Articles

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World City of the Future

Aristotle said that the goal of the city, the organized expression of man's action, is to make people happy and safe. In the period of crisis through which humanity is now passing, there is a need for working out the goals which have to guide man's action. Today, in the middle of the phase of rapid development, the goal of the city must be defined as being to make people happy and safe for better human development.

This is why, in a conference dealing with water, we should not be limited to isolated aspects of the problems, such as water for drinking, or for the production of food, or for industrial and economic development. All these various aspects, and several others, are only parts of the one general goal which should be *Water for Human Development.*

In the Middle of the Crisis

In examining the present crisis between man and water, it has been found that during his recent past man has polluted not only those resources close to him, but also those far out, such as the oceans. Recent observations confirm that pollution can be felt even in the middle of the largest bodies of water on the earth.

There is no question that man has always contaminated and polluted the water - but on a much smaller scale and in such a way that Nature itself could overcome the dangers of pollution and reestablish the balance which existed between natural resources and man. Today, there is a much greater momentum of human activity which can affect much larger areas of water. This momentum is a result of many factors, including an increase in population and an increase in the amount of waste per person, with a much higher proportion of inorganic, non-destructible material. Therefore, nature by its own processes can no longer keep up with the changes created by man.

It should not be forgotten that the effect of water on man is not always beneficial; very often it can be harmful to him. M. G. Candau, the Director General of the World Health Organization, in Geneva stated in 1967 [1] that, in spite of the very deficient data currently available, more than 500 million people probably suffer from enteric infections each year in countries which are entering a phase of development and that more than 5 million infants are killed annually by water-borne infections. In many countries, these are the first or second most prevalent causes of death.

From these estimates, it can be understood how negative the effects of the existence of polluted resources of water can be which, incidentally, have not been created in our

time. These are age-old human problems.
There are also many other traditional types of problems concerned with water which seriously affect man. The actions of floods have always been major destructive forces from Biblical times right up to our present Technological Age. Rough seas and tidal waves also continue to play their part in creating problems for man. Even his home and other structures are still affected by moisture or even direct rain. Similarly, many negative effects of water play a major role on- the erosion of the land.

Just as there are places on earth with too much water, thus presenting one type of problem, there are also areas without enough water. A third of the land area of the earth's surface is arid and semi-arid, and it supports fairly large segments of the world's population. Severe droughts in various parts of the world in Asia, Africa, and America have always created much hardship in terms of food production and water supply. The human needs of water controlled by man amount to 300 gpd.[2] Yet, there are large numbers of people in the world who do not have these amounts available to them.

Some of these traditional problems are now being ameliorated. William H. Stewart, the Surgeon General of the Public Health Service of the United States, said that in Uttar Pradesh, India, after the introduction of water works sanitation, the death rate from cholera was reduced by 74 per cent; from typhoid fever by almost 66 per cent; from dysentery by 23 per cent; and from diarrheal diseases 43 per cent.[3] There is no question that the age-old negative effects of water turning into a medium for the transmission of germs and toxic substances can be reduced.

To the many traditional problems which exist in the relationship between man and water (some of which are on the way to being solved), should be added the new problems of pollution on a large scale. Just as sewage in less-developed areas runs about freely in open ditches (the earliest form of water pollution), in more recent times many parts of the world suffer from excessive domestic and industrial contamination of water, killing marine and fresh water life, and upsetting the natural balance. Similarly, a major factor of ecological disturbance is the large-scale killing (by detergents and other chemicals) of marine life. The future offers even further threatening prospects unless man takes control of his physical environment. In the US alone, few major water supplies are now considered bacteriologically safe without treatment of some kind. There is no doubt that although water is a reusable resource, it can be polluted until it has no further use.

Because of the dramatic awareness of pollution (it is seen, felt, smelled, causes suffering and nervousness), there is confusion. What must be done is to examine the whole

situation in a more detached way by going beyond the moment of crisis to a broader and longer view of the situation.

