Articles

Paper submitted to the 1st World Congress on Water Resources, organized by the International Water Resources Association, Chicago, Illinois, September 24 - 28, 1973.

Global action for man's water resources

THE GLOBAL SYSTEM OF WATER

I am not an expert on water, and I have the courage to address so many of you who are here only because I have twice been honored by speaking engagements before conventions on water[1] and have seen my proposals used.[2]

I am only a bricklayer trying to build for Man houses and cities, in which one of the networks I must consider and include is water. In this capacity, I follow what the experts do and am highly impressed by what scientists do in terms of physics, chemistry, and biology in order to understand the cycling of water on our globe, and by what engineers do for cycling water for all Man's uses. When I read scientific or engineering books and articles I am very impressed on how far we go and what progress we make.

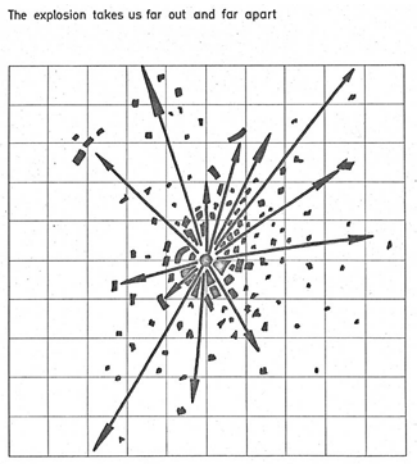


Figure 1

I do not, then, need to speak about any particular problem as experts do. Sitting outside their ranks, however, I can see the total of the effort and can state that we witness, *as* in many other fields, an explosion which takes us far out (Figure 1). We are rightly proud of it, but at the same time it takes us far apart[3]. This is the image we must understand in our era: in research and actual construction we are achieving things which lead humanity to great distances in terms of knowledge or accomplishments, but at the same time we do not perceive the general image and solve our problems as a whole.

It is time to face the problems of water for Man (I am not interested in water for dinosaurs and my interest in water for mosquitoes depends on Man's interests), by facing them, for two very important reasons, as a total system on a global basis.

First, because water is of eternal value for Nature, for our globe, and for Man. It covers 11% of the global surface and *65-70%* of the volume (or weight)[4] of Man's body. We may speak much of oil resources today but in a few generations it will be forgotten and replaced as timber, which was so important for hundreds of thousands of years, has been forgotten as an energy source. But water will remain important.

Second, human action is creating global problems, so solutions must be based on n global scale. We are beginning to make statements and declarations concerning such a global scale, but I feel obliged to

Table 1

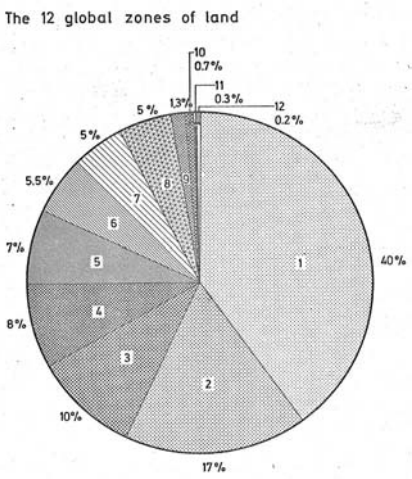


Figure 2

proceed to three specific proposals to help such global action. The basic characteristic of these proposals is that they deal with specific dimensions instead of simply reaffirming good intentions. In this way I hope we can begin a specific dialogue on the basis of what has been defined by Protagoras as "Man is the measure of all things."

WATER ON LAND

My first proposal: In order to save water for Man we must decide on several types of land areas for water use and recycling. It is excellent to recycle water from industrial waste and reuse a percentage of it, but this does not mean that we know exactly what happens to it and that if we drink only recycled water we are going to be as happy and safe as we want. As we don't have enough scientific data to understand about numbers and types of such areas, I went back to the hunters of the Paleolithic Age, to thin farmers of the Neolithic Age, and to several city states in the Middle East, China, and all other continents. It was a long and tiresome voyage of 30,000 years, but it was highly useful because everybody gave me the same answer: by trial and error we found that we needed several types of zones, differing in degrees of our intervention from zero to doing everything we like.

