Towards an ekistic theory
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Towards an ekistic theory

Introduction

We cannot limit ourselves to facts, regardless of how many they are and how well they have been collected. Facts alone do not lead anywhere; they are indispensable, in the same way as the foundations of a building are indispensable even though it is the building we need; in the same way as the stones forming a wall are indispensable even though it is the wall we need. In order to reach the final product we need to order our facts in a meaningful way, so that we can build a wall and understand it. We need a theory relating the facts to each other; when we have such a theory, then we have science.

Such a theory does not need 'to unveil the ultimate nature of things' if it helps us build a meaningful whole out of scattered knowledge and in this way understand our subject better; if it helps us to predict its course, and when necessary, to guide it. We need a theory that can connect the facts to form hypotheses, principles and laws, and all of them to form a comprehensive whole which can help and guide us to progress. It does not have to be the theory, just one theory which can light our way until we can make the next step and develop a better one. Such a theory has to be based on the observation of phenomena, which lead to the formation of hypotheses which will have to be tested and tried until we arrive at an acceptable theory verified by all our tests and experiments and based on all the facts that we have assembled.

In Ekistics, as in so many other sciences, we can proceed by the inductive method. I believe that many of the grave mistakes which are now being made in architecture and planning are being made by people who thought (or as a matter of fact who did not think but who acted as if they did) that they could proceed deductively. We have to collect and observe as many cases as possible; only then can we induce the laws that govern these phenomena. We can only learn about settlements from the settlements themselves.

To achieve this is difficult since we have not yet organised a system of knowledge, we have not accepted common measurements and scales, we do not agree on classifications of settlements and phenomena and we do not have laboratories or hospitals where many cases are available to us. But this is no reason why we should excuse ourselves from trying to learn about settlements by observing them and inducing their laws.

We do not need to observe just the successful settlements – as town-planning handbooks do – or just the modern villas and sky-scrapers thought by architectural magazines to be the most beautiful or 'exciting', modern and 'unusual' ones; we need to observe all settlements old or new, small or large, good or bad (thus avoiding the danger of subjective eliminations) ; only then can we be sure that we will find the proper principles and laws to be able to formulate a theory and a science.

It may be asked whether we are not acting scientifically today, and if not how we should proceed. I will try to explain this process as I understand it. In dealing with human settlements, we are still acting on the basis of belief and experience – personal or general. Normally, general experience is better. However, there is no reason to believe that what is often called common experience is objective and scientific and not merely the result of some older ideas surviving by inertia, or a total of the incorrect ideas one community has copied from others. Belief and experience are both inefficient and insufficient to enable us to grasp the real issues in human settlements.

It is sometimes said, for example, that the city is the root of the evils of our present condition. But what does this mean? Even if the city were the root of these evils – which is questionable – what do we mean by 'city', and what aspects of it are 'evil'? Is it the size, the shape, the form, the Society living in it, Man who has created it, its economic activities or the way in which they operate? There is no satisfactory answer. It can only be said that probably several of the city's elements and expressions may be indispensable for purposes not necessarily directly related to human settlements. The great size of cities, which to many appears to be the root of the evil, offers many advantages which are unobtainable in smaller settlements. The fact that a large city provides a major centre with a major market for goods and ideas cannot be overlooked when we reflect that a greater variety of exchange leads to a greater variety of choice and to higher intellectual and material goals.

An attempt at a systematic interpretation of these phenomena shows that some of the elements and expressions seem to be inevitable and indispensable, while others may not be. For example, the form of the present metropolis is not necessarily the one best suited to the purposes for which the metropolis was created. Thus in the study of human settlements we should:

- clarify the different phenomena and separate what is essential and indispensable from what is non-essential and can be altered – we must acquire the ability of isolating phenomena in different scales (for example, we might come to the conclusion that the size must increase at a certain rate in order to be beneficial, but that forms of cities and shapes of buildings should be changed in different ways);
- classify all phenomena according to their value and importance to the successful operation of human settlements;

- find out how, by controlling several variables, we can eliminate expressions of elements, organs or parts which do not contribute to the successful operation of settlements (For example, we might create better living conditions in a settlement by re-forming its Shells.);
- ascertain how we can achieve the optimum combination of favourable and unfavourable elements.

Without such an understanding of the real issues of human settlements, we are bound to fail in the interpretation of their phenomena. This can be disastrous when acting to enlarge or modify our settlements. Any action undertaken without the proper conception and understanding of what the settlements are and how we should deal with them, can only be successful and beneficial by accident. It is more likely to work against, than to work for the attainment of our goals. The phenomena of human settlements are too complicated to be faced without an overall theory which can incorporate their conception and interpretation. This is gradually being understood by those seriously concerned with the problem, whether their special interests are related to the physical aspect of settlements, or to social or economic activities. I think it typical that Leonard Duhl, who is a member of the Space Cadet Group in the U.S.A., a private group which is concerned with Man and human settlements, leaves no doubt about the position of the psychologist and some other social scientists when he says:

'Action programs concerned with specific areas executed without a comprehensive theoretical base may be wasteful and even misleading. All groups concerned with the well-being of man, who at the same time either consider themselves scientists or are responsible for the administration of a scientific program, should allocate energy and manpower to the development of such theories.'[1]

The need for a theory of human settlements as the basis for action is indispensable in order to help us:

- properly understand the phenomena of human settlements and consequently develop the descriptive science of Ekistics;
- take action in every field of human settlements and thus develop a prescriptive science of Ekistics, a policy, a technology and an art for their formation.

It may be argued that such a body of knowledge would be better acquired by concentrating separately on each one of the elements – Nature, Man, Society, Shells and Networks. I believe that such an approach to the solution of the problems of human settlements would be completely wrong. In a way, this is what is happening today. There are attempts in each of the fields concerned with each of these elements, at forming theories related to each. These theories are not always of equal value; and even if one of them has great value it is not sufficient to guide the development of entire human settlements. The failure to merge theories into a system has contributed to two situations:

- It has led to the development of a separate approach for every element and the real issue of interest has been treated by these fields only as a side issue. For example, physical geography, concerned with Nature, has not concentrated on relating Nature to human settlements as a whole.
- The disciplines concerned with these elements have tended to develop particular approaches towards the entire human settlement. For example, the approach of the anthropologist is different from that of the planner, which in turn differs from that of the engineer, the architect, etc.

It is exactly this which must be avoided in the future. What we need – and this is the only way of achieving the best results – is a unified approach to the entire problem of human settlements. Only a balanced knowledge of all elements and their interaction in the formation of settlements can lead to a successful theory. Only then can we branch out into more specific fields.

If we look at a diagram showing the five Ekistic elements as spheres and their interrelationships as straight lines connecting them (fig. 1), we can say that Ekistics is concerned with all these lines of interrelationships and especially with the total system of these straight lines, while the spheres are the subject of the study of other disciplines contributing to Ekistics.
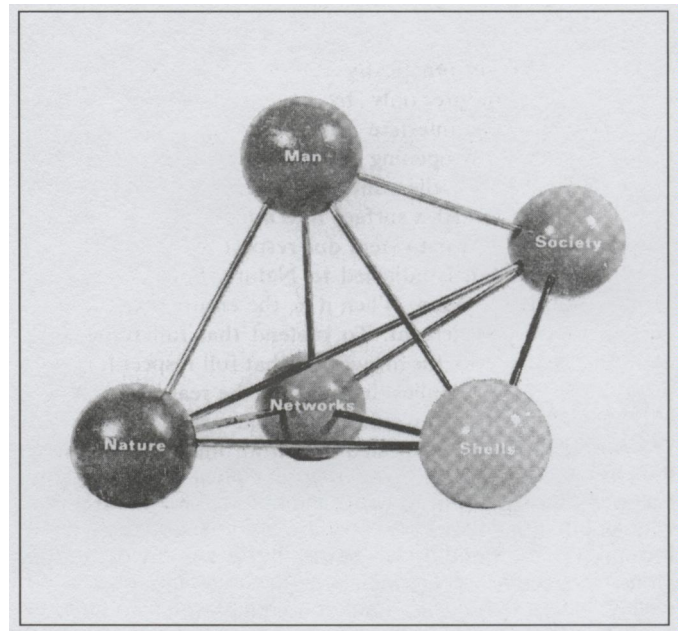

Fig. 1: Ekistic theory is not concerned with the study of the elements by themselves but with their interrelationship.

Once we have a theory of Ekistics, we can proceed with much greater confidence to develop a theory of Ekistics and economics, Ekistics and sociology, Ekistics and anthropology, geography, planning, engineering, architecture, administration, etc. But in order to be successful, such a theory must be part of a broader theory of human and natural phenomena, and must be well coordinated with related theories.

It could be argued perhaps that at the start such a theory must be called a series of hypotheses, for the usual procedure in scientific method is to start with a hypothesis and gradually build up a theory by testing and verifying a sequence of hypotheses. I consider that we no longer need to go through this procedure for the whole theory because:

- even though we have not had an Ekistic theory up to now, we have had Ekistic phenomena for thousands of years; and the total accumulated experience is wide enough to allow us to check on hypotheses and to have an opinion about their validity;
- the phenomena of human settlements are so broad and multiple that the total field of knowledge forms a theory incorporating a number of different principles, laws and hypotheses, and their number will probably increase with time. Thus if some of the hypotheses are proved wrong, there will be no difficulty in changing the larger theoretical concept. I do not believe that such a necessity is very probable for the theory I have tried to outline, but the possibility of some of our principles and laws being inaccurate should always be foreseen, and the theory of Ekistics, like any other theory, will adapt and evolve in the light of experience;
- because of the dangers, even limited ones, of developing an invalid theory, our effort at the beginning should be re-

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stricted to very general principles and laws; since it will be based on general, universal phenomena, observed over long periods of time and in a great number of cases.

On the basis of such considerations I proceed to the formulation of an outline of a theory of Ekistics in two stages, trying to formulate some principles and laws first (in the present chapter) and then to connect them in one basic theory in the next chapter.

Formulation of a theory

How do we build up a body of knowledge to form the principles, the laws and theory of human settlements? One thing is certain: we should separate the objective from the subjective. It is imperative that the body of knowledge to be built up be completely objective and as free as possible from subjective interpretation. This does not dispute the need for strong personal opinions on how to interpret and solve many of the problems of human settlements. To deny this would mean denying the essence of freedom and creative action and the contribution of individual thoughts and ideas. My point is that in order to allow proper freedom of thought and personal creation, we must first understand exactly what the problem is. A great artist only expresses himself in a subjective way after careful study of his subject; he is led to subjective expression through objective study. If this is true of art, which is after all a personal expression, it should be much more true of human settlements, which are not phenomena of personal expression, but which express the needs of a whole Society, formed by the action of the community. Therefore the experts who advise on the problems of settlements should have mastered a wide field of knowledge based on objective facts and leading to a creative expression growing from reason and imagination.

A sound Ekistic theory should assist all who are involved in the intepretation and creation of human settlements. It should be equally helpful to the anthropologist, the scientist, the architect, the humanist, the technologist, the mason, the builder and the artist. It must, therefore, take their experience and knowledge into consideration, but cannot be based on any partial theory related to special aspects of human settlements. There is always a danger that such a theory, concentrating on only one element, will not touch on the heart of the matter, that its lack of focus will mislead it into partial and personal interpretations. So an Ekistic theory must be based on:

- existing settlements;
- extinct settlements known through history or from their ruins (as additional elements of study the settlements of the past can help to shape many parts of the theory, especially those related to the evolution of human settlements and to settlements of minor sizes);
- critical interpretation of the phenomena of these settlements;
- theoretical models, the validity and importance of which should be checked with existing settlements;
- tests and experiments to be carried out in existing settlements, the conclusions of which can be fed back in order to check the theory.

Since it will take time to draw conclusions from the experiments and tests of theoretical models with existing settlements, the theory, at its inception, will necessarily be based mainly on knowledge of existing and extinct settlements and its critical interpretation. The importance of experimentation and theoretical models however, should not be minimised. Although a total reliance on these methods would undoubtedly mislead us at the start, gradually, with increasing experi-

ence, we will be able to rely on them more and more.

A basic question to be answered in relation to the formation of a theory of Ekistics concerns the interrelationship of the different elements of human settlements and their importance in the interpretation of existing Ekistic phenomena as well as the creation of new settlements. In very simple terms this question could be presented as follows: which of the elements should be the basis of our observations and the measure of the others, and which should be adjusted to the others? Should the Shells be matched to the needs of Man, or should Man be adjusted to the requirements of the Shells? Should the Shells be adjusted to Nature, or Nature adjusted to the requirements of the Shells ?

There is a tendency – usually unconscious but sometimes conscious – to give a rather one-sided answer to such a question. Many people creating settlements today would answer that the Shells should be adjusted to Man. But I do not believe those people fully understand the implications of such a statement, for in practice many architectural and engineering solutions are adjusted only indirectly to the expressed needs of Man, and in fact, impose on him Shells for which he has expressed no desire.

There is much talk about the need to adjust architecture and buildings to Man, because, the argument goes, we pay more respect to architectural forms and structural regulations than to the unexpressed desires of Man. What we should really find out is what Man needs and what can serve him best. We should not always regard the prevailing as important and try to perpetuate the existing situation because it requires the least intellectual effort. On the other hand, we should not overlook the fact that a great part of the settlements we will have to deal with throughout our lifetime already exist and, even if we believe that they are unsatisfactory, we cannot change them overnight. So even though it is necessary to find out the real needs of Man, we cannot easily implement solutions which will meet all his requirements. There are also people, especially medical doctors and social scientists who are prepared to give greater importance than is necessary to the opposite statement—that Man should adjust to his habitat for his own happiness. While this is true-for the immediate future (because unless Man can adjust to his surroundings, he will be unhappy) there is no need at all for Man to retain his habitat just as he has inherited it, because this may not serve his needs best, and because he is in a position gradually to change it.

In building up a body of knowledge on human settlements we cannot regard any principle derived from existing human settlements as the sole criterion of the phenomena we are trying to interpret, describe and understand. Personally, I believe that, to some extent, each of the positions mentioned above is valid. Man by necessity adjusts to his natural environment and has to respect its basic characteristics; he cannot disregard the formation of the ground and the natural landscape. On the other hand, he can respect these characteristics only to the degree that they are related to the forces he is developing and to the degree that he cannot change them for his benefit. For example, a nomadic settlement's adjustment to Nature is practically 100 per cent, since nomads interfere with Nature only by utilising grazing grounds. Farmers, however, interfere with Nature by cultivating a certain part of it, by opening paths, by building various small Shells. And urban dwellers interfere even more drastically by transforming the Earth's surface into a man-made landscape. The real issue is to what extent due respect is given to Nature at every level. Man is adjusted to Nature, but Nature must also be adjusted to Man. When it is, the ensuing balance will mean a healthy settlement. To pretend that full respect for Nature would supply the answer, or that full respect for Man

only is the answer, implies disregard of the real issues. As an example, the first case would mean that where swamps are found, they must be respected and Man must live in them. In the second it would mean that any form of Nature and pattern of life found in an area may be upset for Man's sake. This means that if Man does not want to climb, we are entitled to level off any landscape utilised for human settlements. This is unrealistic from both the financial and technological points of view; also it means working against Nature, which has already had a pattern of life developed on it. In the long run these two views, the latter of which is often supported by those responsible for development – some building contractors for instance – only lead to disaster for Man himself: in the end all wrong solutions for the total settlement work against Man, its founder.

Much the same can be said about the relationship between the other elements, such as that of Man to the Shells. The Shells have to be adjusted to Man. But there are certain characteristics of the Shells today, such as their large dimensions and new traffic requirements, which create new conditions for Man; in these respects Man must become adjusted to the Shells. When one floor is placed on top of another and people are obliged to climb stairs, we cannot say that we are adjusting the Shells to Man. In this case, we are adjusting Man to the Shells. When one must take an elevator and be closed in a box for several seconds or minutes in order to climb to the top of a multi-storey building, again it is Man who is adjusted to the requirements of the Shells. The final question in all these cases is: what is the best balance between Man and Shells in a changing settlement? We know by now that it is not simply a matter of adjusting the Shells to Man or Man to the Shells, but of attaining the best balance between all the elements and then between the elements and the entire settlement. This is the basic criterion which should guide us in formulating our theory.

The present body of knowledge of human settlements is based mainly on the past natural development of human settlements. By this I mean development which was never abstractly conceived and implemented in order to be tested in actual life. Development can be called natural when it is based on the desire of Man to serve those of his needs he considers intrinsic through the most direct means. When he wanted a shell over his head, he selected a cave. When he thought that he could build a shell he tried a beehive dome, which was the only way he could then cover the small space needed for his hut. Gradually he attempted to transform this through other types of construction. In every case he sought a desirable accommodation, conditioned by his conception of what could be done; he always tried to build the possible. From time to time he probably attempted the impossible as well, and failed. History does not record the failure of Man in building his settlement, except in a very few instances when great monarchs tried wild schemes which failed but still exist because of their great investment in stone and brick. These failures, however, strengthen my point that the main line of development leading to our present-day settlements was natural.

Most of the principles and laws of human settlements which can be developed today could well be called the natural laws of human settlements, and they will continue to be valid unless some day it is proved that with abstract methods we can evolve other laws that are more beneficial to Man. When this happens, they can be added to the Ekistic theory. Personally, I have great doubts as to whether abstract laws will ever upset the validity of natural laws. Through abstract methods we may reach new types of solutions, but this will not affect the natural principles and laws of Ekistics, if they have been properly conceived.

Principles and laws

Facts are connected in meaningful ways in order to lead to conclusions of more general significance and with validity for a certain number of cases having common characteristics. These meaningful ways have been given different names, depending on the schools of thought which introduced them, on the acceptance of their findings, the chronological order of the reasoning, etc. Such are the postulates, the 'common notions' of Euclid, the axioms of Aristotle. Several of them have been called principles and laws but there is no general agreement as to which one is which, and when a principle turns into a law. I will not enter into these discussions and I will deal with only three terms, *hypothesis, principle* and *law*.

Hypothesis is, chronologically, the first consideration in a meaningful process of inducing general conclusions from specific facts. At the beginning it does not provide sufficient evidence and remains therefore a tentative explanation. A hypothesis is tested in several ways, especially by experiments. If it passes the test successfully and if it fits into a broader system of ideas, it becomes a valid hypothesis and may be accepted as a principle or law. A *principle* or *law* follows a hypothesis. They are accepted hypotheses since it has been found or proved that the statements which they contain remain unvariable under the same conditions.

I do not believe that at this early stage of our effort to formulate a theory of Ekistics we need to enter into a discussion of the differences between all these statements (this may or may not become necessary at a later stage) and therefore I limit myself to the use of the term *hypothesis* to mean statements which need to be validated and *principle* or *law* for those statements which I believe have been validated, either by 'common sense' which after all is the basis of science, or by special explanations which appear in this study.

Efforts have been made at times in the past to state laws about settlements but they were never systematic and seldom accurate. When I was a student I learned that 'all major cities grow towards the west' which was definitely inaccurate, although it could be reasonably accurate for some northwestern European industrial cities where industry was based on coal and therefore the best neighbourhoods, in their attempt to avoid the smoke, moved west, away from the prevailing winds. It is now commonplace that a city should grow in the direction of the areas of greatest attraction and minimum resistance and these can be found at any point of the horizon.

