will have to be taken toward the breeding of new species of fish for this sea.

Solution of these and other analogous problems demands forecasting of the level and salinity of the Aral Sea waters for a long series of years ahead, based upon study of the water and salt balance of the Aral Sea. Study of these questions and development of forecasts of the sea level and the salinity of its waters also constitute one of the tasks of the science-research institutes of the Hydrometeorological Service and the Academy of Sciences USSR in the very near future.

The Stalin plan for the transformation of nature, which is being realized in unprecedentedly short periods, will create exceptionally favorable conditions for experimental solution of the most important problems standing before contemporary geophysics.

Actually, the climate in the Kara-Kuma desert is now exceptionally unfavorable. But in a few years it will be traversed by a powerful water artery -- the Main Turkmen Canal. Enormous expanses of desert will be irrigated and watered; over an enormous area forests and brushwood will grow.

How all this will be reflected in the climate in the region of the canal itself and in the adjacent regions is a question unusually important and interesting both in a scientific and in a practical connection. It is completely essential to trace these changes. For this purpose some meteorological stations with a special program of observation should even now be organized in the Turkmen Canal zone, so as to allow quantitative estimation in the future of the beneficial influence of irrigation and forest plantings on the desert climate.

The construction of the largest reservoir in the world on the Volga and the irrigation and watering of enormous areas from other rivers emptying into the Caspian Sea will lead to a decrease in the discharge of water into the Caspian, and this in turn must be reflected in the position of the sea level. At the present time the significance of the Caspian Sea for water transport is very great, and when the Main Turkmen Canal is put into operation and navigation on the Volga is improved, the significance of the Caspian Sea as a transportation route will grow even greater. The Caspian is also very rich in fish. The best varieties of the most valuable species of fish not only in the Soviet Union, but in the whole world, are caught precisely here. This is explained by the exceptionally favorable conditions which prevail at the present time on the Caspian; among them the low salinity of the water and the shallowness of the northern part of the sea should be counted foremost.

Decrease in the discharge of the Volga and the drop in the level of the Caspian connected with it will lead to an increase of salinity and a diminution of the area of the shallow part of the sea. All this may influence the fishing trade and the operations of water transport. For support of navigation supplementary dredging operations will be required and perhaps even rebuilding of individual harbor installations. Special measures are also required for preservation of the rich fishing trade. A preliminary estimate of the decrease in discharge in connection with execution of hydrotechnical construction and irrigation and watering of huge areas can already be made at the present time. Approximate calculations show that the execution of these projected measures will decrease the discharge of the Volga by 25-30 cubic kilometers within one year. Since these withdrawals will be repeated yearly beginning with 1956, the level of the Caspian Sea will decrease yearly on this account; however, lowering of the level will lead to decrease in the evaporating surface of the sea, on which account evaporation will decrease. Consequently the level of the sea should not drop sharply on account of the yearly withdrawals of discharge in the course of ten years.

However, the well-studied history of the fluctuation of the level of the Caspian Sea shows that the level of the Caspian can rise more than 30 centimeters in the course of one year on account of increase of the natural discharge of rivers. This indicates that in spite of the withdrawal from river discharge for irrigation, there may be years so abounding in water that the level of the Caspian will rise.

The fluctuation of the level of the Caspian is of a cyclic nature; for a series of years a rise in the level occurs, and then for the same number of years there is a fall. Since in the course of the last rather long series of years, beginning approximately in 1929, fall in the sea level has predominated over rise, there is some basis for assuming that the time is not far off when years abounding in water will set in again and the level of the Caspian Sea will begin to rise, in spite of the withdrawal of water for irrigation of fields. In this case the withdrawal of water for irrigation will only somewhat retard the rise in the level of the Caspian, which will favorably affect the work of economic organizations whose activity is connected with this sea. All the installations

are now already adjusted to a low stand of the level, and its rapid rise may bring only harm to the national economy.

However this is only an assumption, based on rough calculations. For correct planning of large economic measures on the Caspian Sea accurate calculation of the withdrawal of water from the discharge of rivers emptying into the Caspian is essential, as well as forecasts of the water content of these rivers in the next few years. The development of such forecasting is also one of the next problems for the science-research institutes of the Hydrometeorological Service.

Construction of the hydrological engineering installations projected by the Stalin plan for the transformation of nature must be performed in an unprecendentedly short time. Meeting of the deadlines demands great exertion and especially clear organization and planning of works. In these problems the Hydrometeorological Service can and must render substantial help to the construction organizations. It will be extremely important for the builders to know the times of passage of the spring high water in the Volga and its tributaries, the Dnepr and Amu-Darya, the maximum water levels, the periods of appearance of sludge, of setting of the ice and of spring ice movement. Hydrometeorological Service must be ready to satisfy these demands and to guarantee for the construction organizations, high-quality forecasts.

With introduction of the Kuybyshev and Stalingrad hydroelectric power plants into the system the regime of the Volga will be radically changed. The majority of data by which the Hydrometeorological Service laid out the regime of the Volga in past years will have only historical value, since they will not answer the new conditions

Declassified and Approved For Release 2012/03/30 : CIA-RDP82-00039R000200150001-3

are now already adjusted to a low stand of the level, and its rapid rise may bring only harm to the national economy.

However this is only an assumption, based on rough calcula- tions. For correct planning of large economic measures on the Cas- pian Sea accurate calculation of the withdrawal of water from the discharge of rivers emptying into the Caspian is essential, as well as forecasts of the water content of these rivers in the next few years. The development of such forecasting is also one of the next problems for the science-research institutes of the Hydrometeorolo- gical Service.

Construction of the hydrological engineering installations projected by the Stalin plan for the transformation of nature must be performed in an unprecendentedly short time. Meeting of the deadlines demands great exertion and especially clear organization and planning of works. In these problems the Hydrometeorological Service can and must render substantial help to the construction organizations. It will be extremely important for the builders to know the times of passage of the spring high water in the Volga and its tributaries, the Dnepr and Amu-Darya, the maximum water levels, the periods of appearance of sludge, of setting of the ice and of spring ice movement. Hydrometeorological Service must be ready to satisfy these demands and to guarantee for the construction organizations, high-quality forecasts.

With introduction of the Kuybyshev and Stalingrad hydroelec- tric power plants into the system the regime of the Volga will be radically changed. The majority of data by which the Hydrometeoro- logical Service laid out the regime of the Volga in past years will have only historical value, since they will not answer the new conditions

are now already adjusted to a low stand of the level, and its rapid rise may bring only harm to the national economy.

However this is only an assumption, based on rough calcula-tions. For correct planning of large economic measures on the Cas-pian Sea accurate calculation of the withdrawal of water from the discharge of rivers emptying into the Caspian is essential, as well as forecasts of the water content of these rivers in the next few years. The development of such forecasting is also one of the next problems for the science-research institutes of the Hydrometeorolo-gical Service.

Construction of the hydrological engineering installations projected by the Stalin plan for the transformation of nature must be performed in an unprecendentedly short time. Meeting of the deadlines demands great exertion and especially clear organization and planning of works. In these problems the Hydrometeorological Service can and must render substantial help to the construction organizations. It will be extremely important for the builders to know the times of passage of the spring high water in the Volga and its tributaries, the Dnepr and Amu-Darya, the maximum water levels, the periods of appearance of sludge, of setting of the ice and of spring ice movement. Hydrometeorological Service must be ready to satisfy these demands and to guarantee for the construction organizations, high-quality forecasts.

With introduction of the Kuybyshev and Stalingrad hydroelec-tric power plants into the system the regime of the Volga will be radically changed. The majority of data by which the Hydrometeoro-logical Service laid out the regime of the Volga in past years will have only historical value, since they will not answer the new conditions at all. In the new conditions the periods of onset of setting and breaking of ice and the periods of onset of highest and lowest water levels will change. In connection with this all the studies which Hydrometeorological Service has had at its disposal for forecasting the water and ice regime will lose their value.

Consequently we are faced with a great deal of work in study of the regime of the Volga and the new conditions of the newly adjusted discharge. The same applies to the regimes of the Amu-Darya and the Dnepr. In the new conditions of the regimes of these rivers forecasting of movement of sludge ice will acquire great significance for the correct exploitation of the hydrological engineering installations.

In summer, in the period of navigation, forecasting of agitation in the vast reservoirs of the Volga and Dnepr will take on especially great significance. Right now it is already essential to approach the problem of determination of wave elements: height, steepness and frequency in time. This information is necessary for planning the type of vessel for the Volga and Dnepr flotillas.

In spite of the fact that there already exist in our country at present a large number of hydrological engineering installations in the form of canals, reservoirs, etc., Hydrometeorological service has not to date sufficient experience in service to these installations and ~~has only slightly~~ occupied itself with study of their water regime. This situation will be completely intolerable in the future. Rational utilization of water resources demands a rational system of work on the hydrological engineering installations projected for construction, since otherwise the loss of an enormous quantity of water which might with success have been used for generation of electric power, irrigation and watering, or for the needs of water transport, is inevitable.

Rational utilization of water resources can be successfully realized only when Hydrometeorological Service knows how to organize calculation of the water in river systems and basins well, and also successfully gives long-range forecasts of the water regime of the rivers. In connection with this Hydrometeorological Service must now radically reorganize its work in study of the water regime of hydrological engineering structures. For this purpose it is essential to reexamine the presently existing network of hydrological stations and posts and without delay to enter upon a systematic study of the water and ice regime in presently operating hydrological engineering stuctures, in order to acquire the necessary experience in this work and to obtain the necessary raw materials for development of methods of forecasting the water and ice regime in the conditions of the newly regulated discharge.

Thus Hydrometeorological Service must conduct extensive preliminary work which may allow it, when the projected hydrological engineering structures are put into operation, to show effective help in planning the work program of these structures with an account of how to obtain the most economical possible effect in utilization of the water resources of each actual year, each actual season or month.

In carrying out these and other measures the workers of Hydrometeorological Service will be working with the whole Soviet people to actively promote the creation of an economical basis for a communist society.

In counterbalance to the enemies of mankind, incendiaries of a new war, the Soviet people step forward as a builder-people, a creator-people -- a sure bulwark of worldwide peace. Through peaceful constructive labor the Soviet people will create magnificent monuments to the great Stalin epoch -- the epoch of the beginning of communism. The labor of our people serves as an inspiring example for all progressive mankind in the struggle for a free and happy life, for peace in the whole world.

THE QUESTION OF CLIMATE AND CLIMATOGENIC FACTORS

K.I. Kashin and

Kh.P. Pogosyan

The rapid development of our national economy makes ever-increasing demands upon all branches of science. The measure of the maturity of any science is its capacity to satisfy the demands presented to it by the national economy. This statement also applies to the science of climate.

The lag of so-called classical climatology behind the demands of life has aroused many researchers to seek new methods and has given birth to various trends in climatology.

In the Soviet Union at the present time there exist four trends in climatology: (1) so-called classical climatology, (2) complex (later transformed into complex-dynamico-climatic analysis), (3) so-called dynamic and (4) physical.

The first trend, which developed in the 19th century, posed the problem of determining the average many-years' regime of individual meteorological elements at various points of the globe. The subsequent development of this trend followed the path of establishing additional climate characteristics by using the meteorological elements and phenomena, both along the lines of setting up average and extreme values and by determining their frequency. This trend was developed chiefly at the Main Geophysical Observatory, which now bears the name of the great Russian climatologist A.I. Voyeykov. Within the walls of this observatory in the twenties a new trend was born, headed by Ye. Ye. Fedorov.

This second trend had the tendency to bring climatology closer by a large degree to practical demands. There were reasons for this, inasmuch as so-called classical climatology had lagged behind in satisfying the ever-increasing demands of the national economy. Rather than characterizing climate through average magnitudes of separate meteorological elements and their frequency, Ye.Ye. Fedorov strove to present the characterization of climate through simultaneously observed complexes of meteorological elements. These complexes were identified with types of weather. The tendency to express climate in terms of weather led Ye.Ye. Fedorov to work out a multitude of weather types. "By a type of weather we mean a complex weather characteristic described by definite features -- by broad or narrow gradations of a large or small number of elements" (Chubukov). Thus in complex climatology climate is studied in terms of weather types and their frequency in various geographical regions.

The third, so-called dynamic, trend is headed in our country by B.P. Alisov. He defines a complex of meteorological elements in terms of the kind of air mass and the dynamico-thermodynamic processes occurring within it. The author tries to explain climatic features in terms of the differences in frequency of air masses and by certain aspects of their circulation in this or that region.

The origin of the fourth trend, that is, the physical, may be referred to the last two decades. Working in this direction at present is a small group of scientists who are concerned with determination of the average composition, over many years, of the fields of pressure, temperature and wind, with problems of heat and the moisture cycle, atmospheric circulation, the physics of the air layer at the earth's surface, and others. Deserving of note are works in this direction by Academician N.Ye. Kochin [6], Academician V.V. Shuleykin [12] on the role of oceans in formation of the climate on the continents, Ye.N. Blinova [2] on altitudinal temperature distribution, the works of M.I. Budyko [3], D.L. Laykhtman [7], S.A. Sapozhnikova [9], K.I. Kashin [4] and others.

Before passing on to an evaluation of which of the enumerated four trends is the most far-seeing, let us dwell upon the question of just what the object of climatology is. For this purpose we ought to examine the definitions of climate which are given by the representatives of the various trends.

It is known that during the last hundred years a multitude of different definitions of climate have been put forward by representatives of the various trends.

Not considering it necessary to cite here all the definitions which have existed in various periods of the development of climatology, we shall confine ourselves to a survey of individual ones among them given in the course of the past two decades.

The reader may find earlier definitions of climate in Ye.I. Tikhomirov's article [10]. Let us remark that in almost all definitions of climate there exist two clearly expressed tendencies. One of them leads up to the definition of climate by way of the average value of meteorological elements, the other through the summation of weathers. Differing essentially from the definitions of climate put forth earlier is the definition given in the mentioned article of Ye.I. Tikhomirov, which is formulated in the following manner: "We should call the climate of any region the condition of the atmosphere which appears as the result of more or less protracted (on the order of ten years) interactions between the atmospheric circulation of the given region and its physico-geographical conditions, understanding the latter in the broadest sense of the term".

From our point of view, the definition of climate given by Ye.I. Tikhomirov is realtively successful in comparison with all definitions put forth earlier. In this formulation, however, mention of one climatogenic factor -- radiation -- is absent, at least in explicit form.

In 1940, B.P. Alisov and Y.S. Rubinshteyn [1], representatives of two trends, jointly gave the following definition of climate: "The regular succession of meteorological processes, determined by the complex of physico-geographical conditions and expressed in the many-years' weather regime observed at a given place, is called the climate of the given place".

In 1946, L.A. Chubukov, a representative of complex climatology, gave a definition of climate which is somewhat different, but close to the foregoing one. It says: "... by climate we have come to mean the whole aggregate and regime of local weathers, and also the processes leading to variation in local weathers, insofar as it is shown by data of many-years' meteorological observation in the region being studied" [11].

Not one of the definitions of climate cited above is satisfactory. The unsatisfactoriness of these definitions consists chiefly in the fact that in not one of them is the full cause-and-effect relationship given; that is, climate is not defined in terms of the causes which stipulate it. Actually, upon analyzing each of the definitions given above one gets the impression that they are all involved with the form of representation of climate, that is, with the method of working out the characterization of climate.

In order to give a sufficiently complete definition of climate one must first of all examine all the basic factors which take part in climatogenesis.

It is known that substantial influence is exerted upon climate by radiation, the uderlying surface and atmospheric circulation. Are there any other factors which take direct part in climate formation? This question should be answered in the negative. In this connection it is essential to make the reservation that we do not take the point of view that it is impossible for man to change climate, but that at the present stage it is possible only through changes of the underlying surface, that is, one of the climatogenic factors which will be discussed separately below.

Thus, only three factors directly determine climate: radiation, the underlying surface and atmospheric circulation.

Proceeding from this, one may give the following definition of climate: climate is the regime of Earth's sheath of air, determined by a process of many years' interaction between radiation, the underlying surface and atmospheric circulation.

Such a definition of climate does not depend on the method of processing observations nor the representation of the various characteristics, which are subject to changes as functions of progress in the fields of science and technology. It is not limited to concepts of climate only at the earth's surface, but pertains to any layer of the atmosphere and includes secular fluctuations of climate.