On the basis of this voyage into history, and on my 40 years of action in 38 countries and all continents, I propose that we commit ourselves for the sake of water to the following 12 land zones all over the globe. Formerly, the hunter could have 2 and the farmer 3 such zones, but we now are dealing on a completely different scale. These zones described briefly here are shown in Table 1 and Figure 2.

Zone one; Real Wildlife (40%): Except for authorized scientists, Man should not enter. We need its virginity.

Zone two: Wildlife visited (17%): Man enters, but without machines, and he does not stay.

Zone three: Wildlife embraced (10%): Man enters, without machines, and stays in temporary camps.

Zone four: Wildlife invaded (8%): Man enters, without machines, and stays in permanent, well-built camps.

Zone five: Wildlife conquered (7%): Man gets control of it in order both to protect and to enjoy it with all his facilities.

Zone six: Natural agriculture (5.5%): Man cultivates in open air, uses water networks throughout, and enjoys the landscape.

Zone seven: Industrial agriculture (5%): Man cultivates

intensively by covering the land to control climate and production, and uses underground water networks, controlling even its temperature.

Zone eight: Man's physical life (5%): In open land Man lives as close to Nature as possible and carries out sexual relations with it from swimming to becoming a nudist, a sportsman, or playing golf. Water is both uncontrolled, outside networks, and in networks.

Zone nine: Low density city (1.3%): What we sometimes call suburbs or small towns, with proper gardens. Water is in networks.

Zone ten: Middle density city (0.7%): What can be called a normal human built-up area. Water is in networks.

Zone eleven: High density city (0.3%): What was the traditional city we now admire or the modern central business district. Water is in networks.

Zone twelve: Heavy industry and waste (0.2%): What we want to separate from Man's daily life. Here water has to be recycled and controlled much more than in any other zone.

TABLE 2

THE ROLE OF NATURE (WILDLIFE) AND TOTAL NATURE (WILDLIFE AND CULTIVATION)

zones	% of Nature and Wildlife in each zone	% of global land area by zone	% of Wildlife on global basis	% of cultivation by Man in each zone	% of cultivation on global basis	% of global Wildlife and cultivation
one	100	40	40	-	-	40.00
two	100	17	17	-	-	17.00
three	95	10	9.5	3	0.30	9.80
four	95	8	7.6	4	0.32	7.92
five	90	7	6.3	5	0.35	6.65
six	20	5.5	1.1	70	3.85	4.95
seven	20	5	1.0	60	3.00	4.00
eight	20	5	1.0	40	2.00	3.00
nine	10	1.3	0.13	30	0.39	0.52
ten	10	0.7	0.07	20	0.14	0.21
eleven	-	0.3	-	10	0.03	0.03
twelve	-	0.2	-	10	0.02	0.02
Total	-	100 %	83.70	-	10.40	94.10

Table 2

In such a way we give 67%, or two-thirds of the total land surface (of which a very big part cannot be visited anyhow), exclusively to wildlife, and the water is free for its own cycles. Even more, that is 83.70% of the total is given to different types of wildlife including isolated ones within settlements and 94.10% if we add man-made cultivation where water is recycled by Nature with some networks created by Man (Table 2), On such a basis Man keeps control of 33% of the land surface but builds cities only on 2.5% which can contain the probable global population of 15—20 billion people within one or two centuries.[5] This is not fantasy; it is based on calculations of future needs.

This proposal is valid on a global scale, but to be practical in a world where we pretend (not South Africa) that we are all equal, the divisions must be made by nations. If one European nation has already eliminated more than two thirds of its wildlife, as many have, it cannot insist, without paying in some way for its own over use of natural resources, that Africa for example, should save wildlife. We cannot achieve our goals without justice. We need a proper distribution of resources and obligations in order to reach our balance among the 12 zones on a global basis.

