

ENVIRONMENT AND THE ROLE OF EKISTICS

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(A) INTRODUCTION

The Role of Ekistics in Long-Term Projections (Methodology and Reliability of Results)

Ekistics (Ek), a global science of Human Settlements (HS) (small or large, ancient, modern or future, isolated, in groups or regions, examined whole or in their constituting parts, from all aspects - geographic, economic, social, cultural, administrative and legal, aesthetic, technological etc.) has been defined and described by C.A. Doxiadis, his collaborators at the Athens Center of Ekistics (ACE), in the journal Ekistics (since 1956), and at the World Society of Ekistics (WSE), and elsewhere. In particular, a number of future-oriented aspects of Ek have been described in the 2nd Red Book: Ecumenopolis, the Inevitable City of the Future, by C.A. Doxiadis and J.G. Papaioannou, Athens 1974 and New York 1975, and in over 350 internal reports of the ACE research project The City of the Future (COF), since 1959, recently summarized in the journal Ekistics by J.G. Papaioannou (see References).

Ek seems to offer a useful tool for the exploration of the future. Indeed, in many respects it seems to offer a methodology of future research more reliable than most other fields in the human sciences, a fact (sufficient reliability of future projections) shown here, whenever referred to, by an asterisk (*). This is due mainly to the fact that most human sciences base their future projections on extrapolations from recent or present trends, even if they take into account modifications of present conditions expected to take place in the future and change the course of extrapolations. Even when corrected in this way, extrapolations are known to be patently unreliable. In such seemingly simple cases as human fertility and population projections (not to mention economics, social or political conditions, culture etc.) experts have often found themselves grossly out of scale, even in short-term projections. Ek does take extrapolations into account, but is fundamentally based on the opposite course - rather than attempting to reach the future beginning with the present, it tries to do so coming backwards from a still more remote future situation, which can be assessed with increased safety. This refers to the fact that humans do, and will undoubtedly continue to, inhabit the earth for a long time. The surface of this planet, and its size (510 million km²) is perfectly fixed and not expandable. At some future point, this surface, mainly land, will become saturated. Signs of saturation in other fields have already started appearing, with land uses corresponding to the demands of humans at a given time. This, together with a few more assumptions about habitability of surfaces, types of land use, patterns of land occupation and their geometry, results in a broad pattern of urbanization of the Earth, expected to be attained, in sufficiently developed form, somewhere between the middle and the end of the 22nd century. This pattern is called Ecumenopolis (Ecp)*, (figure 1) i.e. the ecumene or universal city.

This does not represent a whim, flight of fancy, or a utopian wish, from the authors, an "ideal city of the future", but, on the contrary, the most likely future development, according to physical and biological constraints and laws. It represents, as detailed modelling and analysis have shown, an inevitable pattern of urban development that can be varied considerably in its details, according to changing developments and conditions, but in such a way as to keep it "bound to follow", at least in rough lines, the overall configuration of Ecp. This finding does confer, at least in part, considerable safety* and assurance* for ek projections up to 1 1/2 to 2 centuries or more, and somewhat less for up to 5 centuries or more. A second category of the advantages of ek projections concerns their being well defined in space* and time*. Space definition (Ecp pattern) is particularly clear because of the physical geography of the planet: time definition is also clear because the beginning of the evolutionary curves leading to Ecp is firmly anchored in the present, recent past and near future facts. The end point is fixed by Ecp as a saturation pattern, and the intervening portions of these curves result from likely scenarios describing the evolution toward Ecp.

To better understand the spatial configuration of Ecp, it helps to take into account a complementary concept, equally developed within the COF project: Ecumenokepos* (Eck) (figure 2), the universal garden on this Earth.

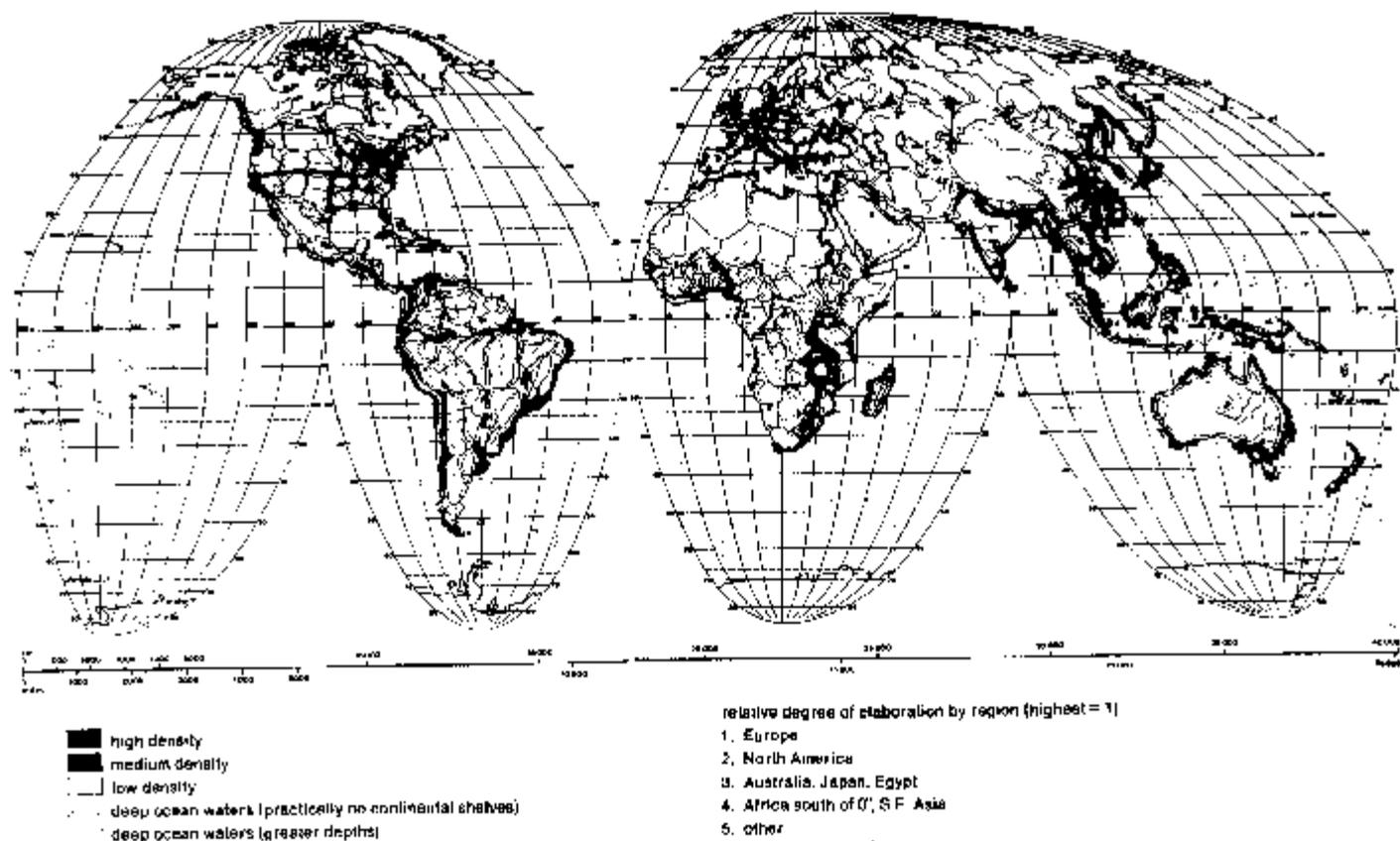


Figure 1: Probable structure of Ecumenopolis with 15 billion inhabitants, 2100 A.D.