The Relationship Between Man and Water

Although the world was not created by water, as some ancient thinkers believed, it was in the warm waters of our earth that life was created. Life, which led to man, began in the water. The blood tissues of man in fact have a content of calcium and potassium quite similar to that of the oceans. Man continues to keep in his "milieu interieur" as the French physiologist Claude Bernard called it, the signs of his great ancestor, the water of the ocean, and this is true of most of the contemporary living organisms which contain 90 per cent of water.

It is in the water, and especially in the oceans, that the quantity of life is much greater, both in number of individuals and in biomass. The average depth of water resources is by far greater than the layer within which the biomass develops on the land, in reality only a few feet high. Animals in the air and below the surface of the earth represent a very small biomass in relation to those living in water.

Because of its quantities, because of the great cycle that it creates, being lifted up to the atmosphere and then falling down on mountains and plains and running into the sea and the lakes, water can be seen as the blood life of the surface of the earth or, as it has been called already, a universal biological fluid causing the greater changes on the surface of the earth. In fact these changes are not only biological, for they alter the very surface of the earth. In ancient times, Plutarch remarked that "water continually dropping wears hard rocks hollow." This fact is very well-known today as the dominant agent of landscape alteration.

Today, water is by far the most common molecule on the surface of the earth. It covers 71 per cent of it and it is the only compound that occurs naturally at the earth's surface as a gas, as a liquid, and as a solid. And in the outer three miles of the earth, water is about three times as abundant as all other substances together and about six times as abundant as the next most common single substance.*

Of the total volume of water, 97.20 per cent is salt water and 2.15 per cent is frozen, with only 0.65 per cent as fresh water on land which, if placed on the non-frozen land area of the earth, would reach a height of 223 ft. Of this, the water of lakes, rivers and streams corresponds only to a height of 3.3 ft, or 0.0001 of the total water volume of the earth, and this is the only water easily available to man.[2]

Man has always appreciated the importance of water to him. From the beginning of his history to the present, he has been attracted close to the water sources, both in order to use fresh water directly for his needs and to make use of the sea water in various ways from fishing to transportation, and lately in order to turn it into fresh water.

During his early development, man has expressed his awareness of the importance of water in various symbolic ways from Pindar, who called water the noblest of the elements, to primitive people who turned back into the rivers the bodies of persons who had died of dropsy, because it was thought that if the corpses were buried, the disorder would return and carry off other people.

Yet, though man has always felt the importance of water, his knowledge about it has been limited. Even today he is forced to recognize just how little he does know. Paul A. Erickson and John T. Reynolds, studying the ecology of a reservoir, have stated that man must "understand natural mechanisms precisely, before we can manipulate them according to our own human requirements." [5] The crisis which exists in the balance of man and water is accentuated by the lack of knowledge about how in the past nature was able to overcome the problems.

As an agent in shaping the surface of the earth, water can create many more changes by transporting rocks from the land to the sea, than by the forces of winds and glaciers. Yet, gravity is not only responsible for this physical change in the environment, but also for the greatest pollution ever caused on earth. That is the natural process of fresh water from rain flowing on the surface of the earth, dissolving many minerals and becoming contaminated until finally, when it falls into the salty sea, it becomes so polluted that man cannot drink it.

It must also be remembered, that changes and pollution have been taking place in the past constantly on a large scale. These led to a system which created man and to which man has managed to adjust. It is not pollution in nature, but man-made pollution which has recently increased, creating the great imbalance from which the world now suffers, an imbalance with much greater dangers for the future, and this is why it must be examined.

The Inevitable Future

Man moves into the future. He actually builds for the future in many parts of the world, but he is not clear as to where he is going. This is a very grave mistake because, although nobody can be certain about the

future, any reasonable person can predict, especially in the field of human settlements, many trends which are leading towards very specific developments. This can be achieved if man's past is looked at and his own evolution and that of his settlements studied.

If man can be logical about the location of human settlements and consider them as biologically defined (it is certain that they will not be located on the mountain tops and will not remain without water), then we will gradually see that they are the results of a system of four forces, three of which have already been decided: the constant force represented by non-changeable characteristics; the force of the declining past, which is committed for a long period in the future; and the force of continuing the past. A fourth category of forces, as yet undecided, is that of creating the future, which means man can change the situation. But in most cases the forces that change the present pattern for the future are in accordance with the age-old laws of nature.