It follows from this definition that the basic problem of the science of climate is study of the process of interaction of the three climatogenic factors.

Although these factors are indeed interrelated, each one in isolation may be analyzed relatively independently at any given moment of time in one or another small geographical region.

Let us analyze the nature of the interrelationship of the three indicated factors. On the rotating earth the general atmospheric circulation is stipulated primarily by radiation. As we know, the components of the radiant energy balance on the earth's surface are determined by the location of the given geographical region on Earth, the time of year, the character of the underlying surface and the circulation of the atmosphere.

If we analyze the components of the radiant energy balance on the surface of the whole globe under conditions of uniform atmospheric transparency (homogeneous conditions of absorption and reflection), and also uniform albedo of the earth's surface, then the components of the radiant energy balance will depend upon the latitude of the ~~place and the time of year.~~ The last two factors, apparently, will be the principal ones and will determine the radiation regime on the globe, which in turn stipulates the zonal atmospheric circulation.

However, under actual conditions the radiation balance components, as was stated above, still depend to a certain degree upon the character of the underlying surface. It is by this that the actual atmospheric circulation, which very substantially differs from the zonal, is explained.

The underlying surface is subject to the influence of both radiation and atmospheric circulation. But this influence has shown its effect on the earth's surface, that is, on the continents and oceans, as a result of the interaction of the two indicated factors in the course of many thousands of years. In the course of a time interval on the order of decades one may consider the effect of radiation and circulation upon the underlying surface to be negligible.

Atmospheric circulation is the most complex of the interacting factors and depends to a large degree on radiation and the underlying earth's surface.

Substantial effect upon the transfer of air masses is exerted by the presence of continents and oceans. The role of continents and oceans in the general atmospheric circulation was acknowledged long ago; however, a correct explanation of this role has been given only in the last two decades.

The role of continents and oceans in the monsoon circulation has been determined by the research of Academician V.V. Shuleykin [12]. In these works, in addition, a quantitative expression for the effect of the ocean upon the continent of Eurasia was given. Later on, Kh.P. Pogosyan [8] showed the role of continents and oceans in creation of seasonal peculiarities of the thermic and baric fields of the troposphere, which directly stipulate the atmospheric circulation over the northern hemisphere. In addition to continents and oceans, the presence of mountain ranges and heights and also of large bodies of water exerts substantial influence upon atmospheric circulation.

It is obvious that the circulation of the earth's atmosphere is derived from radiation and the underlying surface. However, this dependency is defined on a gross scale, that is, the general atmospheric circulation is determined by radiation and the underlying surface of the whole globe or of vast geographical regions of the order of continents and oceans. If, on the other hand, we consider the effect of radiation and underlying surface on the general atmospheric circulation in a small geographical region or at a separate point, we then come to the conclusion that the effect of these climatogenic factors in the given case is extremely negligible. As a consequence of this one may assume that the atmospheric circulation in any small region or point is independent of the climatogenic factor for that region.

On the other hand, atmospheric circulation, having proven to be derived from radiation and the underlying surface, in turn introduces substantial changes in the atmospheric radiation regime in both large and small geographical regions. This is related to the fact that the circulation stipulates origin and development of vertical movements in the atmosphere, which give rise to the formation of cloudiness. As we know, cloudiness changes the radiation regime of the atmosphere. Therefore there is a still greater basis for considering atmospheric circulation to be one of the climatogenic factors.

From what has been presented it follows that it is essential in climate study to clarify the role of each of the three climatogenic factors and to discover their interaction in climate formation. In other words, climatology as a science must occupy itself with the study of this interaction and the determination of the role of each of the above-indicated factors in isolation. By resolutely following this path climatology can render the most effective possible help in solving problems connected with the transformation of nature. At the present moment the most accessible thing is change of the underlying surface. The exact significance of the role of the underlying surface in climatogenesis will allow us to determine the manner and extent of its action upon nature for purposes of improving the climatic regime of one or another region.

Study of the interconnection and interaction of the climatogenic factors and determination of their roles will convert climatology from an almost contemplative science into a science actively cooperating in the transformation of nature. To the degree that our knowledge and radical technical improvements are increasing our possibilities for changing the climatogenic factors and, by the same token the climate, are increasing. Thus, on the basis of study of the climatogenic factors and their interaction a theory of climate may be created.

Together with studies in the realm of climate theory, it is necessary to work out methods for the most expedient possible presentation of observational materials for purposes of complete satisfaction of the growing demands from the national economy, because the existing methods of climatography still do not assure solution of this important problem.

For its solution climatology must be placed on an appropriate foundation. By foundation we mean the factual presence of observational materials charaterizing radiation, underlying surface and atmospheric circulation in sufficient detail.

Materials of meteorological observation must be presented in such a form that it will be possible to draw up an answer to any inquiry, regardless of the diversity of branches of the national economy. In other words, this does not signify creation of special branch climatographies, which is something that many climatologists are attempting to bring about at present. Such a method of processing and presenting materials of meteorological observation should be created as would offer the possib lity of operatively obtaining a characterization of climate both in terms of separate meteorological elements and in terms of any reasonable combination of them.

For this it is essential to develop research directed toward development of new methods of climatography capable of satisfying the ever-growing demands set before the hydrometeorological services of various branches of the national economy.

This can only be realized with mechanized processing of observational materials. Actually, only an index of punched cards with the meteorological observation note-book, is in a position to further the solution of so essential a problem. One of the tasks standing before the Central Hydrometeorological Science-Research Record Office is the creation of mass punch cards -- models for standard and 24-hour intervals. Obviously TsNIGMA [Central Hydrometeorological Science-Research Record Office] must meet this important task in the very near future.

Together with this it is essential to guarantee the accomplishment of broad research works for obtaining reliable climatogenic factor characteristics.

It is altogether essential to obtain data which will exhaustively characterize the elements of the radiation balance. A very great deal of work will have to be done in this direction, since up to the present time there is only an extremely small network of points conducting direct actinometric observations. First it will be altogether essential to carry out calculations of the radiation balance components on a broad scale. As a result of this there will arise the question of reconsideration of the existing procedure for calculation of actinometric characteristics using data of meteorological observations. It is known that at the present time calculations of the radiation balance components carried out by two authors independently of one another differ substantially in their results. Without serious study in this field it will be impossible to determine the role of this important factor in climatogenesis.

In order to determine the role of the circulation factor in climatogenesis we must obtain its correct characteristics for the globe as a whole and especially for individual regions; more precisely, we must in the first place determine the magnitudes of temperature and humidity advection. This problem can be solved on the basis of reliable observational data obtained both at the earth's surface and aloft.

The state of affairs in the study of the third climatogenic factor -- the underlying surface -- is relatively secure. We have at our disposal sufficiently detailed topographical descriptions and physical maps. However, the effect of roughness and other characteristics of the earth's surface on air flow has not yet been adequately studied. The full climatic characterizations included in the manuals and atlases will be utilized in research on various problems connected with determination of the roles of the climatogenic factors.

Thus two big problems stand before climatologists: (1) development of a theory of climate and (2) creation of a new method for such presentation of climate data as will be able to satisfy any inquiries from the national economy.

We must immediately put the question seriously as to whether it is not time to stop limiting climatology to the framework of climatography. The substitution of a climatology limited by a nonviable climatography is regrettably inherent in all the existing trends in climatology, with the exception of the physical.

We are for the development of climatography, not instead of climatology, but upon its foundation. At the present moment it is just this foundation, that is climatology, that does not exist; there exist rather only several trends in climate description, the future possibilities of which we shall consider in our next article.

REFERENCES

1. Alisov, B.P., Izvekov, B.I., Pokrovskaya, T.V., and Rubinshteyn, Ye.S., Course in Climatology. Leningrad-Moscow, 1940.

2. Blinova, Ye.N., The Question of Average Temperature Distribution in the Earth's Atmosphere, with Calculation for Continents and Oceans. Izvestiya of the Academy of Sciences USSR, 1947.

3. Budyko, M.I., Evaporation under Natural Conditions. Gidrometeoizdat, Leningrad, 1948.

4. Kashin, K.I., Temperature Distribution Aloft in January over Yakutsk. Inf. Sb. No 6, 1949.

5. Kibel', I.A., Temperature Distribution in the Earth's Atmosphere. DAN, Vol 39, No 1, 1949.

6. Kochin, N.Ye., Construction of Models of Zonal Atmospheric Circulation. Trudy GGO, No 10, 1936.

7. Laykhtman, D.L. and Chudnovskiy, A.F., The Physics of the Atmospheric Layer at the Earth's Surface. Gostekhizdat, Leningrad-Moscow, 1949.

8. Pogosyan, Kh.P., Seasonal Fluctuation of the General Atmospheric Circulation. Trudy TsIP, No 1 (28), 1947.

9. Sapozhnikova, S.A., Variation of Wind Velocity with Altitude in the Lower Air Layer. Gidrometeoizdat, Leningrad, 1946.

10. Tikhomirov, Ye.I., The Question of Defined Concepts of Climate. Meteorolog. vestnik, No 11-12, 1933.

11. Chubukov, L.A., Complex Climatology. Izd. of the Academy of Sciences USSR, 1940.

12. Shuleykin, V.V., The Physics of the Sea. Izd. of the Academy of Sciences USSR, 1941.

HYDROMETEOROLOGICAL SERVICE TO THE NATIONAL ECONOMY

N.P. Tomfel'd

(This article gives examples of service to the national economy which do not relate to agriculture. A special article on the question of service to agriculture will be placed in the next number of the journal.)

The vigorously and manifoldly developing national economy and cultural edifice of the Soviet Union are in ever greater and greater need of forecasts and various hydrometeorological materials.

The ministries and various economic organizations ever oftener and more encounter in their work the necessity of obtaining help from Hydro-meteorological Service; therefore they are presenting it with ever greater and greater demands for various kinds of factual materials and various types of forecasts.

The basic demands of the various ministries can be formulated in the following way.

The Ministry of River Flotilla USSR and its local organs need, in order to guarantee maximum effectiveness of their work, hydrological forecasts for all the navigable parts of rivers, both natural and regulated, and also forecasts for large and navigable lakes.

The administrations for exploitation of small rivers present Hydrometeorological Service with demands whose satisfaction involves working out detailed hydrological characteristics of small rivers and methods for forecasting them.

The Ministry of Fishing Industry is in extreme need of good forecasts of storms at sea, and also of forecasts of water temperature during the fishing season.

The Ministry of Electric Power Plants and its hydrological energy enterprises demand of the organs of Hydrometeorological Service good calculation data on the hydrological regimes of rivers. This ministry needs forecasts of the spring high water volume both in the period of breakup of river ice and in the time following.

The Ministry of Electric Power Plants, Communications and Means of Communication presents demands for timely warnings of the appearance of glaze frost and needs accurate information on its distribution and intensity of formation.

The Ministry of Means of Communication is systematically in need of advance warnings of heavy storms and snowfalls in winter.

Civil aviation demands of Hydrometeorological Service more accurate characteristics of horizontal visibility, and of altitude and thickness of clouds.

In 1948, the Ministry of Forest Economy first placed before Hydrometeorological Service the problem of organizing a special service for forecasting danger of forest fires.

For complete satisfaction of the above-enumerated basic demands, and a series of others made by miscellaneous branches of the national economy, colossal work must be conducted in various fields of hydrometeorological service. This does not mean, however, that some part of the very important problems which have been indicated cannot be solved at the present moment.

It is expedient to illustrate Hydrometeorological Service's possibilities for solving the problems directed toward it by the national economy with some concrete examples.

The Karelo-Finnish SSR Hydrometeorological Service Administration, which was charged with hydrometeorological service to timber rafting, has attained extremely effective results in its work during recent years. Until 1948 timber-rafting organizations which provide the country with considerable quantities of building timber suffered heavy losses of wood every year in hauling operations on Lake Onega on account of storms. Beginning in 1948 the workers of the Hydrometeorological Service Administration got under way a specialized service to timber-rafting on the lake. For this purpose they worked out, in cooperation with representatives of the steamship company, various hauling routes for the timber rafts, which were utilized depending upon the wind direction.

The following order was introduced into work practice: before each towboat sets out on its voyage its captain gets an exhaustive consultation on the expected hydrological regime of the lake and on weather conditions along the course (forecasts) from attendant specialists. Moreover, if a change for the worse in the weather (a rise in the wind) is expected during the period of the steam-towboat's voyage with the timber barges along the travel route, the management of the steamship company, with participation of Hydrometeorological Service specialists, makes a decision as to what course the barge-tower should follow from then on or in what shelter it should be quartered during the storm period. A series of cases occurred when the towboats' departure time was changed in accordance with weather forecasts.

In order that the barges may be towed along safely on the lake, advantage has usually been taken of periods with favorable navigation conditions. In these periods a large number of accumulated barges have been towed at one time, and the voyages have been completed for the most part without loss of wood.

The operating hydrometeorological service to timber-rafting, systematic consultation of the steamship company management with regard to hydrometeorological conditions on the lake, and constant information possessed by the specialists on duty in the locality of the barge trains made it possible for the steamship company in 1949 for the first time not to suffer total loss of even one barge.

At "Krasnoye Sormovo" shipyard in 1949 and 1950 there were vessels in the so-called "ship pit" which had to be launched on the Volga in the spring high-water period. For this purpose the river level had to reach a definite mark in order for the ship pit to begin to fill up with water. After compilation of a forecast of the spring high water and its communication to the shipyard it appeared that the maximum water level might be only close to the required mark. The danger therefore arose that the launching of the ships would occur under very difficult conditions. Using the forecasts and consultations of UGMS [Hydrometeorological Service Administration], the shipyard administration carried out a series of preparatory measures directed toward facilitation of launchings from the pit with low river levels and determined the time when construction of the ships would be completed in conformity with the periods of passage of the flood peak. At the same time, the hydrological forecasts department performed correlation of the levels at the UGMS posts and at the shipyard administration (at the pit).

From the moment when the forecast was given until the launching of the last ship from the yard uninterrupted communications were maintained for conveying the actual and probable course of [fluctuation] of the level.

As a result of the correct utilization of UGMS forecasts and consultations in connection with ship launchings the yard saved roughly a million rubles in 1949.

In the spring of 1949 the Volga Forest-Fishing Trust had to relaunch a dock which had been assembled. After checking the marks of the bottom of the dock with a trust representative and comparing them with the marks of the maximum water level expected according to forecast, it became clear that with the probable levels the dock could not float. It was recommended to the trust to drop the dock from cribs as low as possible. Moreover, the trust carried out another series of measures directed toward faciliation of the dock's launching.

Regular communication was subsequently maintained with the trust for purposes of checking forecasts, consultation on their utilization and transmission of information on the current condition of the river.

Several days before the flood peak on the river trouble developed: the water level rose in the region of the dock site, the dock floated, but it was impossible to launch it on the Volga on account of ice movement.

The Hydrological Forecasting Department instantly warned the trust that in the very near future, even before the end of the ice flow, they should expect a drop in the level (after the breakup of the jam), as a result of which the dock might settle on an unprepared, jagged place and be destroyed. The trust took steps in good time, and when the water subsided the dock settled on a safe place. The moment of passage of the flood peak and its height were also communicated in good time to the trust, and the dock was successfully launched on the Volga.

Thus, as a result of correct utilization of the Hydrological Forecasting Department's recommendation concerning dropping the dock from cribs and its warning concerning the drop of the level after the liquidation of the jam the dock was successfully launched on the Volga and saved from possible destruction.

The hydrometeorological bureau in Makhach-Kala in May of 1949 warned Dagestan national economic organizations three or four days in advance about expected first autumn frosts and conducted skilled consultations on the stages of development of these frosts.

In most of the organizations precautionary steps were taken to guard the flower gardens and truck garden crops from the autumn frosts. As a result the harvest was saved.

On Rybinskiy Reservoir in October 1949 a storm which had been observed for ten days brought on a stoppage of work in timber-rafting. In connection with a short slackening of the wind which was expected according to the weather forecast the management of Pereborsk piers concentrated the whole towing fleet in time to tow the wood. Making use of the slackening of the wind and the subsidence of turbulence on the reservoir, the towing fleet successfully hauled all the timber across. In the following long period timber towing was stopped on account of the recommencement of storm weather.