WATER IN ITS OWN KINGDOM

My second proposal: in order to save water for Man *we* have to decide on several types of water areas on a

Figure 3

TABLE 3

THE 12 GLOBAL ZONES OF THE WATER KINGDOM

Zones	Characteristics	Man's Intervention
One	real virginity	only scientists for research
Two	natural crossing	only with his body
Three	crossing, staying temporarily	without machines
Four	crossing in groups	with machines under control
Five	" " "	creation of ports
Six	fishing, food production	creation of installations but no pollution
Seven	food production	very special installations
Eight	entertainment	special installations
Nine	commerce and transportation	traditional small ports
Ten	"	large ports
Eleven	"	very large ports
Twelve	waste disposal zone	installations for recycling

Table 3

global scale. Those who know that 97.2% of global water resources are in the oceans may wonder why my first proposal concerned water on land. The reasons are that we know more about it, it is closer to us, and we con control it earlier and more easily than the oceans, but we should enter water's kingdom also and work for Nature? and Man. I traveled again into the past hut was given only one answer: "We know nothing about ocean pollution. It is your problem, for we never really had it."

I recognize that it is a contemporary problem, and I do not have any global experience or real picture, but because I come from a country which is half water and half land - even the seat of the first great confederation of Greek city states was on the small rocky island of Delos in the middle of the Aegean Sea (Figure 3) - I proceed to propose 12 zones for water's kingdom. We must remember that the water zones are three-dimensional, and we must understand the difference between surface and deep-water uses. Unlike for the land zones, I cannot propose percentages for each water zone and therefore my proposal contains the need for immediate tentative definition of the dimensions of each zone (Table 3).

Zone one: Real virginity, which can be retained in lakes and rivers and perhaps in some sea harbors which need to be isolated from pollutants coming from land and sea. There is no reason why countries like Canada cannot declare some lakes as completely off limits to Man, even for swimming, and why every country cannot do the same for at least the upper parts of its rivers. Only scientists should be allowed to enter them for research.

Zone two: Man enters this zone as a primitive animal, he can swim in it or use a timber boat for rowing, but he cannot bring any machine or industrially packaged food.

Zone three: The same as zone two, except that Man can live in sailboats and fish in traditional ways, but without either chemicals or machines.

Zone four: The same as zone three except that specially designed boats may carry people to visit this natural zone, crossing it at low speeds. No material may be discarded in this zone; all waste must be removed to special areas of land or zone twelve.

Zone five: The same as zone four but with some harbors for the above mentioned boats. This water zone will combine with land zone five.

Zone six: This is a production zone for fish and other sea organisms. Every action of Man is allowed, provided his boats and his methods do not cause any pollution for the plant and animal life.

Zone seven: This is a revolutionary type of a zone with lakes, rivers, and harbors dedicated only to the production of plant and animal life for Man. The zone can be controlled in the same way as land zone seven in order to advance the old notion of fishing-collecting into producing food and other materials for Man.

Zone eight: Action of Man is allowed in this zone for every purpose related to his organized entertainment. This means all types of small and major installations are permitted in this zone, allowing Man to indulge in all his sports even by using machines which are not allowed in his natural entertainment zones (2-5).

Zone nine: These are normal but small ports for all sorts of boats and used in a way allowing people to live around them and enjoy them. In some ways it is like zone eight but commerce and transportation are added to entertainment.

Zone ten: One step up from zone nine, with larger ports and larger boats, say up to 100,000 tons. Life in the area is more connected to commerce and trade.

Zone eleven: Very large ports for all sorts of boats including the new giants, and special installations for containers allowing the complete interconnection with city commerce and industry of all sorts.

Zone twelve: This is a new type of zone which we must create for at least a few generations if not forever. It is the waste disposal zone, where the waste thrown into the oceans will be collected for gradual future chemical processes turning the polluted water and waste into something useful first for Nature and gradually for Man.

As I have said, I am unable to define either the surface area or the depth of these twelve water zones, but we must act in this order:

1. Define their characteristics.

2. Tentatively define the percentages of the total global surface of 361.5 million sq. km of water for each zone.

3. Start with establishing some zones as an experiment.

4. Learn more and revise the regulations every five or ten years until we are certain about the new balance Man needs with the water kingdom. Man is not king; we should try to find the way to cooperate with our globe's greatest physical lord.

One more point is of great importance as it applies to the land zones also. The percentages of each zone are going to vary tremendously from country to country because of the unequal distribution of land, water, climate, and other

elements and resources. Therefore, in addition to the decision on global dimensions, we need rules for the distribution of these zones by continents, regions, countries, etc.

