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Origin and Methodology of Human Ecology

Napoleon Wolanski
Department of Human Ecology, Polish Academy of Sciences, 00-330 Warsaw, Nowy Swiat 72, Poland

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ABSTRACT Contemporary roots (since 1916 in geography and since 1921 in sociology) of human ecology and its development starting from doctrinal expressions in different classical scientific disciplines (anthropology etc.), and applied fields (medicine etc.) have been discussed. This period called monodisciplinary subsisted for about 60 years. In the following multidisciplinary period, the mosaic picture of knowledge based on different elementary disciplines has been created, and its beginning dates from the first activity of the International Biological Programme (1964-1974) till, in many scientific centres, today. Current transdisciplinary human ecology has been created for at least 15 years. Human Ecology is polymethodical, however having its own specific methodologies.

Science is, and especially was in old times, a way of description of the world. Its branches correspond to the appropriate, actually existing objects of interest. With the widening of knowledge, and thus the growth of the fund of information, the individual branches divided into sub-branches, which, however also correspond to concrete objects of interest. For example, biology divided into zoology and botany, and the former in time subdivided into many special disciplines, from protozoology to primatology. On the other hand, on a somewhat different principle, anatomy, physiology, and other disciplines came into being.

In the period when the description of the world was no longer sufficient, when it was attempted to foresee the effects of man's influence upon nature and society, sciences began to develop. They correspond to the arising problems rather than the classical objects of interest. The division into problems was of a transdisciplinary character, for it was attempted to perceive general phenomena occurring in nature and society. The degree of generalization did not mean a shallowing of the problem, but rather an expansion of the basis for observation.

For some time now, new branches of science have been appearing as a result of the growth of important social and economic problems. For example, parallel to productive technical (engineering) activity, both the foundations of technology (physics, chemistry, mathematics) and its theoretical generalizations are being developed. These generalizations concern, on the one hand, the organization of production and on the other hand, the science of materials, technology, and so forth. Controversies are going on over the extent to which these theoretical generalizations are branches of science, but it is beyond any doubt that methods of scientific research are applied in them.

One of such scientific problems is the question of the relationship between the "culture-creating man" and nature. In the initial phase, this question was seen as consisting in the opposition of man and the environment in which he is living. The question became extremely important in the phase when people understood that nature is not an inexhaustible resource and that man's influence upon nature could have side-effects harmful to himself. In view of the triad of interrelated phenomena: population explosion, resources scarcity, and environmental deterioration, the problems of interrelations between human populations and the life environment assumed a dramatic dimension. As a result, in addition to

understanding the importance of ecology, conceived of as the economics of nature, the significance of human ecology was perceived.

Human ecology is most frequently defined as man's interrelation with his environment, sometimes as "a relation between society and nature" or "interrelations between human population, culture and environment". Aside from the fact that these definitions are very vague, and thus, from the point of view, of the various branches of science, can be understood too narrowly (which only seemingly looks like a paradox), they do not clearly stated whether human ecology is a scientific discipline concerned with the study of a given phenomenon, an area of social activity (protection of the environment of man's life), or an attitude of mind in viewing the world (that is, a certain outlook upon inter-relations between man and his environment).

ROOTS AND DEVELOPMENT OF HUMAN ECOLOGY

The term "human ecology" first appeared more than 70 years ago (Huntington, 1916) in geography which regarded human ecology as a synthesis of the description of the distribution of man and his products on Earth, and next (Park and Burgess, 1921) as an expression of a definite sociological doctrine in which the role of integrating the community was assigned to territory as the environment in which this community is living (Young, 1974; Sargent, 1983; Tengstrom, 1985; Wolanski, 1987). Somewhat later, human ecology was described by medicine as the study of the effects of the environment's influence upon man, for example, the incidence of diseases under certain living conditions and in a definite natural environment, a discipline previously called epidemiology. Branches termed human ecology appeared in each science which concerned itself with any aspect of relations between man and his environment, in particular, in branches (physical, cultural, and social) of anthropology. Much later, even the theoretical aspects of environmental engineering (town planning, architecture, engineering, ergonomy) came to be termed as human ecology. This initial, monodisciplinary stage, which ended not very long ago, was linked with a different epoch or generation of scientific conceptions. It can be described as the study of the unidirectional influence of the environment upon man, or, less frequently, off man upon the environment (Table 1 A).