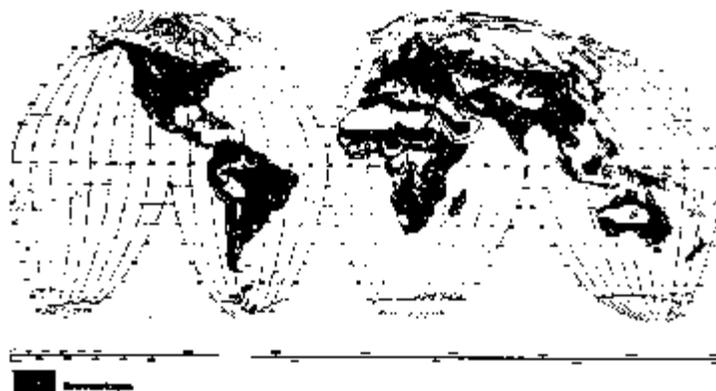


Figure 2: Ecumenoekes, or the global garden, superimposed on a map of Ecumenopolis.

In a way, what is not Ecp is Eck, and what is not Eck is Ecp. Eck has to be visualized as a systematic linking of all Open Spaces (OSs), spaces not built-up, at all scales, through bridges or corridors of protected nature: it is Eck that is fully connected and continuous, leaving Ecp, at all scales, as purposefully isolated "blobs".

Some quite timid efforts towards Eck have already been made (Australia, tropical forests etc.) as an effort to interconnect protected natural areas. In its full development, Eck represents the best and only chance of preserving the natural environment on a grand scale.

A third category of the advantages of ekistic projections stems from the fact that Ecp does not represent utopia (from ancient Greek, meaning "no place"), but an inevitable reality*, or entopia (something in its proper place) that has to be seriously taken into account as such, i.e. as unavoidable. This being so, what choices are left for the present-day planner (indeed, every present-day citizen)? The choices are, fortunately, many, and varied (first, there is not one, but many Ecp patterns in spite of them all having basic traits in common: among these, several are advantageous others disadvantageous, with many variations. What is imperative, therefore, is to try and select pathways leading to good, indeed possibly the best*, types of Ecp. To do this, one has to respect the general pattern of Ecp first (not to try to contradict it, as this would be catastrophic, like attempting to force a river to flow backwards) and, having secured this, try to optimize the course towards Ecp. This is a very substantial and flexible power in the hands of present-day and near future planners. The sooner and more wisely they act, (i.e. in the

spirit of Ecp), the more successful their initiation and guidance of the optimal road towards Ecp will be, and a better "style" of Ecp will be reached in the remote future. This power to act now, and influence the path towards Ecp, beneficially, constitutes the third category of advantages of ek projections.

Findings from the projections of the COF project and the Ecp/Eck models are stated plainly. One should bear in mind, however, that when a statement is expressed here, especially on the remote future, it represents the most likely outcome* of an interplay of real forces, within the context of future conditions congruent with the Ecp theory. Many such statements do incorporate an element of inevitability that should be considered in all seriousness. In the many cases where a range of choices is seen as being available to future societies, it is usually assumed that a slow, but methodical process of trial and error will lead, given enough time, to something like a choice of optimal solution*. Such a choice is expected to be greatly facilitated, not only by the long period of time available, but also by considerable progress in science, technology, information, communication, organization etc. and also by more powerful means and tools placed at the disposal of future societies (increased incomes, available non-polluting energy, new materials, freedom from illiteracy, oppression, famine, illness, fear, etc.). Plain statements made hereinbelow, imply such complex processes over long periods of time necessary for arriving at the conditions described.

Lastly, a fourth category of the advantages of ekistic projections consist in their nuclear or focal, position amidst human endeavors: ek projections seem to exert a concrete influence on projections in other fields of human activity, at least for some aspects of these fields. This means that ek projections do condition, to a certain extent, a broader area than ek proper: there are sectors in the fields of economics, the social sciences, arts and culture, science and technology, politics, law and administration and the environment, where the influence of ek thinking, approach, projection, methodology, and the Ecp concept, do point to rather specific and concrete statements and findings.

Why this insistence on "advantages" in ek theory and practice, concerning long-term future projections? Firstly, because the main theme of this conference, Bios in the Next Millennium, where I heard many excellent presentations which not only do not dare to "approach" a millennium, but speak mostly in terms of developments that concern only the current or next decade. Secondly, and I consider this still more important, because it has become imperative, today, to have a sufficiently long-term perspective, not just 30, 40, or 50 years, nor even 1 or 2 centuries, but much more, say, a millennium. Imperative, because only in such a light can one correctly envisage the crucial and critical problems arising and developing today, threatening to become a real menace for mankind, the biosphere and the whole planet at some unknown future point for each problem, if no urgent, immediate, courageous action is taken. Problems of large-scale destruction of tropical and temperate forest, elimination of innumerable species of animals and plants (wholesale extinction), desertification, erosion, exhaustion of natural resources, climatic change, landscape destruction, widespread pollution of air, water and land, plus toxic and radioactive waste, not to mention the recent scares of "acid rain", the hole in the ozone layer ("ozone hole"), the "greenhouse effect", and so many more threatening env'l problems, present and future, that make the headlines of today's news and others that undoubtedly will make the novel, unexpected news of tomorrow, cannot be solved in terms of years or decades only. They demand a consideration in terms of a sufficiently long-term perspective (several centuries) to be properly understood, analyzed and eventually counteracted and corrected, even if immediate action is unavoidable, if something has to be conserved that is worth conserving for the future. Other basic human problems - war (including nuclear warfare) and peace, equitable distribution of goods (physical and social) and the reduction of disparities, fighting (if not elimination) of poverty, famine, illiteracy, underdevelopment, illness (including new illnesses), alienation and fear, not to speak of a possible physical or psychological degeneration of the human species anticipated by some futurologists, balancing local, regional and international tensions, making our towns and villages more humane, more rationally functional, more attuned to the environment, and so many other human problems also require a long-term perspective for efficient improvement, if not for a completely satisfactory solution. Once more, we need several centuries to tackle them efficiently, even if we have to start acting now on the basis of every piece of available scientifically (or even intuitively) founded knowledge about them. The need for a sufficiently long-term perspective does not have to be overemphasized.