Exceptionally heavy snow storms were observed on Sakhalin in January and February 1949. Warnings of these storms were given ahead of time. The Sakhalin Railroad Administration took steps in time to combat the drifting snow: labor forces and machines were prepared and placed to clear the roads of drifts, trains were kept in the stations. Railroad work stoppage was reduced to a minimum.

On 30 March 1949 the hydrometeorological bureau in Makhach-Kala gave a storm warning to the Dagestan Fish Trust. The trust orders to all fishing concerns, kolkhozes and sovkhozes to take in their nets and seines. The enterprises which put these directions into execution completely preserved their fishing equipment. The director of one fishing concern did not put these instructions into execution and consequently his fishing equipment was destroyed by the storm and the fishing concern suffered great loss.

Regrettably, in the daily work practice of Hydrometeorological Service rather many cases of gross blunders still occur, which disrupt the normal activity of national economic organizations and cost the government dearly.

The cited examples show that profound study of the needs of economic organizations by Hydrometeorological Service leads in the final analysis to great effectiveness in hydrometeorological service to them. These examples allow us to make the conclusion that all forecasters (hydrologists and synopticians) must study the needs of one or another organization for forecasts and various hydrometeorological materials in all their detail. Forecasters who are thoroughly familiar with the needs of the organizations served by them will become active participants in carrying out economic measures. They will become consultants in the process of carrying out these measures and in these cases attain maximum effectiveness in hydrometeorological service to the national economy.

EXPERIENCE IN HYDROMETEOROLOGICAL SERVICE TO PASTURAL STOCK-RAISING IN KAZAKHSTAN

I.F. Porfir'yev,
V.A. Stepanov,
A.P. Fedoseyev

In the vast territory of Kazakhstan there are tremendous desert, semidesert, steppe and high-mountain pasture areas. Climatic conditions in the Republic and the characteristics of the pasture vegetation make it possible to maintain livestock on green fodder throughout the year. Livestock grazing is conducted, basically, on seasonal pastures. To a considerably lesser degree year-round pastures also exist in Kazakhstan.

Range livestock-raising is of very great significance in our country. The three-year plan for development of public kolkhoz and sovkhoz productive livestock-raising places before Kazakhstan the task of increasing the livestock considerably. An ever greater increase in livestock is specified by the plan for the second postwar five-year period.

The growing socialist livestock-raising enterprise must be reliably protected from elemental disasters and, in particular, from unfavorable weather phenomena. Meteorological conditions, as basic factors of the external environment, play a decisive role in the formation of yields of pasture vegetation and have a strong effect on the organism of the animals and on the output of livestock-raising production. Study of unfavorable weather phenomena which have harmful effects on animals out at pasture and clarification of the nature of development of pasture vegetation in relation to meteorological conditions are basic tasks whose solution will allow meteorological service to range livestock-raising to be accomplished correctly.

Glaze frosts, snowstorms, snowfalls, heavy frosts, intense heat, hail and strong winds are extremely dangerous for livestock. Most dangerous for animals are ice formations in all forms: glaze frost on the earth's surface and plant stems, ice crust on the surface of the snow, interlayers of ice within the snow, freezing snow.

A thaw in winter with fall of precipitation and subsequent freezing usually creates serious trouble for pastural livestock raising. When there is glazed frost the animals lose the possibility of moving, cannot procure feed from under the ice or solidly frozen ice crust, cut their oral cavities and hooves, and eat up the ice together with the plant stem remnants, which gives rise to mass caterrhal and intestinal sicknesses.

Strong winds in winter impede normal livestock grazing, scatter the herds and make profit for the wolves. Heavy frosts and intense heat decrease the stock's ability to graze and lower the resistance of the organism. A delayed spring postpones the moment when the stock may begin to feed on green grass.

Lack of precipitation in spring, summer and in the first half of autumn in conjunction with high air temperature (droughtiness) leads to weak development of the pasture grass stand, to premature dying off of the vegetation. The reserve of emergency hay stores is usually extremely limited under such conditions, the pastures' feed resources being poor. The stock consistently get not enough

Declassified and Approved For Release 2012/03/30 : CIA-RDP82-00039R000200150001-3

to get and by the onset of winter appear emaciated. Feed shortages give rise to longer driving distances between pastures, often without watering places along the way.

A combination of such unfavorable conditions for one or several seasons leads to "dzhuts" -- mass destruction of livestock from lack of fodder.

During the last hundred years in Kazakhstan "dzhuts" have been repeated more than twenty times and have damaged livestock raising tremendously.

In the literature there are data on the destruction of livestock in 1850 in what was then Turgay Guberniya, where in two days of snowstorms 257,000 head of sheep and goats were destroyed. In 1879-1880 after a dry summer and a severely snowy and protracted winter 1,929,000 head of livestock, or 42 percent of the stock, fell in Turgay Guberniya and 820,000 in Akmolin Guberniya. In the winter of 1891-1892 heavy storms and copious snow, which created a protracted lack of fodder, led to the destruction of 1,198,000 head of livestock, or 36 percent of the stock, in Turgay Guberniya and 364,000 in Akmolin Guberniya.

An especially acute form of drought in the spring-summer period can also lead to summer "dzhuts", when the weakened cattle are not in a condition to move on to better lands, as was observed in the Ust-Urt pastures in 1911.

Epizootic diseases and mass abortions by the animals are inevitable companions of a "dzhut".

The Kazakhs have fought the "dzhut" by moving the livestock to better places, gathering feed by hand, smashing through the ice crust, digging through the deep snow, wrapping the livestock in felt, etc. But this did not help to any significant degree in easing the dzhut.

Subject to dzhut phenomena in one or another degree are the territories of Kazakhstan, Kirgiziya, parts of Uzbekistan, Tadzhikistan, Northern Caucasia and others. The losses which the nomad economy has suffered in the past from unfavorable weather conditions at the time of wintering of the livestock have been enormous. Only for a socialist economy is it possible to organize measures which guard livestock raising from unfavorable weather phenomena.

Study of the phenomena which give rise to a dzhut, to the end that precautionary measures may be worked out, is an essential task. It is also essential to initiate study of the influence animals have upon the microregime of meteorological factors. This influence can often have an extremely beneficial effect in the struggle against harmful meteorological phenomena.

Measurements of air temperature conducted within the natural boundaries of Aydarla in the animal corrals and the surrounding territory show that even in the open air animals create their own microclimate.

~~The corral~~ was enclosed by walls up to 1.5 meters high and had an area of 460 square meters; in it were 500 mature ~~sheep~~. The weather was calm and frosty. On the evening of 14 February 1949 the air temperature (at a height of one meter) was - 17.6 degrees in the pen, but - 20.7 degrees outside. On the following morning the temperatures were - 16.0 and - 19.0 respectively. When the frost

Declassified and Approved For Release 2012/03/30 : CIA-RDP82-00039R000200150001-3

was heavy the sheep churned around close together, creating a completely distinct climate of the animal environment.

Kazakh ranchers long ago coordinate their grazing technique with weather conditions. For example, in winter the sheep from morning on graze against the wind; in the evening they return to their quarters -- in the direction of the wind. On hot days in summer the sheep are driven out in the direction of the wind in the morning, and in the heat of the day are turned against the wind. Sheep are not pastured in the dew. Utilization of waterless pastures is possible only with fall of snow, which serves as a source of watering places for the stock. A sudden snowfall in the middle of winter can put the stock in a critical position, far from water sources. When the grass stand ices over the stock are driven over onto sandy or elevated places, where according to the Kazakhs' observation the ice crust is sparser and less lasting. When there are heavy winds and snowstorms the stock hide in various hollows of the locality -- river gulleys or thickets of brush.

Organization of hydrometeorological service to range livestock-raising in Kazakhstan was begun in earnest in 1946. Attention was paid first of all to creation of a new network of meteorological stations in the desert and semidesert rayons of the Republic, where range livestock-raising is primarily concentrated.

With participation of public, soviet and party organizations 20 meteorological stations were built in four years under the most difficult desert conditions (no roads, lack of water, absence of building materials). There, where one could formerly see only nomad's tents, and that rarely, there appeared well constructed station buildings with electric lighting, wind-driven generators and radio communications. In addition to fulfilling their direct purpose in serving range livestock-raising, the meteorological stations have also become cultural centers in the remote desert rayons of the republic. Each Kazakh rancher considers it his duty to visit the station, examine the meteorological grounds and listen to the radio. In the last Supreme Soviet USSR election campaign these stations played a large part, providing remote regions with radio communications and developing mass-agitation work among the livestock raisers.

Almost all the stations were opened in winter pasture regions, where the livestock is most subject to the effect of harmful weather conditions.

In proportion as the work has evolved, the program of observation at the meteorological stations has been made more accurate and has been broadened. Early included in the program were observations of pastural fodder vegetation which remains the year round for natural grazing, and of the cycle of the livestock's pasturage in relation to the weather.

Recruited to work out instructions for conduct of observations of pastural vegetation were the Agricultural Methods Division of the Geophysical Observatory, the Botanical Institute of the Academy of Sciences Kazakh SSR, and local livestock raisers, who were thoroughly familiar with the pasture vegetation. A series of problems were defined more accurately in the field by agrometeorological specialists.

Minimum observations of meteorological phenomena harmful to livestock, worked out cooperatively with productional and scientific institutions, were specified in relation to the kind of livestock

Declassified and Approved For Release 2012/03/30 : CIA-RDP82-00039R000200150001-3

(sheep, horses, camels), its fatness and breed (adaptability to wintering conditions), climatic conditions of the range, critical periods in livestock raising (lambing and shearing time and the like).

In the first approximation it was considered that livestock grazing in winter is to be cut off if the following phenomena are present:

(a) glazed frost, ice crust five millimeters thick or more on the surface of the soil, of the snow, or within the snow cover;

(b) a layer of ice on the grass;

(c) heavy snow blanket (loose snow -- 40 centimeters and up, compact snow -- 15 centimeters and up);

(d) bitter frosts (-25 degrees and below);

(e) heavy snowfall, snowstorms, drifting snow;

(f) winds of velocity 10 meters per second or more with negative temperatures.

At the present time Hydrometeorological Service services republic, oblast and rayon organizations with short and long-range forecasts applicable to the territory within the main natural boundaries of range livestock-raising, with emphasis on especially dangerous phenomena -- high winds, snowstorms, glazed frosts and the like. Within the service system monthly agrometeorological forecasts containing a section on expected effects of the weather on livestock grazing and on the condition of the pasture are sent to interested organizations. In addition, these organizations receive an agrometeorological bulletin every ten days with informational data on weather conditions, the progress of livestock pasturage, the condition of the pastures and watering places, livestock drives, provision of insurance funds and the like.

To desert meteorological stations daily and three-day forecasts are transmitted by radio; weather phenomena dangerous for livestock are communicated in the process of making storm warnings. Inaddition, a zoometeorological interpretation of the forecast is transmitted to hydrometeorological stations in range livestock-raising rayons.

Service to separate livestock-raising groups is organized by each meteorological station on its own in relation to local conditions. The service plan is approved either in the rayons or in range headquarters.

At first it was very difficult to get organization underway for getting the meteorological forecasts and zoological advice up to the pasture sectors, to the flocks and herds, which often are disconnected and wandering from place to place in arbitrary directions. At the present time a good operative service is underway at stations located at the same place as range headquarters or close to them, and nomad livestock groups are equipped with portable radio stations. Such stations (or most of them) immediately deliver forecasts and warnings to the presiding officer or zoological technician at range headquarters and are in radio communication for exchange of information with remote bases or livestock-raisers who are wandering from place to place. In the absence of radio communications forecasts are sent by pony express. There was one case in the practice of service to range livestock-raising when an aeroplane was used (through the auspices of the oblast agricultural administration) for dropping leaflets with urgent warnings of imminent snowfalls to livestock herding groups who had already gone out.

To obtain supplementary information from the pasture territory a voluntary network of zoometeorological correspondents was organized, consisting of a number of zootechnicians, shepherds, communications workers and "red tent" nomad chiefs. According to the program which was developed, the correspondents report every ten days to the hydrometeorological station, using special blanks, on the height of the snow cover, precipitation, wind force, and the state of the fodders and livestock pasturage. In the winter of 1949-1950 we succeeded in attracting 30 zoometeorological correspondents in all to the work.

One may judge the effectiveness of the service rendered by meteorological stations to range livestock-raising by [reading] the testimonials of organizations and kolkhozes.

In Taldy-Kurgan Oblast the forecasts and information which are being transmitted have allowed "the kolkhozes to cut down wasteful losses of sheep by a thousand head" (Taldy-Kurgan Oblast Agriculture Administration).

In Alma-Atin Oblast, "On the basis of warnings of expected thaws communicated to range headquarters, 19 kolkhozes carried out [measures for] retention of snow in the sands (snow banks [presumably retaining walls built around snow deposits in the sandy areas to prevent the snow water from running off]), which made it possible to prolong the maintenance of 100,000 head of livestock on waterless winter pastures" (Aydarla Range Headquarters).

In Kzyl-Ordin Oblast "thanks to the timeleness of warnings to range livestock-raisers concerning weather phenomena dangerous to the stock, emergency storage of feed and utilization of pastures were carried out in a rational fashion" (Karak Range Headquarters).

In South Kazakhstan Oblast "in the winter of 1949-1950, thanks to the timely transmission of forecasts and storm warnings, losses of livestock were cut down to one-fourth to one-fifth those of the preceding winter (Tasta Persian Lamb Sovkhoz).

The newspaper Prikaspiyskaya Kommuna on 15 May 1949 reported that "in the March and April snowstorm period the workers of Tolubay Meteorological Station rendered great help to the livestock raisers in the fight to preserve the kolkhoz public livestock".

One might go on to cite a whole series of similar reports on the real help which was rendered to Hydrometeorological Service to pastural livestock-raising in Kazakhstan.

In the very near future the following must be placed among the immediate tasks in hydrometeorological service to range livestock raising:

(1) development of methods of compiling a long-range forecast for the range livestock-raising rayons;

(2) development of methods for observation of glazed-frost phenomena;

(3) study of all phenomena which bring on dzhuts;

(4) compilation of specialized agrometeorological forecasts of the expected development and composition of pasture grass, of times of the dying out in summer and renewal in autumn of green pasture vegetation, of hay-mowing for emergency feed stores, of grazing conditions in critical periods (lambing-time, shearing-time, breeding drives) and the like;

(5) working out of methods for observation of the development of pasture vegetation;

(6) study of pasture-land water resources and forecasting of summer water provision.

Such problems can be solved only in cooperation with other related science-research institutions.

The meteorological station network must be broadened to embrace not only winter, but also summer, spring and autumn, and also high-mountain pastures. A network of mobile meteorological stations, assuring radio communication, will be of great significance in service to livestock on long drives.

It should be noted that the development of radio communications in range livestock-raising rayons will facilitate the work of active service extremely.

Special agrometeorological stations must carry out methodical critical analysis of questions of observation of pasture vegetation and livestock grazing, and also must bring into being a standard-model organization of service to livestock raising directly on the pastures themselves. These stations must be organized according to natural types of pastures in the various vegetation zones.

There is a growing necessity for creation of a large science-research center for direction of the network of agrometeorological livestock-raising stations and for coordination of works with other science-research institutions (Feed and Pasture Institute, Livestock-Raising Institute, Desert Institute and others). The Agrometeorology Division of Alma-Atin Geophysical Observatory might be such a center, provided it supplements its staff with livestock-raising specialists, geobotanists and feed men.

Surveys of seasonal conditions of grazing and maintenance of livestock together with the meteorological observation materials of desert stations, observations of pasture vegetation, condition (fatness) of animals and the pasturage situation should be published in agrometeorological yearbooks in special forms.

For organization of effective service to range livestock-raising and administration of new types of observation at desert stations it is expedient to create a sector on service to livestock raising and pastures in UGMS [Hydrometeorological Service Administration] and to have agrometeorologist-livestock-raiser specialists or geobotanists at GMB [Hydrometeorology Bureau] and the large desert hydrometeorological stations.

Organization of hydrometeorological service to pastural livestock-raising, as one of the means of guaranteeing fulfillment of the party and government decrees on development of livestock-raising, must be established on a sturdy foundation with the necessary bolshevist scope.