The principles and laws needed as a foundation must have an indisputable validity, since they will form the central body of our theory. They should, therefore, be based on as much experience and as many examples as possible. Thus, these principles should:

• have a general validity regardless of the period of human settlements under study;
• not refer to phenomena drawn from only one category of settlements.

They should cover as wide a spectrum as possible and should not be limited to a single period or to one species. Laws about villages will by necessity have a much greater validity than those concerning dynamic settlements. We cannot express opinions about the laws of the megalopolis, since it is only now beginning to take shape. Neither the natural evolution of human settlements nor experimentation can help us today with the megalopolis. We will need time to formulate its laws and we must devise as many models as possible to help us do so. At present we must simply observe and record the data of these new phenomena and proceed carefully on the basis of what we know and what we can demonstrate (fig. 2).
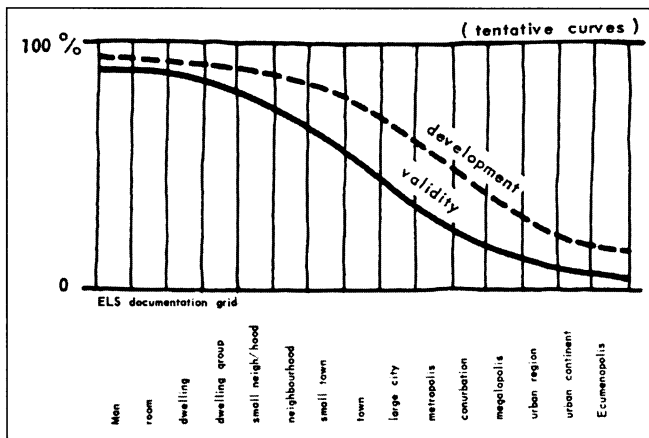
Fig. 2: Validity and development of Ekistic laws in relation to the available historical number of examples.

Fig. 3: Validity of predictions about basic Ekistic phenomena in relation to the size of the unit.

If we are to formulate laws about human settlements we have to ask ourselves what their nature will be. We have to decide what kind of laws we are talking about. Which, out of the multitude of phenomena, are we going to select in order to express the common characteristics of settlements. I think that what we should expect of all laws is that they be:

- true,
- helpful,
- general, and
- simple.

It is obvious why they have to be true and it is understandable that they have to be helpful; any effort to develop a law correlating the age of the citizens with the age of the city, for example, would be pointless, if it existed at all. For similar reasons laws have to be general; we could not possibly be interested in a theory about the existence of a law relating the orientation of the settlements of Java with their size. And they must also be simple, since we cannot expect to develop laws with many terms at such an early stage of our endeavour. When we have a satisfactory system of laws then we can proceed to more detailed and more complicated ones. Even so these laws will have to be true and helpful.

We can have many kinds of laws; they can be divided into laws of elements (connecting two of them at least), or laws of the whole settlement, relating it perhaps with some of its elements.

The first laws that we can develop seem to be causal laws, as, for example 'lines of transportation attract other functions, such as houses and buildings'. We have the cause – the road and its function of transportation; and the effect – the attraction of other functions. If we look at any map of a region in the macro-scale we will recognise the truth of this law. It would, however, be wrong to assume from such statements that the Ekistic theory can be a theory of causality.

Causal laws have to be exact and valid always. 'Every line of transportation attracts other functions', is not exact and not always valid. If the line has just been built, then there has been no time for the attraction of any function. We must qualify the law adding 'after a reasonable period of time'. Moreover, it does not attract functions if they are not related to the transportation line. A railway does not attract the farmhouses, they are primarily attracted by the best farmland and only to a secondary degree by a transportation line.

On the other hand, if we look at the micro-scale of a settlement we will notice that pedestrian paths may not attract other functions, if they are not meant to. As a conclusion we can say that settlements as large units and in a macro-scale
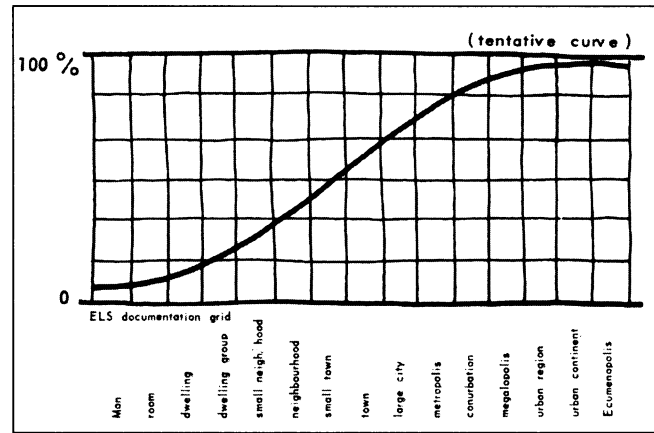
seem to follow a deterministic type of law of cause and effect; but this does not *always* happen, and not at all scales. To make this statement true we must know all the factors influencing the location of functions attracted by lines of transportation, and discover their influence on these functions; only then can we formulate a law of cause and effect that is always valid.

Since such a procedure is not possible we are forced to say that large units usually do follow laws of cause and effect, but that we are unable to determine their totality to such a degree of accuracy as will allow us to formulate these laws in a scientific way.

In practice we have many causes and forces to deal with. In such cases we are much closer to the laws of chance and effect. Our previous law will come close to reality if formulated as follows: 'most lines of transportation attract other functions which are related to them'. In this way we are avoiding grave mistakes – such as taking the statement to mean that tunnels, for example, or transatlantic cables, attract any functions and we are qualifying the functions as 'related'. This law can be elaborated even further: 'most lines of transportation on the surface of land attract other functions which are functionally related to them'. This, in practice, is a law of chance and effect.

Thus, we reach the conclusion that the Ekistic laws are much closer to the laws that modern science in general is following. From the days (in 1927) when Heisenberg introduced in physics the principle of uncertainty, to the theory of games developed by von Neumann, to the theory of statistical differences, modern science is moving on a more realistic road, describing phenomena as they are regardless of how probabilistic this description may be.

If we now think of individuals who are one of the elements of settlements, and their movements, it will be obvious that we can foresee their actions only on the basis of the laws of chances, and if we try to predict their actions only statistical laws can help us.

Whether we start from settlements in a macro-scale or in a micro-scale we will find that their laws are statistical laws. They are laws of approximations, with greater validity for greater numbers of phenomena. It is easier to foresee statistically the movement of people in major arteries of a metropolis than their stroll in one of its small parks. In this respect, the validity of our predictions increases in the larger Ekistic units (fig. 3) unlike the validity of our laws about settlements (fig. 2) which were based on the knowledge which we have about them.

On the basis of these considerations I proceed to the formulation of Ekistic laws based on our experience and divided into three groups. The first group refers to the life cycle of human settlements, regarding them as species which are born, develop and die. The second group refers to the internal balance of human settlements and the third to their location, structure and form.

I have numbered these laws not because I consider that this is necessarily their order – although a reasonable ordering has been attempted – but mainly in order to introduce a proper system of reference.

Laws of development

Creation

Law 1. A human settlement is created in order to satisfy certain needs expressed by different forces, needs of both its own inhabitants and of others.

If a certain group of people needs to produce food for its own survival, it is attracted by an economic force to an area where food can be produced; there it settles, serving its needs in the best way. The need is for food, and the force connects the producer with the locality of production.

However, there may be an area of many villages which need a market or administrative centre to serve them all. As a result, a corresponding urban settlement will be created in the area best serving all the villages. The need is the provision of services to others, and the force is an economic one connecting those providing services with the best locality for this purpose.

Law 2. Following the creation and operation of a settlement new functions are added which had not been foreseen, and consequently the settlement has to satisfy the initial as well as the additional needs. The more it grows the more important these additional needs may become.

Even though a settlement may be created as a marketing centre for the villages of the area, it may develop industry, administration, cultural institutions and other functions, which, once created, are not at all lacking in importance as compared to the original ones, since the settlement has to satisfy all the needs of its inhabitants and of those others served by its inhabitants. At first these needs are structural ones being added to the initial functions by the structure. With the passing of time they become functional needs themselves and lead to the creation of other structural needs.

Law 3. The ultimate goal of a human settlement is to satisfy the needs of its inhabitants, and of the others it serves – particularly those needs leading to happiness and safety.

So we come back to Aristotle. Twenty-four centuries of human experience have brought us to the same old truth. The *ultimate goal* is happiness; and happiness cannot exist unless it is coupled with safety, for otherwise it is deprived of the fourth dimension of time: the concept of future happiness and consequently the feeling of happiness itself is lost.

Law 4. The satisfaction of the inhabitants cannot be ensured unless all their needs – economic, social, political, technological and cultural – are largely satisfied. There is a unity of purpose in the creation of a settlement; it cannot fulfil Law 1 if it covers only a few of Man's needs (fig. 4).

When one category of these needs is not satisfied, there cannot be full satisfaction, and the system is an unstable one tending towards destruction.
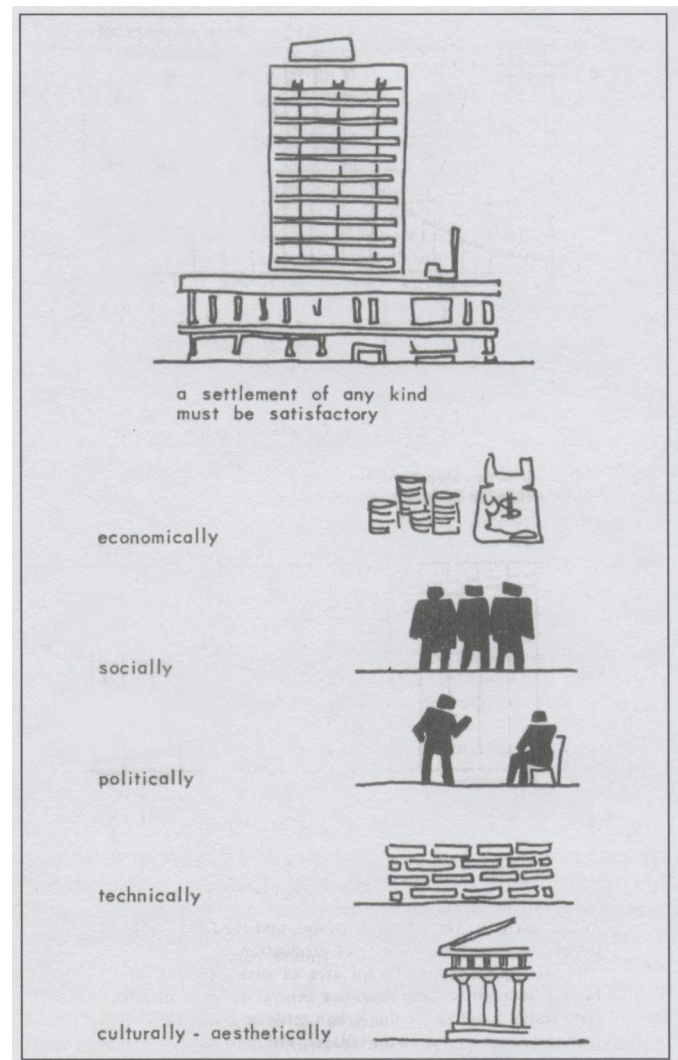

Fig. 4: The unity of purpose.

The balanced satisfaction of human needs is not only indispensable for the existence and survival of the settlement; it is also necessary for the satisfaction of its inhabitants in their everyday life. Consciously or unconsciously, people are dissatisfied when one aspect of their needs is not covered. Let us assume that in a mud-brick village somebody manages to build a marble house. Such an act will upset the pattern of the village from every point of view. Economically, it will be an unwise action because the economy of the village cannot stand a house so different. Socially, it will create trouble, for one person will be trying to live at a much higher level than the others. It will also have internal political repercussions. Technologically, if such a house is built by the villagers, it will be of poorer construction than the mud-brick houses since these people know how to build the latter but not the former. Finally, there will be no aesthetic adjustment to the requirements of marble, no proper expression of marble construction (no builder adjusts to a new material overnight), and the house itself will disrupt the aesthetic unity which had prevailed in the village.

The claim that economic criteria are the only ones of importance in Society cannot be supported where human settlements are concerned, unless one manages to express in economic terms all values of interest to the settlement and to all its elements. This means, for example, being able to express the practical and aesthetic values of the settlement's

landscape as well as Man's connection to the landscape in economic terms. The same holds true of a work of art, or of the aesthetics of a street.

I spoke of unity of purpose, and gave it the meaning of unity between the settlement's elements. But this is not the only meaning and the only expression of unity in settlements. We must think also of the unity throughout the space covered by human settlements, from the smallest to the largest unit. In the building of a settlement a unity of purpose can be found in the serving of all its elements and in the serving of all its units, large or small, throughout terrestrial space. When we are building a house or a room, or merely putting one stone on top of another, we are only soldiers in a great army of builders. We must bring Man and his environment into balance, a balance we have lost in our age. We must understand this basic unity of purpose, and thus relate the house to the town and the town to the countryside. Within this framework we must build roads and villages, and in turn relate these to the central town and the towns further out, ending up with a conceptually comprehensive Ekistic system covering the whole Earth. The reason I use the word 'conceptually' is that many times a pattern will express itself without a specific project, for quite often there is no need for one.

Law 5. Human settlements are created by their inhabitants and their existence depends on them.

This principle raises several questions. First it may be asked why the settlement is created by the inhabitants themselves. Do we not know of cases where the settlement has been created by external action, such as the decision of a ruler, or an industry, or a central government? This is true. Although the great majority of settlements are created by their own inhabitants, there are some which are created through external decisions and actions. If this action ultimately corresponds to the will and ability of those who will inhabit the settlement, it will be successful and will survive. If the opposite is true, there is no hope for the survival of the settlement, unless it is turned into a prison in which the people are forced to remain. Such a thing might happen, but it will not represent the typical case of a human settlement. It is an extreme case of an external force imposing itself on the inhabitants of the settlement not limited to problems of the settlement, but extended to the conditions of their freedom and way of life.

A question may be asked concerning the initiative the technicians involved in the creation of the settlement can have. Regardless of the authority which undertakes the creation of the settlement, how about the action of those who must plan, design, finance and build it? Our principle still holds valid, for if the technicians through their action express the deeper will – conscious or unconscious – of the inhabitants, their decision will be respected and carried out, not only during the phase of creation, but also later during the evolution of the settlement. If the experts do not create a settlement which can satisfy the basic needs of the inhabitants, the settlement will either be abandoned or altered – the latter if the difference between what the experts have done and what the inhabitants need is related to structure or form of the settlement involved. Only when the experts have the full backing of the community can the settlement have a normal period of gestation and a normal birth for only then will it have those strong chacteristics which aid it in its early life.

Law 6. A human settlement is created only when it is needed, and lives only as long as it is needed, that is only as long as there are needs expressed by forces strong enough to justify its existence.

When cattle-breeders are obliged to stay on a mountain for a short period, they build their huts with branches or, if there are no available materials for their shells, they pitch tents. When farmers have to cultivate new land a long distance from their villages, they must build their own shells, be they temporary or permanent. An urban settlement which serves a port or an industry is born and grows together with the port or industry, and the same happens with a settlement at an important crossroads in the country.

The moment of birth is determined by the needs created in a certain location. If these are not sufficient to justify its creation, the settlement will not come into existence. This means that there may be a need for the creation of a new market centre to serve several villages. The economic force, however, which is exercised on a new central location may be very weak because of the distances involved. In such a case a new settlement cannot be created even though there is a need for it. The economic forces are not strong enough to counterbalance the needs of such a new settlement, that is, the income is not high enough to justify a sufficient number of inhabitants.

Development

Law 7. The development and renewal of human settlements is a continuous process. If it stops, conditions leading to death are created; but how long the actual death will take depends on many factors.

A settlement is a living organism and must develop continuously (fig. 5). This development is related to all its elements: Nature, within which it is created, changes. Man and Society
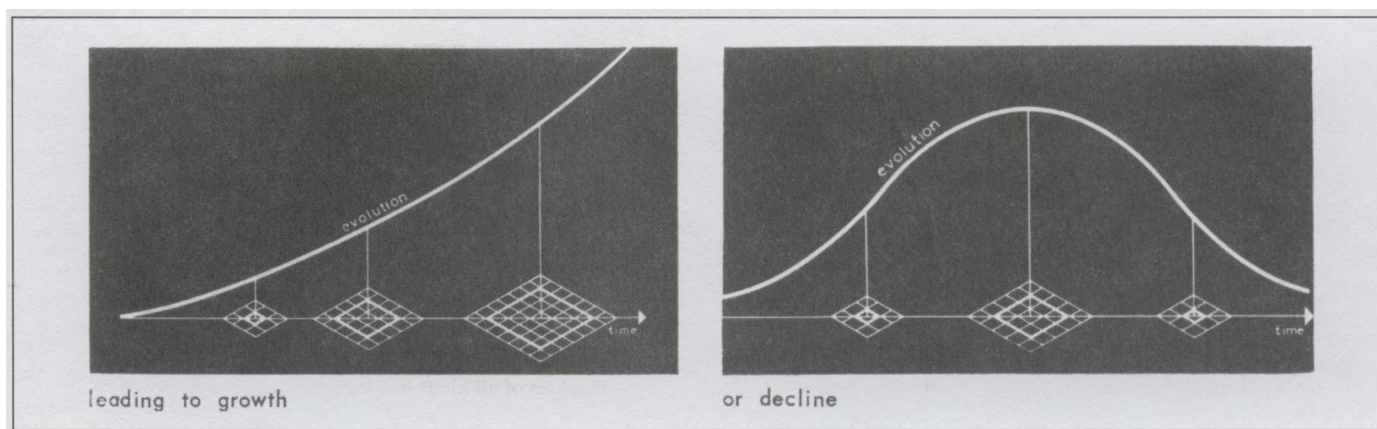

leading to growth   or decline

Fig. 5: The development of human settlements is a continuous process.

develop, and the Shells and Networks change correspondingly. Even if there is no change in appearance, the moments which are added to the life of the people, the movements they make within the settlement, the leaves which grow or those which fall, the changing quality of the texture of houses under the sun or rain – are all changes of the entire settlement. Man, Society, Shells and Networks age – therefore, in a living organism they must be replaced; otherwise, they will recede, and only Nature will gain, recovering the ground lost through the creation of the settlement.

Law 8. The potentiality of a human settlement depends primarily on its location and the whole Ekistic system of which it is a part. These same factors condition the type and size of the settlement at every period of its life.

If a settlement has been created because there was a natural harbour next to it, this settlement will survive as long as there is no larger port near enough to take over the role of the first harbour. If the settlement has been created at a crossroads, it will survive in the same form and size only if the converging roads are not transferred and a new, more important crossroads created. If the settlement has been created as a commercial centre, it will survive until some nearby commercial centre takes over the market it has been serving.

As with all living organisms, the capacity of a settlement for survival depends mainly on its ability to meet competition with similar species, a competition for survival in the same space. If it is a cattle-breeding settlement, and the grazing ground all around is turned into farming land, the cattle-breeding settlement will cease to exist; its Shells may be either eliminated or transformed. If it is a farming settlement producing vegetables and fruit for a nearby city and this city ceases to exist, the settlement cannot survive; it will probably have to grow and market other products which can be transported over longer distances to other cities, which means a different role and probably a reduction of its population. If it is an agricultural settlement within a non-mechanised farming area, it will soon be absorbed by the other settlements which will be economically stronger and will manage to buy up its lands. In each case the survival of the settlement depends on its relationship with the surrounding area and the Ekistic system.

