HUMAN LIFE AND CULTURE: DYNAMIC COMPONENTS OF ECOSYSTEMS

by Napoleon Wolański

Abstract. Contemporary humanity—especially urban-industrial civilization with its domination of nature—is disturbing complex, integrated, self-regulating systems that have evolved over long periods of time. We are threatening not only biological ecosystems but also human self-regulating capabilities at both the biological and the social-systems levels. This paper presents examples of such disturbance both in the organism—respiratory-cardiovascular problems related to environmental pollution—and at the population level—rates of infant mortality and relations between fertility and mortality in light of economic and emotional factors. Prospects for our future survival and flourishing are thus linked less to technical know-how than to ecological understanding.

Keywords: bio-cultural adaptation; ecosystems; evolution; self-regulating systems; urbicenose.

The evolution of the earth and the life thereon, the rise of new species representing ever higher levels of organization, has inevitably produced a rich variety of interrelations among the elements of nature. Although the interrelations vary with the different phases of evolution, their nature remains basically the same: it is self-regulation (self-maintenance). The role of self-regulation is decisive for the independence of separate yet interdependent mechanisms (table 1). This autonomy (independence) and interdependence determines the existence and universal impact of the transformations within any of the

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TABLE 1

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-Globe	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; breeding couples, generations	community system	full outcrossing
	organism	organs, tissues	individuality	human being
	cell	organellas, chromosomes	elementary biotic system	independent cell
	gene	nucleotides	biotic information system	biochemical self-information unit
Abiotic	matter+energy	+basic information (intrinsic)	+additional information/communication (extrinsic)	

constituents of a system. Such interactions can be understood as a specific integrative system of interdependences. However, since every individual element undergoes changes in space and time, the whole of the system is altered by means of compensation (at least within the given relatively isolated area). In fact the system of relationship found in nature is not a steady state (*homeostasis*) but a process of maintaining a relative equilibrium (*homeorrhesis*).

As humanity has continued for almost a half million years now to populate ever new areas, it has adapted biologically to local climatic conditions. The homeostatic units at the individual levels of autonomy have also been altered. The extent of intra-systemic change has varied and has been generally proportionate to the number and complexity of the system's components or subsystems.

Urbicenose and Human Adaptive Capacity

Biologically adaptive transformations are slow-moving; indeed, generations are the elementary units of evolution. The probability of transformations is proportional to the number of persons making up successive generations. The alterations that do emerge between successive generations are hardly discernible, and it takes many generations before the gene-pool effects become tangible in larger populations. Biological adjustments occur within each of the ontogeneses but it takes thousands of generations before the recurrent image becomes solidified.

Apart from the processes of selection, in all likelihood biological alterations are triggered by functional changes which lead to structural transformations. These, in turn, determine what the organism requires of its environment. The interrelations (interactions) between an organism and its environment are responsible for the consolidation of the specific system units, the process largely determined by the organism's behavior. This behavior is linked in turn to the development of the system conveying information—receptors and the nervous system. The development of the brain, particularly its upper structures, has been a product of human adaptation to changing conditions. With time, behavioral controls have become more significant for human adaptation than biological structures, for the behavioral controls have created the new quality which we refer to as *culture*.

The fact that culture is both a product of and a substitute for biological structures can be seen as early as many thousands of years ago when human penetration of ever-new climatic areas was attended by the conquest of new ecosystems (fig. 1). This was the case in arid areas (with their scarcity of water and food) as well as in circumpolar (perpetually cold) territories. Cultural adaptation preceded biological adjustment. The several-thousand year process of adaptation to high altitude (overcoming the problem of hypoxia) shows a greater degree of complexity.

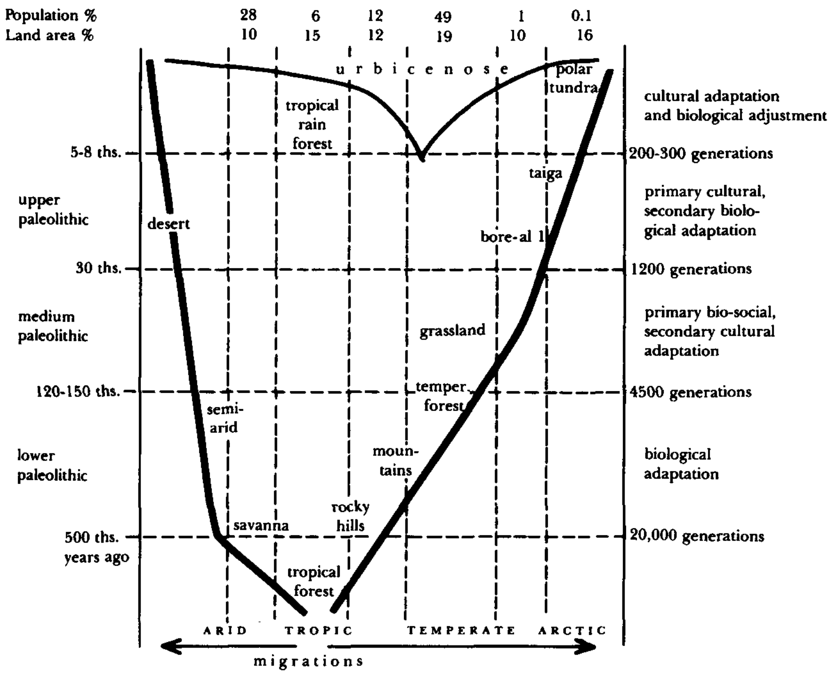

FIG. 1.—Proliferation of genus *Homo* to various ecosystems. On the left—thousands of years of evolution; on the right—the number of past generations. (Original.)

Hunter-gatherer societies represent humanity's most harmonious participation in its ecosystems. The advent of farming and animal breeding, however, upset and dis-integrated natural ecosystems. The intensity of environmental modification has been proportional to the creation of monocultures and the swelling of human groups affecting given areas.

The recent several thousand years of farming and irrigation have brought about a new type of relationship: *urbicenosis*. This urban ecosystem is a human artifact, a product consisting of modified elements of the natural environment. However, it has as its principal constituent human community and its culture. Consequently, the municipal ecosystem is a cultural form resulting from the unique mutual adaptation of the human species and its environment. Biological adjustments come second here and often exert an adverse impact upon the human organism, which increasingly shows subpathological symptoms as a result of its waning of reserves of accommodation, with attendant signs of over-adjustment (fig. 2).

