ANTHROPOLOGIE * XIX/3 * 1981

This paper was presented during the XVth Congress of Czechoslovak Anthropologists at the Symposium on Human Evolution held in Humpolec 1979

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SYNERGISM OF THE MAIN DEVELOPMENTAL FACTORS IN THE EVOLUTION OF MAN

ABSTRACT. — A mutual intensification of the main factors in the evolution of man from his animal ancestors is discussed. The descent from trees of the Pliocene man forrunners resulted in bipedal locomotion with consequent orthostasis which freed the anterior extremities. This made more effective the hunting for larger beasts enabled by cooperation of increasing number of individuals. Protein diet of the creatures thus improved, causing, together with the improving microclimatic conditions (fur wearing, dwelings), a continuous tendency for neoteny resulting in a quick increase of the brain. This, in its turn, favoured an increasingly complex activity of the upper extremities converting them into hands and creating intentional labour including tool-making. The labour was the main stimulus for the development of speach which, on one hand, contributed to further functional improvement of the brain, on the other hand, it resulted in the origin of social consciousness which made possible sharing of experience (social heredity) among individuals of even distant generations.

Morphological, functional and behavioral changes taking place in the course of both ontogenetic development and evolution are caused by various external and internal factors, such as temperature, humidity, quality and quantity of food, internal morphogenetic factors, various hormones, etc., affecting the developing organism. Each of these factors works in a specific way in a specific period of ontogenesis and has originated in a given time of phylogenesis. None of them is independent from the others, however, and often their action interferes and coincides in various way. The coincidence is often connected with a mutual intensification or synergism of effects of most of them.

Synergism is a phenomenon well known in chemistry, concerning e.g. the biological action of various chemicals on microorganisms, plants and animals. It may be either negative action, like in sterilization effects or destroying various helminth eggs, or positive, e.g. in the case of combined action of various fertilizers or vitamins. The effect of each of the synergists may be quite different and they may condition each others action. So e.g. xylol and other hydrogenes penetrate the outer membranes of Ascaris eggs, but are not able to kill them. Phenol, on the other hand, destroys the eggs, but is not alone capable to penetrate the membrane. Their mixture is effective in much lower amounts (cf. Weber, 1958).

The same is true of the action of various factors of evolution of organisms. As a matter of fact, in the course of most of the significant evolutionary changes we observe an interaction of several developmental factors. They may be of hereditary character, like the mutation resulting in the production of the juvenile hormone and its source, the paired endocrine gland corpora allata in metamorphic insects, interrelated with the origin of wings and of the metamorphosis, but they may also be of phylogenetic non-hereditary character (Novák, Zemek, 1977; Zemek, Novák, 1977), like various cases of neoteny in social insects. Often, both types of factors are interrelated and their action is coordinated by natural selection. Such synergism often results in

a typical arogenesis (in the sense of Paramonov, 1967 = aromorphosis of Severtzov, 1931), e.g. the mentioned case of insect metamorphosis, or that of homoiothermia in higher vertebrates interconnected with a higher grade of nervous activity (cf. Krušinskij, 1976), or, with the viviparity in mammals with a number of morphofunctional adaptations.

A similar synergism is also clearly evident in the phylogeny of man and human society where we can analyze it in more detail. The preconditions here are the well developed nervous activity, reaching the psychical level, as occuring in the highest primates (cf. recent anthropoids) and the beginning of social way of life, as occurring in the same group. Under these conditions the iniciating factors were undoubtedly the climatic changes in South African Pliocen tropical forests. The decrease of humidity of this period, resulting in replacing of much of the earlier forest area by open savanahs, caused some of the human ancestors to leave forest trees and begin to live in open grassy land. This profound change in the way of life had a number of important consequences which themselves worked as developmental factors deeply affecting the subsequent evolution (Novák, 1967, 1975, 1976, 1981).