Thinking in these terms, man can foresee that the most probable future for human settlements is one where he can expect to have a larger increase of population in the urban areas than at present, at least for one or two generations, and a larger increase of energy per capita for many generations to come.

Such an evolution of the dimensions of human settlement is going to lead towards larger settlements lying in large plains, near great water resources but also attracted by existing settlements and main lines of transportation. These are the forces which will shape and decide on the location of human settlements.

The formation of future human settlements is going to be completely different from that of the past, which still influences so much the thinking of humanity and only leads to confusion.

From the very first commercial railway created in 1825, the human settlements acquired a multi-speed system which has transformed them and is continuously transforming them, into urban systems which are influenced by every change in transportation which is taking place in their kinetic fields. When a second speed is introduced into the system, the previously circular city takes a completely different shape. The relationships between settlements become much more complex. In this way the conception of settlements growing by concentric circles is leading gradually towards settlements of a completely different nature. If man properly follows this analysis, and makes the corresponding calculations and projections, he will find that from knowledge of human settlements which are already under construction, he is leading towards larger and larger urban systems. It is clear that in a few

generations' time, a universal system of human settlements will be created which can be predicted in its general shape for the whole world, or in parts as for Europe or as for the US.[6]

This evolution is inevitable. This is the future which mankind is building, and to avoid it we have to lead to extreme solutions such as stopping the development of technology. One way to do this is to kill all the engineers and close the universities and research institutes. Another way is to segregate urban and rural people by painting them red and green and by building high walls around cities so that every night the police can throw out all the rural dwellers. In China, every fall, those who enter the cities without permit are sent back to the countryside.

If man does not try to apply such impractical measures, then the universal city of man, or Ecumenopolis, is inevitable. It is in this city that man can face great dangers, as he does not seem prepared to build one of better quality and continues to build one with increasing social and physical problems. There is a great danger that the inevitable city of the future is going to be worse for mankind than the city of the present. But there are several alternative ways of building the universal city of the future, and it is possible that some of these may lead to improved solutions. This is what we will try to examine in the following sections.

The Desirable Future

After recognizing what is inevitable, that is, in the size and location of the city of the future, man has to ask himself what is the desirable future and how he can reach it.

There is no doubt that a city of quality in all its scales is needed, in all its characteristic elements. Such a city should not cover more than 5 per cent of the usable part of the earth (1.2 mil sq mi) and should receive water from the natural areas and other supplies from the agricultural ones. Such a universal city should be conceived as consisting of three parts: its built-up areas, its agricultural, and its natural ones, or to put it another way its "home," its "backyard" and its "natural garden." All these three parts will have to be interwoven into one system by the proper infiltration of each one into the others. In the earlier period of civilization, when the city was surrounded by walls, these three elements were more clearly separated. The city was small and it could afford it. Today the big city of Man has to be infiltrated by natural areas, by open spaces and by water.

It is in this way that a balance will have to be created between land, water and man. Man desperately needs

a balance for biological, physiological and aesthetic needs in every unit of space where he lives. He needs clean air and fresh water in his room; he needs a garden for his house and for his children; he needs a park near his home; he needs to be in contact with nature at every moment of his life in the appropriate scales.

The solution to man's problems for the creation of a proper dynamic balance in his universal city is not easy. Rather than rely on mass immigrations of people towards resources which will create many insurmountable political problems, the solution is in the proper utilization of the natural resources and the products depending on them.

The balance which is necessary between man and nature as a whole, is even more necessary between man, and water, as the latter is indispensable for the former's survival and development. It should not be considered a luxury any more to have pure water from a spring or a small clean river passing through the city. This so-called luxury, today, is an indispensable need for proper human development. To achieve this, we need to understand the process that has led to the lack of quality in our cities. The process of the evolution of human settlements in terms of energy has gradually turned from man's muscular energy into many commercial forms of energy and multiplied the quantities (in a country like the US) to two hundred times more than in primitive times, with a strong influence on the environment.

Man must move towards human settlements which will reestablish man and nature on the surface of the earth. But it would be a crime to try and do this by reducing instead of expanding the energy which man needs. What is needed is much better handling of the huge amounts of energy available to man.