In the second phase of development of human ecology, when the interest in interrelations between man and his environment became widespread, attempts were made to integrate the knowledge on this subject. This integration, however, was of a formal character (Table 1 B), for while it provided variegated of information, it did not even attempt a synthesis. If such attempts were made, they were attempts at an analysis of feedback. In other words, since man influences a given element of the environment, how this changed element influences man, and what are the effects of this influence. Such conceptions, no longer valid, though there are some exceptions (some centres of the Certificate International d'Ecologie Humaine), were something new 35 years ago and still tolerated 10 years ago. This stage is called a multidisciplinary one.

Let us now consider the present conception of human ecology as a transdisciplinary synthesis of the study of "man and his culture as dynamic part of ecosystems" (Table 1 C).

The study of man against the background of his environment has for centuries been the concern of philosophy and the natural sciences. The natural background of man's existence was an evil to some people and an object of admiration to others. The demiurge-nature appeared in at least three forms (in principle, successively): from belief in nature's determinism with respect to man, through excessive belief in man's adaptive possibilities, to the conception of nature as a factor limiting human possibilities. Today we regard each of these views as one-sided and believe that they do not exclude one another. Thus we come closer to the contemporary conception of human ecology as the necessity of understanding man's essence in the light of the

Table 1: Stages of development of human ecology as scientific subject

Stage	*Year of initiation*	*M o d e l*	*Represented by*
A. MONODISCIPLINARY	1916	T→M; N→M; C→M etc	Separate doctrines in each related discipline
B_1 MULTIDISCIPLINARY (Mosaic, in sciences)	c. 1972	T N C ↓ ↓ ↓ etc; M M M	"Certificate in human ecology" of several west European universities: Geneva, Brussels, etc.
B_2 MULTIDISCIPLINARY (mosaic, in engineering)	c. 1975	M M M ↓ ↓ ↓ etc; T N C	International Organization for Human Ecology, Vienna.
B_3 MULTIDISCIPLINARY (mosaic, reversible)	c. 1980	T N C ↕ ↕ ↕ etc; M M M	Society for Human Ecology (?), USA
C. TRANSDISCIPLINARY	c 1985	Man; N; T; C	Commission of Human Ecology IUAES.

Abbreviations: T = climate (temperature etc.), N = nutrition (food, nutritional customs etc), C = culture (education, income, organizations, man-made environment etc), M = man (organism, population, society)

infinite complexity and temporariness of relations in the universe. This makes it necessary for human ecology to be synthetic, interdisciplinary science in the sense of conceiving of interrelations between nature, man, and his culture as a compact system.

In ecology it is important to understand that are three most important living system charcters: interaction, levels-of-integration, and functional-relationship (Fig. 1). And also that each thing has its place in nature, that each change has its consequences, etc. The whole of these determinants, conceived of as the economy of nature, also effect man, who is part of nature. There are also other regularities concerning man: there are optimum conditions for each organism under which the physiological processes are the most effective. The needs of the organism are adequate to its morphology; hence they are relatively constant. These needs make it possible to understand the biological aspect of human activities. Man is content with his situation only for a short time. After he has adapted, biologically adjusted and psychically accustomed, to the given conditions, he no longer feels satisfaction. A subjective need for change then arises, and in effect man initiates such a change through culture. This makes possible the comprehending of man's psychosocial nature and his behaviour. Man is guided not only by real biological needs, but also by imagined aspirations which do not have obviously to reflect reality. Consequently, he transforms the world and takes aggressive actions not always rationally justified. This, too, has to be

