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## MOTIVE FORCES OF THE EVOLUTION OF HOMINIDS IN THE DIRECTION OF SAPIENTATION

**ABSTRACT.** — The principal form of the biological adaptation of man is behavior. A question arises in this connections — can the natural selection affect the formation of a definite type of behavior even if the behavior is primarily an ontogenetic adaptation? Man is the most domesticated from all the species, since during the period of anthroposociogenesis the natural selection concerned primarily the socially adapted behaviour. The human society possessed as its main advantage in the struggle for life a common exploitation of tools and hence it required from its members not only suppression of aggressiveness in relations of their fellows, but also the ability to coordinate complex actions in providing food, protection from enemies and upbringing of slowly maturing offsprings.

We can assume that some changes in the neuro-hormonal regulation which appear in the phenomenon of neoteny, were related in a definite manner to changes in the behaviour.

During the formation period of the *Homo sapiens* species the dominant group of characters was represented by those securing of adaptation of individuals to the existence in the society, although many other things have changed too, these changes follow from correlation independences.

**KEY WORDS:** Behaviour — Adaptation — Auto-domestication — Neuro-hormonal regulation.

The problem of motive forces of the evolution of hominids in the direction of sapientation becomes very topical in connection with new discoveries of an increasing number of fossil forms of possible ancestors or relatives of man. The simultaneous occurrence of many fossil forms discovered during the latest years does not make it possible to insert these forms into a well-arranged sequence of man's ancestors. Of course, the use of tools, social way of life, bipedality, relatively large brain and potentially the ability to use language to communicate suggest a great complexity of occurring changes and complicates the problem of the taxonomy of the genus *Homo*. From this point of view a certain clue can be found in realization of specific proper-

ties of man as a biological species, which can help in determining logically the motive forces of the evolution of the genus *Homo* in the direction of sapientation.

The fact that man differs from other animals at most by his behaviour was known already to Ch. Darwin, who in his books "The Descent of Man" (1871) and "The Expression of the Emotions in Men and Animals" (1872) singled out this difference as the main point. Darwin was not alone, since this fact is rather obvious. Of course, when Darwin was interested in this problem, the disciplines necessary for its study were hardly in a rudimentary state.

During the evolution of behaviour in homeo-

thermic vertebrates with sufficiently large brain possessing the corresponding number of neurons and optimal conditions for their function psychical life develops. The psychical life of birds and mammals fulfils the function of a regulator of complex behaviour which is formed during the individual life and secures the accommodation to the changing conditions in the environment. Psychic life is a reflection (hence its subjective nature) of a definite part of the environment, of that, which requires an active adaptation of the behaviour. The ensemble of sensory organs, which developed during evolution, determines the content of psychical life. Among others, psychical life includes the experience of the individual, stored during ontogenesis. Hence the psychical life is not only specific for a given species, but also individually non-repeatable in the same way as ontogenesis is non-repeatable.

As it is known during the evolution substantial changes in the environment bring about the extinction of species adapted to the original environment and bring also the origin of new species. At the same time the new species arise from the least specialized populations through development and specialization. Exactly from this point of view neoteny is a possible mechanism liberating given species from an excessive specialization and enabling the evolution to proceed in a new direction.

On the other hand, stabilization of the environment results in the stabilization of species, living in this environment. This stabilization manifests itself not only by elimination of most of the deviations from the standard form by the natural selection, but also at the same time by the fact that the species becomes, after all, to be specialized with respect to its own environment. Man is no exception to this rule, even if this is often assumed. The species *Homo sapiens* is specialized equally as any other species and its main specialization consists in socially advantageous behaviour. In other words, the principal form of the biological adaptation of man is behaviour. It is just owing to the very labile, ontogenetically formed behaviour, regulated by the psychical life that the species *Homo sapiens* is adapted to the conditions of existence in the human society.

The psychical life of man is qualitatively different from that of other mammals and birds, since it is determined primarily by social consciousness. Owing to the fact society can influence the behaviour of individuals in various ways so as to fit best the contemporary requirements of the development and existence of the society.