Law 9. The total investment of economic, social, cultural, and other values in a settlement depends at every period of its life on the potential of the settlement itself, and on the broader role it can play in its system, since both condition inside and outside investment.

Normally, a settlement which is built to provide shelter for farmers and their families should correspond to the investment proportionate to their total income. The total value of investment should be in balance with the other needs of the inhabitants, such as for food, clothing, education, entertainment, etc. It is possible, though, that a government interested in cultivating an abandoned or new area and drawing farmers into it, may offer them more extensive facilities than those normally corresponding to their income. In such a case the additional expenditure will be borne by a wider area, eventually by the entire country (or even by other countries). This will be undertaken because of the broader benefits a wider area will gain from such additional investment. In this case, the Ekistic system is supporting a weak settlement for the benefit of the whole system.

The same is valid for other types of human settlements. The economy and total potential condition the value of investment. This is especially true when a settlement is completely isolated and has grown by itself. However, when it belongs to a system covering a broader area, region, nation or the whole Earth – as is usually the case – certain external forces, depending on its role in the broader area, are added to its own forces and potential. A national government may well create army settlements near it for defence purposes, better administrative centres in order to compete with neighbouring areas, or institutional welfare settlements for the rehabilitation of depressed areas.

However, over longer periods and in a wider Ekistic area the first part of Law 8 which states that the total investment depends on the potential of the settlement itself, is valid. Even though for a few settlements, and over a short period of time, investments can be larger than the potential, this is impossible for most settlements over longer periods because the total balance of economic forces would be lost. So, we are led to a broader definition of the same principle: the total investment of values of all kinds in Ekistic regions depends on their own potential. Variations of this basic law will exist only in a rather limited time and area.

When settlements are born and grow without planned action, there is a continuous adjustment of the effort made for additional investment to the needs and potentialities created.
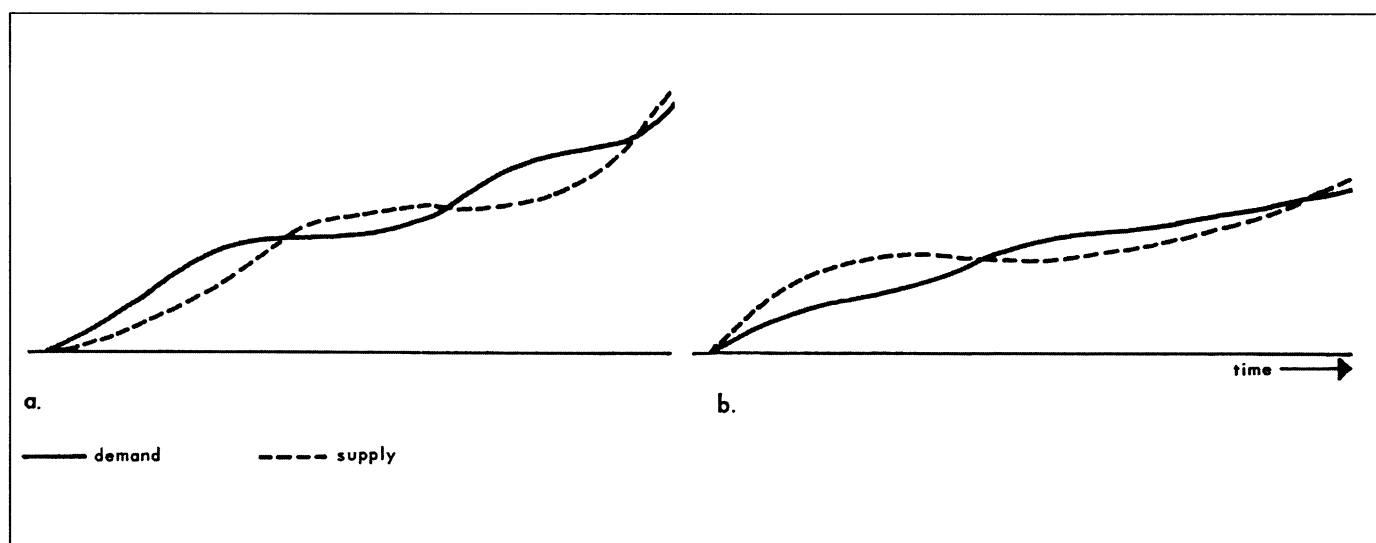

Fig. 6: Relationship between demand and supply in natural human settlements.

In general, there is a relative similarity between the curves of demand and needs, and the curves of the supply of facilities. In these settlements, demand precedes supply. If this lasts over a long period, however, it is probable that supply will catch up and may even precede demand, in which case, if it precedes it beyond a certain limit, it will slow down, waiting for a new growth of demand (fig. 6a).

When settlements are born or grow on the basis of planned action, it is easier to make mistakes in the estimates, and there may be over-investment or under-investment at first. Such action can have a great impact on the life and development of a settlement. Over-investment may have a negative effect because it will mean small results in relation to expectations. This may well mean disappointment among the people who created the settlement and might lead to its abandonment or to a reduction of the necessary effort for its maintenance and functioning. Under-investment, on the other hand, may slow down the normal flow or normal increase of the population (fig. 6b).

Law 9a. Investment in each part of a settlement depends on the forces being exercised on it.

If the forces are only dependent on pedestrian movements then the investment will be in shops and other facilities of interest to pedestrians; if they are dependent only on trucks then we should expect storehouses. If they are forces of cars at very high speeds passing through a non-access highway then there may be no investment on the side of the highway.

Law 10. The values created within a settlement, in addition to the initial needs leading to its creation, act as a secondary force contributing to its speedier development; or, in case of depression, they slow down or even arrest and reverse its decline.

It is quite possible that a settlement created as a harbour town cannot survive when the harbour suffers from nearby competition. If important factories have also been created within the harbour town, let us say during the period when boats were made of timber, this settlement may not be able to survive as a harbour in the era of steel ships; on the other hand, it may well survive as an industrial settlement, based on the timber industries which had been established in it. In such a case, it may lose the percentage of its activities and inhabitants corresponding to the purely commercial activities of the harbour. But if the competing harbour is within commuting distance and the initial settlement has developed important residential facilities, the latter may also survive as a residential suburb of the new harbour settlement. Or perhaps, if the residences and workshops created during the period of timber boats have historic or cultural-artistic value, the initial harbour town might become a tourist or cultural centre.

On the other hand, even if the settlement does not face a decline because of the elimination of some of the causes which created it, but has a normal period of life ahead of it, because of the primary reasons of its development, the fact that it has created additional factories, residences and other functions of some value will attract even more people and thus encourage its further development (fig. 7).

If the initial settlement is agricultural and the primary causes of its creation change – let us say that a large urban settlement is created close-by which grows and takes over the farms of the agricultural settlement – the values already invested in it may determine whether it can survive and in what form it can do so. If its farms have not been irrigated and the land value rises, they will easily become building plots. If on the other hand, its land has been irrigated and intensively cultivated, its transformation into building plots will be delayed

the existing settlement

one possibility : the new centre causes the decline of the old settlement

grid 20 x 20 km

another possibility: the existing settlement survives and grows together with the new one
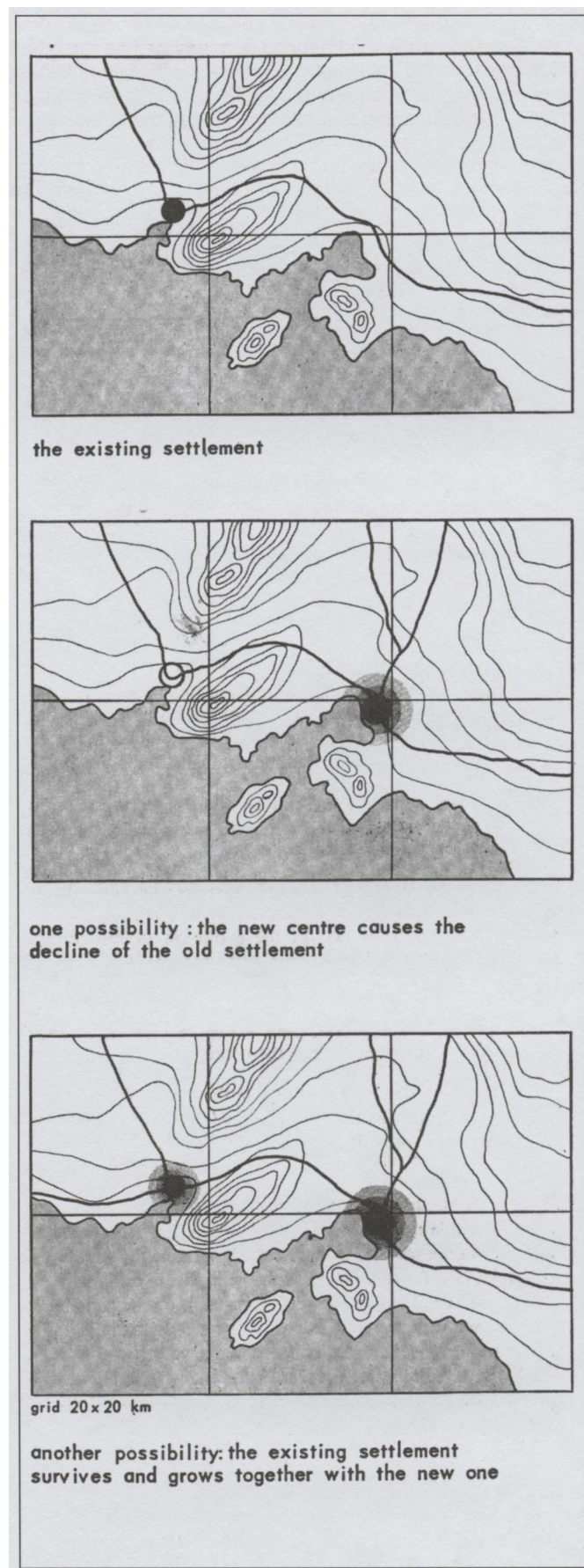
Fig. 7: Impact of a new centre on an existing settlement.

and the settlement may even be able to survive as a truck gardening island within a metropolitan area (fig. 8).

If the investment in the built-up part of the village is small in comparison with the urban investment taking place around it, when the farms are turned into building plots, the Shells of the village will be easily eliminated and replaced; but if the
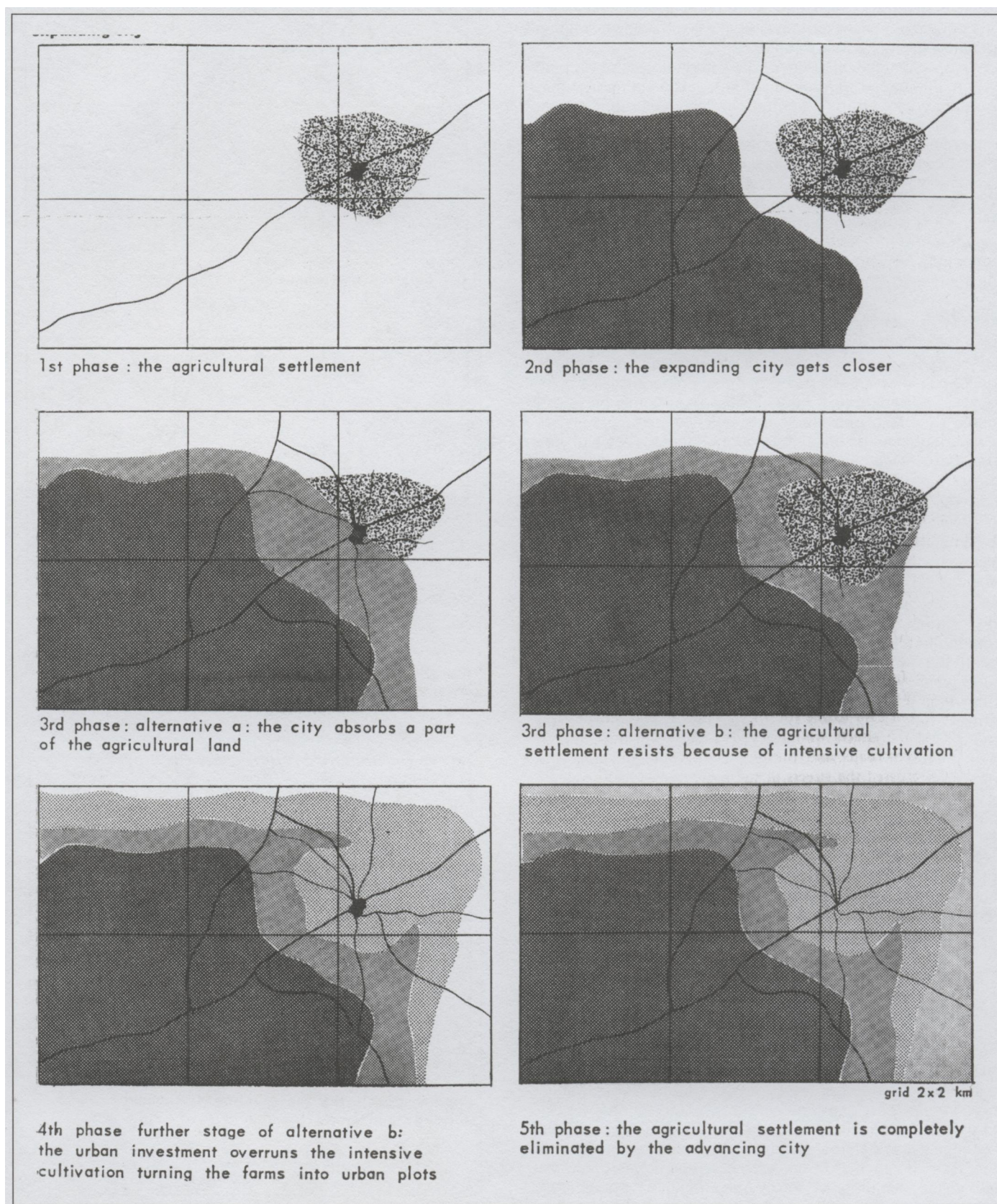

1st phase : the agricultural settlement

2nd phase : the expanding city gets closer

3rd phase : alternative a : the city absorbs a part of the agricultural land

3rd phase : alternative b : the agricultural settlement resists because of intensive cultivation

4th phase further stage of alternative b: the urban investment overruns the intensive cultivation turning the farms into urban plots

5th phase : the agricultural settlement is completely eliminated by the advancing city

grid 2x2 km

Fig. 8: Elimination of an agricultural settlement by the expanding city.

value of the village Shells is great, either from the economic or cultural point of view, it may not be eliminated, but be incorporated into the metropolitan area.

Law 11. In a growing system of settlements the chances are that the largest settlements will grow faster than the others.

This is a basic law of dynamic systems; because of the reasons already mentioned in the evolution of settlements the larger ones attract greater and more functions and grow more than the others.

Law 12. The per capita cost of a settlement increases (other conditions, such as income, being equal) in proportion to the services provided by it and the number of its inhabitants.

In order to show the validity of this law, both parts of it must be explained. I will begin with the first. In order to understand the truth of this statement, we must consider how equal types of services could be provided within several different settlements. If the settlements are of the same size, but the services are increasing in one of them, it is quite natural that these services will become a very heavy burden for the same number of people. If, for example, one out of a number of equal settlements builds a large hospital which serves the inhabitants of only that particular settlement, the burden may become too heavy for these inhabitants, because had it been bearable, it is probable that similar hospitals would have been created in all settlements of a similar size. This is why where a service of a higher order is necessary, the majority of people must live close enough to it to be willing to split the cost among them. This is most economic if other people come into the same settlement because if they live in different settlements, the cost of the total settlement will be higher per capita. A greater number of people will bear the cost of the hospital; but because of the longer distances between them and the institution, the total cost is going to be higher than it is when everyone lives close to it.

We must now show why the cost of a settlement increases also in proportion to the number of its inhabitants regardless of the services provided. Let us take a simple example of a water supply network. If this network supplies a certain number of gallons of water per capita to a settlement of 1,000 inhabitants, it needs only narrow pipes. But if this settlement has 10,000 inhabitants, not only would the narrow pipes of the distribution network be needed to supply all of them with the same amount of water per capita per day, but some mains would also be necessary to bring the water for the distribution network into the communities of 1,000 inhabitants. This water main is an additional cost which must be borne by all the inhabitants. For them, the per capita cost for the supply of water increases because they inhabit a major settlement, although the quality of the services provided is exactly the same. In this case, it is not the facilities provided which increase a settlement's cost, but the number of people they serve.

Law 13. Time is a factor necessary for the development of settlements. As such it is inherent in settlements and is physically expressed in them.

The fact that settlements develop in time compels them to respect certain rules. When, for example, the central square of an old city was originally given certain dimensions, it was not done with the initial number of inhabitants, which could be very small, in mind but the number which the original inhabitants thought that their city would eventually attract. This was quite easily expressed in static settlements, for the element of time in development did not influence them to a very considerable degree. It becomes a much more critical and impor-

tant problem, however, in dynamically growing settlements. In some of their elements the time factor has been taken into consideration, as when a certain width has been given to highways to permit them to bear heavier traffic in the future. But this is valid only up to a certain point beyond which the calculation does not allow for more traffic; therefore, a conflict is created between the highway's design and the demand for higher traffic capacity. The conflict is even more considerable in terms of the shape of cities still considered static without recognition of the fact that they are actually growing dynamically and that the whole city must expand at a high speed. The fact that this basic principle has been overlooked in the present-day cities means that they suffer from the pressure of the three dimensions expanding in time with no space to cover their additional requirements. The Shells are too static to serve the needs of a dynamically growing organism. The 'snail' is growing too quickly in its static shell, an event of tragic significance for dynamic human settlements (fig. 9).
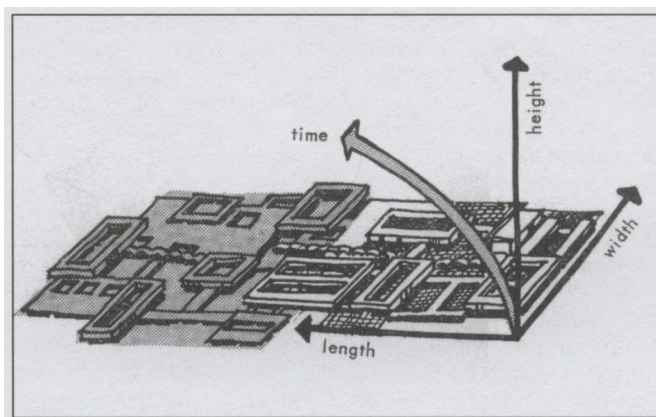

Fig. 9: The fourth dimension.

Law 14. Time is not only necessary for the development of settlements, but also for their existence. Therefore, time, along with the three physical dimensions, becomes a fourth dimension, indispensable to the settlement.

The fact that we walk in a street gives it dimensions proportionate not only to the three physical dimensions of Man, but also to the fourth. If Man could run as fast as a horse, the streets would always have had to be wider and their crossroads and turnings completely different; and if Man crossed the streets at the speed of a bullet, the streets would have had to be straight and the crossings on different levels.

The same holds true for the expressions given to the architectural details of the Shells. For example, because Man walks in the streets of a village, the walls, the doors and windows of the houses are appropriately painted and decorated. When Man moves at the speed of a car, there is no need for the kind of external street decoration which has been in use for thousands of years. The architecture of the settlement where Man moves at his own speed is different from the architecture on a highway. This is another expression of the fourth dimension of time as a factor used by Man in human settlements.

