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Ecology and Ekistics

C. A. DOXIADIS

Edited by PROFESSOR GERALD DIX

Westview Press
Boulder, Colorado

Westview Environmental Studies: Volume 6

Published in 1977 in London, England
by Elek Books Ltd.

Published in 1977 in the United States of America by
Westview Press, Inc.
1898 Flatiron Court
Boulder, Colorado 80301
Frederick A. Praeger, Publisher and Editorial Director

Printed and bound in Great Britain

Library of Congress Cataloging in Publication Data

Doxiadis, Constantinos Apostolos, 1913–75
Ecology and Ekistics.

(Westview environmental studies; v. 6)
Includes index.
1. Human ecology. 2. Cities and towns. I. Title.
GF101.D68 301.31 76–20459
ISBN 0–89158–624–5

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Editor's Foreword

Dr Doxiadis completed the first draft manuscript of this book in the summer of 1975, shortly before his death. It was submitted to the publishers after he had died and I was subsequently asked if I would edit it and provide an introductory note about its author and its place in his thinking.

Constantinos Doxiadis was one of the foremost people of his time, eminent not only as an architect and planner, but also as a philosopher and teacher of young and old of many nations. He was born in Stenimachos of Eastern Romilia, the son of a Greek pediatrician who came to Greece as a refugee—a circumstance which he often maintained was helpful to him in appreciating the problems of the poor and oppressed. He was educated in Athens, where he qualified as an architect at the Technical University and at Charlottenburg where he obtained his doctorate. He became interested not only in town planning, but even more in Raumordnung and Landesplanung,[1] concepts which opened his mind to regional and national planing with their challenges of multi-disciplinary working on wide geographical and time scales.

On returning to Athens, Doxiadis was appointed Director of Town Planning Studies for Athens—he was then in his late twenties—and a little later was instrumental in getting established an 'Office for National, Regional and Town Planning Studies and Research'. Service in the resistance movement during the war was followed by a brilliantly successful period of service to his country in the co-ordination of reconstruction plans and programmes. This provided the apprenticeship for subsequent international activities. Starting with a contract in Iraq he developed a large practice operating in many countries in the general area of architecture, planning and development. He also acted for the United Nations on many occasions—and against it when he thought it too dilatory or unimaginative in its attitude towards the developing world.

It was to this challenge of urbanisation with all its problems and opportunities that Doxiadis addressed his imagination and his great gifts of illumination and persuasion and to which he devoted much of his time and resources. In the early 1960s on the United Nations Committee for Housing, Building and Planning, he called for the establishment of a special agency for human settlements, an agency

comparable to WHO or UNESCO, which would deal with problems as dynamic and incomprehensible as those of health or education. Ironically, the year after his death saw the UN holding the Habitat Conference at Vancouver, with 'human settlements'—in his terminology—as the subject matter. The knowledge that this conference was to be held spurred Doxiadis to drive himself even harder despite the ravages of increasingly restricting illness, to complete a number of books intended either to give background material for the conference[2] or, like this one, to start new trains of thought in others who might after his death further examine and develop some of the ideas that came pouring forth from a fertile mind and a gifted imagination.

Although Doxiadis had written about Ekistics during the war years and immediately afterwards[3] he was preoccupied with action rather than writing until the early 1960s. He passed those years in the role that he described as being that of the bricklayer and the pourer of concrete, learning from experience across the world. Then, deciding that though he had only made the first few steps towards the understanding of settlements,[4] the lessons he had learned might be of value to others, Doxiadis began to write about settlements, the management of the environment and the delicate balance between man and resources. In 1963 he organised the first Delos Symposion and over the next decade he invited to the annual Delos Symposia many of the greatest minds from many fields, in a three-fold attempt to draw attention to what he saw as an imminent urban crisis, to demonstrate the range of disciplines and professions involved and the part that each could usefully contribute to benefit settlements and to try to evolve approaches that might help in the solution of the world's problems. He was a born teacher; imaginative in expression, constructively critical, realistically utopian. He could summarise ideas in a few words or, more often, in a simple diagram. Because it was so obvious that he cared, he was able to bring together people of widely differing professions and experience, age and outlook who would otherwise never have met. He destroyed disciplinary divisions, replacing walls with windows, substituting links for barriers. To many he had a Geddesian ability to synthesise an argument and an impatience to move forward to the next step.

When, as he became incapacitated by illness, he lost the power of speech, he issued a statement that this would enable him to concentrate on his writing, in a new phase in his life. His output continued unabated, papers being read for him by colleagues and friends who reported back comment and criticism for the refinement of ideas. Although, like all great men, he had his critics, and there were those who envied his professional success, at the end there were few who could not admire his persistence and applaud his courage as he fought for what he believed in, and struggled to put forward ideas for public debate.

At an early stage Doxiadis advanced the thesis that there are five elements in human settlements and five forces, or groups of forces, acting on them. The elements that he identified were nature, the backcloth against which everything takes place; man, anthropos, the human individual; society, mankind as a group, sometimes organised but as often not; shells, the buildings and other structures in which we live, work and play; and finally but importantly, networks, the roads and railways, air and sea routes, cable lines and pipelines which enable us to communicate and carry goods. The five forces, or influencing factors, were economic, social, political, technical and cultural. The elements and forces together provide a good basis for the orderly examination of the influences on the structure of a town or region. In the ekistic logarithmic scale (see Glossary) which relates communities of all scales to population and area he produced a valuable tool for categorising settlements, referencing data and identifying problems. Just as the ekistic grid can be used for the summation of information, so also it can be used for identifying gaps in our knowledge. Diagrammatic summaries of these relationships became basic tools in the explanation of his thinking.

Perhaps because, from his vast experience in the development of human settlements, he had so many ideas about the causes of and cures for their ills and so little time and no personal opportunity latterly to explain them properly, many of his ideas and theories have been misunderstood or misinterpreted; condemned often through ignorance instead of being subjected to informed evaluation and criticism, which he always welcomed. His interest in ecumenopolis, the world city, is an example. Doxiadis did not particularly welcome ecumenopolis, nor yet the large areas of megalopolitan growth of America, Japan and elsewhere, but he regarded them as inevitable, and if they were inevitable it would be better to give them order and coherence, to ensure open space and light and air, to use our energies to care for the quality of life instead of wasting them fighting for the impossible. His conception of a major urban settlement was certainly not of some kind of limitless area of concrete and brick with roads and buildings stretching from horizon to horizon and beyond, but you would hardly know this from some of his critics.

Doxiadis was essentially concerned with practicalities and would surely have agreed with Sir Peter Medawar that 'good scientists', amongst whom he would have included good planners and good ekisticians, 'study the most important problems they think they can solve. It is, after all, their professional business to solve problems, not merely to grapple with them.'[5] His aim was always an attainable ideal.[6]

In his later years, Doxiadis became increasingly concerned with the need to achieve some sort of balance between mankind—anthropos, as

he came to call him—and his settlements on one hand, and the global environment on the other. 'With every year that passes', he wrote in 1974, 'I feel more and more the need for a great revolution.'[7] That need was especially related to conservation, 'the wise use of our natural environment . . . the prevention of waste and despoilment whilst preserving, improving and renewing the quality and usefulness of all our resources'[8] and with reconciling the aspirations of mankind with the limitations of a finite world. If we were to do more than grapple with the vast and seemingly intractable problems posed by the conflict between these forces, we would first need to define and categorise component parts in a clear and unmistakable way, so that all concerned knew precisely what was being considered at any time. Additionally, only by defining parts carefully would it be possible to concentrate action at a particular time on those aspects or areas most likely to yield results and least likely to involve the dissipation of effort, locally, nationally or internationally.

The draft for this book was a major attempt to describe the relationship between ecology, the science concerned with the relations between living organisms and with their surroundings, and ekistics, the science of human settlements. In the first part of the book Doxiadis reviews some of the major ecological problems of his time, emphasising that though our knowledge of them is limited we cannot await scientific discovery to complete the picture: we must act, he maintains, on the basis of the best information that is available at the present day, being prepared to modify our plans in the light of changed circumstances or of new knowledge. He defines what may at first sight seem to be a complicated set of zones in which he believed we might act so that we could perhaps give different priorities to different zones at different times or in different parts of the world—he was always anxious to stress that individual problems required individual solutions within an overall method or system. If we are to have any hope of achieving this we must also classify the kinds of settlements we are dealing with in significant categories by size, area, function and other characteristics, such as growth or decline. This brings Doxiadis to the anthropocosmos model and also to the use of what will to many people seem to be complex and idiosyncratic terminology. Some agreed terminology is essential if there is to be any progress from vague generalities to specific analysis or prognostications: Doxiadis supplies one, and almost all the 'new' terms are defined in the Glossary, with others that, whilst not new, are either uncommon or used in uncommon ways. He concludes that our only hope of achieving balance between ecology and ekistics is to define tasks very clearly and the various components and areas concerned, and relate them using the anthropocosmos model.

It was Doxiadis' hope that this book, relating an established

discipline with one only becoming established, emphasising the need for synthesis and for action, for a taxonomy of settlements and a classification of knowledge, might be a first attempt to move along a route towards a more comprehensive and comprehending environmental understanding and professionalism; a signpost that others might follow and later redefine.[9]

Doxiadis' major drafts were frequently submitted to colleagues and often to international groups for comment and discussion before he produced his final version for general publication. Parts of this book had been so discussed, but by death the author was denied the opportunity to prepare it for publication in his own inimitable, but clear English style. These tasks I have attempted, however inadequately, to perform, endeavouring not to change the emphasis of the script nor the character of the writing. Incidentally, in the process, I have developed an ever-increasing respect for Doxiadis' range of understanding. In introducing an earlier work,[10] Doxiadis wrote that 'it is not a textbook, but a statement of creed, not a collection of statistics, but one man's personal point of view. Any value it may have is simply this: that it is the product of years of travel, years of first hand observation, years of thinking and talking. As such it is written "out of my life", and as such it is dedicated to all those . . . who are today asking themselves difficult questions about their role and about their road into the future.' He might well have written in similar terms of *Ecology and Ekistics*. In this book he has moved beyond intuitive understanding founded on experience, to an intellectual understanding which may form the theoretical basis for future developments in the area where ecology and ekistics meet, for he believed 'our task is to define the system of life expressed by human settlements so clearly that it can contain every part, aspect, expression or opinion, known or unknown, foreseen or unforeseen. Once defined, our task is then to learn to control this system wisely for the sake of mankind.'[11]

Gerald Dix
Liverpool

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1 See John G. Papaioannou, 'C. A. Doxiadis' early career and the birth of ekistics', *Ekistics*, **41**, June 1976, pp. 313–19.
2 *Anthropopolis: City for Human Development*, Athens Publishing Center, 1974, and W. W. Norton, New York, 1975; (with J. G. Papaioannou), *Ecumenopolis: The Inevitable City of the Future*,

Athens Publishing Center, 1974, and W. W. Norton, New York, 1976; *Building Entopia*, Athens Publishing Center, 1975, and W. W. Norton, New York, 1976; *Action for Human Settlements*, Athens Publishing Center, 1976, and W. W. Norton, New York, 1976.

3 For example, *Ekistic Analysis* (in Greek), Ministry of Reconstruction, Athens, 1946; *Ekistic Policies for the Reconstruction of the Country, with a 20 Year Programme* (in Greek), Ministry of Reconstruction, Athens, 1947.

4 C. A. Doxiadis, *Ekistics: An Introduction to the Science of Human Settlements*, Hutchinson, London, and Oxford University Press, New York, 1968, p. 2.

5 P. B. Medawar, *The Art of the Soluble*, Pelican Books, London, 1969, p. 11.

6 See *Ekistics*, **41**, June 1976; a special issue designed as a tribute to C. A. Doxiadis, one year after his death.

7 C. A. Doxiadis, 'We need a great revolution', *Ekistics*, **37**, January 1974, p. 1.

8 President John F. Kennedy, Message to Congress, 1962, quoted in Robert Arvill, *Man and Environment*, Pelican Books, Harmondsworth, 1976, p. 249.

9 In this connection refer to Resolution (76) 17, *On the European Network of Biogenetic Reserves*, adopted by the Committee of Ministers of the Council of Europe on 15 March 1976, at the 225th meeting of the Ministers' Deputies. The resolution recommended the creation of a network of biogenetic reserves in Europe, in order to guarantee the biological balance of the various types of habitat, biocenosi and ecosystem. The European system should contribute to a worldwide network of reserves.

10 C. A. Doxiadis, *Architecture in Transition*, Hutchinson, London, 1963.

11 C. A. Doxiadis, 'Order in our thinking: the need for a total approach to the anthropocosmos', *Ekistics*, **36**, July 1972, p. 44.

Editor's Acknowledgements

I have been greatly helped in the editing of Constantinos Doxiadis' draft text by assistance received from a number of people.

Professor Jaqueline Tyrwhitt read a substantial part of the text and suggested many improvements based on her long association with the author, notably as editor of the journal *Ekistics*. Professor Peter Nash of the University of Waterloo, Ontario, and Special Professor R. E. M. McCaughan of Nottingham University, helped by providing background material for some of the definitions included in the glossary, as did Mr Panayis Psomopoulos of the Athens Center of Ekistics: I am grateful to them for helping to remove areas of ignorance on my part.

I am indebted to Mr John Harvey of the Department of Civic Design at Liverpool University for help with Figures 1.2 and 2.4. I owe a very great debt to my omnicompetent associate and secretary, Miss Susan Dilley of Nottingham, who was as adept as ever in translating my manuscript into a presentable text and who made innumerable and without exception, helpful comments at various stages along the way. Finally, my wife Lois not only tolerated my working on the book when I ought to have been dealing with the aftermath of removal, but helped by reading the text and commenting on my interpretation of Dinos Doxiadis' ideas.

All these people, and many others in a less direct way, have helped to improve the book and its presentation of the relationship between Ecology and Ekistics, but I take full responsibility for errors of judgement in setting forth the hopes, belief, aspirations and fears of the substantive author, who provided the impetus and the inspiration.

Gerald Dix

Preface

Ecology is the science which deals with the relationships between all living organisms and their total environment. Ekistics is the science of human settlements which are the territorial arrangements made by anthropos (man) for his own sake. Human settlements result from human action and their goal is human survival. I have formulated the science of ekistics over the last 35 years.

Mankind began interfering with nature immediately after his evolution some millions of years ago, but this interference was never significant because it was similar to that of many other animals. Although some small human settlements were built in late Palaeolithic times, the natural environment and the ecological balances were not greatly disturbed by humans until they started cultivating and creating villages about ten thousand years ago. There was then a basic change in the human way of life from hunting and the gathering of crops to a different use of some parts of the global surface. At that time, there began that human conflict with (or aggression against) the environment, which culminated in the establishment of a system of human settlements without which mankind could not survive.

Subsequently, many cultures and civilisations evolved, some interdependent and some independent, and they all developed their own human settlements in various ways. Some of the settlements, both large and small, were very successful, not simply in terms of efficiency, but also in terms of quality: they were copied by later generations and are admired today. In this process we have evidence of an empirical approach to the development of settlements, with many lessons learned from experience. There is, however, no scientific documentation with the exception of Vitruvius' *De Architectura*, and that is more technology than science. The gradual development of a rational and scientific approach to the planning of human settlements continued to the time of the Industrial Revolution in England. With the advent of the steam-driven passenger and goods train in 1825 the situation changed suddenly, with the result that all subsequent settlements have been very different from earlier ones, some changes being for the better and others not.

Today we live in era of explosions—of population, energy, the economy, mobility, etc.—in which there have been apparently

uncontrollable changes. Natural balances have been upset and human settlements are suffering from our lack of understanding of these extremely complex explosions. It is time to try to formulate a system of knowledge similar to that existing before the 1825 communications explosion and to adjust it to suit modern circumstances. This is why I have tried to develop ekistics as a science and to base it on our knowledge from the past and of the present. This is only the beginning of the long process necessary fully to develop a science of human settlements, but we must start using it in order to advance from the present rather rudimentary state to the level of refinement that circumstances indicate is necessary and practicable.

As the balances necessary to maintain a satisfactory environment have now been lost because of new types of assault on our surroundings we have a major obligation to co-ordinate the ecological and ekistic points of view, adapting human settlements to mitigate any ecological problems they may create. We must meet and endeavour to overcome any conflict by a systematic and balanced approach. This book was written to describe how we can look at ecology and ekistics in a co-ordinated way, working towards common decisions in all situations. The book does not pretend finally to solve the problem of ecological and ekistic conflict, but rather to start the process in a logical and scientific way. To do this I will discuss two subjects: the global ecological balance (GEB) that we need and a method of studying ekistics, as a science, co-ordinated with ecology where the need arises.

The global ecological balance is dealt with in a simple and practical way in the first part of the book. Neither ecology, nor ekistics indicate any formulae by which we may calculate how to achieve the necessary balance and this may lead some scientists to state that we should not try to achieve a balance until we have more precise knowledge, and can make a more accurate analysis. The answer to this view is that none of the ecological balances achieved by humans throughout their history have been based on a truly scientific analysis, but have been achieved through trial and error by hunters and cultivators and, later, by urban dwellers. If we lack proper scientific knowledge it will not do to say, 'Wait till we learn', instead we must have the courage to adopt what seems to be the best approach on the basis of what we do know from science and history. We will learn from our experience and can ameliorate the processes for achieving a global ecological balance in the light of that experience.

In the second part of the book the relationship between ekistics and ecology is discussed. The science of ecology has been developed for more than 100 years and we are now paying great attention to it in many ways in many parts of the world. Ekistics, on the other hand, is still at the beginning of its development and although many important

persons have worked for it[1] and books have been written explaining it[2] and about it[3] and though some people are teaching it, it is still a young and immature science. For this reason, all the possible connections between ekistics and other sciences have yet to be examined, though the process has begun. As there are no doubt many links between ekistics and ecology that we do not yet know, I have attempted here to present the whole range of the subject of ekistics in a way that will be readily understandable to ecologists. I have tried systematically to present anthropocosmos, the world of humans which forms the background or setting to ecology and ekistics and to explain the differences between human settlements that help to achieve a global ecological balance and those which as a result of human aggression against the environment result in imbalance.

Thus the present study does not provide a definitive answer to any question. It simply starts the process in two directions in order to help the sciences of ecology and ekistics come close enough together to make the necessary connections to enable us some day to reach the ultimate goal of global ecological balance, as well as other necessary balances, in the best and most scientific way.

Glossary

Our inability to resolve problems of human settlements can be attributed in large part to a continuing failure to define the subject of our study or the terms used to describe parts of our field of interest. To achieve greater precision old terminology must be more precisely described and new terms incorporated to embrace developing concepts. This glossary represents an attempt to define some of the new terms and the use of older words in this book.

AESTHETIC MORPHOGENESIS Aesthetic: of or pertaining to the appreciation or criticism of the beautiful, received by senses. Morphogenesis: origination of morphological characters, of or pertaining to the history of form, *thus* in the present context the origination of the visual form (of towns).

AGGRESSION The dictionary definition is 'an unprovoked attack, the practice of making such attacks'. In this work the term is used with reference to attacks or assaults in the natural environment, upon natural resources or the natural ecological balance.

ANTHROPAREA Word coined by C. A. Doxiadis from the words *anthropos* (human being) and *area*, meaning the built-up area, in the broadest sense, mostly used by anthropos in his daily life: second type of area in a global spatial hierarchy.

ANTHROPOCOSMOS The world of anthropos as distinguished from the great world or cosmos beyond his reach, and including concepts of area, dynamics and functions. Term coined by C. A. Doxiadis, from the Greek words *anthropos* and *cosmos*, 'man(kind)' and 'world', first used in his lecture entitled 'The Human Crust of the Earth' at the Swarthmore College Centennial Year Celebrations, 1964.

ANTHROPOCOSMOS MODEL Model relating the principal characteristics of settlements and regions, people and activities within the anthropocosmos, with particular reference to numbers and spatial distribution. The model is designed for practical application in the analysis of existing situations, identification of relationships and formulation of policies for future development. Figure 1.1 illustrates the model in its latest form.

ANTHROPOS (*Man* in earlier writings) The Greek word for human being (man), used to indicate the individual with his own

characteristics and problems as distinct from society: one of the five ekistic elements. Note 10 (see Notes and References) includes an explanation of the use of the term.

ANTHROPOSPHERE The world of anthropos, part of the biosphere. Unlike the concept of anthropocosmos, anthroposphere relates only to space and excludes consideration of functions, dynamics and change.

BILLION One thousand million, as used in USA.

BIOGENESIS The theory that living matter always arises by the agency of pre-existing living matter.

BIOSPHERE Region of earth's crust and atmosphere occupied by living matter. A. J. Toynbee, in *Mankind and Mother Earth*, Oxford University Press, London, 1976, says that:

> 'the word "biosphere" was coined by Teilhard de Chardin. It is a new word required by our arrival at a new stage in the progress of our scientific knowledge and our material power. The biosphere is a film of dry land, water and air enveloping the globe (or virtual globe) of our planet earth. It is the sole present habitat—and, as far as we can foresee today, also the sole habitat that will ever be accessible—for all the species of living beings, including mankind, that are known to us. The biosphere is rigidly limited in its volume and therefore contains only a limited stock of those resources on which the various species of living beings have to draw in order to maintain themselves. Some of these resources are renewable; others are irreplaceable. Any species that overdraws on its renewable resources or exhausts its irreplaceable resources condemns itself to extinction.... The most significant characteristic of the biosphere is the relative smallness of its size and the exiguousness of the resources that it offers.'

COMMUNITY CLASS Based on a systematic classification of human communities expressed in the ekistic logarithmic scale (ELS) starting from Class 1, which corresponds to housegroup, ekistic Unit 4, population 35, to Class 12, ecumenopolis, the universal city.

COSMOLOGY Study, philosophy of the universe as an ordered whole, and of the general laws governing it: the part of metaphysics dealing with the idea of the world as a totality of all phenomena in space and time.

CULTIVAREAS Term coined by C. A. Doxiadis, meaning the cultivated areas where the main objective is cultivation of plants or animals; the third type of area in a global spatial hierarchy.

DAILY URBAN SYSTEM Daily urban systems correspond to major urban clusters, such as UDA, within which people will be able to commute daily in the future with new and faster transportation systems as they do at present in well organised metropolitan areas.

DEEPWAYS The whole system of underground lines of transportation for private or mass transportation vehicles, which is indispensable for the solution of our urban problems. Term coined by C. A. Doxiadis, first used in his studies of 1965 and 1966, and in his book *Between Dystopia and Utopia*, 1966.

DYNAPOLIS Dynamic 'polis' or dynamic city, in contrast to the traditional static or very slowly growing city; completely unknown before the eighteenth century. The ideal Dynapolis depends on the type of city under consideration. Term coined by C. A. Doxiadis and used since the early fifties in teaching and writing; used in his book *Architecture in Transition*, 1963.

DYSTOPIA From the Greeks words *dys* and *topos*. *Dys* signifies difficulty or evil and is the opposite of *eu*, good. *Topos* means 'place'. In this combination and context, dystopia is another and more precise word for what anti-utopia was supposed to mean. V. L. Parrington (1947) uses it instead of anti-utopia, as does C. A. Doxiadis in *Between Dystopia and Utopia*.

ECOLOGY Branch of biology dealing with the mutual relations of living organisms and their surroundings; their habits, modes of life, populations, etc.: human ecology, study of interaction of persons with their environment, their spatial distribution in relation to material and social causes and effects.

ECUMENOHYDOR An (ideal) global water supply system; the water supply counterpart of ecumenopolis and ecumenokepos.

ECUMENOKEPOS The global garden, the cultivated food producing counterpart of ecumenopolis, the world or global settlement system.

ECUMENOPOLIS The coming city that will, together with the corresponding open land which is indispensable for anthropos, cover the entire earth as a continuous *system* forming a universal settlement. Term coined by C. A. Doxiadis and first used in the October, 1961 issue of *Ekistics*, from the Greek words *ecumene*, the total inhabited area of the world, and *polis*, or city, in the broadest sense of the word.

EKISTIC ELEMENTS The five elements which compose human settlements: nature, anthropos, society, shells and networks.

EKISTIC LOGARITHMIC SCALE (ELS) Classification of settlements according to their size presented on the basis of a logarithmic scale, running from anthropos (Unit 1) as the smallest measurement to the whole earth (Unit 15). The ekistic logarithmic scale can be presented geographically, showing area or number of people corresponding to each unit, etc., so that it can be used as a basis for the measurement and classification of many dimensions in human settlements. Scale developed by C. A. Doxiadis, first presented in 1961, published in *Architecture in Transition*, 1963, and elaborated by the Athens

Center of Ekistics. Subsequent developments led to the ekistic population scale (EPS) and the ekistic territorial scale (ETS), based on the same arithmetical bases.

EKISTIC POPULATION SCALE (EPS) A classification scale for human settlements on the basis of population. The scale starts with Unit 1, anthropos, the individual person. The next unit is two individuals (from early needs for contact and dependence on another person for sexual relations, marriage, etc.). The third unit is the nuclear family (estimated at 5 members). After the family the scale proceeds with each unit seven times larger than that unit preceding it.