In doing this we should not forget that we are permitting the rich and strong countries to commit a crime against Man. Although the oceans do not belong to any person, community, or nation (how could they?), we now witness different attempts for the legal recognition of ownership which does not exist. We need a rational decision defining who owns what in the water kingdom, which really belongs only to Nature and Man, with the exception of rivers and lakes inside land areas and narrow coastal zones belonging to those who own the land nearby.

I cannot see any other solution but declaring that all water resources of the oceans belong to the United Nations and only coastal zones belong to nations and communities.

THE ANTHROPOCOSMOS MODEL

My third proposal: in order to achieve our previous goals of establishing twelve land and water zones and in order to solve many of our other water problems, we need an overall systematic approach. We have not such approach yet and are unable to act, confused as we are by the complexity of the world we live in. This, of course, is not the case only with water.

One of the main reasons Man is suffering today in many diverse fields is because, unable to understand what is happening around him, he reacts to the most pressing symptoms but does not deal with root causes and misses the total situation.

The confusion in our understanding can be illustrated by taking one example and looking at how ideas of the city as a system using most of the water resources have changed over the last two generations. Forty years ago when I was a student, discussions of the city dealt only with monumental buildings and slums, broad avenues, and narrow, romantic alleys. Later, when I was a young professional, cities were described in terms of their traffic problems and the solutions were technologically impressive highways. In the fifties the social aspects of city problems were considered paramount. In recent years the emphasis has shifted to problems related to the natural environment. In forty years the public image of the city of high income countries has shifted from buildings, to transportation, to society, and now to nature. We continue to be side-tracked into concentrating upon symptoms, missing the total situation of the city.

We tend to forget that the City of Man represents the area of the minimum influence of Nature and the

maximum influence of Society expressed through Man's Shells (constructions) and Networks (mobility). The city cannot be understood by a single element, but only by all five elements considered together. We have not yet done this, so we remain confused about cities. The reason we have not yet done this is that Man is now in the midst of an explosion which has upset the balances created around the globe by long centuries of effort by different cultures. We will solve none of today's problems if we concentrate only on one subject, such as Man, or water, or on isolated relations, such as between Man and Nature, Man and Buildings, Man and Networks, Man and Society, or even Man and water. All our mistakes can be attributed to just such isolations of relationships. To take a single example: the motorways, which were supposed to solve the traffic problems of cities, created many new problems for Society, for Nature, and for Man's cultural values.

We live in Nature. Our real frame is not just the earth, for if the sun were to lose its energy or the planets of the solar system to disappear, our life would be totally disoriented. We are, however, no longer at the primitive stage of utter dependence on the forces of Nature. We have learned how to come to terms with it. History shows that Man has always fought Nature in order to survive; killing animals, or burning forests to start cultivation. His goal was to create his own system of life by achieving a balance between the existing system and its laws and his own interests. Even at the start, then, we must consider not only Man and Nature, but also Man and his Human Settlements which combine Nature and Society and which, in their first stages, could be called "biospheres," later to be replaced by systems totally constructed by Man (expressed in his Shells and Networks) which could be called "technospheres."

My third proposal is to define the system of our life, which is expressed by Human Settlements, so clearly that the definition can contain every aspect, expression, or opinion, known or unknown, foreseen or unforeseen. Once defined, our task then is to learn to control this system wisely for the sake of all mankind.

Success will depend upon our ability to create new balances corresponding to new developments. This means discovering what we dislike and can change, what we love and can keep and what we love but must change. The first is easy from the conceptual point of view but the last is very difficult. *We* shall be forced, however, to change situations we love. We need water for those who have none, and this may mean changes in the natural landscape. The question is which areas to choose, how many and where, and how to change them in a way that will result in a better balance between Man and Nature.

The whole system of our life must be both our subject

and our goal. It must be our subject because if we leave out any part of it the entire system becomes disrupted. It must be our goal, because if we cannot constantly maintain a balance within it we shall be destroyed. This system of life is Anthropocosmos, the World of Man. It contains everything that we can imagine and it has only one aim: to satisfy Man.

