Infantry College. Freely owned 14 languages. In 1899 has graduated from the Academy of Head HQ. In I World war commanded the platoon, brigade and division. Since 1917 he is General-Lieutenant. In 1918 has passed on the party of the Soviet authority. In 1919-1920. - Chief of Academy of Head HQ, 1921-1930. The rector and professor of Institute of orient studies. In 1929 he gets the rank of the Hero of Labor. In 1930 is arrested. Died in Moscow in 1937. In 1958 was rehabilitated.

³ Snesev A. E. Afghanistan 2002. Art. 63

mountain part gives a drain (for about 217 thousand km²). The average drain annually changes from 48 up to 101 km³ at average 63 km³. Waters of the river differ by strong muddy - 2500-4000 g/m³. Also strong wash away of the coasts is noticeable (Deigish).

At the lower reaches of the river some sleeves run into the Aral sea, forming delta by the area about 19 thousand km².

Amu Darya, at which basin the ancient states of Central Asia were situated - Horezm (in a mouth of the river), Sogdian and Baktria (in its middle and upper currents), was known from times of antiquity. In present time almost all drain of the river is controlled and is used for irrigation.

Syr Darya, Jaksart (Greek). Seihun (Arab.), local inhabitants still call it Hashart, Tsenchu-Uguz, i.e. a Pearl river. The modern name does not meet in sources even XVIII c. and the origin is not found. The river is formed by merge of the rivers Narin and Karadarya. Its length from a place of merge is 2206 km. The area of basin is about 462 тыс, km² (from which 150 thousand km² are occupied by a mountain range that gives a drain). A channel is twisty and unstable. The annual drain of the river strongly changes from 22 up to 57 km³ at average significance of 34 km³. The turbidity is high - 2000 g/m³. The drain of these two rivers forming in high-mountainous areas of Tian-Shan and Pamir, make an average of 110 km per year, and to the sea, as a result of natural losses for filtration and evaporation and mainly of intensive selection for irrigation and watering of close deserted grounds comes approximately only a half of this amount of water and all it annually evaporated from the sea surface.

Therefore, more than 100 years ago, in 1882 the famous Russian scientist of the geographer and climatologist A. I. Voeikov mentioned in his report "the Rivers of Russia" has told: "Baseness on lower and on middle currents of the rivers running into Aral, are so dry, that the existence of the Aral sea with its present limits - prove our backwardness, disability to take advantage in a sufficient measure of such volume of the current water and fertility of silt, that Amu and Syr Darya. In the states that able to use a gift of nature, Aral would serve for a drain of water during winter (when water is not needed for irrigation), and also high mountains during summer".

The West-European science has found the Aral sea from Russian cartographical sources, in particular from map made by

Caucasian prince Alexander Bekovich-Cherkasky (or Davlet-Gireem, "Lucky person", as he was named in Turkestan)⁴, in 1-st quarter of XVIII c. For the first time the Aral sea was scientifically investigated and mapped by the Admiral A.I. Butakov in 1848-1849.

In 1899-1902 and then in 1906 the Aral is investigated by an outstanding Russian geographer L.S. Berg and in 1908 he publishes his book "The Aral sea. Test on phisio-geographical monographic". That edition has not lost its scientific significance up to nowadays. For the next years many scientists referred to it to study the sea.

In many respects the fluctuations of a level Aral depended not only on water sources in whole Central Asia, but also from a direction of a drain of Amu Darya.

Archeologists have established, that Amu Darya alternately changed its channel, by running into Aral, and after into Sarikamish. It was connected both as by natural reasons, and under influence of activity of the man (creation of protective dams in V c. Up to AD; destruction of irrigation structures in times of Chinghiskhan or Timur (Tamerlan).

For last 200 years also occurred fluctuations of Aral level, but their amplitude did not exceed 4m. The fluctuations of the Aral level in first half of XX c did not exceed 1 m. In 1911-1960 in Aral brought from Amu Darya and Syr Darya on the average of 56 km³, and about 10 km³ dropped as sediments on a water surface, and the average sea levels were annually kept in a range of 52,2-53,4 m at the mirror area 65-67 thousand km² and volume 1040-1090 km³, i.e. the sea was at the approximate age of 4-6 thousand years.

It is necessary to note, that during the whole history of ancient irrigation of Central Asia the watershed for irrigation from the rivers of Amu Darya and Syr Darya never influenced the levels of the Aral sea, since the amount of water spent for irrigation on all basin of the sea, despite of the huge area of development of territory (in antique time irrigated 3,5-3,8 mln. hectare, including the lower of Amu Darya 1,3 mln. hectare, in lower of Sirdarya

⁴ Alexander Bekovich Cherkasky (7-1717)-one of the colleagues of Peter I, political and military figure, hydrographer. Investigated the Caspian sea, has made the first most correct map, was killed in 1717 in time of gold rush expedition to Hiva.

2,2-2,5 mln, hectare) was insignificant. Fluctuations of Aral level was connected with destructive wars of the states of Central Asia and invasions by foreign invaders. Then the part of a drain of Amu Darya as a result of destruction of artificial dams in Horezm with a fast current has flowed into dry channels of Daudan and Daryalik in Sarikamish.

The general number of islands on the Aral sea by the area of more than 0,01 km² till 1961 is - 1100. Their general area prior to the beginning of drying made 2230 km². Among them there were 12 large islands. They were Barsakelmes, Kokaral, Lasarev, Revival⁵ etc. All islands are of a continental origin. The islands are located along east coast. In the south is settled an original akpetkinsk (Karabailyisk) archipelago, more then 50 islands represented sandy ridges of Kizilkum, drown by sea waters.

Among the largest islands is Barsakelmes, that in translation from the Kazakh language means, " Go - and won't return " .

At drying of Aral Akpetkinsk archipelago islands started to connect with each other, and the gulfs that divided them, have turned in salty basins.

In 1990 the island Kokaral disappeared. It connected with a land, and the gulf Sarishiganak has stopped to exist. Together with them the gulf of Berg has disappeared too. The area of other islands has begun to grow. In 10 years all islands were closed among themselves and with a land, dividing the large sea into two seas: western and eastern.

The Aral sea was surrounded by rich and various living nature.

In 1960 from the beginning of downturn of a sea level, a decrease of tree and bush vegetation has begun, the areas engaged in a reed and molt are reduced. Where the vegetation even was kept its structure became much poorer.

Has disappeared ondatra. The quantity of trade kinds of game was steeply reduced. The majority of water birds have replaced their places, having moved to north, to lakes of Turgaisk valley,

The Economic use of Aral was connected first of all with a

⁵ The island "revival" (area 169,8 km²) is interesting by its destiny, which was found in middle of XIX century and named in honor of Russian king Nikolai. It was included into the range of Imperial islands, alongside with an island Konstantin, named in honor of great prince Konstantin Romanov, the president of Russian geographical society. As Revival it was called in the Soviet time. For long time this deserted island was confidential military range, on which the means of protection from the biological weapon were tested.

fish craft. The fish income reached 40-50 thousand tons, including more than 20 thousand centners of a most valuable Aral fish. Till 1960 the Aral occupied 3 places annually among internal reservoirs of USSR, giving about 13 % from the whole fish income. The basic trade kinds of fishes Aral, besides barbell, were bream, sazan, vobla, pike perch, which made 80 % of productions. Was found here and Aral salmon brought in the Red book former USSR.

In 1980 because of increase of salt waters from 11 up to 20 g/l and the dryings of ancient ways on river canals, the catch of a fish have fallen up to 14 thousand tons. The sea has lost its fish trading importance, and in 1984 the craft in the sea has completely stopped.

In deltas of Amu Darya and Syr Darya on animal craft places up to 1 mln. 130 thousand pieces of ondatra were caught. The most part of fur went on the international fur auction and brought currency. Quite a major number was of hogs there. A reed was used as a building material and as a forage for cattle.

On an island Lasarev the birthplace of limestone was found - the raw material for production of wall stone, tiles and fodder flour: at springs of Djizhelibulak and Duana on west coast - deposits. A high perspective of mine workings of oil and gas in southern part of water area is proved. Perhaps here they receive ore minerals from sea deposits.

Till 1960 the Aral sea as the internal reservoir between Kazakhstan and Uzbekistan served as the basic part connecting ports Aralsk and Muinak, the freight rotation between them reached 250 thousand tons per year (basically, cotton, bread, salt, fish, chemicals, wood).

The economic importance of Aral sea is not limited to the only listed kinds of economic activity. Rather important is the general influence of the Aral sea on close areas, softening their climate. Evaporation of Aral has been forming and determined a climate for all Central Asia. Before drought it vaporized more than 60 kms a year, which then turned in sediments, dropping out in this region. And reimbursement to such enormous evaporation was covered by a drain of Amu Darya and Sirdarya.

The History of the Aral sea cannot be studied separately from its companion - Sarikamish lake. Its life is closely connected to Amu Darya, which alternately brought the waters to the Aral

sea, and later to Sarikamish. The flooding periods of Aral and droughts in Sarikamish and visa versa depended on this, i.e. the principle of informed vessels worked as though.

A numerous water exchanges between Aral and Sarikamish has occurred during the last two centuries and probably not without participation of the ancient farmers - the irrigators.

The ancient delta of Amu Darya is attached not to the Aral sea, but to Sarikamish hollow, which persians considered as a hell for a whole earth ". And still today there dry channels of Daryalik, Daudan and Tonidarya that lead to it from south-east, clearly seen on a relief. Earlier through these channels the significant part of waters of Amu Darya (Jeihun) went to Sarikamish lake.

Approximately 8-10 thousand years ago water filled a whole Sarikamish hollow, having raised its level up to 56 m, and having poured out through cracks of Uzboi, has directed its waters to the Caspian sea. Today Uzboi is an ancient dry channel of the rivers extended for 550 km from Charishla on a southeast of Sarikamish up to canals of Kelkor, representing a gulf of the Caspian sea in XIX century.

The natural receipt of waters of Amu Darya to Sarikamish continued up to the end of XIX century.

Time of revival for Sarikamish began in 1960, after beginning of decrease of Aral sea level. By this time Sarikamish represented an extensive dry hollow with salty lake by the area of 160 hectar, surrounded by sandy desert.

Here, as a result of development of irrigation agriculture in basin of Amu Darya have begun to drop off the drainage waters. For this purpose, as well as in the past, an ancient channel of Amu Darya - Daryalik is used. In 1967 in Sarikamish was delivered 1,4 km³ poorly mineral water, and since 1979 annual volume of delivered waters made 4-5 km³. Now the area of lake is more than 3000 km² with the depth up to 40 m. The average minerals of water in lake has increased from 9,3 g/l (1971) up to 12,1 g/l (1987). The volume of water makes 26 km³. Changes of the hydrological and hydro chemical characteristics of the lake are connected with the perspective irrigation development and chemical content of Amu Darya waters - the deliverance in it of drainage waters in volume of 7,5-8,0 km³. The general amount of a drain of drainage waters

in basin of Amu Darya makes 20,12 km³/year.

The rise of water in Sarikamish has caused appearance of great number of fish. Low salinity allows existing in its waters for such fish like catfish, sazan, pikeperch, and barbell. In 1970 on Sarikamish some fish craft economy appeared. Have increased fish income; in the beginning of 1980 it made 3 thousand tons a year. However for now catching a fish practically is stopped because of increase in water of the contents of toxic substances: pesticides, phenol and heavy metals.

On the coasts and on islands a badger breed appeared in appreciable quantities, jackals are also frequent. In thicket of a reed in a mouth of Daryalik have appeared hogs and ondatra. There are also numerous desert animals - saigaks, foxes, wolves and hares. Population of birds is also rich. Here breed tens of pelican, the cormorants account hundreds of species. In weeds there are ducks.

Thus, all environmental life of Aral sea has moved to Sarikamish.

The level of the Aral sea served as the sensitive indicator of its health. In 1960 started to appear symptoms of infringement fragile balance of automatically adjusting ecological system of basin of the Aral sea.

Almost the whole economy of Kazakhstan, Uzbekistan, Turkmenistan and practically Kyrgyzstan leans on the use of Amu Darya and Syr Darya waters. Almost total control of the rivers of Amu Darya and Syr Darya for creation of the largest zone of irrigating agriculture and cotton base of former Soviet Union without any practical forecast for a condition of rivers, Aral sea and ecological consequences for all Central Asia, letting the sea without inflow of water to it, thus leading it to drying (fig. 3).

The development of cotton-growing and then of the rice plant was based on a progressive increase of irrigated areas in basin of Amu Darya and Syr Darya with 4.1 mln. hectare in 1960 up to 7,4 mln. hectares in 1990. Here on planted grounds 95 % of cotton, about 40 % of rice, 25 % of vegetables and 32 % of fruits and grapes from all manufacture in former USSR were produced.

It is natural that, since this period, the drain of river waters in Aral began to fall down steeply. If in 1910-1960 on the average annually in Aral was delivered about 62 km³ of water, in 1961-

1970 - 43,3; in 1971-1980 - 16,7; in 1981-1990 - 3,5 km³. A drain of Sirdarya in 1974 -1986 did not reach up the Aral, the drain of Amu Darya partially was absent in 1982-1983, 1985-1986 and 1989. The result of this was the decrease of its level in 1960 years on the average on 0,2 m per year, in 1970's on 0,6 m, in 1980's - on 0,85, to the beginning of 1987 its level has reached a mark of 36,4 m, i.e. on 16,6 m is lower, than middle-many-year level till 1961.

Only in Karakum channel (now is constructed 1300 kms of 1400 kms) in 1975-1988 was delivered from Amu Darya annually from 10 up to 13,5 km³ of water, that allowed irrigate for about 850 thousand hectares. The large volumes of water are delivered from Amu Darya on newly established lands through Amu-Buharsk and Karshinsk channels (for about 15 km extra).

Waters of Sirdarya on channel system irrigate the huge areas in the Fergana valley, southeast areas of Uzbekistan, in Kazakhstan. Only small part of a drain used for irrigation, comes back in the rivers. The most part of water is spent irrevocably or is dumped from drainage systems, which are by the integral part of irrigating systems ensuring maintenance of an optimum level of earth waters and normal productive ground, in source less hollows in the deserts, that conducts to occurrence of drought and process of pollution of an environment. Last occurred at the use of poisonous chemicals on the average of 20-25 kg hector a year; mineral fertilizers on the average of 400 kg / hectar per year. Total volume of drain waters in basins of Amu Darya and Syr Darya makes 32,71 km³ / year.

As a result of dump there were formed two vast reservoirs of the Amu Darya - Sarikamish and Syir Darya and Arsanai. Last is formed on a place of canal of Aidar, the system of Arnaisaisk lakes and lake Tuzkan. The irrigating-drainage waters from steppe flow here and waters from Chardarinsk reservoir are dumped.

The crater of soloichaik Aidarkul was filled with water in 1969, when at a high-water on Sirdarya, 21,8 kms water were dumped from Chardara reservoir. The lake Aidar has connected with lake tuzkan and it become as a sole lake system by the area of 2400 km². Now the area of Arnaisk lakes (or Arnasai) changes from 1775 up to 3100 km², the volume of water mass is - from 12,5 up to 35 km³, mineralizing of water in different parts of system changes from 4 up to 12 g/l, at average weight 10,3 g/l.