(B) EKISTICS VERSUS ENVIRONMENT

Another point about the "strange" interrelation of Ekistics (Ek) and Environment (Env), is that each one of those concepts encompasses the other in its entirety and much more: this seemingly logical "contradiction" works out as follows:

1. Ek, by definition, comprises 5 elements: nature, man, society, shells (structures) and networks; these are the basic elements that, taken together, generate a complete, operative Human Settlement (HS), a system of HSs, or a region conditioned by HSs. Nature, in this sense, one of the 5 ekistic elements, represents the entire natural environment of this planet, in the broadest sense, either virgin and unspoilt, or interfered with, polluted, mishandled or otherwise degraded (rarely ever improved) by man. Nature, in this way, represents a basic and most valuable constituent of all HSs.
2. The Env, on the other hand, is, to a very large degree, still natural (unspoilt or altered by man): this represents all of the physical constituents available to the biosphere on the surface of the Earth (sometimes even deep into the surface (e.g. worms, bacteria, abyssal faunas or high up in the atmosphere, e.g. birds): land, water, air, plus the biosphere (floras and faunas, plus micro-organisms). Only a small fraction of this natural environment is occupied by HSs: their built-up areas still represent less than 1% of the surface of the globe, even if their influence on their surroundings is much more pronounced (and often fiercely destructive). To human beings, however, not only this natural Env is of importance, another type of env, the man-made one, is of at least equal, if not greater, importance. This is the env within our homes, within all other types of buildings, in OSs within and around our cities and villages,

sometimes far from them, when conditioned by the presence of man and his structures, monuments, other artefacts etc., and, finally, our social Env, which may include people both very close and far out at great geographic distances from us. These two envs are to be found in constant interaction with each other, each one strongly and constantly influencing the other. It is now clear, and rather frightening, that man's degrading influence on the env in general is increasing at an alarming rate, both in space (geographic extension), and in depth (degree of deterioration).

These rather simple definitions are mentioned here in order to remind and clarify the somewhat intricate interrelation of the concepts of Ek and Env that concern us here.

(C) LONG-TERM STATEMENTS FROM EKISTICS ABOUT THE ENVIRONMENT

We have briefly mentioned the subject matter of the COF project, and in particular, its Ecp and Eck theories. We can now look at what both these theories (especially Eck) and the overall COF project seem to imply about the Env in general and the biosphere in particular, especially in the long term. In doing so, we shall draw information from any of the over 300 sub-projects (internal papers summarized in maps, statistics etc.) and other material that formed the basis for the COF project, without explicitly stating here in general, for lack of space, how those results have been arrived at.

1. Hierarchy of Open Spaces

As with other Ek units, elements and regions, Open Spaces (OSs), i.e. spaces other than those built-up and their immediate surroundings, are advantageously considered as ordered along a clear hierarchy (in area), starting from the smallest individual garden (or even a pot of flowers) finishing with the largest uninhabited areas (wilderness) of the planet. This hierarchical concept stresses the point that OSs, at a given hierarchical level, have to be considered as "interrelated" among themselves, so as to form one unit in the next higher hierarchical level. Such interconnection may be either "real" (physical) (e.g. through "bridges" or "corridors", or "functional" (conceptual), when the ties (links) interconnecting them are not tangible "green OSs", but functions, such as movements of people, goods, information etc.. The important points here are: a) the identification of the "hierarchical level" (see Ekistic Logarithmic Scale, (ELS), figure 3) to which the OS belongs; b) the nature and variety of the links interconnecting each OS with its neighbors within the OS next higher up (first order links) in the hierarchy and the relative strength of such links; and c) similarly for links interconnecting the OS considered with other OSs, more than one step higher up (second order links, etc.) or any number of steps lower down the hierarchy. The identification of the hierarchical levels of OSs, or their "scale", is essential both for properly describing and understanding them and their problems (since such problems differ radically according to scale), and for devising appropriate courses of action for their solution.

Ekistic unit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Community class				I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Kinetic field	a	b	c	d	e	f	g	A	B	C	D	E	F	G	H
name of unit	1 Anthropos	2 room	4 house	40 housegroup	250 small neighborhood	1,500 neighborhood	9,000 small polis	50,000 polis	300,000 small metropolis	2M metropolis	14M small megalopolis	100M megalopolis	700M small eperopolis	5,000M eperopolis	30,000M Ecumenopolis
population	1	2	4	40	250	1,500	9,000	50,000	300,000	2M	14M	100M	700M	5,000M	30,000M

Figure 3: Ekistic Logarithmic Scales and grid for population and area

2. Interconnection of Open Spaces

This has been a fundamental concept of the Eck theory: Ecp and Eck are seen as complementary patterns on the surface of the Earth; this

implies, geometrically, that one pattern has to be continuous, interconnected, and the other disconnected with separate "blobs": since it is imperative to have the OSs interconnected, this pattern has been "adopted" (i.e. considered as most probable) for Eck, leaving Ecp physically disconnected, as is desirable. The underlying idea is that inhabitants should be given the privilege of "walking" (or otherwise moving) through OSs from the smallest to the largest, without ever having to abandon an OS. But this "human use" argument has been strongly reinforced recently, by broader ecological considerations: it has been shown, e.g., that protection and conservation of tropical forests is greatly enhanced if isolated "blobs" of it are connected through "corridors" of rain forest, enabling faunas to move undisturbed from one "blob" to the next; similar considerations are of importance in the conservation effort for various other types of habitats, vegetation zones, coral reefs, etc. The establishment of such carefully planned "corridors" or "bridges" between OSs, at all scales, is of primary importance for both conserving and maintaining what is left of unspoilt nature, and, even more importantly, ensuring that such areas will grow in the future, which will be beneficial for both the OSs themselves and the faunas and floras they include. Such bridges, on the other hand, are seen as a basic, most desirable and effective protective measure, a barrier against the physical spread of Ecp: the thrust leading to such spreading is very powerful, as it is shown, among others, by statistics on the present expansion of large metropolitan areas: the "consumption of surrounding land" grows at an average rate about four times greater than the rate of their population growth.

3. Habitability and Land Use

Humans use available land surfaces on this planet in a bewildering variety of ways, interfering with their "natural" state. One method of classifying land use is to consider whether they tend to serve production (primary: agricultural, forestry, etc. or secondary habitation (for HSs: towns, villages, other installations) or conservation of OSs, (unspoilt nature, wilderness, etc.), leaving aside other, minor types of land use, although each type of land use claims "the best" type of land for itself this cannot be literally satisfied. Traditionally, priorities went to production areas but as land productivity increases, and, in the future, alternative methods of production of food and other goods are expected to partially replace traditional methods and as the importance of protected natural areas (national parks, reserves, sites of special interest, etc.) is gradually being accepted as having higher and higher priorities, the emphasis is slowly shifting and is expected to continue shifting towards protected natural areas, at the expense of production areas. Habitation, which today consumes less than 1% of the total land areas, only affects this balance to an almost negligible degree with the expected growth towards Ecp. However, pressures for land for habitation will increase making it necessary for HSs to accept not using the "best" land, but land somewhat further down the hierarchy of land "quality", although such quality will have to remain acceptable for HSs, leaving the "best" land for the other two categories. Extensive habitability studies for the Ecp project have shown that limiting factors (for habitability re Ecp) are mainly (in this order): availability of water, climate (including climates too extreme, therefore too costly to control), elevation (excluding elevations over 3 or 4,000m and too uneven terrain - excessive slopes, relief etc. - for habitation), and other factors further down the scale of priorities. The pressure for conservation of major "natural areas" on the planet is expected to lead to the assigning of the highest priorities, further increasing with time in the remote future, to such "natural areas", accommodating other needs (production, habitation etc.) "more economically" in both amount (size) and quality of land consumed with the help of mainly technological progress, increased incomes, and better organization and control of land use.