To achieve a balanced Anthropocosmos we must approach all problems systematically, avoiding partial views of particular elements or special goals. Our only road is to constantly create order out of the chaos around us; no easy task. For years at the Athens Center of Ekistics we have been trying to handle a number of research projects in a strictly systematic way.[6] We follow a precise method of classification of the subject matter of the articles in Ekistics Magazine,[7] and we use the same general system in our annual seminars,[8] university lectures, teaching courses, and congresses concerned with or interested in ekistics.

Our experience shows that we are on the right track, but there is still a long way to go. The subject is so vast, containing so many elements and so many different viewpoints that people are overwhelmed by the amount of information. We can take heart from the fact that Han has managed to extricate himself from periods of confusion in the past. Until recently the dimensions of city problems were at the human scale in terms of walking distances, seeing, hearing, etc. After thousands of years of experience of these dimensions, Man was able to understand the totality of his system of life. He could discover the causes of his problems and invent reasonable solutions. Now, however, huge increases in the dimensions of space and energy and decreasing time make it extremely difficult for Man to discern his system of life, his position in his cosmos. We must turn from sentimental to objective approaches. Instead of following psychological or political lines of thought, we must adhere to scientific methods to seek out the truth. This requires that we create an orderly system to confront our present chaos. The only way I can see to do this is:

1. Define our total system of life - the Anthropocosmos - in such a way that any part of it can be clearly located.

2. Define the system of all relationships (causal and non-causal) that may exist among any parts of the system so we can understand the system's operations and changes.

3. Define a method for the evaluation and measurement of all parts of the system and its interrelationships (including those that cannot be scientifically measured), so we can, recognize the relative importance of each problem.

The system of our life consists of five elements in the

following order of creation: Nature; Man, the individual (the forgotten element); Society (more important in some political systems than the individual); Shells; Networks.

Nature consists of land, water, air, climate, flora, and fauna. Each part has many different aspects but, in all, Nature can probably be well represented by 32 basic components.

Man varies from individual to individual, but he can be examined systematically in terms of 12 phases of his life. Man consists of his body, five senses, mind, and soul, so he can be considered in 8 different ways. Throughout his life, then, Man can be represented by 96 components. What a baby sees, what an adolescent hears, and what an old man needs in order to move around in space are very different.

Society can be regarded in two basic ways; in terms of size and in terms of development. Society is very different if we are dealing with a small neighborhood of a few hundred people or a metropolis of several millions. To evaluate this aspect of Society we can use the classification of the 15 ekistic units ranging from a single individual to the total population of ecumenopolis.[10] As for Man, we must differentiate also between primitive and more advanced societies. For this, we can use 6 developmental phases, thereby arriving at 90 components (15 social units in 6 phases).

Shells represent all types of building construction and can be classified in various groups: indispensable buildings, such as houses; symbolic structures, such as temples; technological structures, such as power stations. Experience shows that these can usefully he classified in about 20 categories.

Networks include all land, sea and air routes as well as utility systems (water supplies, sewerage systems, gas and electricity conduits) and all telecommunications networks. The totality of these can be classified in about 20 categories.

We now have 258 basic components derived from the five elements forming our Anthropocosmos. These 258 elements, however, can only be understood in terms of the relations among them; for example, such as how less or more water can change agricultural production economy and the number of people living from it; how the invasion of babies on a road changes its character; how a factory can change local microclimate (by raising the air temperature or emitting fumes, etc.). This means it is necessary to multiply the 258 components by 258, resulting in approximately 66,564 relationships, some of which may be causal, as the ones mentioned above, and some non-causal. For instance, it may be difficult to

judge the effect, other than its aesthetic appeal, of a certain type of plant upon a particular building. In the light of my own experience, however, I will enumerate certain ways we can review, as we must review these components and their relationships which can, I believe, help lead us out of the present chaos.

First, we must differentiate among the units of space. The impact of a factory upon a small town is very different from its impact upon a continent. Any phenomenon can only be understood if we examine it in its appropriate unit of space, from the smallest unit of Man himself (with his body, his clothing, his furniture) to the next unit, the room, then the house, the neighborhood, up to the city and finally, the who1e earth.