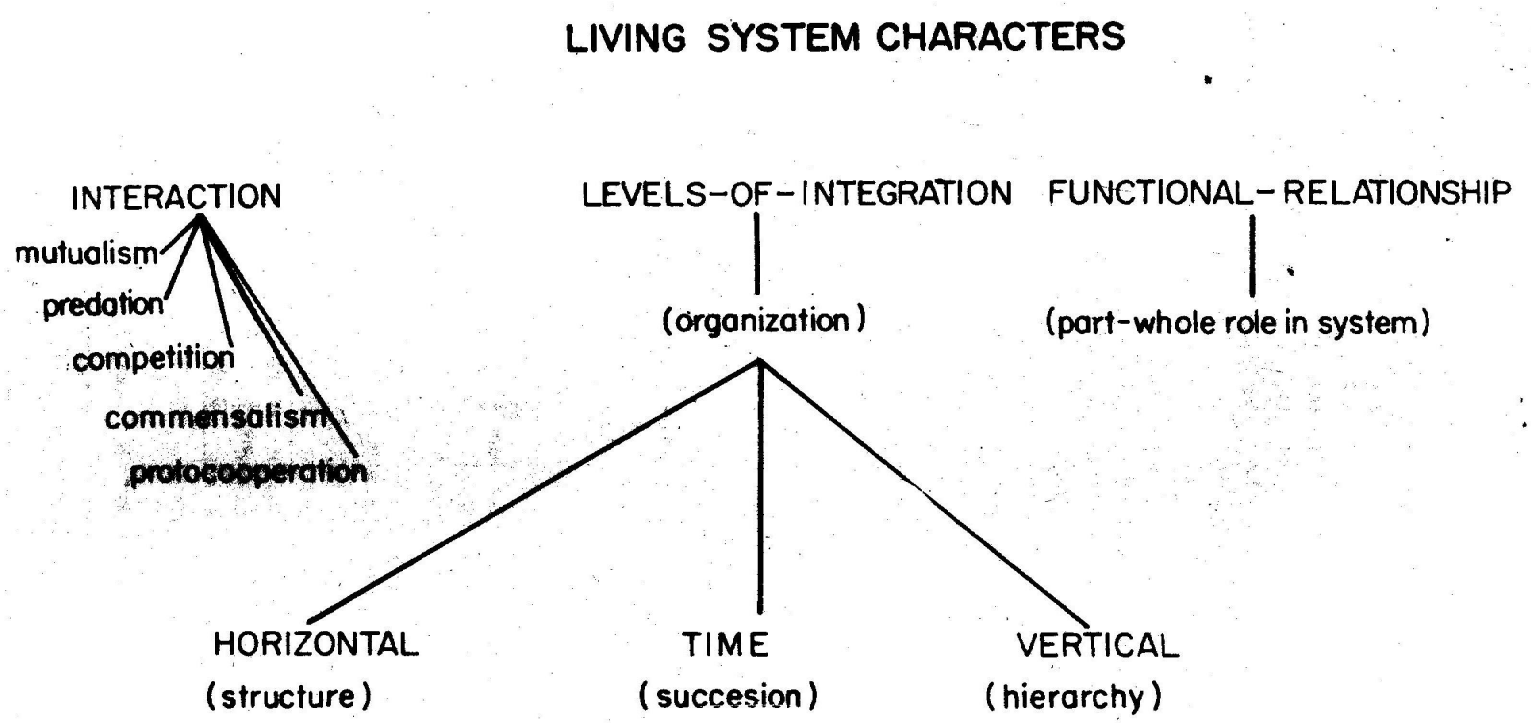


Fig. 1. Living system characters - most important theoretical basis of human (and biological) ecology

understood in order to prevent unfavourable future consequence or side-effects of human actions, including man's pressure upon the environment. The contingencies discussed above are always of a comprehensive character. Therefore, while examining some specific influence of a single factor upon a concrete person, we must remember that it is only a fragment of the changing reality, which is a universal relation.

The above reasoning is so general that it may appear as abstract and practically inapplicable, and perhaps even as devoid of any significance. This is not so, however. These general premises should be related to praxis, also in the sense of scientific studies and analyses.

METHODOLOGICAL PROBLEMS

The approaches to the problem: nature-man-culture, discussed above, have important methodological implications. In research work, elimination of a multiplicity of variable factors has since long been achieved by analyzing one variable factor in the experiment. In studies on man, however, it is most often impossible to apply the assumed experiment because of the potential threat to his health and frame of mind. And the application of this principle in the form of statistical method, which eliminates the scope of variability which is not analyzed, is not possible because of the necessity of collecting immense material (Fig. 2). In an era of computer technology, this difficulty can to some extent be eliminated by reducing the number of potential factors influencing the phenomenon under examination, that is, by analyzing a smaller number of factors not correlated with one another. It is possible to distinguish different types of environments (*e.g.* family environments), stabilize the remaining factors (sources of variability), and analyze the influence of only one factor on the given properties (Fig. 3).

Generally speaking, while analyzing an environmental factor, it should be remembered that it is only one of the factors acting upon the organism. However, almost all human features are multi-factorial. It is therefore necessary to estimate not only force of a given factor according to its own scale, but also its contribution in the shaping of a given feature with respect to other potential factors (Table 2), which may influence the feature under examination. We should remember that we estimate the influence of a given factor at the concrete time and place and upon the concrete population. The phenomenon may turn out to be specific, and so repetition is necessary, also in view of the imperfection of the existing versions of factorial analysis.

The studies discussed here can also be carried out using the multiple or stepwise regression. Automatic Interaction Detector, etc., estimating step by step the participation of the individual factors in the variability of the feature.