4. The "12 Zone" Proposal

In conjunction with the Ecp and Eck theory, C.A. Doxiadis proposed a system of classification of land uses according to "12 zones" (figure 4): "Zone 1", representing the least human intervention (totally "virgin", unspoilt, wild nature, with no visible human presence), and "Zone 12", the most highly-polluted industrial areas (and the worst Central Business Districts (CBDs) of large cities). It is worth noting that, at about the same time, and totally independently, Professor Pierre Dansereau (Canada), devised a similar system (ten zones) of classifying land uses versus human intervention. The strength of Doxiadis' system consists of:

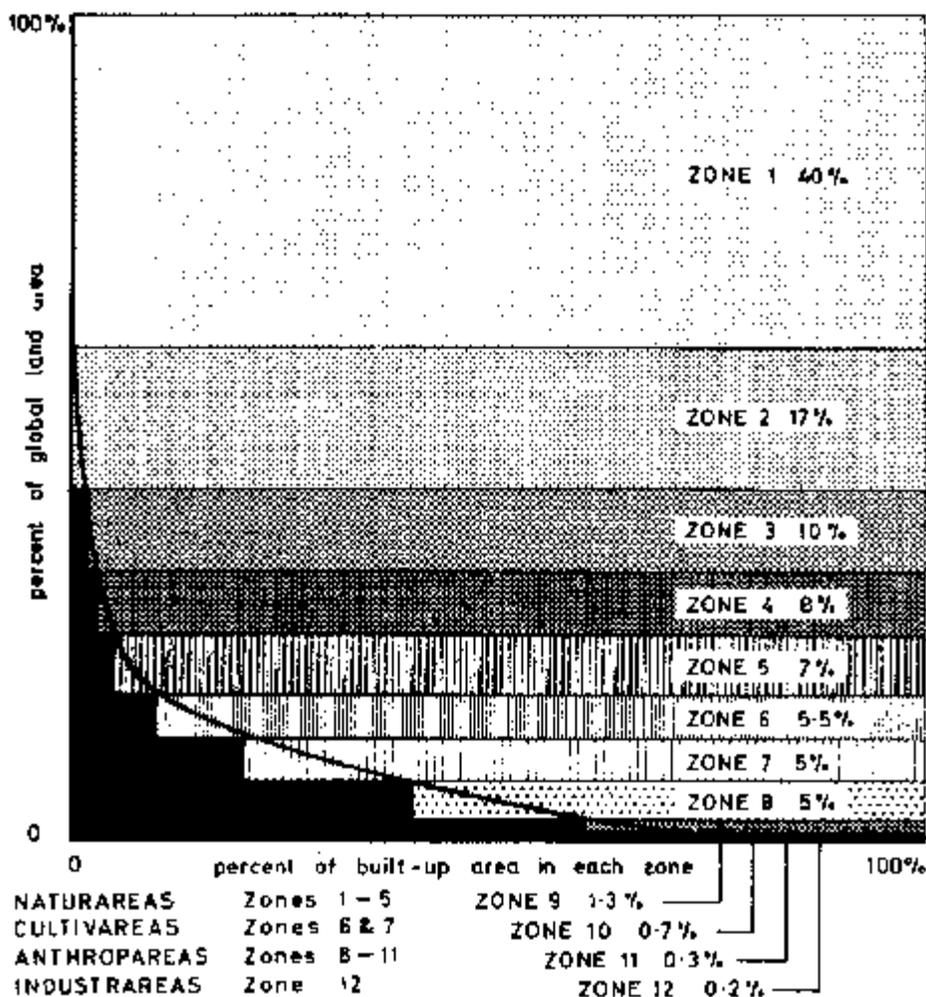


Figure 4: Diagram showing the percentage of built-up areas in the 12 land zones

- Identifying land uses according to the type and degree of human intervention, helping to assess and qualify its impact;
- As a result, a new type of "land registry" map, for any region (eventually the whole Earth), can be devised, where every point will be shown as belonging to a specific "zone";
- Control of land use, present and future, can be based on such maps: in b) above the map shows present land uses, another map (or set of maps) may show "desirable" land uses, to be attained at specified time horizons (e.g. a place now in "Zone 6" to be "upgraded" to "Zone 3" within so many years). Such control will eventually involve both national and international laws, directives and regulations. It goes without saying that the definition of each zone will entail a very detailed, quantified description of activities of all sorts allowed, and activities prohibited, within the zone being defined;
- A more remote goal is the international coordination and, later, unification of such zone control; this will lead to a unification of legislation concerning, among other things, protected areas (national - and international - parks, reserves of various types, sites of special interest, etc., down to control for the protection of single endangered species of plants or animals, etc.; methods of pollution control (pollution being a patently international phenomenon), including waste disposal, air, water and land pollution (with respect to specified types of pollutants and degrees of pollution); control of deforestation, erosion, desertification and other types of land degradation; and many other types of human intervention, positive or negative, on the env, that need to be controlled;
- The system of "12 zones" has not only been conceived for the control of land areas and their uses. Doxiadis proposed similar systems of "12 zones" also for water surfaces (and depths) and the atmosphere, both for identification and control of future uses, up to the international scale.

5. Balance of Man and Nature

Humanity is still in a period of major frantic and growing imbalances between man and nature. It will be seen below that it is expected that such imbalances will soon start diminishing until, at the time when Ecp and Eck set in, say 1 1/2 to 2 centuries from now, one could expect a satisfactory balance of man and nature to be achieved. Indeed, this is regarded as the main feature of Ecp, from which all other characteristics

can be derived. In particular, whatever the future inhabitants of this planet may manage to save from destruction (forests, faunas, floras, endangered species, landscapes, clean land, water and air), so that this wealth and heritage of our Earth does reach the Ecp period, will be expected to have been saved for good and incorporated in the "Conservation mechanism" ("12 zones" and other measures) to be developed by that remote time horizon.

These are only a few examples from the findings and statements derived from the theory of Ek that are pertinent to the Env in the long term. But before examining how (and if) we are expecting to reach that remote time horizon, let us look at some other predictions from the Ek theory, in other fields, that may also throw some light on views about the Env.

(D) OTHER FIELDS INFLUENCED BY EKISTICS (LONG-TERM VIEW)

There are many important fields of human activity and endeavor about which very little, often nothing, can be said on the basis of the Ek theory alone for the remote time horizon of Ecp. Still, there are a few fields about which Ek allows us to say something.