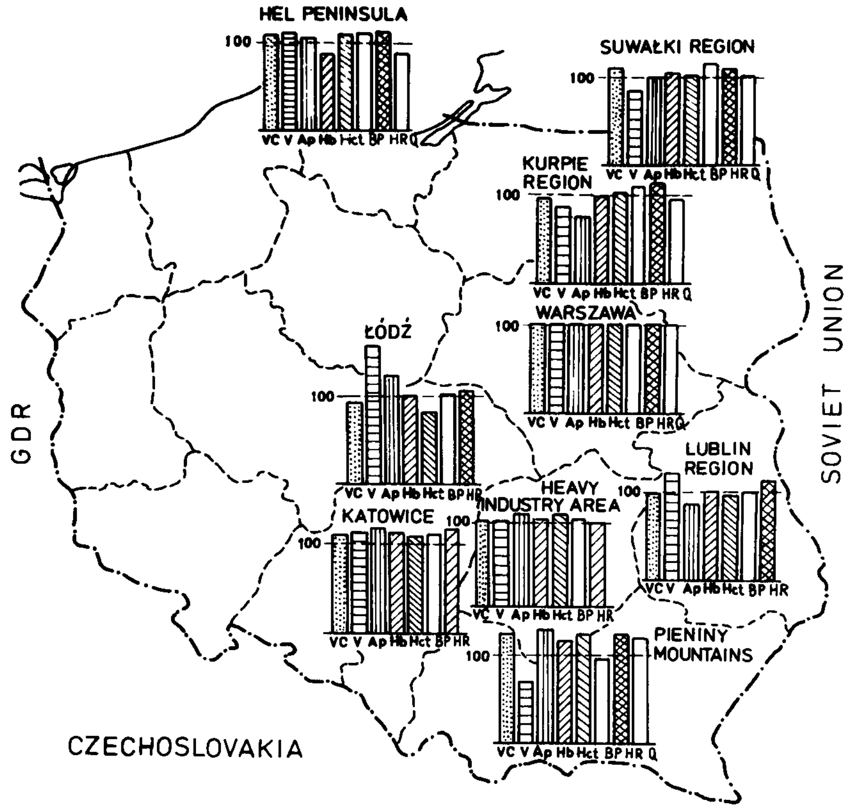

FIG. 2.—Acclimatory adjustment of human populations (respiratory, cardiovascular, and blood traits) to different environmental conditions. Adjustment to seaside conditions (Hel Peninsula) by increase of lung ventilation (V) and decrease of hemoglobin concentration (Hb) and cardiac output (Q); to low mountains (Pieniny) by increase of vital lung capacity (VC) and hematocrit index (Hct), and decrease of lung ventilation (V) and blood pressure (BP). Various traits show reverse changes—a compensation phenomenon. In conditions of high pollution (industrial city of Katowice) all traits under study show an elevation of values—the phenomenon of overadaptation, which means the disappearance of adaptative capacity. Other symbols: AP=apnea duration; HR=heart rate. (From Wolański and Siniarska 1982.)

We have put up towns and cities for our convenience and have continued to improve them for over five thousand years now, a process of cultural accommodation of humanity which has brought about such wonders as indoor climate control and global communications and transportation. However, urban and now trans-urban development has emerged over a span of only 150 to 200 generations, a tiny fraction of the entire history of humankind. This time frame virtually precludes the likelihood of genetic adaptation. As I have already indicated, however, there are reasons to believe that earlier cultural domination over the environment has brought in its wake a secondary biological adjustment which with urbicenoses has mainly consisted in acclimatory adjustment (reversible in ontogenesis) or developmental adjustment (plastic changes, reversible in phylogenesis).

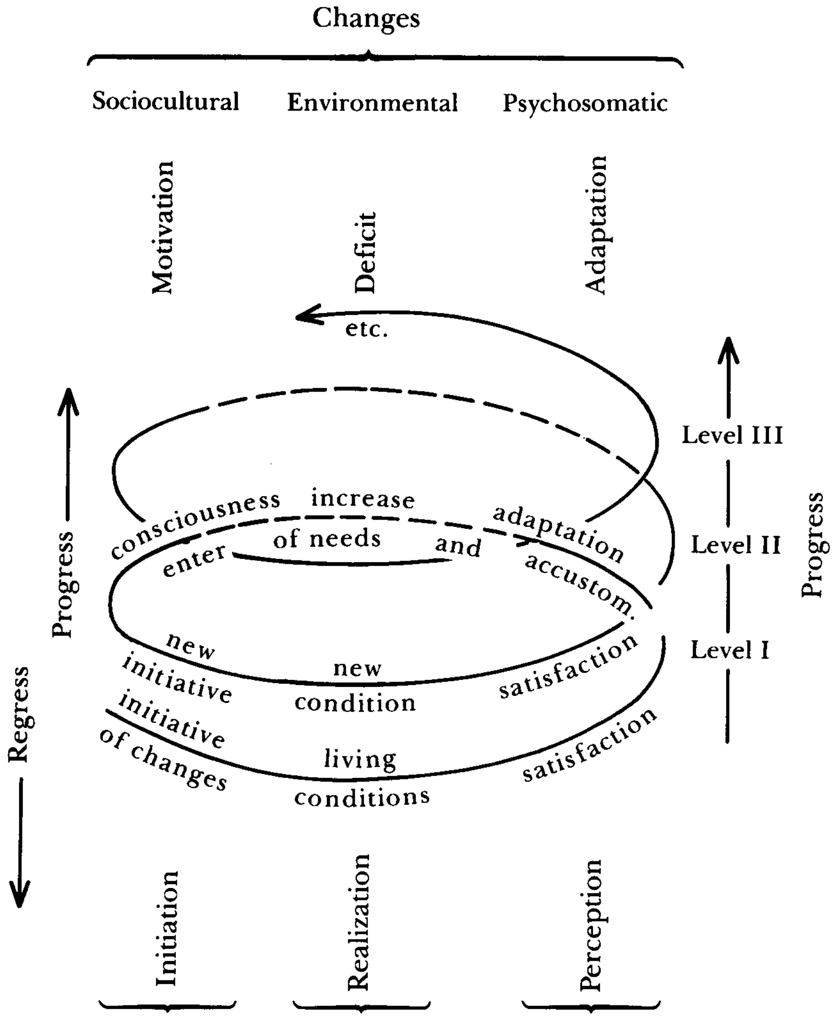

FIG. 3.—Spiral of changes, as an inevitable consequence of psycho-neurological properties of humans. Does it, however, always represent progress? (From Wolański 1982.)

Is Advancement Inevitable?

The feeling of satisfaction with existing conditions is transient in human beings. Over time, biological adjustment and mental accustomation weaken the sense of satisfaction, as our human longing for change is gradually transformed into the determination to flesh out our aspirations. So new conditions are created and a new equilibrium is sought, but the sense of satisfaction fades again only to be replaced by the recurrent desire for yet another measure of adjustment and accustomation (Wolański 1982). The successive circles of this spiral move in a direction referred to as advancement (fig. 3). The desire for advancement is inherent in the immanent properties of the human psyche and is a product of the more complexly developed structure of the human brain. Consequently the determination to increase production, consumption, and comfort as well as the pursuit of emotional and intellectual gratification to an extent exceeding basic biological needs must all be considered natural and characteristic human aspirations.