Extinction

Law 15. The gradual death of a settlement begins when the settlement no longer serves and satisfies some of the basic needs of its inhabitants or of Society in general.

A settlement connected with a port begins to die as soon as the port loses some of its traffic; a portion of its population can no longer survive and decides to move, taking certain values with it. In such a case men are the first to move to a different location, and then the values created by them, if they can be transferred, follow. A work of art can be easily transported, while a building, especially one having no artistic value, will be demolished if the site is needed for another purpose, and abandoned if it is not. Even local traditions may be transferred, though they will change during such a transfer; but such things as the trees in the central square of a village, the elements of Nature under which such cultural values and traditions have been created, will necessarily remain in the same location.

Law 16. In the death process of all or part of a settlement, no investment is eliminated unless its value has been amortised from the economic and cultural points of view, either because of changes within it, or because of changes in the system to which it belongs.

Under normal conditions no investment is eliminated unless its value has been amortised from every point of view. But there may be cases where this is not valid, due perhaps to the decline of the entire system to which this settlement belongs. In such a case the decline of the system or a part of it, may mean the decline of a settlement before its values have been amortised. If, for example, a new city has been created as a market centre for a rural area and needs 30 to 40 years for its amortisation, it will not decline before that period. If, however, the whole rural area is abandoned for some reason, then the city which had been its market centre cannot survive on its own and will decline despite the fact that the investment in it has not been amortised. The case of the need for urban renewal in many cities is a similar one. In the past, a house was not demolished unless it was fully amortised. Today many houses may have to be eliminated even though they are not amortised, if the whole area in which they belong has declined for some social, political or other reason.

Law 17. In the death process of a settlement its elements do not die simultaneously. The same holds true for the values that it represents. As a consequence, the settlement as a whole has much greater chances of surviving and developing through renewal even if some of its elements are dying.

The five elements of a settlement last and live for different lengths of time. This means that if one element dies, the others may cause a regeneration giving the settlement the power to continue living. This is made even stronger by the fact that every element does not consist of one unit only, but of many; consequently, the death of a few houses, or inhabitants, or trees, is not felt by the settlement as a whole since other houses, inhabitants and trees continue to live.

The same principle holds true for the different aspects of life represented by a settlement, i.e., economic, social, political, and so on. All these aspects can be satisfied for periods of different length. A settlement may be amortised from the economic point of view in fifty years, and from the social point of view it may be able to survive for one or two centuries, while from the cultural-aesthetic point of view it may survive for even longer (fig. 10). Thus several aspects with a longer survival value carry the ones with shorter survival values over longer periods and the settlement continues to exist beyond initial expectations.

Law 18. During the process of death, inertia caused by existing forces plays a very important role in slowing down the process.

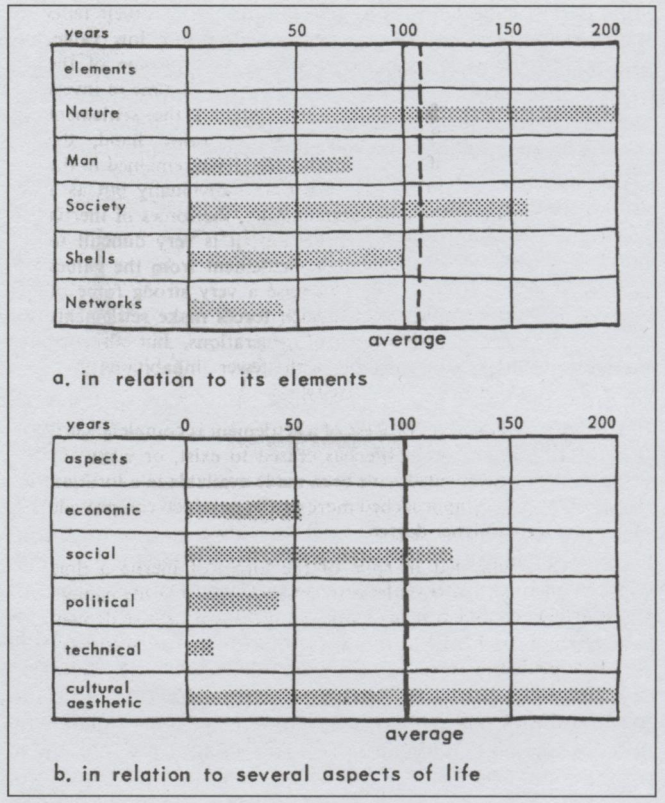When the reasons for the employment of people in a city

Fig. 10: Life expectancy of settlements.

cease to exist, some of the younger people tend to abandon it. Yet the fact that a lot has been invested in good housing and other facilities may keep many people there for a much longer period. A man could move into other settlements to look for new employment, and his family be left behind to make use of a comfortable house and good community facilities until he has been successful enough in the new settlement to provide his family with corresponding facilities. So, the Shells of the community act as a very strong force of inertia. This may even have the effect of reviving a declining settlement, since, during the period when the forces of inertia are operating, new functions may be added to the settlement and a part of its population may be attracted back, allowing the settlement to survive the crisis and live again (Law 17).

The settlement may also develop forces of inertia because of the Shells' capacity to survive for some time even if they are abandoned. While first the productive and then the non-productive forces of the population may abandon it, the Shells of a settlement which have not been demolished have the capacity to survive for several years, perhaps several decades. During such a period the fortunes of the settlement may change once again and new forces may flow in.

So, the forces of inertia slow down the decline of a settlement and delay its death, first because only one part of the population leaves while another part stays behind for quite a long period; and second because even when the entire population abandons the settlement it still retains the values of the Shells, and even dead, the Shells develop forces of inertia.

The value of the Shells determines the strength of the inertia. If the settlement is temporary, with Shells consisting of tents, the forces of inertia will be nil, since when nomads decide to move to a different location, they take their tents with them. If the Shells are permanent, but of low value, not only absolutely but in relation to the income of the people as well

(since perhaps they have had no time to invest enough in accordance with their income) the settlement will be easily abandoned. If, on the other hand, the people, although of a low income level, have remained in the same location for centuries, not only individually but as a community, and the investment is high, the forces of inertia will be much stronger. In such cases, it is very difficult to disassociate the existence of the settlement from the values invested in it, for the latter exercise a very strong force of inertia over their population. Such forces make settlements last not only for decades and generations, but also for centuries although perhaps with fewer inhabitants and functions, and a smaller capacity.

Law 19. The death process of a settlement is complete when every reason for its life has ceased to exist, or when the facilities it provided have been made available in a location which can be approached more easily, or which can provide them to a higher degree.

This means that in spite of the forces of inertia a time will come when the settlement can no longer provide enough for its inhabitants, at least not as much as a new settlement nearby provides, and this induces even the people who were kept behind by forces of inertia to abandon the Shells, which then die.

As long as the Shells have a relatively high value, the forces of inertia are strong and people develop a certain resistance to movement. But when investment in the new settlement and opportunities for life are of higher value than the total of opportunities provided by the old settlement, the latter can no longer survive and is abandoned. In very exceptional cases such settlements are maintained as dead Shells, not by the communities, but by the broader areas interested in them, especially if they have great historical or cultural value; an example of this type of settlement is Williamsburg in the U.S.A. However, in such cases they are given additional life and very often are completely revived and become settlements of even greater importance than before, just because of the values invested. In these cases the Shells have survived and have caused the creation of a new type of life within them. If the settlement had been completely abandoned and no interest had been shown in it, its death would have been final.

Before closing this section containing the first basic laws I would like to point out that these laws are valid only if Man and Society do not take action to reverse them. When I say, for example, that settlements die under certain conditions, this means that Man and Society have not reacted to the ongoing forces in order to save the settlements. This, we should not forget, constitutes the basic difference between the laws of organisms in nature (animals and plants) and laws of settlement where the thoughtful decision of Man can change the course of their development in a revolutionary way.

The course of the life of settlements can be conditioned by their laws if Man does not consciously intervene. This leads us to the last law of this section.

Law 20. The creation, development and death of settlements follow certain laws unless Man decides to reverse their course.

The question whether he is able or wants to is one depending to a great extent on the laws themselves.

Laws of internal balance

Law 21. The elements in each part of a settlement tend toward balance.

If one of the elements gets out of balance, within reasonable limits, the settlement tends to re-establish this balance. If this

can be done in time, the settlement is normal again. If the loss of balance is so extensive that the settlement cannot re-establish it within a reasonable time, the results may be disastrous. When, for example, the population of a settlement grows very quickly and there is not enough shelter for everybody, this leads to the creation of more shelters; should this happen within a reasonable period of time, the settlement will move ahead normally. But should the gap between demand and supply for more shelter be too great, the settlement will definitely begin to suffer, perhaps producing many undesirable effects.

When balance is reached the settlement is satisfactory and orderly. Balance should exist at all times. But overall balance is not enough; it should prevail in each part of the settlement, in each Ekistic unit. If it is limited to the general framework only, the units of a lower order will be in need of redevelopment and renewal.

Law 22. The balance among the elements of a settlement is dynamic.

Since we have noted in Law 7 that the development of a settlement is continuous, we cannot expect the elements to remain in constant static balance. As each of them changes, and in accordance with Law 21 tends to regain balance, we can also expect the balance to change and become dynamic. A population increase means an increased demand for housing, educational institutions, facilities, social institutions and functions; higher incomes mean more complicated functions, and greater investment in the Shells.

Law 23. The balance of the elements is expressed in a different way in each phase of the creation and evolution of a settlement.

In the first phase of creation there is a different balance between Nature, which is the controlling element, and Man, who constitutes the one element added from the outside. The balance in the first phase is dynamic, with Nature playing the greater role. Man must begin to understand Nature, transform and control it. In the next phase Man manages to impose small, probably temporary, Shells on the landscape. He then expands these Shells. It is quite clear from these examples that a different type of balance exists in each phase of creation.

Law 24. The balance between the elements is expressed in a different way in each section and at each scale of a settlement.

This dynamic balance is reminiscent of the Heraclitan philosophy of constant change. We can therefore say that settlements continuously find themselves in a Heraclitan state, while they are tending towards an Aristotelian one.

This balance is expressed in one way in a room, where Man alone is the controlling factor and the Shells are the only other major one. It is different on a highway where the function of traffic is preponderant, where Man is an element under the control of another element, the car, and where Nature is practically altogether absent. On a larger scale, in a whole community, on the other hand, Nature – expressed first by the landscape and then by the climate – plays a much greater role; and on the metropolitan scale the landscape may become the most important factor, influencing even the form of the settlement.

In the past, human settlements were built on the human scale only. Their only inhabitant was Man (and domestic animals) moving at his own speed. Recently, and especially

since the beginning of the twentieth century, first the car, and then the airplane and rocket, have entered the life of Man, imposing new scales and new problems (fig. 11). The car in par-
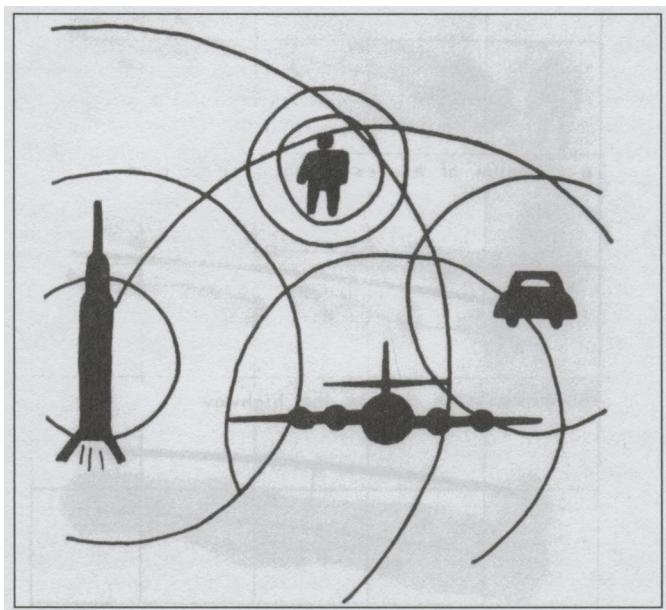

Fig. 11: Many masters and many scales but balance must be established in every scale.

ticular, existing in cities made for Man, ruins their texture, cannot itself move freely, and creates many problems for Man. For this reason, one scale for every kind of inhabitant is the only natural solution for settlements. Man used to have full control; the car has displaced him in various scales and has taken control. What is wrong is that Man is still interfering with the scale of the car, while at the same time he has not succeeded in saving his own scale outside his buildings.

This is the reason why scale is of major importance where human settlements are concerned, and why in Ekistics forms have no importance at all unless they are specific expressions on a specific scale. I will mention one example (fig. 12a). If we take some Ekistic units – houses with their plots – and distribute them along a minor road, their inhabitants will be connected with each other by small lines which are either vertical to or parallel to the small road crossing the settlement; they all form a small community. If we now widen the road and turn it into a highway, and leave the houses as they were (fig. 12b), a community will no longer exist, since people will no longer be connected to each other across the highway, which due to its width and traffic has ceased to connect and acts as a dividing element. This is why the first so-called 'linear city' of Madrid by Soria y Mata, 1882, could not have succeeded; the design of its elements was completely out of scale. The great width of its main street and its street-car-line destroyed the unity of the small community with one- and two-storey houses. Cohesion was impossible.

In order to re-establish cohesion between these houses, we should consider two rows of them with a small street in between as one Ekistic unit, and should then build the highway outside this unit in order to allow it to retain its scale (fig. 12c). In this way, more Ekistic units could be created around the highway and a larger Ekistic unit would emerge (fig. 12d). These minor Ekistic units could then be enlarged without touching the highway, which will form the spine of the greater community (fig. 12e). The result would be the same as with the first houses along the small road, the difference being that instead of houses we would have cohesive communities

which are small units connected to a major community by a major highway. Synthesis in space is expressed in different ways in accordance with the scale of the Ekistic unit.
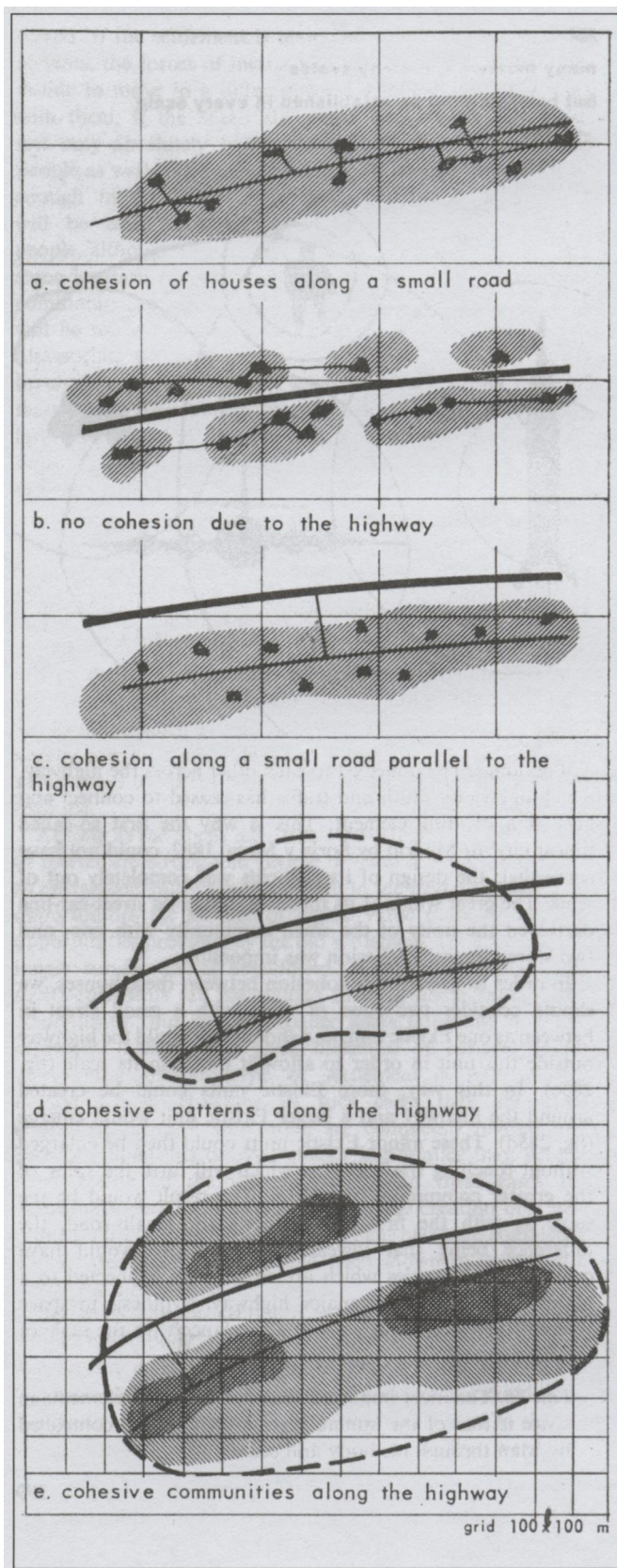

a. cohesion of houses along a small road

b. no cohesion due to the highway

c. cohesion along a small road parallel to the highway

d. cohesive patterns along the highway

e. cohesive communities along the highway

grid 100 × 100 m

Fig. 12: Creation of ribbon development.
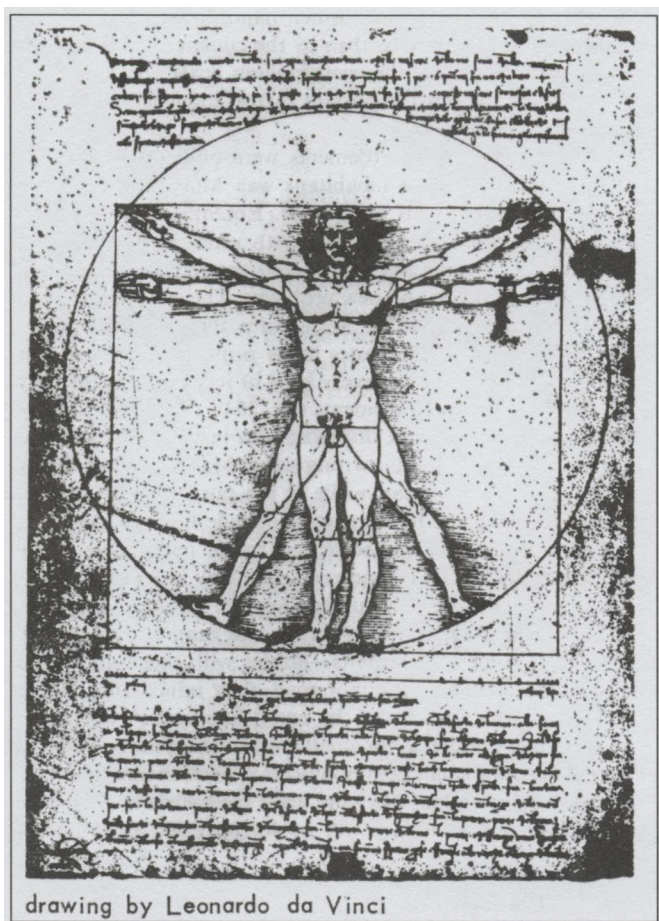
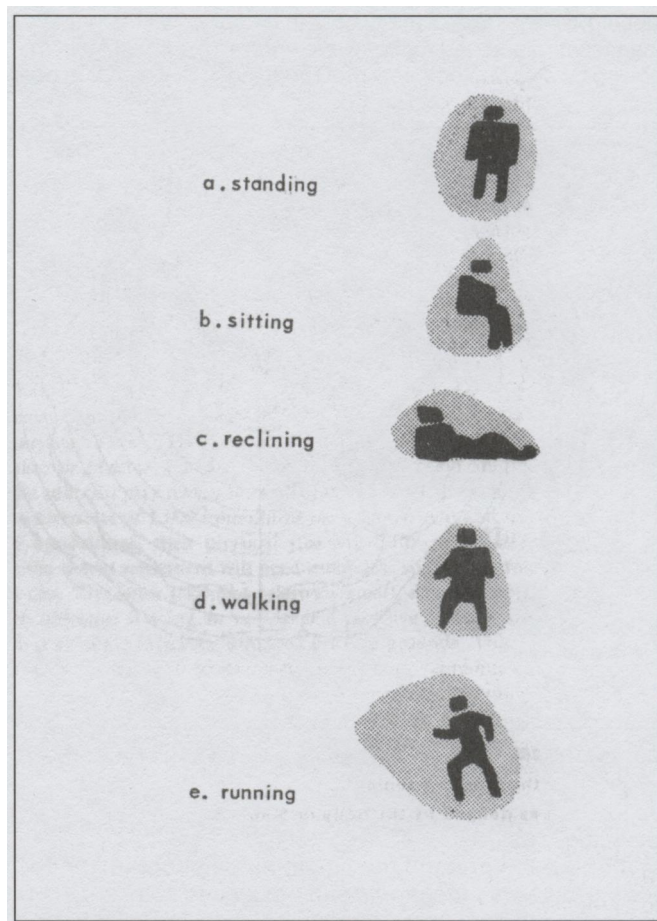**Fig. 13:** The human body as defined by the body of Man.