1. New Spatial Units

- a. In the past, today, and probably for some time into the near future, the map of the Earth is seen as divided into a number of countries, sharply separated from adjoining ones by boundaries or frontiers. Such countries appear as historical units, as a result of compromises between antagonistic ethnic, racial, religious, political and other forces and influences, often resulting from the cost of wars, suppression and oppression of minorities, etc.. At the higher scales, political alliances of various types, between adjoining countries (states in America, the European Community, various coalitions, etc.) may presage the appearance of units larger than countries on the map; at the lower scales, provinces, regions, counties, communes and other administrative units subdivide the countries in a variety of ways.
- b. A recent phenomenon has been the growing influence of large "regional settlements", metropolises or conurbations, and, more so, of megalopolises, urbanised regions, etc., (figure 5) on the region around them: such units often cross national boundaries, as major regions of economic, social, administrative and other influence from the major settlements they include. These "new units" and their boundaries increase in importance with time, and it is more than probable that, given sufficient time, e.g. Ecp, they will supplant and replace the traditional countries: this is seen as a process of slow, but inevitable, adaptation to the new forces likely to prevail at the time of Ecp. The "old" countries will probably not disappear, but become embedded in a different type of "new spatial unit" (figure 6) on this Earth, whose location, extent, character and boundaries will be dictated by the strength of the new conditions likely to prevail at that time.
- c. One should, therefore, envisage a slowly diminishing importance of old national boundaries, to be replaced by an equally slowly-growing importance of the "new units" of Ecp, the "new ones" being superimposed on the "old ones" sometimes in close relation, but also sometimes in harsh contradiction. The "new ones" will be supported by the strength of the "new forces" (a combination of ek and env'l ones), while the old ones will be kept and preserved somehow as historical, or "museum" units. This seems to be a new reality, not to be ignored, although the precise form it may take at such a remote future cannot be fully predicted; furthermore, its implications for env'l considerations are evident.
- d. This picture inscribes itself in the realization of the growing importance of ek considerations with future time, especially so with the overwhelming importance and influence of very large settlements, or organized groups of settlements, like magalopolises: their impact is likely to exceed the sum of all other influences on both regional structure at large, and on the Env.
- e. It also inscribes itself in the more than evident course towards "internationalization".

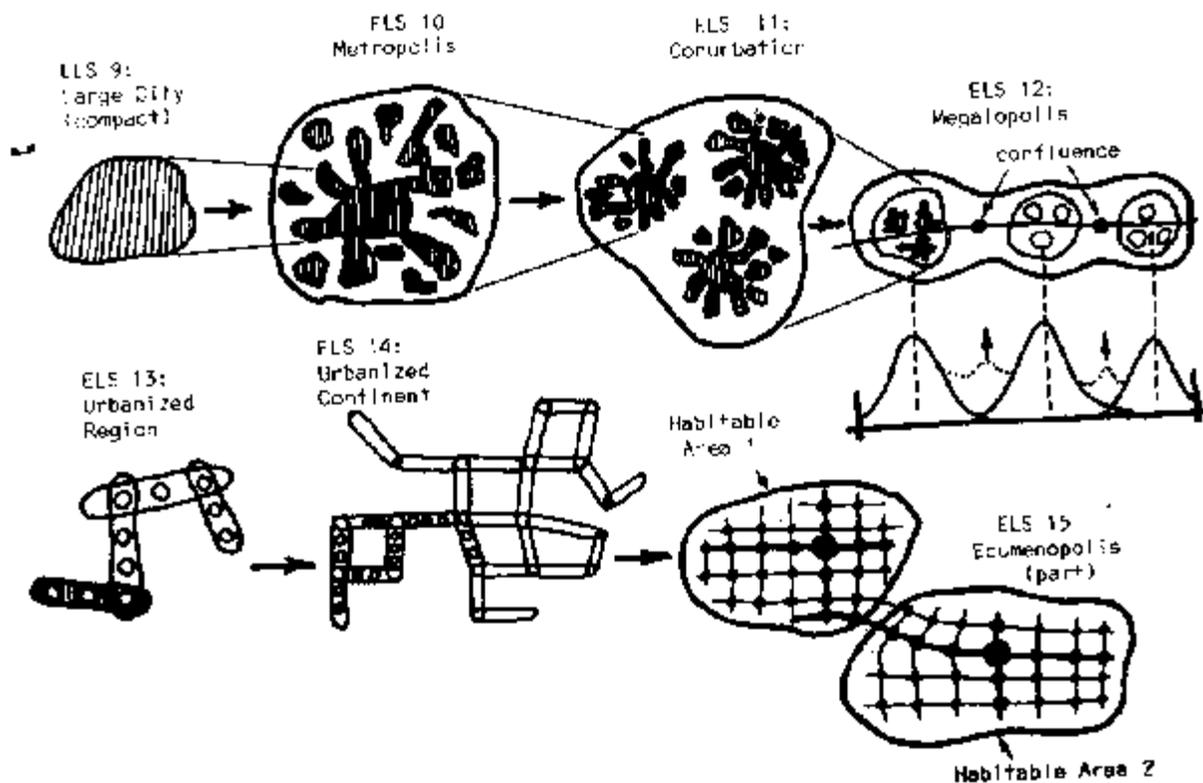


Figure 5: Structural identity of the higher units of the Ekistic Logarithmic Scale (ELS)

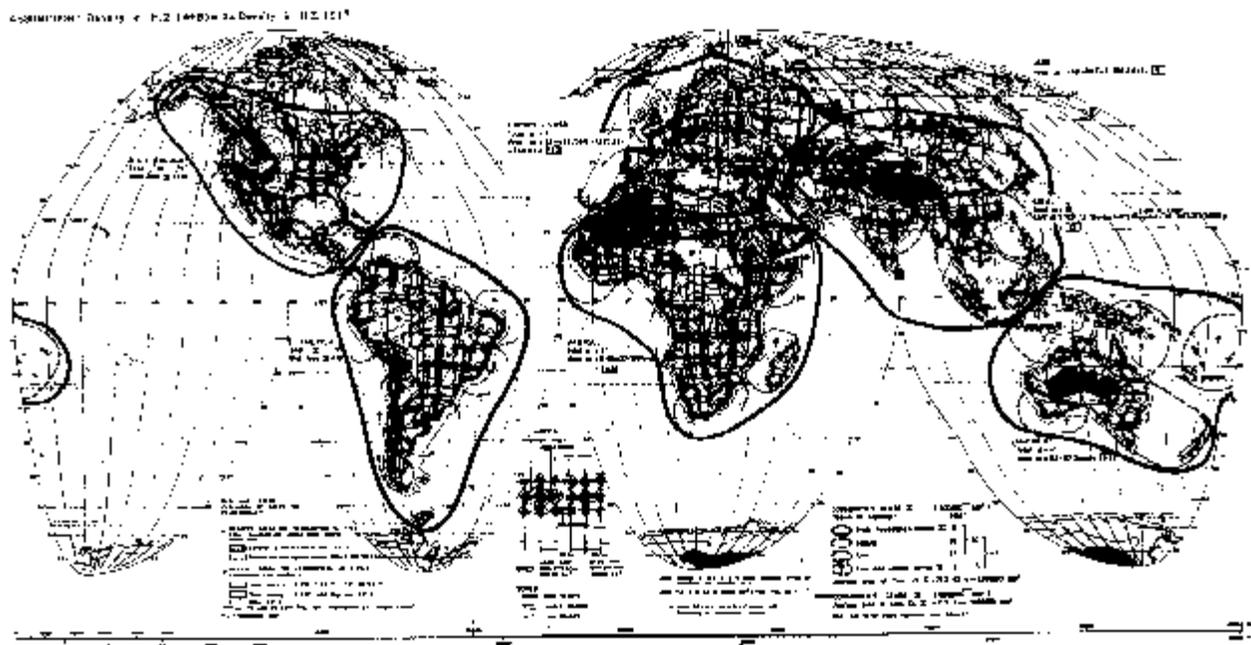


Figure 6: Habitable land basins

2. Progressive Internationalization

a. It is clear that, in recent decades, growing internationalization has become a major force in world affairs. The World War I "Societe des Nations", a first timid attempt at world unification, has become the "United Nations", a much more powerful organization, after World War II, about a generation later. Today, the number of international organizations of all sorts, global, specialized or restricted to specific sectors or major regions of the planet, governmental or non-governmental, has grown spectacularly and continues to grow unabated. What is more, a far larger number of issues are being controlled, in one way or another, internationally, and at far greater depth, reaching clearly beyond "restricted" national control.

