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Water Supply of the United States

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The front pages of the press throughout the country during the past several weeks have dramatized the critical water shortages in many parts of the Nation. The concern that has grown in recent years over the future of our water supplies has been forcibly brought to the attention of the public by the water shortage that New York City is experiencing. This shortage is not the first that has affected an American community and it probably is not the most serious. Ample sources of additional water are known to exist in Upstate New York, and in all probability construction that will bring this water to the city will be pushed as rapidly as possible. Nevertheless, the fact that our largest city, the center of our business life, has an acute water shortage, even though it may only be temporary, causes everyone to realize something of the importance that water has in our national life and our national economy and security. In nearly every State of the Union, one or more communities now has or has had water problems as serious as or more serious than that which now faces New York City. These problems are springing up in increasing numbers, and it is high time that orderly and systematic consideration be given to their solutions and to the avoidance of as many such problems as possible in the future. If the crisis in New York serves to bring this fact into national focus, New York's misfortune may in the long run be a blessing in disguise.

The comments on water problems that have appeared in the press have ranged all the way from the alarmist view that we are short of water on a national scale to the complacent view that all that is needed to cure the troubles is some particular type of conservation or construction which the particular writer or promoter favors. Actually, the truth lies somewhere between these divergent views.

It has been said that we are running out of water. Yet, throughout the period of record the total available water resources of our country, except for local and temporary variations due to droughts and floods, have not trended persistently either up or down but have continued essentially constant. I know of no evidence in either long-term precipitation, stream-flow, or ground-water data, that controverts this statement. During the past several decades stream runoff in many places, as shown by carefully selected records of the U. S. Geolcgical Survey, showed a downward swing which reached its lowest point in the decade from 1930 to 1940, but most records show an upward swing since 1940. In the 1949 water year, the annual flow of all major continental rivers gaged by the Geological Survey was near normal or above normal. Likewise, precipitation data of the U. S. Weather Bureau show no persistent country-wide progression toward long-term declines. Records of water levels in nearly 15,000 observation wells maintained by the Geological Survey and its cooperating agencies show no over-all trend

toward decline. Water levels in some wells have declined, but only because of pumping or other activities of man, or temporarily as a result of severe droughts. Even the great drought of the thirties was subsequently offset by above-average precipitation which fully restored stream flow and ground-water levels to pre-drought stages.

The amazing situation that has arisen in this country, however, is that our use of water has increased by leaps and bounds. A century ago the per capita use of water was probably not more than a few gallons per day. Today, it is estimated that our per capita use of water amounts to more than 1300 gallons per day, exclusive of water used for hydroelectric power, for dilution of wastes in streams, for navigation, recreation, etc. The total for the country probably approaches 200 billion gallons (600,000 acre feet) a day of water now taken from wells and streams for use by industries, municipalities, irrigation projects, and domestic and other users.

During the past century our population has increased about 600 percent. The use of water, however, has increased by several thousand percent. The future is expected to bring an even more disproportionate increase in the use of water. The rapid growth of industry and technological advances, the introduction of new industries such as the chemical industry, the spread of air conditioning and temperature control processes in industry, and the hydrogenation of coal and oil shale for synthetic fuels, will require enormously increased quantities of water. Plans are also going forward for large additional developments of irrigation in the West. In the East, on Long Island and elsewhere, supplemental irrigation to provide optimum moisture for growth of crops has spread very rapidly in the last few years. It is to be expected that such uses will increase rapidly if our national economy is to be maintained at a satisfactory level.

The question is, how does this use of water compare with the amount available? The 200 billion gallons daily that is estimated to be used now is equivalent to between 1 and 1½ inches of water spread over the surface of the country in a year. The average annual precipitation is about 30 inches, and the average annual runoff is about 8.5 inches for the country.

Supposedly, this country-wide average of 8.5 inches that now runs off to the sea should be utilizable by man, but it is not possible in practice. At least a substantial part cannot be used economically because it is flood flow that occurs in such tremendous volume that there is no feasible means of storing it. And of the low flow of the streams, at least a considerable part must be reserved because it dilutes and carries off municipal, industrial, and other wastes. Also, a part cannot be consumed because it supports hydroelectric power, navigation, and other purposes. Moreover, in some streams, there is the problem of maintaining enough flow to carry off the products of natural erosion. Therefore, our use of the 8.5 inches of runoff is severely limited and restricted.

Of the water now used by industries, irrigators, and others a substantial part is actually consumed by evaporation and transpiration as it goes into the various processes controlled by man. The rest of it may be altered to a degree depending on the processes through which it goes, but fortunately it eventually is discharged back into the streams or into the ground and is available for reuse as it travels on its path toward the sea.