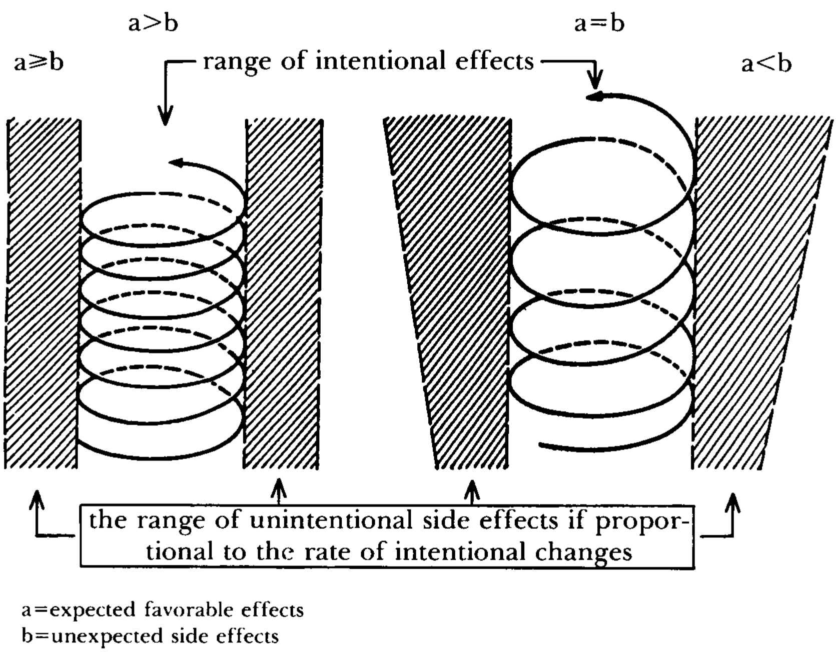

Fig. 4.—Higher rate of environmental changes initiated by humans; greater side effects, mostly dangerous (negative) for humans. Sometimes there are unexpected and higher than expected positive effects. (Original.)

In addition to the quest for advancement, the growth of human population triggers new stresses on the environment. Increased damage equals the product of the size of a population plus their needs and expectations. The growth of population density and increased production and consumption bring about stronger pressure upon the environment (anthropopressure). This involves most of all the emergence of unexpected side effects, whose scale is directly proportional to the rate of the modifications of the environment (fig. 4).

Human biological adjustment to urbicenose is not yet complete. That the process might come to an end is unlikely in view of the rate at which urbicenoses are being altered. Cultural adaptation involving the escalation of production and consumption in pursuit of the fulfillment of growing material expectations, compounded by population growth, poses important risks to nature and humanity. As we face both the gradual depletion of some resources and the environment's limited capacity to absorb modifications (including not only pollution but such conflicts as that between land for farming and for urban development or that between the need for isolation and the fear of restricted and enclosed areas) we must conclude that unrestrained development, combined with a paucity of adaptive changes, leads to self-destruction.

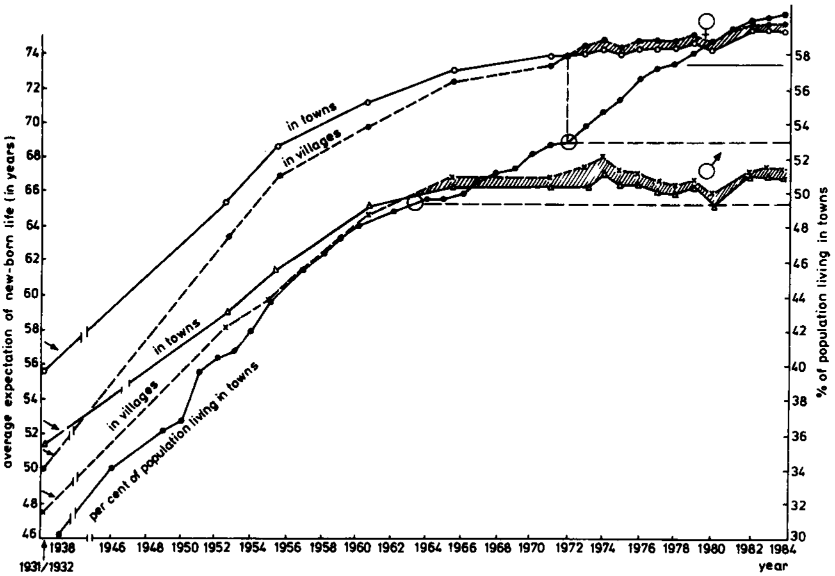

FIG. 5.—The average expected duration of life at birth in Polish town and village populations, versus the percentage of urban population in Poland in the years 1931-87. Since 1964 male town citizens live shorter lives than village inhabitants; among women this phenomenon starts ten years later. The ecological crisis of towns is observed when 48-52% of the population of Poland live in towns. On a world scale we are close to this situation. (Original.)

At the present time some 45 percent of the world's population lives in towns or cities. Most of these are settings which contain municipal facilities that exert particularly adverse pressure upon the natural habitat (hence the separate term to name this system of urbicenosis). There is evidence that both globally and within individual nations the living conditions in urban areas are no longer more advantageous to humans than those found beyond them (fig. 5). Living in urban areas is more detrimental to health and shortens the life span. This is an inevitable conclusion, even though comparison of body weight and height in urban and rural children in the present century shows the former to be the superior population in this respect (fig. 6). Due to the complexity of conditions in urban-industrial civilization, this criterion is a demostrably unreliable index of the merits of urban living conditions.

We must also remember that urban areas can be viewed as a climax in the succession of ecosystems. Climax in ecological succession is only apparently an optimum state, for it involves the absence of opportunities of further improvement or development.

The Rate and Scale of Changes

The growth of human material needs is consequent not only on the escalation of individual, subjective expectations. It also is a function of objective determinants, the underlying cause of which is the growth of the human biomass. This growth is a function of the increase in population size and of long-term changes in the weight of the human body. The biomass may be estimated to have been 14 million tons at the beginning of the common era, 19 million tons at the beginning of the present millennium, 70 million tons around the mid-nineteenth century, 150 million tons around the year 1940 and some 300 million tons today (table 2). Thus one species constitutes in every respect a tremendous burden on the environment, and the unequal density of the population in different parts of the globe creates additional environmental strain. Annual per capita grain consumption now totals 315 kilograms (1,500 million tons) globally. The average person's consumption of food and water during his or her lifetime amounts to 73 tons—over 1,100 times as much as an individual weighs. Moreover, food consumption increases every year by some 0.48 percent while in recent times it has taken the world's population a mere forty-five years to double.

A further and potentially more explosive source of "pressure upon the environment" is the growth of "thinking tissue mass": 300 tons in early anthropogenesis; 270,000 tons at the beginning of the common era; 490,000 tons at the beginning of the present millennium, and some 7,000,000 tons now. Today's amazing mass of brains is equal to the entire biomass of humanity some five or six thousand years ago. The bomb threatening humankind is its own biomass assuming alarming proportions as the surface area of the earth remains unchanged and the competition for available resources becomes more and more severe—"thinking tissue mass" has emerged as the ignition device.