EKISTIC POPULATION UNITS (EPU) Units on the ekistic population scale (EPS) starting with Unit 1, the single individual, then Unit 2, two individuals, Unit 3, the family (estimated at 5 members) thereafter logarithmically, each successive unit being 7 times larger than the next smaller one.

EKISTICS The science of human settlements. Term was coined by C. A. Doxiadis from the Greek words oikos, 'home', and oikō, 'settling down'; first used in his lectures of 1942 at the Athens Technical University. It concerns the human settlement as a living organism having its own laws and, through the study of the evolution of human settlements from their most primitive phase to megalopolis and ecumenopolis, develops the inter-disciplinary approach necessary to resolve its problems.

EKISTIC TERRITORIAL SCALE (ETS) Scale of classification on the basis of area of territory. The scale starts from the total habitable land area of the globe (assumed to be 135 750 000 km^2, excluding Antarctica) and proceeds on the basis of Christaller's spatial organisation by hexagons. The ekistic territorial scale moves from total habitable land (Unit 17) to Unit 1 corresponding to the requirement for the human of 4 m^2. Unit -1 represents standing persons and Unit -2, persons squeezed together to the maximum possible degree.

EKISTIC TERRITORIAL UNIT (ETU) Part or whole of a human settlement in the classificatory ekistic territorial scale, starting from Unit 1, corresponding to anthropos, and ending with Unit 15, corresponding to ecumenopolis. From Unit 4, which corresponds to community Class 1 to Unit 15, which corresponds to community Class 12, the ekistic units coincide with the classification of human communities expressed in the ekistic logarithmic scale (ELS).

ENTOPIA Term coined by C. A. Doxiadis, from the Greek words 'en' meaning 'in' and 'topos', meaning 'place', hence 'in place', or place that is practicable. First used in the Trinity College lectures, Hartford, Connecticut, 1966 and published in *Between Dystopia and Utopia*, 1966.

EPEROPOLIS Derived from the Greek words *eperos*, continent, and

polis, city, it replaces the former term 'urbanised continent' which corresponded to ekistic Unit 14 and community Class 11, with a population of 5000 million.

EPS Ekistic population scale.

ETHOLOGY Science of character formation; science of ethics or of character.

ETS Ekistic territorial scale.

GEB Global ecological balance.

GEOPOLITIK Politics of a country as determined by its geographical features.

GLOBAL ECOLOGICAL BALANCE Balance of the global ecosystem on one hand and human settlements and other interventions by mankind on the other hand, resulting in a situation suitable for the continuation of human life and of nature.

GOAL (of ekistics) The goal of ekistics is to develop a system and a methodology:

(a) to study all kinds of settlements, irrespective of size, location, etc., in order to draw general conclusions about them;

(b) to study each as a whole, without excluding any of its elements in order to illuminate the knowledge of the field and to solve the specific problems of the settlement being studied.

GOALS (of human settlements) The ultimate goal of a human settlement is to satisfy the needs of its inhabitants and of others it serves—particularly those needs leading to happiness and safety. The satisfaction of the inhabitants cannot be ensured unless all needs—economic, social, political, technological and cultural—are substantially satisfied in a balanced way.

HEIMATKUNDE The geography of one's native country, understanding of one's immediate environment, a concept developed in the later part of the eighteenth century. Heimatkunde gives the foundations for areal investigations and regional planning: it is used as a conceptual framework to explain and relate phenomena of the immediate vicinity and adjoining regions. The study of Heimatkunde gives the student a systematic framework for relating himself to his environment.

HOUSE, HOUSEGROUP These terms, replacing the terms 'dwelling', and 'dwelling group' formerly used, correspond to ekistic Units 3 and 4, with a population of 5 and 35 people respectively. Housegroup corresponds to community Class 1.

HUMAN SETTLEMENTS Human settlements are settlements inhabited by anthropos and consist of man (anthropos) alone and in societies and the container, or physical settlement, which consists of both natural and man-made or artificial elements. Doxiadis was careful to distinguish two categories of elements in settlements, associated in Greek with 'polis' on one hand, and 'demos' on the other. In Latin the

differentiation would be between 'urbs' and 'civitas': in English, the differentiation is terminologically less distinct.

HUSTREETS/HUROADS/HU-SQUARE, etc. Terms coined by C. A. Doxiadis to signify the division of the human from the mechanical. A hustreet is a street reserved for human beings only and prohibited to machines.

HYDROSPHERE The portion of the earth's crust covered by water, including lakes. When the complete crust is meant it may be referred to as the hydro-lithosphere.

IFIAS International Federation of Institutes for Advanced Study, The Nobel House, Sturegatan 14, Stockholm, Sweden.

INDUSTRAREA Term used by C. A. Doxiadis, and meaning industrial area, used for industrial and in some cases for recycling or waste disposal purposes: fourth and by area the smallest type of area in a global spatial hierarchy.

KINETIC FIELD The distance anthropos can move within a certain period by walking, by using animals or by using vehicles.

KOMAI Politically subordinate village or quarter of a city, the lowest administrative unit of a city-state; a village, especially unwalled, as opposed to a fortified city. It is said to be the Doric equivalent of the Attic word 'demos'.

LANWAIR Land, water, air. Term coined by C. A. Doxiadis to mean the transportation network conceived as a unified system, in which land, water and air transport systems are brought together as lanwair knots, enabling people and goods to move from aircraft to boats, cars and trains without any extra formalities or difficulties.

LITHOSPHERE The solid crust which envelops the dense high temperature barysphere, or core of the earth. The lithosphere consists of a mass of hard rock, several miles thick, on which the soil lies in loose layers.

MARICULTURE Scientifically organised use of the sea for the production of food and other crops; includes fish farming on an industrialised basis.

MECSTREETS/MECROADS, etc. Term coined by C. A. Doxiadis to distinguish the mechanical from the human. The mecstreet is a street reserved for machines only, from which pedestrian traffic is banned.

MEGALOPOLIS Used since ancient Greece when the city called megalopolis was created in Arcadia. Greater urbanised area developed by the gradual merging of many metropolises and cities into one urban system. Its population is calculated in tens of millions. It is distinct from the metropolis, either because it has incorporated more than one metropolis or because its population is greater. Jean Gottmann gave a special meaning to this ancient term in 1961 in his book, *Megalopolis, the Urbanised Northeastern Seaboard of the United States*. There have since been other megalopolitan studies,

notably those covering the Detroit and Great Lakes areas in USA and Canada (C. A. Doxiadis, *Emergence and Growth of an Urban Region: the developing urban Detroit area*, Detroit Edison, Detroit, Volume 1, 1966; Volume 2, 1967; Volume 3, 1970.

METROPOLIS A major multi-centre urban area with more than 50 000 people, incorporating other small settlements, both urban and rural, growing dynamically to sizes as high as 10 million people. A typical population for such settlements is of the order of 2·0 million, and about half of them have a population of 50 000–100 000. A metropolis is ekistic Unit 10, community Class 7, and a small metropolis corresponds to ekistic Unit 8, community Class 6 on the ekistic scale.

MORPHE Form, shape; shapeliness; especially with reference to beauty of form. Generally form, fashion, appearance, outward form.

MORPHOGENESIS The derivation of morphological characters; the development of form in organisms.

NATIONAL ECOLOGICAL BALANCE Balance between the ecosystem and human settlements and other interventions considered on a national basis.

NATURAREAS The areas of nature where the main objective is to preserve as much as possible of natural values: first and largest type of area in a global spatial hierarchy.

NATURE In ekistics the term is used to indicate the natural environment of man, anthropos, before he starts to remodel it by cultivation or construction. Nature provides the foundation upon which human settlements are created and the frame within which they function: one of the five ekistic elements.

NEB National ecological balance.

NEIGHBOURHOOD A community, often considered in relation to its character and cohesiveness. In ekistics, a small neighbourhood (population 245) is a community of Unit 5; a neighbourhood (population 1715) constitutes Unit 6 on the ekistic population scale. These units correspond to the small village and the village in rural developments.

NEOLITHIC (period) Later Stone Age, characterised by the use of ground or polished stone implements, as distinct from the chipped instruments of the palaeolithic period and by great advances in food production and simple skills. Neolithic refers to that period when man was producing his own food by cultivation of crops and domestication of animals, but was still relying solely on stone as the material for his tools and weapons. The period is hard to define because both agriculture and metal working for tools developed slowly over a considerable length of time. Use of the term Neolithic should be based on the appearance of food production, sometimes

called the Neolithic revolution, commencing in south-west Asia 9000–6000 B.C. This was one of the most important single advances ever made by man, because it allowed him to live and farm permanently at the same location where he could accumulate material possessions. These were prerequisites to the establishment of permanent human settlements.

NETWORKS Term used in ekistics to indicate anthropos-made systems which facilitate the functioning of settlements, such as roads, water supply and other pipelines, electricity, telecommunications, etc.; one of the five ekistic elements.

PALAEOLITHIC PERIOD Period characterised by the use of primitive stone implements, applied to the earlier part of the pre-historic Stone Age. Beginning with the emergence of man and the manufacture of the most ancient tools some 2·5–3 million years ago, the Palaeolithic period lasted through most of the Pleistocene Ice Age until the final retreat of the ice in about 8300 B.C. It may be sub-divided into: Lower Palaeolithic, with the earliest forms of man; Middle Palaeolithic, the era of Neanderthal Man over much of Eurasia; Upper Palaeolithic, starting perhaps by 3800 B.C., with Homo Sapiens, and the cave art of W. Europe.

PHYTOCOSMOS The plant and vegetation system of ideas, or world. A term derived from '*phyte*', a plant, that which has grown, and 'cosmos', the world or universe as an ordered system.

POLIS Greek word 'polis' or city, corresponding to ekistic Unit 8 and Community Class 5, it replaces the term 'city' in the ekistic logarithmic scale. The ekistic population scale indicates a population of 84 035 as typical for a 'polis'; it was formerly shown in earlier studies as having a population of 50 000.

PROTISTA A third kingdom of organised beings, not definitely distinguished as either animals or plants, thus comprising the Protozoa and Protophyta, with those forms indeterminately assigned to either group.

ROOM Ekistic Unit 2, with a population of 2.

SHELLS All types of structures used by anthropos for living in or for the accommodation of animals, machinery, produce, manufacturing, etc.; the structures within which and by which mankind lives and carries out his different functions; the structures that cover ekistic functions: one of the five ekistic elements.

SOCIETY Used in ekistics to indicate human society with all its characteristics, needs and problems; individuals are examined only as parts of it: one of the five ekistic elements.

SUBSYSTEM Parts of the whole which display a unity or strength of association one with another distinguishing them from the system as a whole but of which they nevertheless form a part.

SYMPOSION Philosophical or other friendly discussion; set of contributions on one subject from various authors and points of view at a meeting: a convivial meeting for drinking, conversation and intellectual entertainment. Used in ekistics with particular reference to the Delos Symposia, see Note 1 in Notes and References.

SYSTEM System is variously defined in relation to various subjects, e.g. biology, physics, music. Characteristically, a system is a set of objects together with relationships between the objects and between their attributes. Relationships are important, rather than the size of the objects and the place of the parts in relation to each other may be said to give a system its character and to differentiate it from other systems: thus a system is a distribution of members in a dimensional domain. The members may constitute sub-systems.

SYSTEMATICS The subject or study of systems, especially in relation to classification.

TAXON Taxonomic group, especially genus or smaller group.

TAXONOMY Classification, especially in relation to its general laws or principles; that department of science, or of a particular science or subject related to classification.

UTOPIA An imaginary and indefinitely remote place, a place or state of ideal perfection, especially in laws, government and social conditions. First used by Sir Thomas More for an imaginary and ideal country in his book *Utopia*, 1516, it is a Greek word, a combination of *ou*, 'not', and *topos*, 'place', meaning nowhere or no-place.

WILDLIFE ZONES Of the twelve land zones, the first five have a wildlife element, decreasing in importance within the zones from Zone 1, real wildlife, where there is virtually no human activity; to Zone 5, wildlife conquered, where humans are in complete control. There are corresponding ocean and coastal wildlife zones.

ZOOCOSMOS Animal system of ideas, or world (*cosmos*).

When first mentioned in the text, the above terms are set in bold.

Part One
Global Ecological Balance: The Common Goal of Ecology and Ekistics

1

From Crisis to Setting of Goals

1.1 Introduction

We are in the middle of a major ecological crisis on a global scale. We have no practical experience that will help us to meet it, as it is the first crisis of such seriousness and magnitude in historical times. However, in the past century, the science of **ecology** has been started on the basis of studies of natural history which go back to Aristotle's time. Now there are many studies, some of which are of very high quality, and we are beginning to understand what really happens and what has to be done.

To learn more about ecology and to determine and implement the right policies against all ecological dangers will take many generations. In the meantime, even when we open our eyes to all partial problems and their causes we will continue to make many mistakes. This is because we cannot and should not stop development until we have carried out more research. There are so many very poor countries which badly need development, involving major works, a lot of industry and many ecological changes. To stop or greatly delay change is neither realistic nor feasible. What we have to do is guide the changes.

We know a great deal about many aspects of the ecological system we influence by our action, but there is much that we do not know and that we must, therefore, learn. This requires time. To guide the changes, we need the knowledge and the courage to take some basic decisions. Experience shows that the societies which managed to survive for a long time in the same location were those which retained the same ecological balance by creating several types of zones, such as built-up areas, cultivation areas, forests, etc., keeping them in the same places. This is also what we need now, only this time we need many more types of zones because we are dealing on a much larger scale with more complicated phenomena (see Chapter 2).

Only to consider the types of solutions that we need is not enough; we must at all times consider the ways and means by which they may be implemented, for otherwise they may turn out to be **utopian** and of no practical value. We must, therefore, conceive an implementation programme and plan. Our whole effort may not lead anywhere, at least for quite some time, if we do not enter the implementation phase as soon

as possible. That is why I present a plan for immediate action that can start at once.

1.2 Setting of Goals

1.2.1 The Past

We know little about the ecological balances that existed at the time of the beginning of life on our planet, but we do have more knowledge about the general situation in the **Palaeolithic** period, starting perhaps two or more million years ago and particularly since the **Neolithic** period beginning ten thousand years ago. That humankind passed successfully through these ages with their many changes, and survived, indicates that there was always a balance between natural resources and human intervention in using them.

It is quite probable that humans always assaulted nature in order to use its resources to fulfil the needs of mankind. Although these attacks on **nature** were often, and especially at first, so isolated within the global environment that they did not cause any significant change, they nevertheless mark the beginning of man's **aggression** against the ecological system. When the impact of mankind was greater and changed the ecological balance, two roads lay ahead. The first led towards a new balance serving nature and human needs. The second road, continuing aggression against nature, led towards such over-consumption of natural resources that the system was completely upset, and there was no balance. This meant disaster for humans as well as for many other components of the ecological system.

Hunters, fishermen and farmers had to discover how much of each resource they could use each year in order to be sure that they could draw on the same source of supply over the years to come. This was quite a natural solution and involved interfering only to such an extent with the existing system that its operation could continue in a balanced way. This form of 'limited attack' or naturally controlled aggression, leading to a settlement between all elements of the ecological system, was not a human invention: we know from animal experts that this is the way of the world with those animals which manage to survive. The formation of territories within which each animal group lives is one example of a means whereby the over-exploitation of natural resources is avoided and the necessary balance achieved.

When comparing animal with human ecological balances we find that since the first crop cultivation and domestication of animals in farming and breeding areas in Neolithic times human balances have changed more quickly. At first ecological balances were achieved within the territories of individual communities. Later when civilisation and the

earliest urbanisation began, change was accelerated and consideration of balances for broader territorial units became valid. This wider spatial factor is important in relation to urban communities where changes were more rapid and potentially more dangerous. Over the centuries the scale has changed, but the result is a large-scale system, which is balanced overall and has an urban centre that might be regarded as out of balance by those not used to the notion of urbanisation, with its advantages and disadvantages.

We do not know how many times the system has failed in smaller scales; but we know that, at least since historical times, changes due to over-aggressive and too speedy development have led to great disasters. As C. H. Waddington tells us: 'The great ecological catastrophes of early civilisation—and there were several—did not occur in Christian lands. The first civilisation of Mesopotamia ruined its environment and destroyed itself by pushing its agricultural productivity beyond what the circumstances would bear, leading to erosion of the fertile soil into the rivers, and silting up the harbours. The ecology of most of the eastern Mediterranean, particularly the nothern shores of Africa, was also ruined by unduly exploitative agriculture, under civilisations dominated by Greek, Roman and Islamic religions. In contrast it was mediaeval Christianity which turned the somewhat inhospitable, swampy, tangled woodlands of northern Europe into agriculturally rich country.'[4]

The same situation prevailed in other areas at other times. Even today we can see evidence of ecological catastrophes by looking at the mountains of the Lebanon, famous at the time of the Phoenician civilisation for their magnificent forests, and finding they are now almost barren. The rate of change and the degree of aggression against nature increased even more with the onset of industrialisation, leading to the expansion of towns and the setting up of those industrial plants, atomic power stations and distilleries which result in a form of ecological change so great that it may be regarded as industrial rape. Where ecological balance is completely upset the danger for life is great.

Humans have survived from the earliest civilisations to the present day because they have been able to reconcile aggression with the conservation of resources, and to develop settlements in harmony with nature.

1.2.2 The Present Crisis

The origins of our present ecological situation date back two centuries to the time when humanity entered the era of applied science and industry. Clearly the problem is not one of political doctrine, of capitalism or communism, but rather of industrialisation. In Russia, for example, the problems of pollution are very great, sometimes

dangerously so, reaching extremes not common in other industrialised areas.[5] When, for example, we know that 'sixty-five per cent of all the factories in the largest Soviet republic, the Russian Soviet Federated Socialist Republic (RSFSR), discharge their waste without bothering to clean it up',[6] we become aware that the real cause of dangerous pollution lies in the great need for industrial production. Only now that we have opened our eyes and seen the problem, do we realise its seriousness and begin to react properly to it. Once we feel the pain we proceed to diagnosis and therapy but, since our reaction to our ecological disease does not happen overnight nor everywhere at the same time and since there are so many forces that make therapy difficult, we think that it will take humanity two more centuries to overcome all the symptoms and restore the balance.[7]

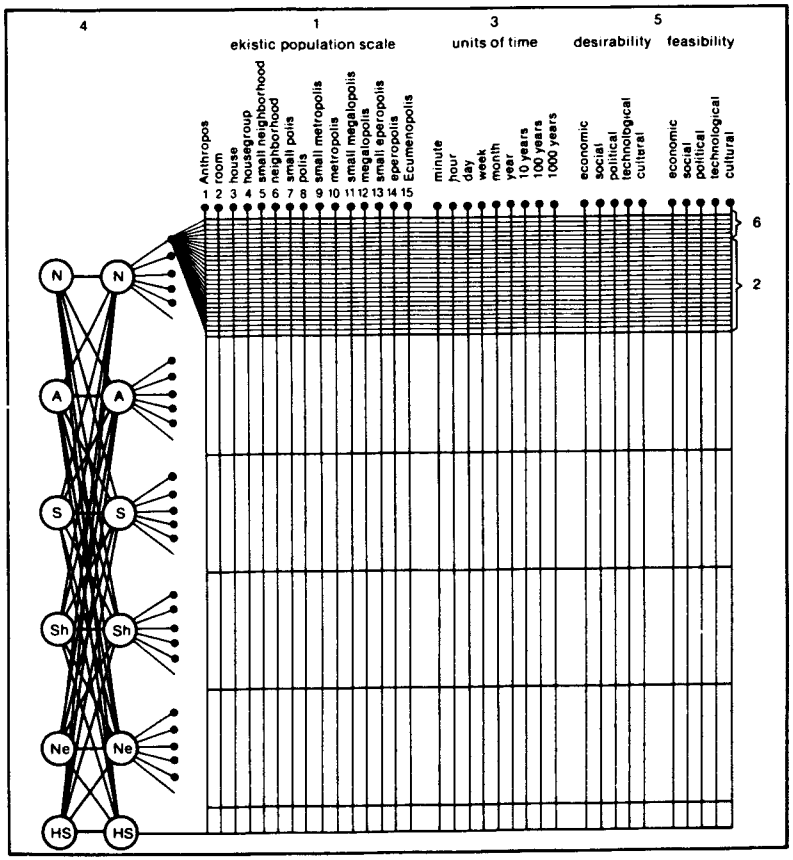
Not since the last radical changes of climate has there been such a crisis on such a scale as that we now face. The many serious crises that have been experienced in recent decades have been of local and in some cases regional significance: none has reached the global scale of that resulting from man's present ecological aggression. The symptoms of the present crisis are numerous and many experts are studying them. Lately, several efforts have been made to present all the symptoms in a systematic way and Konrad Lorenz has tried this in an even broader way by a system referred to as the eight deadly sins.[8] Any systematic presentation would be extremely complex if it were to include all the very many symptoms and phenomena of the suffering global ecological system, including the over-exploitation of natural resources and the decline in the nutritional quality of food,[9] amongst many others. It would have to include particular reference to the time factor, for the rate of change is of prime importance; a major change at a very low speed may pose fewer problems than the sudden disturbances created by a small change taking place more rapidly.

As the presentation of the whole phenomenon of the present crisis is beyond the scope of this study, I will give a short, general picture to show the complexity of the phenomenon and the need to face it systematically.

The total ecological system consists of many parts and there are many interactions between the parts. In a simplified way we can speak of its five **ekistic elements**—nature as a system; humans as individuals (which we had better call **anthropos**[10] rather than man to avoid using only one sex to represent all humans); **society** as a system; **shells**, that is all types of buildings; and **networks** of all sorts. Through such a classification we can distinguish between the natural ecological system without the intervention of humans (nature); the human system in two parts, the single individual (anthropos), which we often tend to overlook and humans as social systems (society); and the anthropos-made

environment as expressed by shells and networks. Such a system is shown in Figure 1.1, where in the left hand column of the **anthropocosmos** model we see the five elements and their basic subdivisions, their interaction and their influence on the whole system, which we take as the study unit of anthropocosmos, that is, the world of anthropos, or humankind.

With a comprehensive approach such as this, we can see, for example, how a climatic change is related to parts of nature, which may



1. ekistic population scale
2. ekistic territorial scale
3. ekistic time scale
4. ekistic elements
5. aspects
6. principles

FIGURE 1.1 The anthropocosmos model

perish through drought; how it affects anthropos, the individual human who may be ill and unable to work through starvation and how it affects society with changing, probably deteriorating, social relationships. We see that shells, or buildings, may not be affected, but the networks will be affected if changes in water supply systems or road transport are involved. In extreme cases the **human settlement** might be abandoned. In other cases, in due course a tolerable balance might be restored, depending largely on the time factor and the rate of change. Systematic study is clearly essential and, as clearly, complex.

1.3 The Greatest Dangers

We have seen that the most difficult aspect in dealing with global ecology is the great number and complexity of its problems. As we cannot deal with them all at once, I have chosen here to concentrate on those aspects that I consider to present the greatest dangers.

From my experience of working in many countries and on many problems I feel that we must face up to two particular problems. The *first* one is the lack of action for the whole ecological system on any large scale, let alone a global one. If we wait until we have a complete scientific understanding of the whole, or even a complete understanding of a single aspect, our action may be too late. We must act on the basis of what knowledge we have. The *second* great problem, perhaps even more dangerous than the first because it is very specific, is that we may overlook the greatest limitation of our globe, which is that its usable space is finite. It is true that we face many risks such as the elimination of several types of resources, but technological developments allow us to be optimistic that some day we will manage either to produce more from new sources or to recycle many resources so that they will never be exhausted. Are we not doing this already, with nature giving us the lead, with the recycling of water in so many ways?

What we can never recycle is terrestrial space, nor can we expand it. The view that we can create many multi-storey structures or transfer several functions underground is reasonable, but it cannot lead to any important solution on a global scale, because life in multi-storeyed buildings is in many respects inhuman.[11] Living in satellites in outer space may make sense for scientific and related goals, but does not provide any real expansion of the space we can use for our global population.

It is abundantly clear that the capacity of our container is fixed in terms of space and basic resources such as soil, water and air. What is this capacity? Can we not be optimistic that better science, developing technology and the full application of our expanding ecological

knowledge will increase the global capacity for supporting even more people in a better way? We can believe in anthropos and his capacity to develop a much better system of life, but one aspect that will not be altered is the space available to him and it is this that will really limit the number of humans who can live on the surface of the globe. This unchangeable spatial limit leads us to conclude that the maximum number of humans who can live in a high equality environment in a world that is self-supporting in terms of food is 22 **billions**, or six times the present world population.[12] Figure 1.2 shows the global capacity and actual population at different times in history.

It must be emphasised that it will only be possible to support 22 billion people if we use our resources properly. At present throughout the world we can see the uncontrolled expansion of cities onto first quality agricultural land. If this continues and the global population grows there will be little hope for anthropos, for it will be impossible to achieve the necessary agricultural production on mountains and areas with poor soils. Another example of the way in which we overlook the spatial aspects of world development can be found in the absence of any adequate plan to face the problems created by the expanding drought areas of Africa. The conclusion is clear: humanity is in great danger because we overlook the need for the proper use of the total global space.