Except Arsanai and Sarikamish, for about 100 reservoirs are located - stores of drainage waters with the area exceeding 10 thousand km². Such analysis and the losses of water of two rivers cannot be compensated at the expense of evaporation from a surface of the sea. By a natural consequence of decrease of receipt of water was the fast fall of a level of the Aral sea and increase of its salinity. Fall of a sea level have bared 23 thousand km² sandy surfaces. Only in delta of Amu Darya since 1961 more than 50 lakes have dried up, the area of Tugaev (black woods lasting along coast of the Central Asian rivers) and reed thicket have reduced in 2 times and has reached 1 mln. hectare. Vegetative and the fauna of Priaral has lost 50 % of gene funds. The arisen process of drought has captured, more than 4,5 mln. hctr. has transformed pasture ground in desert that has brought a serious damage to cattle farms.

Over the whole Priaral the level of soilwaters was lowered and it has caused a change of nutrition routine of plants and processes of soil formations.

The drained strip of the Aral bottom became source powerful dusty storms. The dust is transferred over 150-500 km. From south east coast of Aral 15-75 mln. tons of a dust are raised each year. It contains poisonous sulphate and chloride of salt and is distributed on weave Thousand square kilometers, harming generative and vegetative to bodies of plants, reducing efficiency of pastures productivity of agricultural cultures.

Because of dusty sediments almost three times has increased the turbid of an atmosphere, and it has an effect for dispersion of solar radiation and temperature of a soil surface. The Aral sea absorbed heat in summer time and created it during winter. It created humidity to Priaral. Now humidifying action of the sea has decreased in 2 times. The large problem represents the wind deliverance of salt. In present the water of the sea contains about 10 milliard. tons of salt. The scattering of this salt on the ground with the thickness in 5 cm, will cover the territory by the area of approximately 10 mln. hctr. The transfer of such amount of salt in close irrigated areas represents the great danger. The hydrochloric dust, getting on pollen of blossoming plants, kills or sharply reduces crops. In the eyes of the inhabitants of Priaral, the formation of new desert - Aralkum is proceeded (fig. 4),

Almost 450 years ago an English chronicler Jenkinson wrote:

" Water, which all this country uses, is taken from canals, led from the river Oksus (Amu Darya - U.A. I.Z.) To a great exhaustion of this river.. in near future all this country will be, probably ruined and become desert because of lack of the water, when there will be no waters of Oksus".

The nature suffers, but people suffer more. As a result of complex development of region of the Aral sea and, as a consequence of drying, in region a level of disease and mortality among the population has increased, especially among the children (in Karakalpakstan the infant mortality exceeds a former Union level in 3 times). Has increased typhus and stone biliousness illnesses, chronic gastric, diseases of kidneys, gullet cancer, tuberculosis. Common stress of the population sharply has increased, that conducts to social intensity in a society.

THE ARAL SEA ²

The Aral sea is a large lake in Central Asia, which on the recent calculations (1900 -1902) occupies the area of 67 962 sq. km (without islands); the both main rivers of Russian Turkestan run into this lake: Amu Darya and Syr Darya. It seems that this lake was not known to the ancient; the most information can be found about the Aral sea in the inconsistent messages about Meotid in Central Asia {it is supposed, that the name of the Azov sea is transferred to Aral, as the name Tanais = Don is transferred onto Syr - Darya} and about "Oksyisk swamp" (Oxiane limne, palus Oxiana; Ammiak Marcelin - palus Oxia). In ancient Chinese sources (from II c. Up to d.a.) in area of the Aral sea in the most general words it is mentioned as "Northern sea" or "Western sea". Can it be that the Aral sea is identical to lake (Limne), mentioned by the Byzantian ambassador Zemarkh (568 d.e.).

More detailed news we can find from Arabian geographers. May be the Aral sea is mentioned already in Ibn Hordadbeha as Kurder lake (Buhaira). The description of this sea,without naming it, gives Ibn Ruste (the end of III c/the beginning of X c.); under his description the lake,intowhichruns Amu Darya,has diameter of 80 farsahs (according to Istahri and later authors, 100 farsahs). At a mouth of Syr Darya (at Ibn Haukal, two days of a way from "New settlement", arab. al-karyat al-hadisa, pers. Dihi-nau, turk. Yangikent, which is identified by ruins Djankent, approximately in 22 km to south-west of present Kazalinsk) coastal line IV / X c., obviously didn't differ from present. Same probablycan be said concerning a southern coast; Makdisi counts from Mizdahkan (situated opposite Gurgandzhda, or present Kuna-Urgencha, in 2 farsahs from a then right coast Amu) 2 days of a way up to Kurder, therefrom 1 day of a way and 2 post stations (barid, for 2 farsah) up to Parategin (written as: Berategin and Ferategin) and 1 more day of a way up to coast of lake. It is not possible to imagine whether there were the nowadays almost dried up lakes at Chinka, such as Aibugir,

¹ Bartold Vasilyi Vladimirovich (1869-1930) - one of the most known representatives Petersburg period of Russian Orientals the end of XIX-first third of XX centuries. The academician, professor of Petersburg university with from three age of 30 a member of almost all European academy and scientific societies, the specialist of widest range in east disciplines.

² From the book " the Encyclopedia of Islam ".

connected with the Aral sea. Anyway the Aral sea wasn't connected with Sarikamish. The one who wanted to make travel from Horesm and country of pechenegs, had (according to Gardizi) to move from Gurgandzh to "Khorezm mountains" (Chinku), and from there through waterless desert; "Horezm lake" remained to the right of this road. Istahri and later geographers describe "Horezm lake" (Buhairat al - Harizm) according to the validity as the closed salty lake; only Mahsudi (by this author the lake is named as city Dzhurjani, i.e.Gurganju) wrongly assumes the presence of connection between the Aral and Caspian seas. In Jahan-name (beginning VII / XIII c.) and in works dependent from this source (including at Jurjani, died in 881 / 1476-77), except the name " Horesm lake " is used also another name " Jend lake " (Buhaira-and Jend, by the known city in the lower current of Syr).

From VII / XIII up to X / XVI centuries we have no any data on Aral sea, except the borrowed earlier written sources. Hafiz-i Abru (820/1417) asserts, that the "Horezm lake" mentioned in "ancient books", during his time did not already exist any more. The Amu-Darya by that time in general considered as inflow of Caspian sea; on some sources, Syr Darya also did not run into Aral sea. Already in VIII / XIV centuries the merchant Bedr ad-dinar ap-Rumi (as mention by a geographer Ibn Fadlallahom al - Omari) makes Syr Darya " to change its direction " in three days of a way below Jend. According to Hafiz-i Abru, this river connects with Amu; by babur-name. Syr Darya does not connect with any river, but disappears in sandy desert. Regarding Amu, these geographical data can be confirmed with messages on historical events in a lower reaches of the river; but regarding Syr Darya we don't have any similar data. Even Abulgazi names Aral sea as " the sea of Syr " - Syr-tengezi; Abulgazi, apparently, didn't know that Syr Darya once did not run into this sea. Amu Darya, according to this author, only after 980/1572-73 again has found a way to Aral sea; raises the doubts, can these words relate to the Aral sea in the description about travel of Englishman Jekinson (1558r.). The word aral (the turkish, island here, probably, a designation of islands of delta) for the first time is mentioned at Abulgazi as the name "of place, where the river runs into lake"; from here the sea has received later this name (by Kyrgiz¹- Aral-tengizi). In XII /XVIII centuries the islands of delta with capital in Kungrade appear as the independent state which has been again united with Khiva only

at Mohammed - Rahim-khan (1221 - 1241/1806 - 1825),

From Russian sources the Aral sea for the first time is mentioned in so-called "the Big Drawing" (the beginning of XVII century) under the name "the Dark blue sea" and wrongly connected with Caspian sea. The same Russian name designates the sea on the map enclosed in Noord en bost Tartarye of Vitsen (first edition in 1687)². The name "Aral sea" for the first time is mentioned in Russian sources in 1697. On the West-European maps we find this name in 1723 (at Delili); however the Greek Vasily Vatatsi who has visited Central Asia in 1727, asserts as if he was the first who has brought the news about this lake to Europe, by making a big sensation in London. For the first time the lake has been scientifically described and taken on a map only by expedition of Butakov and Pospelov (1847-1848). The assumption, that the area of lake was considerably reduced for historical time (that cannot be coordinated to above mentioned historical data), has arisen as a result of repeatedly observed approach of a coastal line; however for the last 20 years in Aral sea, as well as in all other lakes of Turkestan, constant rise of a water mirror is observed. Everywhere water has reached a coastal line of 1847, and in some places has considerably passed it. Probably, and for past centuries it is necessary to assume periodic lowering and raising of a water mirror of lake, and in general natural-science theory of fast drought of the countries distant from the sea (Persia, Turkestan, etc.) appeared insolvent as a result of studying of the Arabian geographers.

The literature. In 1900--1902. L.Berg investigated the sea by the assignment of Turkestan department IRGO; the report about it see in newspaper "Izvestiya" of a corresponding department: Berg, Materials (besides the report of historical news about this sea by Bartold, Data about Aral sea and the essay of this work: Barthold, Russische Arbeiten [1902], 8, 216); also by him, the essay of Aral sea the same author in 1908 releases the detailed monography about Aral sea in Russian "Berg, Aral sea" (the title paper also in German: De r Aral-See. Versuch einer physisch-geographischen Monographic).

³ "kazahoz"

⁴ "the Map for the first time is published in 1687, the book - in 1692"

THE CHRONOLOGY OF ARAL

- 1627 In the book "Books, Glagoleva the Big Drawing " Aral sea named as" the Dark blue sea"
- 1697 On Remezov map* Aral sea (Aralsko sea) for the first time is represented as the internal lake completely separated from Caspian sea into which Amun-Darya (Amu Darya, Oks), Sirt (Syr-Darya, Yaksarg) and many small rivers.
- 1715 The first expedition by A. Bekovich-Cherkassk to Caspian sea. The most correct map of Caspian sea, the description of all east coast of Caspian sea almost till Astrabad gulf is made. Appeared, that Amu Darya does not run into Caspian sea.
- 1717 Peter's I trip to France where, in particular, he has met G. Delilja and has assured him that Oksus (Amu Darya) does not run into Caspian sea, but runs into completely unknown Aral sea.
- 1723 On the map of a French court geographer Delilja the Aral sea for the first time is named as Aral.
- 1731 The translator of Foreign Affairs Board Megmet Tevkel and two officers - geodesists have made first photo pictures of the coast of Aral sea.
- 1732 Greek Vasily Vatatsi asserts, that for the first time he has brought the first data on Aral sea to Europe.
- 1740 Lieutenant Dmitry Gladyshev and geodesist Ivan Muravin making film shooting from Kuvandarya (the left inflow of Syr-Darya) up to Hiva.
- 1741 I. Muravin created a map "A new map of the way from Sanburg through Kyrgyz, Karakalpak and the Aral territories up to city of Hiva and a part of the Aral sea and the rivers running into it, a part of Syr Darya, Kuvan Darya, Ulu Darya " (Ulu Darya - it is Amu Darya).
- 1753 English trader Hanvej was the first European who has plotted on a map a former dry channel of Amu Darya.
- 1820 Russian scientist Meivndorf has passed the places that at the end of XVIII century were filled with water of the sea.
- 1823 The expedition of Colonel Feodor Fedorovich Berg (Fridrih Wilhelm Rembert) to the western coast of Aral.

- For the first time have made a number of astronomical supervision and routing shooting of the western coast for military - topographical is made.
- 1825 Aral-Kaspyisk expedition by F.F. Berg.
- 1826-
1832 The map of the Aral sea made on the basis of the new data, described in A. Levshin's book " the Description of Kyrgyz - Cossacks or the Kyrgyz - Kaisaks hordes and steppes " .
- 1840 Shootings and astronomical definitions on northern and northeast coasts of Aral sea are carried out.
- 1847 Near the mouth of Syr-Darya strengthening of Raim is based.
- 1848 Alexey Ivanovich Butakov is appointed for shooting and the description of Aral sea. His well-known round-the-world seafarer F.F. Bellinsgauzen recommended. Under A. Butakov's management during 2 months a general studies of Aral sea have been made, measurement of depths, definition of breadths. The island named in honour of the Russian Emperor Nikolay I was open (in Soviet time has been renamed in Revival). It was part of Imperial islands, alongside with island "Konstantin", named in honour of Grand duke Konstantin Romanova, the president of Russian Geographical society, and island "Revival". In Orenburg under supervision Butakov constructs a two-gun schooner " Konstantin which has been delivered to Syr-Darya, for strengthening of Rayam in 64 kms from a mouth. The crew has consisted from 27 persons, including - the exiled poet T. G. Shechenko.
- 1850 J. Hanykov for the first time has published a map of Ivan Muravina in " Geographical news " issued by Geographic society, It had the name " the map of a path from fortress Orsk through Kirgiz, Karakalpak, Aral territories up to city of Khiva, described and is composed Geodesies by Ensign Muravinym in 1743 " ; The Hydrographic department of the Sea ministry prints a sea chart of Aral sea on the bases of shootings by

- Butakov and Pospelov;
The hydrographic map of Aral sea is published in Saint-Petersburg.
- 1851 Fort Raim is removed to Kazalinsk.
Maksheev's A.I. work " the Description of the Aral sea "is published in" Notes of Russian Geographical society".
In "Notes of Russian Geographical society the explanatory note for a map of Aral sea and Khivan Khans with their vicinities, is made and published by J.V.Hanykov.
- 1852 A.Butakov delivers the disassembled kind of two iron steamships to Raim "Perovskiy" and "Obruchev", constructed in Sweden.
- 1853 A. Butakov, being on a steamship "Perovskiy", was distinguished at capture of Kokand fortress Ak-mosque.
A.I.Butakov for the research of the Aral sea under an offer of A. Gumbolt has been elected as the honorary member of the Berlin Geographical society.
- 1854 Butakov transfers the Aral shipyard to a fort № 1 (Kazalinsk).
- 1855 A.Butakov has made the discription of Syr Darya from Kumsuat for 85 kms above Perovsk (Kizilorda).
Promoted in captains of 2-nd rank;
The Russian government has occupied the Bukhara-Afghani border on site of Kerki-iola with a staff of boundary armies in kishlak Pattagissor. Beside, has been decided to construct the military city Termez. The research for for an irrigation been made by B.N, Kastalskiy.
- 1858 A.Butakov floats withships of Aratsk flotilla across Amu Darya up to Kushrada for assistance of embassy in Khiva.
- 1859 A.Butakov with a troops of 140 persons makes military actions at Kungrada; then, " having delivered troops to Kazalinsk,bysteamship "Obruchev" has returned todelta of Amu Darya and has made its inventory down to Nukus.
- 1861 A. Butakov has delivered two steamships "Aral" and "Syr darya" to Kazalinsk, ordered by him in England and the USA.