It is very important to examine comprehensively the properties of the organism and of the population and environment. In a simplified version, this can be a presentation of the set of features of the individual populations against the background of the average value (that is, the value proper to one of the populations). From this we shall draw conclusions concerning, for example, the compensatory manner of adjustment, "overadjustment", or maladjustment (Fig. 4).

It is also important to take into account the dissimilarity of adaptation mechanisms at different levels of organization (Table 3). These different levels of organization of the abiotic and biotic world and human community are the consequence of universal relationships (interaction) and levels-of-integration (Fig. 5). In the process of evolution, these relations take the form of self-regulating systems. This is the result of integration in the form of a system of mutual adaptation which determines autonomy. It appears, however, that, similarly as in ecological succession, systems of this type also have their own development cycles and can achieve perfection (climax). This state is only seemingly optimal, for in reality it may mean the lack of ability of further improvement—and this signifies the lack of chances for development. In view of the dis-

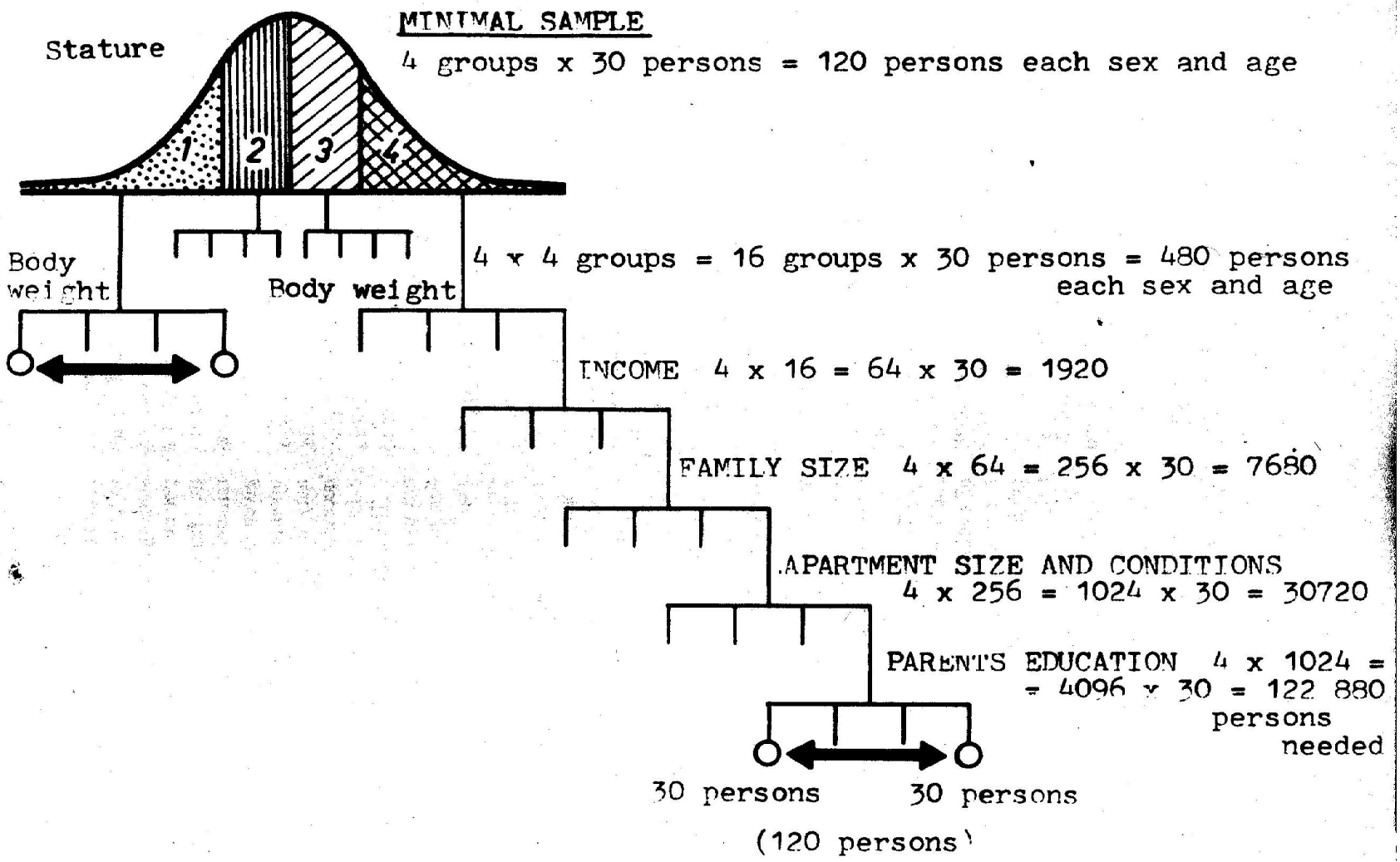