Not only do we lack any guidance for the use of space on a world scale but we see many signs that private interests and profits bring about competition among humans causing the wrong use of spatial resources. Such a case, for example, can be seen in the refusal in Australia to use a lot more land for agricultural production, although there is a greater global need for food. Some of these phenomena can be overcome by special agreements with total human interests as the main goal. But these are not the major problems for some day they will be resolved: much more serious and far more intractable is the difficulty of returning to agricultural use the good quality land that has already fallen victim to building development.

That ecumenopolis (Figure 1.3) will come into being, there is no doubt. If it develops in the absence of an overall ecological concept and proper guidance, the result will be disaster.

1.4 The Solution

The big question is: how can we avoid the loss of those ecological balances that still exist today, a loss that would result in the deterioration of human development and, consequently, in disaster for humankind? The final solution undoubtedly lies in the achievement of a

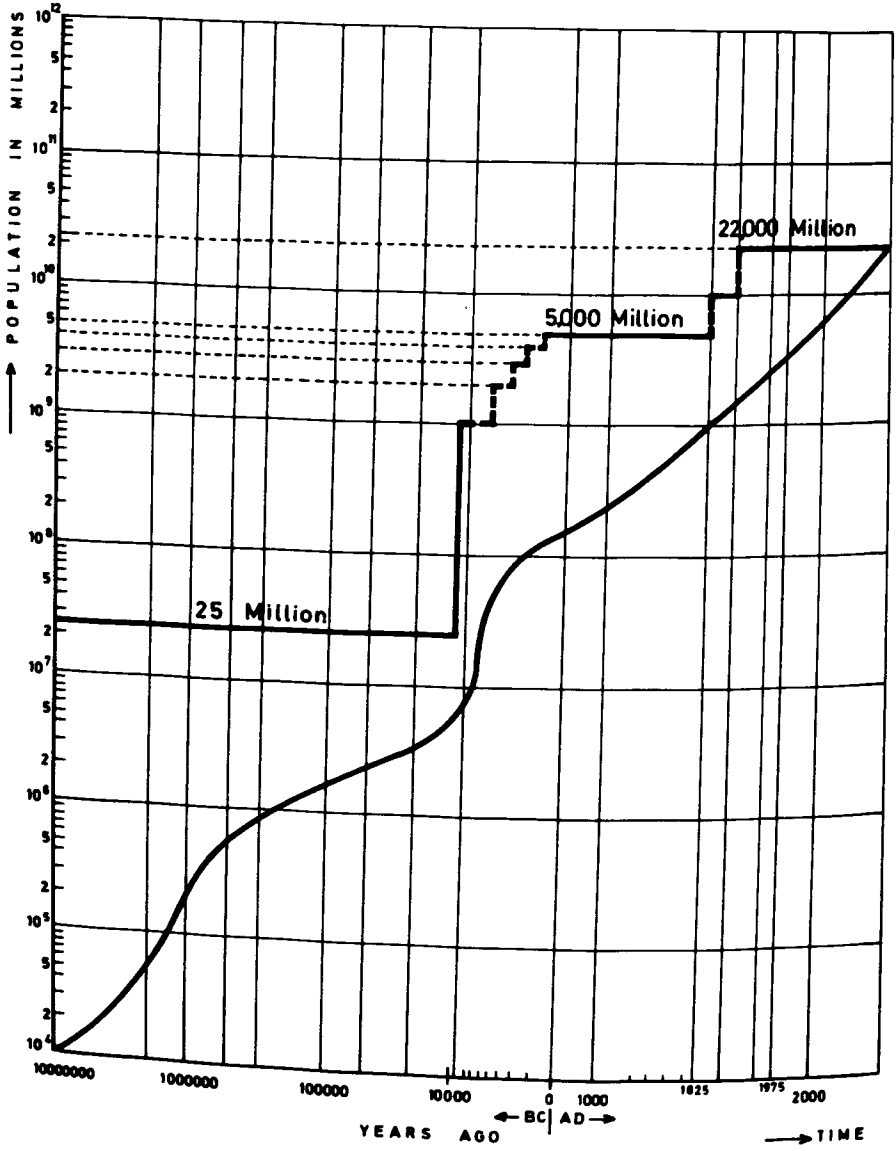


FIGURE 1.2 The evolution of the global population

new **global ecological balance (GEB)**. This will help humankind to develop properly, by solving our present and future environmental problems and helping in the achievement of a state of equilibrium which will guarantee safety and happiness, defined by Aristotle as the goals of the city.

Looking at the situation realistically one must conclude that although there is no doubt an ultimate solution, there is no possibility of reaching it within one or even two generations. The reasons are two-fold. *Firstly*, although ecology is the science that will eventually provide the answer it cannot immediately be develped to the point of providing operational solutions on a global scale. *Secondly*, although there is much talk about arresting economic energy and population growth, it is not realistic to expect this to happen in the short term, despite all the efforts that have been made. Evidence from the United Nations Conference on Population, held at Bucharest in 1974, demonstrates that economic development and urbanisation are the answers to impending global scale problems.

The conclusion is clear: we have an ultimate goal, but we know that it cannot quickly be achieved. What can we do now? Again, the answer is clear: we must try to overcome the difficulties which delay its achievement by developing ecology as rapidly as possible in all its aspects as part of our whole system of knowledge. This involves learning more in order to achieve the real synthesis that we need. It is the task of ecologists and related scientists and many have already begun work on it.

Should we wait whilst this great scientific exploration is under way, so that we know about the whole system before we begin to influence it—or should we try to resolve those problems that we know about before we understand the totality? The total system that we are dealing with is a system of life that cannot be halted to wait for an ideal solution. For every problem that we solve others appear as the system changes. The **system** consists of many interacting activities, comprised within very many **subsystems**. When environmental development occurs, ecological changes are involved. In fact, we build new environments every day and from now to the year 2000, humans will build more than they have done since the beginning of time.

When we wonder whether or not to act now, with only partial knowledge, we should remember that throughout history although many people must have been lost through lack of ecological balance, as still happens today, those within a balanced system managed to survive. This occurred with hunters, fishermen, farmers, cattle-breeders and urban dwellers, who were wise enough to use their territorial space in a reasonable way. Depending on their needs, they cultivated the area which could be properly irrigated in a natural or human-made way;

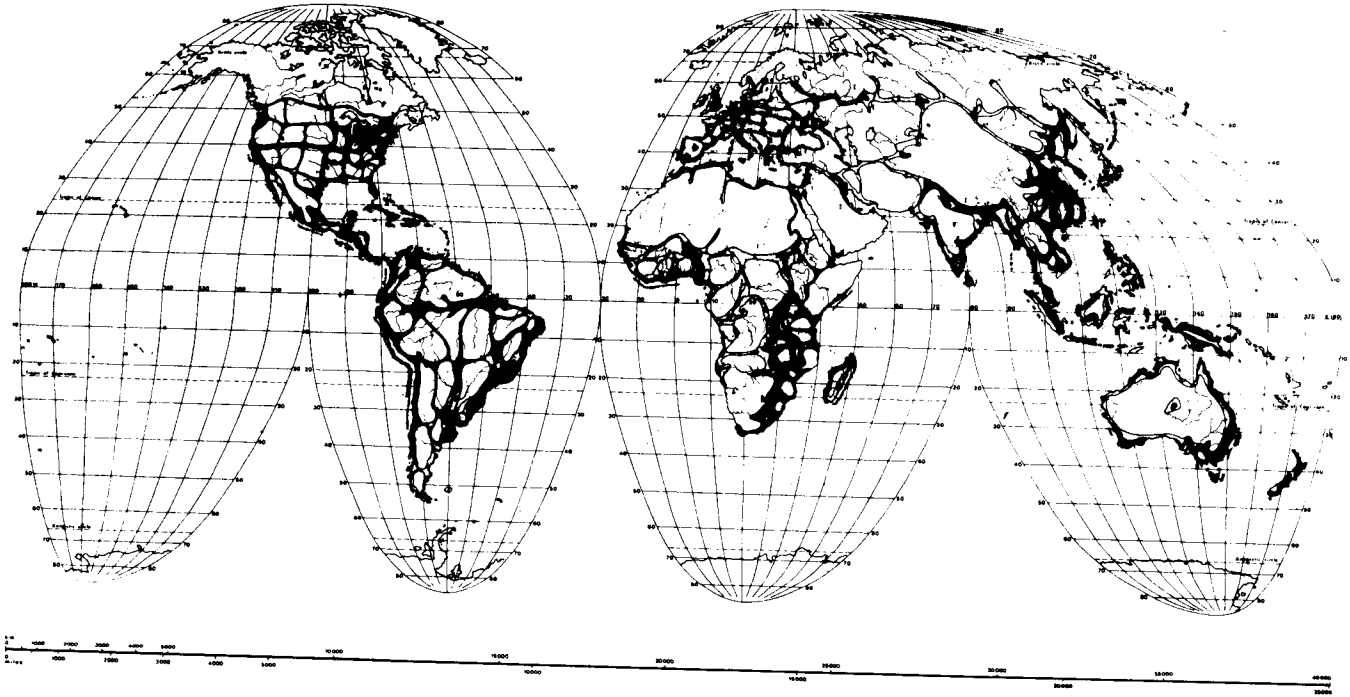


FIGURE 1.3 Ecumenopolis, A.D. 2100. The density of population decreases with the density of shading

they left forests where they needed them to collect water and other resources, and they only built on a very small percentage of their territory.

What really happened was that those who survived changed the natural ecological system they had inherited into a new, properly balanced, human one. They knew that, as Protagoras stated in classical times, anthropos is the measure of all things. They did not relate their ecological balances to the needs of elephants or rats or cedar trees, but created one suitable for human beings.

Experience led anthropos to discover the need to change from an attitude of aggression against nature to a more balanced view, creating human settlements that were in harmony with their surroundings. Similarly, the development of ecology and increased awareness of the relationships between living organisms and their surroundings has led to the development of **ekistics**, first as a discipline, and later as the science of human settlements, through which settlements may be planned in balance with nature. Just as primitive hunters and farmers learned about their territories and acted from experience as good ecologists, so did early mankind plan his settlements in a balanced form. The wisdom and the science were there but they were limited to special cases and did not cover the system as a whole and thus, when conditions changed with the advent of industrialisation, the age-old wisdom was inadequate to deal with situations not previously experienced.

From observation of historical circumstance we can discover the approach necessary to avoid the danger of allowing the global ecological system to get out of balance. We have to use the age-old method of defining the use of space by basic functions. We do not yet know how to do this for we lack the ability to make the necessary measurements, but through ecology and ekistics together, we may discover how to do it over the next few generations. In the past we learned a lot by trial and error and we must continue to do so, monitoring all actions and consequential changes so that our theories and conclusions may become scientifically based.

We need the courage to decide now on the best use of terrestrial space and all its multifarious resources. If we develop the globe scientifically, our march into the future will lead towards a humane ecumenopolis based on a global ecological balance. It will serve and respect human goals and values and enhance the quality of life.

2

The Ecological Types of Space

2.1 The Confusion

Setting **goals** is not enough, even though it indicates good intentions and leads to utopias which are necessary to help us dream in the right direction, but to be practical, we must turn these utopias into **entopias**. This is not an easy thing to do for it requires a multitude of detailed studies on a global basis. To make these studies we shall have to mobilise experts all over the globe and convince them of the need for and the feasibility of the goals we have set. Only after setting the goals and looking towards the top of the mountain ahead of us can we move in its direction and take the first steps of the many that one day will lead us to the top. Although we do not know what the mountain path will be like, we have determined the route we should take.

To define the use of space for the future we must first look about us and see how it is used today. If we try to explain each existing use of space in detail, we will find reasons fulfilling individual needs, but no reasonable system serving any broader cause in a rational way. As we are in the middle of many explosions of population, economy, energy, mobility, etc.,[13] and we have no goal set for the use of space, we are leading the whole system into confusion. We now have data which shows in a very positive manner[14] that when the population, economy and urbanisation explosions took place in Athens in the classical period, Athens itself was drawn into a confusing pattern. This may explain why Plato was in favour of zero growth patterns when speaking about ideal city-states and why he proposed very specific dimensions for them. Study of classical Athens confirms that our present-day confusion in the use of space is quite natural and not a new phenomenon: it should have been expected because of our lack of knowledge of the overall concept of use of space and of guiding its use.

Confusion and disorder on land can be seen by flying over it and even in some places by driving through it. It is also evident in the oceans and the atmosphere. On land the cause is often private interest leading to, and finally being guided by greed. For example, if I buy a plot where three-storey buildings are allowed and then convince the authorities that I should be allowed to erect twenty-storey buildings, I may make six times as much profit, but create an enormous spatial disaster.[15] In

oceans and water areas generally most problems are created from contact with adjoining land uses. Most water pollution comes from the land, but some is caused by boats of different kinds and from the air. Similarly, the atmosphere is polluted by the misuse of land resources and, to a smaller degree, by aircraft. The lesson is clear: the great confusion in the use of space is primarily due to the wrong use of land resources and secondarily of water and air.

As a projection of present trends, the future does not look at all hopeful. Three examples can be quoted to show this. There will be a great expansion of nuclear fission, the number of plants increasing from 134 to 400 within the next six years, with a five-fold increase in electricity production from 57 billion watts to 287 billion watts.[16] This will present a new problem in the use of space. The second example arises from the imperative and increasing need for the recycling of materials, for which there is no overall concept of location, method or timing, but which we can be sure will create new spatial demands. The third example follows upon the continuing expansion of urban systems at decreasing densities, using up more and more precious land near expanding cities—a practice which makes little sense.

Such changes create many problems and increase the confusion in urban space uses because their influence on the total system is much greater than the rate of increase in terms of surfaces. The reason is that we are not dealing with the expansion of a single compact system but of multi-nuclei, multi-network systems. Today, the way we create and continually expand all kinds of networks, including road, rail, electricity, gas, oil and telecommunications linkages, explains the high degree and speed of the spatial confusion that we are now in and which is rapidly growing worse. Figure 2.1 illustrates the complicated and unco-ordinated pattern of networks in the urban Detroit area.

The situation created by the changing relationships of humans to space is much more complex than it appears, even in the confusing visual picture we get. We have to realise that we do not know the answers to, and therefore have no policies on such diverse problems as, for example, the elimination of small farms as they become less economic than large-scale agricultural production, the types of urban systems that best serve all human needs and not only private economic interests, the distances at which people can best live in the rural areas in relation to cities and finally, the rate at which humans themselves change as they move into urban systems.

If we look at some of the legal aspects of this situation, we can easily see how its complexity confuses us. I give two examples. The first is the creation of skyscrapers. Three-dimensional space can no longer belong to the land-owner as it did in the past when no one was able to build more than a few storeys high. Then, every land-owner had the right to

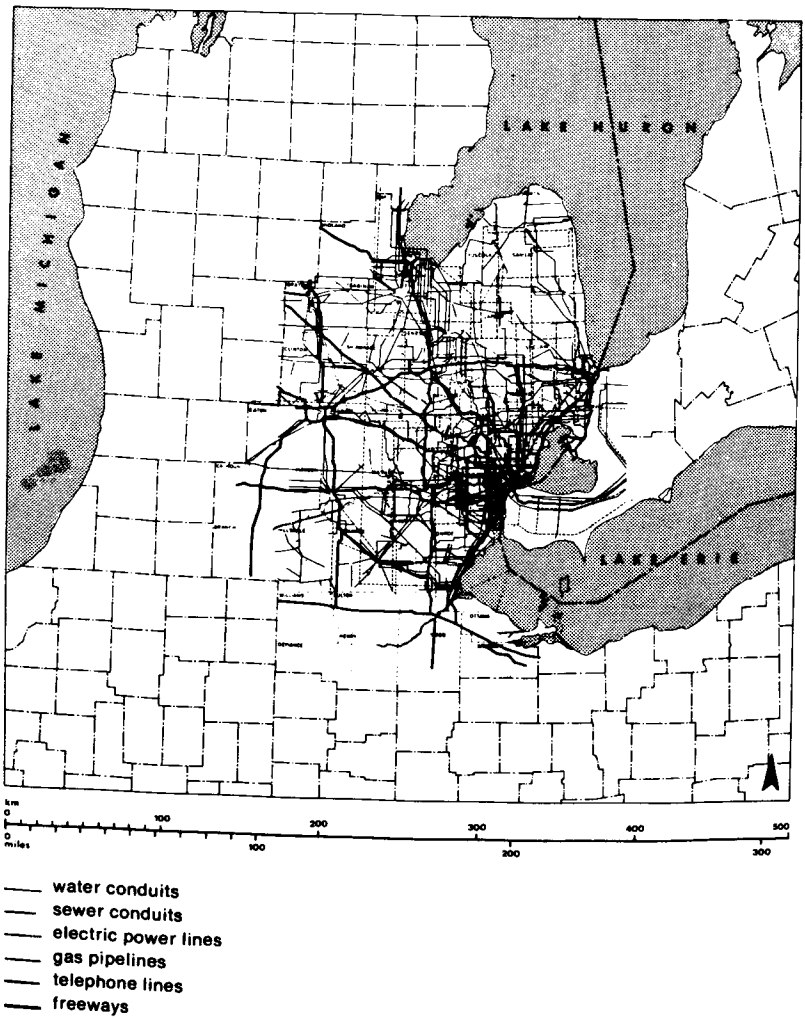


FIGURE 2.1 The unco-ordinated system of networks in the urban Detroit area

build as high as he wanted, but because of technical limitations the value of this freedom was limited. Now that everyone can build much higher we must revise the law and introduce a more reasonable approach to the ownership of space.[17] My second example is related to the question posed by the very title of Christopher Stone's book *Should Trees Have Legal Standing?*.[18] These examples show the kinds of legal problems directly related to ecology which must be answered.

The overall situation of our global space inside the system of life of humankind is very confusing indeed. A great revolutionary change is taking place, and we have no precise idea of what it is or where it leads. But we have an obligation to get out of this confusion even in a simple and experimental way: we have the duty to start the process by taking some decisions with courage.

2.2 The Balance

There is only one way to get out of the confusion and achieve the balance we need: we must clarify our intentions by defining and establishing types of spatial areas necessary for the survival of humans and their ecology. In this way we will make clear who is responsible for what and where, in the environment.

2.3 The Four Basic Spatial Areas

We need four basic types of areas:

1. The areas of nature where our main intention is to preserve as much as we can of the natural values. These are the **naturareas.**
2. The areas of cultivation where our main goal is cultivation of plants (agriculture) and of animals (breeding) on land or in water for the sake of humans. These are the **cultivareas**
3. The areas of humans, Anthropos, where our main goal is to serve the needs of human life, excluding those needs served by the other types of areas. These are the areas we mistakenly call built-up areas, forgetting that only a small part of them is actually built over. They comprise everything belonging to the system of human life except those uses included in the other three areas. These are the **anthropareas.**
4. The areas of industry and mining, where humans process natural resources by man-made, and increasingly, by biological means. These are the **industrareas.**

The four types of area have been presented in the order in which they were created on our globe by humans who first lived in the natural environment, then when they cultivated it, established a need for areas for permanent habitation. Later they developed industries and began the utilisation of mineral resources. For other reasons, such as the area required and the amount of energy humans spend in each of them, the sizes of the areas follow the same order. The largest ones are naturareas,

followed by cultivareas and anthropareas, industrareas being the smallest. In a certain way, we can say the more energy anthropos uses, the less area he occupies. Similarly, we can state that the intensity of building and space coverage increases from naturareas, where we build the minimum possible, to industrareas where we build the maximum reasonable, which may, in some cases, be near to 100% plot coverage.

The way that this definition of four types of areas will help us can best be understood by comparing them with the separation of administrative responsibility amongst four secretariats or ministries, one dealing with nature or the natural environment; one with cultivation, wrongly called agriculture in some countries; one dealing with human settlements, often wrongly called housing, which is too limited, or urban affairs, which is too vague, or public works which is too narrow, and one dealing with industry.

The definition of four types of area, differentiated by use, is important, but cannot lead to balanced development until we define what proportion of the global space should be covered by each type, and what each should contain. The various areas must, therefore, be subdivided into well defined zones, the space devoted to each use being specified on a percentage basis. Whilst this involves space generally, we must consider water and air separately. Coastal areas have characteristics combining those of land and water areas, and must, therefore, be considered separately as a fourth type of territory.

The application of scientific methods, in this case specifically those of ecology, will take place by stages. For the moment we will stop at the second stage, the definition of types of ecological zones which can be identified within land, water, coastal and air space.

2.4 The Twelve Basic Zones

In every type of territory we need twelve types of zones, which range from the most virgin one of nature, to industry, the most raped one. Theoretically, we could say that the first types are ecological and the last ones ekistic, but really they all belong to both—to ecology, representing nature and its laws, concerned with the total balance and to ekistics, representing human activity, concerned with human settlements.

The basic principles for the twelve zones are the following:

NATURAREAS

Zone 1 As nearly virgin as possible

Zone 2 Visited by some humans but without permanent human installations

Zone 3 Humans enter and stay but without machines
Zone 4 Similar to Zone 3, but with human settlements built of natural materials
Zone 5 Nature prevails but humans enter with machines and can use the zone (forests, etc.) by stages and by sections

CULTIVAREAS
Zone 6 Natural cultivation in traditional ways, that is without coverage of plants and animals by artificial roofs, without controlled climate, etc.
Zone 7 Cultivation but with new methods allowing for much greater exploitation and higher productivity

ANTHROPAREAS
Zone 8 Natural areas used as resorts, for sports, etc.
Zone 9 Inhabited at the lowest reasonable density
Zone 10 Inhabited, but at middle densities
Zone 11 Inhabited at the highest reasonable density

INDUSTRAREAS
Zone 12 Every possible use for achieving the goal of the best industrialisation

2.5 The Twelve Land Zones

Out of the whole of terrestrial space which is connected with anthropos, that is the anthropocosmos, we first define twelve types of land zone, corresponding to the twelve basic zones defined above. Although the land is smaller in terms of surface area and usable volume than the water or the air, it is the centre of human activities and the setting for most of them. When we study the whole global and biological system for historical or other reasons, we may have to start with water resources; when we are concerned with anthropos we start with land.

The total land surface, or land empire, can be divided into two kingdoms—open land and land below water. Although both are very important because of their resources and contribution to the total ecological system, we will here consider only the first kingdom. The influence of the second one is indirect and can be dealt with in another phase of this study.

The twelve types of land zones (see Figure 2.2) in this kingdom of open land are as follows.

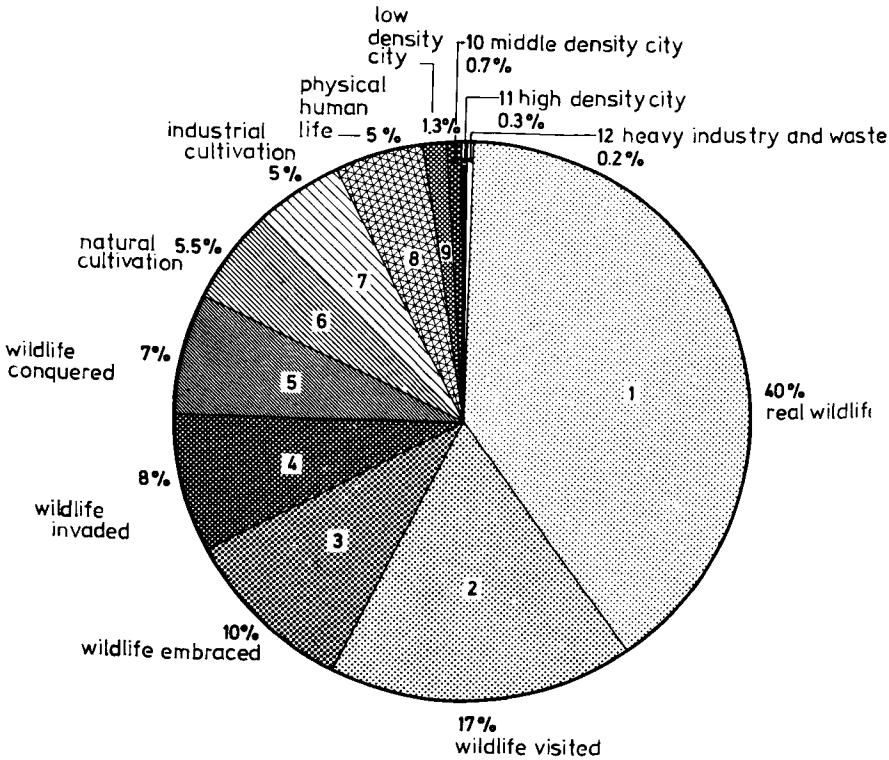


FIGURE 2.2 The twelve global zones of land showing percentage of surface area appropriate for each land use.

NATURAREAS

Zone 1 — Real wildlife No human activity or visits should be allowed, except by scientists carrying out specific research tasks.

We should keep as many parts of the global ecological systems as possible as natural as we can. We should not forget that many nature reserves suffer a lot from invasions, such as safaris.

There is not yet any scientific answer to the question as to how much of the global surface should be included within Zone 1, but it is important that it should include polar areas and deserts, well vegetated and animal populated areas like the Amazon basin, as well as examples of every climate and type of environment. We badly need to save examples of *all* types of natural areas without human influence and learn from their evolution.

If we manage to preserve such areas in all types of environments and without creating any problems because of non-use of the land, it is

reasonable to expect them to cover 40% of the global land surface, at least at the beginning of this effort until we learn more.