Fig. 14: Single human bubbles as defined by the body of Man.

Law **25.** The most important balance of all the elements in space is that of the human scale, which is fully controlled by Man through his body and senses.

The human scale begins with the space required by Man in his movements, which for all practical purposes is in the shape of a bubble with a diameter equal to Man's maximum dimensions when he stands with his arms extended horizontally. The drawing of Leonardo da Vinci, although drawn for another purpose, is the best representation of the average dimensions of this bubble (fig. 13). Naturally, its size changes from man to man, and even for the same man, since his position in space, his movements and his speed change, and the bubble changes accordingly. When he is sleeping, for example, the bubble is elongated and flat at the bottom. When he is walking, the bubble is an elongated spheroid which is rather elliptical on a horizontal plane with the longer axis parallel to the direction of his movement. When he is running, this spheroid is even more elongated (fig. 14).

The complete study of the human scale cannot be limited to the static human bubble as represented by Leonardo da Vinci. We must look at it in two ways. First, Man does not consist of a body alone; the complete Man has body, senses, mind and soul. The real human bubble consists of many bubbles radiating in different ways around Man (fig. 15).

Second, Man does not stand still. This is why Leonardo's drawing alone is misleading and we have to show it side by side with the moving man, who not by his dimensions alone but by his movement as well defines the human
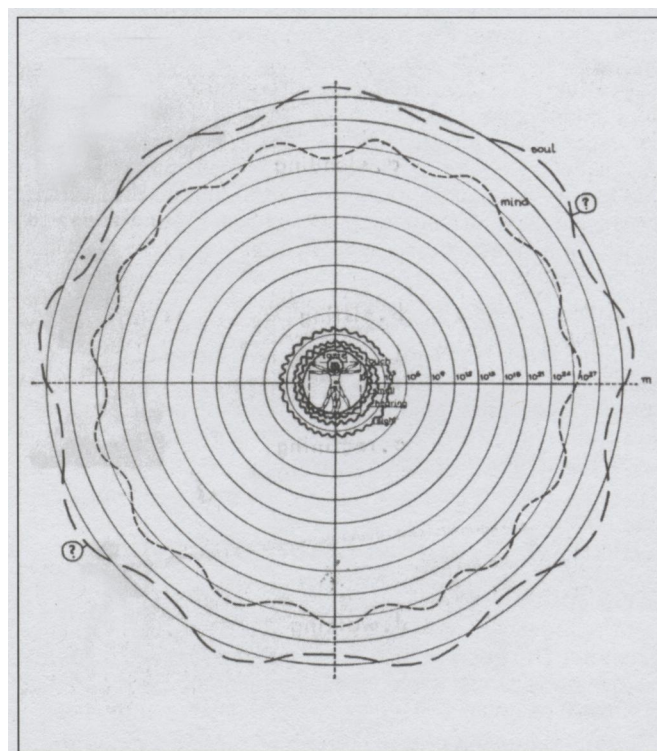

Fig. 15: The total system of human bubbles as defined by total Man.

towards a study of the dynamic
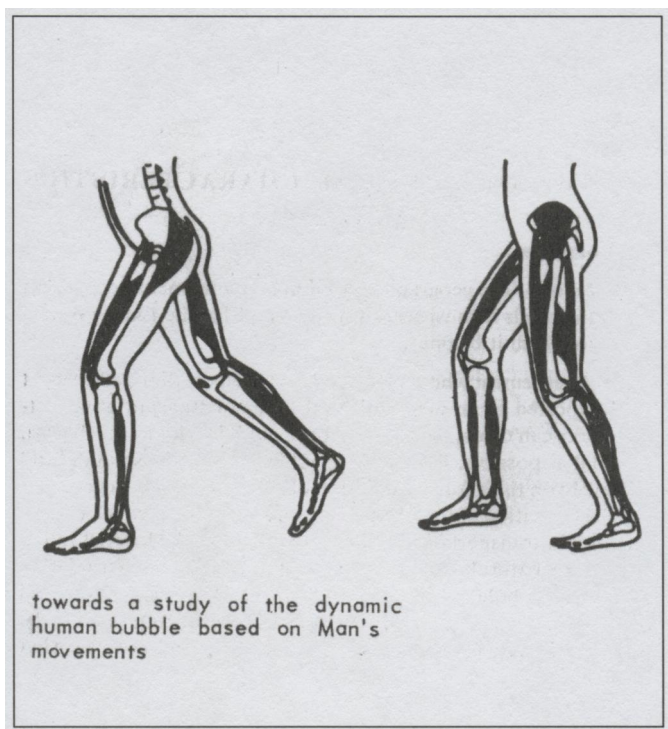human bubble based on Man's
movements

Fig. 16: The human bubble as defined by the body of Man.

scale (fig. 16).

When we understand the single human bubble and the scale it imposes properly we can proceed to combine many of them in different ways, depending on the conditions and the forces which are being exercised on them (fig. 17).

This human bubble is the smallest unit we deal with in Ekistics. Its normal dimensions in a horizontal projection are between two and three square metres (21-32 sq. ft.) depending on the size and the position of Man. The next unit is the room; then come the house, the dwelling, the group of dwellings, the small neighbourhood. These units increase up to a certain size, beyond which we begin to lose the notion of the human scale. The limit is, as practice has shown, a unit corresponding to the ancient cities and to the urban distances Man likes to walk today. Both lead us to believe that such a unit has a radius of no more than a ten minute walk, which means a maximum diameter of 2 kms, or an average of 1,500 metres or just less than a mile. This distance coincides with the distance from which one is able to see a building of importance, which may be located at the centre of a community. This is the distance over which Man can easily have a visual aesthetic grasp, the area which he can easily comprehend with his own senses. It is up to this scale that Man is in full control, a control which decreases from the smallest Ekistic unit, the room, to the larger one of the community (one mile long). His control decreases at a higher rate beyond this limit.

Laws of physical characteristics

Location

Law 26.   The geographic location of a settlement depends on the needs it must serve for itself and for the Ekistic system to which it belongs.

A settlement whose role is to be a transportation centre must be located in an area which all kinds of transportation
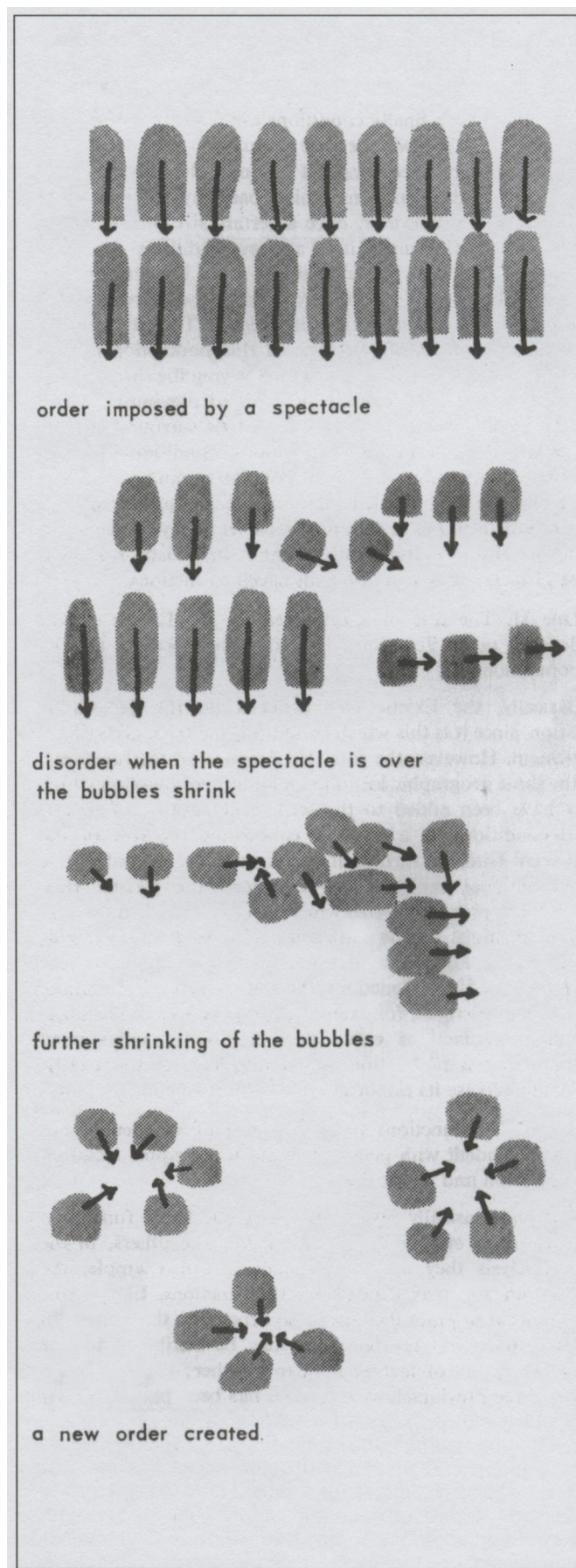

order imposed by a spectacle

disorder when the spectacle is over
the bubbles shrink

further shrinking of the bubbles

a new order created.

Fig. 17: Combined human bubbles.

networks can cross; near the sea or on a plain with as much open land as possible. But the geographic location does not depend solely on the natural formation of the area. It also depends on the formation of the Ekistic system. A settlement which is to be a main transportation centre must not only be located in the proper natural setting, but also in a key position in relation to the whole system of settlements. For example, if all settlements are coastal, the transportation centre should be near the coastal region's centre of gravity, and not near that of the inland plain, where only small and unimportant settlements are located.

Law 27. The topographic location of a settlement depends on its needs and its physical size. If a settlement must cover the need for a port, it will be drawn by an economic force to a neutral harbour.

If the size of the settlement which is to become a port town is very small, it can be located on a hill near the port. But, if the settlement is large, only a plain near the harbour will give it a chance for proper development. The dimensions of the settlement determine the selection of the topographic site.

Size

Law 28. The population size of a settlement depends on its role in servicing certain needs for its inhabitants and for its Ekistic system.

Needs and the forces which express these needs determine the size of a settlement. In our era a settlement is no longer an independent organism separated from others. At the beginning of Man's history there used to be relatively independent settlements, self-sufficient and located at great distances from other settlements. This type has by now been practically eliminated, or is in the process of being so. Today the size of a settlement depends on its geographic and topographic location, which conditions its Ekistic location (i.e. its location within a broader system), which in turn conditions its role as a part of it. Any attempt to understand the size or any other basic phenomenon of a settlement by disassociating it from the system of which it is a part will be misleading. The belief that the size of settlement D can be disassociated from its whole system is erroneous, for it is quite clear that the population of D depends on its role in the entire Ekistic system (fig. 18). The same is true of any small settlement A1. Its general role is that of a class A community, and consequently its population is conditioned by this class A location. In addition to this, its specific location in the proximity of D, in spite of the fact that its primitive function was the same as A2, leads to a greater population than A2. A1 has been brought into closer contact with a major settlement, from which it absorbs the capacity of new functions, which leads to a different population size.

We do not know much about what happened in the past and whether there were any conscious attempts to limit the size of settlements, or of cities in particular. We have reasons to believe that the size was limited in most cases by the population itself. The very fact that in many cities people built walls and managed to live within them over long periods of time implies that the population size of the settlement was confined by the limitation of its physical size through walls. Because of all the existing conditions in our era of dynamic settlements, we know of many efforts made either in theory or in practice to limit the dimensions of settlements. We know equally well that these efforts are doomed if they overlook the fact that the settlement can and must grow in accordance with the requirements of its Ekistic role. If its functions in their evolution do not require a larger population, then the population is limit-
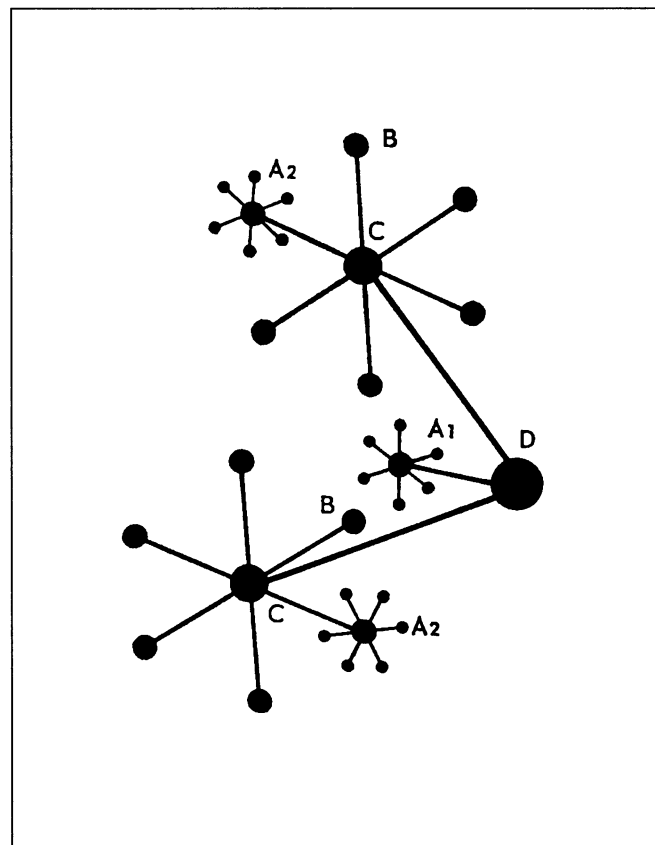

Fig. 18: Population size of settlement D is a result of the connections within a whole system.

ed to what was originally thought possible. If, however, the functions in their evolution require a larger population, there is no reason to believe that any human force can set a limit to the size. No political or social system of the present era has proved to be stronger than the force of economic activities and the Ekistic system, which in the final analysis defines the population size of every settlement.

Law 29. The physical size of a settlement depends on its population, its needs, its role within the Ekistic system and its topographic location.

Whereas the population size depends on the functions of the settlement and its Ekistic role, the physical size is influenced by various factors. The size of the population is the first and deciding factor, but the functions of a settlement and its Ekistic role can play a very important role as well. If we have two settlements of 1,000 inhabitants each, one urban and the other agricultural, their physical size will differ immensely, since the urban settlement will need much less space than the rural one. The latter might be relatively small, if the farmers live by intensive farming, or very large if they live by extensive farming or cattle-breeding and need grazing grounds. This is valid both for the total settled part, i.e. the entire community area, and the nucleus or built-up part. A farming community of 1,000 people with a very large area can have a built-up part as small as an urban community, or perhaps even smaller if the whole community lives on dry-farming and there are no cattle to be housed in the built-up part. On the other hand a farming community where the cultivation is in-
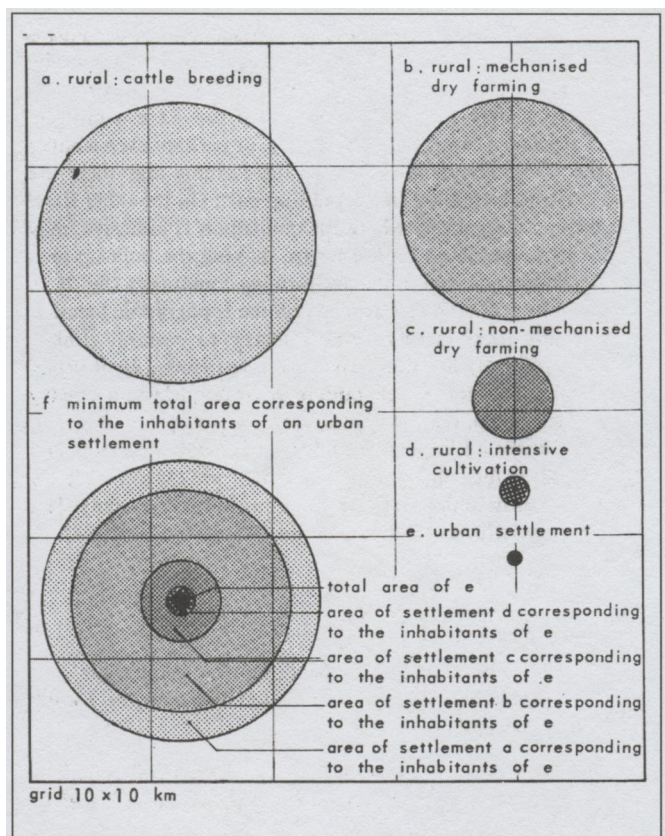
Fig. 19: Physical dimensiions of settlements of 200 families.

Fig. 20: Climate effects upon the physical layout in a coastal area, Paros, Greece (1961).

Fig. 21: Climate effects upon the physical layout in a tropical area, Somanya, Ghana (1961).

tensive, may have its houses built on the farms, making the built-up area much larger than that of the dry-farming community (fig. 19).

The physical size also depends on the topographic location and many local factors – from climatic to cultural – linked with it. A windy location may force a settlement, be it urban or rural, to be very densely built in order to mitigate the heavy winds (fig. 20). On the contrary, if it is a very hot area and the winds are an important factor for a better micro-climate and better living conditions, we may then witness a completely different community structure tending towards a much less dense pattern in order to allow for ventilation (fig. 21).

Functions

Law 30. The functions depend on the geographic and topographic location, the population size and the Ekistic role of the settlement.

The geographic location determines the general functions of a settlement, such as its function as an agricultural or industrial centre, while the topographic location conditions these functions more specifically. If the geographic location allows for agricultural production in general, it is the topography which finally conditions the produce of the area.