Thus, the comparison of availability and use of water on a national basis is complex and has many ramifications. However, it appears safe to say, despite the fact that accurate and detailed information is not available, that perhaps several times as much water is available throughout the country as a whole as is now used or consumed. All of which leads to the bold statement that our Nation's water supply as a whole is entirely adequate for all present needs.

However, it does not follow that our water supply is adequate for an indefinite length of time in the future. Nor does it by any means follow that our local supplies in every case are even now adequate.

Instead, as I stated in the beginning, there are many localities throughout the country today, including widespread areas in certain places, where the presently available supplies have been developed to such an extent that serious problems have resulted. In some of these places additional supplies cannot be obtained within the present economic limits, and decentralization of population, industries, and agriculture is a real possibility. In other places, additional water can be obtained, but it will cost more, and the problem is to obtain it in the best and cheapest way.

These problems in the aggregate are very real and are of grave concern to the people who are experiencing them. They cannot be taken lightly. It is one thing to say water problems may be solved by decentralization of man's activities, and another thing to carry it out. We must do everything within our ability to solve the existing problems if possible without such decentralization, and to anticipate and prevent other problems from occurring in the future.

The major way to solve water shortages still appears to be to make better use of water that is already available in our streams or ground-water reservoirs, and which in large part is not now being used or is being ruined by pollution. To do this effectively we need more water data.

Some water supply problems can be solved by importation of surface water from other drainage areas that have a surplus. Others might be solved by elimination of pollution upstream, making the existing supplies more usable. Impounding of streams salvages flood waters and also lessens pollution problems by using the stored water to supplement stream flow during periods of low flow. Multi-purpose dams and drainage basin developments are helping a great deal in many parts of the country.

Another means of solving many local problems is to make better use of our ground-water reservoirs. By and large, the development of these reservoirs will not make more total water available, at least away from coastal areas and away from places where the ground water is now being used by wasteful phreatophytes, for if not developed the water will seep out into streams and be available as stream flow. However, ground-water reservoirs do have several natural advantages that in general have not been fully utilized. The most important advantage is position. Much of our country is underlain by water-bearing formations of one kind or another through which water may move great distances before being withdrawn from wells. Thus, nature does a part of the job of collecting and transporting the water to the points of use.

Many of these water-bearing formations are tremendous underground reservoirs. As with surface reservoirs, they collect water in wet periods and store it for use in dry periods. Two special advantages of the underground reservoirs are freedom from large evaporation losses and freedom from sedimentation.

As the press has proclaimed, in some places the ground-water reservoirs are already being utilized to the maximum extent possible under natural recharge conditions, and in a few areas are even over-developed. But in many other places there are large undeveloped supplies available which might very well be used. Their use would be the means of salvaging water which otherwise seeps out into the oceans or into streams where it is not needed or where it cannot be impounded for use.

Furthermore, there is the possibility of augmenting the natural recharge of our ground-water reservoirs by artificially recharging with surface water which otherwise would run off to waste during high flow, or which in some cases would be partially lost by evaporation from surface reservoirs. Such practice is termed water spreading. By such practice, the ground-water reservoirs might be made to serve almost identically as surface reservoirs, to store excess water during high flow for later use when flow is small. Such unique use of underground reservoirs is already being practiced on a fairly large scale in California and on Long Island, New York, and on a smaller scale in other parts of the country. Effective utilization in this manner of more of these underground reservoirs, including the ones whose natural recharge is already fully developed, it is believed, will go far toward remedying the situations many localities face today, where supplies are plentiful most of the year, but are short in times of dry weather.

The most urgent prerequisite to undertaking these various solutions of our existing and pending water problems is more basic water facts. We can talk in general terms about our water resources, and for many areas we do have adequate basic data, but for much of the country our current store of such facts is pitifully meager. The general tendency in the past has been to take water for granted, and not to worry "until the well goes dry." Now we are being given cause for worry. It will be impossible, of course, to go back into history and gather satisfactory data on stage, flow, recharge, discharge, and quality-of-water changes with time--those facts, once gone, are gone forever. However, for the future, and to help solve the serious water problems of the present, we can make a beginning at the earliest possible time to develop comprehensive programs for collecting and analyzing the water-resources data that will be necessary for sound development. Careful detailed appraisal of our water resources and the establishment of an adequate water accounting system for our major sources of supply will materially assist in solving our present water-supply problems, and will provide a basis for the prevention of future problems of increased magnitude.

74094