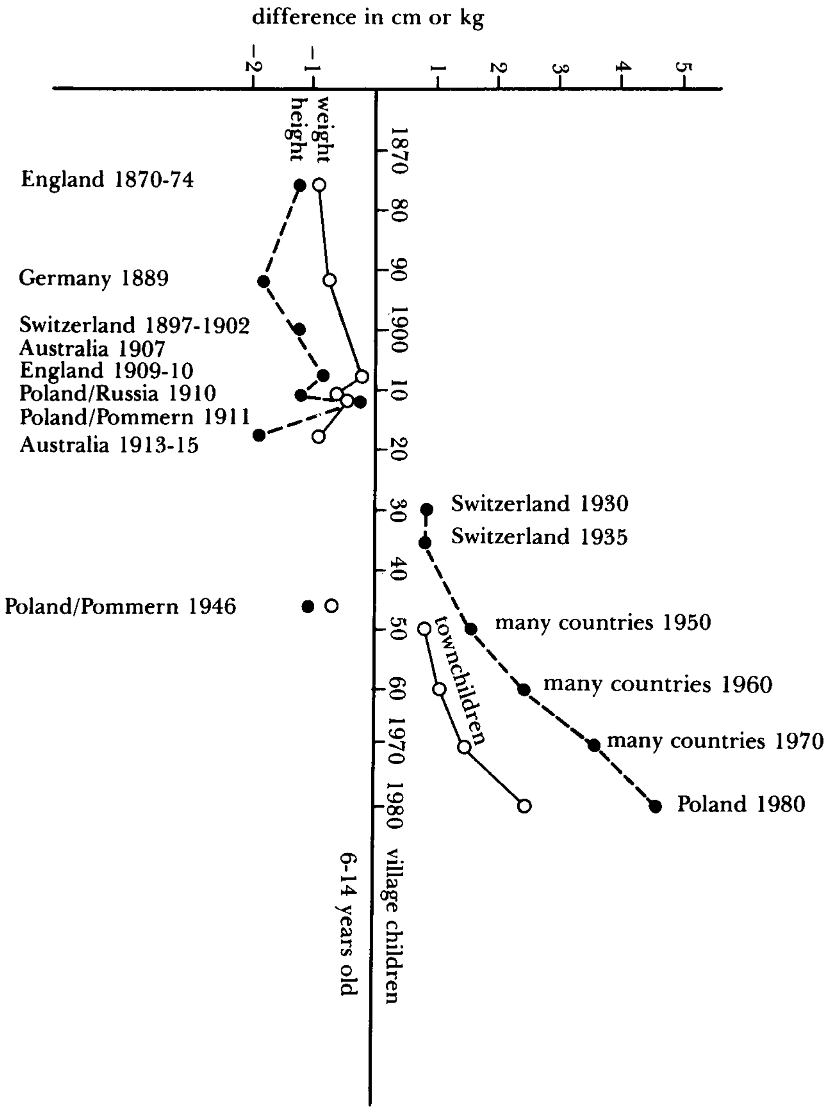

FIG. 6.—Until the second decade of the twentieth century rural children were better developed physically than town children. Higher values of physique in most town children are a phenomenon of approximately the last seventy years. However (for example), during the Second World War and just after (1946 in Poland), relations similar to those in the nineteenth century were again observed. (Original.)

TABLE 2

CHANGES OF WORLD POPULATION, ESTIMATED "BIOMASS" OF HOMO, AND MASS OF THEIR "THINKING TISSUE"—AND RELATED CHANGES OF ENERGY CONSUMPTION AND POPULATION SIZE

Thousands of years ago, or year in C.E.	World population in millions	"Total biomass" of pre-human body in millions of tons	Average brain size in cubic cm.	"Thinking tissue mass" in thousands of tons	Energy consumption per capita/day in kc.	Population size	Form
1 million-500 ths	0.250	0.01	475	0.12	2,000	<100	Australopithecus Primitive man
			1,000	Tool making revolution			
100 ths	0.400		1,300 1,360	 Agricultural revolution	4,000		Hunting man Primitive agricultural man
8 ths	5	0.275	1,400	7	12,000	<300 few cities 100,000	
1000 C.E.	350	19.3	1,400	490	24,000		Advanced agricultural man
1650 C.E.	500	28	1,400	700		villages <1,000 many cities <100,000 some cities <500,000	
				Industrial-scientific revolution			
1830 C.E. 1930 C.E. 1975 C.E. 1988 C.E.	1,000 2,000 4,000 5,000	60 124 260 330	1,400 1,400 1,400 1,400	1,400 2,800 5,600 7,000	70,000 250,000		Industrial man Technological man

The human prospect indeed looks ominous when viewed in terms of the mass of the brain or the number of such biological "computers of the n-th generation." However, what has not been taken into account in the above argument is the question of the resources of information contained therein and the revolutionary nature of the ideas the brains can store. Moreover, human beings differ with respect to their individuality—including all their bodily constituents, their aspirations, and their upbringing with the impact it exerts upon them. Further, there are emotions which deaden reason and pain, thus serving as natural restraints to check excesses of exuberance. A conflict of interests may trigger either confrontations or the neutralization of aspirations; yet their harmony if incorrectly channeled could lead to the devastation of the planet.

Two channels serve the accumulation of information in human beings—biochemical (molecular) and cultural (knowledge)—which, apart from their favorable effects, also can generate "contaminating" or destructive behavior (fig. 7). There are also two channels for the transmission of information between human generations—genetic and cultural—both of which are extremely conservative in nature (fig. 8). The former still operates beyond our consciousness, while the latter may be consciously controlled as part of the process of education.

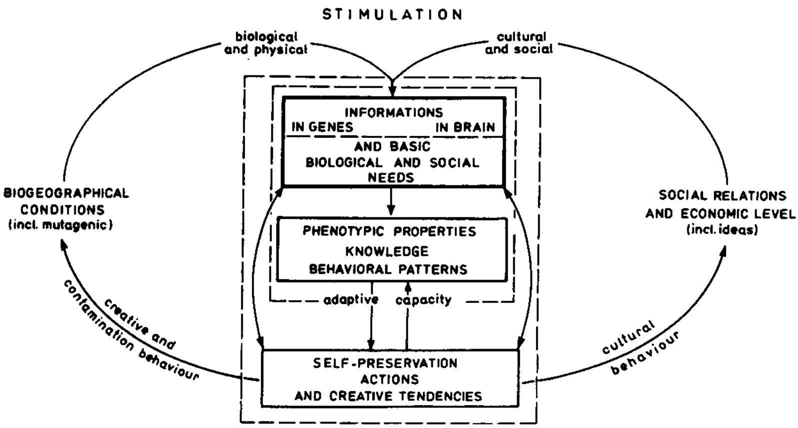

FIG. 7.—Two channels of the cumulation of information in the human organism, and their behavioral consequences. (From Wolański 1976.)

Consciousness of cultural information-transmission can help shape the conditions for societies, families, and individual persons. Modern cultures often exhibit substantial diversity. This diversity, like genetic diversity, may perform the role of a safety valve[1] for the mounting environmental and human risks, provided there is successful employment of relevant education projects regarding humanity's relations with its environment. However, it should be noted that disturbances of either genetic or cultural transmission—especially those that exert pressure to drastically accelerate changes and upset certain biorhythms—may prove to be hazardous.