A question arises in this connection — can the natural selection affect the formation of a definite type of behaviour even if the behaviour is primarily an ontogenetic adaptation? (We do not consider here the degree of its complexity neither how adequate this question is in the given situation.) The second question to be solved concerns the peculiarities of behaviour specific for the species *Homo sapiens*, since just those were the subject of the natural selection and hence conditioned the process of anthroposociogenesis. The third and most diffi-

cult question is whether it is possible to verify, at least in principle, the formulated hypotheses with the help of fossil material.

The evolutionary approach to behaviour leads to the conclusion that during the evolution at first prerequisites for a general perfection of the analytical capabilities of the central nervous system are formed and also increases its role in the regulation of the functions of the organism in general. Under these capabilities we understand primarily the level of development of the mechanisms of registration, central elaboration, preservation and utilization of information by the central nervous system during ontogenesis.

The psychical life as an individual subjective model of the environment perfects itself and becomes more complicated in connection with the perfection of the brain and is directly related to the complexity of behaviour. Thus, e.g., in beasts of prey one finds the capabilities to make elementary judgements much higher than in herbivorous animals. Special characteristics of the psychic life of primates were formed in connection with their type of life, nourishment, locomotion, etc. The high level of the development of the psychical life of all the recent primates was demonstrated by numerous data of laboratory examinations and observations in the natural conditions. The way of locomotion (see Napier, 1967) affects primarily the differentiation of functions and morphology of upper and lower limbs. The upper limbs started gradually to fulfil the cognitive function in connection with the development of manipulative abilities. At the time of the origin of extinct Hominoidea — common ancestors of man and recent apes — the evolution was directed towards an increase of the adaptive value of behaviour, based on a highly developed psychical life and rudiments of elementary thinking. That is to say we can assume that the ancestors of man possessed a highly developed intellect and were capable (of course, in the primitive prelogical form) of thinking already from the beginning of hominization. These properties made for them possible the adaptation to various conditions of living — in a tropical rain forest, on the edge of forest, in mountains — all the world over where heterogeneous vegetation, insects and small animals serving as a nourishment could be found. The ability to use clubs, stones or other things as tools (bones, etc.) and also to modify them in a definite way according to the purpose increased considerably the chance to survive.

The data concerning the special characteristics of the psychic life of contemporary apes can serve as an indirect evidence for the high level of intellect of the extinct common ancestors of man and recent apes. Chimpanzees, gorillas, orang-outans are not only capable of a primitive thinking, but can also under certain conditions to employ, when communicating with man or other individuals of their own species, a system of symbolical communication, similar to the human language, even if in the form of a system with a limited combination facility (Premack, Gallup, Griffin, Gardner, Fouts, Savage-

Rumbaugh, Terrace, Pettito, Seidenberg et al.). The psychical life of apes is according to experts much closer to the psychical life of man than to the psychical life of monkeys, let alone other mammals.

Another substantial problem consists in necessity to find out whether the natural selection can not only contribute to the evolution in the general direction of increasing the level of organization of the central nervous system, but also influence the formation of a definite type of behaviour. This question is at present open and subject of both scientific and ideological discussions. To be sure, we can presume that the answer to this question is likely to be positive. It seems that the selection can support certain hereditarily fixed special properties of the neuroendocrine regulation related to the type of behaviour which can be termed as "domesticated" (Belaev and associates). In the researches of the group of geneticists from Novosibirsk with foxes it was found that the selection of marks of domesticated behaviour brings the result already after a few generations. That is to say that in the experimental population many more descendants behave from the birth as domesticated animals without any drill or another influence of the experimentalists. The friendly relation of the foxes toward man was suggesting the behaviour of the dog. Of course, the individuals of the experimental population had still other common marks similar to dog's characters — playfulness, social behaviour towards other members of the group and also morphological marks — the form of ears, tails, etc. and also physiological peculiarities, e.g., reproduction cycles. Belaev writes: "It can be naturally considered that as a result of a very complex morpho-functional connection between the nervous and endocrine system the selection of animals according to their behaviour can automatically change their hormonal status or influence the systems of receptors in cells and thus the specificity of their biochemical, primarily enzymic activity with all the consequences for ontogenesis, following from these changes".