Zone 2 — Wildlife visited In many ways this resembles Zone 1, but visits are permitted in order to give humans the chance to observe nature, though machines should be excluded. This is the zone of natural and not commercial safaris, where visitors rely on their own energy and do not stay in organised tourist camps. The study of the resources of this zone may lead to the transfer of selected parts to other zoning categories, for exploitation by mankind.

The total land area included in Zone 2 could amount to 17% of the global surface and should comprise all types of environment from deserts to thick forest.

Zone 3 — Wildlife embraced Humans who have not entered the era of cultivation can live in this zone so long as they continue their same type of life, and others can enter for visits, living in temporary camps. Human knowledge of nature can be increased, as compared with Zones 1 and 2, because of the possibility of staying longer in the zone to carry out prolonged observations, collecting food, hunting and generally living with nature.

The total area of Zone 3 could be 10% of the global land surface. A part of it is already inhabited by many sorts of primitive tribes and another part should be added if the broader goals are to be served.

Zone 4 — Wildlife invaded Humans may enter this zone and build permanent camps which can be visited by many, as now happens in some mountainous areas, which people visit for mountain climbing, skiing and related purposes. Similar solutions with permanent and well organised camps are necessary for other types of areas, on a co-ordinated basis, minimising the destruction that would result from too many individual efforts.

Land in this zone has to be visited very systematically but in a natural way; that is without the use of machines. This means that it has to be relatively close to the inhabited areas or anthropareas comprising Zones 8, 9, 10 and 11.

The total area of Zone 4 could be 8% of the global land surface.

Zone 5 — Wildlife conquered This is a zone of natural **wildlife** that is completely controlled and exploited by humans. Here belongs a large part of the commercially exploited forest, the parts where timber grows in a natural way and is not cultivated, as it is in areas of Zone 6. Here also belong the sites visited by people with machines, motor cars, railways, etc., where hotels and other facilities are built for temporary visitors.

As the zone is visited by much larger numbers of people than all the four zones already discussed, which together cover 75% of the global land surface, it is exposed to much greater pressure, wear and tear, than they are; for this reason it needs much greater care and protection.

The total area of Zone 5 can be 7% of the global land surface.

CULTIVAREAS

Zone 6 — Natural cultivation This zone includes those areas where agriculture and cattle-breeding take place in the traditional way in the open-air, buildings only being used as storerooms and for protection of animals from weather and attack. More and more of this area will be irrigated because non-irrigated cultivation is insufficiently productive and will gradually be abandoned. Some areas, however, do not need or are unsuitable for irrigation.

Many parts of the zone will be isolated, far away from anthropareas. These will be the more natural and traditional areas representing many values of the past, present and future. In other parts near the inhabited or anthropareas, great care will have to be exercised to ensure that for economic or technological reasons, conversion or degeneration to Zone 7 does not take place.

The total area of Zone 6 can be 5·5% of the global land surface.

Zone 7 — Industrial cultivation This zone comprises areas where modern methods of cultivation, including factory farming, are used for both crops and livestock. Cultivation in this zone will require a much larger rate of investment than Zone 6, but it will yield much more as a result of the use of commercial forms of energy, industrialised methods, machines of all sorts, and automation. The uses and methods that predominate in this, the newest type of zone, will create many new problems. We may expect to see the complete elimination of the natural landscape in many parts of the zone, where a pattern of roofs will replace a distant view of beautiful fields and orchards. In spite of these drawbacks, Zone 7 will be badly needed for greater food production. We should, therefore, prepare for it, especially by the early provision of the enormous number of networks, including those needed for water, electricity and other forms of power, and for the movement of produce and waste that will be required.

The area of Zone 7 will probably some day reach 5% of the global land surface.

The importance of Zones 6 and 7 will continue to be very great, as no matter how much food may be produced in the distant future by industry (Zone 12), the food output from these two zones will continue to be very important and without question human survival for the foreseeable future depends on them. The lack of an overall ecological concept and guidance leading to the wrong use of global space, greatly affects these two zones, and they are now under attack from many expanding cities and from industry. Our ecological goal must include saving them from attack and helping them to expand as much as possible, within the areas best suited for them. Their intensive development for increased production will certainly take place some

day: our major task now is to save them from invasion by buildings, as otherwise it will not be possible to turn them into efficient cultivation areas, even in the distant future.

Serious efforts are being made towards the establishment of a world food bank. This could do immense good for humanity provided that we have enough land for food production. The allocation of 10·5% of the global surface area for this purpose is based on realistic calculations and must be achieved, or possibly even exceeded by the reduction of zones 1 to 5. Zones 1 to 5 amount to 82% of global area and a transfer of 4% of global area from their uses would mean a reduction by 1/20, but it would increase the amount of land for food production by 2/5.

ANTHROPAREAS

We must next consider the four zones of the anthroparea, which, with the industrarea, are where the dangerous systems created by humans operate. Although we know much less than we would like about ecology, we know far less about human settlements. This is a further reason why we have consciously to develop the science of ekistics, a science whose principles were subconsciously acted upon in earlier times, in the process of human survival. The task has been made more difficult with the appearance of so many forces, like the motor car and mass communications, about which we have little or no historical experience, and because of population, economy, energy and mobility explosions which are improperly understood.[19] Many existing cities have grown three times greater in area than in population, thus endangering adjoining cultivareas. At the same time, high density development in inner urban areas has created problems of a different kind. If we are to achieve a balance we must face up to the task of increasing overall urban densities, whilst at the same time decreasing those in many central areas. That we need to do this demonstrates how little we knew when we built the settlements: it is also indicative of the effort that we must make. In this spirit I examine the remaining zones of the anthropareas and the industrareas.

Zone 8 — Physical human life That this type of function has not been completely clarified nor adequately defined is one of the main reasons for the confusion in our settlements. Zone 8 should include provision for every human recreational need, but should exclude homes and other buildings which form parts of built-up settlements.

In many ways these areas will resemble naturareas, but unlike Zones 1 to 5, where the goal is to preserve and develop nature, the goal here is to serve only human needs by providing for relaxation and training in all sorts of activities from very natural ones like mountain climbing to very organised sports requiring stadia, etc. In an environment which is no

more than 10% built-up and looks very green and natural, we can build all kinds of sports grounds, entertainment installations, hotels and second homes. Humans must be given the opportunity in this zone for all sorts of relationships with nature, including sensual ones where humans can, as nudists, embrace and touch nature.

The total area of this zone may be as much as 5% of the global land surface, or twice as much as the four remaining built-up zones of anthropos and industry.

Zone 9 — The low density city This is the area which in some countries is called the suburb. It is an organic part of the city which cannot exist without it. Its main function is residential, but it includes other uses necessary to provide facilities and services, and may include commerce, handicrafts, research, light industry and other employment that causes no disturbance. Some existing cities include development at unreasonably low densities, but in this zone we mean to include reasonable, practical, low densities of about 70 persons per hectare (28 persons per acre). Development is likely to be mainly of two or three-storey houses with some higher ones for special groups of people who need well organised care readily to hand.[20]

The total area of Zone 9 should not exceed 1·3% of the global land surface, that is, a little more than the total of Zones 10, 11 and 12.

Zone 10 — The middle density city Residential use should prevail in this zone, but will no longer be the predominant function. The non-residential uses found in a purely ancillary role in Zone 9 are present in larger proportions and are more important in this Zone, which may be described as being 'mainly residential'. Middle density means an average, in the residential parts, of about 110 persons per hectare (45 persons per acre).

The total area of Zone 10 should not exceed 0·7% of the global land surface, and is thus about half the extent of Zone 9.

Zone 11 — The high density city This zone includes the central areas of large cities where there is a mixture of all types of functions, with, in some cases, as much as 30% or 50% residential use. This zone will be dominated by central area functions. High density means an average of 300 persons per hectare (120 per acre). The minimum of 80 persons per hectare (32 persons per acre) is similar to that of traditional cities, like ancient Athens—cities that we admire today.

The character of the zone is unsuitable for the complete range of human development, for children cannot properly thrive at these densities: thus living here will be appropriate for single people, both young and old, for married people without children, visitors and part-time residents. This is a valuable zone for central functions, but potentially dangerous for human development if it is inhabited by the wrong kinds of people.

The total area of the zone should not exceed 0·3% of the global land surface.

INDUSTRAREA

Zone 12 — Heavy industry and waste zone This is the kind of zone that we lack today, to the detriment of the quality of the environment and of industrial development. Although there are several industrial zones all over our globe, some few of which are very well organised, nowhere are there the big and isolated zones that we badly need (Figure 2.3). Thus, the big industries, instead of being concentrated inside special zones and isolated by special measures, are widely distributed and create great nuisance problems and health hazards.

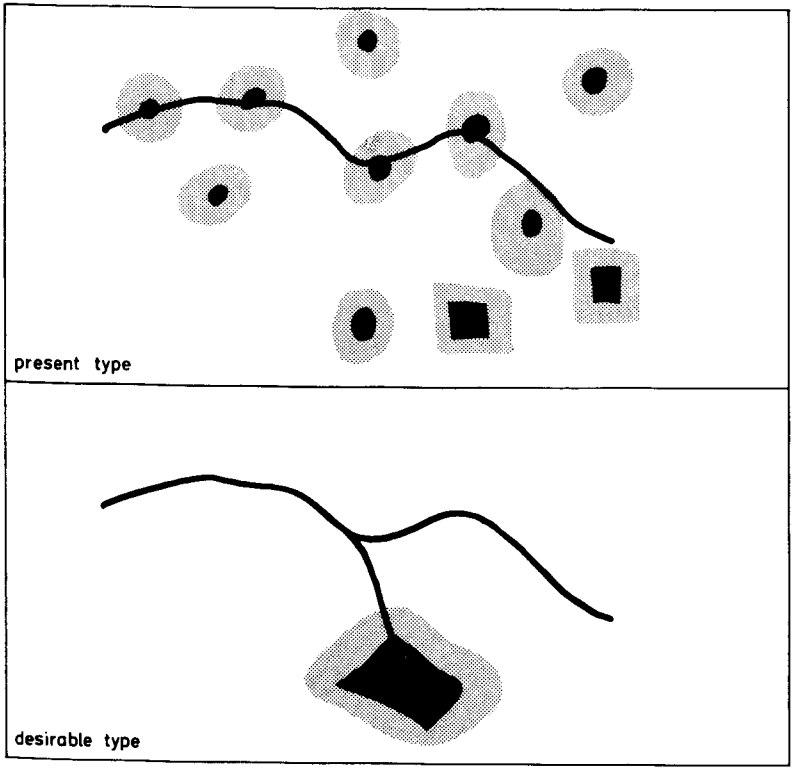


FIGURE 2.3 Distribution of heavy industry and waste zones

Land in this zone should be located where it can be isolated by a natural or man-made feature in the landscape from all zones that should not be disturbed. This may well involve locations at great distances from anthropareas, but with modern means of transport and because

individual sites would be less dispersed, the establishment of large heavy industry and waste zones should not pose serious communications or transport burdens. Provided proper technology is correctly applied, industry need not be at all disturbing. What is disturbing is its mixture with other functions and zones. Disposal of noxious waste and all major types of recycling should be restricted to this zone. Whatever disasters the industrareas may cause from an ecological point of view are related primarily to what they absorb and what they emit, not to their location, which is the subject of our present concern.

The total area of Zone 12 should not exceed 0·2% of the global land surface.

The above description of the twelve land zones is very short. It includes some of the principal characteristics of each zone, but there are too many to describe them all in detail. To illustrate how many there are I give three important examples not so far mentioned.

The first concerns the differing speeds of land transport in the various zones. In Zones 1 to 4 there will normally be no mechanised transport, other than for very special purposes. Transport at low speeds will be possible in Zone 5, and permissible speeds will increase in other zones, with high speed travel in Zones 11 and 12 and in special high speed corridors between zones.

Another criterion for classification is related to the provision of lights outside buildings, influencing the outer environment. Here again, there are differences between zones. There will be no lights of this kind in Zones 1, 2, or 3, and lighting will reach maximum intensity in Zones 11 and 12. In the case of Zone 8, physical human life, there should be only a few external lights, so that people can enjoy a peaceful environment. In Zone 9, mainly low density residential development, conditions are similar, but here we may wish to have lighted signs associated with local facilities or emergency services. By the same token, the intensity of lighting will increase to Zone 11, and in Zone 12 lights may have to operate day and night. These characteristics are not only related to the amount of energy used for lighting, but also to the location of lights for circulation, security and advertising. Therefore, the many ways in which lighting is used must be regulated.

The third criterion is the use of fire or fire-producing machines or materials. One of our main tasks is to save both the natural and anthropos-made environments from fire. This means that people should not even be allowed to enter some zones with matches or other similarly flammable materials, and in other zones they should be allowed to make fires only in accordance with rules. These rules will have to be more strict in regions like the Mediterranean, where forest fires can start and be spread much more easily than is the case in areas of greater rainfall.

Thus, we conceive the notion that, apart from the general rules about each type of zone on a global basis, we will also have special rules for every type of area and region.

The percentage of global land surface given for each of the twelve zones (see Figure 2.2) should be regarded as tentative until further studies can be carried out on a global scale. In every continent, nation and region, different percentages of land area will be appropriate for the various zones and land uses, depending on geography, existing development, condition and value of existing natural environment, potential for growth, productivity and so on. Policies depend on very many factors and will be influenced by political systems and control capability: it will be easier for China and Russia to preserve values in accordance with an agreed programme than will be the case in other countries having a higher proportion of private ownership of natural resources.

Finally, we need to clarify the relationship between natural or wildlife areas and those where human aggression occurs against them: there is always confusion about what a human settlement means in relation to the global environment. To do this we proceed in the following way. First we reassess and determine the percentages of the global land surface occupied by every zone, as already explained. Figure 2.2 shows the percentage of the global land surface occupied by each zone and from this we see the four areas cover the following percentages of the global surface: naturareas, Zones 1–5, 82%; cultivareas, Zones 6–7, 10·5%; anthropareas, Zones 8–11, 7·3%; and industrareas, Zone 12, 0·2%. Figure 2.4 shows the percentage of built-up land in each zone. From this we see that although some zones within naturareas include roads or buildings, there is open and cultivated land in other zones which brings the total global land area given over to wildlife and cultivation to 94·1%.

From this kind of study and its progressive development and refinement we can better appreciate how the global ecological balance depends on a better understanding of the differences and relationships in nature and on the application of results of more careful and very detailed studies for which the present proposals and percentages provide only the first frame.

2.6 The Twelve Water Zones

The water territory is much larger than that of the land. In terms of surface area it is about three times larger, but in terms of volume, the difference is many times greater. In spite of its great importance we do not yet know enough about the whole water system, although there are

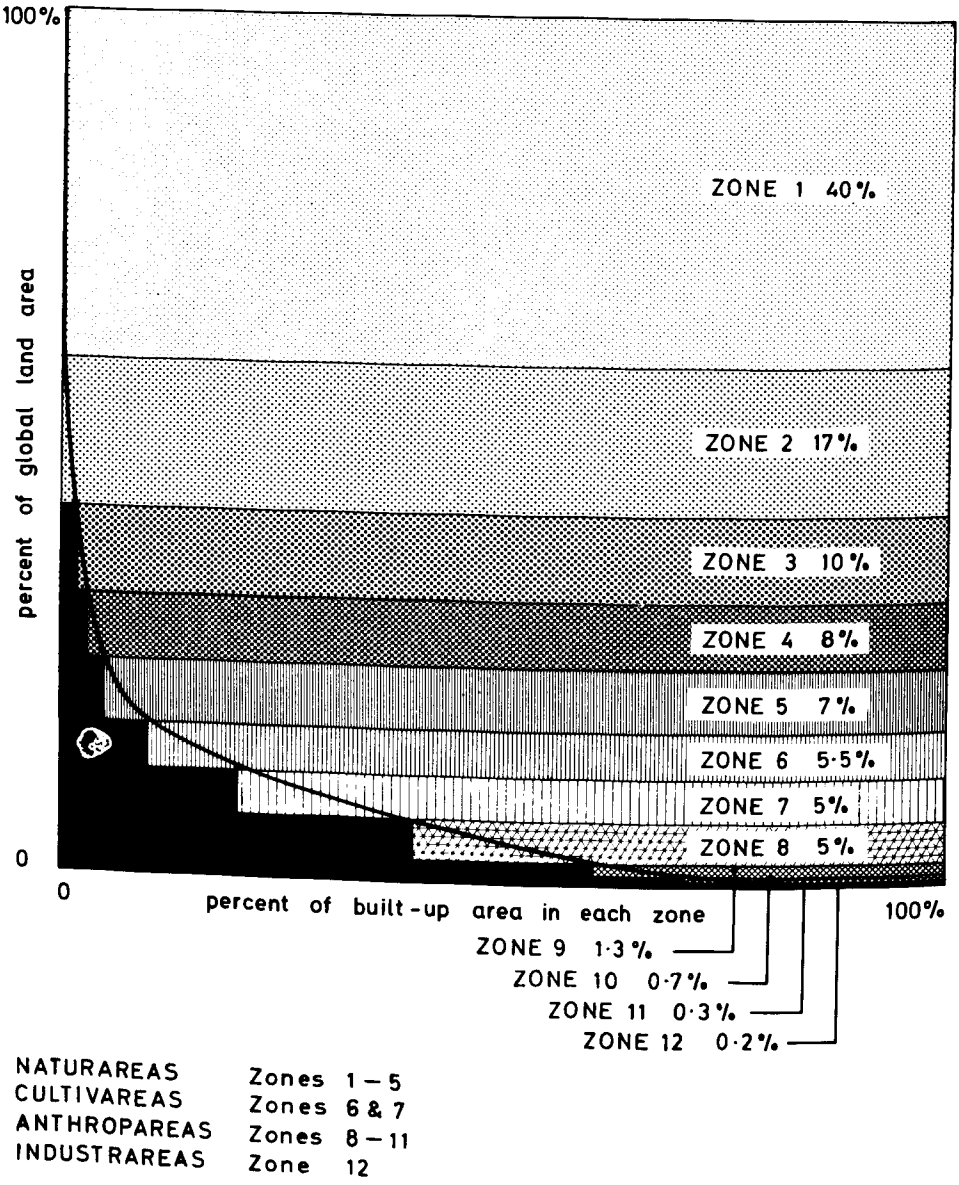


FIGURE 2.4 Diagram showing the percentage of built-up areas in the twelve land zones

some very detailed studies for some parts of it, such as the atmosphere, rivers and lakes. The reason for this paucity of knowledge is not only due to the huge dimensions and the number of components in the system, but also because of its complexity, necessitating research involving many sciences, from physics to ecology, which are not yet sufficiently co-ordinated for this purpose.

The total water territory is a huge empire which is divided into three kingdoms: the open water one, the underground one and the atmospheric one. This huge empire is a very big reservoir of energy and 'the sea is the boiler and the condenser of a giant thermodynamic machine, the sun being the heat source'.[21] On the other hand, water is the territory that suffers more heavily from pollution. For example, 'most of the oil reaching the sea does not come from the tankers, it comes from the atmosphere, from automobile emissions and industrial wastes'.[22] Much of the overall chemical pollution starts on land, in the air and in river water and finally pollutes the oceans. Here we will deal with the first kingdom only and the other, more complicated ones, will be dealt with in another phase of this study.

We lack any systematic division of open water into zones, except for oceans, territorial sea and the international straits. We must consider what kinds of zones we need to define for the water empire in order to attain the global ecological balance that is our aim. Strange as it may seem to many people, I propose that the same types of zone be applied to the water empire as for the land. How, it will be asked, can we separate a wildlife zone in the ocean, from an industrial one, when the water flows freely from one part to another? We must remember that we are not considering water in the oceans alone, but also water in rivers and lakes which is largely surrounded by land, and where we can achieve both understanding and balance. However, the definition of twelve water zones does not mean that we can realise them at once, any more than we can the land ones; it just indicates that we have set our goals. It is in this spirit that we look at the twelve water zones, systematically considering them separately as water zones on the land kingdom and water in its own kingdom of the ocean which is part of the water empire. There are almost certainly water zones in the air also, but we will not consider them at this stage.

Water Kingdom on Land

When we speak of the water kingdom on land we mean all forms of water resources, from rain falling on the land surface and draining to rivers and lakes, to underground water. These all form a system which feeds the ocean kingdom, which will be considered separately. Water zones on land do not present problems that are very different from those

of the equivalent land zones: a brief discussion will thus suffice to indicate the limitations of each zone.

NATURAREAS

Zone 1 — Real wildlife This zone can contain some lakes and rivers as well as sources of water, etc., provided that the whole system feeding them is also included. There is no reason why countries like Canada cannot declare some lakes as completely prohibited to anthropos, nor why every country cannot do the same for at least the upper parts of some of its rivers. Only scientists should be allowed on or in them for research purposes. The case of Lake Nakuru in Kenya[23] which is a wonder of the avian world and is threatened by the pollution coming down from the Great Rift Valley, clearly demonstrates how carefully the territories comprised within every zone have to be defined.

Zone 2 — Wildlife visited; Zone 3 — Wildlife embraced; and Zone 4 — Wildlife invaded The boundaries of these zones need very careful definition. Water coming from them into other zones may very well be free of all pollution other than that from the air or from the rain. Amounts of pollution can be monitored at the entrance of the other zones and gradually controlled.

Zone 5 — Wildlife conquered—This is the first zone where water must be completely controlled and used by humans for the sake of wildlife within the zone and for the sake of anthropos outside it. Control will be effected by dams, drainage canals and similar means. Humans will be able to enter this zone with their machines.

CULTIVAREAS

Zone 6 — Natural cultivation; and Zone 7 — Industrial cultivation These are zones where water will play an increasingly important role. Firstly, the circulation of water must be completely controlled and extended. This process began thousands of years ago in Asia, where water control aided cultivation and contributed to the development of several civilisations. Even in low income countries like China, such zones exist. Agriculture developed in these zones may achieve very high levels of productivity. Some aspects of pollution may even be exploited for food production, a possibility being investigated by scientists in Belgium[24] and elsewhere.

ANTHROPAREAS AND INDUSTRAREAS

Zone 8 — Physical human life Procedures in this zone are in many ways similar to those in Zones 6 and 7 but with one major difference—if some parts of the zone become useful for food production, they should be transferred to either Zone 6 or Zone 7, as appropriate, where crop growing is a major goal. If the separation takes place in a proper way no

problems will result. The incorporation within Zone 8 of small areas of cultivareas could be beneficial for educational purposes.

Zone 9 — Low density city; Zone 10 — Middle density city; Zone 11 — High density city; Zone 12 — Heavy industry and waste zones There is no need for any radical change from the ideal pursued since ancient times in zones such as these; that is, to have enough water for all urban needs and efficient ways to dispose of waste. Existing and developing technology will help to achieve these goals in the best possible way. Water circulation in these zones will be mostly underground, but we should not forget that water in canals and lakes can be used for recreation purposes and also to change the climate and the aesthetic environment. Thus, water should be considered as a positive element in these zones and not just as the major component in the water supply and the sewerage system.

In terms of surfaces to be covered by the water zones, we cannot be more specific at this stage of the study than to say that they should correspond to the twelve land zones, because they have to be fully co-ordinated with them. More detailed studies will show where co-ordination may be impractical, as, for example, where a land zone is crossed by a canal or pipe belonging to a higher order water zone.

The Oceans

We now move to the other water kingdom, that is, to the oceans. Here again our goal is the identification of similar types of zone, but it is difficult to isolate the zones. However, even though chemical pollution may spread considerable distances through the sea, we should try to save some water wildlife areas. The fact that a slightly polluted current affects a certain port or stretch of coastline does not mean that we should not try to save the water from other kinds of pollution.

The twelve zones described below have the same basic characteristics and goals as the land zones.

NATURAREAS

Zone 1 — Real wildlife This will be the most difficult to create in the oceans. However, isolated bays receiving water only from Land Zone 1 or related zones, and not from the oceans may be considered as constituting Zone 1. On occasion, we may close a bay by a dam or other large-scale engineering work, creating an area that is potentially in this category.

Zone 2 — Wildlife visited The characteristics of this zone should be easier to achieve than those of Zone 1 as the demands are not so great. Here humans will enter, but as primitives did, that is by swimming or using timber or timber boats for sailing or fishing, but they must not bring any machines or industrially packaged food.

Zone 3 — Wildlife embraced The situation in this zone will be similar, for here humans can not only visit daily, but can also live, provided they forget modern technology and do not introduce any chemicals.

Zone 4 — Wildlife invaded Great care will be needed in this zone as ideally it should be as unspoiled as Zone 3, although it will be visited by many people. It is the zone where the education of children, students and adults, perhaps as tourists, will take place and where their eyes will be opened to what wildlife is in water. Specially designed low-speed boats will be used in these waters and all waste will be removed for disposal in Water Zone 12 or Land Zone 12.

Zone 5 — Wildlife conquered This zone will be similar to Zone 4, but includes harbours for the boats that visit Zone 4. Careful co-ordination with Land Zone 5 or Coastal Zone 5 will be essential.

