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PHILOSOPHY FOR WATER DEVELOPMENT

There is probably no one in this room who has not had an experience analogous to the one I here describe. You sat at the dinner table next to a nice lady who impressed you with her breadth of interest in community affairs. She said to you "Oh, you work in the field of water resources. That certainly is a major problem facing the United States, isn't it? You know, we have had long discussions about this matter in a club to which I belong. We have made a considerable study of this matter and all of us are convinced that a key element in the survival of America is to find a solution to our water problem.

"You know," she said, "there are certainly a lot of different kinds of organizations mixing up in the field of water. They all seem to be running off in different directions. It seems to me that one of the things we need most is a national water policy. Don't you think so?"

I know how you answered the question. You must have about got started on a discussion of some of the complications when the conversation turned to the question of how long did it take you to get home in that last big snow. So, in effect, you continue to talk about the water problem even if merely as you exchange pleasantries about the day's weather. But then you went home and you thought some more about what the nice lady said and you asked yourself "well, now, truly how do we solve the Nation's water problem? What has a national water policy to do with a solution of this problem?" In the next few minutes I wish to exchange with you some of our thoughts on this matter.

If we are to evolve a policy to solve a problem we first must be able to define what the problem is. The ultimate water problem exists in its most forceful reality when you turn on the tap and nothing comes out. When anyone has this experience the water problem at that moment is in his lap.

Now let us see what this really means. It means that any person anywhere feels that he is entitled to have at his call clean and useable water in any reasonable amount. When any of these things are missing a so-called water problem exists. First, then, the water must be available on call. In other words, every one wants his share of the water at his own convenience and time. Owing to the

variability of the occurrence of water in the hydrologic cycle, this means that in some manner or other water must be stored to carry over from the times of plenty to the times of dearth. But the first mistake we tend to fall into is to think of storage principally as reservoir space behind a dam on a stream. We must begin to think, also, about all the other alternative ways in which water is stored on the earth--in lakes, in the ground, in stream channels, as soil moisture, and as various combinations of these. It is quite necessary to begin to think about the most efficient ways of utilizing the different kinds of storage available to us in the hydrologic cycle and ways in which these other forms of storage can be used to manage a variable resource.

The second requirement when you open the tap is that the water should be of such quality that it can be used for the intended purpose. When we think of water quality there is too great a tendency to think about pollutants injurious to health. Owing to the fact that the technology is well developed for removing bacteriological pollution from water, this really is far from being the most important aspect of water quality. For example, consider the fact that about 46 percent of all the water used in the United States is used by industry. Consider further that 95 percent of the water used in industry is for cooling. The principal effect of cooling use is to increase the temperature of the water. Once the temperature has been increased, its efficiency as a cooling agent is materially decreased. Against the fact that only a little less than half of all the water used in the United States is for cooling we can match the fact that there are not more than about six hundred places in the United States where water temperature is consistently measured. How do we expect to manage the water resources with regard to this important aspect of its quality with such infinitesimal information about that quality characteristic?

You would not think of making out checks to pay your bills at the end of the month without having in front of you your bankbook stubs, some sort of notes or receipts on the purchases you have made, a bank statement, and a few other kinds of information which you consider essential even for the most rudimentary attempt to manage what you think of as your limited funds. But is not our problem in water rather similar? We do not have enough water to satisfy simultaneously all the demands which collectively we are placing on the resource. Do we seriously think that we can manage this resource without having enough facts even to find the inflow and outgo or enough knowledge to see what happens when we choose one alternative over another?

Now, let us look at another aspect of the water problem. When you turn on the tap you want the assurance of an ample supply. We know quite well that there is plenty of water in the United States for, at the present time, we are only using one gallon out of every five available to us. There is, therefore, no overall shortage in our total resource. But we will remember, upon being reminded, that when we turn on the tap we have no thought in our mind--as a matter of fact, it has not even yet been mentioned here--about what this water costs. We said we wanted it at our beck and call, of good quality and of reasonable amount. We assumed, but did not say, that after all water is so cheap that cost has very little to do with it. It is true that in the past water has been cheap enough, and there has never been serious worry about its cost. However, as the competition for water increases, these other qualities of water supply which we expect and indeed demand will be available, but at a price.