b. It is one of the basic premises of the Ecp theory that, by and large, this trend will continue, both within the near future, and within the remote one. It will exceed the limits of this paper to explain why this is assumed: it is not a mere extrapolation of present trends

(although this is quite a solid argument, too), but it results from quite a number of independent considerations.

c. A growing degree of worldwide internationalization goes hand in hand with env'l considerations: most major env'l issues appear, already today, to be most significant on a global scale, be it pollution of various types, (including nuclear radioactive one), desertification, acid rain, the hole in the ozone layer, the greenhouse effect, climatic change, destruction of both tropical and temperate forests, etc.. Such phenomena do not stop at "national frontiers", and their impact extends to neighboring or remote countries (with respect to the point of origin of the disturbance), often to other continents, or to the entire globe (and beyond, if we consider the pollution of extra-terrestrial space by satellite debris, other trash, radiation etc.). The important point here is the growing realization of the urgent need for the international character of environmental control: the highly likely prospects of growing internationalization, well into the remote future, therefore, are closely connected with an increasingly efficient env'l control over the whole planet.

3. Science and Technology

a. Scientific and technological forecasting cannot project too far into the future, with any degree of certainty, where specifics and very detailed issues are concerned. On a more global scale, however, predictions become much more trustworthy, and far-reaching into the remote future: the general fact that both scientific and technological progress will continue, probably not only unabated, but even accelerating, is beyond dispute, within the Ecp theory; in spite of the present, and very recent "scare" for uncontrolled technological progress, it is extremely unlikely that this will even result in a stopping (or even an appreciable slowing-down) of technological progress, even more so, of scientific progress. What is much more likely is, that, given time, control over technological progress will be much more rational and efficient, obviating the need for stopping it, which would be as irrational as stopping the course of a river; this means ensuring that improved technology is totally controlled and properly used for the benefit of both humanity and life on this planet in general.

b. It is also extremely probable that future generations will realize, more and more, the importance of science, firstly, and secondly, of technology, devoting to them a slowly, but steadily, increasing percentage of their GNP, say from around ca 1% (for R and D) in most countries, and up to 2-3% in a few cases, today, to a "ceiling" of between 5 and 10% at the time of Ecp. What is more, the proportion of science, and of basic research, which is very small today everywhere, will increase considerably, in the long run, with respect to applied research and development.

c. A corollary of such views is that dealing with major env'l issues will become much more systematic, based on firmer control, therefore, is likely to become much more efficient in the long run.

4. Income

a. Another tool or weapon, in the hands of future generations (especially remote ones), is that of greatly increased incomes. Projections of incomes within the COF project, showed, among other findings, that, whereas income disparities (say, between rich and poor countries, rich and poor regions within a country, or even between rich and poor quarters within a city) are still on the increase and are likely to reach a maximum disparity (and, with it, more unrest, revolutions or even wars) about one to two generations from now; thereafter, such disparities will start diminishing, bringing rich and poor units closer together (diminishing tensions) without wiping out the gap entirely, however, at the time of Ecp.

b. Not only gaps will diminish, but large parts of the Third World, today, still below the threshold of development, will have accomplished a considerable degree of development. Per capita incomes, therefore, will be considerably higher not only in the countries of today's developed world, but also in those of today's Third World.

c. With generally increased incomes at their disposal, tomorrow's (remote future) societies will be able to deal with problems too difficult to be tackled efficiently today. This will constitute another powerful tool or lever, in their hands, for facing the major problems of their time, and for avoiding - much more efficiently - the catastrophes that threaten today's world so dramatically.

5. Organization

a. A further tool, very powerful in the hands of remote future societies, will be that resulting from the expected spectacular progress in organization in general. This is expected to start with the "information explosion" that is already here, together with its present-day main tools (computers: software, hardware, networks etc.), as well as its immediate extensions, such as organization methods, documentation, expert systems, artificial intelligence and so many new branches now emerging. It is to be expected, with almost absolute certainty (if humanity survives), that such an "information explosion" will accelerate, well into the Ecp era, and that the number, variety and efficiency of its "daughter branches", timidly emerging today, will increase spectacularly.

b. This will lead to a long-term situation where organization in general, on the basis of novel, scientific information systems, will be much more efficient, allowing complex problems to be solved more quickly, more correctly, and more democratically (easily "polling" public opinion on major issues).

6. Art

a. Very little can be said about details of the artistic horizon at the time of Ecp; predicting styles, trends, and even more so, techniques in art, is quite insecure.

b. Still, two things seem to be highly probable: first, hand in hand with the much more pronounced balance between man and nature expected when Ecp is reached, together with an abatement and calming down of the frantic and uncontrollable growth rates prevailing today for quite a number of phenomena (without going to the undesirable extremes of either "no growth", or "negative growth", but simply keeping growth rates manageably low), a much calmer "atmosphere", or context for future life, is likely to prevail at Ecp time: this is likely to result in a long, classicist period in art, in general, following the "romantic upheavals" during the preceding periods of still frantic growth.

c. Second, the undoubted spectacular progress of science and technology at that time will put into the hands of tomorrow's artists new tools, whose usefulness we can scarcely predict: e.g., think of the revolution of the appearance of recorded and broadcast music, electronic music, computer music, etc.: already today, just one generation (or less) after their generalized adoption, they offer possibilities that could never have been imagined, say, before World War II. True, such "technological tools" do not guarantee "new masterpieces" such as those of Monteverdi, Bach, Mozart (to speak only of Europe): still, they make them more probable in the future, besides democratizing music (both making music more approachable to large masses of people and helping with their education, etc.). Such democratization in several art forms beyond music (painting, theatre, etc.), plus, undoubtedly, new art forms, is a highly probable and distinctive feature of the social content of art at the time of Ecp.

7. Human Scale

Although Ecp seems to concern itself only with the largest spatial scales (continents, to the whole globe), it also preserves, most characteristically, the smallest human scale. A special, major research project of the ACE, the "Human Community", investigated in extenso, through a multiplicity of mathematical models, what is termed "Community Class IV", an ek unit with a population of around 5 or 10,000 inh., that seems to have played a very important role in the history of HSs (e.g. ancient Greek settlements) until today, being alive and well in most countries with a low or medium economic development (e.g. modern Greece). The preservation of the human scale, besides having been proved to be highly beneficial in the past and present, seems to be also essential in future projections, e.g. Ecp: not only its vast scale, but its hierarchical subdivision down to such small units, has been shown to be a necessary prerequisite of its smooth functioning, incorporating important social (and cultural and economic) considerations that are expected to make Ecp not only livable, but advantageous as a human habitat, bringing into the picture another env'l dimension.