- 1863 A. Butakov makes the inventory of r. Syr Darya from Perovsk up to natural boundary of Baildyr-tugaj for 807 versts.
- 1864 Russian armies under command of generals Tchernyaev, Skobelev and Golovachyov have crossed the Russian border and have acted in a campaign on Kokand and Khivan Khan reins.
- 1867 At the Annual Assembly of London Geographical society the chairman Murchison has declared an award of a medal of the founder of a society to admiral of Russian fleet A.I. Butakov " that admiral Butakov the first has lowered the ships on water and has founded navigation on Aral sea; and also for the successful research made by him subsequently in main mouth of Oksus (Amu Darya) in Khivan Khan rein. Having proved, that across Syr Darya running in northern Aral sea, steamships can rise on 500 miles upstream, Russia for the first time has opened to Europe a safe route of the connection with China through the western Turkestan ".
- 1868 Russian armies have occupied Tashkent and Samarkand, also Kokand and Khiva.
- 1869 Engineer - technologist N.F. Uljanov has made the project on which began construction of the channel from r. Syr Darya for an irrigation of the grounds of Hungry Steppe.
- 1872 The first irrigational construction of the main channel from Syr Darya, named "Kaufman" (works have been stopped in 1881 as per vast expenses) is organized.
- 1873 The contract is signed on which Bukhara emirs recognized protectorate of Russia above itself.
- 1874 N.A. Severtsev has passed along southern coast of Aral sea;
A. A. Tillo on behalf of Russian geographical society and his Orenburg department has made levelling in „ the Aral-Caspian region " ;
I.A. Strelbitsky for the first time has made calculations of the area of a water surface of Aral sea which has made 65780.1 km (without the area of islands).
The Russian geographical society has directed in Khivan Khans rein the expedition under the direction of known

- scientist N.G.Stoletov which surveyed Kunya Darya and Daudan from Amu Darya up to Sarikamish hollows.
- 1875 In Paris the monophafy de Gue is realised(De Goeje " Das alte Bett des Oxus ") about an old channel of Amu Darya.
- 1876 Geologist N.G.Petrusevich has found the Sarikamish hollow, on a basis of levelling from New Urgench its mark has been determined;
- 1877 the Office of the Turkestan general - governor has issued " temporary rules about irrigation in Turkestan territory";
the Second expedition of the Russian geographical society in Khivan under managemen of Fillipov for researches in delta of Amu Darya, shooting of sleeves and floods, drawing up of a hydrographic map (works were conducted during 3 years).
- 1878 In times of high waters the water of Amu Darya have reached up to Sarikamish hollows and have considerably lifted a level of its lakes (for more than 5m), placed on bottom.
- 1879 A member of an imperial family Grand duke Nikolay Romanov ordered to destroy a dam separating left-bank channel Kuna-darya from the main channel of Amu Darya.
- 1899 The work of A.I.Gluhovskogyi's expeditions on researches in Khoresm, the old stories of Amu Darya, Sarikamish hollows and Uzboi.
- 1883-
1881 A.V.Kulbars's (von Kulsbars) publishes " the Description of territory of the lower reaches of Amu Darya " in Notes of the Imperial Russian geographical society.
- 1882 Known climatologist and geographer A.I.Voejkov in his speech " the Rivers of Russia ", made on assembly of physical sciences departments Society of amateurs of natural sciences, anthropology and ethnographies, wrote:
"... A lower reaches on bottom and even on middle current of the rivers running in Aral, are so dry, That existence of Aral sea in its present limits is the proof of our backwardness, disability to take advantage in a sufficient measure in such weight of the current water

- and fertile silt that Amu and Syr bear. In the state able to use gifts of the nature, Aral would serve for a drain of water in winter (when it is not necessary for an irrigation), and also in summer high waters... ”.
- 1883 Geologist A.M.Konshin, studying areas of Sarykamyshta and Uzboy, has come to a conclusion that Sarikamish has been filled with water and connected with Araks in prehistoric times.
- 1885 At a court yard of Bukhara emir the Russian Imperial political agency was established which assisted Russian citizens in reception of concessions on irrigation of the empty grounds;
- 1886 Russia imports 67 tons of a cotton from Turkestan, "The status about management of Turkestan territory" was issued.
Grand duke N.K.Romanov has organized construction of Bukhar-channel in Hungry Steppe for an irrigation of the new grounds in steppe and supply of waters in possession of Bukhara emir (construction was conducted for 6 years). In Sirdarya the stone dam named by N.K.Romanov "Tsar - dam" was arranged.
- 1887 At Turkestan general - governor, the post of a regional irrigator " for management of large irrigated channels in area " was established and temporary rules about irrigation of Turkestan territory were issued.
- 1888 The office of the Turkestan general - governor Rozenbah has issued " the Instruction on the rights and duties of irrigational grades, district chiefs, canal-aksakals and mirabs on management of irrigation in Turkestani territory.
- 1889 I.A.Strelbitsky has repeatedly carried out the calculations of the area of a water surface of Aral sea on the basis of the map of the Asian Russia made by him, in scale of 1:4200000 and maps of the Asian Russia of the same scale issued in 1883 by a military - topographical department of the Joint Staff. The area of Aral sea has made 65252, 4 km². The area of islands 2517,0 km.
- 1891 Through the channel Buharyk ran water, however, after break of a dam on a head part it has been deserted.

- A great prince N.K.Romanov by his own means starts construction of the new channel named by him the channel of Nikolai I
- The priest from Vladimir-city A.Chajkovskiy has published a historical hypothesis of formations of Amu Darya "Turkestan and its ruiver".
- 1892 The post of the official assignments by an irrigational part is formed by the general - governor of Turkestan.
- 1893 V.I.Gluhovskoy has presented the project of passing the waters of Amu Darya on its old channel to Caspian sea for formation of continuous Amu Darya-Caspian water way from borders of Afghanistan across Amu Darya, Caspian sea, Volga and Marinsk system up to Petersburg and Baltic sea.
- 1896 J.A.Rehtazamer through Russian imperial political agency has made the application for construction of the channel in length of 300 versts from Amu Darya up to the grounds of Bukhara emirats. The channel Nikolay 1 (throughput 11 m³/s, length - 70 versts, the area of an irrigation - 7 thousand tens) started to operate.
- 1897 The management of agriculture and state property of Turkestan territory was established.
- 1899 L.S. Berg, the prominent researcher of Aral sea, in future academician of the USSR, the president of all-union geographical society, travels along a coast of the sea and makes scientific works in the sea.
- 1900 L.S.Berg publishes the book " Fishes and fishery in mouth of Syr Darya on the Aral sea "
- 1901 L.S.Berg published " Sketch of the Aral sea " in magazine " Physical geography ".
The construction of the main channel under the project of F.A Elistratov for an irrigation of 45 thousand tens in north east part of Hungry Steppe began. In 1913 the construction was finished.
- 1902 Bartold, basing on collected by him the historical archeologic data, has established, that waters of Amu Darya flew on Uzboi from half of XIII century till 1573, though the facts testifying the use of Uzboi for navigation in 1392;
Bartold publishes monography " Data on the Aral sea

- and a lower reaches of Amu Darya in the most ancient times up to XVII centuries "
- 1903 In the Russian Turkestan the American "archeologic" expedition worked. In its structure there was E.Hantington who later became the largest geographer.
- 1905 A.A.Tillo' and U. Shokalskyi published their researches in which the area of the Aral sea was included.
- 1906 L.S.Berg in detail surveyed the coast, depths, structure of water, fauna of the Aral sea.,
- 1907 American geographer E.Hantington has released the book " The Pulse of Asia " in which hopelessness of development of irrigated agriculture in Central Asia was proved.
- 1908 Issue of the book of L.S.Berga "Aral sea. Experience of the phisic-geographical monography "
- A.I.Voejkov has acted with article " Irrigation Zakaispisk area from the point of view of geography and clmatology", published in News of the Imperial Russian geographical society. L.S.Berg names this article " the best - ornament of the world geographical literature "; A.I.Voejkov wrote an article "Cotton in Turkestan territory and conditions of its development " and emphasized in it:"In Amu there is so much water that it is possible to irrigate more than 4 millions hectares ").
- 1910 The rules " About the sanctions to private businessmen to make the researches for an irrigation of the grounds in Turkestan " were issued.
- 1911 At Turkestan management of agriculture and state property the Hydromodular part is created, headed by land-reclamation engineer A.N.Kostikov (later academician VASHNIL, corresponding member of the USSR, the founder of Soviet meliorative science); M.N.Ermolaev has developed the schematic project of an irrigation of lower reaches of Kashkadarya in two turns: 1 - to irrigate the ground in east area of Kerkinsk by waters of the rivers of Kashkadarja and Guza-Darya; 2 -with waters of Amu Darya to irrigate southern area Kelifo-Kerkinsk;
- Department of ground improvements has organized a party of irrigating researches in Bukhara under

- E.N.Blumberg's management. M.N.Ermolov has developed the schematic project of an irrigation of lower reaches of Kashkadarya.
- 1912 A.G. Ananjev has received the first irrigating concession in Bukhara emirats (72,5 thousand tens of grounds).
- 1913 Opening of the channel named Romanov - the first successful irrigational object in all Turkestan. The area of an irrigation of 32 thousand tens due to waters of Syr Darya. "
- 1914 V.V.Bartold publishes the book "the History of an irrigation of Turkestan"
- 1915 F.P.Morgunenkov offered the project of an irrigation of the empty grounds of southeast coast of Caspian sea with winter and superfluous waters of Amu Darya. The fence of water ' in the channel from Amu Darya should be higher than Nukus at a mouth of Tahiatash. After realization of this project as asserted by F.P.Morgunenkov, the territory of Zakaspijsgaj turned in " Russian California and Russian Egypt ".
- 1918 V.I.Lenin has signed decree of sovpubcom " About assignment of 50 million roubles for irrigational works in Turkestan and about the organization of these works"., In Tashkent the resolution on the organization of Turkestan autonomous republic is accepted. Turkestan Management on water management "Turkvodohoz" and Technical irrigational committee Is organized. All main channels and irrigational constructions of Turkestan republic went in conducting of the National Commissariat of Agriculture.
- 1920 Decree of Council of National Commissioners of RSFSR "About restoration of cotton culture in Turkestan and Azerbaidjan Soviet Socialist Republics". The proclamation of former Khivan Khan rein of the Khorezm National Soviet republic. the council of National Commissioners of RSFSR has ratified the Head comitee for water management and land improvement of VSHN, which had the responsibilities for management of irrigating works in Turkestan. Bukhara National Soviet Republic was established.

- 1921 G.K.Rizenkampf has offered schematic civil-engineering project of Trans-Kaspian channel with a fence of water from Amu Darya with interflow of Vakhsh and Pijanji at a length of 1500 versts for an irrigation of 300 thousand tens in Afghanistan and 2200 thousand tens in Kaspian area.
- 1924 Session of the Central Electoral Committee of Councils of the USSR has accepted the decision about formation of new Soviet Socialist Republics of Central Asia.
- 1925 On the First Turkmen congress of Councils brings an attention to the question about transfer of waters of Amu Darya to southern oases of republic and Western part of Turkmenya;
Under the direction of engineer G.N.Vinogradov the scheme of the water-ground use in the reservoir of Kashkadarya is made.
The project negatively answered to a question on an opportunity of water delivery in steppe Karshinskuyu.
- 1927 "The water from Amu Darya is put to Kelif Uzboi. Trial dump has passed through chain of Kelif hollows on 100 km;
The management of Amu Darya delta irrigated systems was established (UPRADIS) in Novo-Urgench.
The book by V.V. Tsinzerling "The irrigation on Amu Darya" was published.
- 1929 The presentation of Aral fishcraft station.
- 1930 The technical and economic report " the Problem of nutrition by waters of Amu Darya of the western areas of Uzbekistan " was made.
- 1933 The construction of meat factory in Muinak has began. Construction has been finished in 1941 First canned food of beef and turtle meat was produced. Then it became fish-canning factory.
- 1935 In Kara-Kalpak is constructed the main canal Kyzylketken by extent of 25 kms with the head charge of 210 m ' /c. A fence of water from Amu Darya.
- 1936 A small platform for tests of the biological weapon is organized on the island of Revival.
- 1937-
- 1939 The forest reserve on island of Barsakelmes with a

view of protection of a deserted complex and restoration of animals for it was organized: a saigak, dzheiran, the yellow suslik.

Channels Su-ali and Leninyab are incorporated into one large channel in a head of construction of engineering type. The new channel got the name of V. I. Lenin Decision of Central Committee VKP(b) and SNK USSR "About measures on the further rise of cotton industry in Uzbekistan".

1940 "Decision of the Government of the USSR and Central Committee VKP (b) " About measures on the further rise of an agriculture and, in particular, cotton in Turkmen SSR ". By the decision it has been told: "... To start since 1940 to pass of Amudarya waters on a channel of" Kelif Uzboi; to carry out submission of Amudarya waters in basins of the rivers of Murghab and Tedzhen for the further development of an irrigation there". A channal "Lenin" is constructed in the extent of 110 kms with the head charge of 240 m³/s for an irrigation of the grounds on the left coast of Amu Darya in Hodzhelyisk and Kungrad regions.

1943 On SyrDarya the Karakum water reservoir was built.

1944 CK VKP (b) has accepted a decision on measures of reconstruction and developments of cotton industry in Uzbekistan".

1945 Decision by Sovnarkom of the USSR " About measures on restoration and the further development of cotton industry in Uzbekistan " .

1946 Decision of 1945 is promulgated by special decision of Sovnarkom of the USSR " About the plan and actions on restoration and further rise of cotton industry in Uzbekistan for the period of 1946-1953 "

D.Zajkov publishes " Modern and future water balance of Aral sea".

In Tashkent Kurulyai the promise is given to Stalinu I.V. "from a name of Uzbek people to 1953 to finish a manufacture of cotton in Uzbekistan with 2400 thousand tons.

1948 It is constructed Farhad hydrosystem is constructed (HYDROELECTRIC POWER STATION and a water basin

- of daily regulation in useful volume of 0,15 km³), providing a main water-fence from r. Syr-Darya for an irrigation of all Hungry and Dalverzinsk steppes.
- 1949 The decision of Council Ministers of the USSR from March, 19 March 1949, № 1140 " About actions on the further development of cotton production in Tadjik SSR for 1949-1952 ".
The decision of Council of Ministers of the USSR from March, 19, 1949 № 1141 " About measures on the further development of cotton production in Uzbek SSR for 1949-1952).
L.S.Berg in the academic series <<Results and problems of a modern science " has released the book " Sketches on a history of Russian geographical discoveries " in which he has included the chapter " A.I. Butakov - the researcher of Aral sea ".
On island of Revival the construction of the first (and the largest) in the USSR the range for test of the bacteriological weapon on the basis of the Siberian ulcer has begun, also plague, Q-fevers and other most dangerous infections.
- 1950 Under I.V.Stalina's initiative the decision of Council of Ministers of the USSR from 11 September 1950 № 3906 " About construction of the Main Turkmen channel Amu Darya - Krasnovodsk, about an irrigation and watering of the grounds of southern areas of Prikaspijsk plains in Western Turkmeniya, the lower reaches of Amu Darya and the western part of desert of Karakum is accepted.
construction of the Main Turkmen channel Is started.
The kid of the Aral pike perch are removed to the lake Balkhash.
- 1951 Decision of Council of Ministers of the USSR from April, 30, 1951 № 1426 " About measures on maintenance of performance with the Ministry of cotton industry of USSR, the Ministry of Agriculture of the USSR and the Ministry of state farms of the USSR design and survey and building works on an irrigation and watering the grounds in connection with construction of Main Turkmen channel Amu-Darja-Krasnovodsk " .

- The beginning of construction of the Amy-Bukhara channel.
- 1952 the Decision of Council of Ministers of the USSR from September, 2, 1952 № 3975 " About an irrigation and land development for the further development of cotton production in Andizhan, Namangan, Fergana and Surhan-darvin areas of Uzbek SSR".
- 1953 the Decision of Council of Ministers of the USSR from October, 22, 1953 № 2673 " About reorganization of management of construction of "Sredazgipstroj" of the Ministry of Agriculture and preparations of the USSR in trust on construction of water-economic constructions in cotton-growing areas of Central Asia ".
In connection with the found stocks of fresh water in lens of "Yashan" (sufficient for satisfaction of requirements of the Western Turkmenistan), construction of the Main Turkmen channel is stopped.
- 1954 the Decision of a Central Committee of the CPSU and Council of Ministers of the USSR " About the further development cotton production in Uzbek SSR in 1954-1958 ":
the Decision of a Central Committee of the CPSU and Council of Ministers of the USSR from April, 21, 1954 № 747 " About the further development of cotton production in Turkmen SSR for 1954-1958 ".
the Decision of a Central Committee of the CPSU and Council Ministers of the USSR from June, 5, 1954. № 1114 "About the further development on cotton production in Tadjik SSR for 1954-1960".
Bio-range on island Revival has began to work.
On peninsula Kulandy specially for needs of militarians from island Revival a stud been bult - the nutrient medium which prepared from horse blood was necessary for creation of stamps.
- 1956 The beginning of Kara Kum canal. Construction.
the Decision of a Central Committee of the CPSU and Council of Ministers of the USSR from August, 6, 1956 № 1059 " About an irrigation of virgin lands of Hungry steppe in Uzbek and Kazakh SSR for increase in manufacture of a cotton ".