Let us summarize then the first aspects of our answer to the lady's question. We must begin by making it crystal clear that we cannot continue to talk about the Nation's water problem. It is not a single problem. The word "problem" is completely inapplicable. Even a brief discussion of the ideas just enumerated tells us forcefully that what we call a problem is in fact a series of complicated interrelationships any of which, or any combination of which, may eventuate in a problem for somebody. We must recognize that, in fact, a water problem does not exist until someone cannot obtain water at the right time of the right quality in the proper amount and at a cost he is willing to pay.

We can now take the next step in this reasoning. This is the most important step of all. This complicated series of interrelationships which we have been too prone to call a problem are indeed not of the character to which there are answers. The water problem which we continue to hear about does not have a solution. Before I elaborate my meaning, let me say that I have chosen those words to convey that unequivocal meaning--there is no solution to our water problems. Now to explain. The complex interrelationships which exist in the hydrologic cycle and which determine the manner in which water may be managed provide by their very nature a complicated series of alternatives concerning which decisions must be made. We wish to provide as many people as possible with water available at call, of reasonable quality and amount, and at a sensible cost. To provide these qualities will always involve decisions. Decisions are choices, which imply alternatives. But, by the very nature of the organization of human society and the effect of human actions on the environment, these alternatives have certain consequences. In any single situation a person is called upon to choose between certain alternatives. If his decision is carefully considered, he has weighed the probable effects of choosing one alternative over another. I submit that what we call the water problem breaks down to a complicated and unending series of decisions, each of which has long-term and often widespread effects.

To make this point clear, let us consider a plan of development. There is a widespread conviction that a plan of water development would be most efficient and effective if it is constructed on the basis of drainage basins and with due regard to multiple uses. I do not care to dispute this view, but I would like to show how this fits in with an idea of an unending series of decisions without any final solution of what we call the water problem.

A water development plan, whether it is for an individual well, an industrial plant, a municipality, or a drainage basin is predicated on the existence of a foundation of facts and knowledge. For example, I put down a shallow well in the front yard of my shack on the Wisconsin River. The need was clear enough. I wanted water at call (which is possible if I prime the pump), of good quality (which means I could drink it), in reasonable amount (I only wanted enough for ordinary household needs), and at a fair cost (which was nothing more than the cost of a pump and a few hours of my own labor). What facts would I need? First, I had to know where I wanted the water delivered, which was four steps from the front door. But I had to know that if I put a well where I wanted it I was going to get water there--water which answered the above requirements. Well, this was

easy enough because my shack is on the sandy terrace of a large river in glaciated terrain. The river is only a few hundred yards away, so I knew something of the probable elevation of the water table. This was part of the knowledge I had to have. It was absolutely essential, also, that I know enough about the hydraulic relationship between the water table in the sandy terrace and the water level in the river to assure myself that the water table at that point was going to have a hydraulic gradient which would not bring polluted river water to my well. It is quite obvious that I had to have some knowledge of hydraulics, some specific facts and had to be able to forecast that the effect of my withdrawal of water would not reverse the hydraulic gradient and cause my initial supply of potable water to be later polluted as the result of my actions. This last point is one of the most essential. Operating on the facts and knowledge which we have, we must be able to make forecasts based on sound hydraulic principles. Too, these forecasts must reflect not only the situation which existed before development, but an entirely new situation which may be created by our action.