CULTIVAREAS

Zone 6 – Natural fishing This zone may readily be defined in terms of the coastal seabed and coastal species but is more difficult in the case of anadromous fish, coming from Zone 6 in the water kingdom of land. It is almost impossible to delimit the zone in relation to those anadromous and migratory fish which move at times far into the oceans. For the present we speak only about what can be territorially defined. This is the zone for the natural and human controlled cultivation of fish and other sea organisms under natural conditions. Every type of activity consistent with this goal should be possible in this zone, provided that neither the boats nor the production methods used cause any pollution problems for plant or animal life. It is in the direction of saving such natural zones as well as the corresponding coastal ones that ecology has won such battles as those in parts of the North Sea, where the natural environment has been saved from the construction of oil platforms.[25]

Zone 7 — Industrial mariculture This zone will be of revolutionary importance, as will the corresponding Land Zone 7. Here there will be located and developed the areas which can be dedicated to industrial production of plants and animals of all sorts, and fishing or animal collecting will be carried out in the most efficient automated way. Jacques Cousteau was right when he stated that we will have to 'abandon industrial fishing and turn to aquaculture'.[26] We definitely should do so, for by this means we could increase the productivity of the sea many times.

The remaining five zones are related to increasing human activities and development projects and therefore they come close to land and in many ways they coincide with the coastal zones which follow.

ANTHROPAREAS

Zone 8 — Physical human life This is where every human action can be allowed, provided it serves human recreation without disturbing the existing ecological balances. Even better, it may re-establish values lost by previous ecological aggression. This means that all types of installations, small or large, are permitted, allowing humans to indulge in all sports, using machines which are not allowed in the natural environment zones 1 to 5.

Zone 9 — Low density This zone corresponds to the low-density land zone. Small ports for all kinds of boats will be used in a way that allows people to live around them and enjoy boating and sailing. In some ways it is like Zone 8 but with the addition of commercial transportation to entertainment centres or areas. Figure 2.5 shows on the left a small traditional port of Zone 9 which receives only traditional boats. On the right there is a more modern port, Zones 10 and 11,

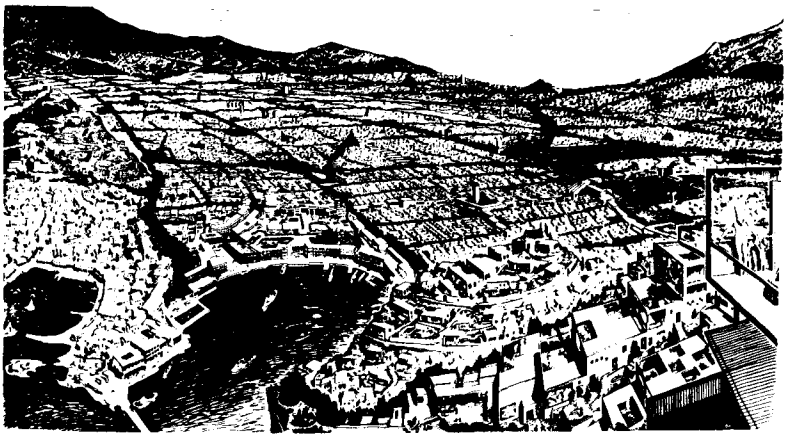


FIGURE 2.5 Entopia, the place that is possible, showing on the left a traditional port, Zone 9, and on the right of that a modern port, Zones 10 and 11

designed for larger boats sailing at higher speeds and carrying substantial cargoes. If we mix these two very different systems with their different scales they will greatly disturb many aspects of our system of life from the organic to the aesthetic.

Zone 10 — Middle density; and Zone 11 — High Density These zones will both be based on modern technology. The first will contain ports for more and larger boats, let us say up to 30 000 tons, and life in it depends on commerce and trade. The second will include better port facilities for all possible sizes of present and future shipping, with special installations for containers, roll-on, roll-off transport allowing complete interconnection with city, commerce and industry.

INDUSTRAREAS

Zone 12 — Waste disposal zone This is another new and revolutionary type of zone designed to serve specific needs at least for a few generations and possibly forever. It is the zone where the waste which cannot yet be recycled and is now discharged into the oceans by ships or from the land, will one day be collected for future chemical and biological processing, to turn the polluted water and waste into something useful.

In closing this section we must again remind ourselves that we are not yet ready to define the surface, or even the depth, of these zones. This has to be achieved by steps, but the definition of the territories and the water agencies can help. This is beginning on a national basis in France, but nowhere yet for multi-national or international territories. At present we have a very incomplete concept of the water empire, its kingdoms and its parts and thus we cannot plan for its future and its necessary management. In this study we have only made a start by considering the basic, elementary concepts and processes.

2.7 The Twelve Coastal Zones

The land and water empires are closely related in many ways, as we have seen, and nowhere is this more so than in coastal areas, where the relationship assumes a very specific form. Theoretically, the coast might be expected to lie within the appropriate land and water zones but in reality coastal areas must be considered separately because their characteristics may combine features of one land zone with those of a very different water zone. Clearly, where zones of different categories of different kingdoms meet, a special solution, or method of categorisation may be required.

The physical extent of the phenomenon should not be underestimated. The official figure for the length of coastal zones of the oceans of the world is 261 300 kilometres, but the real figure is undoubtedly much greater, for we must take account of the variation and undulation of coastline that is omitted from generalised global maps, and to this we must add the coastal zones of lakes and similar water areas. In many cases, coasts attract greater activity than is characteristic of or permissible in either of the abutting land and water zones, as two examples may demonstrate. Land lying within Zone 1, real wildlife, may have a coastline of such aesthetic or scientific interest that it should be visited by people for educational and recreational reasons. Again, one can visualise situations where a coastal strip ideally suited to physical human life, including permanent settlements, lies between land in Zone 6, natural cultivation, and ocean that is properly

regarded as Zone 1, wildlife zone. Coastal areas are particularly vulnerable to pollution and to degradation because of excessive use arising from their value and attractiveness to humans and as a result of their political importance. For all these reasons it is important that coastal areas be separately classified though there is every reason to believe that a classification system of twelve zones, based on the same principles as those propounded for the land and water kingdoms will be both appropriate and practical.

Of the twelve coastal zones the first seven comprise the naturarea. Because of the special needs of coastal transportation systems and the pressures to use the coast for many other human activities, these zones are unlikely to constitute as large a proportion of the total coast as do the corresponding land zones of the total land.

The inevitable development of ecumenopolis will automatically increase the pressures for coastal development[27] but with increased understanding and control we may achieve a proper global balance between ecumenopolis and the corresponding global garden, or **ecumenokepos**. To make proper provision for an overall balance of this kind and to cater for efficient provision for anthropos, we must provide for an increase in Zones 8, 9, 10 and 11, the anthroparea in the coastal kingdom, as compared with the proportion in equivalent zones in other kingdoms.

The coast is often the most appropriate location for the kind of large industrial and waste zones for which there is such great need in much of the world, but this combination of use and location is potentially of great danger. In facing it we must remember that industry is necessary and that we can overcome ecological problems if we face them in a reasonable and creative way. This does not mean that we should refuse to consider coastal locations for industrial or waste zones, but that we should be even more selective over their location and operation than we are in many island sites. Even if Coastal Zone 12, industrial and waste, reaches as much as 1% in some regions, as compared with 0·2% of global land required for these uses, there should be no danger if bays with the right kinds of geology, climate and landscape are selected for these uses. To sail for 200 miles near the coast and to see a two-mile bay full of industries cannot worry anyone if the site is properly planned and no dangerous pollution takes place.

When we consider the view from the sea in this way we are reminded of the many factors with which we are concerned in planning coastal development. For tens of centuries people sailing towards Athens could see the Acropolis rising above everything else as the symbol of the city. In the last few years an attempt was made to build multi-storey buildings on the coast, a development that would have reduced the Acropolis to visual insignificance as rapidly as it made rich the owners

of the towers that were to be the symbols of our new civilisation. The cultural aspect was forgotten as were other issues, but government action saved the situation and finally kept the Athens coastal zones in balance with the total environment. It is in this spirit that we must see our total system and the very great role of the coastal zones which are so important for the quality of our life.

2.8 The Twelve Air Zones

Air covers the largest territory of all, and unlike land and water, is a unified empire which cannot be subdivided into kingdoms. The many natural forces that act within it change its balance continuously and, sometimes, dangerously. By comparison with the vastness of airspace, human activity is insignificant, even where it involves the use of the largest aircraft and the construction of the tallest buildings. Over much of the land most human activity takes place at a height of no more than six feet, and is therefore considered for our zoning purposes as belonging to the land use. The situation is similar over the oceans, where human activity is even less significant.

For future ecological and ekistic reasons and for consistency in scientific enquiry it is appropriate generally to consider twelve air zones, the characteristics of each being directly related to those of the zone beneath it. In practice, however, the guiding rule cannot always apply, as an example will show. Whilst we can say that Land Zone 12, heavy industry, necessarily means that the airspace above it cannot be anything other than Zone 12, we cannot always keep the air above Land Zone 1, real wildlife, free from penetration by aircraft whose routes may need to cross the zone. However, this example may point to what our goal may have to be: if we can keep wildlife zones on land, why not also in the air? We may not achieve complete success in this, but if we try we will have the opportunity to study the possibility of air corridors based on ecological considerations as well as on those that apply now. In any event, we need a much better approach to the problem of air transportation or better air movement.[28] When we try a scientific approach we shall find that even from the economic and organisational point of view what happens in air movements today is wrong. There are grounds for hoping for the achievement of co-ordination of the two desires, to be able to travel better and more efficiently and to minimise disturbance to ecological balances. Setting of goals in each area of interest is the only sound foundation for a better future.

In this spirit we make a preliminary definition of the twelve types of air zone on a global map. Observation and recorded data will indicate

adjustments necessary where natural action in the atmosphere or pollution from human activity prevent the correspondence between an air zone and the land and water beneath it. In this way the first air zone map will be adjusted to correspond to reality, probably resulting in a smaller proportion for naturareas than in the case of land and water zoning.

As the air is common to all nations international effort in this direction is most necessary. In climatology, collaboration has already begun and there are signs of it in other disciplines. The necessary co-ordination could be achieved by ecology.

3

From Setting of Goals to Actual Implementation

3.1 Can We Really Achieve our Goals?

After setting the goals, necessary to achieve a global ecological balance (GEB), I made specific proposals for the ecological types of space that we need. As the purpose of this study is not to create a theory, but to facilitate the implementation of a practical plan, we have to answer the question: what is the value of these proposals? They are the basis for a move from well meaning, idealistic declarations and unco-ordinated action towards a realistic, co-ordinated action programme, capable of implementation. Many efforts are being made all over the globe and mankind is moving from declarations to specific studies, especially since the UN Stockholm Conference of 1972, with such efforts as the UNESCO programme, 'Man and the Biosphere',[29] the Pacem in Maribus movement to save the Mediterranean,[30] the UN Caracas Conference on the law of the sea, the IFIAS[31] programme on 'World Water Resources and Strategies for Management' and several others. My proposals are intended to help to insert dimensions in all our decisions in order to make them work, remembering, with Protagoras, that anthropos is the measure of all things.

Are not the dimensions of these proposals so huge that their realisation is improbable? I think not: they are not really 'huge' for the word is meaningless unless it is related to time, space and resources. We learn from Mary Leakey[32] that humans tried to create their first small elementary water supply network 500 000 years ago. They created irrigation systems 5000 years ago in Egypt,[33] complete sewerage systems 3750 years ago in Nippur, India,[34] a water supply tunnel 4260 feet long in Samos, Greece, 2500 years ago,[35] and more than 2000 years ago they were building dams in China.[36]

In those days, humans used from 2500 to 10 000 calories per capita per day and had an annual per capita income of less than $100. Now incomes have risen more than 40 times and energy consumption more than 80 times. By comparison with the historical examples that we know about, on the basis of energy consumption and income, our modern irrigation systems should be capable of reaching lengths of

20 000 km (12 400 miles) which is equal to one half of the global circumference or the maximum distance that we have to face. Our tunnels, at more than 200 km (124 miles) in length would be capable of passing through the largest mountain areas. With such systems we could solve all our problems just by keeping the normal pace of evolution.

We may well ask when we are going to achieve the great changes that we need. Can they be realised in our five year programmes or within one generation's time? We can and do achieve many things with five year plans, but other things require longer periods.

The answer is 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.[37]

But this is not the only example from history. Any proper feasibility report can show that no farmer can have the kind of house that in fact he owns in many parts of the world and cost benefit studies can show that no medieval city could build a huge cathedral. But they both were built and we admire them today because humans were able to start processes and continue them step by step over a few generations to the stage of completion.

My answer to the pessimists who laugh or cry at broad concepts about a much better world, is to say, 'Let us have the proper concept on a global scale, by planning the dimensions and types of global spatial zones. Let us conceive the overall system we need and elaborate on it with science and technology. If we do this, someday anthropos will enjoy a life of much higher quality than he now experiences in his global city, or ecumenopolis, which will cover 2·5% of the total land surface, surrounded by the global garden, or ecumenokepos (Figure 3.1), properly irrigated and supplied with an ideal global system of water or **ecumenohydor**.'

The conclusion is certain: we can definitely achieve our goals and we can attain a global ecological balance. We cannot yet say when, but once we have set the goals and adopted a plan of action, it will soon become clear how and when we will reach our goal of an ideal balance.

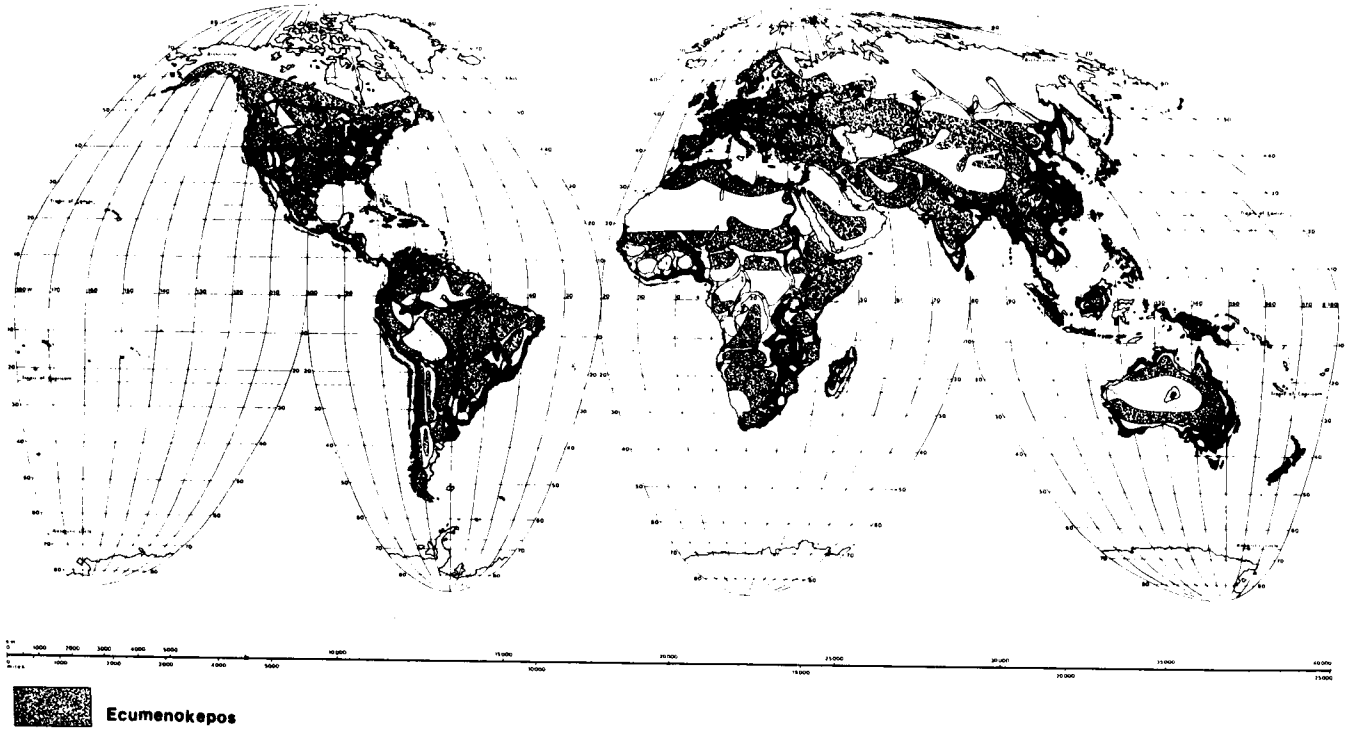


FIGURE 3.1 Ecumenokepos or the global garden superimposed on a map of ecumenopolis

3.2 The Twelve Zones at All Levels

At this stage the whole zoning proposal with its twelve divisions of different but specified proportions must be regarded as applicable on a global scale only. It is unlikely that the distribution of zones within any one nation or region will match the overall world proportion of zones of each kind and it is important that any global determination of zones should take account of national needs and aspirations.

Let us consider the drawing up of zone boundaries on a national scale, for to be practical in a world where we believe that all are equal the division must be by nation. If in becoming rich a European nation has done away with two thirds of its wildlife, as many have, it cannot insist that to maintain a global balance some African countries should retain every single part of their wildlife—and remain poor in consequence. Neither goals nor justice will be achieved that way. If there is to be a global balance, there must be a proper and realistic distribution of resources and obligations. If we forget this truth we may run into difficulties in reaching agreement on principles, and we may fail in implementation.

We should not forget the lessons to be learned from the UN Conference on Population held in Bucharest in 1974 where the discussion clearly showed the big gap that exists between speaking about problems in general and discussion of specific remedies for particular countries. At that conference many delegations argued for the adoption of policies designed to restrict the rate of increase of population, yet few countries were prepared to agree to policies that might reduce their own numbers. Nobody can or should agree on a single population policy, as every country is at a different phase of development and has different needs and goals which it would like to achieve within a global balance. We face the same difficulties with our spatial zoning as we strive for an ecological balance. Proposing various sizes of zones of different kinds on a global scale certainly does not imply that those proportions are valid by continent or nation, region or city, community or neighbourhood.

It is not possible at this time, nor in a study such as this one, to consider a range of approaches to the dilemma posed by the necessity to equate global balances and national needs, but we can consider two practical approaches to the problem. The first way is to look at the political boundaries and consider national divisions and administrative sub-divisions, moving from the global level to more than 150 national units and then to many tens of sub-units. Such an approach does not help towards a rational solution: the very fact that there is no continental overview indicates the weakness of the method. The second practical way to approach the problem is to rely on ekistic units which

are based on geography, administration and other factors.[38] As nations are the units which take the political and executive decisions for themselves and, through the United Nations, for the whole globe, the final practical solution is to use the ekistic scale for scientific work and to move to the national one for the decisions which are needed.

In order to illustrate this systematic approach we will apply the ekistic scale. There are fifteen ekistic levels beginning with the global ecumenopolis, going down to the continental unit or **eperopolis** proceeding to **megalopolis**, **metropolis**, **polis**, **neighbourhood**, **house**, **room** and anthropos.[39] Nations like the USA, USSR and China correspond to ekistic unit 13, whereas others like Singapore correspond to ekistic unit 9 or 10.

In our consideration of the global ekistic unit 15, ecumenopolis, we must, for example, reach agreement on the supersonic aircraft which threaten all nations, even when the SSTs only fly over at high altitude without landing. In dealing with continental ekistic units, level 14, we have to look at the problems of climatic interaction leading to the expansion of the desert in Africa and consider water requirements on an international scale. In this way, going down the scale, we have to face many eternal problems, such as lack of water, as well as contemporary ones such as increasing pollution in specific areas. When we move to ekistic units 12 and 11, that is to the megalopolitan scale, we have to face the misuse of land resources, the lack of co-ordinated transportation and utilities systems, and many other problems. The same ekistic units may also comprise big national states, such as Nigeria, which are changing rapidly in some of their parts (like Lagos), and badly need action in many ways.

The next ekistic units, 10 and 9, may well represent small highly urbanised city states like Singapore, or small and mostly rural ones like Cyprus. Necessarily, because of organisational circumstances, although the scales are smaller, we have to face the whole range of problems. Most of these ekistic units are metropolises which present mainly characteristic urban problems, including aggression against the countryside. It is at this level that people begin to ask themselves if they do not live too far from the centre of the settlement, as in Los Angeles, and if the time has not come to create a mass-transit system to reduce both total urban costs and pollution.

Lower in the ekistic scale, at the levels of polis and small polis (ekistic units 8 and 7, that is the traditional town) and neighbourhood (ekistic units 6 and 5) we begin to face other problems, such as the lack of natural green areas and open spaces, many sorts of pollution including noise disturbance, and the lack of social balances.

Finally, when we consider the very small ekistic units from the housegroup (ekistic unit 4) to house and room (ekistic units 3 and 2) and

to anthropos himself (ekistic unit 1) we face many problems of the kind already mentioned at higher levels as well as new ones related to quantity and quality of architectural space, and to the human relations with their environment as seen from the biological, the physiological and the psychological points of view. Here I want to emphasise that this presentation is not theoretical but is based on practical experience[40] of the application of a systematic approach in many parts of the world. The application of the ideas of the twelve zones and four types of area is demonstrated in plans for the future of Greater Athens (Fig. 3.2), accepted in principle by the government and on a smaller scale in the island of Patmos which has many cultural and natural features that warrant saving.

I base the conclusions that I reach on experience over forty years in more than forty countries, advocating and fighting for the development and application of a systematic approach to the solution of our environmental problems. Using the **ekistic logarithmic scale**[41] it is possible to identify fifteen levels in a hierarchy, each of which may be the point of origin of a number of environmental phenomena or problems, which may affect other levels in the hierarchy. Clearly we must concentrate our effort for problem solving at the level of origin of each problem but we must take care to spread our effort sufficiently widely to cover all the hierarchical levels that are affected.

We cannot hope to solve any problems of the relationship between ecology and settlements by limiting our action to the creation of the twelve zones at the global level or at any other single level. Were the United Nations to agree on a global ecological balance, or GEB, at the world level, the concept would be incapable of implementation without provision for a system of rules or a programme for agreement about the application of the twelve zones by continent, by nation and then within each nation down to the micro-level of the room and its relationship to its occupants. The different proportions of the twelve zones must vary from region to region in a country, but together they must lead to a **national ecological balance**, or NEB, which again, in order to be successful, has to be part of a broader balance at continental level (CEB) and at the global level.

Again, we can reach a basic conclusion. The global ecological balance is dependent on the achievement and maintenance of a complex series of balances at lower levels. It is the complexity of the situation which deters us from facing it and starting the kind of programme that is needed. We must resolve conflicts between interests representing different levels in the ekistic hierarchy over such proposals as industrial location or transport networks. When there is conflict between two levels, should the power lie in the larger unit seeing the wider view of the development, or in the smaller unit that is most directly affected? A

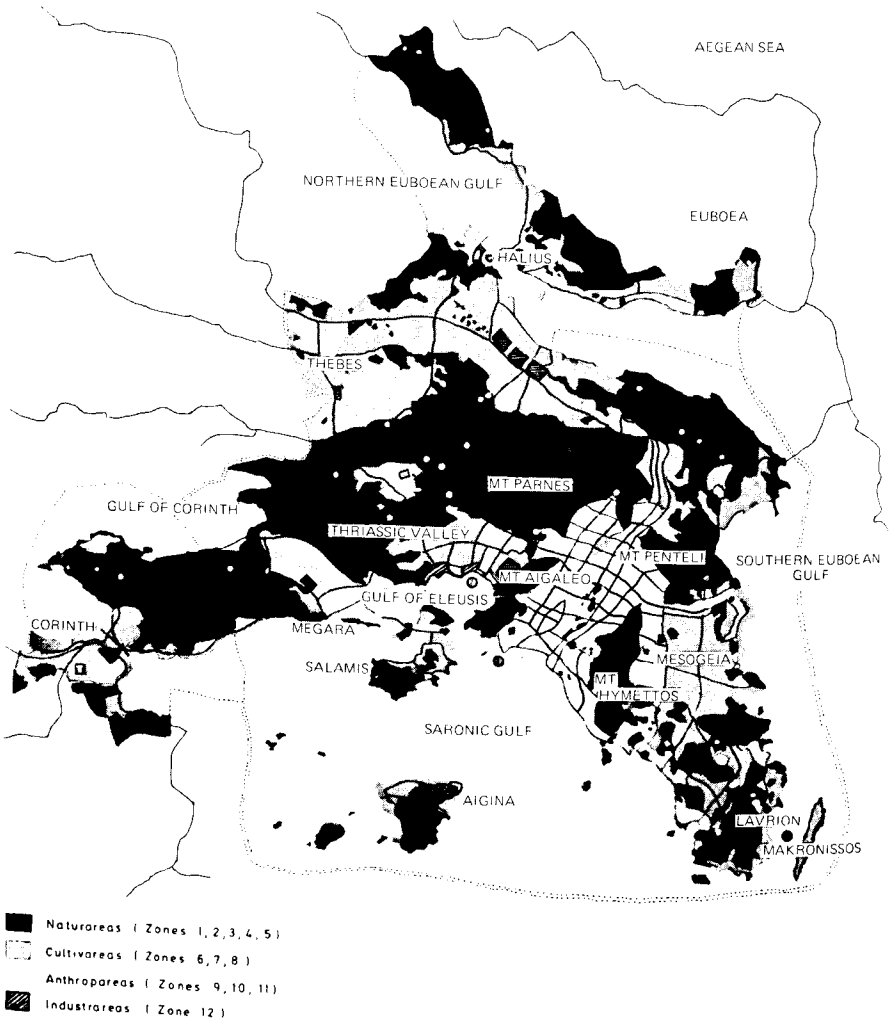


FIGURE 3.2 Athens and its future A.D. 2000. Doxiadis Associates' proposals for the development of the Greater Athens area over the next quarter century demonstrate the essentially practical nature of the 12 zone system. For the sake of clarity the zones are here grouped into the four types of area described on pp. 18–19

method for the resolution of conflicts such as these will be complicated, but when we can apply it successfully we will have made an important step towards the attainment of the global ecological balance.