- L.K.Binnova's book " Hydrochemistry of Aral sea " was published.
- 1957 M.M. Rogov's book "Hydrology of delta of Amu Darya " has come out of press.
- 1958 The Decision of a Central Committee of the CPSU and Council of Ministers of the USSR from June, 14 1958 № 645 " About the further expansion and acceleration of works on an irrigation and land development in Uzbek SSR, Kazakh SSR and Tadjik SSR". The USSR publishes a book by Lopatin G.V., Dengin R.S., Egorov V.V. "the Delta of Amu Darya".
- 1959 The Decision of a Central Committee of the CPSU and Council of ministers of the USSR from 2 june 1958 № 841 " About measures on development of the irrigated grounds in a first-order zone of Kara Kum canal and second-order construction of this channel in Turkmen SSR "
- In publishing house " Geographizdat " in Moscow, was published Lykarev's book "The Aral sea".
- 1960 The average level of Aral sea - 53,40 m and inflow of water to the sea across Syr-Darya and Amu Darya is 56,0 km³, a mineralization of water - 7,2 g/l.
- 1961 The decrease of a level of Aral sea has begun. Constructed self-flowing south hunger steppe channel in the name of A.A.Sarkisov (extent of 127 kms, the charge in a head of 360 m³/s
Constructed Karshinsk channel.

The mark of the Aral sea level - 53,29 m

- 1962 The decision of a Central Committee of the CPSU and Council of Ministers of the USSR from June, 29, 1962 №747 "About measures on liquidation of backlog in development of cotton production in Turkmen SSR".

The mark of the Aral sea level - 52,97 m

- 1963 the Order of Council of Ministers of the USSR from December, 24, 1963 № 2540 " About a spadework on an irrigation and land development of steppe Karshinsk

in Uzbek SSR and steppes of Kzyl-Kum in Kazakh SSR". On base of Glavgolodnosteppestroj of Ministry of Agriculture SSR the Main Central Asian management on irrigation and construction of state farms is formed. On Amu Darya the construction of Tahiatash hydrounit had begun which guaranteed water-security up to 900 thousand hctrs of the grounds in a lower reaches of Amu Darya.

Hydrographic service of the Navy of the USSR publishes "Locies of Aral sea".

The mark of the Aral sea level - 52,61 m.

1964 Uzbekistan has made 4 million tons of a raw-cotton.

The mark of the Aral sea level - 52,49 m

1966 Plenum of Central Committee of the CPSU has accepted the Decision " About wide development of land reclamation for reception of high and steady crops grain and other agricultural crops ". In its frameworks the plan of an irrigation has been developed and drainages of the grounds, designed for 10 years (1966-1976.).

Karakalpakrissovhozstroy is organised in which all rice sowed state farms were included from various ministries and departments.

The mark of the Aral sea level - 51,89 m.

1967 On r. Sanzar the bulk Dzhizak water basin of seasonal regulation with full (and useful)volume is constructed. Central Committee of Uzbekistan and Council of Ministers of Uzbek SSR have accepted the Decision " About urgent measures on increase in manufacture of rice, increase of water-security and meliorative improvement of the grounds of collective farms and state farms in Karalkalpak SSR ".

The Limarev book was published "Coasts of Aral sea of an internal reservoir of arid zones"

The mark of the Aral sea level - 51,57 m

- 1969 The Institute of Geography of the USSR issues the collection " Problems of Aral sea " under edition of S.J.Geller.
B. V. Andrianov's book is published "Ancient irrigating systems of Priaral (in accordance with the creation and development of irrigation)

The mark of the Aral sea level - 51,29 m.

- 1970 The Decision of a Central Committee of the CPSU and Council of Ministers of the USSR from June, 25, 1970 № 482 "About acceleration of works on an irrigation and land development of steppe Karshinsk in Uzbek SSR".
For the first time the future of Aral sea is considered in report of prospects of development of land reclamation for 1971-1985, regulation and redistribution of a drain of the rivers "; prepared by the State plan of the USSR, the Ministry of Agriculture of the USSR, Minvodhoz of the USSR and VASHNIL and approved by Central Comitee And Council of Ministers of the USSR in 24,07.1970 No. 612.
"Navigation across Aral sea Has stopped.
The beginning of construction of Tuyamuyunsk hydrounit for 452 kms from a mouth of r. Amu Darya which will allow to irrigate 500 hctr.of grounds. With hydrounit three coastal water basins are constructed: Kaparas - with full capacity 1 km, Sultansanjar - 2,7 km, Kosibulak - 1,5 km.
The Aral sea level - 51,43 m; volume - 964 km³; area - 60,3 thousand km².
"The atlas of ice of the Aral sea" was published.
- 1971 Decision of the Ministry of the USSR, May13, 1971 № 284 " About measures on the further development of a national economy of Turkmen SSR " (in 1971-1975 to bring the irrigated grounds - 105 thousand hctrs, improvement of meliorative conditions - 200 thousand

hctrs, reconstruction of irrigated systems of 80 thousand hctrs, a capital plan -2 thousand. hctrs).

State plan of USSR on the basis of Decision Central Comitee and Council of Ministers of the USSR from 16.04.1971" About measures on the further development of land reclamation and their agricultural development for 1971-1975 " has given instruction for Ministry of water economy of the USSR to develop actions on the organization research and design works on transferring parts of a drain of northern rivers in a river basin of Volga and the Siberian rivers in basin of the rivers of Syr-Darya and Amu Darya.

the Beginning of construction of Karshinsk channel with a water-fence of 5 km³ annually.

Began construction of big Karshinsk channel. Six pump stations lifted water for 150 m above the Amu Darya with the charge of 240 m/c, for about 5 km³ in one year.

The mark of the Aral sea level - 51,06 m.

1972 In magazine " Water resources " №1 the scientific report is published by a group of leading scientists of Institute of water problems on a problem of Aral sea. "Scheme of complex use of water resources of Aral sea basin " Is made.

Decision of Central Committee of Uzbekistan and Council of Ministers of Uzbek SSR "About measures on the further rise of an agriculture in Karakalpak SSR".

The mark of the Aral sea level - 50,54 m.

1973 Amu Darya water has come to steppe of Karshinsk. The book "Microbiology of Aral sea" by M. N. Novozhilova in Alma-Ata was published.

The mark of the Aral sea level - 50,22 m.

1974 Input for operation of Tahiatash hydrounit, the last constructed on Amu Darya, in front of Aral sea.

the Atlas of non-backboned of Aral sea" was published.

The mark of the Aral sea level - 49,85 m.

- 1975 Under the management of Academician Gerasimov I.P. works the temporary scientific and technical commission GKNT by an estimation of influences of changes of a level of the Aral sea on an environment and economy of adjoining region.;
- In Tashkent the First coordination meeting on studying influence on an environment and an estimation has taken place and socio-economic consequences of decrease of a level of the Aral sea".
- In publishing house of the Moscow State University the A. N. Kosarev's book "the Hydrology of the Caspian and Aral seas" is published.

The mark of the Aral sea level - 49,01 m.

- 1977 the Second coordination meeting has taken place In Alma-Ata on studying influences on an environment and an estimation of social and economic consequences of decrease of a level of the Aral sea".
- The all-Union meeting has taken place in Moscow " Scientific bases of actions on prevention of negative consequences of decrease in a level of Aral sea".

The mark of the Aral sea level - 47,63 m.

- 1978 The Decision of a Central Committee of the CPSU and Council of Ministers of the USSR "About carrying out of research and design works on a problem on transfer of northern and Siberian rivers in southern areas of the country" is accepted.

The mark of the Aral sea level - 47,06 m.

- 1979 Decision by Soviet Ministry of the USSR from March, 26, 1979 № 283 "About measures on the further economic and social development of northwest areas

of Kashkardarjinsk of area of Uzbek SSR" (in 1979-1982 to enter the irrigated grounds - 10 thousand hctr). Began filling the Tuyamuyun reservoir with water on Amu Darya.

On island Barsakelmes ("You will go - you will not return") the national park is organized.

The mark of the Aral sea level - 46,45 m.

- 1980 In Nukus the session of presidium AN USSR has taken place in the form of scientific - practical conference "Problems of Aral and in deltas of Amu Darya". At the meeting on the State Committee on a science and techniques (SCST) the decision on establishing of special TED on problem of Aral which is entrusted to Souzgiprovodhoz is accepted. Within the framework of preparation of the report carrying out of research works has been planned as task of SCST "To investigate influence of water-economic actions on a mode of Aral sea and connected with decreasing level of social and economic developments of Priaral. To develop scientific bases and actions on rational use and protection of natural resources in conditions of anthropogenous desertification of Priaral". The parent organization on scientific researches had been appointed The Institute of geography of AS of the USSR. On Northern Aral the last fish is caught.

The Level of Aral sea - 45,75 m; volume - 644 km³; the area - 51,7 thousand km².

- 1981 In Moscow the All-Union coordination working meeting under task of SCST is held. In Tashkent the A> AA. Rafikova, G. F.Tetjuhin's book "The Decrease in level of the Aral sea and change of an environment of a lower reaches of Amu Darya" is published.

The mark of the Aral sea level - 45,18 m.

- 1983 The Institute of geography of AS of USSR at participation of SOPS of the State plan of the USSR and Souzgi provodhoz has prepared and has transferred scheduled bodies and a Central Committee of the CPSU special " the Report concerning degradation of eco-system of Aral sea and deltas of Amu Darya and Syr Darya and the anthropogenous desertification of Priaral caused by irrevocable withdrawal of a drain of the Central Asian rivers with the purpose of an intensification of irrigated agriculture ".
In Moscow the all-Union coordination working meeting under task of SCST is held.

The mark of the Aral sea level - 43,55 m

- 1984 In Tashkent the book "The Problems of Aral sea and in delta of Amu Darya" is published.

The mark of the Aral sea level - 42,75 m

- 1985 In Nukus the regional session of Central Asian branch VASHNIL devoted to questions of Aral and delta of Amu Darya has taken.
In Moscow the final all-Union coordination working meeting under task of SCST is carried out.
Technical and economic report (TER) by Souzgidrovodhoz on regulation of a water mode of the Aral sea is made with the help of Institute of Geography AS of the USSR and AS of UzSSR, KazSSR, TurkSSR and other organizations.

The mark of the Aral sea level - 41,94 m

- 1986 The decision of a Central Committee of the CPSU and Council of Ministers of the USSR from March, 17, 1986 № 340 "About measures on acceleration of economic and social development of Karakalpak SSR" (in 1986-1990 input of the irrigated grounds of 52 thousand hectares, a capital lay-out of the irrigated grounds - 25 thousand hectares, improvement of a

meliorate condition - 10 thousand hectares, a reorganization of irrigating systems - 10 thousand hectares).

The decision of a Central Committee of the CPSU and Council of Ministers of the USSR "About cessation of work on transfer of parts of a drain of northern and Siberian rivers".

È111Nukus visiting session of AS of USSR on problem of Aral in which 78 organizations of Moscow have taken part, Leningrad, Uzbekistan, Turkmeniya, Kazakhstan is carried out etc.

The mark of the Aral sea level - 41,10 m

1987 The session of specially created Governmental commission on an ecological situation in Aral sea basin under J.A.Izraelja's presidency.

The Governmental commission for preparation of offers on improvement of water delivery of a national economy is created led by vice-president of AS of the USSR academician. V.A.Koptjugom.

In Nukus the state commission works under the direction of chairman of Goskomgidromet of the USSR J.A.Izraelja on studying an ecological and sanitary condition of coast of Aral sea.

The group of scientists of Institute of water problems of AS of USSR has sent the letter to a Central Committee of the CPSU with alarm for destiny of water delivery of republics of Central Asia.

The book is published by Molosnova G.I, Subbotina O. I and Chanisheva "Climatic consequences of economic activities in a zone of Aral sea".

Rubanov I.V., Ishnijazov D.P., Baskakov M.A and Chistjakov P.A.'s book "Geology of Aral sea" is published. In system of Ministry of Land Improvement and Water Conservation of the USSR are created the basin water-economic associations (BWO) "Amu Darya" and "Syr-Darya".

The water level in Aral has decreased to a mark of 40,29 m, volume - up to 401 km³, and the area of a

mirror - up to 41,1 thousand km², the mineralization of water has exceeded 20 g/l.

The small sea was separated from Big and there was a drained crosspiece.

1988

The decision of a Central Committee of the CPSU and Council of Ministers of the USSR "About measures on radical improvement of ecological and sanitary conditions in area of Aral sea, to increase of efficiency of use and strengthening the protection of water and ground resources in its basin".

The report of the Governmental commission "the Modern condition and offers on cardinal improvement of ecological and sanitary-and-epidemiologic conditions in area of Aral sea and lower reaches of the rivers of Amu Darya and Syr Darya" is prepared.

Complex scientific-journalistic expedition "Aral-88" is organized under the initiative of editions of magazines "Pamir" and "the New world" (the head - G.I.Reznichenko).

First All-Union meeting on problems of the Aral basin "Ecology and the literature", organized by Public committee on rescue of Aral at the Union of Writers of Uzbekistan. The meeting was mobile (Tashkent - Nukus - Muinak - Uchsai - the Tashauz Channel - Horezm - Tashkent).

In Moscow in the Central house of the writers and in editions of some newspapers and magazines under the initiative of the Uzbek public committee on rescue of Aral, the Kazakh public committee on problematics of Aral and Balkhash, and also the international movement of poets "XX century. The world and ecology" have been carried out.

In Nukus organization "Aralvodstroi" for rescue of Aral is created.

There was a separation of Small Aral from Big Aral. Because of abundance of water the crosspiece between Small and Big Aral has disappeared.

The Mark of a level of Aral sea - 39,75 m

1989 The decision of the Supreme Soviet of the USSR "About urgent measures of ecological improvement of the country". It ascertained, that "... the situation in area of the Aral sea has practically got out of control. Priaral became a zone of ecological disaster".

The decision of Council of Ministers of the USSR creates Research coordination center "Aral". It was headed by V.M.Kotljakov - director of Institute of geography AS of the USSR.

The decision of Council of Ministers of the USSR "About the organization and work on artificial increase in deposits in mountain areas of Central Asia with a view of updating water-stocks of the rivers of Amu Darya and Syr-Darya and Aral sea".

Problem of Aral was discussed on specially called Academic council of Institute of geography of AS of the USSR. The group of participants of public Aral movement has addressed to the Second congress of People's Deputies of the USSR, and also in Political Bureau of the CPSU, Supreme Soviet of the USSR and CM of the USSR with an appeal to reconsider the program of the decision of the Aral ecological crisis and to displace the accents on the decision of urgent social problems.

In Shavat city the symposium "Development of the concept of social - ecological development of lower reaches of Amu Darya (Priaral) as special an economic zone" has taken place.