CALCULATION OF SNOW-COVER DENSITY USING METEOROLOGICAL DATA

N.G. Dmitriyeva

Regular observations of snow density were initiated in Russia in the winter of 1903-1904. However, even with compilation of the water cadastre they did not succeed, essentially, in collecting sufficient information on the thickness of snow in such oblasts of the European territory USSR as the Ukraine and the whole northeast. The state of affairs is especially insecure in this connection in Siberia, not to mention the majority of mountain regions.

The necessity for determination of the magnitude of the snow stores has stimulated us to attempt to determine the quantitative effect of the basic meteorological factors under whose influence snow compression occurs, both in winter and at the time of its thawing in spring.

The density of newly fallen snow depends on the dimensions of the snowflakes. With large snowflakes it is equal, according to R.G. Rozental's data [5] to 0.056, with middle-size snowflakes to 0.091 and with small flakes to 0.135. It should be noted that freshly fallen show very quickly compresses to 0.14-0.16.

From A.A. Shepelevskiy's summary [6] one may come to the conclusion that the maximum density of newly fallen snow which has not yet been compressed by the wind universally attains values of 0.14-0.16. Our data, as will be seen below, confirm these values.

Of the causes which contribute to the compression of snow B.P. Veynberg [2] puts the pressure of the freshly fallen snow upon the underlying layers in first place. But in natural conditions the effect of gravity is almost always resisted by existing interlayers of frozen snow crust, which promote a more uniform distribution of weight upon the underlying layers, and by the process of sublimation which leads to decompression of the layers next to the ground. In any case, in temperate zone forests where the action of the wind is negligible, the average density of the snow by the end of winter, as observations show, does not exceed 0.20-0.23 on the average; consequently the average compression of the snow during the 3-4 winter months, if the density of fresh snow is considered equal to 0.14-0.16, proves to be insignificant.

How the density of snow may increase under the effect of mechanical action, as shown by experiment, has been established by I.V. Kragel'skiy [3]. A snow cover with an average density of 0.18 was stirred up, and 24 hours after this, without any additional action, the density turned out to be 0.32. Wind stirs up snow to some degree. It breaks up the snowflakes while they are still falling, then pulverizes and tamps down the snow. The compressional role of the wind is obvious, and the problem boils down to exposition of the quantitative aspect of this phenomenon.

Not less essential and also universally known in general outline is the compressional role of winter thaws and spring warmth. When the snow is melting, part of the thaw water is retained within the snow mass and brings about an increase in its density. Especially substantial compression of the snow will obviously occur when there is alternation of thaws and freezes, and also in places where the flowoff of thaw water is hampered (in recesses in the relief in localities with small incline).

With thawing there occurs a fusion of the crystal faces and a consequent settling and compression of the snow. Let us familiarize ourselves with Ye.G. Popov's observations [4]: he established a relation between the density of the snow and the sum of positive air temperatures accumulated up to the moment of observation. One may conclude from these observations that within the interval of density values from 0.27 to 0.36 each degree of positive temperature corresponds to an increase of density by 0.004. It should be noted that the obtained snow compression magnitudes are somewhat too high, since there was no flowoff of thaw waters.

An approximate calculation of average density of snow cover by meteorological data should be reduced primarily to calculation of the actions of wind and positive air temperatures upon the snow.

Let us dwell first of all upon an evaluation of the compressing action of positive air temperatures upon the snow. This action comes through distinctly in places where the compressing role of the wind is small. A forest, obviously, is such a place. For all the sparseness of information on snow density in forests we succeeded in finding its average value for eight points (at each three to four density values were determined on the lastday of various months). We succeeded in fainding normal values of density at the end of May for only one point which is situated in the mountains at an elevation of 1,475 meters.

The relationship between the normal values of the sums of positive average daily air temperatures and the normal values of density at the end of the calculated period is represented in Figure 1. Let us note that the data by which the relationship was constructed pertain to various geographic zones and to the whole winter. Consequently this relationship is correct for various conditions of a snow cover's existence.

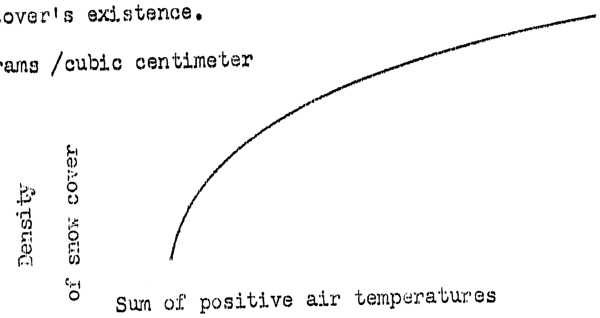

FIGURE 1

The depth of the snow cover in the cases studied varied from 20 to 130 centimeters, but we did not succeed in discovering that it had any noticeable effect on the density magnitude.

The compressing role of the wind is revealed in analyzing normal density values in places where there are no, or almost no, winter thaws. We succeeded in finding such regions with no particular difficulty. The wind's effect on the snow cover needs to be accounted for beginning from the time when it is laid down and up to the moment in which one is interested. Obviously one should take the wind into account only in the case where its velocity exceeds a certain critical value at which movement of the snow begins to take place. According to observations the snow begins to drift when the wind velocity is four meters per second.

One may assume that complete crushing of such fragile formations as snowflakes occurs very soon after the snow begins to "sweep". Subsequently, when the snowflakes are crushed, a strengthening of the wind brings about formation of wind firn [frozen snow crust] which protects the underlying snow layers from wind action.

Expressions for the magnitude of wind action in the form of sum of balls, total magnitude of the pressure exerted by the wind on the horizontal surface, or magnitude of a fictive path traversed by the wind suffer from the fault that in estimates of this kind the value of an important factor -- time -- is leveled off. One heavy snowstorm or several drifting snows may be expressed by one and the same ball sum, although in the latter case the compressing effect must certainly be more considerable.

Taking into account what has been said, and also the accuracy of observations made using a wind vane (having in mind the velocity at the earth's surface), we settled on an expression for the magnitude of wind action in the form of the number of 24-hour periods with wind velocities greater than six meters per second. A magnitude of the critical velocity equal to six meters per second (and not four meters per second) was accepted because one cannot determine the number of days with velocities exceeding four meters per second from the climate handbooks.

Shonw in Figure 2 is the relationship between the number of 24-hour periods with wind velocities exceeding six meters per second and the normal density of the snow cover. The deviation of the points from the average line of the relationship does not exceed ± 0.03. It is evident from the diagram that in the absence of days with wind velocities exceeding six meters per second the snow density is equal on the average to 0.15-0.16.

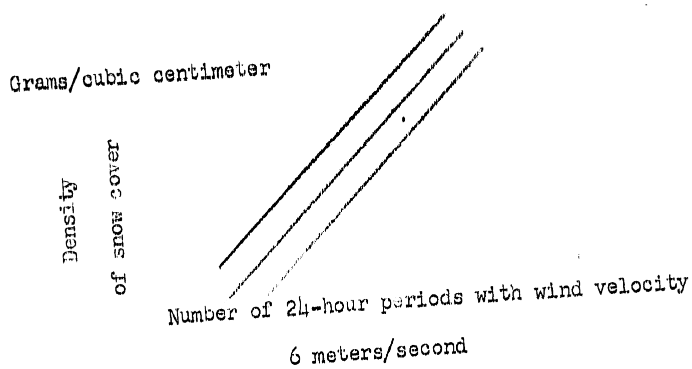

FIGURE 2

By comparing the two relationships (Figures 1 and 2) we see how substantial the wind's role is in the process of snow compression. Whereas compression of the snow cover to a density of 0.28 requires fifty 24-hour periods with wind velocities over six meters per second, which is not a rare phenomenon in a great part of the USSR's territory, thermal compression alone requires 30 degrees of positive average daily temperature for attainment of the same density. Therefore any attempts to bypass calculation of wind action (like that made by A.P. Braslavskiy [1]) are known beforehand to be doomed to failure.

It follows from Figure 2 that with snow density 0.15-0.38, to one 24-hour period of effective wind action there corresponds an increase of density equal to 0.0024. It is probable that with greater densities the compressional effect of the wind will be less.

The joint action of wind and thermal compressions can be represented in the following form:

$$D = D_0 + 0.002 \cdot 4\tau_v + k\sqrt{\Sigma\theta_t} \qquad (1)$$

where D is the average density at the end of the calculation period;

D_0 is the initial density of the snow cover;

τ_v is the number of 24-hour periods with wind velocities $\geqslant$ 6 meters per second;

$\Sigma\theta_t$ is the sum of positive average daily air temperatures at the end of the calculation period;

k is an empirical coefficient; for densities lower than 0.26 it is taken as 0.007, and for densities equal to or greater than 0.26, as 0.002.

Calculations of normal snow density (on the last days of the winter months) for 16 points according to formula (1) gave the results shown in Table 1. The good correspondence between the calculated data and the actual allows one to conclude that this formula is applicable for calculation of normal snow-cover densities.

Table 1

Range of deviation of calculated normal density from the actual	Number of cases	Percent of total number of cases
0.00 - 0.02	28	85
0.00 - 0.03	32	97
0.00 - 0.04	33	100

After this the possibility of applying formula (1) for calculation of decadal [every ten days] density values (by years) was clarified. The snow cover density was calculated and compared with the actual by individual points for all ten-day periods beginning with December and up to the last ten-day period of spring. Observed density values were left out of account only when the magnitude of the snow reserves did not tally by 30-40 millimeters both with the snow reserves of neighboring ten-day periods and with the total solid precipitation which had fallen between the two ten-day periods; that is, density determinations which could be known beforehand to be erroneous were not taken itno account.

All the points with reference to which we succeeded in calculating decadal snow cover densities and comparing them with the factual were grouped over the following regions; north, center, southwest, west and the eastern slopes of the Southern Urals. The results of the calculations are placed below.

It is essential to dwell upon the peculiarities of calculations of decadal snow-cover density as compared with calculations of the normal surface [sic -- should be "normal density"].

The first peculiarity of calculation of decadal snow-cover density is the necessity of determining the compressional action of snow which has freshly fallen in the winter period.

The density of newly fallen snow in winter after it has lain 5-10 days should be accepted as equal to 0.15, if during that time there has been no wind with velocity exceeding the critical, or should be calculated using the expression

Declassified and Approved For Release 2012/03/30 : CIA-RDP82-00039R000200150001-3

$$D_f = 0.15 + 0.024\,\tau_v \qquad (2)$$

where D_f is the average density of the freshly fallen snow and the other symbols are the same as in expression (1).

After the density of the freshly fallen snow has been calculated, calculation of the average density $\bar{D}$ is carried out using the equation

$$\bar{D} = \frac{D_n H_{n-1} + D_f\,(H_n - H_{n-1})}{H_n} \qquad (3)$$

where $\bar{D}$ is the average density of the snow cover at the time of observation,

D_n is the average density calculated without taking the fresh snow into account,

D_f is the density of the freshly fallen snow, H_n is the depth of the snow cover at the time of observation, H_{n-1} is the depth of the snow cover before the snowfall.

In cases where there is no wind during the calculation period with velocity exceeding the critical, when there should be no substantial blowing-off of snow from the precipitation gauge, expression (3) may be replaced by the following:

$$\bar{D} = \frac{D_{n-1} H_{n-1} + P}{H_n}$$

where P is the quantity of precipitation during the calculation period.

The correction for freshly fallen snow should be introduced only in cases where the snowfall has been considerable. For practical purposes fresh snow (lying only 5-10 days) exerts substantial compressional effect when it forms a layer 7-10 centimeters thick. In general, however, one has in each separate case to make estimates using formulas (3) and (4). If the calculated average density turns out to be 0.03 (the usual accuracy of calculation) less than the density calculated without taking the fresh snow into account, then further calculations by expression (1) are conducted taking the calculated density into account.

In calculations of decadal densities one encounters still another feature.

In many springs the snow begins to be compressed and even to melt, since there are average daily air temperatures close to zero degrees and sometimes positive. In the latter case, however, there is always a steep 24-hour air temperature cycle and the daytime temperatures are considerably above zero degrees. Naturally in these conditions -- with thaws in the daytime and freezes at night -- strong compression of the snow takes place. This circumstance could not be taken into account in the investigation primarily because thermal compression and thawing of snow in forests was analyzed. As we know, thawing occurs here [in forests] chiefly on account of advective heat. The average positive temperature during a twenty-four hour period may be approximately found by way of the maximum air temperature.

A sign of when one ought to take into account only either the daytime or the average 24-hour positive air temperature is the fact of diminution of the depth of the snow cover. If the diminution of depth occurs when the average 24-hour temperatures are negative the calculation must be conducted using sums of the positive daytime temperatures, but if the diminution is observed when the average 24-hour temperatures are considerable (exceeding 8-10 degrees) the compression calculation may be conducted using the sums of these [i.e., usingthe average 24-hour, rather than only the daytime, temperatures]. We use just such a criterion when the decadal densities have been determined.

Thus for calculation of the average density of the snow cover at any time the following data are necessary: the time when the snow cover was laid down, the number of 24-hour periods with wind velocity greater than six meters per second during the time extending from the laying down of the snow cover up to the time the density of the snow is being determined, the sum of positive average 24-hour or daytime air temperatures during the same period and, finally, information on the depth of the snow cover or the quantity of precipitation for purposes of introducing a correction for the freshly fallen snow in cases where there have been considerable snowfalls. In cases where the initial density of the snow cover is known, the same initial data are needed for a shortened period, and D_0 is replaced in the expressions by the magnitude of the initial density.

The calculations are so simple that there is no need to cite examples. We shall therefore confine ourselves to a summary of the distribution of errors in the calculated densities. Inserted for comparison is the distribution of errors obtained in determining densities by way of their normal values (for corresponding 10-day periods).

As has already been indicated calculation was made for 720 ten-day periods according to stations in the basins of the Northern Dvina and Mezen (148), Middle Volga (169), Upper and Middle Dnepr (42), Belaya (112) and Tobol (250). For regions with consistent winters the calculation gave an error of up to ±0.03 in 91 percent of the cases. In the southwest, where thaws are often observed the accuracy of calculation turned out to be lowest; here (the basin of the Middle Dnepr and Oka) the error was greater than ±0.03 in 17 percent of the cases. The general characteristics of the calculation's accuracy are apparent from Table 2.

Table 2

Range of Deviation	Deviation of the Calculated Density From the Actual		Deviation of the Actual Density From the Norm	
	Number of Cases	Percent	Number of Cases	Percent
0.00-0.02	460	64	346	48
0.00-0.03	620	86	446	62
0.00-0.04	690	96	525	73
0.00-0.05	720	100	590	82
0.00-0.08	--	--	676	94
0.00-0.10	--	--	710	99
0.00-0.14	--	--	720	100

The density calculations can probably be made more accurate by way of improving the calculation of positive daytime air temperatures and of times of fall of fresh snow.

REFERENCES

1. Braslavskiy, A.P., Forecasts of Spring and Winter Runoff and Their Utilization in Water-Conservation Calculations. Proceedings of the First Conference on Regulation of Runoff, Academy of Sciences USSR, 1946.

2. Veynberg, B.P., Ice. OGIZ, 1940

3. Kragel'skiy, I.V., Processing a Snow Cover by the Method of Mixing and Repeated Crushing. Symposium "Physico-Mechanical Properties of Snow and Their Utilization in Airport and Highway Construction", Academy of Sciences USSR Publishing House, 1945.

4. Popov, Ye.G., Thermal Balance and Intensity of Snow-Melting. Trudy TsIP, No 9 (36), 1948.

5. Rozental', R.G., Density of the Snow in Irkutsk. Izvestiya of the Academy of Sciences USSR, Vol 20, No 1, 1904.

6. Shepelevskiy, A.A., Determination of the Density of Snow by its External Features. Meteorology and Hydrology, No 6, 1939.

"SULOYS" OFF THE SOUTHEASTERN COAST OF THE CRIMEA

G. V. Rzheplinskiy

Along the line where the velocities of marine currents converge on the surface of the sea an accumulation of a large quantity of foam, algae, fish fins and similar objects is sometimes observed floating on the water's surface.