Fig. 2. The minimum number of persons necessary to examine the relation of stature to body weight, depending on four family qualities: income, family size, apartment size, and parents' education. It has been presupposed that each of the variables and each of the factors influencing them is divided into four classes, and the minimum number of persons in the class is 30. To examine the relation of stature to body weight, depending on the four qualities mentioned above, with the principle of one variable factor in the experiment being observed, the sample should number close to 123,000 person of the same sex and at the same age. Such a number of persons cannot be found even in a very large city.

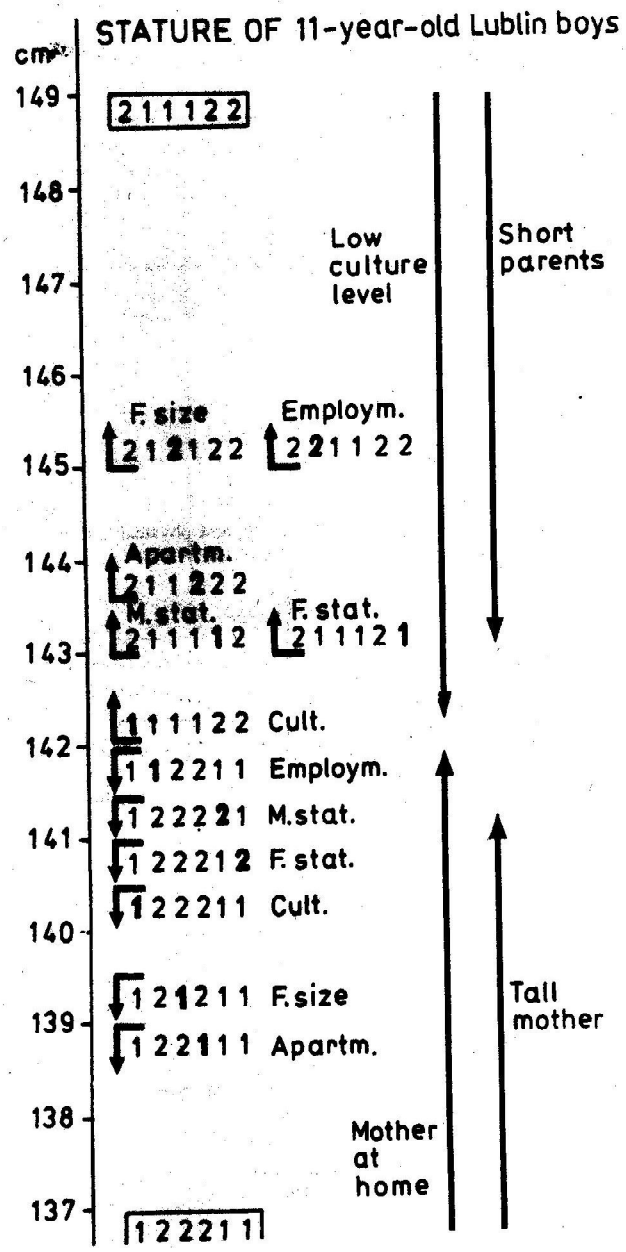
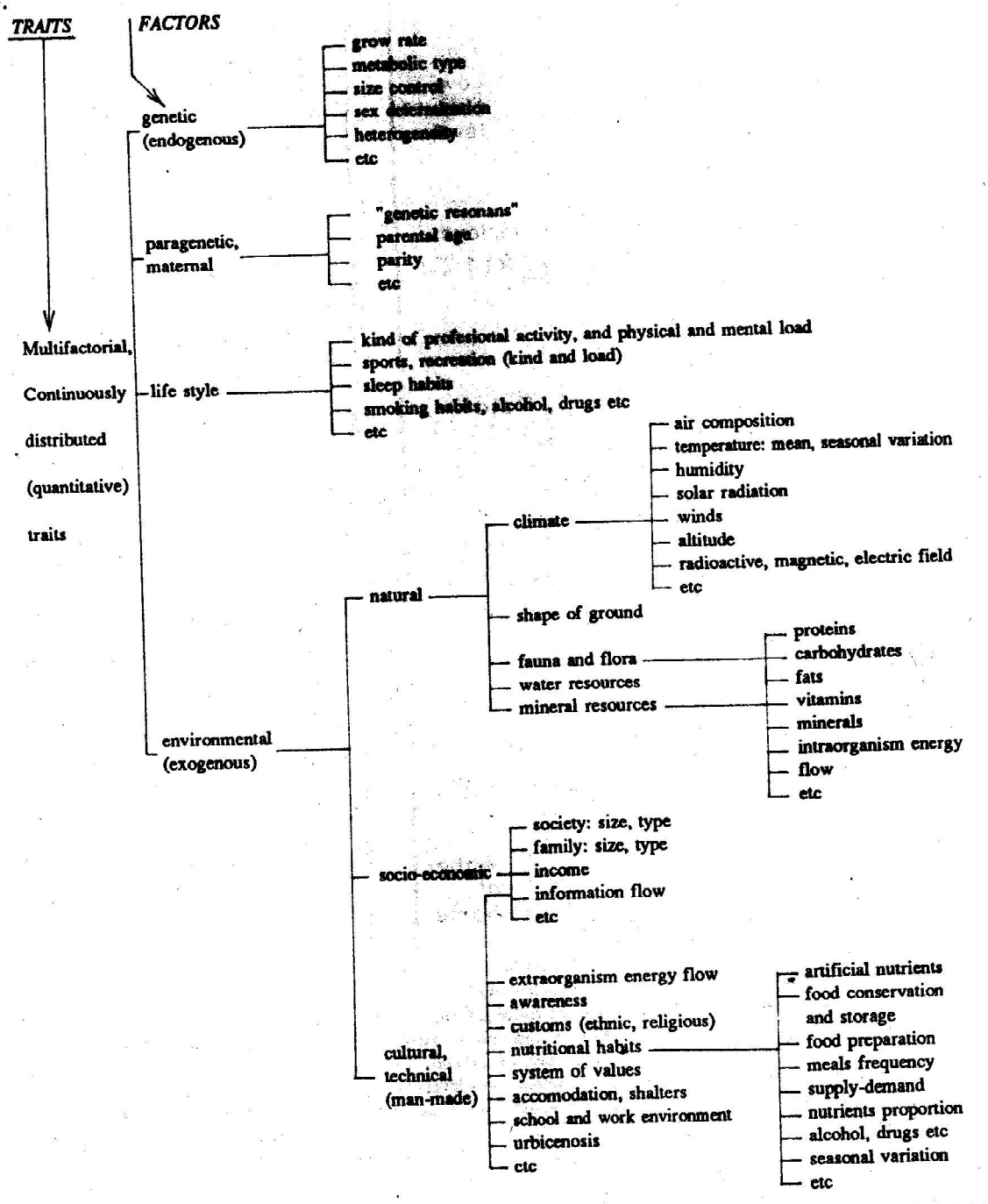