Next comes the time scale, divided into at least 10 units from one second to a thousand years. Any evaluation of the components and their relationships must be regarded in terms of time. Some noises may bother us only for a second, some ocean pollution may have an effect for eternity. One's actions tomorrow may have little effect upon a metropolis, but may seriously affect one's own home. This means we have also to deal with 150 units of space-time.

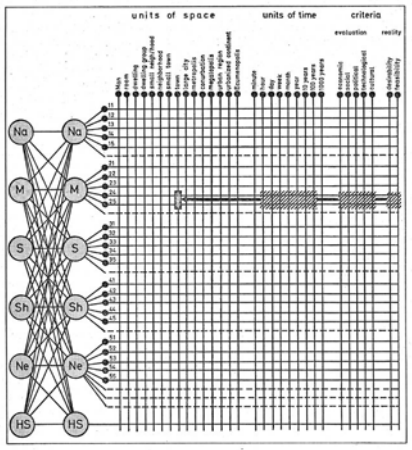
The third criterion is an evaluation of their quality. To arrive at any understanding of the meaning of the components of the five elements and their relationships with Man and his values, we have to examine them in the light of Man's basic concerns: economic, social, political (or administrative), technological (or functional), and cultural (or aesthetic).

Fourth comes what I call reality: the criterion of desirability and feasibility. We may dream of an ideal city in a wonderful garden, but we have to recognize that it is not feasible today, and may never be.

The result is that we have 10 criteria of evaluation (5 each seen in 2 ways) and 150 units of time-space. By means of them we can evaluate what is happening, or what may happen, to any element, or relationship. We can perceive its structure, follow its development, and recognize whether or not it is healthy. If it is not, we can see how it can best be moved from observation to diagnosis and therapy.

In this way we can begin to establish an order out of the present chaotic and confused situation. We have 258 basic components of the system of our life -our Anthropocosmos- and these have 66,564 relationships among them which can be understood and evaluated by means of a system of 1500 units (150 units of space-time multiplied by 10 criteria). Our total conceptual model, which can illuminate all aspects of the Anthropocosmos as a developing system, has 100 million parts.

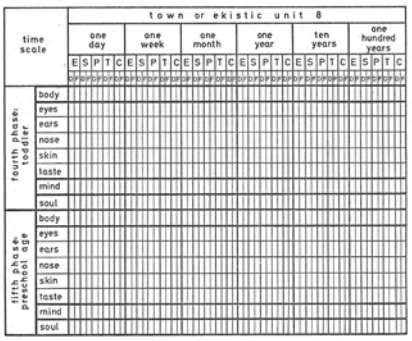
the Anthropocosmos model



part of the total model given in detail in figure 5

Figure 4

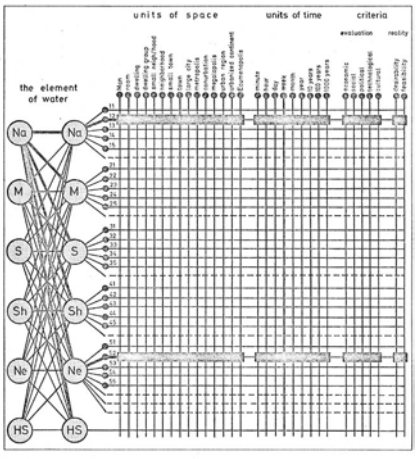
part of the Anthropocosmos model



E economic
S social
P political
T technological
C cultural
D desirability
F feasibility

Figure 5

the Anthropocosmos model and the sciences covering parts of it



sciences and technology related to water

Figure 6

This is a frightening figure, and really a simplified and reduced one because each part can be subdivided into many more parts, but it helps if we look at a simplified graphic model (Figure 4) on which we can record, in an organized way, everything that exists or is happening in the system as a whole, or in any particular part of it (Figure 5).

On this model we can pinpoint our subject, in our case water and its relationships, and define (Figure 6), the disciplines and the role they play. If we make the effort to place our specific problems in this model, we can see where we stand, where we can go, and where and how we can join forces with others to cover the complex system of the Anthropocosmos.

I have personally used this model in many ways, and have gradually published it and presented it to clients and scientific groups.[11] I have never received any meaningful negative comments and have found that it can be used for very simple empirical, heuristic, and in part, deterministic problems. I am convinced that its wider use can help bring order into our thinking about the complex problems of today.