3.3 Conservation and Development

The definition of the twelve types of zone, first on a global basis and later at other levels, sets the frame for proper conservation and development policies. These policies and their programmes have to define what we must do and when, showing how and where our action is needed. Once we have set the goal for every place by the definition of zones, we will have a yardstick against which to assess all proposals for development and all measures for the amelioration of unsatisfactory environmental conditions.

For example, if we know that an industrarea lies at a distance of fifteen miles from an anthroparea we have the basis on which to face, first, the problem of atmospheric pollution which may have lasting influence, secondly pollution which may be very weak at a distance of 15 miles and finally noise nuisance which may be of very little importance at that range.

On the other hand, we must give high priority to dealing with pollution of all kinds caused by motor cars. For our convenience we need to use motor vehicles within anthropareas and as this is likely to be the case in the future we must do our best to ensure that vehicles do not cause environmental problems. Chemical pollution caused by exhaust emissions is already being reduced but we have yet to face up to noise pollution. We can, however, specify the kind of performance we would ultimately like to see and until then monitor levels of noise to find out where the worst problems lie and who are the biggest offenders in this respect.

By moving progressively forward, with increasing detail, in the manner already discussed, we can help in the conservation of those values that are worthy of conservation. At the same time, we can strive towards the achievement of values of higher quality that we need and can develop in an entopian way, even if our initial dreams seem to be unrealisable and utopian.

The conservation of existing ecological values and the development of new ones in ecology and ekistics are our two practical goals. The application of the twelve zone classification system helps to determine in which areas one science only is needed or is very dominant, and those areas where a partnership between the two sciences is necessary. Naturareas, Zones 1 to 5 are almost exclusively of ecological concern, ekistics making an appearance on a small scale in Zone 5. The trend to ekistics continues in Zone 6 and more so in Zone 7, which are both cultivareas. In the anthropareas, Zones 8 to 11, ekistics is increasingly the dominant science, and even more so in the industrareas, Zone 12, though in no case must ecological considerations be underestimated.

3.4 A First Plan of Action

To move from the setting of goals to actual implementation we must have a plan of action.[42] As it is too early for agreement on a final plan, I propose the following steps:

1. There should be a symposion on the global ecological balance to provide an opportunity for open discussion in a broad and general manner between experts from all the disciplines concerned with ecology and ekistics.
2. Collection of data and preparation of more detailed plans for several areas at different levels, using the system of twelve zones, to test its feasibility further, should be encouraged.
3. A further report on global ecological balances should be prepared and discussed. I consider this book as a second report developing and bringing into one document, material and experience gained in the preparation of earlier studies perpared in recent years[43] which together form a single background document.
4. Proposals on the implementation of a global ecological balance should be published by the World Society of Ekistics and other interested bodies for consideration by the appropriate agencies of the United Nations. Any plan of action adopted by the United Nations, including the creation of a special agency, should indicate how the programme is to be financed.
5. The United Nations and related agencies should plan their action in greater detail, selecting some experimental areas for the study of the global ecological balance.
6. The United Nations' plan of action should be implemented.

Part Two

Ekistics seen as a Science Related to Ecology

4

Anthropocosmos

We live in a great cosmos, but we are a very unimportant part of it, at least in terms of dimensions. We live on our earth where we have been unimportant for millions of years, both in terms of numbers and of influence; but gradually we have started exercising greater and greater influence, first by cultivating plants and animals, and then by building villages and cities. Our power to cause change is now much greater and, according to the pessimists, very dangerous. The fact is that today our earth is not only the frame of our life, as it is for every plant and animal, but also in some respects and areas, its condition is the result of our action. For this reason we have to see our earth as the anthropocosmos, or world of anthropos, which is a part of the **biosphere**.[44] The term includes the notion not only of area but also of dynamics and functions, and is less limited in this regard than the concept of the **anthroposphere**.

The real dimensions of the anthropocosmos begin with the sun, without which we cannot exist, and go down to our own cells, chromosomes, genes, etc. For practical reasons, in this study we will restrict the dimensions that we consider by starting with a part of the biosphere (the lower part of the atmosphere, the total **hydrosphere** and the upper part of the **lithosphere**), going down to the individual unit of mankind, anthropos. The reason for this limitation is that both the larger and smaller units are so well covered by **cosmology** and astronomy, biology and genetics that there is no need to include them in our consideration of the anthropocosmos. Cosmology looks at our earth as a very small planet, biology as a system of nature, ecology as a balance between all plants and animals, ethology as the world of anthropos and beast, and we badly need all these views to open our eyes to the world about us and to train our minds to understand it. As humans, at present the most influential and most dangerous animals in the world, we must thoroughly understand the system in which we live. We must never forget that 'Mankind is the measure of all things, of the existence of the things that are and of the non-existence of things that are not',[45] as Protagoras said when the Greeks were forming their city states.

Anthropocosmos is influenced more and more by mankind's dynamic activities which range from such simple acts of aggression as hunting to the infinite complexity of major human settlements. Whether

ethologists are right when they say that aggression is an inherited characteristic or whether behaviourists are right when they maintain that the demands of life necessitate its appearance, the fact remains that anthropos has always been aggressive towards nature. The great battle against mosquitoes, whose elimination by chemical and other means has saved the lives of millions of people in many parts of the earth, is but one example of a continuing process of aggression and balance in which the development of settlements is an essential element for permanent survival. In all of this mankind must be the measure.

Anthropocosmos is the framework for our life system and it has to serve anthropos for ever, not simply some individual short term interest. We must improve our understanding of the anthropocosmos and the management of human settlements so that long term balances are maintained, or in some cases, restored. This will not be easy, but we can begin the process by defining five basic tasks that are indispensable for the fulfilment of our purpose. These are: to clarify the *overall concept of anthropocosmos* and of the *notion of human settlements*, to establish the *language* we should use, to develop the logical and *taxonomic frame* for our studies and to define the necessary *basic classifications*.

4.1 The Overall Concept of Anthropocosmos

Forty years ago, most people talking about cities spoke only of monumental buildings or slums, impressive avenues or narrow romantic streets. Later, discussion was mainly concerned with traffic problems and the preparation of technologically impressive solutions involving the construction of major highways. In the fifties, all the problems of life were believed to be social ones. More recently, they have been related to the natural environment and now to energy utilisation. So, in four decades, the image and concern about the 'city' as our system of life in the high income developed countries has shifted from buildings to transportation, then to society and now to nature and energy; although we know that in fact people all over the world suffer from much more complex situations than these fashionable attitudes would have us believe. We must not allow passing fashions and incomplete diagnoses to divert us from understanding the real problems or basic diseases of human settlements, and their causes.

We cannot even agree on which of the currently popular aspects we should concentrate our attention. At a recent important international meeting of influential people concerned with the 'environment' and the need to preserve it, most of the speakers concentrated on pollution by chemicals. But the personal reactions of the audience ranged from indifference to anger, because the discussion did not deal with social or

cultural problems, and no mention was being made of the need to save historical monuments. Each person had his own point of view, each view was perfectly valid, but there was no overall environmental concept. The result was confusion and chaos. We have not yet defined our subject, and therefore we can neither evaluate the present situation nor decide upon the road that we should follow.

There is much discussion at the present time about what it is fashionable to call the 'quality of life', but the debate is of no value in the absence of any classification of the relationship between quality and quantity in environmental issues, and without the realisation that what we are concerned with is a system of life, not just an assembly of separate components.

It seems to be accepted by some that the overall concept of a system of life can be achieved by imitating those countries which are the strongest from the economic point of view. The problems that we face in the anthropocosmos are related to global and local cultures: in seeking to find solutions we should not follow the example of any single country or group of countries, for even the most 'developed' ones have innumerable failures and difficulties to face over their human settlements.[46] It is clear that each of us tends to look at one part and a particular phase of the development of the anthropocosmos, but no one looks at it as a whole.[47]

Many of the mistakes that we have made can be attributed to development carried out in the absence of any understanding of relationships within the total system.

The answer to the lack of an overall concept for anthropocosmos and the way to resolve our confusion lies in the creation of a frame model on which we can build the whole study properly. We need to:

1. Define our total system of life, anthropocosmos, by creating a systematic frame so that any part can be clearly located in relation to the whole.
2. Define all relationships, causal or non-causal, that may exist between the various parts of the system so that we can understand their functions and changes.
3. Define a method for the evaluation (or measurement) of all parts of the system and their relationships (including those that cannot now be scientifically measured), so that we can recognise the relative importance of each.

4.2 The Human Settlements

The second task that we must undertake in our attempt to reach a position where we can maintain the balance between settlements and

surroundings, between ekistics and ecology, is to clarify the concept of human settlements. In both space and time dimensions we begin with the cosmos and come down to the biosphere, to anthropocosmos and then to human settlements, which are the latest and smallest of units.

Human settlements range from the very temporary, where the ground has been levelled for a night's sleep, to those that are semi-permanent or permanent; from nomadic tents to huge, immovable cities occupied by millions of people, cities that are ever-growing and merging into one human settlement, that is, into ecumenopolis.[48]

What are human settlements? Are they cities, villages, housing, people, society and buildings—or something else? In 1964 I proposed that the term human settlement be used to describe the territorial arrangements made by anthropos in the cause of his own survival, his safety and his happiness and for human development as we now conceive it.[49] A motion to adopt the term was defeated that year in the UN Committee on Housing, Building and Planning, but it has subsequently been accepted for general use, although there is still no agreed definition.[50] Human settlements are confusing because they are the most complex systems on the globe, two orders higher than cells and one order higher than bodies, if we follow Sir Julian Huxley's classification of individuals.[51]

Confusion about human settlements arises because in the absence of any systematic study of them we are unable to relate particular characteristics and problems with specific types of settlement. We lack **systematics**, or what Simpson[52] defined as 'the scientific study of the kinds and diversity of organisms and of any and all relationships among them' when speaking about animals.

It may be argued that human settlements are no different from each other and that any systematic study of them is impossible; yet there are greater differences between the various genera of plants and animals, and in spite of this we have both botany and zoology. How fortunate that Carolus Linnaeus was not deterred from the preparation of his botanical classification system and how necessary is a similarly systematic and scientific approach to human settlements. The question is: how can we achieve it?

In applying systematics to human settlements we are dealing with a much smaller number of specimens (no more than a few tens of millions,[53] excluding rooms and house units and considering only total systems from hamlets to cities) than with any kind of animal or plant. The very fact that we know of more than 300 000 species of plants and more than 1 000 000 species of animals demonstrates how different are the scales of numbers that we talk about. The number of which we are aware is increased by new discoveries and by new creations as a result of inter-breeding at the rate of between 10 000 to 20 000 species per year

and sometime we may speak of millions of species of **protista**, plants and animals; that is as many species as the total number of human settlements.

Human settlements started taking a specific form some 10 000 years ago, having first begun to appear some time in the late Palaeolithic period, perhaps 40 000 years ago, or even earlier. There is evidence from discoveries by Louis and Mary Leakey, of a construction involving flat floors and curved walls at Olduvai, Tanzania, that is more than 1 800 000 years old.[54] But even these buildings bear no comparison with plants and animals that have developed over hundreds of millions of years. Thus, our experience of the development of human settlements is based on knowledge over a completely different order of time scale than is our knowledge of animals and plants. On the other hand, the scale of human settlements allows us to see, feel and measure all phenomena about their birth, evolution and present situation. Many of these phenomena have to be assumed when we study animals, plants and cells.

The systematic and scientific approach that we badly need in our study of human settlements[55] is likely to be in many respects more difficult than is a scientific approach in zoology or biology and in other respects it will be less daunting. There is a long-term goal and in establishing ekistics,[56] the science of human settlements, we are on the road.

4.3 The Language

We need a common language and nomenclature because neither the overall concept (anthropocosmos, consisting of so many parts) nor our goal (to create and live in proper human settlements) can be realised if we do not understand each other through the use of a clear and common language.

A few examples will demonstrate the need for such a language. There is as yet no agreement at all about such basic terms as urban territory or urbanised areas although Charles Abrams made a pioneering effort in this direction.[57] The sciences related to our subject are inadequately described. Geography was defined as human ecology by Harlan Barrows in 1923[58] and different people attach different meanings to terms such as **Heimatkunde** and **Geopolitik**.[59] Our confusion becomes more apparent when we consider the elements of human settlements and speak of nature, of structures (are we really speaking of structure—or of form, in which case we really speak of **aesthetic morphogenesis**?) or of function. It is clearly easier to speak of and to define human settlements, such as hamlets or even villages, that are

physically separated than it is to define the parts of more complex urban areas. Despite Gottmann's very clear pioneering study[50] and later work in this field[61] there is still no agreement at the metropolitan and megalopolitan levels, nor about the definition of parts of towns. It is reasonable to conclude, as Beaujeu-Garnier does, that 'the definition cannot be the same for all times and all countries',[62] because in reality there are many more species than we imagine. We are forced to the conclusion that the terminology and nomenclature we use refers in most cases to very general categories only and not to more systematically defined taxa.

We have to develop a language so that people dealing with human settlements can understand one another, whatever native language they speak and wherever they work. This will involve the development of scales and standards which can be used for comparative studies and which can be the mechanism of the standard language as well as for the classification system, the derivation of which is our fourth task. This language must be clear and accurate and, where practicable, should incorporate existing acceptable agreed terminology.

I quote four instances which demonstrate the need for a more precise language of human settlements. First, instead of speaking only of highways, be they above ground or below it, we should in addition use the terms *surfaceways* and *deepways*. Secondly, when we use the term 'sidewalk' and teach our children always to walk at the side of the road, we forget that in so doing we indicate to them that we are the slaves of the machine that passes down the centre. One of the objectives of a humane anthropocosmos should be the separation of man and machine in many cases. This can be reflected in our language by adoption of the term **hustreet** for those for pedestrian traffic and **mecstreet** for those primarily for vehicular traffic.[63] We can combine this with the concept of highways, surfaceways and deepways to give a simple classification of roads and streets in which hustreets or huroads might be surface paths or deep paths and mecstreets or mecroads might be highways or deepways. Deepways should only be used for humans when there is no reasonable alternative. Thirdly, now that for the first time in history we use land, water and air transport we should indicate their separate roles as part of one system by the use of the term **lanwair**[64] (land, water, air) to encompass the transportation totality.

My fourth example demonstrating the need for and use of a new language of human settlements arises from the way in which many people consider only the built-up areas and forget the cultivated land and recreational space of parks and planting. This situation is increasingly confused with the expansion of the daily urban systems and of the increasing kinetic fields of anthropos.[65] It is imperative that we understand that human settlements consist of four basic types of

areas as explained in Part One, that is the naturareas, cultivareas, anthropareas and industrareas.

When there is a general understanding of the need for a language of human settlements and we start creating it we can open the road for our fourth and fifth tasks, the creation of a taxonomy and a classification system.

4.4 The Logical and Taxonomic Frame

The fourth task is a creation of a logical and taxonomic frame for the systematic understanding and classification of human settlements and the anthropocosmos. **Taxonomy** is the basis of 'the theoretical study of classification, including its bases, principles, procedures and rules'[66] and numerical taxonomy is a scientifically correct use of the principles.[67] In the absence of a proper systematic method, we have to use both Aristotelian logic, as Linnaeus did, and taxonomy which hopes 'to arrive at judgements of affinity based on multiple and unweighted characters without the time and controversy which seem necessary at present for the maturation of taxonomic judgements'.[68] Someday it may be possible to use only a well developed numerical taxonomy, but at present it would be inappropriate to place any reliance on a single approach. Although some geographers, including Peter Haggett, have considered the problem of taxonomy of regions,[69] there is to my knowledge no proposal for a total taxonomy of human settlements.

As ekistics has started late as a science, it should at least learn from the weaknesses and successes of other sciences and try to cover the gaps as early as possible. To select appropriate classification methods is difficult, but I give here a brief summary of my conclusions.

Classification of settlements usually involves very general categories, such as villages, towns and cities and there is a tendency to place undue emphasis on appearance, forgetting that a 'purely morphological definition must be subordinated to the concept that the species is composed of populations in which variability is inherent'.[70] Anatomy and other features matter more than appearance and a classification system must evaluate all characteristics.

There are arguments in favour of a classification system starting with the smallest settlements and working up to the largest elements, and other equally logical arguments based on the subdivision of large units into smaller components or subdivisions. I propose an ekistic system that combines both approaches and involves two basic characters, the dimensions of population (the more important one) and territory (the less important one) and combinations of these two characters. This is

not a new approach, as in most cases population is a basic character and experts like Berry and Garrison state that 'city-size relationships is a base on which to build or to relate city-size relationships to other relationships',[71] but it can lead us forward. The ekistic system uses an ascending incremental scale for the classification by population, increasing from a basic unit, whilst the territorial scale is based on the progressive subdivision of global space.

Unit 1 on the population scale is anthropos, a single person. The next unit, two persons, is important because of human relationships arising from social, psychological and sexual reasons. The third unit is the single family and I estimate it as consisting of five members because this looks quite normal for the present global average of between 4·4 and 5.[72] After the single family unit, we proceed by multiplying by a standard figure as there is no other logical way for subdivision of any human groups. This factor can only be by 7 as we will see later in relation to our examination of territorial units. In this way we construct the **ekistic population scale** (Table 4.1).

TABLE 4.1

Ekistic population scale (EPS)

EPS unit	*Settlement class*	*Persons*
15	Ecumenopolis	69 206 436 005
14	Eperopolis (continental)	9 886 633 715
13	Small eperopolis	1 412 376 245
12	Megalopolis	201 768 035
11	Small megalopolis	28 824 005
10	Metropolis	4 117 715
9	Small metropolis	558 245
8	Polis	84 035
7	Small polis	12 005
6	Neighbourhood	1 715
5	Small neighbourhood	245
4	Housegroup	35
3		5
2		2
1		1

The habitable space of the globe is the basis of the territorial scale and this I assume to be 135 750 000 km², excluding Antarctica which covers 14 245 000 km².[73] The subdivision is directly related to the notion of human settlements and proceeds on the basis of the only really practical theory of spatial organisation, by hexagons. This was first developed by Christaller[74] and has subsequently been adopted in a

number of studies.[75] This approach leads to the **ekistic territorial scale** (Table 4.2) in which Unit 18, the biosphere, has an undefinable area; Unit 17, habitable land, 135 750 000 km^2, is seven times the area of Unit 16, which with an area of 19 392 857 km^2 is seven times the next smaller

TABLE 4.2

Ekistic territorial scale (ETS)

ETS unit	*Settlement class*	*Square metres*					
18		000	000	000	000	000	000
17		135	750	000	000	000	000
16		19	392	857	000	000	000
15	Ecumenopolis	2	770	408	000	000	000
14	Eperopolis		395	772	000	000	000
13	Small eperopolis		56	538	000	000	000
12	Megalopolis		8	007	000	000	000
11	Small megalopolis		1	153	850	000	000
10	Metropolis			164	836	000	000
9	Small metropolis			23	548	000	000
8	Polis			3	364	000	000
7	Small polis				480	570	000
6	Neighbourhood				68	650	000
5	Small neighbourhood				9	800	000
4	Housegroup				1	400	000
3						200	000
2						28	059
1						4	084
−1							583
−2							083

unit and where Unit 1 corresponds to the human bubble[76] of 4 m^2. Units −1 and −2 represent standing persons and persons squeezed up to the maximum possible degree.

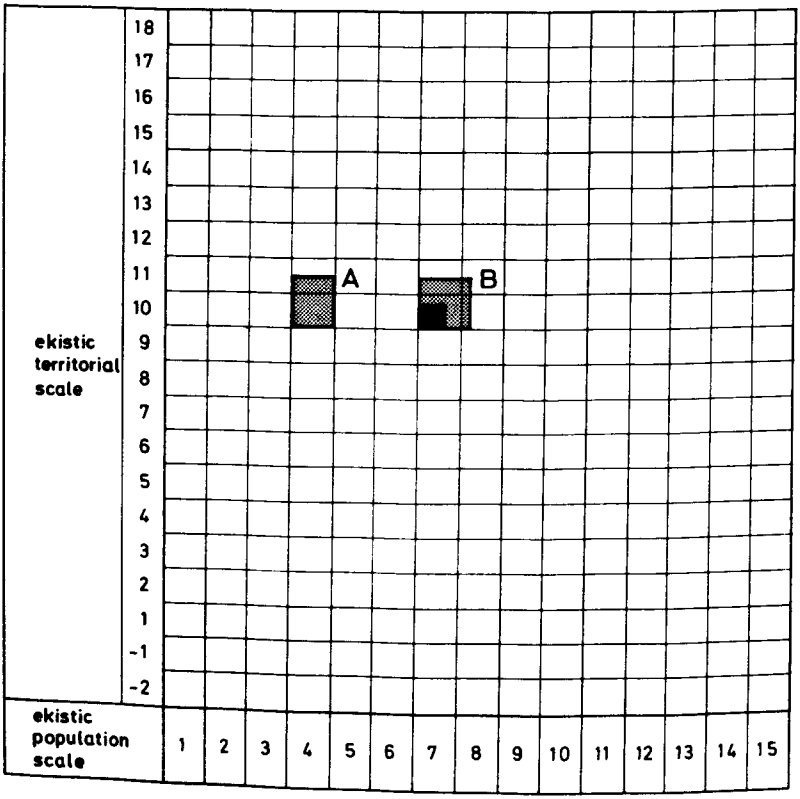
Combining the scales of the two characters, population with 15 units and territory with 20 units, we arrive at a total of 300 units defining relationships between anthropocosmos and human settlements, with a corresponding number of taxa based on the two characters.

4.5 The Basic Classification

Our fifth task is to devise a basic classification of human settlements. This is badly needed to enable us to clear up confusion and misunderstandings about the present lack of definition of our subject. The task is a huge one, for whilst we have to deal with at least 14 million

present day settlements[77] most studies in the past have dealt with the division of settlements into functional and service classes[78] or relate only to particular parts of settlements, such as shopping centres.[79] I present some first steps towards a basic classification of settlements.

A proper classification system will involve the consideration of a very great number of characters, but here I use only a few, sufficient to demonstrate the process to be followed. The combination of the two most important characters, population and territory, leads to a matrix of 300 classes, as shown in Figure 4.1. We cannot classify settlements adequately on this basis only but must also consider the range of the principal economic functions of each settlement. We must, for example,



A uni-level settlement of hunters' band
B two-level settlement of a small polis

FIGURE 4.1 Classification of human settlements on the basis of population, territory and number of levels

differentiate between the single function level of the settlement of a hunter's band and the two level function of a small polis, or town, which may serve its own territory and that of adjoining villages, as A and B, Figure 4.1, clearly indicate. With the introduction of additional classificatory characters, this approach can lead towards the development of models with a degree of detail appropriate for a specified range of tasks and can help our understanding of social organisation and social archaeology.[80]

4.6 Conclusion

By defining the five tasks and studying ways of fulfilling them we begin the process of understanding the anthropocosmos and human settlements and of escaping from our present chaos. But it is only the first step of the immeasurable number that we must take if we are to achieve a balance between our settlements and our acts of aggression against nature.

5

The Anthropocosmos Model

We have seen that in order to understand anthropocosmos we need a comprehensive model that will allow us correctly to locate any part within it, to define all relationships within the system and to evaluate parts of the system and their relationships. I have been working on the anthropocosmos for forty years and I have used and presented many tentative models in ekistic practice and theory,[81] the last one being the anthropocosmos model[82] that I have developed over the last four years (see Figure 1.1). After this experimentation, I now present the total model of anthropocosmos which can include every single element, cell, organ, individual, existing within it, as well as the different views and relations between them and our own criteria of quantity and quality.

The model can encourage and help interconnection between relevant disciplines, and help anthropos to discover what he wants (which he does not yet know) and how to achieve it, with harmony as the ultimate goal, and without the nightmare fears that have coloured much recent environmental thinking.