Selection of materials is published in magazine "New world" and "the Aral accident".

The known geographer Smiths N.T. Publishes in News of AS of the USSR in a geographical series "the open letter to scientists, writers, water-business executives, everyone that is worried with an ecological situation in Priaral".

The meeting has taken place in Nukus "Problems of Aral and Priaral".

Workers of a science, literature and culture of Uzbekistan created special fund of rescue of Aral (the account № 007007778 in Kuibishevsk branch in

Tashkent Gosbank).

Problem of Aral was discussed on specially called Academic council of Institute of water problems of AS of the USSR.

The big sea was separated from Small.

The mark of the Aral sea level - 39,08 m.

- 1990 The Supreme Soviet of the USSR has recognized the Priaral as a zone of ecological accident. The Supreme Soviet of Turkmen SSR has accepted the decision "About an ecological condition of territories of Priaral of Turkmen SSR and measures on its improvement". It has been recognized, that territories of Tashauz and the area of Chardzhousk Dargan-Atinsk are the zones of ecological disaster. Union-republican consortium "Aral" which founders became the governments of Uzbekistan, Kazakhstan, the Kyirghyz, Tadjik, Turkmen and Karakalpak republics, state concern "Vodstroj", Khorezm, Kyzyl-Orda and Tashauz Executive Committees is created. The governmental commission for development of measures on restoration of ecological equilibrium in Priaral and the control over their realization has declared competition on development "Concepts of preservation and restoration of Aral sea, normalization of an ecological, sanitary-and-hygienic, medical and biologic and social and economic situation in Priaral".
- 1990 In Alma-Ata under the initiative of the Kazakh Association for the United Nations "the International round table" "How to save Aral" has taken place. In Tashkent Akramov Z.M., Rafikov A.A.'s book "the Past, the present and the future of the Aral sea" is issued. Under the invitation of executive director UNEP M.Tolby the trip to Nairobi delegations of Committee of a Supreme Soviet of the USSR on questions of ecology and rational use of natural resources has taken place. In the signed Report a number of arrangements has been fixed, in particular, management of UNEP has

agreed to speed up realization of the Aral project and to increase its status. In structure of UNEP the Center on Aral should appear.

1991

The Decision of the CM USSR " About a course of performance of the CM USSR Decision "About urgent measures of ecological improvement of the country on problems of Aral sea". In it the Aral problem is named "the largest ecological accident of our planet".

In Minsk at the first meeting of country leaders of the CIS, the Report on preparation of the intergovernmental agreement on problems of Aral has been signed.

The second meeting of the international working commission of experts of the project of the USSR / UNEP has taken place in Moscow. The purpose of meeting - discussion of substantive provisions " Concepts of preservation and restoration of Aral sea, normalization of an ecological, sanitary-and-hygienic, medical and biologic and social and economic situation in Priaralye".

The third session of the international working commission of experts under the project of the USSR / UNEP "Assistance in preparation of the Plan of action on preservation of Aral sea".

At the Meeting of ministers of land improvement and a water management of the Central Asian republics in Tashkent the Application on sharing water resources of Aral sea basin, is accepted.

"Sovintervod" has developed Substantive provisions of the Circuit of complex use and protection of water and ground resources of basin of the Aral sea till 2010. Ministry of Natureof the USSR, AS of the USSR, Ministry of Health of the USSR, Ministry of Agriculture and Food Production of the USSR have developed the Concept of preservation and stage-by-stage restoration of Aral sea in its coordination with conditions of social and economic development of republics of Central Asia and Kazakhstan.

AS of the USSR and the GCN(Goscompriroda) of the USSR withparticipation of representatives of Republics of Central Asia and Kazakhstan have developed

Substantive provisions of the concept of preservation and restoration of Aral sea, normalization of an ecological, sanitary-and-hygienic, medical and biologic and social and economic situation in Priaralye.

The institute of geography of the AS of Kazakhstan has developed Conceptual bases of the interstate program of liquidation of consequences of the Aral crisis.

NGO SANIIRI (Uzbekistan) has developed the Concept under the decision of a problem of the Aral region in view of social and economic development of republics of Central Asia;

In Central Asia construction of new large irrigating systems and commissioning of new files of the irrigated grounds in area of Aral sea is suspended.

NIKC "Aral" publishes the collection "the Aral crisis (historical-geographical retrospective show)".

In the USA magazine " Environment " publishes article of director of Institute of geography of the AS USSR V.M.Kotlyakova " Aral sea basin - a critical ecological zone".

The president of Institute of the world watch (Worldwatch) proff. Leicester Brown publishes in the USA article "Aral sea goes, goes, goes ..." (Aral Sea: Go, Go. Go ...).

1991 In the USA F.Miklina's monography " Crisis of water resources management in the Soviet Central Asia " (The Water Management Crisis in Soviet Central Asia) has left.

Conference in New York, the USA, " Crisis of Aral sea".

In the USA in magazine "World and I" M.Glyants and I.Zonn's article about a situation in Aral - "Silent Chernobyl" (A Quiet Chernobyl) is published.

The Book of V.P Zuev "Aral impasse . Circulation for one sea (Experience of private{individual}investigation of the Aral accident)"has left.

In a series of monographies " History of lakes of the USSR" has left the fifth book " the History of lakes Sevan, Issyk Kul, Balkhash, Zaisan and Aral".

Independence of republics of Uzbekistan, Turkmenistan and Kazakhstan is proclaimed.

Mark of a level of Aral sea - 37,56 m

- 1992 In Almaty has taken place the meeting of heads of water-economic bodies of new Central - Asian republics where the Agreement between Kazakhstan, Kirghistan, Uzbekistan, Tajikistan and Turkmenistan about cooperation "in sphere of a joint management of use and protection of water resources of interstate sources" has been signed .
- In Tashkent the heads of the water-economic organizations of five countries of the Central Asia have signed " Regulations about of the interstate coordination water-economic commission" (ICWC).
- Extraordinary VIII session of a Supreme Soviet of Republic Karakalpakstan of the twelfth convocation has accepted the decision " About a recognition of territory of Republic Karakalpakstan a zone of ecological disaster " .
- The university of the United Nations and Global Fund of the Infrastructure, Japan, in Tokyo organize the International symposium " Management of an environment of region of Aral sea " .
- Issue of the book of Grigory Reznichenko " the Aral accident " (a diary of the expedition "Aral-88").
- UNEP publishes " Diagnostic research " on development of the Plan of action for Aral sea (Diagnostic Study for the Development of an Action Plan for the Aral Sea Basin).
- The UNESCO together with the Federal Ministry of Education and researches of Germany have begun st. phase of the project on ecological researches and monitoring of deltas of Aral sea as bases for restoration (the project proceeded till 1996).
- On August, 27-28 the International scientific - practical conference has taken place in Nukus on development of the basic directions of the decision of the problems, connected with ecological accident of Aral sea in which presidents of Academies of sciences of the Central - Asian states, about 100 prominent scientists and experts

of Russia , the USA, Japan, Germany, Holland and other advanced countries of the world have taken part. The resolution and the reference of conference to the United Nations, presidents, the governments and parliaments of the Central - Asian republics have called to declare the Priaralye zone of ecological disaster and to create international body on coordination of actions of the world community on rescue Aral.

Closing biorange on island of Revival as the island has departed to Uzbekistan and Kazakhstan (after disintegration of the USSR).

In Tashkent R.M.Razakov 's book "The Aral sea and Priaralye : problems and decisions" is published.

In magazine "Water resources", №2 a line of articles on problems of Aral sea basin by G.V.Voropaeva, D.J.Ratkovicha, A.I.Budagovskogo and L.V.Ivanovoj, are published.

In the USA, at University Villanova of Pennsylvania state, the seminar " Central Asia : its strategic value and prospects "has taken place. At a seminar the report of M.Glyantsa, A.Rubinstajna (USA) and I.Zonn (Russia) "Tragedy of Aral sea basin: a sight in the past at planning the future "has been submitted (Tragedy in the Aral Sea Basin. Looking back to plan ahead).

The Stockholm institute of an environment of the Boston Center has published results of microcomputer model for modeling existing water balance and an estimation of strategy of water resources management in region of Aral sea.

Mission of the World Bank on five republics of the Central Asia.

Creation of scientific body ICWC on water-economic problems of Aral sea.

Mark of a level of Aral sea - 37,20 m.

1992-

1993 "The Program of Aral sea basin" is represented to the World Bank.

1993 In Kzil-Orda, by five presidents of the Central - Asian

republics "the Agreement on joint actions under the decision of a problem of Aral sea and Priaralye, to ecological improvement and maintenance of social and economic development of the Aral region " is signed . The heads of the states of the Central Asia initiate creation of the International Fund of Saving the Aral. By the president of Fund the president of Republic Kazakhstan N.A.Nazarbaev is elected.

Statement of the president of Uzbekistan I.Karimova on 48th. sessions of General Assembly of the United Nations in New York, the USA. In particular, he has told: "Taking into account really global scales of accident, Uzbekistan would welcome creation of the special Commission of the United Nations on Aral which as agreed with the governments of region and through opportunities of the United Nations would involve the international forces and means in the decision of this ecological tragedy. Among first steps this Commission could prepare on this problem the International conference under aegis of the United Nations in Nukus".

By the decision of the ICWC, is created Scientific-Information Centre (SIC) ICWC. The site is in Tashkent.

By the decision of the ICWC is formed permanent body Secretary of the ICWC with a site in Khojent. Interstate Council on problems of Aral sea basin is organized. The ICWC is included in structure of Council.

Fundamental work of French scientists R.Lettolya, M.Menge "Aral" is published.

During carrying out in Hague, Netherlands, 43rd. sessions of International executive committee (IEC) and 15th. Congresses of the International commission on irrigation and drainage (ICID) have been signed the report between Republic Uzbekistan and the ICID about support and help of the ICID in the decision of problems of Aral sea.

In Almaty the seminar organized by the government of Kazakhstan, "Cooperation between the countries of Aral sea basin - a necessary condition of efficient control and steady development of water resources of basin"

has taken place.

Joint mission of the World Bank, UNEP and UNDP in the central - Asian republics for rendering assistance in an establishment of priority projects of five states of Aral sea basin in structure of 22 experts on studying urgent problems of Aral.

In Washington, the USA, the international seminar organized by the World Bank " Crisis of Aral sea " is lead.

At dam of Takhiatash hydrounit, on the right coast, the Museum of basin of Amu Darya is open.

In Tokyo, Japan, the second seminar of the United Nations University and Global fund of an infrastructure of Japan " Management of an environment of region of Aral sea " carried out.

Sergieva V.P., Beera S.A., Elpinera L.I., Vinogradova V.G.'s work "medical-ecological Aral sea" is published.

The mark of a level of Aral sea makes 36,95m.

- 1994 The decision of the president of Turkmenistan "About increase in capacity of water basins of Turkmenistan". In Nukus by the heads of five states of the Central Asia withparticipation of the government of the Russian Federation authorize "the Program of concrete actions in Aral sea basin", consisting of 8 basic directions. Mission of the World Bank to the countries of the Central Asia with the purpose of definition and preparations of special projects under the program of Aral sea phase. Eight projects of the Program of Aral sea basin are born on meeting of donors in Paris and approved in the first phase in the sum of 40 million dollars. The interstate commission on social and economic development, scientific and technical and ecological cooperation of Interstate Council on problems of Aral sea basin is organized. In Varna, Bulgaria, the International Commission on irrigation and drainage (ICID) has organized the Special session devoted to a problem of the Aral basin. The republic of Uzbekistan became member of the

ICID.

In structure of the ICID the special group on the Aral basin is created, its tasks are determined and the Plan of action is accepted.

The meeting of countries - donors has taken place in Paris under the Program of Aral sea basin, organized by the World Bank, UNDP and UNEP.

"Gidrometeoizdat" publishes Kuks V.I.'s book "the Southern seas (Aral, Caspian, Azov, Black) in conditions of anthropogenous stress"

In Brussels, Belgium, by the department of E-3 of the European Union (EU) carries out meeting on realization of the project "Water resources management in the Central Asia".

In English geographical magazine "Geographical "article about Aral by T.Sayko and I.Zonn "Deserting a dying sea" is published.

The mark of a level of Aral sea makes 36,60 m.

1995 In Nukus under aegis of the United Nations the International conference on steady development of the states of the Central Asia has taken place. The culmination of conference became a meeting of heads of the states of the Central Asia and signing of Nukus declaration.

Consortium "Aral" is created.

In Tashkent the seminar under the project of Aral sea, organized by UNESCO and the Ministry of researches and technologies of Germany, is lead.

A meeting of presidents of 5 states of the Central Asia in Dashoguz (ex.- Tashauz) on problem of Aral.

In Tokyo the International symposium " Management of ground and water resources in Aral sea basin "has taken place , organized by the Japanese society of engineers of irrigation, drainage and land improvement?(JSIDRE).

In Tokyo, at University of the United Nations the International conference " the Central - Euroasian forum on water resources : Caspian, Aral and Dead seas -

water crisis and prospects "has taken place (Caspian, Aral and Dead Seas: Central Eurasian Water Crisis). In city to the Father, Japan, in Research institute of lake Biwa has taken place the international meeting " the Forum on the Caspian, Aral and Dead seas: prospects of water resources management and a policy ". In Japan (in Japanese language) the book "Light and Shadow of Global Water Environments and International Disputes. Caspian, Aral and Dead sea and 21st Century of Eurasia ad Central Asia" is published. (Light and Shadow of Global Water Environments and International Disputes. Caspian, Aral and Dead sea and 21st Century of Eurasia ad Central Asia). UNDP in Tashkent issues the brochure "Crisis of Aral". In Vagening, Netherlands, the seminar on "Interaction of an irrigation, a drainage and an environment in Aral sea basin" has taken place. In publishing house Kluwer Academic Publishers released the international magazine "Geojournal "(vol. 35,n.1), devoted to Aral sea basin and ecological anthropogenous acciden.

The mark of a level of Aral sea has made 36,11 m.

- 1996 The government of Kazakhstan has signed the preliminary agreement with the Japanese oil company "Sekiu Codan" about development of large oil fields on Kazakhstan site of Aral (near c. Aralsk). The third international symposium on management of ground and water resources for steady development in Aral sea basin, Tokyo, Japan. By an expert estimation of Republic Uzbekistan Glavgidromet the mark of a water level in Aral sea makes 36 m. In Bishkek presidents of Republic Kazakhstan, the Kyrgyz Republic and Republic of Uzbekistan have discussed problems of use of water-power resources. In Tashkent the international conference "the Scientific substantiation and practical use of managing information systems by water and ground resources" is held.

In Ljubljana, Slovenia, the special technical session MKID on problems of Aral sea is carried out.

In a series of NATO "Ecology", т. 12 (NATO ASI Series) the collection of a seminar of the NATO "The Aral sea basin" under edition of Micklin P. and Williams W.D. is published.

The university of the United Nations publishes the book in Tokyo "Regions of risk. Comparisons of threatened environments", under edition of J.X.Kasperson, R.E.Kasperson, and B.L.Turner) in which N.F.Glazovskog's work "Aral sea" is included

In Adelaide, Australia, is published N.V.Aladin's book and W.D.Willams "Aral Sea".

The mark of a level of Aral sea - 35,48 m.

1996-

1997

NIS ICWC has developed " Substantive provisions of Regional water strategy of the Aral basin " and has presented them to World Bank.

1997

At a meeting of heads of the states of the Central Asia on problems of Aral sea basin the Almaty Declaration is signed. During re-structuring the existing interstate organizations the International Fund of Rescue of Aral (IFAS) is transformed. By the president of Fund the president of Republic Uzbekistan I.A.Karimov is elected.