Fig. 3. Body size of 11-year-old boys in families of various types. Using factorial analysis, the types of families have been denoted by a six-digit code, in which the cultural factor together with income comes first, employment is second, family size - third, apartment size (and also the kind of the town district) - fourth, mother body size - fifth, and father body size - on sixth place. In the individual places, 1 means a low value of the given factor, 2 mean a high value; for example: 1 means a low level of culture, and 2 means a high level of culture. One-category differences between families as regards one trait create conditions for using one variable factor in the experiment.

Table 2: Classification of factors responsible for traits variability in man (proposals for multifactorial analyses by Napoleon Wolanski, 1987)



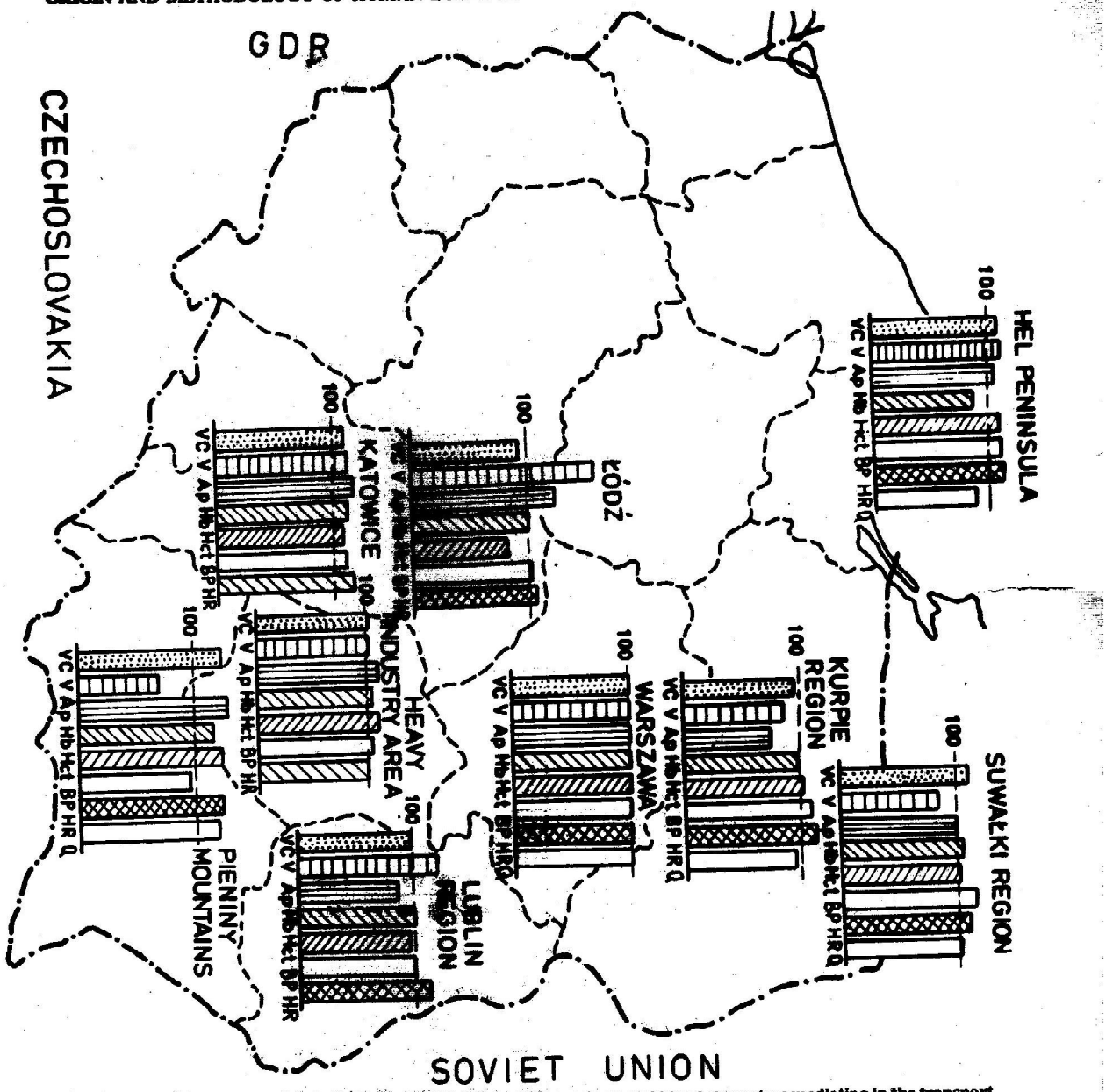


Fig. 4. Comprehensive analysis of respiratory and cardiovascular systems and blood characters mediating in the transport of oxygen to tissues under different environmental conditions. The local values for young men have been expressed in per cent of average value for Warsaw (capital city of Poland, average polluted and industrialized = 100%) young men. The denotations: *VC* = vital capacity, *V* = lung rest ventilation, *Ap* = apnea duration, *Hct* = hematocrit index, *IIb* = hemoglobin concentration, *BP* = blood pressure, *HR* = heart rate; data for Poland: the agricultural villages of Suwalki and Kurpie regions, fishery settlements of Hel peninsula, health resort and agricultural villages of Pieniny mountains, Lublin Coal Basin villages under industrialization, Silesian heavy metallurgy industrial center, great metallurgy industry city Katowice and great textile industry city Lodz (According to Koziol-Kolodziejska, 1989 and Wolanski data).