Now let us turn from this simplest of cases to the ultimate in water development planning--a basin plan. After the organization of available facts (which are usually too few) and the consideration of the hydrologic environment (which is not very well understood) we devise a plan of engineering action based on economic principles. These economic principles are, by custom and the structure of society, usually considered immutable, but, in fact, could be altered if we so desired. Much of the engineering design of a basin plan of water development is determined by the particular economic framework within which the design is made. The question of whether that last aspect of the water supply--reasonable cost--can actually be met, is greatly affected by the period used for the computation of amortization, what interest charges are made and how they are to be applied and, finally, by our preconceived ideas about what water should cost us. This is in nearly all cases determined by what we have been paying for it.

Usually happily unaware of the limitation of our hydraulic knowledge, we proceed to make an engineering design for water development in a river basin. Have we solved our water problem? Hardly. Whether we knew it or not, there were certain prognostications inherent in our design which went far beyond the estimates of greater population, greater economic stability, capability of the society to meet the interest and amortization costs, and the willingness and desire of the people served to meet the conditions required. For example, we have probably blithely planned to redistribute the water in time and in place and have quite forgotten to forecast what the plan of development will do to the stability of river channels in the area. How will reservoirs, levees, or well fields affect the manner in which water will flow under the different hydrologic conditions of the future that will result from a wide variety of possible combinations of local rainfall, vegetation, infiltration, withdrawal, recharge, soil moisture, and the rest? The particular situations for which actual forecasts were made constitute only a small part of the possible conditions which could indeed exist in the future.

Let us not worry too much for the moment about these combinations usually considered too intangible to justify even an attempted forecast. Rather, let us consider the way the drainage basin will operate in an overall sense. After the

dams are built, there will be the operational decisions. How much water should be released from this dam in order to provide enough low flow to keep pollutants diluted to acceptable limits? How much water should be let out of the reservoirs after a high flow in the anticipation of a second flood following on the heels of the first? How should the recreation pool in a particular reservoir be handled in the face of an expected water shortage and in view of the fact that this particular hot summer every man and his aunts and uncles want to go fishing or bathing or water skiing in this one place? And the channel that we dredge to improve the navigation--what will be its effect on the wedge of salt water lurking in the estuary or on the pollutants from that new industrial plant upstream, the chemical nature of which has not even been determined in the laboratory? Have we solved the water problem?

It seems to me that each step in water development which, in itself, requires the marshaling of alternatives and the forecasting of the results of the alternative choices becomes merely a prelude to a new set of choices, a new set of forecasts, and an even wider variety of possible decisions.

This line of argument leads me to the conclusion that there is, in fact, no single or final solution to our water problem. There is only a continually changing set of new decisions which must be weighted with due regard to increasingly complex interrelationships which have been materially altered by the decisions we made last week, last year, and in the last decade. I am convinced that nothing can make a greater contribution to the ability necessary to make sound decisions than a widespread understanding of this, the nature of our water problem. A decision today must be made with full recognition of the next decision, which probably will be made tomorrow. And further, it must be understood that it is facts and knowledge about hydrologic interrelationships which are required to make the forecasts of the effects of the various alternatives which we face.

Now, let us briefly look at the final statement made by our attractive dinner companion. What kind of national water policy do we need? What would be your answer? Only to the extent that a national water policy makes the people in our society more understanding of the nature of the so-called water problem will that policy be worthwhile. Any water policy, to be effective, must somehow make easier, more logical, or more definite our course of action in making decisions which, like Cadmus sowing the dragons teeth, continually multiply. And finally, because the period of development of any resource is short compared with the limitless period of management of the resource after development is complete, any water policy must be more concerned with the decision-making principles of water management than in decision making for water development.

Next time you sit next to that lady at the dinner table and she says "What are we going to do to solve our water problem?", may I suggest that you answer, "There is no solution to the water problem." There is only an unending series of individual decisions and each one is made more complicated by the one we made yesterday. We will make these decisions increasingly better if we begin to think more specifically than we have in the past about the need for facts and understandings of the hydrologic environment with which we have to live.

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