The permanent executive and administrative body - Executive Committee of the International Fund Rescue of Aralo (IFAS Executive Committee) in Tashkent with branches in all states of the Central Asia is created.

The international technical meeting of countries - donors has taken place in Tashkent " Programs of Aral sea basin".

second phase of the project of UNESCO and the Ministry of researches and began technologies of Germany (has ended in 2000.).

In " the World Atlas of desertification " the Estimation of desertification and mapping of region of Aral sea" by Novikova N.M, Kusta G.S., Ptichnikova A.V. is

published

M.Glantz, R.Figueroa have acted with article "Is adequate Aral sea of the status of the World heritage" in magazine "Global Environmental Change" which subsequently has been transferred and issued in Russian.

- 1998 At the international donor support development of the regional project the water resources management and environment of Aral sea basin " is started.
"Uzbekneftegas" has drilled on island of Revival a search chink depth of 1207 m. The chink has not left from lower cretaceous adjournment, attributes of oil and gas is not marked.
Realization of project of UNDP has began "Development of potential of basin of Aral sea".
University of the United Nations in Tokyo, Japan, publishes the book "Central Eurasian Water Crisis: Caspian, Aral and Dead Seas" under I.Kobori and M.Gljantsa's edition.

The mark of a level of Aral sea - 34,24 m.

- 1999 Kara Kum canal is renamed by the decision of the president of Turkmenistan into the Karakum-river.
The meeting of heads of the states of the Central Asia taken place in Ashkhabad on which by president of IFAS the president of Turkmenistan S.A.Nijazov is elected.
In Almaty the international conference on problems of use of transfrontal water resources of Aral sea basin has passed.
In publishing house "Cambridge University Press" (England) has issued the book "Creeping Environmental Problems and Sustainable Development in the Aral Sea" under G.Gljantsa and Michael's edition.
In magazine "Problem of development of deserts" the special heading "Aral and its problems" in which original scientific articles and practical recommendations on problem of Aral are published.

The mark of a level of Aral sea - 33,80 m.

- 2000 By the decision of ICWC the coordination metrological center is established (CMC) in Bishkek (the Kyrgyz Republic).
The beginning of construction in desert of Turkmenistan of Karakum " lake of the Golden Age " for gathering drainage waters from lines of areas of Turkmenistan and the Khorezm area of Uzbekistan.
In Tashkent the book " Water resources, and problems of Aral and environment " is published.

The level of Aral sea - 33,3 m.

- 2001 The USA have offered Uzbekistan the services on repeated deactivation of island of Revival. The price of the transaction - 6 million dollars.
Large-scale prospecting works on search of oil on the Aral sea have begun. Chisel works in northern part of Aral carries out by joint-stock company "kazakhkasyiskshelf", and at the western coast by the joint venture "Kulandi-Energy corporation". Prospecting drilling will be carried out on islands Barsakelmes and Revival, and also in area of settlements of Kokaral and Kaskakulan.
Began its activity the Central - Asian Regional forum of University of the world of the United Nations (University for Peace).

The mark of a level of Aral sea - 32,16 m.

- 2002 In Moscow the magazine "Land improvement and a water management", devoted to decade of MCVK is issued.
The book "The Aral Sea: Selected Bibliography" been issued under edition: of proph. Jacque Nihul (Belgium), Alexey Kosarev, Andrey Kostjanoj, Igor Zonn (Russia).
In Tashkent the International conference "The Problems of Aral and priaral - an imperative to the international cooperation " is carried out. The Organizers of conference: International fund "Ecosun", Tashkent club

"Ecosun" (branch of the Roman club), representation Roszarubezhtsentr in republic Uzbekistan, Zhukorgi congress in the Republic of Karakalpakstan.

In February the decision of the states of the Central Asia by the the President of IFRA elects the president of republic Tadjikistan E.SH.Rakhmon

Mayor of Moscow J.M.Luzhkov has directed to the president of the Russian Federation V.V.Putin a problem note on a question of use of superfluous and freshet waters of the Siberian rivers for involving to economic circulation suitable for an irrigation of the grounds of Russia and Central Asia.

On October 6 the meeting of heads of the states of the Central Asia has taken place in Dushanbe on problems of basin of Aral sea where the Dushanbe declaration is signed and the 14 basic directions are approved " Programs of concrete actions on problems of basin of Aral sea for 2003-2010 ".

In Moscow the future issue of the newspaper " the Green World " (№ 11-12), devoted to the president of the Russian Federation with the publication of the above-stated note of J.M.Luzhkov and critical materials under the TEO on transfer of a drain of the Siberian rivers to Central Asia 1975-1985.

In Philadelphia, the USA the informal international meeting on a problem " the Climate, water resources and development of a river basin of Amu Darya " has taken place.

The Russian - Uzbek expedition (Institute of oceanology of P.P.Shirshov) to Aral sea is taken place.

A level of Aral sea - 30,90 m?(fig. 5).

2003 In Kyoto, Japan, within the framework of carrying out of 3-rd World forum on water resources has taken place, special session "Regional cooperation on the divided water resources in the Central Asia".

In Liege, Belgium, the symposium "the Drying up and dying seas" (including Aral sea was) has taken place. In Almaty, Kazakhstan, The conference "Ecological

stability and the advanced approaches to water resources management in the basin of the Aral sea" has taken place.

The international conference has taken place in April in Moscow "Russia and the Central Asia: problems of water and strategy of cooperation".

In Moscow G.V.Voropaev, G.H.Ismajylov, V.M.Fedorov's book of "the Problems of water resources management of the Aral-Caspian region" has come out of press.

The appendix
Mid-annual value of levels, volumes and the areas of Aral sea.
Water inflow in Priaralye for 1960-2002.

Years	A water level (m)	Volume (km ³)	The area of a mirror (one thous. km ²)	Water inflow in Priaralye (km ³)		
				Syr-Darya	Amu Darya	Total
1960	53,40	1083	68,9	21,1	43,0	64,1
1961	53,29	1079	68,5	-	30,9	-
1962	52,97	1060	65,9	5,8	27,6	33,4
1963	52,61	1038	64,3	10,6	33,1	43,7
1964	52,49	1030	64,8	15,0	38,3	53,3
1965	52,31	1019	63,1	4,7	25,5	30,2
1966	51,89	993	61,7	9,6	33,1	42,7
1967	51,57	974	60,9	8,7	27,0	35,7
1968	51,24	952	60,1	7,3	28,0	35,3
1969	51,29	955	60,2	17,5	55,5	73,0
1970	51,43	964	60,3	9,8	28,0	37,8
1971	51,06	940	59,7	8,2	15,8	24,0
1972	50,54	909	58,9	7,0	13,2	20,2
1973	50,22	891	58,4	8,9	31,2	40,1
1974	49,85	870	57,9	1,9	6,3	8,2
1975	49,01	822	56,7	0,61	10,6	11,2
1976	48,27	779	55,7	0,57	11,1	11,7
1977	47,63	742	54,6	0,48	9,0	9,5
1978	47,06	713	53,9	0,78	21,3	22,1
1979	46,45	680	52,9	3,2	11,1	14,3
1980	45,75	644	51,7	2,5	8,6	11,1
1981	45,18	616	50,7	7,4	6,3	8,7
1982	44,39	574	49,3	1,7	0,54	2,2
1983	43,55	532	47,7	0,94	2,3	3,2
1984	42,75	499	46,2	0,60	8,0	8,6
1985	41,94	466	44,6	0,68	2,4	3,1
1986	41,10	432	42,8	0,51	0,44	0,95
1987	40,29	401	41,1	1,6	8,2	9,8
1988	39,75	380	39,9	6,9	16,4	23,3
1989	39,08	354	38,4	4,4	1,0	5,4
1990	38,24	323	36,4	3,5	9,0	12,5
1991	37,56	299	43,8	4,0	12,5	16,5
1992	37,20	286	33,9	4,6	28,9	33,5
1993	36,95	278	33,2	7,9	18,8	26,7
1994	36,60	266	32,3	8,9	21,7	30,6
1995	36,11	250	31,3	5,2	5,1	10,3
1996	35,48	230	29,7	5,1	7,5	12,6
1997	34,80	210	28,0	4,6	2,2	6,8
1998	34,24	194	25,5	7,6	23,9	31,5
1999	33,80	181	23,7	5,5	6,4	11,9
2000	33,30	169	22,9	2,9	2,6	5,5
2001	32,16	143	21,2	2,8	0,40	3,2
2002	30,90					

THE PALEOCLIMATIC SITUATION, THE DRAIN OF THE ANCIENT RIVERS AND WATER BALANCE OF ARAL IN LATE PLEISTOCENE AND HOLOCEN

1. Introduction

The problem of a perspective estimation (forecast) of natural resources, including hydroresources arid countries, draws steadfast attention of experts since in conditions of already existing water deficiency at all very significant, but long enough reduction of waterflow rivers can have heavy economic consequences. We shall add, that problems of change of a drain directly are connected to problems of change of a climate, first of all, with changes of temperature of air and humidifying. Development of long-term and superlong-term forecasts is impossible without knowledge of climatic and hydrological conditions of former epoch. Parameters of a river drain of the basic rivers of Aral sea basin, water balance of this reservoir and the basic parameters of a climate in late pleistocene and holocen, i.e. during last 20 thousand years below are investigated.

2. Paleoclimat

The climate of Central Asia (as well as any other geographical area and the Earth as a whole) is characterized by the certain instability which is shown as temperature "splashes" or deviations from norm of deposits for the certain time interval. It as has shown A.V.Shnitnikov/26/, is reflected in a hydrological mode of the Central Asian rivers in which numbers of shallow are allocated or, on the contrary, concerning abounding in water years. In scale of hundreds and thousand years in deserted and semidesertic zones there are more the radical changes of the climate which has received the name of arids and pluvial phases. However various attributes of these phases were treated ambiguously, was considered as the big success to prove even the general character, type paleoclimat, climatic parameters of it were specified approximately, being based on analogies to a modern climate of the same type. However, as appeared, application of a principle actualism in this case can lead to serious mistakes as former climatic conditions not always have

analogues in modern structure of climates of the Earth. Besides datings of phases were conditional and flimsy.

Results of long-term discussion of a problem have been brought by A.V.Vinogradovym and E.D.Mamedov/5/. The subsequent researches have found out many essentially new moments and have led to new decisions. So the greater, for example, has been revealed, than it was considered till now, scale of climatic fluctuations in pleistocene, two types Central Asian arids (hot and cold), and also internal distinctions of pluvial phases are established. And, at last, last years/18/the new technique of reception of quantitative characteristics paleoclimates is developed on the basis of water-balance calculations.

E.D.Mamedov's scale characterizes large-scale of climatic rhythmic. Therefore in work/15/he has presented "stretched" late pleistocene and halocene to the part of paleoclimatic scales, and in late halocene has allocated Sanjar micropluvial both a modern hot and dry phase (termez phase). The characteristic of separate phases (we shall remind - qualitative) is given in works/4, 5/.

History and chronology of changes of a climate in an interval of last two thousand years studied palynologists of the Moscow state university/2/. Works were conducted in Prikaspi, Priaralye and Kazakhstan. In result two humidifyings have been established: in VIII and XIII-XV centuries AD and two arid intervals, separated from pluvials transitive phases. Period IX-X of centuries is characterized inconsistent: in one of works/1/it is spoken about sharp arid climate of this time, and in other work/2/-period IX-XII of centuries concerns to pluvial phase. Sizes of deposits and temperatures are received on palinology datas.

Rather detailed history of climatic fluctuations in halocene is restored by A.A.Lyapin/13/for Murgab oasis.

Comparison of the regional scales developed by the author together with E.D.Mamedov for Average Zerafshan, and the materials considered above shows their significant similarity.

Table 1

Climat chronology of halocene and stages of development of Aral sea

Divisions of halocene	Time, Years back	Regional pleoclimatic scale	Types Climate	Phase of development Aral sea		
Late	The modernity	Tetmez phase	Hot dry	Regress		
	-1000	Sanjar micropluvial	Semidesertic type	Transgression		
	-2000	Tubel arid	Hot dry	Regress		
Average	-3000	Lyavlyakan pluvial	Warm Be relative Damp Steppe type (chestnut Steppes)	New Aral basin		
	-4000			Regress		
	-5000			Ancient- Aral basin	Uzboy Phase	
	-6000				Douzboy Phase	
	-7000					
	-8000					
Early	-9000	Janak arid	Cold Dry tundra Type	Paskevech basin		
	-10000					
Ancient	-11000					
	-12000					

3. A drain of the basic Central Asian rivers in late pleistocene and halocene

Estimations of a drain of paleochannels were made on ancient-middlehalocene of oldriver Amu Darya (Akchadarya), Zerafshan (Echkiliksay, Daryasay, Makhandarya, Gudjayli and Taykir) and Uzboy. Besides charges of water Janadarya - the channel of ancient Syr-Darya functioning in Middle Ages have been designed.

One of ways of reception of charges of water for the ancient rivers is their calculation under hydraulic formulas in view of characteristics of channel for chosen time. Calculation of speeds of streams was made under Shezi formula, high-speed factors were defined under V.N.Goncharova, N.N.Pavlovsk, A.Shtriklera's formulas, etc./19, 25/.

At paleohydrological reconstruction of channels the most difficult and so important is definition of a characteristic water level, a bias of a water table and a roughness of channels. The water level corresponding maximal channels filling to the charge of water is in the best way expressed in a relief. More often it either a coastal shaft, or height edge bottomland, and if the first parameter the settlement charge is a little bit overestimated is used and if the mark bottomland settlement charge of water is underestimated, is used.

We had been used formulas of calculation of the charge of water under hydraulic characteristics of channels, developed for uniform movement at which the bias of a water table is accepted equal to a bias of a bottom of a water-current.

The roughness of the rivers of Central Asia practically is not investigated. Separate researches were carried out for the foothill-mountain rivers. There are no data on a roughness paleorivers. On G.V.Kulichihina's researches/12/for lower reaches the rivers of the given area it is possible to recommend values of a relative roughness within the limits of 0,020-0,025, on occasion up to 0,040. Close values of a roughness of ancient channel of Uzboy have been accepted also by A.S.Kes/9/.

Table 2

Mid-annual charges of waterpaleo rivers

River basin	Charges of water, m ³ / with			
	Under characteristics of bends	Under hydraulic formulas	Under the formula of a spill-way	Average
Basin of Amu Darya (early - average halocene)				
Sazangansay *		1,72-2,38		2,05
Zerafshan	680	330-930		608
Akchadarya		3160		3160
Uzboy	2180	2060	2160	2130
Amu Darya				5770
Basin of Syr-Darya (IV-III centuries up to AD, XI-XV centuries AD)				
Janadarya	-	770	-	770

* The modern charge of water is equal 0,43 m³ / with.

At last, for transition from maximal to mid-annual charges of water their modern parities received on the basis of hydrometric supervision approximately for the same sites of the rivers were used. Results of calculations are resulted in tab. 2.

Data on a drain of the rivers are coded in their channels, and the sizes a meander channels are indicators of a drain. The theoretical model of development of bends is not developed, but geometrical and hydraulic parities (ratio) for various types a meander are received many. These parities (ratio) are based on two assumptions: the most typical parameters of bends are the step of a meander (length of a wave), radius of meandering, width of a channel. Characteristics of bends are defined basically by the charge of water/19, 25/.