At these same lines of convergence eddying splashes of water are sometimes also observed and the noise of breaking wave crests is heard at a time when the sea is relatively calm on either side.

A large number of birds is usually concentrated in such places, finding here an abundance of food by day and resting at night on floating logs and wood debris (for example in Okhotsk Sea).

These lines of convergence of marine currents, which sometimes extend for tens of miles, are called "suloys".

Suloys are common phenomena in seas with strong ebb-flow currents (Okhotsk, Barents, White seas), in straits between seas, through which water exchange occurs, and in regions where large rivers issue into the sea. In spite of their widespreadness suloys always attract the attention of seamen. At the same time one must say that undeservedly little attention is given to the study of suloys. But meanwhile ~~data~~ on suloys can ~~sometimes~~ prove to be more useful in study of the hydrological regime than a whole complex of standard hydrometeorological observations conducted on some one of the many hydrological verticals.

The fact is that suloys usually represent a boundary line on either side of which it is not only the current that is different; here the temperature, salinity, color and transparency of the sea water change abruptly. Therefore information on the layout of a suloy on the sea surface and on its changes in time allows one to judge on the characteristic features of the dynamics of the marine currents and on the hydrological regime of the sea region. Observations of suloys are the more important in those sea regions where they are more or less stationary and are almost always observed in the same places.

Sometimes suloys appear at sea only in the presence of a characteristic conjunction of hydrometeorological conditions. In such cases observations of suloys allow one to obtain an idea of the changes in the sea's hydrological regime which are called forth by the given hydrometeorological situation. Suloys observed by the author in a thirty-mile littoral zone of the Black Sea in the region of the southeastern coast of the Crimea is June and July of 1948 and 1949 may serve as an example.

In this region of the sea the current velocities are comparatively low, and the water masses, it would seem, are almost homogeneous; therefore the discovery of suloys here with all the features inherent in this phenomenon seemed a surprise.

The results of observation showed that, in all probability, the emergence of suloys in this region of the Black Sea is connected with the regime of breeze winds and with the peculiarities of the shoreward and seaward drive phenomena. Therefore, making use of generally known facts, let us dwell upon the latter phenomena.

After the winter cooling in the sea region under investigation an initial heating of the surface layer of the water off the coast usually proceeds until the last ten days of May and first ten days of June. By this time the temperature of the water at the sea's surface sometimes reaches 18-21 degrees, and then winds from the western quarter, which are stipulated by the western air mass transfer which is general for the whole sea, begin to blow. These winds cause the layer of warm water to be driven away from shore in the direction of the open sea, which phenomenon is accompanied by a lowering of the sea level at the shore. As a consequence of this, cold and saltier water emerges from the depths onto the surface in the coastal zone, its inflow into the coastal zone partially compensating for the outflow of water from the shore.

The more prolonged the seaward winds, the greater the distances from shore at which one may encounter warm water (25-30 miles) and the broader the cold water zone bordering the shore.

At the end of May (though in 1948 this occurred only at the end of July) the seaward winds stipulated by the western air mass transfer usually slacken, recurring ever more and more seldom, and the breeze winds usual for this region of the sea are established in the coastal zone. The shift of night and day breezes occurs regularly, and a calm is sometimes observed at the time of their shift, in the morning and evening.

In this period the night breeze is always stronger than the day. It seems to us that the dominance of the night breeze over the day is explained chiefly by the presence in this period of the summer season of cold water at shore and warm water (warmer at night than the dry land) in the open sea. For this reason there exists a tendency, independent of the time of day or night, toward movement of the air stream from the cold water to the warmer, that is, from the shore in the direction of the open sea.

The night breeze winds usually reach a velocity of 4-5 meters per second and in contradistinction to the seaward winds of the western quarter, which have died away, embrace only a 15-20 mile coastal zone. At a certain distance from shore beyond which the velocity of the night breeze becomes small there arises a shoreward current of warm water, and here there begins to be formed, if one may call it such, a warm front of sea water. This front is so sharply expressed that it represents a typical suloy. The water temperature, which is almost unchanged from the shore to the suloy, rises abruptly here by 3-5 degrees.

Observations of the currents on both sides of the suloy show that the warm water far beyond the suloy will move toward shore, but at the suloy boundary the current is parallel to the suloy and the velocity of the current increases sharply. On the cold-water side approximately the same kind of picture is observed, with this exception, that the current of cold water becomes parallel to the suloy only indirectly at its boundary, but close to it component currents toward the suloy still occur.

To either side of the suloy the warm and cold currents have opposing directions, which brings about the formation of whirlpools along the suloy line. The distribution of surface currents on both

Declassified and Approved For Release 2012/03/30 : CIA-RDP82-00039R000200150001-3

sides of a suloy which was observed in one of the cases we encountered is represented in Figure 1. The current velocities written by the arrows are in meters per second.

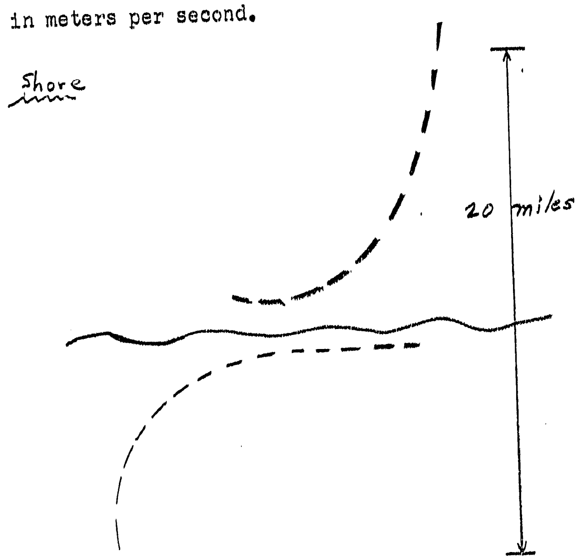

Figure 1.

According to the 1948-1949 observations such a suloy arose, after the dying away of the seaward west winds, 20-25 miles from shore in the Yalta region and 10-15 miles [from shore] in the Kiik-Atlam region. Sometimes intermediate, less sharply expressed suloys occurred at short distances from the basic suloy, but the more sharply expressed the suloy, the greater was the temperature change observed in crossing it.

Systematic observations of the positions of the suloys testified that a suloy in the form of a warm seawater front is gradually advancing in the direction of shore. When the night breeze reached its maximum development it was clearly apparent that the wind, strong

Declassified and Approved For Release 2012/03/30 : CIA-RDP82-00039R000200150001-3

at shore, slackened in the direction of the suloy and in direct proximity to it died down to a calm. Beyond the suloy only a brief surge, moving away from shore, persists, while from the suloy shoreward the sea was usually covered with breaking wave crests. Above the suloy at night a band of clouds of convectional origin was often formed.

Standing at anchor in the vicinity of the suloy one could make observations on its position. It seemed that in the presence of the night breeze the suloy remained unchangeably in one and the same place, but in the morning, as soon as the breeze died down, the suloy slowly began to move in the direction of shore. However the suloy did not have time during the day to hit against it. On the following day the suloy could again be seen at approximately the same distance from shore as on the day before, that is, at the boundaries of the reach of the night breeze out to sea.

In the middle or latter half of July (as it was in 1948-1949) the night breezes had died down, and their extension out to sea did not exceed two to five miles. Sometimes from dawn until 11 or 12 o'clock a calm or a weak wind from the sea (one to three meters per second) was observed. In these periods the suloy, which was located two to five miles from shore in the morning, advanced rapidly toward shore on one of the last days and finally hit against it. The suloy first of all reached promomtories projecting into the sea, in which connection it is curious to note that when it was still far from shore (two to three miles) bulges were formed on the shoreward side of the suloy in the direction of the promontories, while opposite the bay, on the contrary, the bulges were on the side toward the open sea.

In 1949 in the Karadag-Il'ya region the suloy joined the shore in the following sequence: 15 July, Kiik-Atlam, then Karadag, and 19 July, Il'ya. In the bays of this region, however, the suloy held back 1-1.5 miles from shore until 21-27 July. In the bays, just as in the open sea, the suloy was located in the morning at the boundary of the seaward reach of the breeze.

The position of the suloy in one of the bays, which is represented in Figure 2, is recorded in terms of the peculiar distribution of isotherms on the sea surface.

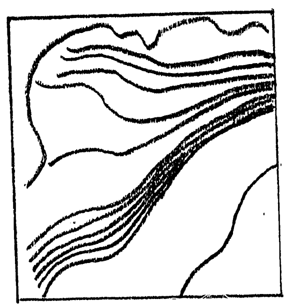

Figure 2.

The seaward and shoreard drive mechanism and the process of suloy formation are graphically recorded from the results of observations of the vertical temperature distribution along a profile perpendicular to shore (Figure 3). The distribution of isotherms represented in Figure 3a corresponds to the period of the large-scale seaward drive called forth by the west winds. One can see that the temperature gradually increases from shore toward the open sea. Embraced by the seaward drive is a very broad coastal strip of sea, going out beyond the limits of the diagram; even 30 miles from shore the isotherms in the depths have a slope in

Declassified and Approved For Release 2012/03/30 : CIA-RDP82-00039R000200150001-3

the direction of shore. The destruction of the abruptly different layer ten miles from shore, and also the characteristic curvature of the isotherms, with a convexity toward the sea surface, testify to the presence of ascending currents of cold water, not only next to the shore, but in the whole ten-mile zone off the coast. This also testifies to the absence of a closed seaward-shoreward circulation.

Observations of the currents have shown that along the entire profile the whole surface layer of the water is moving toward the open sea. Only in the depths close to shore is a weak undercurrent of cold water observed moving in its direction.

The situation changes essentially after the seaward winds of the western quarter have died away (Figure 3b); at the boundary of the seaward reach of the breeze a warm seawater front is formed. The surface currents related to the temperature distribution represented in Figure 3b were shown in Figure 1. The inflow of water toward the suloy -- warm from the seaward side and cold from the shoreward side -- is obviously compensated for by its outflow along the line of convergence. Vertical circulation of the water here is in all probability absent, for which reason a suloy cannot be considered to be a vertical division line and represents a phenomenon only at the very surface of the sea. Actually, the same isotherms emerge to the surface at the suloy as already characterize the horizontal surface of division in direct proximity to the suloy. The layer of abrupt change characterized by these isotherms in the vicinity of the suloy hinders vertical exchange between the warm surface layer of the sea and the deeper cold layers; at the boundary of the suloy the horizontal density gradient stipulated by the drawing together of these isotherms hinders horizontal exchange.

Thus the suloy which was formed in the given case was a zone several meters wide along which a layer of abrupt density change intersected the sea surface, this layer representing in the natural state a horizontal division surface.

As has already been said above, the suloy under consideration approached shore in proportion as the night breezes slackened. The zone of cold water bordering the shore became ever narrower. The temperature distribution represented in Figure 3c corresponds to the moment the suloy contacted the shore.

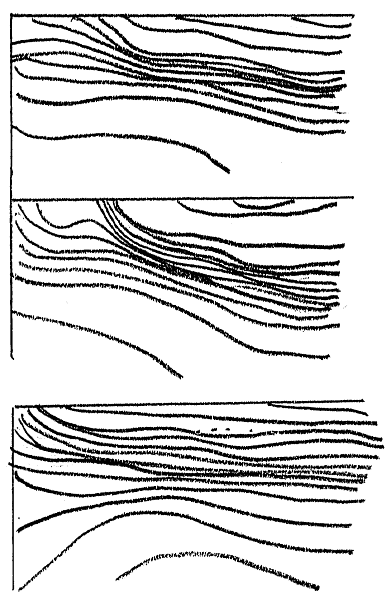

Figure 3.

Comparing Figures 3b and 3c it is curious to note the following circumstance: one and the same isotherm (drawn in a thick line) remains connected with the middle of the layer of abrupt density change. After the abutment of the suloy upon the shore this isotherm, and with it the layer of abrupt change, rises several meters toward the sea surface. Measuring on Figure 3b and 3c the areas bordered by this isotherm and the sea surface we become convinced that these areas have remained unchanged. This fact can serve as a basis for the assumption that the advance of the suloy to shore is analogous to the smooth spreading of warm water over the surface of a cold sea.

Observations of the sea level showed that after the suloy joined the shore the sea level here did not essentially change. Consequently the cold water which was found earlier at the shore did not warm up and did not mix with the warm water coming in hence from the open sea, but gave place to the warm water. One if left to assume that after the cessation of the seaward drive the cold water sinks again to the depths. Figure 3c confirms this assumption: in the foregoing diagrams the cold water isotherms were raised in the littoral zone in the shoreward direction, but after the cessation of the seaward drive these same isotherms sink toward the depths in the shoreward direction. Direct observations of the currents also testified that cold water was flowing into the depths away from shore.

Thus the coastal strip of cold water located between the shore and the suloy represents a zone where water emerges onto the sea surface from the depths, is here enriched with oxygen, warms up somewhat, and then partially withdraws anew below the warmed surface layer of the sea.

As was indicated above, the motion of the suloy toward shore is accompanied by a slackening of the night breezes. Probably these two phenomena -- the suloy's shoreward motion and the slackening of the breezes -- are found in two-way dependence. As a consequence of the suloy's shoreward motion the cold-water area bordering the shore becomes ever smaller; consequently its role in strengthening the night breeze, the faster the suloy's approach to shore. After the suloy joins the shore the night breeze is scarcely perceived. The night temperature of the dry land in this period obviously becomes equal with the temperature of the sea.

In conclusion it should be noted that even visual observations of suloys make the results of standard hydrological observations of the distribution of temperature, salinity and currents in the surface layer of the sea substantially more precise.

Observations of suloys give a known representation of the scales and mechanism of seaward-shoreward drive phenomena and in some cases indicate the existence of real boundaries of the seaward reach of the breeze winds.

Seaward drive phenomena represent a redistribution of water masses under the influence of a definite wind regime. The process of the suloy's shoreward advance can serve as a graphic example of the fact that after the change in the seaward wind regime the water masses are again redistributed, rushing to occupy their initial, natural position, which is characterized by distinct horizontal stratification.

Observations of suloys can also provide grounds for theoretical research on the seaward-shoreward drive phenomena and breezes in the region of the Black Sea referred to above.

SHORT REPORTS AND ARTICLES

A GRAPH INTERPOLATOR OF WIND VELOCITY AND DIRECTION FOR STANDARD ALTITUDES

I. K. Troyan

The accuracy of wind determination aloft by the pilot-balloon method depends not only on the quality of the observations, but also on the accuracy with which the obtained data are processed. Practice shows that observers often make errors in interpolating wind velocity and direction for standard altitudes.

The following methods for interpolation of this kind are well known: arithmetical proportion, aerological ruler, and interpolation by formulas and graphs. The method which works best is that of interpolation with the aid of an aerological ruler, but, regrettably, these rulers are not everywhere available, and the remaining methods are less practical and are not always well mastered by observers.

We propose a simple and operative method of interpolation of wind velocity and direction for standard altitudes. This method is not new and has already been partially written up in a series of meteorological textbooks as the method of constructing a graph each time using the processed pilot-balloon data; we propose, however, to construct a permanent graph-interpolator.

For this purpose one must take a sheet of millimeter [graph] paper. Below, along the horizontal line (the axis of abscissas) the wind velocity range is laid out on a scale of one millimeter = 0.1 meters per second; the length of the range is 40 centimeters. On the top of the graph, also along a horizontal line, the range of wind directions is laid out on a scale one millimeter = one degree (Figure 1).

Along the vertical line (axis of ordinates) the altitude range is laid out on a scale one millimeter = ten meters. Starting with the base of the scale altitudes are marked off by hundreds of meters (from the earth up to 1400 meters). But in order that one may also interpolate for high altitudes (above 1400 meters) the numerals 1, 2, 3, 4, 5 . . . 9 kilometers are inserted in parentheses at the base of the scale; in interpolating in each separate case [one of] these numerals must be considered the beginning altitude. The same numerals inserted above are displaced in relation to the numerals at the bottom of the scale. This means that if we take the altitude as 00 (that is, at the earth) at the base of the scale, the altitude on the second horizontal must be considered equal to 1000 meters (one kilometer); if, however, we take the base of the scale as one kilometer, then the altitude on the second horizontal will be equal to two kilometers, and so forth.