THE FEASIBILITY PROBLEM

If anyone asks me if my three proposals concerning water are enough to save the situation, I will answer in the negative. Such a global problem, which has always existed and has been intensified in the last two centuries, cannot be solved easily, and especially not without very specific measures of action.

What, then, is the value of these proposals? They are the basis for a move from well meaning, idealistic declarations and uncoordinated action towards, a realistic, coordinated action program. The first two proposals lead toward immediate trial and error, and the third proposal leads toward coordination of knowledge; an increase of trial and decrease of error. Many efforts are being made all over the globe, and mankind is moving from declarations to specific studies, especially after the UN Stockholm Conference, with such efforts like the UNESCO program on Man and the Biosphere,[12] the Pacem in Maribus movement to save the Mediterranean,[13] the IFIAS (International Federation of Institutes for Advanced Study) program on World Water Resources and Strategies for Management and several others. The meaning of my proposals is to help, to insert dimensions in all our decisions in order to make them work, and to remember that Man is the measure of all things.

Are not the dimensions of these proposals so huge that their realization is improbable? No, for they are not really "huge" because this word is meaningless unless we connect it with time, space, and resources. When Man

tried to create his first small and elementary network for water 500,000 years ago, as we learn now from Mary D. Leaky,[14] when he created irrigation systems 5,000 years ago in Egypt,[15] complete sewerage systems 3,750 years ago in Nippur, India,[16] a water supply tunnel 4,260 feet long on Samos, Greece 2,500 years ago,[17] and when, more than 2,000 years ago, he was building dams in China, we must be grateful about what we call "huge."[18] In those days Man had from 2,500 to 10,000 calories per day per capita, or an annual income per capita of less than $100. Now incomes have increased 40 times and energy 80 times. This means that on the basis of incomes and energy, our irrigation systems can reach lengths of 20,000 km (12,400 miles) at least, and our tunnels more than 200 km (124 miles). With such systems we can solve all our problems just by keeping the normal pace of evolution.

But when are we going to achieve the great changes that we need? Can we realize them in our five-year programs or within one generation's time? The reply is that we can and achieve many things with five-year plans, but many other things require much longer periods. Again the answer has been given by history. I start by quoting Mao's story about a foolish old man who wanted to dig up mountains and distribute water over wider areas. A wise old man said "How silly! It is quite impossible for you to dig up these two huge mountains." The foolish old man replied, "When I die, my sons will carry on. When, they die, there will be my grandsons, and then their sons and grandsons, and so on to infinity. High as they are, the mountains cannot grow any higher, and with every bit we dig, they will be that much lower. Why can't we clear them away?" He then went on with his digging.[19]

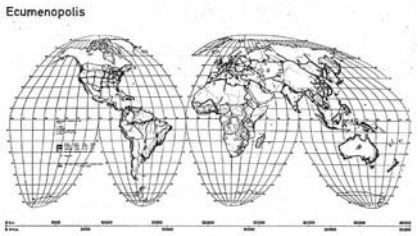


Figure 7

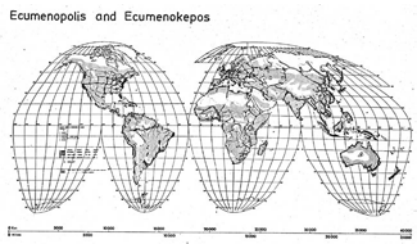


Figure 8

But this is not the only example from history. Any proper feasibility report can prove that no farmer can have such a house as he has on many mountains of the world and no medieval city could build a huge cathedral. But they both happened and we admire them today because Man was able to start processes and finish them step-by-step in a few generations.

This is my answer to all the pessimists who laugh or cry at broad concepts about a much better world: Let us have the proper concept on a global scale, by planning the dimensions and types of global land and water zones. Let us conceive the overall system we need and elaborate on it with science and technology. If we do this, someday Man is going to celebrate a life of much higher quality in his global city, or Ecumenopolis, (Figure 7) which will cover 2.5% of the total land surface, surrounded by the global garden, or ecumenokepos (Figure 8), properly irrigated and supplied with an ideal global system of water or ecumenohydor.

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