The solution lies in separating man's natural plane of movement from the sources by burying the transmission lines of energy. This is the normal process with all the networks created by man. He had first water on the surface of the earth, but now he also has it underground. He had first sewers on the surface of the earth and now he is in the process of burying them. He had pipes of all sorts on the walls of his buildings and they are being brought within. This same process has to take place for energy and for all our networks. In this way the surface of the earth will turn again into an area of high quality for man.

There are great possibilities of improvement over present standards: by technological means, by better organization of resources, and by more careful planning. In this way a picture of a highly satisfactory and desirable universal city emerges. Such a desirable

city can definitely be built and need not remain a Utopian one. Studies carried out recently, like the one for the developing urban Detroit area,[2] have shown that it is possible. The task is, today, to see how this realization can be achieved in terms of the balance between man and water.

The Water Needed

The first thing to clarify is the water needed. This is not difficult because from man's evolution it is clear that water is indispensable for his survival and development, and that he is using it on the basis of certain laws. The first thing that is needed is the *quality* of water—not only of the potable water for domestic purposes for which can be defined how clean it should be, but also the water of the sea, in the lakes, and the rivers and the water that is brought into daily life in order to enrich the environment within which man lives in monumental ways as well as in simple ways, as shown from ancient cultures to the present. Appropriate measures at all levels can secure the necessary qualities of water by avoiding pollution, by purifying water in relation to resources.

It is not only quality that has to be preserved and ameliorated, but also *quantity.* If an assumption is made that the population of the earth will increase six times more than at present before it levels off, then it can be seen that the quantity of the water which will be needed (if it is assumed that the total consumption per capita will reach a level which is two and one half times higher than the present one) is going to be of the order of 5,500 cu mi, or fifteen times greater than at present.[2] This gives the scale of the total quantities involved. But if specific areas are looked at, it shall be seen that some may be overwhelmed with water, while others may experience large deficits. This is primarily due to the uneven distribution of water over the earth as a whole, adding a third major problem, that of resolving the water distribution on the earth according to the basic needs.

The fact that quality can be assured in a technologically advanced country and the fact that the proper quantities per capita for the average person of a city, region or country may be reckoned on, does not mean that man should be satisfied. He must also be aware of *equality,* which is very often forgotten. This cannot be achieved until water, in the proper quality and quantity, is available for every one. Even in the ancient days, in the old kingdom of Egypt, Ra, the God of Creation, made the statement: "I made the great flood waters that the poor man might have rights in them like the great man, I made every man like his fellow in his time." [8]

In this time, man feels more and more the need to

realize what has not been achieved in days of old. If there is any equality which cannot be overlooked, this is the equality in the relationship of man to his natural resources, of man to water. This is quite difficult to achieve, though by no means impossible. On the contrary it represents an imperative need that has to be fulfilled. Until equality is reached in this sense, man cannot speak of a world which leads towards human development. These balances are real ones, not of averages, and they must be achieved everywhere and for everybody.

The need for an extensive inter-penetration between man and his environment at all scales within the universal city of the future has been stressed, and it has been seen that this is not only highly desirable, but also feasible. In the case of open spaces, gardens and forests, this inter-penetration is visualized as leading to a universal pattern that could be appropriately termed the "universal garden" to which every citizen of tomorrow's earth will have both the right and the ease of access. This, then, fulfills one aspect of the balance of man and nature.

A similar picture can be evolved in the case of water: water will be present everywhere in the universal city of the future, at the appropriate quantities and qualities, for all types of uses, at all scales and readily accessible to everybody. Water can be considered, then, the life-giving fluid of the universal city, or as "universal blood stream," which, as in living animals, brings life to all parts of the natural system, even the minutest ones. This would restore water to its time-honored position of not only serving all basic utilitarian needs—drinking, domestic uses, public utilities, transportation, industrial or agricultural uses—but being present as a symbolic element everywhere: as an opportunity for recreation, sport and enjoyment; as a mark for purity, for movement, for freshness, for cleanliness; as a vitalizing agent for a multitude of purposes; and as a source of life.