Consequently one may find on the altitude scale any altitude for which he needs to interpolate the velocity and direction of the wind.

The lines corresponding to standard altitudes should be drawn heavily on the graph so that they may be located more conveniently in interpolation.

The graph must be pased onto thick cardboard or a plywood board and covered with a sheet of transparent plexiglass or celluloid of the same dimensions in order that the points and lines which will be plotted in working with it may be washed off.

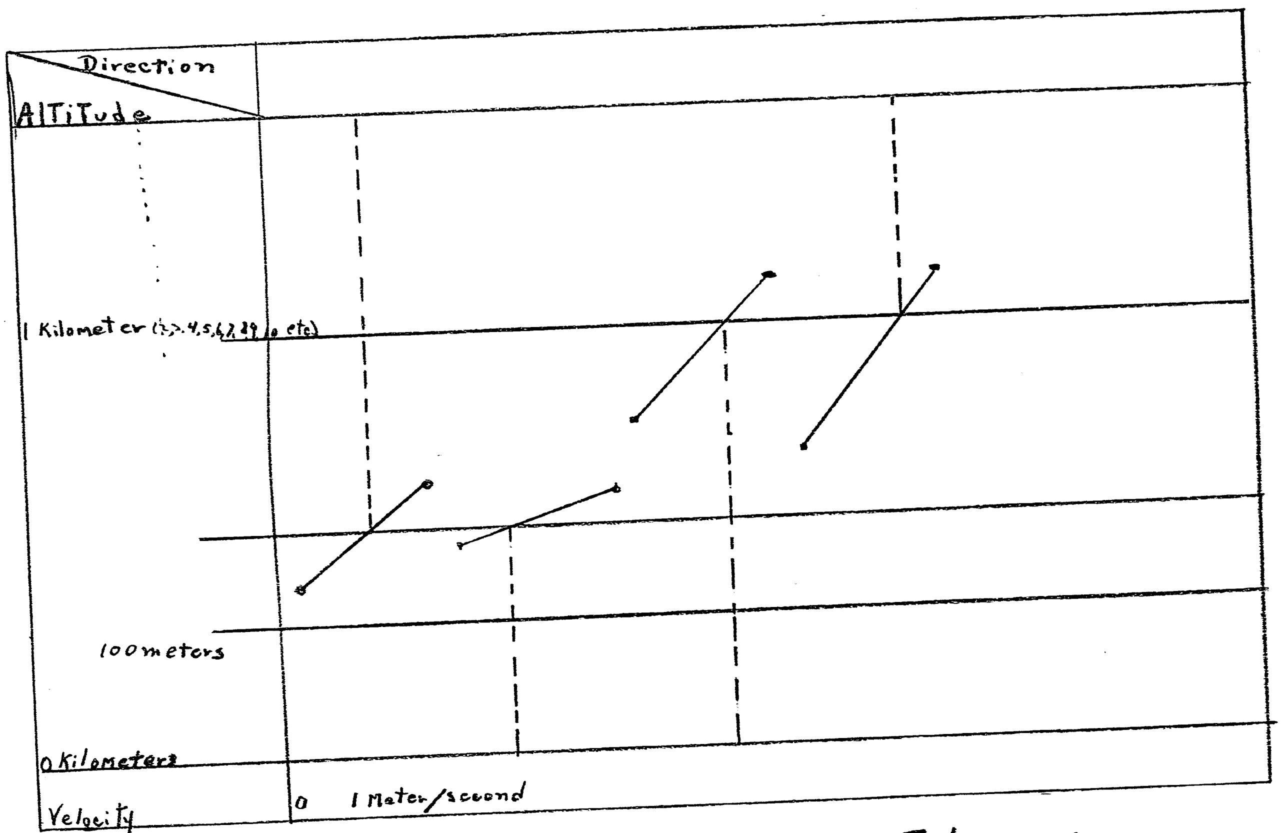

Figure 1. Graph - Interpolator

Declassified and Approved For Release 2012/03/30 : CIA-RDP82-00039R000200150001-3

Let us observe the use of the graph-interpolator by examples.

Example 1. Let us assume that after processing pilot-balloon observations the following wind velocity and direction data are obtained for the middle of certain layers:

H	v	D
450	5.2	35
630	9.8	50

H is the altitude of the middle of the layer in meters, v is the velocity of the wind in meters per second, and D is the direction of the wind in degrees.

We are required to determine the velocity and direction of the wind at the standard altitude 500 meters. Let us proceed in the following manner: on the altitude scale (the vertical at the left) we locate an altitude equal to 450 meters, on the velocity scale (the bottom horizontal) we locate a velocity equal to 5.2 meters per second, and at the intersection of these two lines we place point 1 (Figure 1). We find the second altitude, equal to 630 meters and the velocity 9.8 meters per second, and at the intersection of the lines of these two magnitudes we place point 2. We join these two points with a straight line. From the point where the line intersects the standard altitude 500 meters (the heavy line) we drop down below and find the wind velocity for an altitude 500 meters, which is equal to 6.5 meters per second.

The direction of the wind for the same standard altitude 500 meters is determined analogously. On the altitude scale we find the altitude 450 meters, on the direction scale (the horizontal at the top) we find the wind direction (35 degrees), and at the intersection of the lines of these two magnitudes we place point 3; at altitude 630 meters and direction 50 degrees we place point 4. We join this pair of points with a straight line and at the place where the line intersects the standard altitude 500 meters we refer up above and obtain the direction 39 degrees for the altitude 500 meters.

Example 2. Let us assume that the following wind velocity and direction data are obtained for the middle of certain layers:

H	v	D
2640	12.7	220
3120	16.5	248

We are required to determine the velocity and direction of the wind at the standard altitude 3000 meters. On the altitude scale we locate the altitude 2640 meters, considering for this purpose that the base of the scale corresponds to two kilometers and counting off 640 meters upward. On the velocity scale we locate the velocity equal to 12.7 meters per second. At the intersection of the lines corresponding to these two magnitudes we place point 5. For the second altitude 3120 meters (considering the base as two kilometers) and for the velocity 16.5 meters per second we find the corresponding point 6. Now carrying through the operation described above we find the velocity 15.6 meters per second.

The wind direction is determined analogously. We find point 7 for altitude 2640 meters and direction 220 degrees and point 8 for altitude 3120 meters and direction 248 degrees. We obtain for altitude 3000 meters the wind direction 241 degrees.

In the case of interpolation of wind velocity and direction for standard altitudes reckoned from sea level the elevation of the place of observation above sea level is added to each altitude of the middle of a layer above the level of the earth. As a result new mean-layer altitudes are obtained, above sea level, but with the former data on wind velocity and direction. After this the interpolation of wind velocity and direction for standard altitudes above sea level is carried out.

In conclusion let us note that the construction of this kind of interpolator-graph at any meteorological station presents no difficulty at all. We hope that the proposed interpolation method will raise the accuracy of the processing of pilot-balloon observations.

A GRAPH FOR CALCULATION OF THE VERTICAL TEMPERATURE GRADIENT

M. S. Gol'dfarb

The proposed nomogram is intended for calculation of the magnitude of the vertical temperature gradient with an accuracy of up to 0.01 degree for gradient values from 0.05 to 1.00 degree.

The thickness of the layer (Δ H) for which the gradient may be found lies within limits from 50 to 1100 meters for a temperature difference (Δ T) between the upper and lower boundaries of the layer of from 0.2 to 10.5 degrees.

The nomogram is constructed in accordance with the formula $\gamma = \frac{\Delta T}{\Delta H}$ for various values of Δ T which remain constant along [the whole length of] each curve. For calculation of γ we need to find the given value of Δ H in meters on the horizontal scale, follow up along the vertical to the point of intersection with the curve corresponding to the given value of Δ T, and from the vertical scale read off the value of γ in degrees per hundred meters.

Figure 1. Nomogram

EARTHQUAKE RECORDING AT METEOROLOGICAL STATIONS

S. M. Koshcheyev

On 30 August 1949 at 19 hours 12 minutes an earthquake was registered at "Nikitskiy Sad" ["Nikitskiy Garden"] meteorological station (eight kilometers from Yalta).

The jolts were rhythmic and frequent. As a result of the earthquake the ceiling cracked (the line ran from north to south). According to the accounts of the inhabitants the chimneys of certain houses tumbled down and the walls showed cracks from 0.5 to 10 centimeters long.

It is interesting that the self-recorders installed in booths in the yard of the meteorological station (thermograph, hydrograph) did not respond to the earthquake, but the barograph, which was installed in the room, recorded the moment of the earthquake with a jolt, registering a deviation from the pressure curve upward and downward in the form of a dotted line.

We think that if the barograph mechanism is made more sensitive, the moments of earthquakes can be recorded at a great number of points, inasmuch as there are meteorological stations everywhere.

DISTINGUISHING THE MEZHEN' FLOW IN RIVERS OF CENTRAL ASIA

Z. V. Dzhordzhio

(From a paper on the them "The Mezhen' in the Rivers of Central Asia", read at a seminar of hydrological forecasting sections of TsIP [Central Forecasting Institute].)

The rivers of Central Asia should be considered to be fed by the melting of snow and glaciers. Therefore let us agree to consider the rivers of Central Asia to be found in the mezhen' condition when these primary sources of supply are absent, and let us show how one may distinguish the beginning and end of the mezhen'. In this connection let us note that the methods for distinguishing a mezhen' which have been proposed up to now do not solve this problem altogether decisively and strictly.

The difficulty in distinguishing the mezhen' is comprised in the fact that the transition from the spring (or summer) high water to the mezhen' in mountain rivers of Central Asia usually proceeds slowly, and to determine the boundary between them decisively is not easy. After the maximum flooded state on the rivers, which is produced by thaw waters, passes, one may consider the thawing of the primary mass of seasonal snow in the mountains to be finished. Against the background of a general abatement another series of small discharge waves are usually observed. The latter reflect the variation of air temperature, in relation to which the melting of the remains of seasonal snow and glaciers is augmented or retarded. This is the first phase of the rivers' approach to the mezhen'. Then the discharge fluctuation waves become ever less and less noticeable, a rise in air temperature already yields no wave of discharge increase and brings about only a delay of the abatement. This period may be considered as the closest approach of the river's state to the mezhen'. Finally the fluctuation of air temperature ceases to be reflected in discharges of river water, and the slow abatement, at times with small delays, continues independently of the air temperature cycle. This time may be considered to be the beginning of the mezhen' period, that is, that period when a river is predominantly fed by subterranean sources.

The transition from the mezhen' to the high water in spring is also not always simple to distinguish. Snow melting begins with the low zones of the basin where there is usually little snow, and it gives a very small increase of river flow. Moreover, in spring in Central Asia there are often rains which may yield substantial flow and make the distinguishing of the beginning of that increase of flow which is due to snow melting difficult. Let us note that individual rain floods may occur in many rivers not only in spring, but also throughout the entire cold half of the year, when melting of mountain snow stores and glaciers does not occur.

Let us consider how we may define the beginning of the mezhen'.

After the river has ceased to respond to fluctuation of air temperature the abatement does not cease and sometimes continues until the middle of winter or even until spring -- until the beginning of the next high water.

The cessation of discharge from melting snow and glaciers may occur as a consequence of the snow stores being already exhausted or of negative temperatures setting in in the mountains, precluding the possibility of intensive melting of the remaining snows and glaciers. On rivers whose basins contain no glaciers and where the altitude of the catchment area is not great, cessation of surface feeding occurs as a consequence of the depletion of the season's snow reserve, and the mezhen' sets in very early, when it is still summer (June-August). Rivers with average basin altitudes and little glaciation reach the mezhen' state in the beginning of autumn (September). On rivers with feeding regions located at high altitudes and with considerable areas of glaciation in these regions the surface discharge must cease late (October). It is obvious that for the first two river groups cessation of surface discharge and the return of the river to the mezhen' state can set in long before the air temperature in the mountains passes below zero. For the last group of rivers, however, the mezhen' period sets in most nearly at the time the air temperature passes below zero, when the high-mountain snows and glaciers are cut off from the range of thawing.

For all rivers the transition to mezhen' may be distinguished without having data on the remaining snow reserves nor the air temperature in the feeding region. The sharp cessation of surface discharge may be determined from the daily cycle of the levels and discharges of the rivers.

In all the rivers of Central Asia, in the sections close to the rivers' egress from the mountain region into foothill valley, there appears to a greater or lesser degree a daily discharge cycle, which is connected with the daily air temperature cycle (that is, with the intensity of melting of snow and glaciers). The disappearance of the season's snow stores or cessation of the melting of high-mountain snows and glaciers, together with a descent of the zero isotherm below a certain boundary, has the consequence that the daily river discharge cycle disappears. This indication is also placed in the foundation of the method for distinguishing the mezhen'.

The daily discharge cycle may be discovered by three standard observations of water levels (discharges). But it is especially clearly seen on limnigrams [depth-gauge records].

For purposes of checking the date of onset of the mezhen' and cessation of surface feeding specified according to the daily discharge cycle for rivers which have snow and glaciers at high altitudes, as for example Sokh River, one may use data on the position of the zero isotherm. This position may be defined by aerological data or calculated using air temperatures at high mountain stations. For certain rivers in Central Asia one may use data from the station on Fedchenko Glacier, which is located at an elevation of 4200 meters above sea level in a region of great glaciation and maximum seasonal snow accumulations. We established, for example, for the Sokh and Vakhsh rivers that the transition from the mezhen' to the flooded state and from the flooded state to the mezhen' occurs approximately when the zero isotherm crosses the 3700 meter (absolute) line in spring and in autumn. Let us note that the extremities of glaciers in the glaciation system of the Vakhsh and Sokh rivers have marks down to 3000 meters (absolute) and below. One may conclude from this that surface feeding almost ceases earlier (by 10 to 20 days) than [the time at which] the whole feeding area is completely cut off. One may find the explanation of this in the fact that conditions for the melting of the glacier extremities are already unfavorable in the last days of October; at this time the weather changes sharply in the mountains, snowfalls begin, the freshly fallen snow does not melt, and the thawing of the glacier extremities cannot yield any substantial discharge.

The dates of the termination of the mezhen' may be distinguished using the same sign -- the appearance of a daily cycle in the rivers' discharge.

The essential difficulties in determining the dates of the end of the mezhen' are, as has already been said, connected with the fact that in spring in Central Asia frequent rains and rain discharge is superimposed upon the discharge from melting snow, thus disrupting the daily discharge cycle. In these cases one may cut off the rain discharge and isolate the snow discharge from it if one knows the air temperature and position of the zero isotherm in the presence of which snow melting in the mountains is possible. In cases of reciprocal superimposition of several rain floods with simultaneous passage of floods due to snow melting, one should consider the end of the mezhen' as that date when the river no longer returned to mezhen' discharges after the rains and when there was basis for assuming that the increase of discharge occurred not only on account of rains, but also on account of the snow melting which had begun.

SHORT-RANGE FORECASTS IN A MULTI-TRIBUTARY SECTION

R. A. Nezhikhovskiy

Cases where forecasts of levels at a lower point have to be given not by one or two, but by three and more higher points are often encountered in practice.

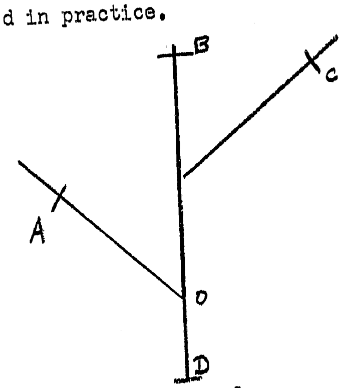

Figure 1

Figure 1 schematically shows a case where a forecast for the lower point D is given in terms of three higher points A, B, and C. For such cases the problem of forecasting the levels has formerly been almost always solved by means of selection of an equation of the type

$$H_D = aH_A + bH_B + cH_C , \tag{1}$$

where H_A, H_B, and H_C are the levels at points A, B, and C respectively, taking into account the time of run to point D; a, b and c are coefficients.