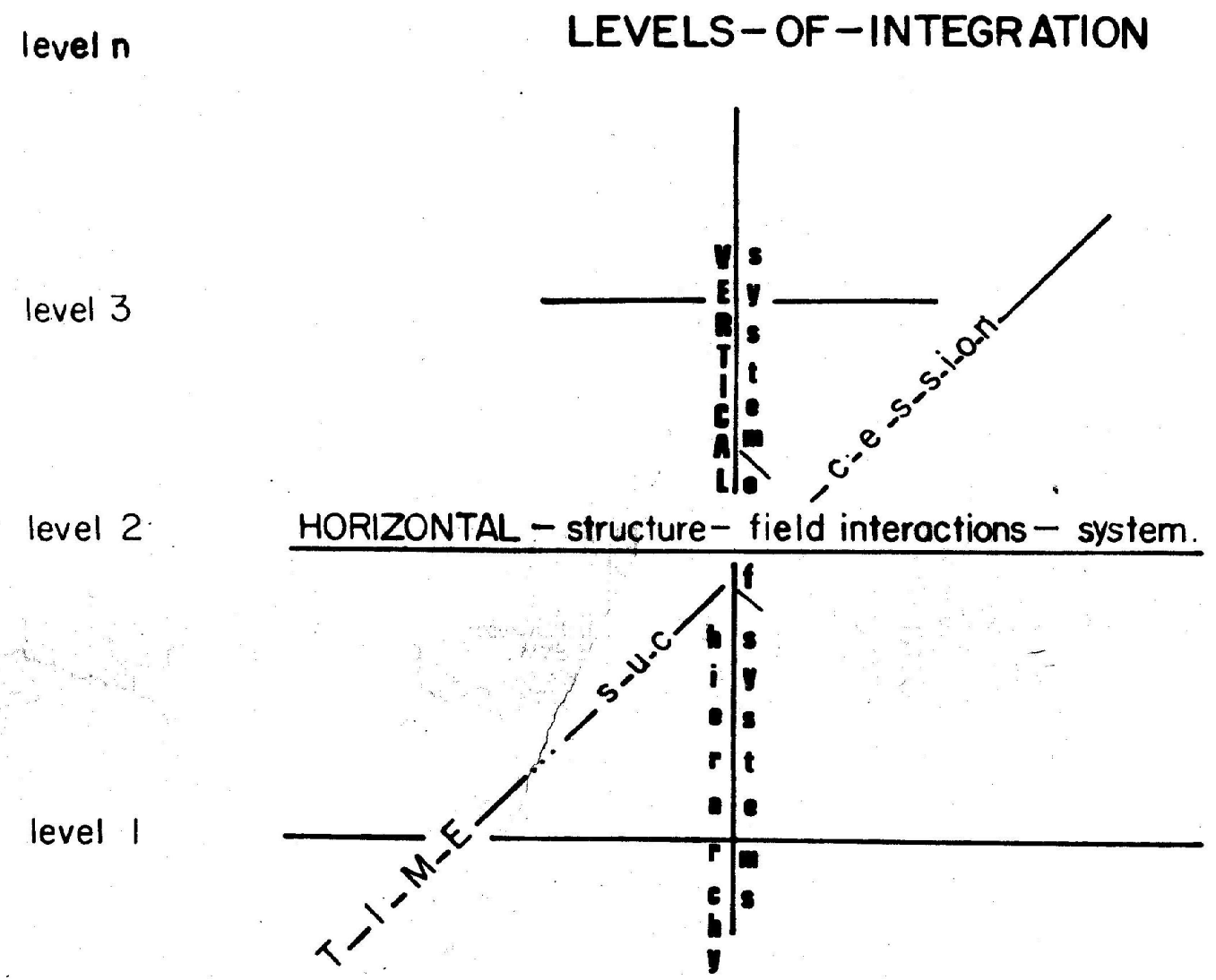


Fig. 5. Levels-of-integration, one of most important living system character: horizontal (structure, system), vertical (hierarchy, system or systems) and in time (succession)

Table 3: Levels of autonomy and related integrative systems of nature and society

Scale - Part	*Level of Autonomy (self organization)*	*Substructures (internal organization)*	*Adaptive System (integration)*	*Succession Aspect (climax stage, if any)*
World	biogeocenosis	landscapes, biomes, biocenoses, communities	ecosystem	urbicenose, conurbation, city
Social	nation	ethnic groups, tribes	political system	no boundaries
	society	castes, classes, families	sociocultural system	egalitarian society
Biotic	population	cohorts, groups	community system	full outcrossing
	organizm	organs, tissues	individuality	human being
	cell	organellas, chromosomes	elementary biotic	independent cell system
	gene	nucleotides	biotic information system	biochemical self-information unit
Abiotic	matter + energy + basic information (intrinsic) + additional information (communication, extrinsic)			

chrony of the development of various elements of biocenosis, it may mean lack abilities of further adaptation, and thus (more or less soon) the end (death) of a given form of existence.

It is worth noting that human ecology is polymethodical, since it is founded on methods (techniques) of research used in all those branches from which it derives information for its synthesis. In the sense explained above, it is both a scientific discipline, and a point of view and level of generalization, and this determines its methodology.

The views discussed above are the result of an international discussions held in 1985-1988, which was summed up at the First World Academic Conference on Human Ecology (WACHE) in Madrid in September 1986 (Wolanski, 1987) and in the Second WACHE in Zagreb in July 1988.

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