The Changes Needed

In order to achieve man's goals and give to everybody on this earth the quality and quantity of water that he needs for his development, man must proceed in a way that will help him to change his policies and his programs. If he does not achieve this, he will not achieve these goals and will not satisfy these needs.

The first consideration is the quantity of water which is needed in relation to the one which is possible to control and make available through the annual water cycle. On the basis of calculations already made, it is known that the total quantity of water which can be made available is in the order of 4,800 cu mi. The needs of mankind will be larger than this; they will be probably of the order of 5,500 cu mi, if the population reaches the 20 billion

mark.[2]

This comparison of supply and demand is misleading if man forgets that the available resources and needs change from area to area and from season to season. Therefore, although it appears that up to a century from now that the resources will exceed the needs of the whole earth, in most areas this will not be so. The needs will be much greater than the available resources, as is already apparent.

In order to understand this comparison, the annual water cycle which provides man with water must be looked into, and if it is studied carefully it will show that only a small part of it can be considered as controllable. The greatest part of it, the water falling by precipitation on the surface of the earth, flows into the sea, infiltrates into the ground and evaporates, or falls on frozen zones. Only a small part of it, that is 6.6 per cent, is at present controlled by man.[2] A very well-developed technology will be needed to control fifteen times more of the water and reach the mark which will help to provide water to all people of the earth with a population five or six times larger than the present one. This will not be easy though, especially for several parts of this earth.

It is for this reason that there is a necessity for the conception of a new water cycle, not any more based on the water falling by precipitation every year, because a large proportion of it always will be lost, but on additional water which will be kept outside of the system of precipitation in order to be used for human purposes only. If, every year, a small amount of the fresh water can be kept back and not allowed to fall into the sea and be polluted or to evaporate, then a second cycle of water can be created which will be moving, not because of solar energy and gravity, but because of human initiative mobilizing other sources of energy and gravity.

Today a great mistake is committed by allowing the water to go into the sea to be polluted and then desalted again. It is more sensible to collect it at higher altitudes so that it can be guided towards the areas of need. On the other hand, grave mistakes should not be repeated like the one made in many tropical countries where a substantial quantity of the water collected over a long period in dams is lost through evaporation. By creating smaller dams in higher altitudes, and by creating an interconnected system of protected reservoirs, a closed circuit of water can gradually be built which, added to the natural circuit, will lead towards the solutions which are needed for all parts of the world.

The reservoirs can be easily protected from evaporation; inexpensive chemicals are available which can be easily spread in monomolecular layers over large water areas, greatly reducing evaporation, but without killing fish or

other fresh water life. Improved techniques, visualized for the future, will serve the same purpose. Open reservoirs will have the additional advantage of serving as centers for recreation, fishing, sailing, and so on. A certain amount of primary cleaning of their water may be necessary but this need not be too costly. If a fuller protection is needed, fully covered reservoirs can be built; although more expensive, they are still likely to be within the investment possibilities of future societies.

Many of these reservoirs will be interconnected for a more balanced and economical handling of peak flows due to local conditions (of both availability of water and demand for it), and of other needs for regulating and controlling water use. In this way this interconnected system of dams, reservoirs, and other control mechanisms will ensure the proper balance in the availabilities of water within the universal city, in every part of it.

In a few cases where even this system does not suffice (arid areas, long periods of drought, etc., when the usable run off is much too small), detailed studies have shown that it can be successfully supplemented by other ad hoc measures. One method involves desalting water near the coasts and pumping it up to supplement the system. This can be economically achieved up to 620 mi inland or over 3,300 ft of elevation. Other such measures could be devised so that even pronounced local or seasonal water deficiencies can be accounted for.

Manufacturing industry uses water an average of 2.2 times. As predicted by Constantine R. Kollar and Robert Brewer of the Water Resources and Engineering Services Div. of the Business and Defense Services Admin, of the US Dept. of Commerce, the same water can be reused six or more times and can be foreseen as a need for all types of uses, with further future improvements, so that the closed controlled cycle will be very effective.[9] This leads away from the present attitude of "using" or "consuming" (i.e., essentially wasting) water, into the new concepts of advanced water treatment, the resultant recirculation approach, and, eventually, the fully controlled closed water cycle.