It must be remarked that equation (1) itself accords ill with the nature of the relationship being determined; moreover the work of selecting coefficients a, b and c is an extremely labor-consuming affair. All this explains why in recent times an equation of the following type has begaun to be used in practice:

$$Q_D = Q_A + Q_B + Q_C, \tag{2}$$

or

$$Q_D = mQ_A + nQ_B + kQ_C, \tag{3}$$

where Q_A, Q_B and Q_C are the discharges at points A, B, and C respectively, taking into account the time of run to point D; m and k are coefficients greater than 1, equal respectively to $\frac{F_{A'}}{F_A}$ and $\frac{F_{k'}}{F_k}$

($F_{A'}$ and $F_{k'}$ are the areas of the catchment basins of the rivers and of their outlets, at which points A and C are located); n is a coefficient greater than 1 and equal to the ratio

$$\frac{F_O - (F_{A'} + F_{C'})}{F_B}$$

Conversion of Q_D, which has been predicted by equation (2) or (3), is carried out using the discharge curve for point D. Obviously application of equation (2) or (3) is possible only if curves of the discharges at points A, B, C, and D are available.

All that has been said above is well known to hydrologist-forecasters, but we should like to note the following here.

1. In forecasts of the levels at point D there is no necessity for converting from the Q_D predicted by equation (2) or (3) to H_D on the discharge curve; this conversion leads to unnecessary errors and complicates the "running" correction which is almost applied in short-range level forecasting. It is more convenient, as the experience of the Central Forecasting Institute [2] and the UGMS [Hydrometeorological Service Administration] has shown, to use a graph of the type shown in Figures 2a and 2b.

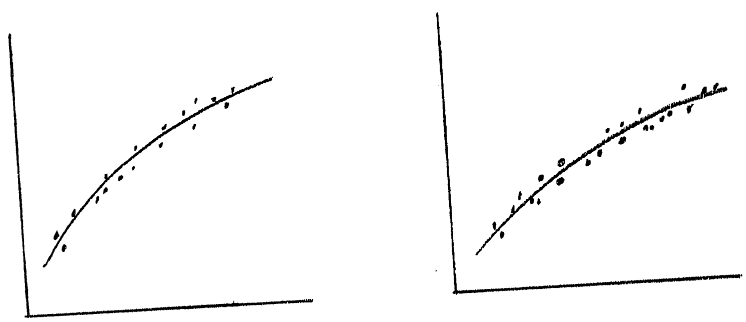

Figure 2.

2. Coefficients m, n and k are more correctly selected by proceeding from the correlation of discharge norms rather than from catchment basin areas.

3. In order to shorten the work of calculating with the polynomial

$$mQ_A + nQ_B + kQ_C$$

the discharge curves

$$Q_A = f(H_A); \qquad Q_B = f(H_B);$$

$$Q_C = f(H_C)$$

should be reorganized into the curves

$$mQ_A = f(H_A); \qquad nQ_B = f(H_B);$$

$$kQ_C = f(H_C).$$

In this case instead of determining H_A, for example, from the discharge curve Q_A and then multiplying this discharge by a coefficient m, we shall obtain the final product mQ_A.

The author's work experience on the Yenisey shows that preference must be given to utilization of a function of the type in Figure 2b over utilization of equation (1) even in a case when there are no discharge curves for points A, B, and C. In this situation it will only be necessary to construct curves of the discharges at points A, B and C by one or another method. For this purpose the following methods for construction of discharge curves in the absence of raw date can be recommended:

(a) G. P. Kalinin's method [2] which allows one to transpose a discharge curve from one point to another with the aid of the method of corresponding levels;

(b) B. V. Polyakov's method which makes it possible to construct the discharge curve, knowing the bottom of the channel and river flood-valley and also the inclination, and having a transverse profile of the active cross-section;

(c) D. L. Sokolovskiy's method [3] which allows one to construct a discharge curve by points in groups of three.

We obtain one point by superimposing on the coordinate field the minimum observed level and the discharge calculated from a chart of isolines of the modulus of minimum summer discharge and the second point from data on the mid-mezhen' level and the discharge calculated from a chart of isolines of the discharge norm. We obtain the third point, finally, from data on the maximum observed level and the maximum discharge calculated for the same frequency as the level with the aid of methods well known in hydrological calculations.

REFERENCES

1. Appolov, B. A., Hydrological Information and Forecasts. Gidrometeoizdat, 1945.
2. Polyakov, B. V., Hydrological Analysis and Calculations. Gidrometeoizdat, Leningrad, 1946.
3. Sokolovskiy, D. L., Hydrological and Water-Conservational Calculations for the Designing of Small GES [Hydro-electric Stations). Gidrometeoizdat, Leningrad, 1946.

OBSERVATIONS OF RIVER WATER TEMPERATURE

I. Ya. Liser

Data on water temperature in the autumn period, one the eve of ice formation, present great interest for hydrological forecasting. These data enter the hydrological forecasting departments of UGMS [Hydrometeorological Service Administration] in the daily hydrological telegrams, but, regrettably, they have essential shortcomings.

The fact is that in the majority of cases the observers, since they have made their observations from the shore, register a water temperature which is only characteristic for a small offshore section.

There are two causes for such a situation:

(1) observers carry out the "Teaching" badly in respect to observations of water temperature and in their inspections of water meter stations pay little attention to this aspect of observation;

(2) even when the directions of the "Teaching" are carried out it is the water temperature of the offshore zone which is recorded. In doing this it should be taken into account that observations are often conducted in a zone influenced by tributaries.

Insofar as the information on water temperature obtained from the stations does not give a correct picture of the river's thermal regime effective utilization of it is also hampered.

On the basis of the work experience of the Hydrological Forecasting Department of the Krasnoyarsk UGMS one may make the inference that the information on water temperature obtained is used extremely slightly. Moreover, it is sometimes misleading.

In spite of the importance of obtaining reliable data on water temperature no practical steps have yet been taken in this direction to date.

An experiment in obtaining representative water temperature data was made by Krasnoyarsk UGMS. With this purpose directions were given to selected base stations in the autumn period of 1947-1948 for making supplementary observations of water temperature. The latter were to be conducted at a distance of 100-200 meters from shore with the thermometer immersed to a depth of 1-2 meters. The data obtained were communicated daily to the Hydrological Forecasting Department of the UGMS.

Ten such stations were selected in all on the Yenisey. Analysis of the supplementary observation materials in the 1947-1948 period allowed one to conclude that these data are of great value.

Thanks to the fact that the water temperature observations were carried out beyond the offshore zone, they reflected well enough the temperature of the whole stream. The water temperature according to the supplementary observation data was usually higher than the temperature in the shore zone; the temperature difference was as high as three degrees (Table 1).

TABLE 1

Water Temperature of the Yenisey River (1948)

Point	Date	Water Temperature in Degrees Centigrade at shore	200 meters from shore	Difference
Krasnoyarsk	October 19	3.0	4.0	1.0
Yartsevo	October 7	5.2	8.2	3.0
Turukhansk	October 15	1.5	2.4	0.9
Ust'-Port	October 12	6.0	6.6	0.6
Ust'Port	October 13	3.3	6.1	2.8

As a characteristic example one may cite the water temperature observations on the Yenisey at Dudinka (the lower stream). Here, during 1946, observations were conducted at the shore, in the zone of influence of the Dudinka River, which flows in at the side. The water temperature fluctuated sharply and showed no coordination at all with the onset of ice formation. Beginning with 1946 observations were conducted here from the expeditionary launch Giprorechtrans via an excursion out on the Yenisey River where the influence of the Dudinka River is excluded. These data turned out to be representative and therefore free from the shortcomings indicated above. Moreover, attempts to utilize them for forecasting the beginning of ice formation at Dudinka were successful.

On the basis of what has been written one may conclude that supplementary observations of the water temperature in the middle part of a river current are positively expedient and essential.

It seems to us that the question of designating a network of points within the region of activity of a UGMS where representative observations of water temperature must be conducted (with the assurance of floating equipment for these points) has come to a head. In addition, instructions for the conduct of such observations should be compiled. In the working out of the instructions the period during which the supplementary observations should be conducted should be established. For purposes of hydrological forecasting, observations are necessary in the period from the moment the water temperature drops until the beginning of ice formation.

It is essential to point out that the problem posed is of primary significance for the great rivers of Siberia, which present the greatest interest for navigation.

It should be noted that water temperature observations can be successfully conducted by the vessels of the river flotilla which are out on voyages. In this connection it is essential to establish contact with the appropriate organizations of the Ministry of River Flotilla.

PROBLEMS OF GROWTH OF AN ICE SHEET AND ACCELERATION OF ITS SETTING

A.S. Ofitserov

When some obstacle to a current is immersed in it there forms in the surface layer of the current a dead zone with extremely small or even zero velocities. This dead zone influences the speed of growth of the ice sheet in a definite way. For this reason study of it may present not only theoretical, but also practical interest. And it was precisely practical problems which stimulated us to conduct a small study of this zone in laboratory conditions and in nature.

An hydraulic trough of rectangular profile 9.0 meters long, 0.5 meters wide and 0.25 meters deep was used for the laboratory work. Through this trough water discharges Q of from 3.2 to 30 liters per second were allowed to pass, with depths H of from 57 to 223 millimeters and velocities v of from 0.036 to 0.53 meters per second. A metal sheet two millimeters thick with a horizontal lower edge was immersed from above into the stream. This guard was 0.5 meters long and spanned the whole width of the stream. The depth of immersion S of the shield into the stream was measured in relation to the actual water level line. The dead zone was measured along the length L, that is, from the shield to the upper edge of the water head. The boundary of the dead zone was always sharply defined, and measurements of L were conducted with an error which did not in any case exceed ±5 millimeters.

We conducted more than 250 experiments with the obstacle which spanned the whole width of the stream. They all lay in the region of Reynolds numbers (Re) 3900-37500 and Froude numbers (Fr) 0.00061-0.297 and were carried out with water temperature from 3.2 to 3.8 degrees.

The research results were processed and gave law conformities analogous to those presented in Figures 1-4.

Figure 1 represents the function L/S=f(H) for various Q with S/H=0.05. One may deduce from it that with increase of the depth of stream the length of the dead zone increases, and with depth of stream remaining the same the length of the dead zone decreases with increase of the current velocity.

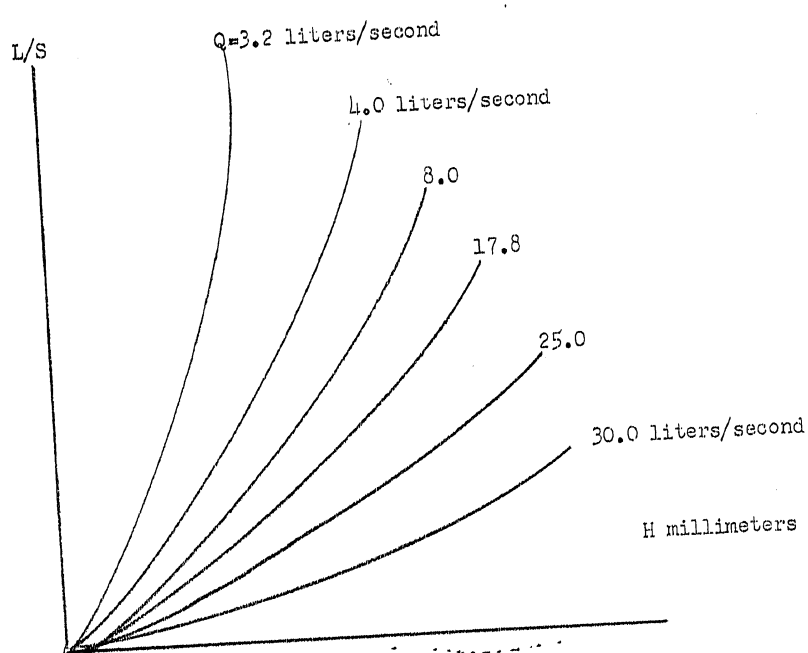

FIGURE 1.

Figure 2 represents the function L=f(a) for Re=5,000; Fr=0.0037 and 0.0094; it follows from this relationship that with increase of the immersion depth S of the obstacle the length of the dead zone increases, and the growth of the dead zone slows down as the depth of immersion of the obstacle increases.

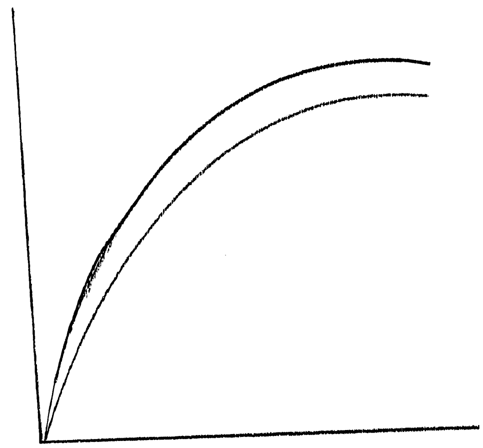

FIGURE 2.

From Figures 3 and 4, where the functions $L/S=f(S/H)$ for Re=5,000 and 31,250 and Fr from $0.61 \cdot 10^{-3}$ to $6.0 \cdot 10^{-3}$ and from 0.030 to 0.297 are presented, it is apparent that L/S decreases with increase of Fr, and with increase of the relative constraint of the current the role of Fr decreases.

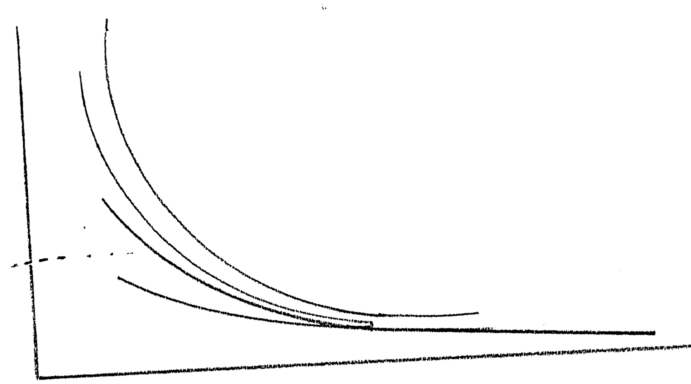

FIGURE 3.

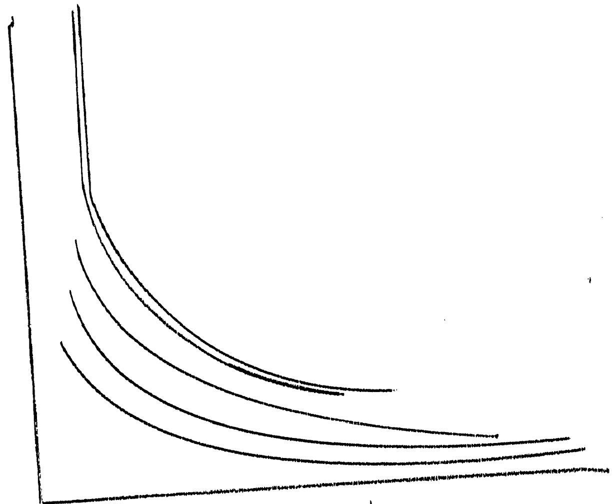

FIGURE 4.

From the graph compiled from sections of the curves in Figures 3 and 4 and representing the function L/S=f(Fr) for S/H =0.01, 0.05 and 0.1 (Figure 5) it follows that L/S → 0 as Fr → 1.

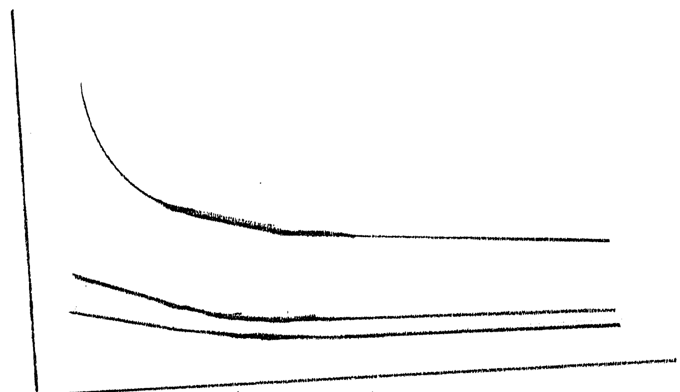

FIGURE 5.