5.1 Basic Dimensions

In building the anthropocosmos model we must classify settlements in significant categories. Whilst species of plants and animals have disappeared and individual plants and animals live for a limited time, most human settlements that have been established remain in ever changing form to this day. Thus, unlike botany and zoology, ekistics is concerned with the problems of dynamic change. A town that is growing may have potentials and problems so different from a declining town of the same population that they must be separately classified. An ekistic classification must therefore be related to phase and stage of development as well as settlement type, the notion of developmental phases being somewhat akin to those in medical science. The classification of human settlements requires the use of several levels and ranks and I propose a pattern as used in zoological and botanical ranking, shown in Figure 5.1 as follows:

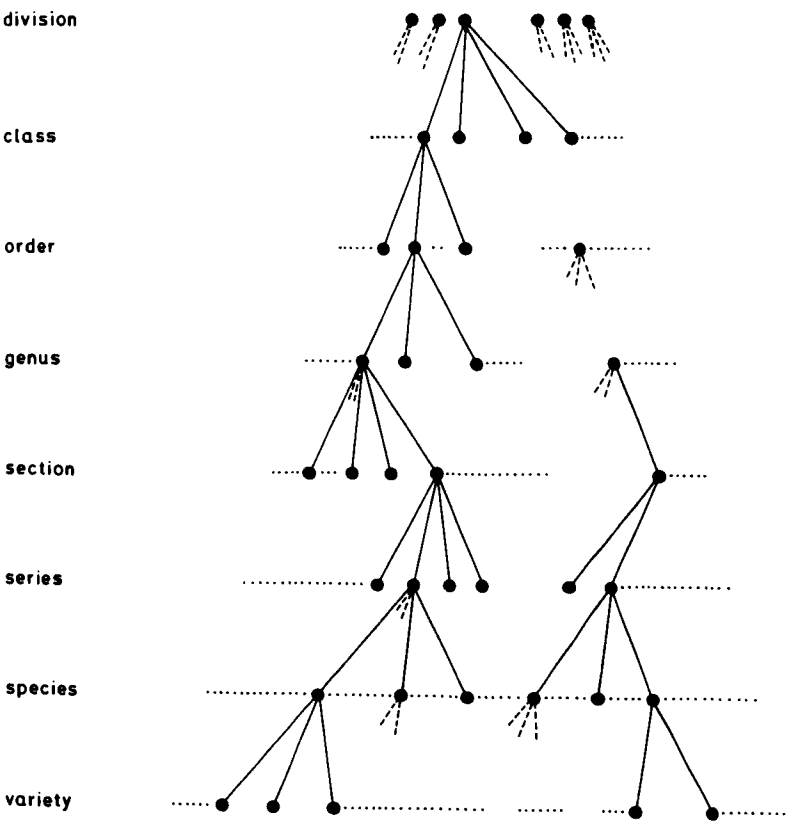


FIGURE 5.1 Part of the tree of fundamental classifications

Division (Basic dimensions and economic functions)
Class (Ekistic population)
Order (Central and peripheral)
Genus (Structure and function; compact, dispersed, etc.)
Section (Structure and function; natural, planned, both, static)
Series (Structure and function; radial, orthogonal, etc.)
Species (Satisfaction of five principles)
Variety (Satisfaction of five aspects)

Size causes little or no confusion in the proper classification of animals and plants, but as we have seen, dimensions are fundamental to the ekistic ranking of settlements. At present many people are misled by the use of the same term 'city', to describe major centres such as Peking and New York, each having many millions of inhabitants, as well as to describe infinitely smaller settlements, perhaps with a population of about 10 000. Only a system based on size can begin to overcome this

difficulty, additional clarification being given by the incorporation of economic criteria, differentiating places of similar size that perform different functions. These criteria may be included in developments of the basic grid frame of the ekistic population scale (EPS) and the ekistic territorial scale (ETS) grid.

The basic dimensions alone will prove inadequate properly to classify a settlement, for they convey a static picture and we need information that indicates a dynamic state. For example, even where administrative boundaries remain constant, economic and kinetic fields may grow immensely in some areas[83] in the manner characteristic of a dynamic polis or dynapolis.[84]The increased distance over which people travel to work each day is leading to new concepts about territorial units related to cities and broader geographical subdivisions[85] and to guidance for their futures.[86]

5.1.1 Classification by Basic Dimensions

The design of the theoretical frame should be followed by an actual classification by divisions and at present this is completely missing.[87] I propose six basic divisions, comprising respectively the hunting, cultivating, industrial, urban, central and mixed human settlements. There are two subdivisions for each type: the one-speed (human and animal) and multi-speed (humans and animals and trains, motor cars, etc.). Thus we have a total of six divisions and 12 subdivisions. Examples are shown in Figure 5.2.

The subdivisions are further divided into classes on the basis of dimensions of population and territory. The population hierarchy, with units ranging in size from EPU4, housegroup, through polis, EPU8, and megalopolis, EPU12, to the largest unit, EPU15, ecumenopolis, is shown on Table 4.1.

A simple case has already been demonstrated for the classification into divisions of primitive hunting and cultivating settlements (Figure 4.1). A large number of different ages in many parts of the world, have yet to be identified as belonging to the same division in the classification system: by the application of dimensions this can be done and they can be compared properly. An example may be found in the comparison between the settlements of the Neolithic chiefdoms in Wessex, England[88] and the ancient Greek **Komai**: all probably belonging to the same division, **ekistic population unit** 5 or 6 and **ekistic territorial unit** 9. As a second example we may compare the basic dimensions of primitive towns such as Early Bronze Age (about 3000 B.C. to 2300 B.C.) settlements in Palestine with Greek towns of the archaic and classical periods (800 B.C. to 300 B.C.). This comparison demonstrates that the polis was probably created in territories of a similar order and with an average radius of about 7·5 to 10·4 km.[89]

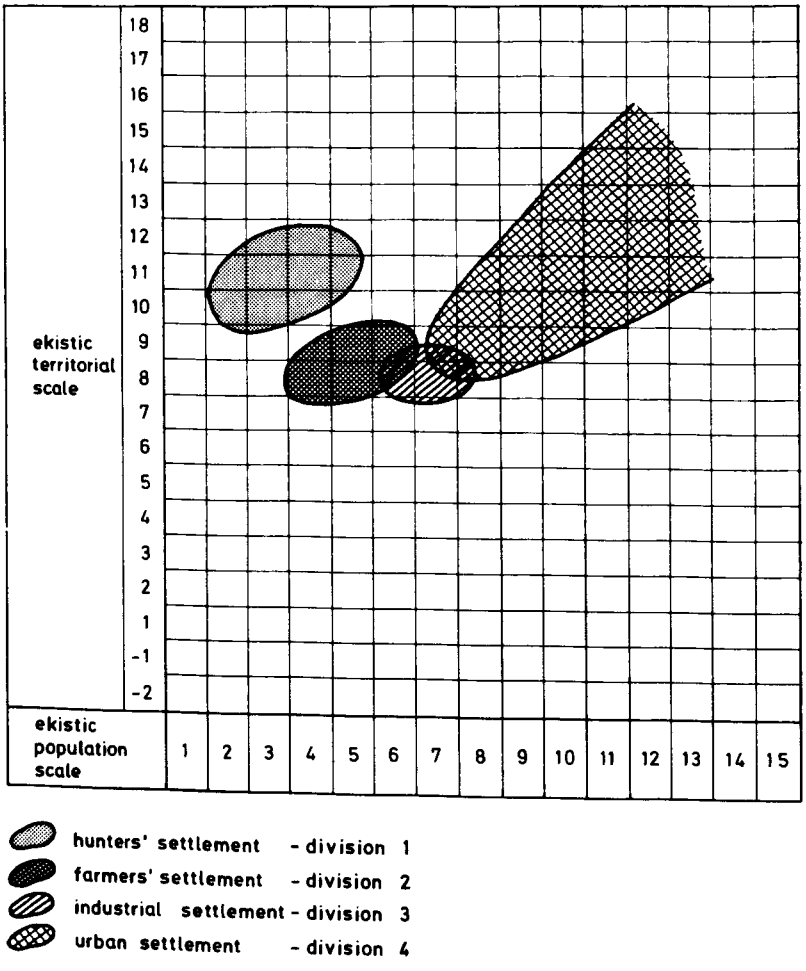


FIGURE 5.2 The model of basic dimensions: classification of human settlements on the basis of population, territory and basic economic functions

The hierarchical classification of settlements using the ekistic population scale (EPS) is not by itself sufficient to classify them properly: for this purpose it must be combined with the **ekistic territorial scale** (ETS). We know that megalopolises range from 28 to 201 million people (EPS Units 11 and 12, Table 4.1) and on the basis of numbers of people we might classify the Chinese Empire as a megalopolis, yet to do so would clearly be wrong. Imperial Peking with a population of 1 million was a small metropolis serving a population of perhaps 100 million. It should, therefore, be classified differently from both a modern

metropolis of 1 million and a modern megalopolis of 100 million. When we make this comparison of territory covered[90] with that of the north-eastern megalopolis of the USA[91] we understand how different they are and how important it is to use the EPS and ETS scales in combination. This is shown in Figure 5.3 where a central settlement of Class 7 on the **ekistic population scale** and Unit 9 on the ekistic territorial scale (population 12 000 persons; area 2 354 000 hectares), serves peripheral

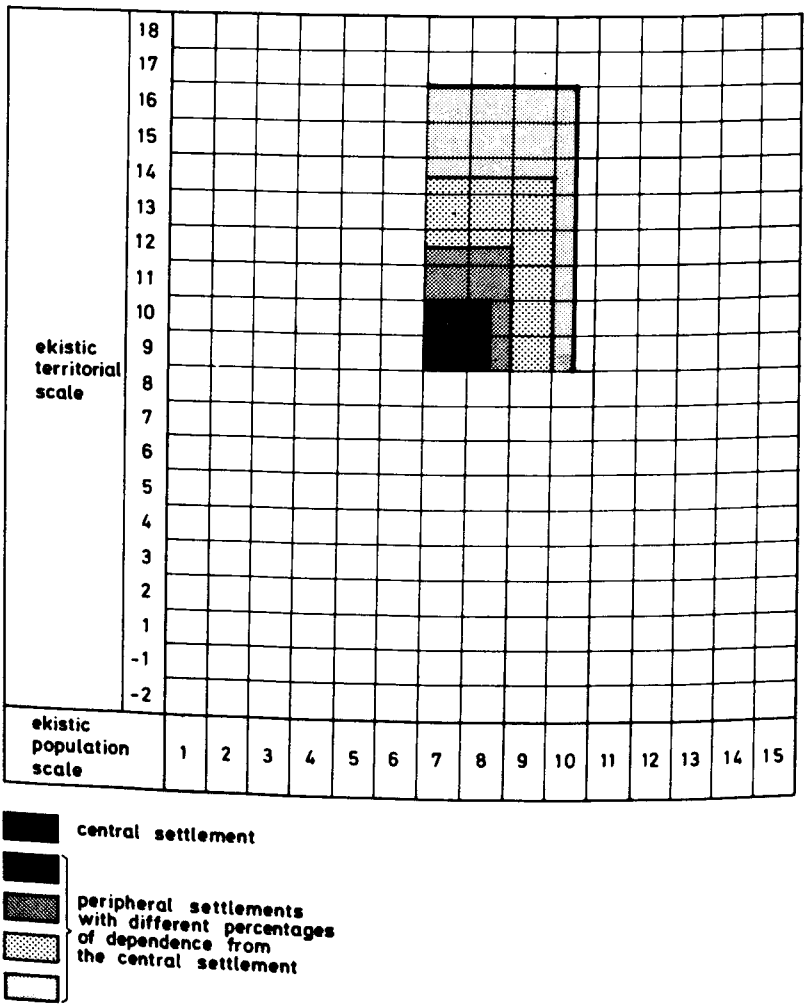


FIGURE 5.3 Central and peripheral human settlements on the ekistic model of population and territory

settlements of Unit 10 on the ekistic population scale and Unit 16 on the ekistic territorial scale (population about 4 million, area approximately 1 940 000 000 000 hectares).

Moving from classes to *orders* we see how central human settlements having the same population may through the multi-level system of peripheral settlements in their field of influence serve populations and areas of very different size and character. This is illustrated in diagrammatic form in Figure 5.4, where a small metropolis, EPU9, may also serve EPU10 and EPU11. The territorial units served may range from ETS10, to ETS15 or even 16 in less densely populated areas. Thus for a settlement in the small metropolis class we can have as many as 20 sub-orders.

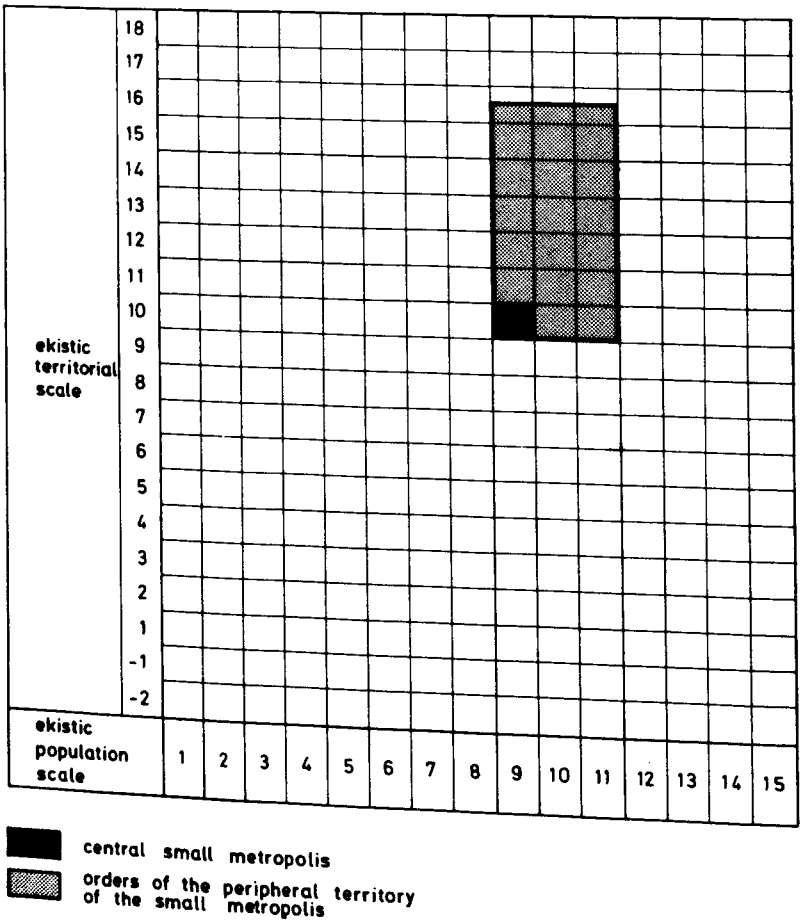


FIGURE 5.4 The small metropolis in its total urban system

5.2 The Structure and Function

After the systematic classification of human settlements by basic dimensions we can consider their categorisation by structure and function. The greatest mistake that one can make about settlements is to consider them as if they were static, whereas in reality they are complex and dynamic.[92]

Examination of the structure of human settlements can be misleading in itself for many analyses overlook the fact that the interests of anthropos extend far beyond the built-up area and that area itself often includes substantial unbuilt space, used for parkland and sports grounds. Human settlements are best considered as consisting of the four types of areas already discussed: the *naturareas*, where anthropos is only a visitor and hunter; *cultivareas*, where anthropos is cultivating nature; *anthropareas*, where anthropos lives and uses nature's territories for all expressions of his life, from houses to work, entertainment and sports; and *industrareas*, where anthropos transforms resources, as in industrial processes or mining.

The structure of a settlement depends on the relationship between the four areas and this can be understood first through the dimensions of the areas and then from examining the structure of each area, considering separately the five ekistic elements, nature, anthropos, society, shells and networks. For example, the general density indicates the relationship between nature and anthropos, whilst housing density measures the relationship between anthropos and shells in a part of the anthroparea. In this way we can measure all human needs involved in the physiological, aesthetic and psychological relationship of anthropos and space.[93]

Without time dimensions, interaction and function do not exist in any living system. The model of structure and function, Figure 5.5, indicates the relationship between the ekistic elements and the human settlement in terms of time, the ordinate showing the creative forces and the abscissa recording the time when the events or actions took place and their duration. In this way we can appreciate dynamic forces influencing settlements.[94]

5.2.1 Classification by Structure and Function

The most important structural characteristics are the four basic types of land area and it is at this point in our classification system that we begin to talk of *genera*. The important differentiations are between compact and dispersed settlements and the number in each category depends on how we measure their size and density. Classification can be based on the central settlement only or on the total one, including the whole spatial system, but as the total system can be very complex in

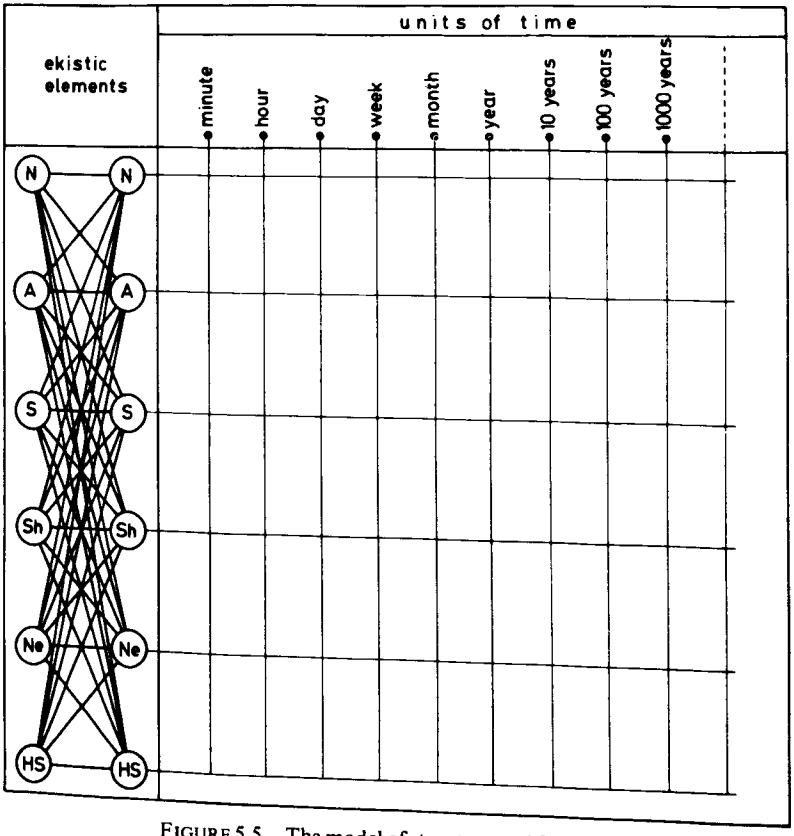


FIGURE 5.5 The model of structure and function

multi-level human settlements, the best approach is to regard the central human settlements as genera in our classification system, the different relationships between central settlements and their peripheral areas being classified as sub-genera.

In the next stages of classification, as shown in Figure 5.1, we consider sections and series. The *sections* depend on the forces of creation of human settlements, whether natural, completely planned or mixed. Subsidiary classification into subsections is made on the basis of when the settlement developed and how long it lasted. The *series* depend on the physical structure alone, for both planned and unplannned settlements can be radial or orthogonal, simple or monumental.[95]

5.3 Human Satisfaction

In our consideration of environmental quality we must always

remember that our goal is human happiness and safety for human development. We can measure our success in achieving this goal in very many ways and we can speak of anthropos in general, of a particular group, or a special individual. It is best that we should first be sure of the feelings of anthropos on a global basis and later consider groups and individuals on a local basis.

We use every possible value as a criterion for our judgement of the quality of the environment without dividing the criteria into different categories. Basic dimensions can be criteria for identity and taxonomy, but not for quality. We need criteria for dimensions, structure, function and time, all of which I have discussed and for quality and satisfaction which I describe here.

The assessment of satisfaction poses many problems, both dimensional and non-dimensional. The density inside the anthroparea according to ETU and in relation to shells is one partial measure of satisfaction, but does not provide a complete answer, if we do not clarify whether we evaluate a situation from the economic, social, political-administrative, technological, or cultural aspect. Again, our judgement depends on whether we speak of desirability or feasibility. Thus we are led to the model of satisfaction, Figure 5.6 which completes the total picture in terms of quantities and qualities.

5.3.1 Classification by Human Satisfaction

After classifying settlements down to the level of *series* on the basis of dimensions, structure and function, we continue classification amongst *species* on the basis of the extent to which settlements satisfy five basic principles or ekistic requirements, which have guided mankind throughout history. These we show in Figure 5.6 and relate to the maximisation of contacts, the minimisation of effort, and the optimisation of protective space, of the quality of the total environment and in the synthesis of all principles. These can help in the evaluation of dimensional and non-dimensional factors.

The model of satisfaction Figure 5.6 enables us to resolve some of the confusion concerning the meaning of satisfaction. If some of the inhabitants of a small and beautiful 'ideal' polis say that they do not like it because it does not have a university or a big hospital or enough jobs, this means that they do not like this *species* of settlement and would prefer a larger one, perhaps a metropolis. Similarly, a cat can be the most beautiful cat in the world, but a person may hate it because he only likes horses or dogs: his preference is related not to quality but to the kind of animal. Through this type of approach we can also learn whether an 'ideal' town which is beginning to be abandoned (because the first and second principles of satisfaction are not being met) could improve its prospects for the future by developing better connections

aspects / principles	desirability					feasibility				
	E	S	P	T	C	E	S	P	T	C
1. maximum of contacts										
2. minimum of effort										
3. optimum of protective space										
4. optimum of quality of the total environment										
5. optimum in the synthesis of all principles										

FIGURE 5.6 The model of satisfaction

through high speed routes and also whether such action would or would not be feasible. Whether or not a principle is satisfied may be due to the failure to satisfy one or more of the aspects, or all of them.

Such a classification proceeds into the last rank, *varieties*, which depend on how many and which aspects are satisfied and how many are not. It is at this stage that we can understand how the most beautiful and developed town on an island or mountain may come to be abandoned. It may satisfy all five principles from the political, technical and cultural aspects, but not the first principle from the economic and social aspect. Failure in relation to two of the 50 criteria of the model (Figure 5.6) is enough to lead a human settlement to disaster. Failure of the settlement will be inevitable unless its function can be changed to that of a variety of settlements, all of whose characteristics it has.

5.4 The Total Model

Through continuous classification we have reached the point where we can formulate the framework of the anthropocosmos model, which incorporates dimensions, parts, elements, structures, functions and criteria. To achieve this we have to merge all three models so far presented (Figures 5.2, 5.5, 5.6) into one total model. From Figure 5.7 we see that the model of satisfaction (Figure 5.6) represents a small part of the model of structure and function (Figure 5.5) which in turn represents a small part of the basic dimensions model (Figure 5.2). The anthropocosmos model, Figure 1.1, incorporates everything in the same grid and clarifies the overall concept of the anthropocosmos. This model can help us conceive the ideal yet feasible human settlements that we need. Obviously, the simplified way in which it is presented here makes it impossible to incorporate all aspects and every order of dimensions of the city, some of which are at present immeasurable. A glance at a single book on human geography[96] will show how many aspects there are to one well-developed discipline and we can speak of 500 million parts of the total model.[97] What the model does is to provide a frame for the ordering of later information and for the identification and classification of problems and relationships; the preparation of algorithms, operations research[98] and exact calculations by computer for which it has to lead to code numbering.

The model thus represents the classification process already presented (division, class, order, genus, section, species, variety) and shown in Figure 5.1.

The frame of the model can be used as a whole[99] or its use can be limited to any two of the six basic characters (for example, ekistic population scale and elements, or criteria and elements) or in detail to any of their parts (for example climate, part of nature, and anthropos).[100]

5.5 Conclusion

To escape from the ecological crisis that faces mankind and to overcome the chaotic situation in our settlements requires that we first define the tasks facing us and determine ways of carrying them out; and, second, that we merge the tasks into one anthropocosmos model in the manner attempted here. In doing this we find that in the absence of any single discipline covering the range of the anthropocosmos model, people of one discipline accuse those of other disciplines of failure of understanding or of action; rather as an architect might blame an engineer for defects in his buildings or as a planner might accuse an

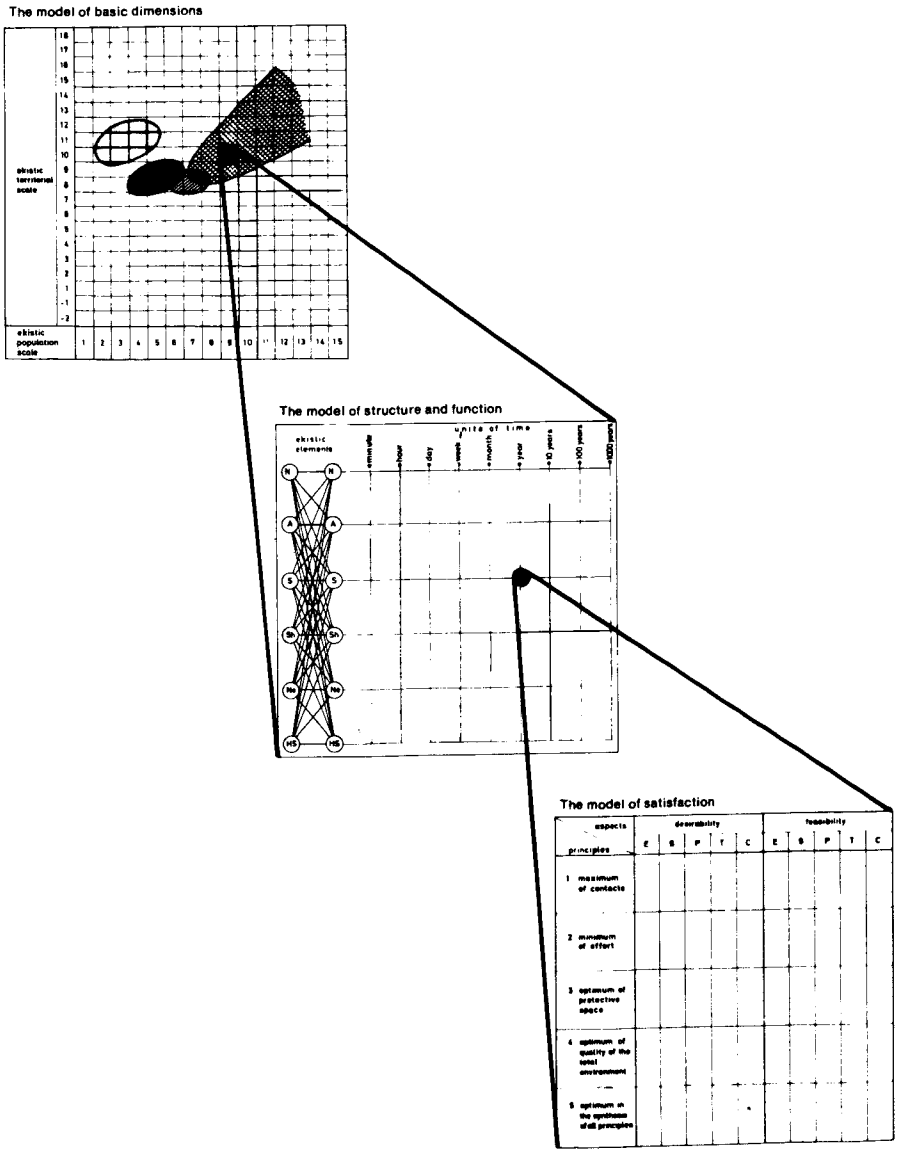


FIGURE 5.7 Combination of three models (Figs. 5.2, 5.5, 5.6)

economist, or perhaps a politician of causing the shortcomings in a plan or development programme. Only when work in all the relevant disciplines is properly related and co-ordinated will we be able to help anthropos to decide what he really expects of his settlements and how he can achieve it: only then will aggression and settlements, ecology and ekistics be in balance.