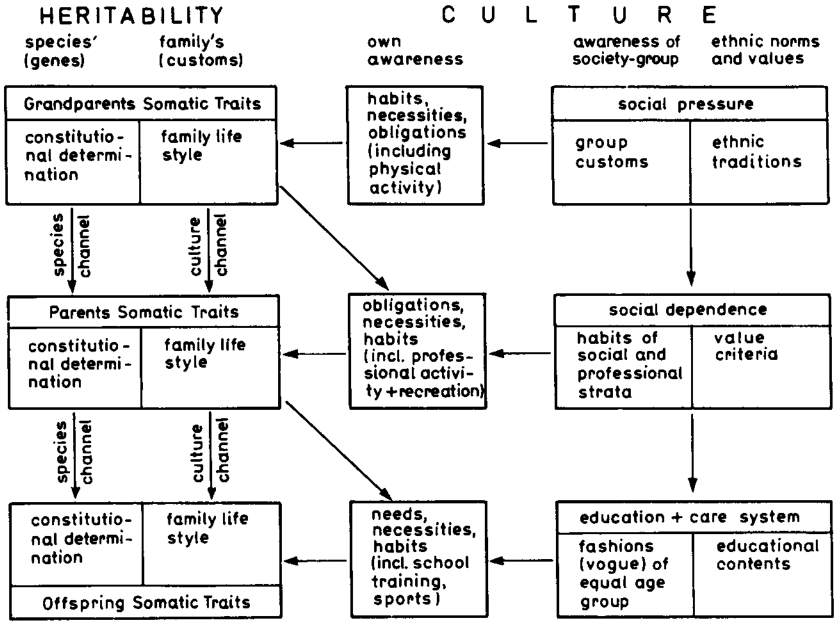

FIG. 8.—Two channels of "heritability" between human generations. The role of the genetic factor is most frequently overestimated, because of the effect of "living together." The role of cultural factors in interrelation with biological factors is not well known. (Original.)

Self-regulation and Self-control

The transmission of biological information includes important mechanisms of self-regulation. Some mechanisms of self-regulation have also been culturally developed, such as ethnic customs, religious commandments and prohibitions, and moral norms. Such mechanisms are found within individual levels of autonomy (see table 1). They have acquired their present stability by way of evolution, and they cannot be upset without the risk of triggering dangerous aftershocks.

Among the biological mechanisms of self-regulation are organismic adjustments (regulatory, acclimatory, and developmental) which are designed to lead to a state of equilibrium between the individual organism and its environment (fig. 9). When these mechanisms have failed to operate properly, humans would use—and they still use—culture-related mechanisms in order to deactivate or alter adverse environmental stimuli (an extinguishing or rectifying feedback—

fig. 9). However, when cultural mechanisms prove inefficient—and even prior to their employment—there occurs self-regulation at the biological level of a total population. Regulation at the level of populations is primarily a product of recombination (gene mixing) and mutation, assuming the form of differentiated survival. Faced with the ongoing debate about whether such mechanisms are operating now, I have conducted relevant studies on diverse fecundity and survival in present-day Polish populations (Wolański and Januszko 1986-87). While the results demonstrate the occurrence of such selection, it is not unlikely that it exerts most of all a stabilizing impact (table 3).

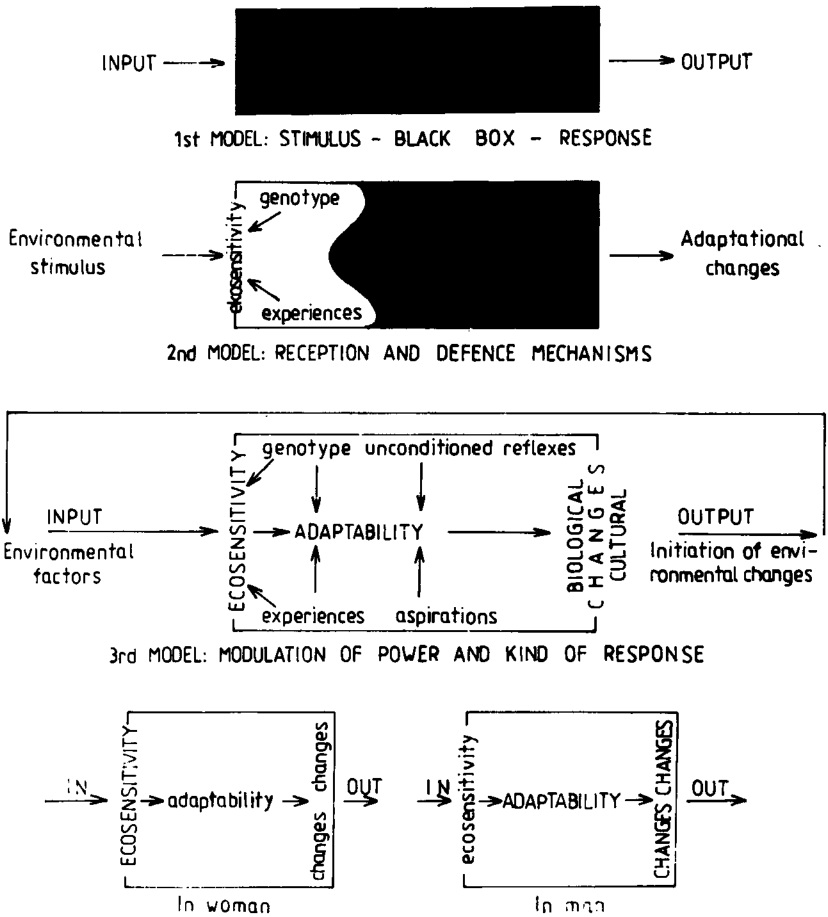

FIG. 9.—Organism-environment interactions, and the mechanism of modulation of perception and transmission of environmental stimuli in organisms (ecosensitivity and adaptability). Biological adjustment and/or cultural adaptation (feed-back, including initiation of changes of environment) are final effects. (Original.)

The phenomenon of assortative mating represents another example of the mechanisms of biological self-regulation. There are good reasons to believe that there is an optimum genetic similarity between spouses (a species module of mate similarity) that is conducive to reproductive fitness and the development of offspring. The similarity corresponds with random mating in an average cross population of 300-500. One might expect that in smaller and endogamic populations random mating would lead to excessive genetic similarity between spouses. However, these populations show negative assortative mating—choosing a dissimilar partner and thus increasing chances for genetic diversity (fig. 10). In large populations, in turn, random assortation might generate excessive differences between spouses, and in consequence we find positive assortative mating—choosing a spouse with characteristics similar to one's own and thus decreasing diversity. This phenomenon indicates that one should respect the instinct-guided mating of married couples—what the young call romantic love.

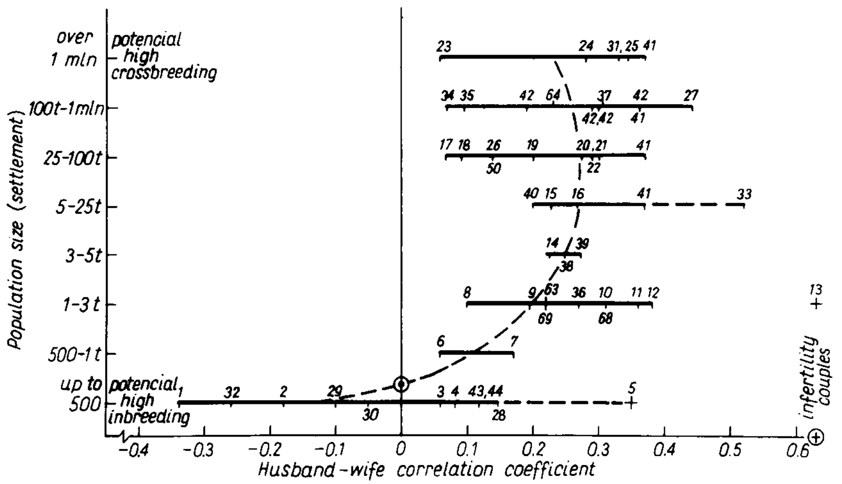

FIG. 10.—Assortative mating of husband and wife: correlation coefficient for stature in populations of various sizes. (From Wolański and Siniarska 1984.)