We receive the equations of connection between characteristics of bends as:

$$r = 51,8 e^{0,0021 L}, \quad (1)$$

$$B = 17,0 e^{0,0018 L}, \quad (2)$$

$$B = 77,0 e^{0,0009 r}, \quad (3)$$

Where r - radius meandering, L - a step of a meander, B - width of a channel, m .

In New Southern Wales by R.V.Young/33/empirical dependence of a step of a meander on the charge of water is received:

$$L = k Q^b, \quad (4)$$

Where Q - the charge of water, k and b - factors, and an exponent b in R.V.Young's formulas and other authors/29, 31, 34/is practically constant and equal 0,46-0,51. The factor k in the formula (4) varies according to different authors considerably and depends, apparently, basically from washing outs of the lands, developed by a stream, and in some cases - on the accepted units of measurements of charges of water.

For our conditions dependences are received:

$$L = 44,0 Q^{0,048}, \quad (5)$$

$$r = 0,66 Q^{0,99}, \quad (6)$$

$$B = 0,44 Q^{0,84}. \quad (7)$$

The charges of water received under these formulas, are resulted in tab. 2.

Time of functioning ancient channels was defined basically on archeological finds - to parking of the primitive person. Besides in holes, incorporated in the bottom of a valley pra-Zerafshan in area of Uchashi well, rather low-power peat horizons were opened. Top from them it is dated on C14, and two close dates are received: 4630+100 years about AD and 4590+130 years up to AD/6, 20/.

Researches of a drain of the ancient rivers were carried out also in left-bank part of Zerafshan hollow on premountain plain of mountains Karatepe.

Basic element here is ancient alluvial-proalluvial loop, in relation to its channels crossing - the fourth terrace. These elements cross-section a difficult network of the erosive valleys

originating in mountains and stretched aside Zerafshan. Valleys in most cases have trapezoidal and troughed sections and on slopes of them two are traced, not considering the mentioned plain and cones of carrying out on its surfaces, terraces.

In a local scale stratigraphy pleistocene/15/ foothill alluvial-deltoid plain concerns to karnab (Tashkent) complex which, in turn, is compared to average pleistocene scales Interdepartmental stratigraphy committee. The cones of carrying out enclosed in a body of plain, chronologically correspond to the third - sukaytin terrace of Zerafshan. I.A. Tuychieva has come to a conclusion, that thickness of the deposits composing a terrace, corresponds to the end late pleistocene. Thus, more and more late formations concern to holocene/15/. The first terrace on time is synchronous to the same terrace of Zerafshan having absolute dating of any part of average holocene, and the second has ancient-earlyholocene age.

Estimations paleochannel the set forth above rivers - Amu Darya, Syr-Darya, Zerafshan and Uzboy were carried out on rather well expressed in a relief and nowadays dry channels. In foothill-mountain areas the scheduled arrangement of a hydronetwork basically remains to constants, channels redeepened and ancient channels can be seen traces only on excesses of slopes of the valley approximately adequate to levels ancient bottomland. In these cases reconstruction paleochannels can be made under two obligatory conditions: the geological structure of territory should be rather monotonous, the bias of a surface should be whenever possible to constants. Described premountain valley adjoining from the north to mountains Karatepe, as a whole answers these conditions. Then it is obvious, that at homogeneous addition of the thickness developed by a stream, the width and depth of a channel (indented) are defined by watering stream and are in interrelation.

These dependences are received by us for 22 water-currents of the given area as/18/:

$$b_u = 0,25 e^{3,5h}, \quad (8)$$

$$b_g = 4,65 b_u^{0,62}, \quad (9)$$

Where h - depth of a stream, b_H and b_B - width of a stream, m, on a bottom and on top, accordingly.

Under these three characteristics channels, using excesses of slopes with the expressed traces of ancient terraces (bottomlands), the idealized sections of paleochannels were under construction and the maximal charges of water were calculated. For transition to mid-annual charges of water their linear communication {connection} received on supervision of hydropost Sazagan, located in 3-4 km from a place of works/22/was used.

Questions of water balance ancient Aralo-Sarikamish reservoir, its sizes and fluctuation of sea levels are inextricably related with a problem of an estimation of a drain on channel Uzboy. History of Uzboy, a structure of its valley and terraces, structure of adjournment and so forth are most full reflected in A.S.Kes's works/9/.

It is necessary to remind, that the river Uzboj, extent more than 500 kms, prevailed the beginning in a southern extremity of the extensive sea Aralo-Sarykamyskogo and ran into Caspian sea. To A.S.Kes it is proved, that Uzboy - a typical river channel of sufficient extent, with figure typical for the rivers in the plan with meanders. For a channel of the river typically monotonous falling to the West, with usual for water-currents of flat territories biases 0,0003-0,0004, behind exception full of rapids places and directly top site of the channel beginning in 7-8 kms is higher than mountain Kugunek.

According to two diameters, A.S.Kes borrowed from work/9/, us designs the maximal charges of water Uzboy. For calculation of mid-annual charges of water it is logical to use communications {connections} between mid-annual and maximal charges of water of the rivers Amu Darya and Syr-Darya for mouth sites. In view of these parities average charges of water for two dam locations are equal 2110 and 2010 m^3 / with. For specification of the calculated charges of water characteristics meander Uzboy, and the charges of water calculated under formulas (5-7) have been used, appeared equal 2280 and 2080 m^3 /sec.

At last, taking into account, that the headwaters, are more exact a place refall of water from the sea in a channel of the river, it is possible to interpret as a spillway - threshold, we have

calculated the charge of water acting from the sea in a channel under the formula/28/:

$$Q = \sigma mb\sqrt{2g} H^{3/2}, \quad (10)$$

Where σ - factor of flooding (0,85), m - factor of a threshold (0,33), b - width of a stream (on the average 150 м), H - a pressure of water (a difference of marks of a sea level and a bottom of a channel of 4-5 м, g - acceleration of a gravity (9,81 м/с²). The charge of water is equal 2160 м³ / sec.

Thus, results of calculations of the charge of water in three independent ways of calculation are very close, and the average charge on Uzboy in early - average holocene can be estimated in 2130 м³/sec/23/.

Let's note in summary, that our estimations of charges of water in Uzboy coincide with S.A.Kovalevskogo's data/11 / which considered, that in Uzboy to Caspian sea 275 cube flows down a second (2671 м³ / c), but wrongly believed, that Uzboy unites in itself waters of Amu Darya, Syr-Darya and Chu. On the geological and archeologic data/8, 9/beginning of a drain in Uzboy concerns to early holocene (6-5 thousand up to AD) - time of filling Aralo-Sarikamish hollow up to marks and formations has spent on drink of 72-73 м at mountain Kugunek. When has spent on drink it was developed up to marks of 52-53 м, the water level in the sea was established for rather short time for marks of 63-64 м, and then stabilized on marks of 57-58 м (ancient Aral stage).

In 2 millenium up to AD, in connection with downturn of level of Aral, the drain on Uzboy fades. New, rather short-term stage of functioning of Uzboy concerns to a so-called small glacial epoch and covers the period with XII on XV century inclusive. Not the year round, and during separate seasons the drain on Uzboy, probably, was observed and during later times.

The basic conclusion - a drain of the Central Asian rivers in early - average holocene was more modern in 3-4 times.

4. Late pleistocene and holocene history of Aral

Evolution of the closed reservoirs - fluctuations of their level,

the area of a water table, volume of prisoners in them of waters, etc. - it is connected, first of all, to a varying parity of credit and debit components of their water balance. With reference to Aral this general position has been precisely formulated by A.V.Shnitnikov: "... History of Aral is a history of its transgressions and regresses, i.e. a history of variability of a condition of all waters in its basin, and from here and in the lake "/27/. We shall add only, that as a result of a long prevalence incoming parts of water balance above account the lake can become waste.

In the Aral hollow traces of seven sea levels are established. It - a terrace on an absolute mark of 72-73 m, ancient Aral terrace (absolute height 57-58 m), later Aral terrace (absolute height 54-55 m), a terrace corresponding to a maximum level of a modern stage of 53 m, and coastal lines on absolute marks: 43,0-44,5, 40,0-41,0 and 35,5-36,0 m. Besides on the columns taken in gulfs Paskevich and the Tshe-Bass at an absolute level about 31 m, I.G.Vajnbergsom and V.J.Stelle allocates ground deposits so-called "paskevich" stages of development of Aral sea. Paskevich stage on I.G.Vajnbergsu and V.J.Stelle/3/-a stage of steady long regress of the sea while three subsequent higher of a level are connected, most likely, with stages of stabilization of a sea level during its rise after paskevich stages. S.O. Khondkarian/24/has described a terrace on a mark of 63-64 m, expressed fragmentary and considerably destroyed, concerning, probably, also to ancient Aral stage of development of the sea.

Formation of adjournment paskevich stage, in opinion of the specified authors, covers late pleistocene and early holocene. Thus, taking into account a wide scatter of the absolute dates received for salts from adjournment of paskevich stage, I.G.Vajnbergs and V.J.Stelle are guided, mainly, on palynology data and general provisions on change of vegetation in late pleistocene and holocene.

The specified I.G.Vajnbergsom and V.J.Stelle the top chronological boundary is concretized in view of archeologic researches in this region. So, A.V.Vinogradov/7/, being based on absence in these areas a little expressive mesology materials (except for the final stage of mesolite) and, on the contrary, an abundance of monuments neolite time, dated crisis from adverse for existence and moving of the primitive person of climatic conditions and water-security (paskevich stage) to rather damp

warm climate of Iyavlyak pluvial 7-6 (or 8-7) millenia up to AD.

In I.G.Vajnbergsa and V.J.Stelle's constructions the question on borders and Paskevich level of basin is poorly covered. It is mentioned only, that it was characterized by very low level and that Aral during this stage broke up, at least, to two independent reservoirs - basin of the Small sea and the basin occupying its other hollows. " Coastal formations of these basins, - write I.G.Vajnbergsa and V.J.Stelle, it is necessary to search bathymetric below known flooded coastal formations "/3/.

In our opinion to consider as one of the lowest quasi-stationary of Paskevich level of basin a coastal line on absolute marks of 35,5-36,0 m which concerns I.G.Vajnbergsom and V.J.Stelle to "taranglik" stages of development of Aral more correctly.

Low Paskevich level of basin can be treated differently. It agrees paleogeographical A.S.Kes's to circuit/10/, at the end of late pleistocene and during a significant part of halocene waters of Amu Darya flew down in Sarikamish hollow and further on Uzboy to Caspian sea; in Aral the waters of Syr-Darya at this time carried. It is thought, however, what not last role in water balance of Paskevich of basin was played also with climatic conditions of territory and, in particular, a weak river drain.

Question on time ancient aral transgressions - one of the most debatable questions in problematics of Aral. Actually the direct instruction on age of ancient aral terraces is its parity with neolites material which rigidly limits the top age limit of a terrace to 3 millenium up to AD.

Archeologic and paleogeographical researches of 1970-1980 allow to date definitely rather if not the beginning, high levels of ancient Aral basin. It - time of occurrence of a drain on Uzboy, namely: 6-5 millenium up to AD. Thus, ancient Aral basin existed in an interval of time 8-5 thousand years ago. Basically this conclusion will be coordinated to S.O.Hondkariana's data/24/. Indirect

Acknowledgement of it is concurrence of ancient Aral transgressions with the period warm concerning damp -pluvial climate and the raised river drain when all simultaneously function deltoid old river Amu Darya and nowadays dry channels of Syr-Darya: Kuvandarya and Inkardarya/17/.

The basin of a 72-meter level has existed rather not for long. Occurrence of a drain on Uzboy, caused outflow of waters,

has lowered a sea level till 63-64, and then up to 57-58 m. As hydrometeorological conditions of basin Arala thus have not changed, inflow to the sea proceeded at a rate of 91-131 km³/year, outflow, by our estimations of different years, varied at a rate of 63-72 km³/year/23/.

The annual volume of evaporation made 76-79 km³ or in view of the area of a mirror 780 - 810 mm. These sizes of evaporation from the sea less than its modern value in 1,4-1,5 times.

The further task was coordination of these numerous, but isolated materials for an estimation of the basic components of water balance of the sea under various climatic conditions in region. It is necessary, on the one hand, for cross check of the saved up data, and with another, - completions of blanks in them.

The equation of annual water balance of the sea looks as follows if to leave in it only the main components:

$$F(h) \frac{dh}{dt} = Q_{\text{зод}} + Q_{\text{подз}} + (X - E)F - Q_o, \quad (11)$$

Where h - a water level in the sea; F - the area of water area of the sea at the given level; t - time; Q_{зод} and Q_{подз} - annual superficial and underground inflow to the sea; X and E - annual layers of an atmospheric precipitation on a surface of the sea and evaporation from it; Q_o - outflow of water on Uzboy.

As the periods when powerful coastal terraces were formed were considered, it is possible to admit, as has been made by us/30/, that at this time the sea level was approximately constant, that is dh/dt=0.

Usually as characteristics of change of a climate accept change annual (or seasonal) the sums of an atmospheric precipitation and average annual (or seasonal) temperatures of air. Therefore it was necessary to find dependence of components of water balance of the sea on these parameters. For this purpose the given stations Tamdy well reflecting integrated meteorological conditions Priaralye, and the data on modern fluctuations of components of water balance of the sea have been used. With the help of the found dependences evaporation E and deposits X for the periods with known

conditions of a climate have been designed.

Inflow of water $Q_{\text{вод}}$ as it is marked above, was estimated or under characteristics of ancient channels, or if such data were not, on dependences of a drain on deposits and the sizes of a congelation/21/. Outflow on Uzboy for those periods when it existed, has been determined on morphometric characteristics of an ancient channel/23/. Underground inflow was accepted constant and equal $1 \text{ km}^3/\text{year}$.

Then the technique which allowed to calculate, for example, with what has been developed should be changes of temperature of air at the set changes of deposits. It is possible to solve and a return task: on the set changes of temperature to calculate required for maintenance of balance of change of deposits. In result it was possible to receive the general data on changes of climatic and hydrological conditions in Priaralye for the last approximately 20 thousand years (tab. 3).

Table 3

Changes of a climate, drain of the basic rivers of Central Asia, level and the sizes of Aral sea for the last of 20 thousand years

Time	Sea level, m	The area of a water table, $\text{km}^2 \cdot 10^3$	Change of temperature of air, °C	Change of the annual sums of deposits, %	A drain of Amu Darya and Syr-Darya, km^3/year	Outflow on Uzboy, km^3/year
Centuries of a new era						
The modernity	53,0	66,09	0	0	56,9	0
XVI-XIX	52,0	62,70	-	-	-	-
XV	53,1	68,33	-2,5	30	58,0-59,0	7-8
XIII-XIV	53,7	71,82	-2,2	30	60,0-62,0	10
XII	53,1	68,33	-0,5	20	63,0-64,0	7-8
XI	50,0	58,15	-0,5	-10	49,0-50,0	0
IX-X	-	-	-	-	-	-
VIII	51,8	62,06	-3,6	80	44,0-45,0	0
V-VII	52,0	62,70	-0,5	20	52,0-53,0	0
I-IV	28,5	14,08	-	-	-	-
Thousand years						
Back						
2-2,5	54,5	77,58	-	-	-	27
2,5-3,5	-	-	-	-	-	-
3,5-4	54,5	77,58	-2,0 - -2,1	40-50	82,0-83,0	27
4-5	57,0-58,0	96,87	-3,6 - -3,7	60-100	118,0-126,0	63-66
5-7	63,0-64,0	108,8	-3,6 - -3,7	60-100	127,0-131,0	67-72
7-9	72,0-73,0	148,1	-3,6 - -3,7	60-100	91,0-92,0	0
9-10	43,7-44,5	48,81	-4,5 - -5,0	-50 - -40	33,0-34,0	0
10-12	40,0-41,0	38,97	-12,5 - -13,0	-70 - -60	13,0-14,0	0
12-20	35,5-36,0	31,25	-13,5 - -14,0	-80 - -70	9,0-10,0	0

It is necessary to note, that for some periods of it to make reliability of results, naturally was not possible, and, decreases in process of removal from the modernity in depth of centuries.