6

Epilogue

In the first part of this book we looked at the effort that will be necessary in ecology and ekistics if we are to attempt a first definition of ways of achieving a balance between natural and man-made environments on the earth's surface. Ways of attaining this common goal or an empirical basis without full scientific knowledge, were discussed. This approach is in some ways experimental, but we should not forget that there is no other way if we are to start moving towards a global ecological balance today and not at some far distant date.

In Part Two, something very different has been attempted following a completely different approach. In the belief that science can guide us, and in the knowledge that no existing science covers the whole world of humans, we begin the process of formulating a new science. As the world of humans consists mainly of parts made by nature or by mankind we start to bring together the disciplines concerned with each. The closest to our needs of the many disciplines related to nature is ecology: I have, therefore, chosen it as the one with which connection should be made. As the anthropos-based parts are more closely linked with technology than by specific sciences I chose a discipline which is connected with all aspects of human settlements and is in the process of becoming a science. That discipline is ekistics, and it is also the one that I know best. Thus, in this part, an attempt has been made to connect disciplines, technologies and sciences in the process of understanding the anthropocosmos, the world of humans.

Thus, two processes have been started here. One is essentially practical and can help us through trial and error to do what is necessary, immediately: the other is theoretical and can lead us gradually to the development of the science of human settlements. The parallel progress of these two approaches is the safest road to follow, because if both are developed simultaneously each will benefit from the other. We must, therefore, continue with both approaches in a number of ways, of which the following are the most important.

Firstly we must make as many attempts as possible to reach ecological balances at different scales in all parts of the world. This study has been mainly concerned with a global ecological balance and on the basis of size that will be the most difficult to achieve. We can, however, begin at the level of the polis or even the village group and

learn from our experience. Instead of thinking of urban planning and considering human needs only, we must try ekistic planning which includes nature and can lead us to the balance that we need between nature and anthropos.

Secondly, ecologists and ekisticians working together on research projects will learn much from each other about both sciences and thus will help to make the necessary connections in the whole system of anthropocosmos, which is our ultimate goal. Ekistics has been developed by bringing together architects, planners, engineers, sociologists, economists, geographers and others: it is time to take a further big step by a similar process of co-ordination between ecology and ekistics.

Thirdly, we must introduce co-ordinated education programmes. All those who are studying architecture, planning, economics and other subjects concerned with humans and their settlements should also be required to study basic ecology. Similarly, those studying ecology, geography and related disciplines should be required to learn about the elements of ekistics. In this way we will help to establish firm connections between disciplines and attract to this area of activity those few young minds interested in inter-disciplinary innovation.

Following this road and using these approaches, we will be able, in the future, to avoid the present day misunderstandings and conflicts amongst those who approach our subject with different points of view and from different disciplines. We will help them to bring their views closer together and so make more realisable the goal of achieving an ecological balance between the natural world and that made by humans. In this way humanity will someday celebrate the redirection of the human energy that now goes into aggression against nature, towards the development of the balanced human settlements that we need.

Notes and References

1 *The Delos Symposia*

The first Delos Symposion was held in the Summer of 1963 when 34 international experts met together, at the invitation of C. A. Doxiadis, to discuss the world crisis in human settlements. Their discussions were sufficiently fruitful for the Symposion to become an annual event, and in the years from 1963 to 1972 ten Delos Symposia were held in the relaxed atmosphere of a cruise ship sailing around the Greek Islands. The participants varied in age, nationality, sex and profession. The thing they had in common was a keen interest and deep concern in the plight and the development of human settlements, including both the deteriorating cities of the 'rich countries' and the rapidly growing cities of the 'poor countries'.

At the conclusion of each cruise participants assembled in the fourth-century amphitheatre on the island of Delos and there listened to a reading of a 'declaration' that recorded the gist of their week-long discussions. These records, which were drafted by Barbara Ward or Margaret Mead, had been circulated and amended by the participants before their formal presentation to the gathering.

The 224 Delians who participated in one or more of the first group ot ten Delos Symposia came from a great number of different countries at all stages of technological 'development' and represented the whole range of disciplines and professions involved in the formation and development of human settlements. Each Symposion had a major theme, and each was reported at some length in a special issue of the journal *Ekistics*.

1963 'The present crisis in human settlements', *Ekistics*, 95, October 1963.

1964 'A framework for a new discipline of human settlements', *Ekistics*, 107, October 1964.

1965 'Problems of living at high densities', *Ekistics*, 119, October 1965.

1966 'Nature and human settlements', *Ekistics*, 131, October 1966.

1967 'Strategy for the development of human settlements', *Ekistics*, 143, October 1967.
1968 'Man and his settlements', *Ekistics*, 155, October 1968.
1969 'Society and human settlements', *Ekistics*, 167, October 1969.
1970 'Networks and human settlements', *Ekistics*, 179, October 1970.
1971 'Our buildings (Shells) and human settlements', *Ekistics*, 191, October 1971.
1972 'From knowledge of the past to action for the future', *Ekistics*, 203, October 1972.

Since 1972 the Delos Symposia have been held under the auspices of the World Society for Ekistics.

The World Society for Ekistics

Following the second Delos Symposion held in 1964, a number of the participants decided to form the World Society for Ekistics, with the following aims:

To promote the development of knowledge and the ideas concerning human settlements by research and through publications, conferences, scholarships, etc.;

To encourage the development and expansion of education in ekistics;

To educate public opinion concerning ekistics, thus stimulating worldwide interest and co-operation;

To recognise the benefits and necessity of an interdisciplinary approach to the needs of human settlements, and to promote and emphasise such an approach.

The World Society for Ekistics has been accepted as an International Non-Governmental Organisation in Consultative Status with the United Nations. The invited membership is restricted to people who are aware of the grave problems confronting all human settlements and who are personally involved in the co-operation and positive action that is necessary to solve these problems and contribute to the improvement of the human environment.

The Officers of the World Society of Ekistics from its inauguration to date have been:

1967–69

President:	Lord Llewelyn-Davies
Vice-Presidents:	A. B. K. Brohi

	R. Buckminster Fuller
	Roger Grégoire
Sec. Gen./Treasurer:	P. Psomopoulos
Members of Council:	C. A. Doxiadis
	Jean Gottmann
	José Ramón Lasuén
	Margaret Mead
	Alfred Otoo
	C. H. Waddington

1969–71

President:	Margaret Mead
Vice-Presidents:	R. Buckminster Fuller
	J. Gorynski
	Roger Grégoire
	Sir Robert Matthew
Sec. Gen./Treasurer:	P. Psomopoulos
Members of Council:	C. A. Doxiadis
	Jean Gottmann
	Eiichi Isomura
	Barbara Ward (Lady Jackson)
	José Ramón Lasuén
	C. H. Waddington

1971–73

President:	Jean Gottmann
Vice-Presidents:	Robert A. Aldrich
	J. Gorynski
	Eiichi Isomura
	Sir Robert Matthew
	Vikram Sarabhai (to January, 1972)
Sec. Gen./Treasurer	P. Psomopoulos
Members of Council:	Karl W. Deutsch
	G. Gusti
	T. A. Lambo
	Margaret Mead (Past President, *ex-officio*)
	Jérôme Monod
	Barbara Ward (Lady Jackson)

1973–75

President:	Eiichi Isomura
Vice-Presidents:	J. Gorynski
	T. A. Lambo

	Sir Robert Matthew (up to 23 June, 1975) (also acting President)
	Jérôme Monod
Sec. Gen./Treasurer:	P. Psomopoulos
Members of Council:	Hans Asplund
	J. R. Bhalla (July to September, 1975)
	Jean Gottmann (Past President, *ex-officio*)
	Charles M. Haar
	Alexander B. Leman
	Reginald S. Lourie
	Amos Rapoport
	Barbara Ward (Lady Jackson)

1975–77

President:	R. Buckminster Fuller
Vice-Presidents:	Gerald B. Dix
	Laila S. El-Hamamsey
	Roger Grégoire
	Charles M. Haar
Sec. Gen./Treasurer:	P. Psomopoulos
Members of Council:	Hans Asplund
	J. R. Bhalla
	Eiichi Isomuira (Past President, *ex-officio*)
	Alexander B. Leman
	Reginald S. Lourie
	Miloš R. Perović
	Amos Rapoport
Secretariat:	The Athens Center of Ekistics, P.O. Box 471, Athens 136, Greece.

In addition to taking responsibility for the Delos Symposia since 1972, the World Society for Ekistics has also held a series of meetings on education for ekistics over a period of several years, and a number of regional conferences in different parts of the world.

2 C. A. Doxiadis, *Ekistics: An Introduction to the Science of Human Settlements*, Hutchinson, London, and Oxford University Press, New York, 1968.

3 EKISTICS—ΟΙΚΙΣΤΙΚΗ: the problems and science of human settlements, monthly journal published by the Athens Technological Organisation, 24 Strat. Syndesmou Street, Athens 136, Greece.

4 C. H. Waddington, 'Values, life styles and the future of the technological society', *Anticipation*, **17**, May 1974, p. 38.

5 C. A. Doxiadis and J. G. Papaioannou, *Ecumenopolis: The Inevitable City of the Future*, Athens Publishing Center, Athens, 1974, pp. 267–8, and W. W. Norton, New York, 1976.

6 Marshall I. Goldman, 'The convergence of environmental disruption', *Environmental Psychology: Selected Readings*, Caroline Toepfer *et al.*, eds., MSS Information Corporation, New York, 1972, p. 255.

7 Ibid.

8 Konrad Lorenz, *Civilised Man's Eight Deadly Sins*, Methuen, London, 1974.

9 Philip L. White and Diane Robbins, eds., *Environmental Quality and Food Supply*, Futura Publications, Mount Kisco, New York, 1974.

10 For years I thought that 'anthropos' (the ancient Greek word for human) would be better than the English word 'man' to describe human beings or mankind, because the word 'man' is also confused with the masculine gender. Now the American Anthropological Association has passed a resolution (November 1973) and taken the following decision: 'In view of the fact that the founders of the discipline of anthropology were men socialised in a male-dominated society which systematically excluded women from the professions and thereby prevented their participation in the formation of our discipline, including its terminology; and being trained as anthropologists to understand that language reinforces and perpetuates the prevailing values and socio-economic patterns that contribute to the oppression of women; we move that the American Anthropological Association:

a. urge anthropologists to become aware in their writing and teaching that their wide use of the term "man" as generic for the species is conceptually confusing (since "man" is also the term for the male) and that it be replaced by more comprehensive terms such as "people" and "human being" which include both sexes.

b. further urge that members of the Association select textbooks that have eliminated this form of sexism which has become increasingly offensive to more and more women both within and outside the disciplines.

I agree with this basic goal and throughout this book have used the word *anthropos* (plural *anthropoi*) as meaning human of both sexes. Unfortunately, however, because of the grammatical structure of the English language, in several instances it has been

impossible to avoid the use of masculine pronouns when referring to *anthropos*.

11 C. A. Doxiadis, *The Great Urban Crimes We Permit by Law*, Lycabettus Press, Athens, 1973, pp. 36–9.

12 C. A. Doxiadis, 'The future capacity of our container', a paper submitted to the IFIAS Workshop held at the Athens Center of Ekistics, 13–17 May 1974. This paper summarises studies made over 40 years into *one* aspect of the earth's capacity, in terms of human settlements. In this area it is possible to define capacity for the foreseeable future on the basis of historical studies over the period of the evolution of mankind, related to his normal physiological and psychological needs.

Before the agricultural revolution the whole globe was capable of supporting 350 000 tribes of hunters, totalling 25 million persons at an average density of 300 hectares or 3 km^2 per person. Evidence points to an actual population of only 4 millions, utilising only 16% of global capacity, but with many people living in camps or caves at an average density of several hundred per hectare. Figure 1.2 compares capacity and actual population at different times in history. We conclude that global capacity was defined by anthropos' productivity but that the density within settlements was different. With the start of civilisations, improvements in agriculture and the growth of towns and villages, global capacity increased to 5 billion people. Within the settlements, density remained at a few hundred per hectare, and was lower in the larger cities, particularly when there was no danger of attack. Thus, as a result of the agricultural revolution 10 000 years ago and of subsequent urbanisation, global capacity increased 200-fold, from 25 million to five billion. In reality world population only reached one billion in 1825 when anthropos was utilising 20% of the total global capacity.

We may ask, what is today's global capacity in terms of anthropos' space requirements? If the entire land surface, including deserts and polar areas, were to be occupied by one city at the present density of 90 persons per hectare, the total capacity would be 1 336 billion people, or 380 times more than the present world population. If the habitable areas only were occupied the total capacity would be half that figure, 668 million people. This would mean that outside the great city of anthropos only uninhabitable areas would be available for recreation, which would have to be camel riding or ski-ing. Making the normal provision for recreation of double the built-up city area, global capacity would be 223 billion people, or 64 times more than at present.

Under these conditions there would be no space for farms and food would have to be produced in factories *inside* the cities or be imported from other planets. This is not a practical possibility even in the very distant future. We have tried, therefore, to calculate the percentage of land which should be left for food production. After making adequate provision for water resources we concluded that about 90% of habitable land should be left for agriculture, forestry, etc. This would leave sufficient space for settlements, having a total global capacity of 22 billions, or about six times greater than at present.

We conclude that unless we assume a change in anthropos' living habits, self-sustaining global capacity can grow to no larger than six times the present population, and as long as he continues trying to maximise his potential contacts and to minimise use of effort and energy to reach them, population density will be unchanged.

By trial and error, anthropos has always managed to achieve a balance between himself and nature, and as a result the majority of villages, towns and cities survived. In the past people did not seek to answer the specific scientific problems we pose today, but they found the balance in a practical way.

On this basis, paralleling scientific research on all global problems, let us take some basic decisions on the use of the global territory and start implementing them. If experience shows they were not the wisest decisions they can be revised. Let us establish two programmes, one for long term detailed scientific research and the other for immediate action. I am already working on the second one.

13 C. A. Doxiadis, 'The four explosions of our cities', paper delivered at the International Convocation on the World Population Crisis, New York, 19–20 June 1974. Also published in *Ekistics*, **38**, October 1974, pp. 229–32.

14 'The Ancient Greek Cities' project of the Athens Center of Ekistics is creating an archive of information on ancient Greek cities in order to understand better the evolution of human settlements. I. Travlos, M. Petropoulakou, E. Pentazos. 'Athens: ekistic elements—first report', Athens Center of Ekistics Monograph Series, Research Report No. 17, 1972.

15 Doxiadis, *The Great Urban Crimes We Permit by Law*, op. cit., pp. 11–16.

16 Philip W. Quigg, 'World Environment Newsletter', *Saturday Review/World*, 29 June 1974, p. 21.

17 Doxiadis, *The Great Urban Crimes We Permit By Law*, op. cit., pp. 25–30.

18 Christopher D. Stone, *Should Trees Have Legal Standing?*, William Kaufman, Inc., Los Altos, Calif., 1974.
19 Doxiadis, 'The four explosions of our cities', loc. cit.
20 C. A. Doxiadis, *Anthropopolis: City for Human Development*, Athens Publishing Center, Athens, 1974, and W. W. Norton, New York, 1975.
21 Richard N. Gardner, 'The politics of the oceans', *Dialogue*, **7** (1), 1974, p. 92.
22 Jacques Cousteau, 'Investigating the sea', *Dialogue*, **7** (1), 1974, p. 100.
23 Philip W. Quigg, 'World environmental newsletter', *Saturday Review/World*, 13 July 1974, p. 35.
24 Jan Sjöby, 'Pollution may help solve the hunger problem', *International Herald Tribune*, 20 August 1974.
25 Terry Robards, 'Ecology wins over oil in British decision', *International Herald Tribune*, 13 August 1974.
26 Cousteau, loc. cit.
27 Doxiadis and Papaioannou, *Ecumenopolis: The Inevitable City of the Future*, op. cit.
28 C. A. Doxiadis, 'Movement in the future: the new transportation systems in ecumenopolis', paper presented to the Royal Aeronautical Society Spring Convention, London, 15 May 1974.
29 UNESCO Programme on 'Man and the biosphere' (MAB), Paris, London, Montpellier, 1971–72. MAB Report Series Nos. 1, 2, 3, 4, 5, 6 and 7.
30 E. Mann Borgeses, *Pacem in Maribus*, Dodd, Mead and Co., New York, 1972. 'Pacem in Maribus' Research Project on Mediterranean Development and its Relations with the Marine Environment, Project Director: Professor Norton Ginsburg.
31 IFIAS, International Federation of Institutes for Advanced Study. See Glossary.
32 *1973 Nature/Science Annual*, 'Summing up the year', Time-Life Books, New York, 1972, p. 181.
33 I. E. Houk, *Irrigation Engineering*, Vol. 1, John Wiley and Sons, Inc., New York, 1957.
34 H. E. Babbit, *Sewerage and Sewage Treatment*, John Wiley and Sons, Inc., New York, 1953.
35 E. R. Andrews, 'History of Samos 700 B.C.–70 A.D.', American School of Classical Studies, School Papers, Athens, 1929.
36 M. Gayn, 'For water the Chinese move mountains', *International Wildlife*, November/December 1972, p. 25.
37 Ibid.
38 Doxiadis, *Ekistics: An Introduction to the Science of Human Settlements*, op. cit., pp. 29–31.

39 Doxiadis and Papaioannu, *Ecumenopolis: The Inevitable City of the Future*, op. cit., pp. 10–12.

40 Doxiadis Associates International, Consultants on Development and Ekistics (Strat. Syndesmou 24, Athens 136, Greece), was founded by C. A. Doxiadis in 1951. With a staff of about 700, the firm has conducted planning and development activities in forty countries. Activities have included the planning and development of new cities and the renewal of existing urban centres, the development of university and industrial complexes, and the study and planning of multi-national regions. Doxiadis Associates International has several affiliated companies and regional offices in Brazil, Germany, Iran, Jordan, Nigeria, Pakistan, Saudi Arabia, Spain and Zambia.

Doxiadis Associates Inc. (1058 Th. Jefferson Street, N.W., Washington D.C. 20007, U.S.A.) affiliated with Doxiadis Associates International, is a US corporation providing design, planning and development services on projects ranging in size from single buildings to entire urban regions. DA Inc. was founded in 1959 by C. A. Doxiadis, who was Chairman of the Board of Directors and Chief Executive Officer.

41 See Glossary for definition. The Ekistic Logarithmic Scale, ELS, as originally defined, included 3 minor units and 12 major ones and was based on population, each of the major units being approximately 7 times the size of the next smaller unit in the hierarchy. Later the scale was developed to produce the Ekistic Population Scale and the Ekistic Territorial Scale, the multiplication factor between a unit and the next smaller one was fixed at 7 exactly.

42 At the 1974 Delos Symposion Doxiadis proposed a series of conferences by which a plan for action might be developed before the United Nations Habitat Conference of 1976. These ideas were developed in his draft for this book and had been submitted to the UN. His recommendations were not acted upon and have been overtaken by events.

43 C. A. Doxiadis, 'Water and human environment', *Water for Peace*, Vol. 1, International Conference on Water for Peace, Washington D.C. 23–31 May 1973, U.S. Government Printing Office, Washington D.C. 20402, pp. 33–60.

C. A. Doxiadis, 'Global action for man's water resources', paper delivered to the First World Congress on Water Resources on Water for the Human Environment, organised by the International Water Resources Association, Chicago, Illinois 24–28 September 1973.

C. A. Doxiadis, 'Marriage between nature and city',

International Wildlife, January–February 1974, pp. 4–11.

National Physical Plan and Programme for Greece: The study was commissioned in November 1972 to provide proposals for the distribution of population and the economic and social activities to the year 2000. These national proposals were to be based on the regional possibilities and constraints identified in the study.

The existing situation in all the sectors of activity that could influence the planning proposals was analysed in an endeavour to find the best solution. By use of a standard method developed by Doxiadis Associates a great number of alternative solutions was created, of which only a few were proposed for a policy decision. In a later stage, these proposals were evaluated on the basis of twenty-five criteria in order to determine a preferred solution which will be studied in detail. The final National Physical Plan will divide the space of the country into land use categories. The programme will refer to the measures necessary to attain the desired distribution of population and to achieve the desired land use structure.

Physical Plan for the Region of the Greek Capital. The purpose of this study, the contract for which was signed in November, 1972, is to suggest desirable and feasible proposals for the distribution of economic and social activities in the Greater Athens Region for the year 2000, the distribution to be realised through a series of most important development programmes.

The study proceeded by four stages:

a. Identification of explicit and implicit programmes.
b. Elaboration of alternative regional plans.
c. Selection of the best alternative.
d. Detailed elaboration of the selected alternative and proposals of the necessary programmes in ten-year steps.

'The human settlements research project', report of the Athens Center of Ekistics prepared for the IFIAS Workshop which took place in Athens, Greece, 13–17 May 1974.

'Action for Human Settlements', Delos Symposion (Delos Eleven) organised by the World Society for Ekistics at the Athens Center of Ekistics, Athens, and at Porto Rafti, Greece, 8–13 July 1974.

44 Paul A. Weiss, *The Science of Life: The Living System—A System for Living*, Futura Publishing Company, New York, 1973.

45 Plato, *Theaetitus*, 152A, Loeb Classical Library, Harold North Fowler, trans.; William Heinemann, London, 1961, p. 41.

46 C. A. Doxiadis, 'Three letters to an American', *Daedalus*, **101**, Autumn 1972, pp. 163–83.

47 'A City for Human Development', a three-day symposion organised by the Athens Center of Ekistics, July 1972. Participants: René Dubos, Erik H. Erikson, Dennis Gabor, Reginald S. Lourie, Margaret Mead, C. H. Waddington, Th. Doxiadis, Sp. Doxiadis, C. A. Doxiadis. See *Ekistics*, **35**, April 1973, pp. 174–237.

48 C. A. Doxiadis, 'Ecumenopolis: the coming world-city', *Cities of Destiny*, Arnold Toynbee, ed., Thames and Hudson, London, 1967, pp. 336–58.
C. A. Doxiadis, 'Ecumenopolis: tomorrow's city', *1968 Britannia Book of the Year*, University of Chicago, Chicago, Illinois, 1968, pp. 16–38.

49 C. A. Doxiadis, 'A city for human development: eighteen hypotheses', *Ekistics*, **35**, April 1973, p. 177.
Doxiadis, *Anthropopolis: City for Human Development*, op. cit., pp. 11–54.

50 *Habitat 76*. 'United Nations Conference on Human Settlements', Vancouver, Canada, 31 May–11 June 1976. Report by the Preparatory Planning Group submitted to the Executive Director of the United Nations Environment Programme, 31 December 1973.

51 Sir Julian Huxley, *The Uniqueness of Man*, Chatto and Windus, London, 1941.
Doxiadis, *Ekistics: An Introduction to the Science of Human Settlements*, op. cit., p. 42.

52 G. G. Simpson, *Principles of Animal Taxonomy*, Columbia University Press, New York, 1961.

53 Doxiadis, *Ekistics: An Introduction to the Science of Human Settlements*, op. cit., p. 85.

54 *Atlas*, May 1971, p. 72.

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