The process of selection is interrupted by migrations which were conducive to cross-breeding. However, heterozygotic individuals are more sensitive (fig. 11) to external environmental stimuli than are homozygotic ones. It is also known that heterozygotic children in conditions of malnutrition are more hindered in development than homozygotic children of a similar age but are better able than the homozygotic children to benefit in physical development from good living conditions (Wolański 1974; 1977).

TABLE 3

CONTRIBUTION OF SIX ROTATED LATENT FACTORS TO MULTIPLE REGRESSIONS OF FERTILITY AND SURVIVAL INDEX IN FETUS (SI_0), IN EARLY INFANCY (SI_1), IN 2-12 MONTH OLD INFANTS (SI_2) AND TOTAL SURVIVAL OF OFFSPRING IN FAMILIES UNDER STUDY (SI_{total})

Regression and variance	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Identification of factor	culture and income of family	body build and blood pressure of wife	body build of husband	size and physical illness of spouses	health and living conditions	marriage age and age difference of spouses
Number of pregnancies,						
Regression coefficient, b	−0.4366	0.0933	−0.2643	0.0200	−0.2297	0.1437
Standard error (b)	1.345	1.403	1.381	1.406	1.388	1.399
Significance, P	0.001	0.3	0.01	—	0.01	0.1
% of pregnancies explained	8.44%	0.40%	3.43%	0.02%	2.46%	0.98%
Survival index in fetus,						
Regression coefficient, b	0.2435	−0.6264	0.7836	−0.8391	−0.0185	−2.1487
Standard error (b)	13.33	13.32	13.31	13.21	13.34	13.17
Significance, P	0.5	0.5	0.4	0.4	—	0.01
% of fetus survival explained	0.03%	0.20%	0.34%	0.4%	0.00%	2.44%
Survival index in early infancy,						
Regression coefficient, b	0.1253	−0.9342	0.9190	−0.4099	−0.7735	0.6309
Standard error (b)	6.180	6.116	6.115	6.170	6.137	6.151
Significance, P	0.5	0.02	0.02	0.4	0.05	0.1
% of 1 month infants survival explained	0.04%	2.09%	2.14%	0.38%	1.44%	0.98%

TABLE 3 (*Continued*)

Regression and variance	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
Survival index in 2-12 month infant,						
Regression coefficient, b	1.0031	0.3077	0.3005	−0.2061	−0.5073	0.4052
Standard error (b)	6.014	6.079	6.079	6.083	6.067	6.074
Significance, P	0.01	0.45	0.4	0.6	0.2	0.2
% of 2-12 month infants survival explained	2.38%	0.23%	0.24%	0.10%	0.64%	0.42%
Total survival index of children,						
Regression coefficient, b	1.3240	−3.5482	1.1119	−4.3249	−0.7253	−2.3149
Standard error (b)	19.78	19.53	19.79	19.40	19.81	19.69
Significance, P	0.4	0.01	0.4	0.001	0.6	0.08
% of children survival explained	0.39%	2.93%	0.31%	4.16%	0.12%	1.28%

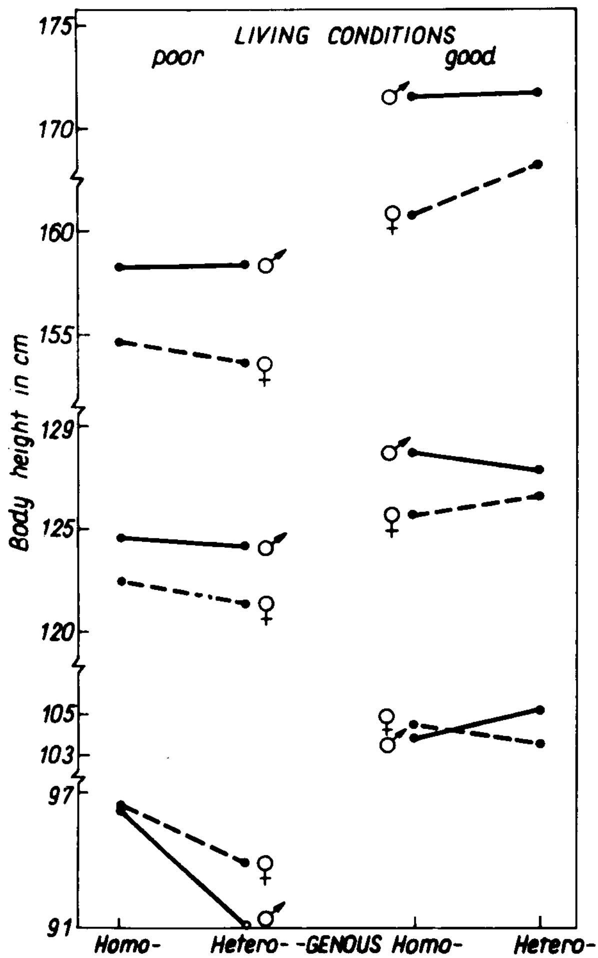

FIG. 11.—Stature in children of four, eight and sixteen years old from agricultural villages (poor living conditions) and from a city (good living conditions). Potentially heterozygotic children are more sensitive to environmental factors than potentially homozygotic children: in similar living conditions they are respectively shorter or taller. (After Wolański 1977.)

It is also to be remembered that migrations leading to crossbreeding and to greater heterogeneity of populations increase the so-called *high hybrid vigor* characteristic of heterozygotic individuals. This may constitute an additional input of activity but it does not by any means boost the fecundity, which is higher on the average in homogeneous (endogenous) couples (Wolański 1974; 1978; 1982). The smaller rate of fecundity is attended by a greater vigor among offspring, which also is a kind of self-regulation.

WHAT DISTURBS WELL-BEING AND HEALTH?

The development of civilization and increased migration go hand-in-hand with the development of industry and the "industrialization" of agriculture and animal breeding. The spread of variety of strains and of pollution are side effects of this planned development.

The simultaneous growth of the ecosensitivity of an organism and of the concentration of harmful agents (even when the latter does not exceed the limits of adaptive capacities) compounds the risks. It is a set of simultaneously occurring phenomena whose presence we normally do not realize, but which must be comprehensively analyzed with a view to the undertaking of appropriate safety measures. Mechanisms of biological self-regulation (such as assortative mating) may, however, prove to be insufficiently effective when the heterogeneity of a population becomes excessive as a result of immigration, and also when extremely rapid growth increases not only air and water pollution and food contamination but also psychological distresses and strains.