It may be asked whether the population size determines the functions, or vice versa. It is quite clear that on the contrary it is the functions which basically determine the population size. However, once a certain size of population prevails, the settlement by itself acquires additional functions because of that size. For example, a small industrial centre is created because of the required function of serving a big new industry in a large agricultural region. The city acquires a population of 10,000. Because of this population it now plays the role of a

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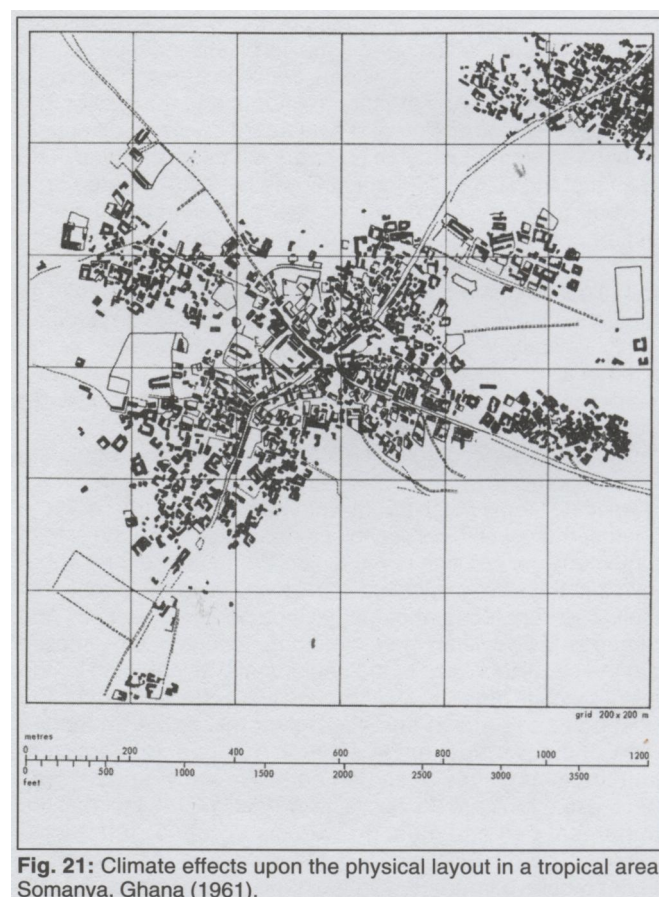
small urban centre serving the surrounding area, for unlike the villages which existed previously, it has certain facilities which can serve the whole surrounding area much better. Such additional functions, conditioned by the population size, draw additional population, and so on.

Finally, the Ekistic role conditions specific functions. If an urban settlement has certain functions, let us say if it acts as a commercial and administrative centre, its Ekistic role as a class D or E centre conditions its specific functions.

Law 31. The role of a settlement in the Ekistic system depends on its functions, its geographic location and its population size.

Basically, the Ekistic role depends on the geographic location, since it is this which conditions the basic class of the settlement. However, the role also depends on the functions. In the same geographic location an additional function which may have been added to the settlement because of special local conditions or a decision concerning the role of the settlement (such as turning it into a military, administrative or educational centre) also conditions the Ekistic role. Finally, the population size which has been reached because of the functions of the settlement adds to its Ekistic role by changing and reclassifying the settlement within the whole system, if new functions have increased the population. A class C settlement, for example, can play a class D Ekistic role if the functions established because of government decision add a pop-

ulation which may change the Ekistic role and increase its importance.

Law 32. The functions and Ekistic role of a settlement are interdependent with geographic and topographic location, population and physical size.

Although basically several of the physical and functional characteristics of a settlement determine the others, in the final analysis they are interdependent. For example, the population size may depend on the functions, Ekistic role and physical size, but the latter also depend on the former. In these relationships greater value may be attributed to one factor or group of factors than to another; this is why in some of the previous laws, emphasis has been placed in only one direction. However, there is no relationship between these physical factors and functions which is not reversible. The relationship is merely more basic in one direction than in the other.

Because of these relationships, each of the six factors already mentioned in Laws 26 to 31 – that is, geographic location, topographic location, population size, physical size, functions and Ekistic role – forms a circle within which all possible connections are justified to different degrees. There are no missing links between the circles; some of them are simply stronger than others. The radiation to and from every one of these circles represents one of the previous six laws while the total stands for the law of interdependence (fig. 22).
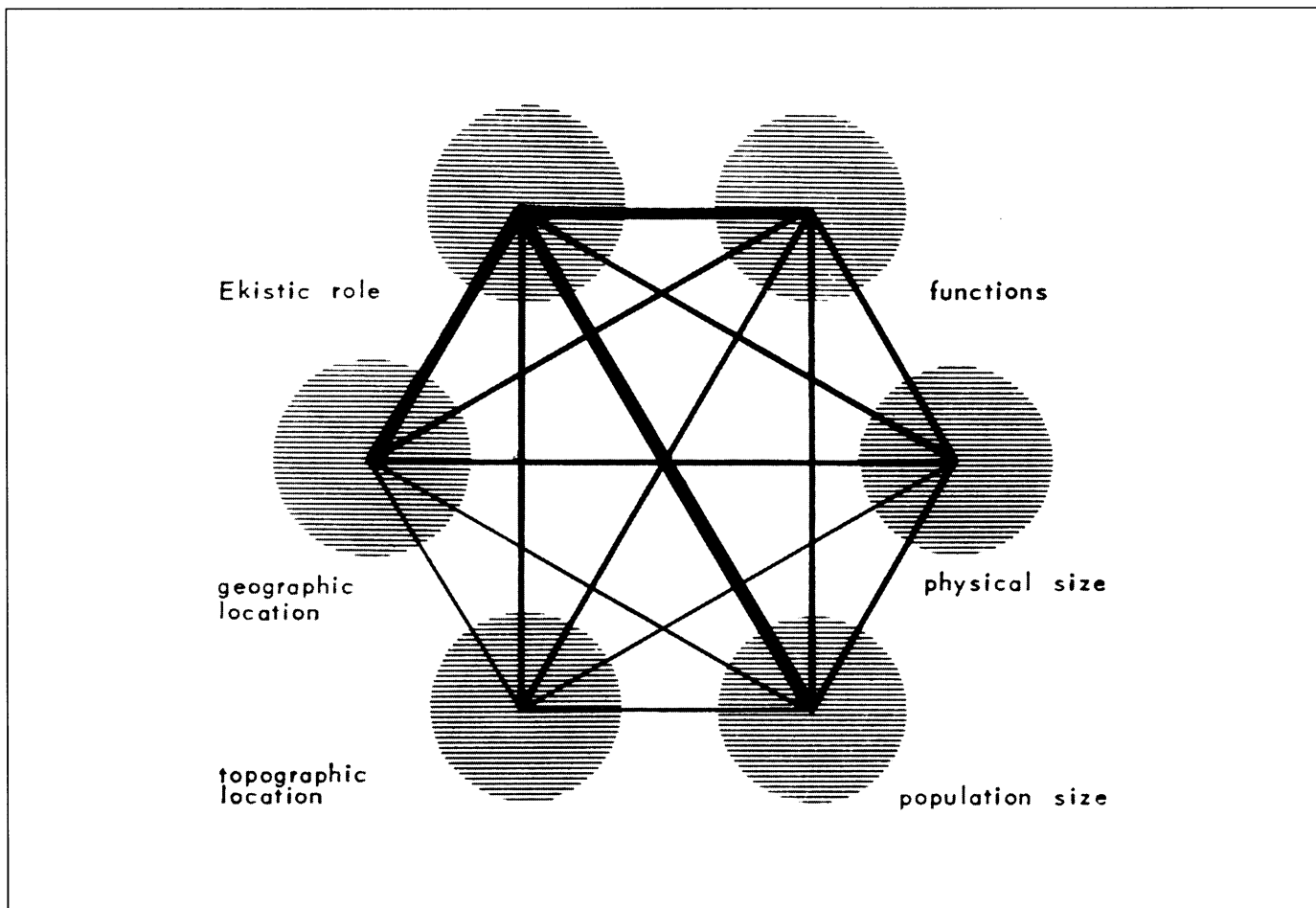

Fig. 22: Interdependence of factors and functions.

Structure

***Law* 33.** The basic cell of human settlements is an Ekistic unit which is the physical expression of a community. This unit should function without being fragmented in any way, for if it is, the settlement will not perform its role properly.

People tend to live in communities of common economic, social, cultural, religious, political and other interests. In human settlements this fact is also expressed in a physical way, by the Shells of the settlement. For example, one basic characteristic connecting all the elements of a community (a shopping centre serving the whole community), should be enough to discourage the splitting of the community into two parts by a canal, if there are no bridges, or by a highway or railway, if there are to be no proper connections above or below it, etc. Should such a split occur, the uniformity and the continuity of the community's texture will cease to exist, in this respect the community will stop functioning as a whole, and the settlement will be deprived of its most basic characteristic – the existence of properly functioning Ekistic units.

In order to function properly, a settlement must have specific social dimensions which are expressed in the form of communities. These may be on a minor or major scale, but on every level they must be complete in order to function properly. Any part of a human settlement should consist of an appropriate number of communities. If we expect an independent

community
class VI

community class V
supersector
supermarket

community class IV
sector, secondary
school, religious
buildings,
shopping centre

community class III
sector, elementary
school, playgrounds,
shops

community class II
larger neighbourhood
gardens, shopping corner

community class I
playgrounds, neigh hood
meeting place
houses-residence

the continuous lines represent the hierarchical structure, the dotted ones represent the possibility of other connections also
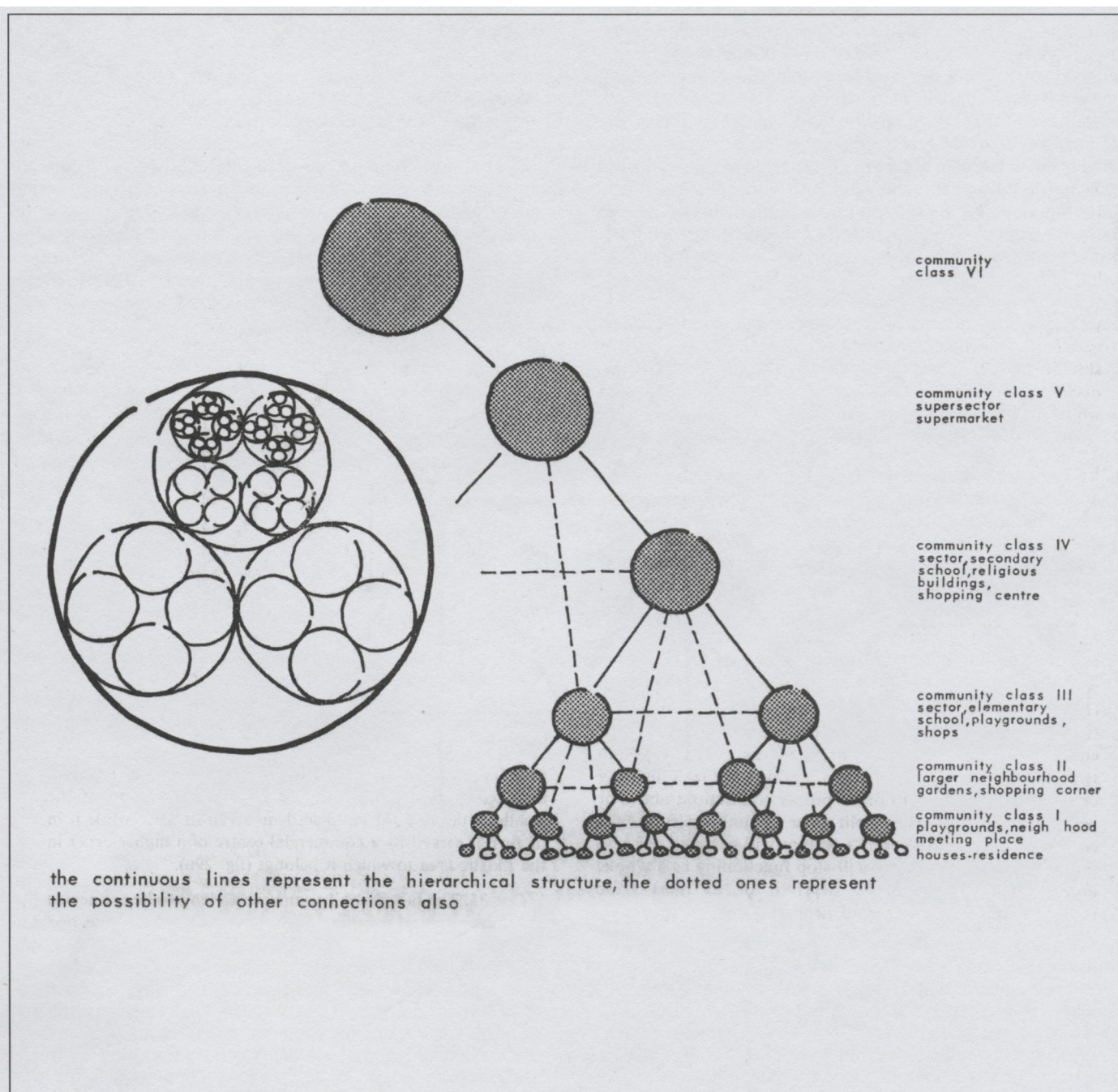
Fig. 23: Hierarchical structure of settlements.

Ekistic unit to function properly, it should be a community of such size as to guarantee its survival.

Law 34. All communities, and therefore, all Ekistic units tend to be connected to each other in a hierarchical manner. Every community of a higher order serves a certain number of communities of a lower order, and the same is true of specific functions within Ekistic units.

A small city may well be the centre of an area of five or six smaller cities and 30 to 50 rural settlements. And it may also be one of the five to eight cities of a similar size which are served by a city of an even higher order. The same holds true for all specific functions within the city. If a city is a commercial centre, it serves the commercial centres of the smaller cities and the rural settlements in its area, while it in its turn is served by a commercial centre of a higher order in the Ekistic area to which it belongs (fig. 23).

Law 35. The fact that all communities tend to be connected in a hierarchical manner does not mean that this connection is an exclusive one. Many other connections at the same level or at different ones are equally possible, but for organisational purposes the connections are hierarchical.

The settlements do not create one-way connections between communities, on the contrary they tend to create many types of connections in all directions; therefore, the possibilities of multiple and not only hierarchical connections are open. It is natural, however, that any organised activity should follow a pattern of hierarchical connections; a merchant with a shop in a community class III, for example, does not buy from the wholesale merchant of class IX, but from the distributor of class V or VI. The administration of municipal services follows the same pattern. This pattern is also followed by any citizen connected with any function, unless he is dissatisfied with the services close to him or unless a service of a higher order is closer to him than one of a lower order. If he wants to buy bread he normally goes to centres class III or IV, but if a supermarket class V happens to be closer to him he might satisfy a need of a lower order in a centre of a higher one.

Law 36. The existence or creation of communities and functions of a higher order does not necessarily mean the elimination of those of a lower one.

The need for a large shopping centre does not mean the elimination of all corner-shops. The same holds true for an urban supermarket and a 'regional supermarket'. Every commercial centre has a function of a different class, magnitude and structure. The corner-shop serves needs which cannot be served by a supermarket situated at a great distance from homes. This law has been overlooked by many people. The fact that we need corner-shops and small units has led them to believe that supermarkets are inhuman. They are as mistaken as those people, who, when the supermarkets first appeared, thought that we should eliminate all services of a lower order because we no longer needed functions or communities or Ekistic units of this type. Practice has shown that both points of view are equally wrong, since there is a hierarchy of functions and communities, and the hierarchical system must function as a whole if the settlement is to function satisfactorily.

This law mentions the existence and creation of communities of a higher order. While it is clear how widely valid this is in existing communities, it is not always true in practice, since the creation of communities of different orders often leads to the elimination of communities of a lower order; especially if their existence depends on the same authority which decided on the creation of a community of a higher order. Sometimes

attempts have been made by the local people to ameliorate the situation by creating, sometimes in spite of the decision of the planning authority, the missing communities of a lower order. This has happened with several new schemes where only a supermarket has been planned and no other shopping facilities have been allowed at lower levels. In such cases people have often remodelled houses in order to provide the missing minor shopping centres, or even created temporary markets on street corners.

Law 37. The type of services and the satisfaction provided by every Ekistic unit, community and function of a higher order to those of a lower order depend on time-distance and cost-distance.

The fact that a hierarchical structure of Ekistic units, communities and functions is needed does not mean that the services provided are the same on every level, for the type of services depends on the level of the Ekistic units and communities. The type of services alone is not enough to measure the satisfaction afforded to the inhabitants. In order to measure the satisfaction one must measure the time-distance and cost-distance, which play an equally important role. An Ekistic unit and a community may well provide services of a higher order, services desired by the inhabitants of Ekistic units and communities of a lower order; let us say that it provides a theatre where the lower units have only a cinema. If, however, this theatre is located at a distance of 100 km from the lower communities, they will visit it infrequently. The satisfaction being offered is weakened by the time-distance especially, and eventually much more so by the cost-distance if there is no public transportation.

Law 38. The overall physical texture of a human settlement depends on its basic Ekistic unit, that is, its Ekistic modulus.

The Ekistic modulus can be as small as a house, or the size of a block, or even the sector of a major community unit between highways, etc. This modulus depends on the size of the Ekistic units and defines its scale. If the Ekistic unit is a house and the modulus the room, and if the rooms are large, the scale of the house is large. If the Ekistic unit is a small city, its modulus is the city block; and if the block is large the scale of the city's texture is large. As a city grows to a large size the original size of its blocks (i.e. its street networks) becomes too small a modulus: they become out of scale. Then there is a necessity for a larger modulus which can be made of groups of blocks – or super-blocks separating pedestrian and vehicular traffic – such as the half mile square blocks in some city plans; or the community unit itself may become much more cohesive, as in the case of the sectors of the metropolitan area of the city of Islamabad.

Law 39. The texture of a human settlement changes as its dimensions change.

For a small city the house or even the housing group or city block may be a good modulus for the entire texture; but for a major city it is too small a unit. The texture of larger human settlements should change when the population of a settlement grows from say 100,000 to one million, since the settlement is unable to operate efficiently with a texture of small blocks. During this expansion major arteries must have made their appearance, either as railways or highways. The texture of the human settlement has probably been re-shaped during its growth. If this has not occurred, it is because of the settlement's inertia; while its inability to change its built-up structure results in its texture being no longer appropriate. The settlement has failed to adjust to the new requirements and consequently it is suffering.