5. Conclusions

Thus, the climatic situation in Central Asia for the last of 20 thousand years underwent significant changes. It is curious, that for this rather long even to measures paleography the period mid-annual temperatures of air always were below modern. E.D.Mamedov's opinion on exclusiveness modern hot and dry, so-called "termez" phases of development of a climate thus proves to be true.

For last two millenia our estimations of temperatures of air practically coincide with those T.A.Abramovoj, the scale of change of deposits by our calculations is less.

The greatest changes of climatic characteristics are revealed for the end late pleistocene when temperatures of air were on 10-14°C below modern. Was essentially colder and in early - average holocene. Under these thermal conditions raised (increased) in 1,5-2,0 times, in comparison with modern, wetness region has caused development of a mountain congelation and the river drain raised in 3-4 time.

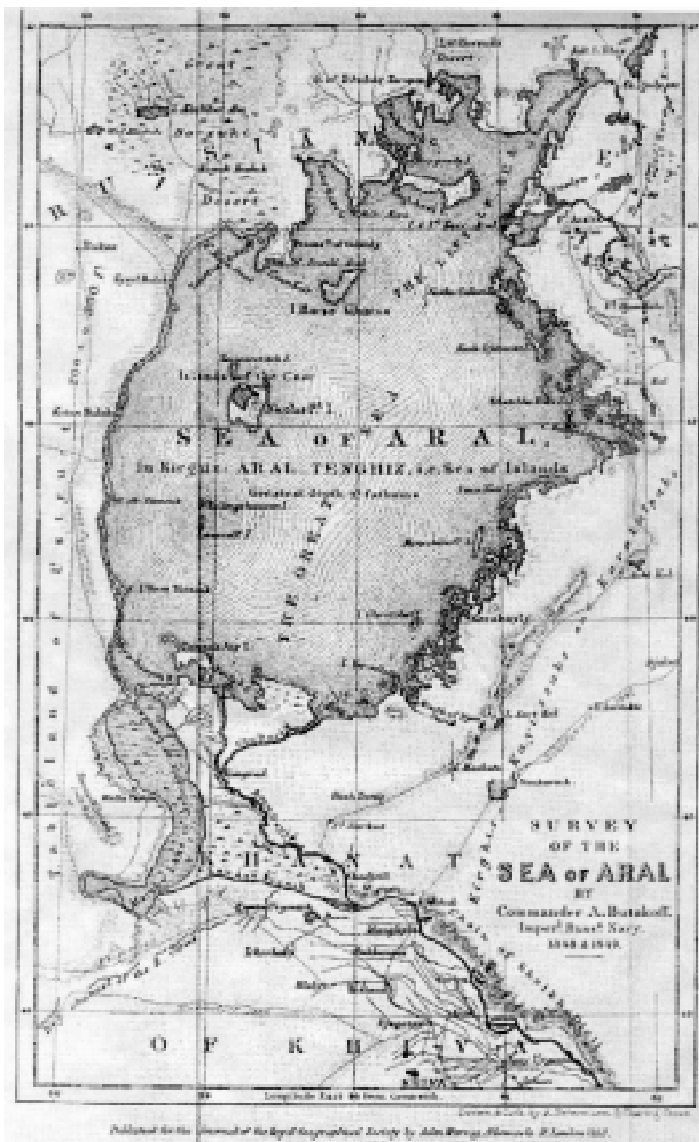
Smaller, in comparison with present, evaporation from Aral has caused it transregressive stages and extremely high levels of a mirror, that, in turn, has defined a drain of water on Uzboy to Caspian sea.

It is necessary to notice, apparently, what not all stages in development of Aral in pleistocene-holocene have received the substantiation. Not clear, for example, what climatic situation corresponded to ultralow regress in the beginning of a this era. In this connection the conclusion arises, that at this time Amu Darya essentially changed the direction what A.S.Kes repeatedly expressed, and at climatic conditions of Aral rather close to the modernity was reduced till the sizes less modern. If it so we have analogue of present lake in the past.

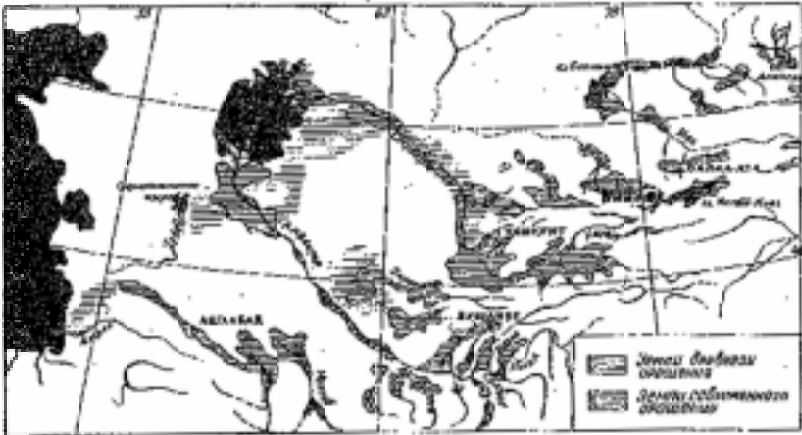
Appendix



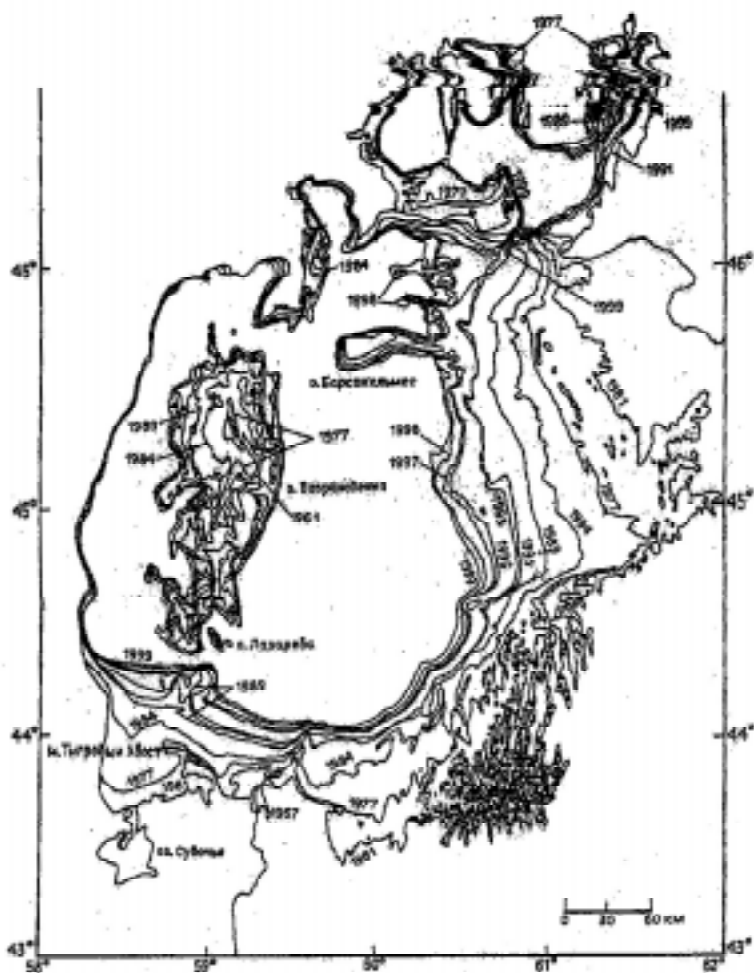
Рис. 1. Арал в отношении к крупнейшим озерам мира



Pic. 2. Aral sea map in 1960
 Source: Officer's Atlas, M., 1984.



Pic. 3. Irrigated Territories of the Central Asia and south of Kazakhstan



Pic. 4. The Map of coast line position changes of Aral sea from 1957 till 1999.

(Source: V.N.Mikhaylov, V. I.Kravtsova, F.N. Gurov, D.V.Markov, M.Gregar "Estimation of modern condition of Aral sea". Bulletin of Moscow University. Serie 5, geography, №6, 2001, p.14-20).



**Pic. 5. Space picture of Aral sea.
(NOAA-16, 9 November 2002)**

The picture is kindly submitted by A.Kostyan,
Oceanology Institute named by P.P. Shirshov.

The literature

1. Abramov T.A. Paleogeography of the USSR arid zone during an epoch of the Middle Ages // Quarternary period: methods of research, stratigraphy and ecology. Thes. rep. - T.1.-Tallinn, 1990. - With. 7-8.
2. Abramova T.A., Varushenko A.N. Paleogeographical conditions of Kazakhstan and Central Asia in Middle Ages // Bull. The Moscow State University. - 1990. - N3. - p. 29-36.
3. Vaynbergs I.G., Stelle V.J. Latest quarternary stage of development of Aral sea and its connection with changes of climatic conditions of this time // Fluctuations moisture of the Aral-Caspian region in holocen. - M.: the Science, 1980. - p. 175-181.
4. Vakturskaja N.N., Vinogradov A.V., Mamedov E.D. archeologic - geographical researches in area Daryasaya // Archeologic discovering of 1968. - M.: the Science, 1969. - p. 411-412.
5. Vinogradov A.V., Mamedov E.D. Landshaftno - climatic conditions of the Central Asian deserts in holocen // the History of material culture of Uzbekistan. - Tashkent: the FAN, 1974. - p. 37-38.
6. Vinogradov A.V., Mamedov E.D., Sulerdjitskiy L.D. first radiocarbon dates for neolith of Kizilkum // Mod. arche. - 1977. - N 4. - p. 267-269.
7. Vinogradov A.V. ancient hunters and fishers of Central Asian Interfluve // Tp. The Khorezm archeological-ethnographic expedition T. XIII. - M.: the Science, 1981. - p. 172.
8. Discontinuance of a drain of Uzboy and problems of Aral sea // Problems of development of deserts. - Ashkhabad. - 1976. - N 6. - p. 24-29.
9. Kess A.S. Channel Uzboy and its genesis // Tp. YOKES AH.-1939. - T. 30. - p. 121.
10. Kess A.S. Ampere-second. Aral sea in holocen // Ethnography and archeology of Central Asia.-M.: the Science, 1979. - p. 19-23.
11. Kovalevskiy S.A. Krasnovodsk - Uzboy - Neftedag (To knowledge of oil deposits of Zakaspiy) // Oil and shale facilities - 1926. - T.10. - N6. - p. 736-756.
12. Kulichikhin G.V. roughness of ancient channels of deserts of Central Asia // Questions of a hydrology of Uzbekistan

- and adjacent territories. - Tashkent.: Tash SU, 1987. - p. 42-45.
13. Lyapin A.A. feature палеогеографии deltas of Murghab and Tedzhen (the медно-Stone Age, an epoch of a stone) // Problems of development of deserts. - 1991. - N 2. - With. 63-69.
 14. Mamedov E.D. To a problem of pluvial paleoclimat deserts of USSR // Questions of physical geography and agroclimatology of Central Asia. - Tash SU. - 1978. - N 572. - p. 44-45.
 15. Mamedov E.D. Pluvials of arid in late pleistocene and holocene histories of deserts of USSR and the adjacent countries // Development of the nature of the USSR in late pleistocene and holocene. - M.: the Science, 1982. - p. 37-43.
 16. Mamedov E.D., Trofimov G.N. Paleoclimate and evolution of lakes in Zakaspiy holocene // VII symposium on a history of lakes, on November, 25-28 1986. thes. rep. - Leningrad - Tallin: AS, 1986. - p. 212-214.
 17. Mamedov E.D., Trofimov G.N. To a question about long period fluctuations of a drain of the Central Asian rivers // Problems of development of deserts. - 1986. - N 1. - p. 12-16.
 18. Mamedov E.D., Trofimov G.N. Hydrological phase of Dasht and climate chronology of holocene of Central Asia // Uzb. geol. mag. - 1992. - N 1. - p. 54-57.
 19. Nedjikhovskiy R.A. Channels network of basin and processes of formation of a drain of water. - L.: Hydrometeoedit., p. 1971. - 376.
 20. Definition of absolute age quarternary adjournment on C14 by means of the proportional counter / A.V. Vinogradov, A.L. Devirts, E.I. Dobkina, N.G. Mark // Absolute geochronology of quarternary period. - M.: AS, 1963. - p. 137-138.
 21. An estimation of a congelation and a drain in river basin Zarafshan in holocene / G.E. Glazyrin, E.D. Mamedov, A.S. Merkushkin, G.N. Trofimov, N.A. Chernova // Tr. SARNIGMI. - 1989. - Iss. 132 (213). - p. 107-113.
 22. Resources of superficial waters. T. 14. Central Asia. Iss. 3. Amudarya River basin - L.: Hydrometeoedit., 1971. - p. 472
 23. Trofimov G.N. Paleohydrology of Uzboy // Bull. The commissions on analysis of quarternary period. - M.: the Science, 1986. - N 55. - p. 107-111.

24. Khondkarian S.O. Transgressive of a phase of development of the Aral basin in holocene // Fluctuations of moisture of the Aral-Caspian region in holocene. - M.: the Science, 1977. - p. 35-36.
25. Khorton R.E. Erosive development of the rivers and catchment basins. - M.: Edit. foreign Lit., 1948. - p.159
26. Shnitnikov A.V. Intracentury variability of components of the general moisture.-L.: the Science, 1969. - p. 131-13346.
27. Shnitkov A.V. Destin of the big lakes of Central Asia and Western Siberia // Rep. On annual Readings of memory of L.S.Berg. - L.: Hydrometeoedit., 1976. - p. 48-53.
28. Shterenlikht D.V. Hydraulics. - M.: Poweratomedit., 1984. - p. 554-556.
29. Ferguson R.I. Meandre migration: equilibrium and change / / River channel changes. - Chichester, 1977. - P. 235-248.
30. Glazirin G.E., Trofimov G.N. Changes in the Aral sea level and the run-off of main rivers in Central Asia for the last 20000 years // Abstracts of conference papers " Third international meeting on global continental paleogidrology gloceph, 98. Rissho University Kumagaya Campus, Kumagaya the Japan Alps, 4-11 Syptember 1998. - Kumagaya, 1998. - P. 23-26.
31. Hasegawa Kazuyoshi. Universal bank erosion coefficient for meandering rivers // J. Hydroul. Eng. - 1989. - N6. - P. 744-765.
32. Rickmers W.R. The Duab of Turkestan.-Cambridge: Univ. Press, 1913. - 564 p.
33. Wang Shiqiang, Ren Zhang. Cause of formation of channel patterns and pattern prediction // Hydraul. and Environ.: 23 Congr., Ottawa, Aug. 21-25, 1989. - Ottawa, 1989. - Vol. B - P. 131-138.
34. Williams Rhea P. Unit hydraulic geometry - an indicator of channel changes // US Geol. Surv. Water-Supply Pap. - 1987. - N 2330. - P. 77-89.

CONTENTS

Introduction	3
Aral, which we have lost	4
Aral sea	16
The Chronology of Aral sea	19
The Paleoclimatic situation, the drain of the ancient rivers and water balance of Aral sea in late Pleistocene and Holocene	57
Appendix	71
The Literature	76