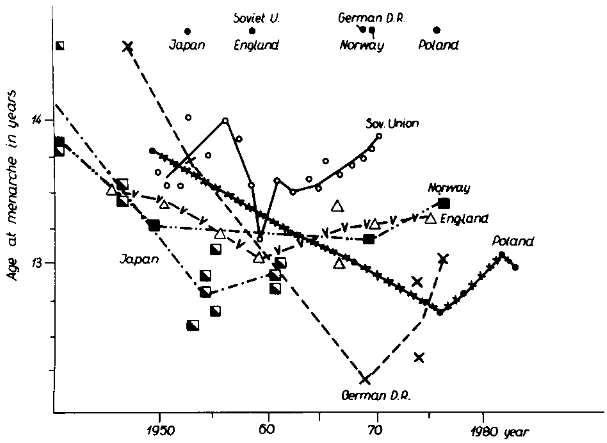

FIG. 12.—Changes of age at menarche in the last forty years in six countries. General multifactorial trend of acceleration is observed in most countries in the last two centuries. In the last thirty years there are some phenomena involving the retardation of puberty, which probably express the world economic crisis. The risk factor in the contemporary world is not isolated; economics is a global phenomenon. (After Wolański 1985b; some data for Poland are from the personal communication of Charzewska.)

Currently among the most frequently cited factors underlying health disorders are the distortion and devastation of natural environments due to inadequate cultural wisdom. Such a view fails to take account of the fact that human well-being and health are altered not only by diseases and socio-economic calamities but also to a lesser extent by socio-cultural unrest and economic imbalance. The human organism is a very sensitive indicator of all sorts of changes occurring in its habitat, which includes the cultural as well as the natural environments.

It is well known that when the annual growth of the gross national product (GNP) per capita is less than 2.5 to 3 percent there occur instances of tardy sexual maturation (fig. 12), increased infant mortality (fig. 13), and changes in the ratio of births and deaths (fig. 14) (Taranger 1983; Wolański 1983; 1985a, b). Moreover, emotional distress may not only delay but may also accelerate maturation (Wolański 1988). As I have mentioned above, these factors exacerbate the problem of interpreting current changes in the biological condition of human populations (see fig. 6).

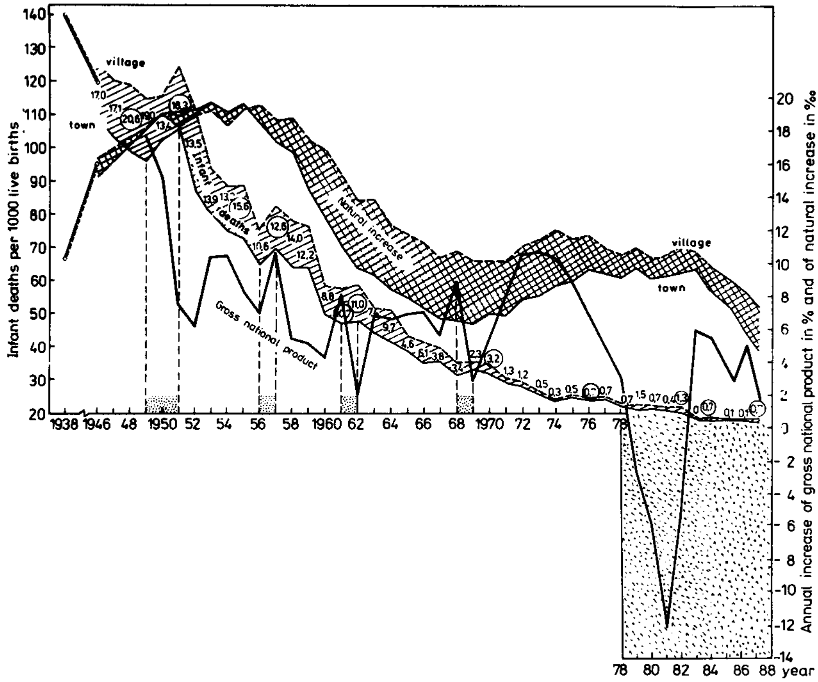

FIG. 13.—Relation of changes in the infant death rate in Poland in the years 1938-87 to the annual increment of gross national product (GNP) and natural population increase. Drastic changes are followed by an increase of infant mortality; especially greater differences between villages and towns are observed (in cycles). (Original.)

Studies conducted in Poland demonstrate that all abrupt economic changes are linked to increased infant mortality rates. This phenomenon could be ascribed as much to emotional states as to material deprivation (see fig. 14). Indices such as the infant mortality rate represent complex phenomena: the interplay and relative worth of natural environment and national cultures. Underestimated by some governments, culture has proved to be a vehicle of continuity not only for ethnic groups but for biological human populations as well, since culture comprises attitudes toward hygiene and health habits, life-style, nutrition, and the like.

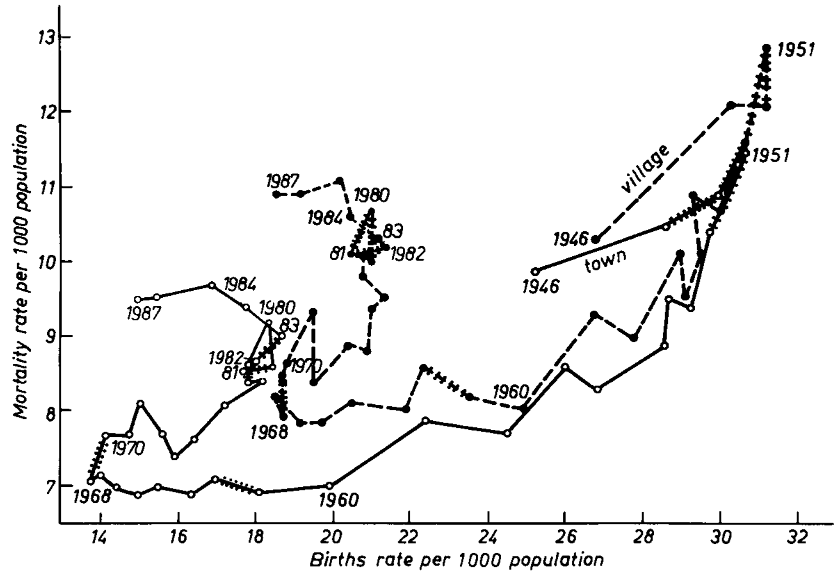

FIG. 14.—Changes in the birth rate versus the mortality rate per 1,000 population in Poland in 1946-87. Compare with critical periods of economic change (GNP) from fig. 13. Drastic changes (lines with points) in direction are related to rapid changes in annual increase of GNP. (Original.)

The interplay between biology and culture is illustrated by studies covering four thousand families from rural farm areas, as well as from areas differing in the degree of industrialization and in the number and size of towns and cities. Conducted in Poland in the years 1975-78 (Wolański and Siniarska 1982), the studies were intended to provide a definition of the economic and demographic transformations affecting the contemporary populations and to establish a forecast for a post-industrial society (table 4). These anticipations cover both socio-economic and biological transformations.