8. New Ethics

A broader consideration of env'l issues on this planet leads to a progressive change of values: the past and present anthropocentric model of the biosphere where all its constituents (floras, faunas, landscapes, etc.) are valued according to their "utility" (economic or other practical value) for man, is seen as having to give way, gradually, to a broader value system: the world does not exist "simply to serve man": it has its own value, in a conception of new ethics (world ethics): man does not exist just to exploit the rest of the biosphere, which has an inherent right to life, preservation and respect: man has to integrate himself in the global system of the biosphere. It would take us far out of this paper to try and develop this "new philosophy": in conjunction with Ecp (and Eck) this new value system places a much greater emphasis on the preservation of everything making up our Env: floras, faunas, individual species of animals, plants, micro-organisms, even individual entities within a species (this animal, this flower), landscapes and their constituent parts, etc.. To the objection that nature itself (God?) makes, e.g., one animal eat another, or that expansion of some populations (weeds, locusts, pests, parasites, starfish, micro-organisms, etc.) may be highly undesirable, the "new ethics" answers that what has to be respected and preserved in nature, is the "normal balance" of species, populations, communities of animals and plants, as seen over vast areas or long periods of time, irrespective of temporary, "pathological" events that may occur under special circumstances: what has to be considered, is precisely the "pathological" (destructive) interference of Homo sapiens with nature at large.

Such a view, which is expected to be strengthened with time as we near Ecp, places a much higher value and priority on the generalized preservation of nature in all its aspects and dimensions. An extension of this view requests our respect for the preservation of extra-terrestrial Env, too: both the solar system as a whole, and beyond.

9. Beyond the Earth

It has been considered, even seriously proposed, that, since we have made "a mess" of planet Earth, we should start looking, now, but more so in the future, to new, "clean" extra-terrestrial habitats for man of the future, in a move towards "abandoning" the Earth progressively. What these habitats could be has formed the object of wild speculation: new satellites, new "space platforms", "artificial planets" (or planetoids, asteroids, etc.) on the one hand: existing bodies within the solar system (planets, the moon, other natural satellites, asteroids, etc.) either as they are, or following a radical "intervention" (explosions?) to change conditions there, "reconditioned" for human living, not to mention "natural" bodies outside the solar system, in still wilder speculations, on the other hand.

It might take some time to refute such views in detail: the careful and firm opinion of the COF team is that, although some form of life outside planet Earth is quite likely within the next several centuries, especially for scientific, experimental or other special purposes, and will be expanding with time, it is clear that:

- a. the number of people living in such difficult and extravagant extra-terrestrial habitats will have to be negligibly small, compared with those living on Earth, and
- b. it will be far easier, cheaper, simpler, more logical, and more efficient to try and "correct" deteriorating conditions on Earth, prior to seeking extra-terrestrial solutions.

In this way, the Ecp models assume that the bulk of the human population will be located on Earth, and not beyond it, for quite a number of centuries, even after the incipient Ecp.

10. General Remarks

Such a picture for humanity and its Env, looks rather "rosy" for the remote future: too "rosy" to be probable, pessimists may say. Not so! First, we do not take into account here what irreplaceable part of our "capital", our "heritage", on this Earth, will be irretrievably lost, in the mean time. Second, whatever part of it future societies manage to save, restitution of a satisfactory Env after so great a loss will be difficult, and probably insufficient. And third, even under such conditions, the positive aspects expected to prevail at the time of Ecp, as summarized above, are surely not too optimistic, but they will probably be scarcely sufficient to solve all of tomorrow's (Ecp) difficult problems at the level of higher expectations, aspirations and values desired by the inhabitants at that time.

(E) THE TRANSITION TO ECUMENOPOLIS

1. The picture painted by the "Ecp model" (see Introduction) may seem rather optimistic at first sight, although it probably is not (see above and below). But several questions arise: are we likely to reach the Ecp era? What will happen in the meantime? What kind of Earth and human society (and individuals) will be available, prior to Ecp, to build an acceptable Ecp on them? We shall try to provide some answers to these questions.
2. First, what is the likelihood of a major catastrophe occurring before Ecp? To summarize the findings of Ecp, let us immediately state that the likelihood of such a major catastrophe is very real indeed: still, it is rather small, say to the order of 5 to 10%. To illustrate this point, let us first enumerate some of the more likely threats:

- a. Nuclear catastrophe - (e.g. nuclear war, "nuclear night" following a nuclear war, nuclear explosion - Chernobyl-type, but bigger - radioactive waste dumps and major leakages, even the blowing of the entire planet, etc., including novel, future types of nuclear threats): a very real, although rather improbable, danger;
- b. Natural catastrophe - (e.g. comet or asteroid impact on Earth: unusually violent earthquake, volcanic, or other geological activity, floods, tsunamis, etc.): not to be excluded, although still less probable;
- c. Gradual Climatic Change: ozone hole(s), UV-radiation killing life; excessive warming (greenhouse effect) plus major melting of polar ice and important raising of sea level (drowning cities, fields, installations, etc.); new "Ice Age"; excessive drought periods, desertification etc.. The dangers are real, more immediate (ozone) or more remote (warm, cold periods etc.): likelihood appreciable;
- d. Manmade, "geographic scale", interventions. Miscalculated or misplanned "major engineering projects" of the future, such as diversion of major rivers, interference with polar ice, volcanoes, and other "catastrophic projects"; cases where a rather minor physical change caused by man may trigger a much bigger eventual natural imbalance: not to be excluded;
- e. Biological degeneration of the "Homo sapiens" species, anticipated by some specialists. This may also involve physical degeneration (e.g. loss of locomotion due to insufficient exercise), loss of immune response (AIDS and similar viral or other infectious agents, even less controllable than HIV), psychological degeneration (pronounced laziness, loss of capacity for work, loss of respect for "loftier" human and env'l values and demoralization, and the like), etc.: a danger not to be discounted;
- f. Other causes of extensive catastrophes, appearing as less probable now, but becoming more threatening in the future; or entirely unpredictable, new types of catastrophes.

Therefore, the likelihood of such major catastrophes really happening is not to be discarded, even if it is small.

3. The reasons why the COF project claims that the likelihood of such threats materializing, although real, is rather small, are many. Humanity has faced similar, even worse, threats in the past (epidemics, famine, floods, wars etc., that exterminated thousands or millions of people, when the population of the Earth was orders of magnitude smaller). It has always proved able to survive and regenerate. Even in the near future, humanity is much better prepared to face such emergencies: it will possess scientific and technical information and skills, warning systems that are much more rapid and efficient (allowing preparation to face emergencies), financial means that are on a much grander scale, organization and administration much improved, international collaboration more efficient, etc.. Second, each type of threat, "traditional" or novel, now forms the object of systematic study, the public is alerted to it, and planning for both prevention and correction is becoming increasingly efficient. Campaigns are launched, general mobilization becomes more efficient. These, and many other arguments, do reduce the likelihood of catastrophic phenomena happening, or, once triggered, increase the likelihood of their efficient control. Still, all this leaves a non-negligible possibility of types of catastrophes already known, or other, unpredictable ones, actually occurring, with sufficient ferocity to wipe out humanity, or more generally life on Earth, completely, or to a very major extent.