Such a closed cycle means that there will be a need to lower the level of the oceans by 0.4 in. only for a population which will be double the present one. Even if a population five times larger than the present one is reached, the surface of the oceans need only be lowered by 1.5 in. Such a change could not produce any problems for any area of the world. The creation of such systems will allow a much better use of the fresh water, since its potential mechanical energy would be collected at higher altitudes, avoiding pollution and chemical energy action in the plains and the sea.

The creation of two cycles of water, the open one, based

on evaporation and precipitation, and the closed one, based on energy made available by man, may gradually lead towards the servicing of the areas of higher altitudes by the open cycle and of the ones of lower altitudes by the second. In general the man-made cycle will not therefore need to lead water towards the higher altitude. By proper study of these two cycles, man will be able to guide water towards the areas which need it, at the appropriate time, and serving all in the most efficient way.

Such considerations require a much better concept of the role which the different parts of the earth can play in the future. Up to now, mankind was living under the influence of the principle that as stated by Henry David Thoreau: "In Wildness is the Preservation of the World." In fact this is the motto for the Wilderness Society. In view of mankind's many mistakes during recent generations, this was a wise statement. But today, because of the increasing influence of man on large areas of the world, and decreasing areas of wildness, the danger of the world will be great if preservation takes place only in the wildness. Mankind reaches the stage at which it has to try to change this motto so that it reads: "On the whole Earth should be the Preservation of the World; in every part of the Earth Man must find a way to Preserve and Conserve." In every part of the world balances should be created which will serve nature and man. Man should not be looked at as an enemy of nature. He is a creature belonging to it and can only survive as the servant of nature by fulfilling his role as agent in the biological system of which he is a part.

A much more serious study of the systems which serve the relationship between water and man is required. If the other systems created by man, like transportation systems, are considered, it will be seen that the changes which have occurred over the recent periods are much greater than those of water supply systems. For the first time in his history, man has changed his daily movement from small areas with a radius of 3 mi which gave birth to the village and the city, to areas of much greater kinetic fields with a radius of several tens of miles by car, and thousands of miles by air. If we look at the daily urban systems of the US, for example, it will be found that they are already interlocked and overlapping. This does not happen with the water supply networks. Again, looking at the trip length of the American citizen in large cities, it will be found that his average trip length in 1960 ranged from 5 to 9 mi. Studies have predicted [10] this may average to about 10 mi by 1980. This will result in an annual increase of 1.3 per cent over the 20-yr period. There are no figures available for the water supply networks, but there is no sign that they increase in a corresponding way. It is known, however, that they increase at a slower rate with the rapid area expansion of cities.

It is logical though to think of larger systems needed for the water supply of mankind: nature herself has created a

transportation network in the form of a water cycle which covers the whole earth, supplying areas which are losing water through evaporation without replacing all of it, through the rivers, by such connections as the Gibraltar Strait which brings in water from the Atlantic to fill the void. What nature does on a worldwide scale, man must learn to achieve through larger and larger manmade systems.

To achieve this, man must develop better and wiser systems, beginning with conservation, which requires a much greater attention. This is especially true for the greater part of the surface of the earth which should remain in natural condition, and where waterworks will have to take into consideration many factors which are often overlooked. It is in the same spirit that man must start thinking again of hydroelectric projects. Although at times they do not seem very important from the economic feasibility point of view, they are much more important in the control of water which otherwise could be completely lost to the oceans and would have to be recovered through much higher cost. It is only when the whole system of the water cycle and its advantages and disadvantages are studied that the proper technological and economic solutions can be decided upon.

How this is going to be achieved requires a lot of research work and creative thinking. But some ideas on how the whole system of the settlement of man works, can help him look into these broader relationships. Man has been using his muscular energy for daily movement in a very high percentage at the beginning of his history, and in a very reduced one since he created cities and civilization. At first, he could optimize the use of his muscular energy. On the contrary, he has not, since the creation of cities, been able to optimize the energies for his daily movement in relation to the total energy available to him and, at this very moment, he does not know how much energy he has to spend for this purpose within his urban systems. This is one basic reason for the crisis with which man is confronted. This leads to the observation that man still overlooks the real substance of his settlements when he speaks of their growth in terms of people only, surface areas covered by them, or their income, while they really grow much more quickly in terms of energy. The point has to be reached at which man can relate the life of the human settlements to the real forces within them, one of the most important of which is energy.