1. London, England (1962): Dynamegalopolis – Average density of built-up area 120 inh/ha (48 inh/acre).

2. Tokyo, Japan (1962): Urban settlements central area – 10-20 million group.

3. Paris, France (1956): Urban settlements central area – 5-10 million group.

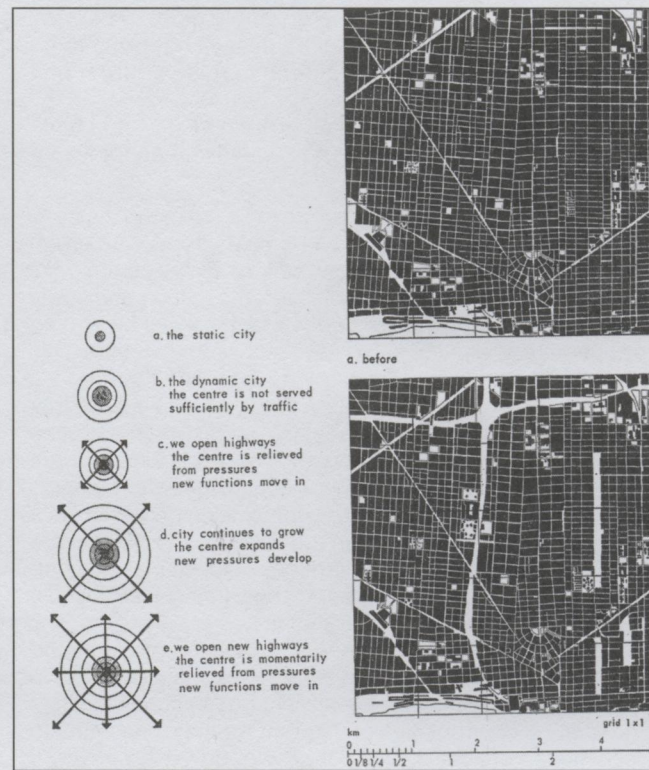4. Downtown Detroit, USA (1961): (below) Death of a settlement's centre by surgery; (right) Urban renewal by surgery.

a. the static city

b. the dynamic city
the centre is not served
sufficiently by traffic

c. we open highways
the centre is relieved
from pressures
new functions move in

d. city continues to grow
the centre expands
new pressures develop

e. we open new highways
the centre is momentarily
relieved from pressures
new functions move in

a. before

Fig. 24: Comparison of major urban settlements.

In this respect we can compare Tokyo and London where the old texture of the city has been preserved, to Paris where the texture was changed in the time of Baron Haussmann, and to an American city, like Detroit, where the texture was again changed with the opening of freeways (fig. 24).

Form

Law **40.** The main force which shapes human settlements physically is the tendency towards a close interrelationship of all its parts.

Since all parts endeavour to congregate as close as possible, they tend to form a circle with a centre which exercises a centripetal force. As new parts are added, they come to the centre in order to be as close as possible to all others. When new parts can no longer be added in the centre they come as close to it as possible. It is only when they cannot be effectively incorporated in the centre of the built-up area, that they are arranged on the periphery.

Because of this law and because of the centripetal force, small settlements have a very cohesive shape, always tending towards a circle. Without such a force, their parts would be unconnected and would practically 'float' at will. On the basis of this principle, houses not connected with production or any function connected with Nature also tend to be as close to each other as possible. The degree to which this is possible is defined by the space needed around them (fig. 25).

Since within a settlement the parts are not of equal dimensions and importance, they tend to arrange themselves so that those more closely connected are brought even closer, while those less immediately connected to each other move even farther apart. In a village, the peasants' houses are close to its centre. Since these occupy a small space, they can be densely built; they contain the families of people who have many reasons to be close together in order to use common facilities, etc. Dry-farming areas on the other hand, which only certain members of the family occupy for a certain number of hours a day, need not be as close to each other and are usually arranged in the periphery of the settlement. Such a structure is physically expressed as a settlement consisting of two parts: the nucleus or built-up part with a network of streets quite close to each other allowing for small plots and small houses, with the remaining part of the settlement containing the farms served by streets at a much larger distance apart corresponding to the considerably larger size of the farms in relation to the building plots within the built-up nucleus. Theoretically, were this force the only one shaping the settlement, we should be led to the formation of nuclei or built-up parts consisting of one central square and radial streets leading towards it (fig. 25).

The centripetal force does not seem to work in very small settlements. When there are only a few houses – say, ten or 20 – a centripetal force is not always in operation. It seems that because the distances are too small and because it does not matter whether people walk two minutes instead of one, their need to congregate in one centre does not work in the same way. There can also be another explanation for this phenomenon. Such very small settlements have no focal point and are not big enough to have developed a central square or central functions; therefore, in the absence of a centre there is no centripetal force. The fact is that centripetal forces only appear to begin operating in settlements with a few score houses. A parallel could be drawn with the capillary forces in very narrow tubes, where, instead of having the surface of a liquid at a horizontal level, we see it taking a convex or a concave form. As in many natural phenomena, general principles are no longer valid on a micro-scale, the same stands true for settlements.
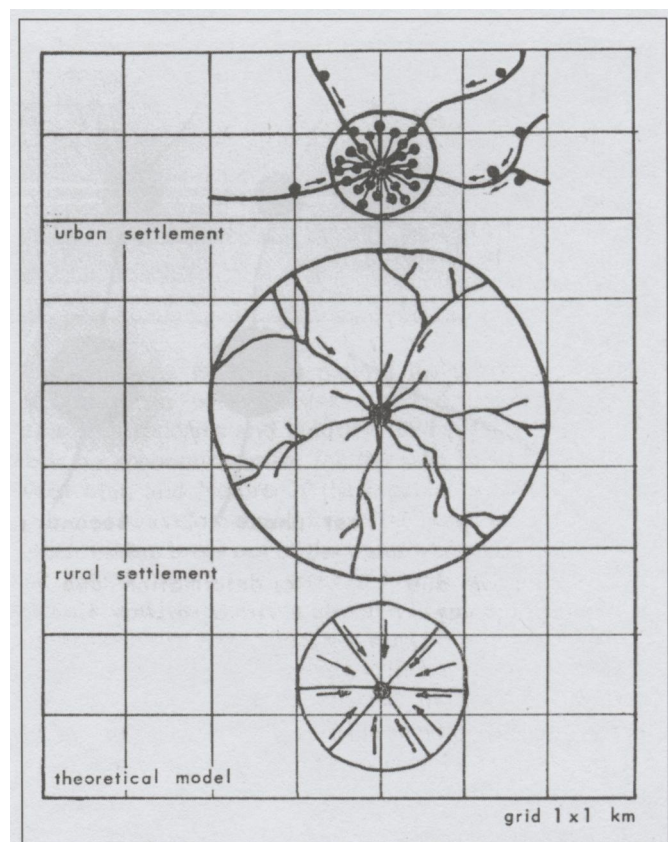

Fig. 25: Centripetal forces.

Law **41.** A centripetal force leads to forms of settlements conditioned by curves of equal effort, which ideally appear as concentric circles.

This effort may be expressed physically as the effort required to walk a long distance across a plain versus the effort required to climb a hill, or in the time required to cover these distances, or in the money needed when one must pay in order to move within the settlement. Whether the prevailing curves are of effort, time or money, depends on the values of these elements in every specific case. If, for example, the settlement is small and people do not own mechanical means of transportation, the only important characteristic is human effort, which is the deciding factor. In such a case a settlement on a hillside will tend to have its larger dimensions along the contour lines rather than at right angles, since moving horizontally is easier than going up or downhill (fig. 26).

If the settlement is large and the inhabitants are wealthy enough to own cars, the prevailing characteristic will be time. Thus, a settlement which has a network of streets allowing for the same speed throughout tends to be circular. If, however, one highway crosses the settlement, and the speed on it is twice as much as that within the normal road network, the settlement will tend to take a form corresponding to a combination of the time required for movement both within the normal network and on the highway (fig. 26).

If the settlement is such that some people move on foot, some by private car and others by mass transportation, the money factor tends to prevail and the settlement will usually take a form corresponding to the amount the inhabitants can spend on transportation. This may lead to much more complicated forms, since the movement of one part of the population may be determined on the basis of the human effort required, another on the time required and a third on the basis of money needed. But if, in addition to means of transportation by road,
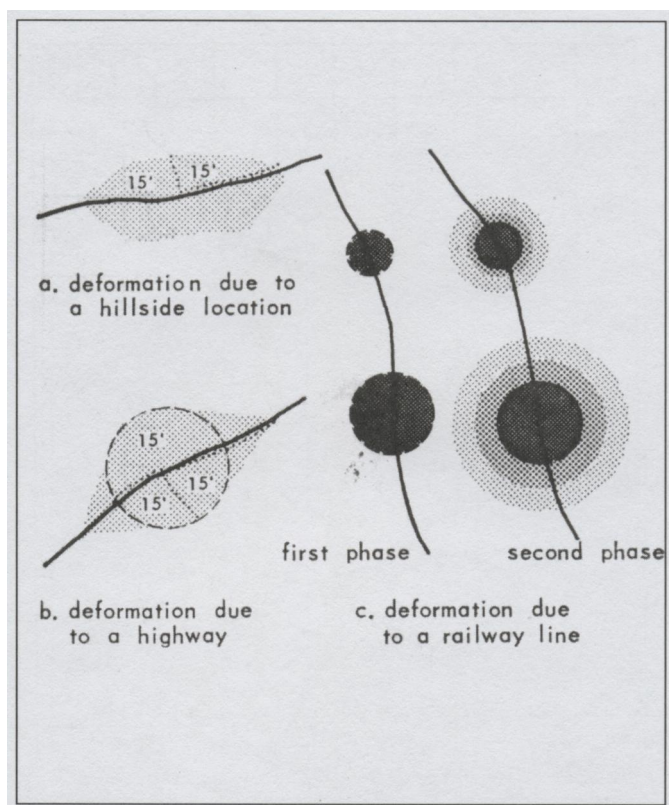
Fig. 26: Equal effort principle.

the city has a railway passing through it which stops only at certain distant points easily accessible by train, the fares may be quite expensive for everybody, so that the train will be used only by a certain number of inhabitants. This may lead to a still more complicated form of a series of built-up parts around the station, which can later merge into one (fig. 26).

Law **42.** Linear forces lead to the formation of linear parts of settlements; under certain conditions, this may lead to a linear form of the entire settlement for a certain length only, and after a certain period of time.

If instead of having railways (which create settlements around their stations) we have highways (which facilitate traffic along them while access to them is not completely limited as with railways), then the settlement tends to become linear (fig. 27). If the highway has limited access, then we may have a tendency for the creation of a linear settlement on the one side. The width and distribution of land uses along the highway always tend to be the same.

Fig. 27: Theoretical pattern of linear settlements.

Law **43.** Undetermined forces, usually caused by the form of the landscape, lead to the formation of settlements of an undetermined form.

These settlements may take shape on the banks of a river or by a lake or by the seashore with a beautiful view or even by a narrow valley. They may resemble linear ones or they may well be of a completely undetermined form. Their width and distribution of land uses may also not be the same.

Law **44.** The form of a settlement is determined by a combination of the central, linear and undetermined forces in adjustment to the landscape and in accordance with its positive and negative characteristics.

An elongated valley will by necessity have an elongated settlement, for its development along the main axis of the valley is easier than at a right angle (fig. 28). A landscape which is divided by rivers will lead the settlement to a form adjusted to the shapes of the land left intact. It is not easy to cross a river many times or to build a settlement on a delta. Thus, a settlement which grows in a valley near a river is built mainly where the river is most easy to cross. Its later expansion will follow forms that avoid the necessity of building on the swamps of a delta or of making many river crossings.

There are also positive aspects of the impact of the landscape on the form of the settlement. If, for example, a settlement is built near a bay, it is quite natural for parts of it to be influenced by the positive aspects of a coastal area which attracts both residents and industry. This may occur even if there is no economic motive for the sake of better contact between Man and Nature. If the inhabitants are fishermen they want to be as close as possible to the beach where they can pull their fishing boats out of the water whenever the weather is bad. In this case, the element of Nature acts not only as an element of production, but also as a line of transportation. But even when this factor does not exist, in order to take full advantage of the beauty provided by the sea, or the sea breeze, the settlement will become adjusted to the form of the landscape; this may well result in a crescent-shaped form. In such a case, the focal point of the settlement, the centre itself will also be elongated.

Law **45.** A settlement grows in the areas of the greatest attraction and least resistance.

Laws 43 and 44 lead to the conclusion that settlements and their overall functions develop along their main lines of transportation, conditioned by other elements, such as Nature, the type of Society, special functions, the types of transportation used, the cost of movement, etc. These laws also lead to the statement that the growth of settlements takes place on the basis of the curves of equal effort, equal time, equal money, etc., or a combination of these, as adjusted to the actual landscape. In addition to them, Law 45 clarifies that not only attraction but also the least resistance influences the growth of settlements.

Law **46.** A factor with a direct impact on the form of a settlement is the need for security which may at times be even more important than the main centripetal force.

The form conditioned by the need for security depends on the kind of potential danger. In the past, the need for security influenced settlements in the same way as centripetal forces did. The danger coming from outside exercised pressures on the settlement leading it to a circular form which offered the minimum length of walls to be defended with the maximum enclosed surface (fig. 29a).

Then, airplanes threatened the settlement and therefore the opposite form was necessary for defence against an air at-
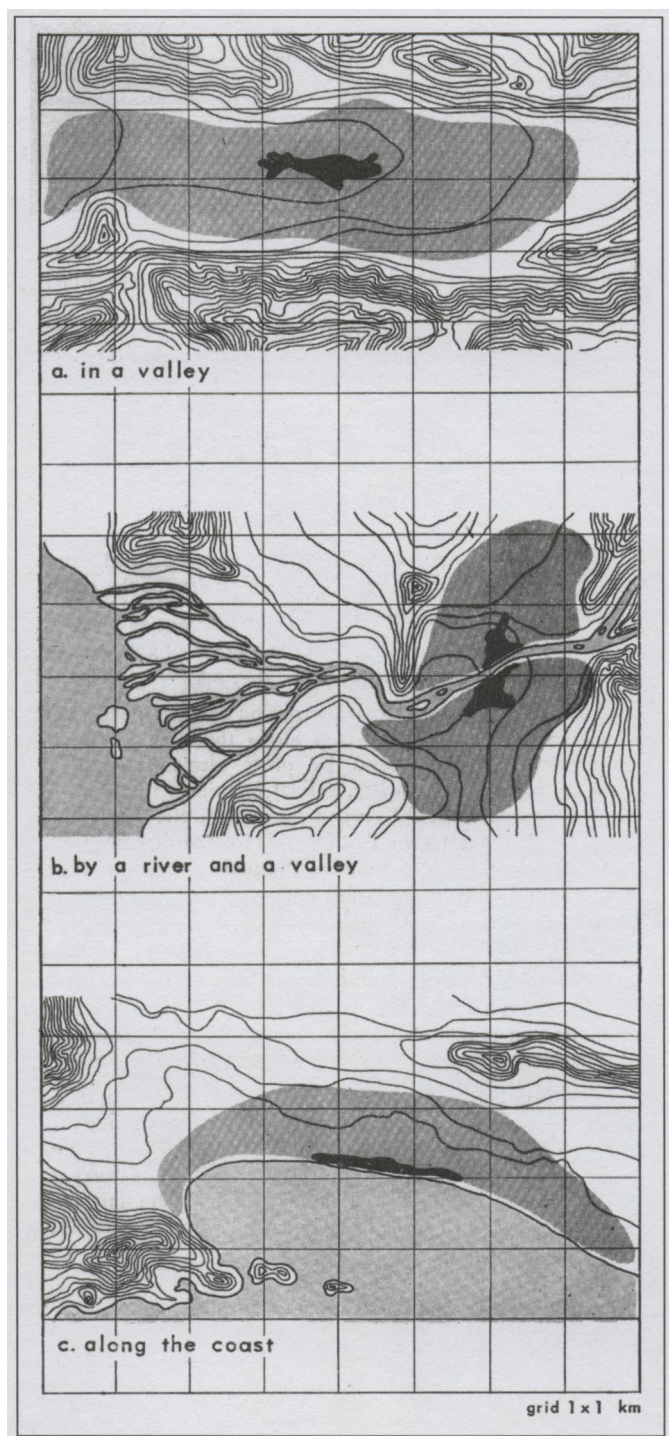
Fig. 28: Forms of settlements determined by the landscape.

a. in a valley

b. by a river and a valley

c. along the coast

grid 1 x 1 km

Fig. 29: Forms of settlements determined by the need for security.

grid 500 x 500 m

a. attack by land leads to a compact walled city

grid 5 x 5 km

b. attack by air breaks the city into pieces

grid 50 x 50 km

c. nuclear attack leads to the conception of a system of settlements

tack. It was no longer necessary to present the minimum length of periphery line for defence; on the contrary it became necessary to be spread away from the centre, which might be hit, in order to present the enemy with a maximum surface. In this case, security comes into conflict with the settlement's natural centripetal forces (fig. 29b).

The fear of an attack by an even larger force from the air – nuclear weapons – may force settlements to be even farther apart, since the vulnerable area will be much larger and entire major settlements could be eliminated during an attack. Security, therefore, de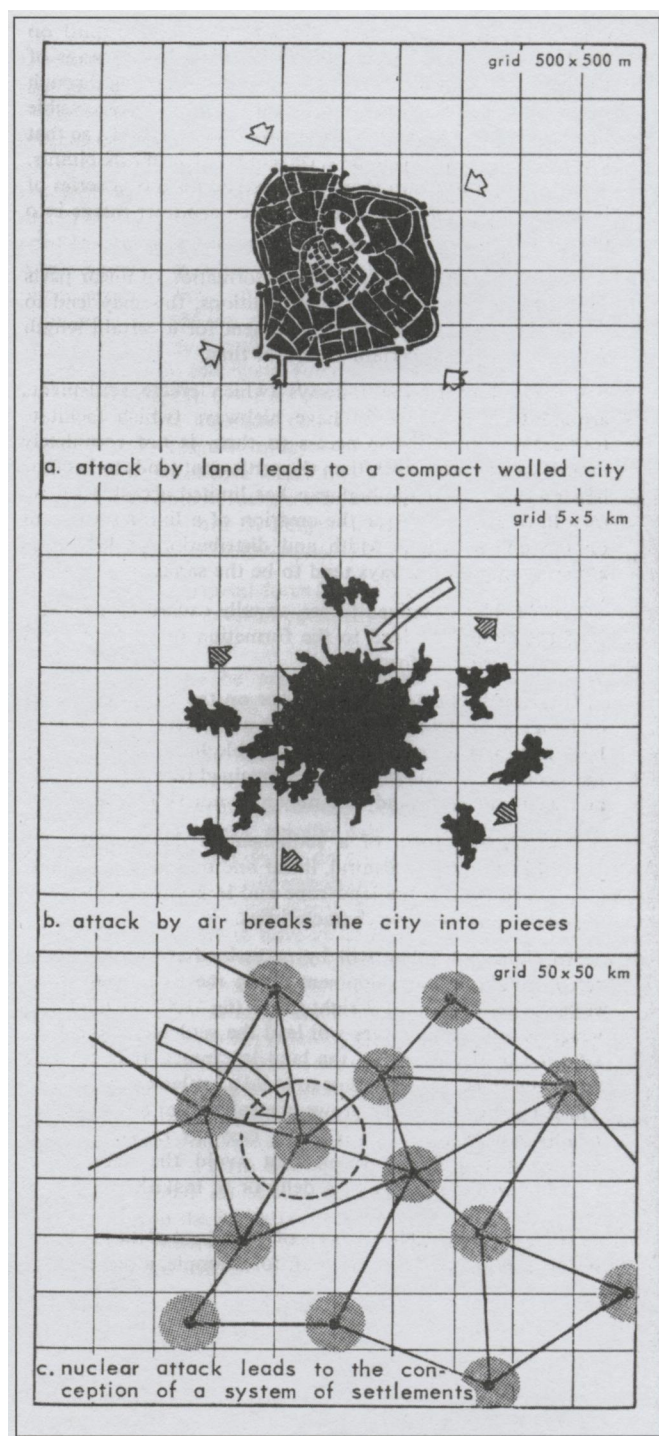velops centrifugal forces which may spread the settlement over larger areas, with a number of very small parts and many others which may become linear. Thus, from the point of view of security, modern weapons are leading us towards new types of settlements which look much more like systems of nodal points and transportation lines than the compact built-up areas that prevailed in the past. A system which depends on many nodal points and circulatory lines becomes more important than the one-nucleus compact settlement since only such a system can survive, even if its central nucleus is completely destroyed (fig. 29c).