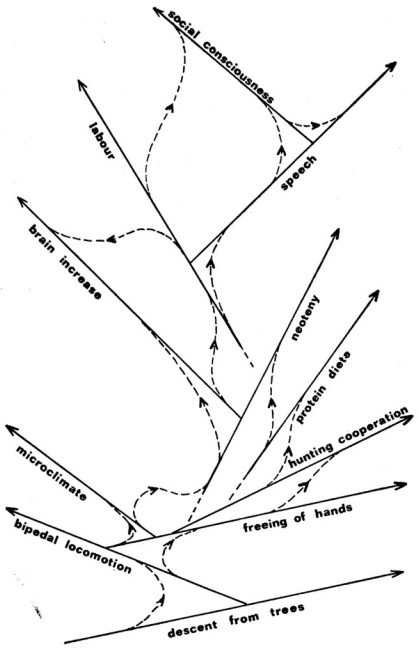

FIGURE 1. *Interactions and mutual intensification of the main factors in the evolution of man.*

The primary two of these phylogenetic changes were the transition to bipedal locomotion connected with the change to upright straight posture (orthostasis) and thus freeing of the first pair of extremities from the locomotory function and the passage from gathering way of life to hunting for larger beasts (hunters — gatherers) resulting in a significant increase in animal protein diet.

Let us consider now the consequences of these two primary factors in further anthropogenesis. The bipedal locomotion with upright body position which raised the head to a higher level has significantly extended the outlook of man's ancestors compared with quadrupeds and improved thus their ability in looking for pray and avoiding danger. And the freeing of hands created the possibility of using them in their various activities, first of all in reaching food as e.g. throwing stones and using sticks to kill hunted animals, and later to prepare various tools for hunting (spears, later bows and arrows) and to skin and divide the pray. The hunting of larger animals unlike gathering, requires cooperation of larger amounts of individuals of the society (group) and creates thus conditions for its further improvement and acceleration of the evolution in the direction of sociogenesis.

We can thus see a strong effect of the bipedal locomotion, and the interconnected orthostasis and freeing of hands, on the hunting caused by the same factor, i.e. the descent from trees. It resulted in an improved feeding which itself favoured, through natural selection, the bipedal locomotion. In this way the combined effect of both factors is much stronger than would be that of each of them separately. An other effect is that the action of either factor is enhanced, even if the return action on bipedality here is mediated through natural selection.

The improved protein nutrition, both in quantity and quality, has two main concequences. First, it reinforces the ontogenetic development and function of the brain (the importance of sufficiant protein diet and consequences of its lack are well known from the developing countries) and secondly, it seems to be one of the main causes of the ontogenetic and this means also of the non-hereditary phylogenetic neoteny. This in its turn has a profound effect on the increase of the brain. An other effect of this preserving an earlier ontogenetic state to the adult stage is the deepening of the social way of life by removing various antisocial behaviour patterns of the ancestors which only appeared in later ontogenetic stages of the ancestors, obliterated by neoteny. Either of these factors produced feed-back action on the improvement of nutrition and other living conditions of the human ancestors (on the hominid level already) and their combined action is thus gradually enhanced. We see thus here again a typical synergism among improving nutrition, neoteny and reinforced brain function.

The joint action and mutual intensification of all developmental factors mentioned results in further deepening of the social way of life and cooperation. An other evolutionary step in this direction is the beginning of the division of labour and the origin of deliberate work including the production of tools, which becomes later the main developmental factor and stimulus on the psychosocial form of motion of matter. It is the intentional work also, which grows to the main stimulus for improving communication among members of the early human society and the origin of speech. Here again a typical synergism appears: the development of intentional work requires the improvement of speech and this, as the main factor of the "social heredity" (in the sense of Dubinin, 1972), strongly favours further improvement of work. Both these factors jointly strongly stimulate further development and perfectioning of the brain function, which in its turn favours their further strengthening.

An other typical feature connected with the synergism of the developmental factors is their gradation, it is gradual strengthening of their activity connected with increasing speed of evolution in the given direction. It is an immediate consequence of the mutual intensification of their activity which makes a gradual process from the action of each of them. The strengthening of their action by synergism seems to be the main reason of the mentioned acceleration of evolution so conspicuous during the whole anthropogenesis up to the recent progress of both technical and cultural development.

The synergism of developmental factors is thus to be viewed as one of the evolutionary regularities which had an important role in anthropogenesis. They were the following three main groups of factors mentioned above which contributed the most significantly to the acceleration of human evolution: bipedal locomotion, hunting and improved protein diet; increase of the brain and improvement of its action together with the deepening of the social way of life; and intentional work, speech and further intensification of the brain function. Further analysis of their interaction on the basis of concrete investigations may favour our understanding of the whole process of human evolution.

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