Taken as a whole, the volume of water which man uses for his life corresponds to a weight 6,000 times larger than all material resources he uses; or, taken in terms of quantity reaching man personally, it is 89 per cent of all his needs" for energy which is the greatest force developing within human settlements. There are not enough data relating to energy made available today for

water supply systems (although the Athens Center of Ekistics has made a series of studies on worldwide future water availabilities based largely on energy considerations, and some of these have been quoted in this paper), but even general comparisons make it clear that man does not use enough energy for water supply systems and that in the future he will require more energy in order to create the proper water cycles to serve him in every respect. More energy, increased incomes, and better technology for the use of water resources will lead towards complete fulfillment of the human needs for development. There is no prediction that man still has to face energy deficiencies on this earth. On the contrary, the probability is that there will be more and more energy available to man at lower cost with better technology, greater efficiency, mankind will accomplish more with less energy, as Dr. Glenn T. Seaborg, Chairman of the Atomic Energy Commission had predicted lately.

Since sufficient amounts of energy are among the main prerequisites for water control, in the sense just described, it can be predicted that both general progress and rapid development of specific and new technologies in fields such as energy and communications will be available at each scale. Thus, a new approach for "Water for the Service of Man" will be fully feasible at the time the "Universal City" materializes.

Action for the Future

Looking into the future, how can man best act in order to answer the demand for water for human development ? The answer lies in the recognition that mankind has to pass the approaching crisis, and lead towards development of more resources until, later in the future, a stable level of population is reached; that is, the level of the universal city, which is likely to be attained in a few generations from now.

Man is not yet as water conscious as some civilizations have been in the past. Civilizations in all parts of the world from the Mediterranean to Japan have managed to create proper balances between man and water and more general ones between man and nature.

Water consciousness is the first need. A type of city design will emerge from this, oriented towards the preservation of water as much as possible, making the most of it, and developing new methods of using it in a much less wasteful way. The adoption of such types of design, especially during the main period of crisis (end of this century, beginning of the next) will have to be seen as a condition *sine qua non* for the survival of our cities and their inhabitants during this difficult period.

The second need is to learn more by carrying out much

better research; to increase knowledge; to foresee the alternatives for the future; to develop simulation models for the reestablishment of better, easier and more economic balance in the system of man, water and land. Efforts which are carried out in many fields of knowledge are leading towards this direction. But, as stated before, they have not led yet to any definite conclusions. Therefore, the need of an overall guidance in research for the development of all the water cycles is imperative.

The third need is for the creation of technologies on a simplified pattern as for water supply and drainage networks. The very fact that connection has not yet been made with the other utilities, that rational city plans have not been able to be created coordinating all needs of man with all his networks from his movement and his transportation, to water, electricity and gas supply, sewers and drainage, telephones and telecommunications, shows that there is no need to solve all difficult scientific problems in order to serve man better and lead towards the realization of his goals. There are many sectors where immediate action can be taken and is not.

The fourth need is concerned with the many areas of the world which can be saved by the use of the knowledge and the technologies which already exist. For them, it is a matter of economic and technical assistance to reach a level which would help them to avoid at least the basic problems created by water networks such as the pollution of basic water resources which lead to diseases and deaths in unacceptable numbers.

Having reached this point, man can ask himself whether he can achieve these goals. A look back at history shows that man has managed to survive in the savanna, in the deserts, and in such isolated places like Easter Island, where for many centuries the Deep Gardens were created, helping man to exist within completely unfavorable conditions. All this must lead to the necessary conclusion that man can face his present and future problems if he does not lose his patience because of this present crisis; if he does not concentrate so much as he does on the day-to-day problems; if he develops again the attitude to look at the urgent problems and serve them, while looking at the overall problem of the evolution of man as a part of the biological system developed by nature on the surface of the earth.

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