In the case of an obstacle which does not span the whole width of the stream the length of the dead zone, as the experiments showed, decreases considerably. Thus, if the width of the stream

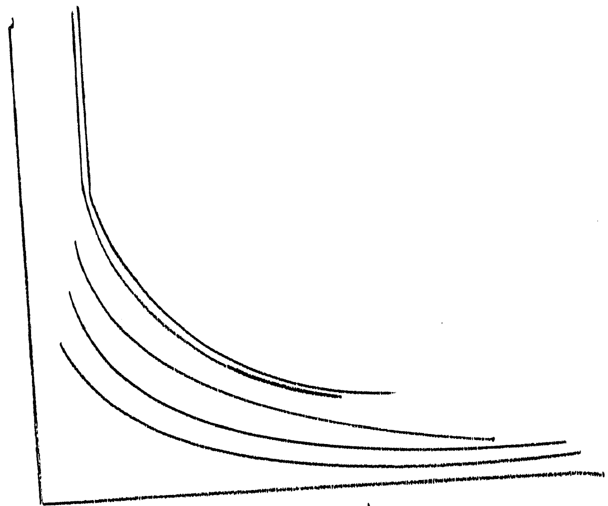

FIGURE 4.

From the graph compiled from sections of the curves in Figures 3 and 4 and representing the function $L/S=f(Fr)$ for S/H $=0.01$, 0.05 and 0.1 (Figure 5) it follows that $L/S \rightarrow 0$ as $Fr \rightarrow 1$.

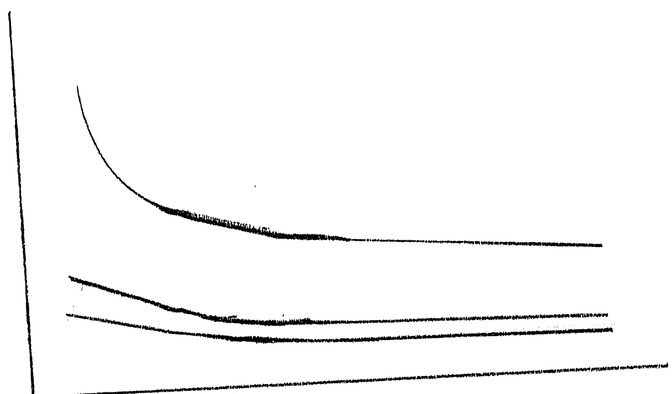

FIGURE 5.

In the case of an obstacle which does not span the whole width of the stream the length of the dead zone, as the experiments showed, decreases considerably. Thus, if the width of the stream is designated as B, the width of the gaps as b and the length of the dead zone when the blockage is complete is taken as unity, then the variation of L can be represented by the following data:

b/B	0	0.02	0.04	0.06	0.08	0.12
L	1	0.6	0.4	0.25	0.15	0.05

In front of the gap itself the length of the dead zone is still less (by 30-50 percent); with $b/B > 0.1$ there is no dead zone at all opposite the gap. In the presence of gaps in the obstacle the veolocities in the dead zone increase with increase of b/B.

Measurements of the thickness of the dead layer with the aid of dyes showed that in laboratory conditions it amounts to ~ 1 millimeter. Observations of the variation of the velocities of the stream under the dead layer showed that the gradient $\partial v/\partial H$ in the dead layer and under it are extremely great and the actual velocities of the current under the dead layer are established close to the layer.

In the case where a series of obstacles were set up along the stream it became clear that, independently of the density of distribution of the obstacles, if S/H was the same for all of them, the length of the dead zone in front of the first obstacle remained unchanged. It was shown, further, that behind the obstacles the turbulence of the stream is increased, and with other conditions remaining identical the length of the dead zone in front of the obstacles following the first is always considerably less than in front of the first.

The experiments in natural conditions were conducted in February and March on a river 9 meters wide, with an average depth of 0.39 meters and an average velocity of 0.3 meters per second. For this river Fr=0.02 and Re≅73,000. The obstacle was first solid, and then with gaps of 0.5 meters at the shore.

From this research it was shown that with S/H ≅ 0.2 the length of the dead zone L=0.5 meters or L/S ≅ 6.0; in the presence of an opening the dead zone shortened, and oppostie the opening it was absent. It was shown, further, that formation of an ice sheet on the dead zone proceeds just as fast as on a standing reservoir, and that the ice sheet itself creates a dead zone. The length of the latter in the experimental conditions levelled out to 0.15-0.25 meters. The presence of waves eliminates the dead zone.

In general the research showed that a dead zone is formed by the ice sheet itself and that it serves as a zone of preparation of the water for freezing. The longer this zone, the faster, all other conditions being equal, will the ice field grow; in other words, the smaller the Froude number for the stream, the faster the growth of the ice field on it. The speed of expansion of the ice sheet is apparently inversely proportional to the square of the current velocity ($Fr = \frac{V^2}{gH}$).

By applying an obstacle, one may speed up the setting of the ice. The depth of immersion of the obstacle in the stream, inasmuch as the expansion of the ice field is basically stipulated by the dead zone which is derived from the ice field, can be for this purpose as small as one pleases. The number of obstacles can be limited to one.

FROM "METEOROLOGY AND HYDROLOGY'S" EDITORIAL OFFICE

The editorial staff of the journal "Meteorology and Hydrology" is informing the authors of articles sent in to the information collection "Meteorology and Hydrology", which was published until 1950, that the editorial staff is glancing through the information collection's portfolio and is reserving to itself the right to select certain articles for placement in the journal "Meteorology and Hydrology". The articles which remain after the selection, unsuitable for printing in the journal on account of their great bulk or for any other reasons, will be directed to Gidrometeoizdat [Hydrometeorological Publishing House] with the recommendation that some of them be placed in Hydrometeorological Service's information collection which is to be published by Gidrometeoizdat as the material is accumulated.

CRITICISM AND BIBLIOGRAPHY

V.V. ARISTOVSKIY "HYDROMETRIC INSTALLATIONS AND CONSTRUCTIONS", GIDROMETEOIZDAT, LENINGRAD, 1949.

Hydrometeorological Publishing House's issue of the book being reviewed, which is the first printed course in constructional hydrometry, must be welcomed in every way. This book, which is on the whole not badly composed and excellently published in a big edition (10,000 copies), will undoubtedly find broad application, both as a textbook for training engineers and as a practical handbook for workers in the GUGMS [Main Administration Hydrometeorological Service] hydrometeorological network and in departmental organizations.

The book consists of two parts. The first treats questions of installation and calculation of hydrometric layouts and includes two chapters: (1) building operations and (2) installation and construction design. A short description is given here of production methods for board, pile, stone, concrete and metal jobs and basic information on construction mechanics and strength of materials is cited. This part is richly illustrated with drawings, diagrams and calculated examples.

The second part of the book gives a description of hydrometric installations and constructions of various types with photographs of their operating layout and diagrams and outline sketches of their principles. Almost all the model designs and concrete examples of hydrometric installations presented here are derived from those published in the GGI archival works. It would not have been superfluous to have mentioned this in the foreword to the book as well as in the text.

Declassified and Approved For Release 2012/03/30 : CIA-RDP82-00039R000200150001-3

The fact that the book will find broad application compels one to approach its evaluation especially attentively and to note in it, together with great and indisputable virtues, a series of more or less essential shortcomings. The latter, in our opinion, boil down to the following.

First Part. In section 1, chapter I, the author analyzes the production of earthworks and in particular of water drains from trenches. In connection with this, after having dwelt briefly on various methods of artificial strengthening of the ground (refrigeration, silication, cementation and bituminization) so as to guarantee its impermeability to water, the author speaks just as briefly about the water drain as such. Meanwhile in hydrometric construction practice it is in many cases precisely the correct organization of water drainage which acquires essential significance, whereas not one of the above-enumerated methods for artificial reinforcement of the ground is generally applied. It would have been more useful to dwell in more detail upon the characteristics of the various pump systems which are applied for water drainage, upon their discharge, operation features, etc., and upon the question of just what pump systems are most convenient in the conditions of hydrometric installation construction and why.

In section 2 (pile jobs) the author dwells in excessive detail on the driving of piles with the aid of manual and steam piledrivers, which are not generally used in hydrometric practice.

In dealing with concrete jobs in section 3, the rules for inspection and storage of cement, the simplest field tests and the care of the concrete after [removal of] the vaulting cell ought to have been dwelt upon. It needs to be noted that in a case where the quality of the cement is unknown or arouses misgivings, a field test of the concrete is extremely important. It is not pointed out that water which contains organic impurities (swamp, and sometimes lake, water) is not good for concrete.

In section 4, chapter I, "Metal jobs and constructions", it is printed that "Rivet assemblies are applied especially often, on account of the simplicity of riveting jobs", and further: "For small hydrometric installations which are being carried out at the hydrometric stations themselves rivet jobs ar preferable to welded". One can scarcely agree entirely with this point of view. The process of riveting is complex enough; it demands mill or hand manufacture of the rivets, the drilling of a great number of holes and, above all, can be executed only by experienced, qualified master craftsmen, who are not easy to find in the conditions of the rank-and-file hydrometric station.

At the same time the author, after having spoken in detail about rivet joinings, mentions welded ones only very briefly. It seems to us that both the one and the other should have been written up, in any case, in equal detail.

In section 5, chapter I, the author asserts that it is possible to draw up an engineering design alone for hydrometric installations. This is completely incorrect. In designing these installations one may sometimes confine onself to a set of design specifications alone, without having drawn up an engineering design, but never the other way around. The compilation of design specifications is, essentially, fundamental, and moreover is an extremely important stage of designing.

Chapter II is entirely devoted to the theory of and examples of calculations for, hydrometric installations and constructions. It was absolutely necessary to place it in the book, and on this score one must agree with the author, who writes in the foreword that "into the course there enters basic information from ... strength of materials and construction mechanics, transformed and supplemented for application to the particular features of hydrometric installations". The only incomprehensible thing is with just what information the author has supplemented the universally known statements from strength of materials and construction mechanics which he has written up. It is also completely impossible to understand why in chapter II, which treats hydrometric layout calculations, no reflection at all is found of:

(1) hydraulic and hydromechanical calculations for hydrometric pressure installations;

(2) calculations for boat and ferryboat crossings, which are very often encountered in hydrometric practice (there is no description of them in the second part of the book either);

(3) calculations for hydrometric installations and the principles of their design in a permafrost zone;

(4) calculation and principle of design of winter-proofing arrangements for hydrometric installations.

The question of regulation of the natrual discharge of hydrometric pressure installations, which has great principal significance and yields itself easily to calculation, is not elucidated either. The failure to calculate this circumstance may strongly affect the accuracy of discharge calculation and bring to naught the whole preeiminence of thin-walled weirs as precision measuring devices. It should be noted that in the second part of the book, in describing specific (projected and accomplished) hydrometric installations the author does cite examples of their hydraulic and hydrotechnical calculations. However, it would have been more correct to place the mentioned examples in chapter II of the first part. There too should also have been cited the basic postulates of the theory behind these calculations. A disproportionately large place is set aside for the theory of calculation of the durability and stability of installations.

Second part. In section 1. "Automatic water-level recorders":

(a) The instruction that "the connecting pipe is laid below the depth to which the ground freezes" is not always feasible. Therefore winterproofing of the pipe or conservation of the whole set-up during the winter (as is usually done in places with severe winters) ought to have been specified.

(b) The construction of a big booth (1.5 x 2.0 x 2.3 meters) above the self-recorder shaft is not compulsory; in conditions where the self-recorder does not run in winter time a small case for the instrument itself is frequently erected above the shaft (see for example Figure XXX 131 and 145).

In section 2, "Hydrometric bridges and pipe crossings":

(a) It is correctly noted that a pipe suspended on two cables is preferable in performance to a one-cable pipe. It is incomprehensible why a one-cable pipe, which is less convenient and not safe, is described further on in the book.

(b) It is recommended that the lowerlimit of the diameter of a block for suspension of the pipe cable be determined by the formula D=400 Δ. This formula, taken from cableway construction practice, is not applicable to hydrometric crossings. Figure 30 shows a pipe suspended on a cable 20.4 millimeters in diameter. According to hydrometric experience the block diameter demanded by the author is excessively great (the diameters of the individual wires, depending on the type of cable, can vary from 1.1 to 4 millimeters, and the block diameter, consequently, from 0.45 to 1.6 meters).

(c) The pipe crossing illustrated in the same Figure 130 has a sag of 4 meters for a span of 100 meters. Such a large sag creates serious operation difficulties. The GGI recommends that the cable be tightened until a sag is obtained which is equal to 1/50 - 1/100 of the length of span, which is achieved without essential increase of the cable diameter or reinforcement of the support.

(d) The author considers that "for large pipe cable lengths -- over 250-300 meters -- it is more rational not to fasten the cable at one of the shores and to provide it with a weight which automatically compensates for variation of the cable length with temperature fluctuation". Pipe crossings as long as this are not constructed. To make the cable balance with the pipe and men would require a load no less than 10 tons in weight, which renders such a design unrealistic.

In section 3. "Measurement Weirs and Troughs";

(a) Figure 131a does not show the Verkhneusad'yevskiy weir (as it says below the picture), but a weir on Central Ravine.

(b) In a footnote the author writes that studies of the slit weir have shown its unsatisfactory qualities and that it is preferable to use a radial weir. This remark is completely correct, and therefore it would have been more useful to present in the book the data on the radial weir, which was studied in detail by the GGI in 1949. It is to the point to say that the formulas for determination of the discharge of water through a slit weir pertain to a weir with an angle of 9 degrees 32 minutes, and not 10 degrees; these formulas are unreliable and it was worthless to present them.

(c) In the interpretation of D.L. Sokolovskiy's formula for determination of the mximal discharge of the spring high water (249), parameter A is incorrectly called the maximal intensity of snow-melting.

(d) In dealing with the hydrotechnical calculation the author only speaks of the necessity of carrying it out and presents a general picture of infiltration under a weir. As a method of calculation, construction of a hydrodynamic grid is recommended; the author presents no illustration of the construction. Meanwhile the construction of a hydrodynamic grid for more or less complex arrangements of underground contours presents considerable difficulty. At the same time such arrangements (for example bottom controls or baffle controls equipped with teeth) are altogether possible in hydrometric practice and there exists for their hydromechanical calculation the sufficiently accurate and incomparably easier fragments method of Academician N.N. Pavlovskiy, which should also have been presented.

(e) As an arrangement for guaranteeing the inundation of an hydraulic jump the author describes only a jet well, which is by far not always the best means, since it brings about an increase in the volume of concrete and earthworks and an increase in counterpressure. It would have been appropriate for the author to have indicated other, easier and no less effective types of dampers (apron, Senkov beam).

(f) Almost nothing is said about crib constructions in weir installations. Meanwhile installations of this type should find broad application in permafrost conditions.

(g) In weir installations an arrangement of drain pipes joining the upper water with the under is compulsory; something should have been written about this.

(h) The inverse slope of the bottom of the discharge funnel of a hydrometric trough amounts to 0.166, not 0.084 (the error in "Instructions for Hydrometric Stations and Posts", number 6, part II, is repeated in this book).

(i) The formula for determination of the discharge of water flowing through a hydrometric trough is given incorrectly.

The section "Artificial Control Cuts" (section 4) is worked out extremely sketchily. Only general indications from "Instructions for Hydrometric Stations and Posts" on arrangement of control cuts and a description of two designs developed by the GGI are presented. In particular, there are no concrete directions on the layout of the simplest control channels.

Uniform terminology is not always maintained in the book. For example an automatic water-level recorder is often called a limnigraph (an obsolete and inaccurate term), the terms "level" and "horizon" are mixed, etc.

One should not conclude from this enumeration of omissions and errors discovered with careful scrutiny that the criticized book is not of good quality; they only testify to some of the places where the work is unfinished, especially in the second part. This is a pity, when these omissions might have been quickly and easily corrected before the book was printed, had it been submitted to preliminary discussion.

Since the Hydrological Institute [GGI] is the central methods organ in the field of hydrometry, administering all hydrological works in the GUGMS network, one may express the wish that Gidrometeoizdat had drafted GGI to review manuals and textbooks in hydrometry.

O.N. Borsuk, A.R. Skuye

CONTENTS

SHORT REPORTS AND ARTICLES

CRITICISM AND BIBLIOGRAPHY

Editor, K.I. Kashin   Technical Editor, L.B. Kononova

Copy Editor, M.P. Busheva