4. The Critical Period

- a. As already said (D4), income projection models of COF have shown that income disparities, on many scales, are likely to reach a maximum some one or two generations from now. Such disparities are most likely to be accompanied by social tension and upheavals, revolutions and, indeed, wars.
- b. The deterioration of the Env is proceeding, right now, at an alarming rate: tropical forests are disappearing at an unprecedented rate, causing the extinction of major species of large animals, innumerable smaller ones, including birds, reptiles etc., and millions (tens of millions, according to a responsible view) of species of insects and other invertebrates: at the same time the loss of biological variety is a major catastrophe of the biosphere. Important natural cycles (carbon, oxygen, nitrogen, etc.) are being disrupted by the disappearance of forests, to the extent of threatening both climatic balance, and the livability of the atmosphere, water and other resources. Not only tropical, but temperate, and even boreal forests are being destroyed to an alarming extent (human intervention, acid rain, etc.). Animal species of all sorts, and plants, are quickly becoming endangered, and soon thereafter massively extinct, in alarming numbers.

Pollution is extensive, and growing (the Third World being "added") for land, water (seas, lakes, rivers, groundwater etc.), air; radiation hazards are on the increase, as is chemical contamination through toxic waste, pesticides, etc.. It becomes increasingly difficult to find areas on the planet that are almost free of extensive, often insidious polluting agents.

To these "traditional" types of env'l deterioration, new types are added, with increasing frequency: acid rain, the ozone hole, the greenhouse effect etc.. It is more than likely that still other types of env'l deterioration, unknown or unsuspected today, will manifest themselves in the not too distant future.

- c. The picture that emerges looks like this: the Env is deteriorating rapidly mainly as a consequence of the population growth of humanity, and its increasing income, "development" effort, expansion, improper planning, lack of knowledge but also of good will, and many other factors. It is to be expected, however, that, as growth rates for population, income, land consumption, energy use and other phenomena, start diminishing and reach reasonable levels somewhere during the first half of the 21st century, the rate of env'l deterioration will diminish, too: whatever has survived could be preserved much more easily and effectively, thereafter.
- d. The major problem is: what will survive, even if a major catastrophe (E2) is avoided? Very little, is the alarming answer, if an all-out, large-scale, international campaign and mobilization of the masses of population everywhere, is not most urgently and vehemently implemented. Is mobilization at such a scale likely to occur? Surely not, if complacency and neglect of major issues are handled by politicians and experts all over the world and by the public at large, in the loose and inefficient way prevailing today.
- e. What is needed, therefore, to save the planet (and humanity, with it) - not completely, since so much has been already irretrievably lost - but at least to some "acceptable" degree, is a real revolution in thinking, conceptualizing, planning and properly implementing rational plans, immediately and pursuing such implementation relentlessly, with unprecedented vigour and determination, realizing the impending danger of a complete destruction of the planet.
- f. Such action might seem far fetched. Still, the Ecp project assumes that something on this scale is still feasible: realizing the danger may drag humanity out of its lethargy sooner than many people expect. Indeed, there are already many signs around (the "Bios Conference" is one of them) that something along these lines is already starting to appear, in many domains. All hope is not yet lost.
- g. We gave just two examples of the crisis we are in, and that is likely to continue for at least one generation: income disparities (with social unrest), and env'l deterioration. It is quite characteristic that many more phenomena contribute to this major crisis: there is no space to describe them here. Still, most of them are closely related to the frantic growth rates of everything today (and tomorrow, in the near future). With their inevitable slowing-down (which has already started: e.g. population growth rate for the whole world, after reaching a maximum of 2% yearly in 1960, has now subsided to under 1.7%), control is sure to become much easier, and much more efficient.
- h. If humanity, therefore, manages to cross the major hurdle, around, say the year 2020 or 2030, those humans (and animals and plants, etc.) surviving thereafter, are likely to have an easier time coping with their diminishing and more controllable problems.

5. The Further Way Towards Ecp

- a. Past this hurdle, the year 2020 or 2030, the most remote future will start looking more controllable. This will not be an abrupt improvement: a long period of very slow, gradual improvement is likely to follow, leading, 1 or 1 1/2 centuries later, to a proper Ecp.
- b. During this "slow regeneration era" things are likely to improve, slowly, but securely, and in a climate of increasing reassurance of avoidance of further major catastrophes.
- c. The actual course of events leading to Ecp is, naturally, more complicated than that. The COF project describes, in some way, how this is likely to develop. Suffice it to stress here, that once the "major hurdle" has been overcome, subsequent evolution towards Ecp will be smoother, and more positive.
- d. The "end result", Ecp and Eck, has been described in some more detail in section A and, mainly, C and D above, in a way that made it look "rather too rosy". The present section, E, explained why this picture is much less rosy than it seems, especially in view of the intervening major crisis we are still in. However, if humanity decides to engage in the all-out major effort just mentioned (E4e), it stands a reasonable chance of emerging from the "crisis" reasonably unharmed, to a degree that will allow it to regenerate and move constructively towards a truly positive "Ecumenopolis/Ecumenokepos era".

(F) ADVANCED ECUMENOPOLIS

1. The Ecp configuration, in a fairly clear and mature form, is expected to be reached somewhere towards the middle or the end of the 22nd century. Indeed, as already stressed, distinct signs leading to it have already appeared, one form being the spectacular growth of megalopolises and urbanized regions (see COF literature) in our time, as well as other regional transformations.
2. The Ecp configuration, once reached, is likely to last for a long time. C.A. Doxiadis claimed "at least two or three further centuries" for this state of affairs; such a prospect leads us to some five centuries from now, i.e. half the time horizon ("a millennium") proposed for this Conference. Indeed, no abrupt change is expected even after this new time horizon, so some form of an "Advanced Ecp" (figure 6) is likely to obtain still later, as we approach the "millennium" mark.
3. But Ecp, early or advanced, is unlikely to represent a "fully static" situation. Changes in it will continue, even if at a slow pace, involving some "residual" population, income, energy consumption, etc., growth, at a slow or very slow pace. Such growth could be controlled so as not to be detrimental, any more, to the Env saved; science, technology, information and organization are expected to be in a sufficiently advanced state to provide rational, relatively cheap and environmentally fully acceptable solutions to the completely novel problems of that remote future era.
4. By and large, therefore, the overall situation, both for humanity, and for the biosphere on this planet, can be assumed to continue "improving", at a slow pace, for the coming Ecp centuries, for quite some time. And this is visualized to happen keeping the Earth as "The Paradise of the Solar system" it has been for so long, without unnecessary recourse to fanciful extra-terrestrial "solutions", although space exploration, further and further out of this planet, is definitely expected to continue developing and increasing, making humanity increasingly aware of its tiny, but important, share in the wider Cosmos.

Abbreviations used:

- ACE: Athens Center of Ekistics
- CBD: Central Business District
- COF: City of the Future (research project)
- Ecp: Ecumenopolis
- Eck: Ecumenokepos
- Ek, ek: Ekistics, ekistic(al)
- ELS: Ekistic Logarithmic Scale
- Env, env'l: Environment, environmental
- GNP: Gross National Product
- HS: Human Settlement(s)
- OS: Open Space(s)

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