TABLE 4

Economic and Demographic Changes Connected with Industrial Development and Urbanization and Their Effect on the Social and Biological Status of Populations, in Contemporary Populations (The Case in Poland)

	Economic status			Demographic factors		
Stage, level	Living conditions	Nutrition	Physical activity	Migrations	Population growth	Population density
Input Preindustrial (rural)	Various: generally low housing standard, overcrowded apartments	Limited: mostly twice a day, great seasonal variation in villages	Seasonal variation, high in summer	Low: medium to high emigration, lack or low immigration	High: great fertility and infant mortality	Low
Early industrialization	Initial economic growth, better housing facilities	Traditional rural, not regular, increasing carbohydrate consumption	Overloading, especially in two profession people (peasant+factory worker)	Increasing local immigration of working "power"	High: High fertility and moderate mortality	Medium: but increasing, population growth housing development
Advanced industrialization, early-urbanization	Economic growth, rapid industrial development, not all changes positive: pollution, stress	"Mass" cafeterias, not rational feeding pattern, increasing protein consumption	Moderate great variation according to professional group and social strata	High immigration of working "power" and professional people	Medium: moderate fertility and limited mortality	Great and rapidly increasing: tendency to living in towns, population growth housing development

Ethic norms	Biological and health status			
Customs behavior	Health status PHS	Genetic status	Physical development	General
Close personal contacts, moral norms related to church and traditions of community	Weak, low sanitary level, high frequency adult age disease, high morality general	High selective pressure, inbreeding depression, negative assortative mating. High value of genetic pool	Poor, low nutritional status, positive status of respiratory system, medium physical performance	Generally positive natural environmental conditions, low economic level, poor housing
Conservative rural, with losing interfamiliar contacts	Increasing public health service (PHS) decreasing adult age morbidity	High selective pressure. Formal breakdown of, izolates inside population. Positive genetic changes	Moderate nutritional status and physical development, acceleration of maturation, increasing growth stimulation, medium physical performance	Mostly positive changes in environment and population.
Mixed: Decline of ethnic identification. Increasing education and cultural level	PHS developing to therapy. Increment of childhood morbidity decreasing adult age morbidity	Moderate selective pressure. Breakdown biological but aformation of social isolates, ecosensitivity increase. Moderate predisposition	Improvement of nutritional status and physical development, disharmony in development of various organ structure and functions. Retardation of menopause. High physical performance.	Economic develop-intensive. Some moderate negative changes in natural and social environment. Positive changes dominate over negative.

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TABLE 4 (*Continued)*

	Economic status			Demographic factors		
Stage, level	Living conditions	Nutrition	Physical activity	Migrations	Population growth	Population density
Industrial centers, industrial towns, cities	High economic level and industrial development, pollution control, devastation of soil, water problems; negative effects dominate over positive in natural and social development	Animal protein consumption increase great supply and demand of great variety of foods, pollution hazard in foods	Decrease in physical activity including professional (automation, motorization)—Leisure increase	Intensive migrations: immigration, emigration, limitations of permanent residentship	Low: Limited fertility and mortality	Great: maximal in downtown growth control, housing development population growth
Output Post-industrial	Pollution control, recultivation of soil, water control. Planned economy	Rational nutrition, food pollution control	Recreation	Regulation of residentship	Control of population growth	Tendency to living in town vicinity

Ethic norms	Biological and health status			
Customs behavior	Health status PHS	Genetic status	Physical development	General
Lax morals. "Solitude in crowd." Further increment in education and cultural level	PHS development to industrial medicine and specialized clinics. Increment of morbidity. Therapy not fully effective because mass civilization disease. Decreasing of duration of infectious disease	Low selective pressure. Crossbreeding. Positive assortative mating. Genetic load increase. Negative genetic status	Possibility of alternative ways of development, lowering of heritability. Developmental deviations. Prolongation of reproductive period. Low physical performance	High economic level. Negative effects dominate over positive. Overadaptation and nonadaptation effects in human populations
New stratification of society. Changes in ethic norms	Prophylaxis, increasing psychiatric service	Genetic counselling/in future also genetic engineering	Stabilization of physical development and maturation time on high level (optimal?)	Controlled economic development, and social changes

Conclusion: Humanity as a Part of Nature

Human beings, engaged in the development of culture, especially in economic development, must bear in mind that they are part of nature, which has value of its own. Humanity is a product of nature, but increasingly nature is subjected to human control, exercised in a variety of ways. Our cultural pluralism includes phenomena that diversely disturb natural equilibrium (homeostasis of ecosystems). As we upset the regularities of nature we often ignore the fact that human life remains a biological formation, an integral part of nature in both primitive and highly developed societies. We are dependent on nature as biological organisms, products of millions of years of biological evolution and hundreds of thousands of years of cultural adaptation to the conditions found in the populated areas of this planet. We are slaves to a variety of natural conditions whether we like it or not. If we do not find adequate cultural tools we must make them; such is demanded by the rigid laws of biology. Besides, there are grounds to believe that cultural transformations are not irrelevant to our biology. The realm of emotions is both a product and the cause of the properties characteristic of our species.

Many forms of human civilization have come and gone, just as untold numbers of animal species have arisen and perished. Still the human species has survived as a result of its inherent cultural pluralism; diversity appears to be essential to humankind's future development.[2] Thus we have a biocultural warrant for respecting and maintaining ethnic and civilizational differences and trends among the societies of the world. To seek unification or uniformity is wrong. Monocultures are doomed to extinction. If the whole of humanity formed an urban-industrial civilization, the aggravation of the crises attendant on the present model of civilization could lead to a global catastrophe. The feeling that a certain model is optimal is inevitably a product of the perceptions characteristic of a given time, area, or socio-political system.

Modern European cultures and social systems are rooted in Greek philosophy and civilization and in Judaic and Christian beliefs, and thus they have encouraged us to subdue nature. The ideologies championing migrations, reproduction, and the subduing of nature appear to have been responsible for the present ecological crisis. There are, however, other civilizations and cultures which feel closer to the whole of the animated world. They make up the cultural diversity of humanity, a source of hope for a better future.

What then can be done? What strategy should be adopted in the development of our civilization and for the reinforcement of the biological strength of the species and survival of human community? I would say we require a controlled advancement relying on local and regional ethnic traditions and also on the latest environmental research (biogeocenoses). Human culture is one component of the ecosystems which we inhabit. Culture must not take precedence over nature or the latter will be destroyed. Culture must be understood as part of the natural system for the sake of the future of this planet which has humanity as its most dynamic constituent. Human societies are unique systems of humanity's relationships with nature. These systems should enhance nature's existence and development. Culture as a system of control of a habitat has a variety of manifestations. This diversity of expression should be preserved—just as we are trying to preserve all the animal species still found in the world—as unique gene pools storing information accumulated over millions of years of evolution. Likewise cultures are systems created by thousands of generations. They must not be wasted, not merely because we love tradition but especially because they are repositories of wisdom from the past that offer resources for improving the future of this world.

NOTES

1. Such is the meaning of the genetic diversity of organisms: ensuring the survival of a species in the event that the given organism (genotype) develops properties and needs inadequate to the properties of its environment.
2. As I have pointed out before, such is the significance of genetic diversity.

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