Law 47. Another force which exercises an influence on the form of a settlement is the tendency towards an orderly pattern.

For example, if the settlement is small (fig. 30a), the centripetal forces may themselves define the final shape. But should the settlement grow large enough, it will become apparent that the centripetal forces lead to an unmanageable form (fig. 30b) because the blocks will be very small in the centre and very large in the outlying area or if we want equal blocks, the street pattern will not make sense. In any case the form of the plots does not help the construction of rectilinear buildings. If we respect only the principle of order as derived from the desire of people to build their houses in rectangular space, which requires rectangular plots, this will lead to a grid-iron system for the road network (fig. 30c).

So, we are led to the conclusion that a settlement should be formed like a wheel on the basis of the centripetal principle, and like a grid-iron on the basis of the desire and tendency for absolute order. These two patterns contradict each other. We cannot combine a centripetal with a grid-iron pattern. Neither the desire for maximum cohesion nor for maximum order has any meaning or leads anywhere if deprived of the comprehensive view of how best to serve the total problem of the settlement. Only those forms of settlements make sense which can on every specific occasion merge reasonably the basic principles of settlements for cohesion and an orderly pattern. How this is done depends on each specific case and is the subject matter of a chapter on the morphology of settlements.

Law 48. The final form of the settlement depends on the total sum of the forces already mentioned as well as others such as tradition and cultural factors, which play a greater role in the lower units. The final form is a result of the interplay of these primary, secondary and tertiary forces.

How these forces interact, which one is stronger and which weaker, is not an easy question to answer, since their interplay changes on the basis of many variables. Location, as we have seen, differs in importance according to the size of the settlement. The basic structure of a settlement depends not only on its size, but also on its type of traffic. Traffic not only depends on the number of people, or on economic activity, but also on the means of transportation. It is reasonable to try to acquire gradually a better understanding of the interplay between some of these forces which will lead us to the formulation of rules. In this sense, it is useful even at this point to explore some of the related laws.

Law 49. The form of the settlement is satisfactory only if all the forces of varying importance within it can be brought into balance physically.

We have already seen that all the elements of a settlement tend to be in balance (Law 21). This must also be expressed in a physical way, otherwise the form of the settlement will be unsatisfactory. The elements and the forces are diverse and play a different role in the varied types of Ekistic units and at the various levels of the Ekistic scale.

There are forces which influence only the smallest Ekistic scales. For example, the preference of one individual or one family for a certain type of house is a force of only local importance. The architecture of this house is a combination of the force of the smallest Ekistic unit – that is, the preference of the inhabitant – with the forces of the community in which he lives, the forces of a major Ekistic unit. Man alone cannot decide on the architecture of his house; he must respect the regulations, and in a certain way also the common desire of the community for a house acceptable to most of its members. For example, even if there are no regulations prohibit-
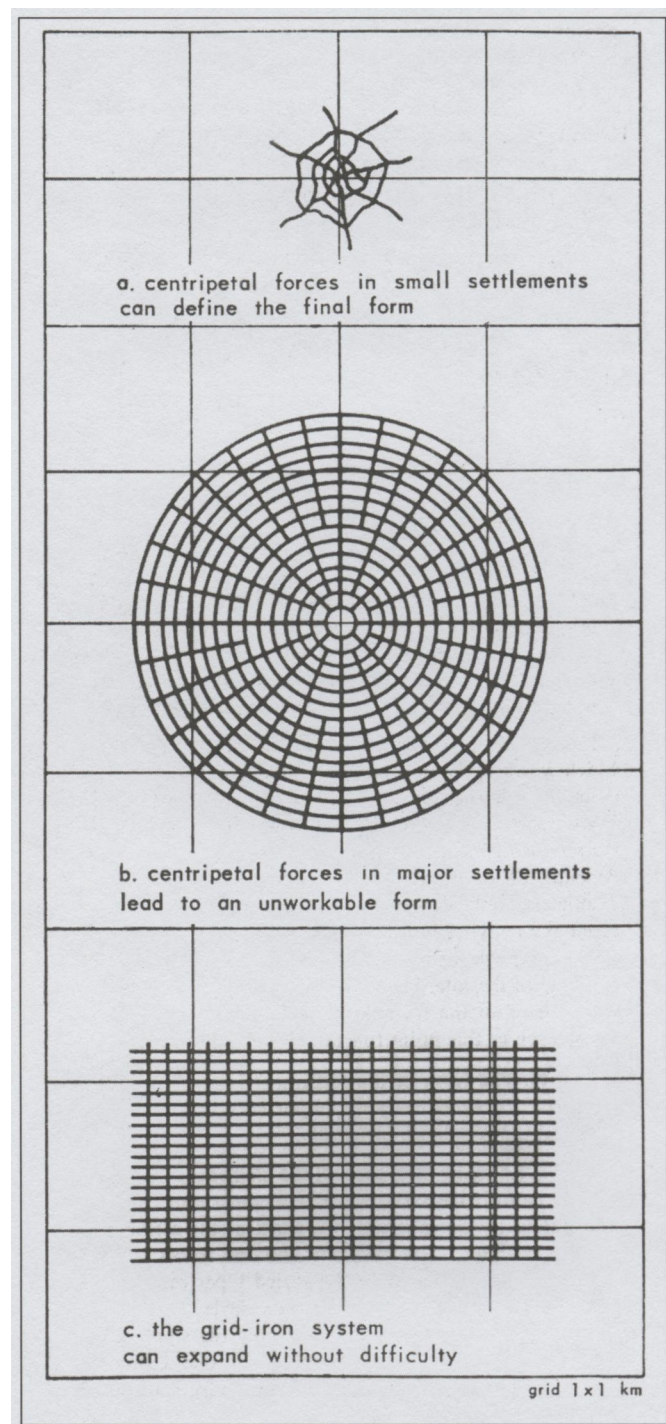

a. centripetal forces in small settlements can define the final form

b. centripetal forces in major settlements lead to an unworkable form

c. the grid-iron system can expand without difficulty

grid 1 x 1 km

Fig. 30: Tendency to achieve an orderly pattern.

ing it, it is difficult to accept a house painted black. The community would most probably protest and force the owner to change the colour to a more acceptable one.

All forces are broken up and act at different levels. For example, the house is much more influenced by the forces of the immediate neighbourhood than by those of the major community or the major city. In accordance with this rule, however, we will find that there are forces influencing this house which are derived from the city, the region, the nation, and finally even the whole world. Forces such as industrialisation, building materials, the behaviour of concrete and the
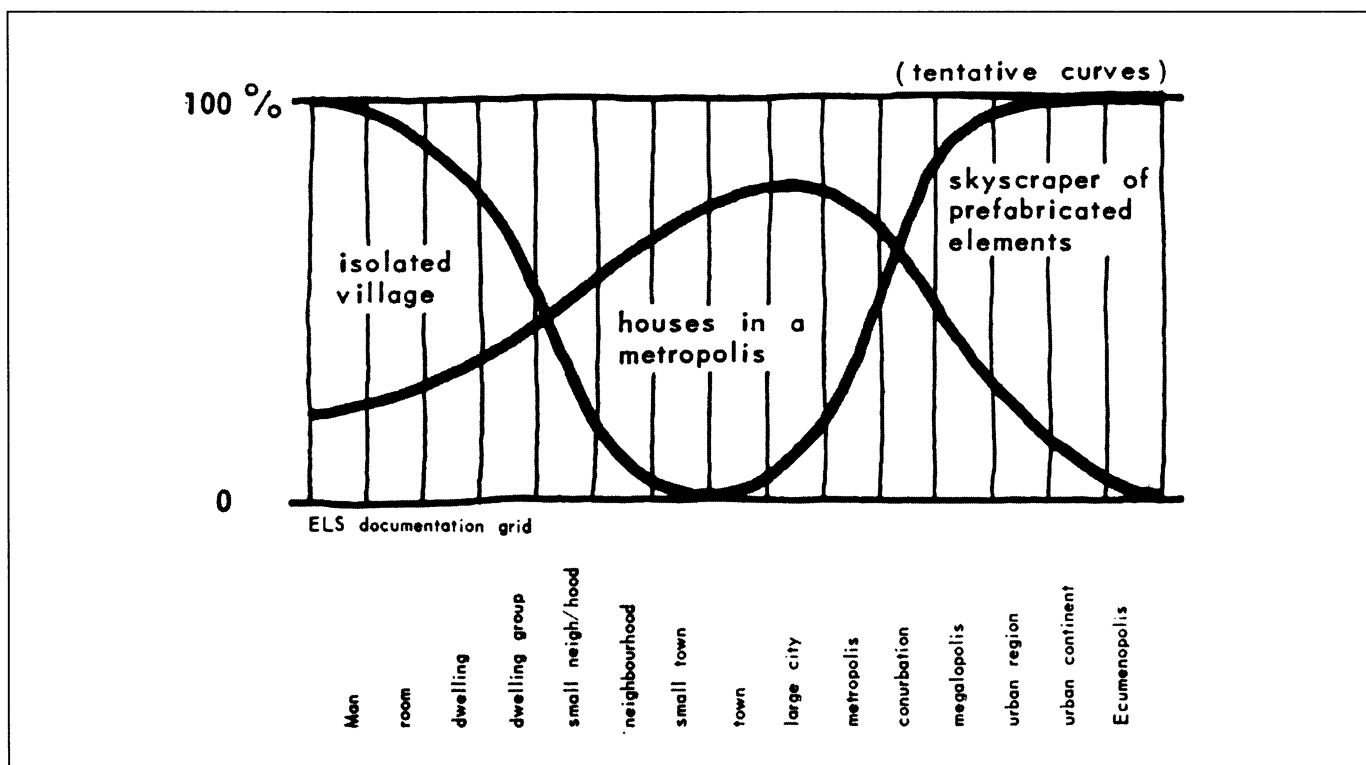
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Fig. 31: Forces influencing the form of Ekistic units.

rules conditioning it, are of international importance; whereas decorations, which may be created even with the same concrete, are very local in content.

Thus, the sum total of the forces influencing a settlement on every level is equal to that of the forces derived from Ekistic units on all levels (fig. 31). The curve showing this may vary in steepness due to forces derived from the smaller units or from forces derived from the higher unit.

Law 50. The right form for a human settlement is that which best expresses all the static positions and dynamic movements of Man, animals and machines within its space.

Man sits, stands, walks and runs in a city; so do animals serving his purposes, as well as machines. The form of the city should respect and express all these positions and movements within the settlement, for otherwise the form will not correspond to the main content of the city, that is, Man as well as the animals and machines. In the same way in which Marshall McLuhan states that 'only phonetic writing has the power to translate man from the tribal to the civilized sphere, to give him an eye for an ear',[2] only the proper expression of all needs can satisfy us aesthetically. I will mention one example: a central square serves the functions of people who stand, walk and circulate in it. It is stable and static and the people in it move slowly. So, the perspective of the roads leading to it should not be open, since this will transmit the image of through movement, which is contrary to the function of stability in the square (fig. 32a). The perspective leading to such a square should be closed, only then will it truly express the real needs of the square and those who use it (fig. 32b).

Law 51. The right form is that which expresses the importance, class and, consequently, the relative scale of every Ekistic unit with the proper basic moduli and their subdivision.
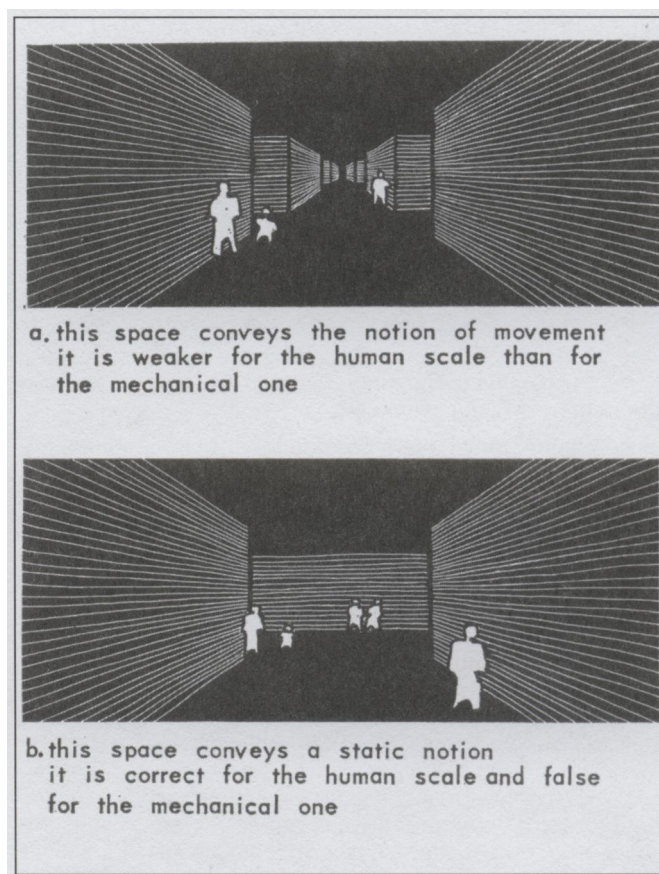

Fig. 32: Conception of space in relation to the human and mechanical scales.

In a small city, let us say ancient Greek Miletus, the traditional city-block is its proper modulus (fig. 33a). The same is valid for most other small cities or villages. When the city is larger, a normal city-block, as the only modulus of its texture (fig. 33b), leads to an overall form which is deprived of scale and character. Such an overall form needs divisions of a higher order; the block may remain as one of their sub-divisions (fig. 33c).

Law 52. The densities in a settlement or in any of its parts depend on the forces which are exercised upon it.

Traffic density depends on the forces which bring traffic into a certain area. Population density during office hours depends on the forces which create a need for office functions in this particular area. The same is true of residential or of any other type of density.

Law 53. In human settlements formed by a normal process the pattern of densities changes in a rational and continuous way according to the level of the Ekistic unit and the functions served.

Such a principle means that there are no unreasonable transfers from very low to very high densities. There is a rational pattern for changing densities following the pattern of the hierarchical community structure. This principle is valid when the development of the settlement has taken place slowly over the years, either without conscious planning by Society, which imposes regulations, or with an intervention which respects the natural structure of the entire settlement.

According to this principle it is impossible in any Ekistic space which has been developed normally, especially at a normal speed, to have an area with a density of habitation, functions, investment and settlement not adjusted to the whole. If in the texture of the settlement there is any waste space, it will tend to be taken over by functions which will fill this area at the required density of people, functions and investment. If this does not happen, it will usually be due to man-made conditions of legal, administrative or economic significance. Human settlements cannot bear vacuums or a weakening of their texture in any section. If a vacuum remains, the settlement tends to fill it with functions, the densities of which are conditioned by those of the surrounding area.

Law 54. The satisfaction derived from the services provided by the Ekistic unit to the inhabitants greatly depends on the proper density of the settlement.

A settlement may have a great number of inhabitants, but the services provided to them may be on a very low scale, should the density of their habitation be very low, and the distances between people and between the people and central functions be large. On the other hand, an area with a smaller number of inhabitants who have settled in the right density is able to provide them with more satisfactory services.

The principles of the relationship of satisfaction derived from services to densities is derived from Law 37, since time- and cost-distances increase with lower densities, the services provided at lower densities decrease in importance. Densities can be expressed in different ways, such as in the physical proximity of the people who have settled, the physical proximity of the functions and the elements of the Shells, the degree of investment which has taken place over the whole area, etc. All these types of densities are of a similar nature, and they tend to increase or decrease simultaneously, although these changes are effected by different coefficients.
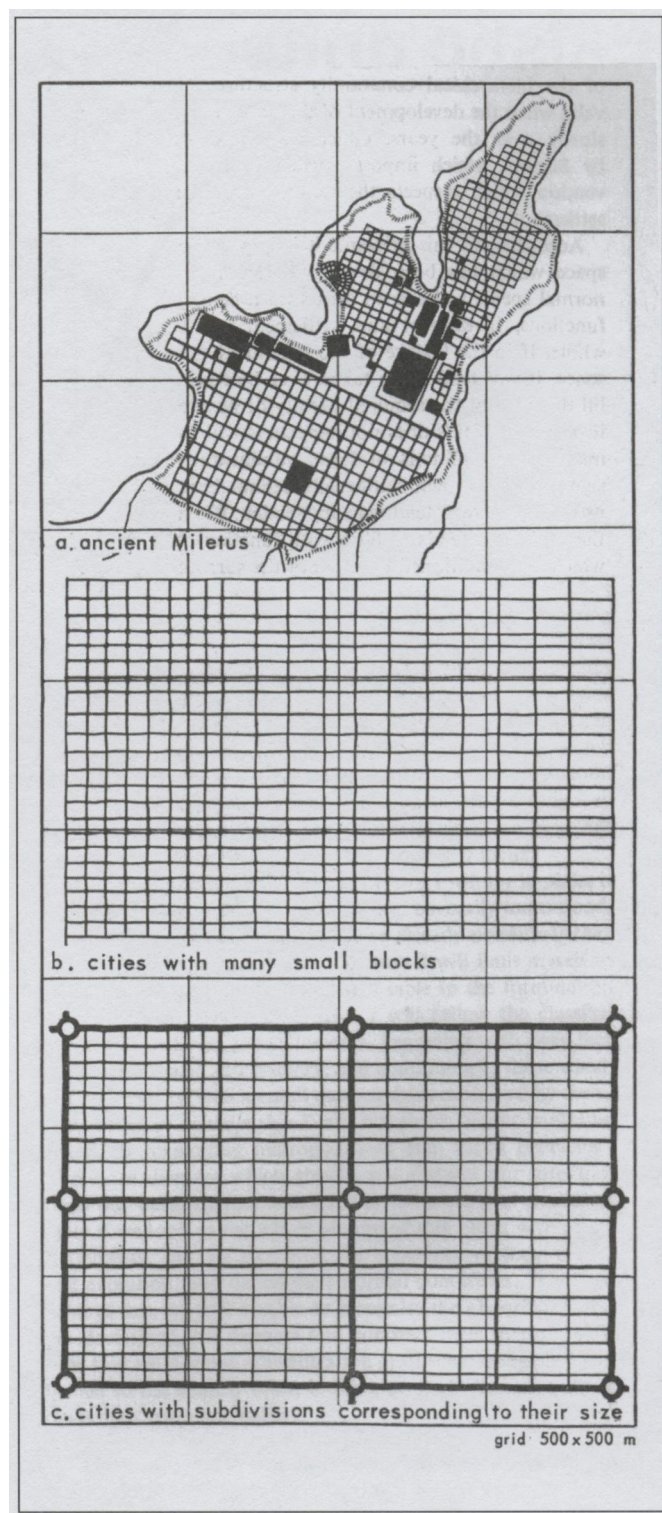

a. ancient Miletus

b. cities with many small blocks

c. cities with subdivisions corresponding to their size

grid 500 x 500 m

Fig. 33: The proper structure of a settlement has to express its scale by the proper modulus.

Notes

1. Leonard J. Duhl (ed.), *The Urban Condition,* page 69.
2. Marshall McLuhan, *The Gutenberg Galaxy, the Making of Typographic Man,* page 27.

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