In animals selected according to their behaviour the level of 11-oxycorticosteroids (hormones of the suprarenal glands) in the periphery blood differs significantly from that in the control group and, at the same time, the morphological structure of the suprarenal glands is changed, too (Trut, Naumenko, Belaev, 1972). Most important was the fact that some neurochemical characteristics of the brain, i.e., of hypothalamus, central brain and hippocampus (Popova, Vojtyenko, Trut, 1975). The content of the mediator serotonin and its metabolite 5-oxyindolylacetic acid in domesticated foxes was higher than in controls. This fact is in harmony with the behaviour of these animals, since it is known that serotonin acts as an inhibitor suppressing aggressive behaviour. The increase in the serotonin content can also suggest that the regulation of the hypothalamo-hypophyseal-suprarenal glands and hypothalamo-hypophyseal-sex glands systems by the central nervous system is affected, since serotonin plays an important role there. Belaev believes that the selection of domesticated behaviour changes substan-

tially both the central and peripheral links of the neuro-endocrine regulation of ontogenesis (Belaev D. K., 1979).

Man is the most domesticated from all the species, since during the period of anthroposociogenesis the natural selection concerned primarily the socially adapted behaviour. Since the neuro-hormonal regulation of ontogenesis in man is very similar to the regulation in other mammals, probably even their changes were analogous. Although until now the hypothesis that suppression of aggressiveness is a purely social problem is widely spread, considerations about possible role of hereditary fixed mechanisms of the ontogenetic regulation of the neuro-hormonal system on the suppression of aggressiveness is not entirely baseless. As an indirect evidence for this idea may serve cases of pathological aggressiveness connected with abnormality of sex chromosomes (e.g., YYY) and also the higher percentage of this abnormality among notorious criminals than the average in the rest of the population (Hook, E. D., 1979).

The facts concerning the functional expression or depression of genes in ontogenesis under the influence of various metabolites including hormones can probably be considered as demonstrated; of course, their significance in the evolution is less known, even when various authors published their hypotheses in this direction (Zukerkandl, Poling, 1964 and others). These are until now mostly speculations, requiring further experimental verification.

The environment in which man is living differs considerably from the environment of other animals. Firstly there is a material culture — the result of work of all generations. The main peculiarity of this part of the environment is its continuous complication, perfection and tendency to surround man with artificial devices protecting him from any extreme influences of the "wild" nature. Gradually a "buffer" develops between the individual (as biological being) and nature, which becomes an essential condition of the human existence in general.

Another part of the environment is the mental culture, originating during the history of the society in the form of either exactly formulated or only subconsciously observed traditions, rules of conduct, values and also art, science, law, philosophy originating at later degrees of the society development. It is just this part of the environment which exerts decisive action on the development of the psychical life of man during ontogenesis. At present facts are already known confirming the important role of this part of the environment in formation of the youngest parts of the central nervous system (e.g., brain, as it is known, terminates its growth in the age of 20–25 years).

Due to the fact that many characters typical of the human population are very diversified and mainly they do not possess any special adaptive value the illusion arises that natural selection does not affect man any more. The opinion was even put forward that man, due to the artificial environment



and especially as a result of medical care puts in danger his own genetical fund, since genetically pathological individuals survive. This opinion originates from incorrect ideas about the biological specificity of *Homo sapiens*. The disturbances of the biological adaptation that might endanger the existence of the *Homo sapiens* species are connected with the inability to link up with the contemporary level of development of the human society. And this holds for individuals with substantially impaired mental ability — feeble-minded, imbeciles or persons suffering from serious mental diseases. Even if society is securing their existence they mean no menace to the biological future of mankind. Far greater danger is bestowed in the arms race, upsetting the ecological balance or in inconsiderate exploitation of the world's limited natural resources.

It is a delicate question whether this idea might be tested on fossil material. But it seems that there are no basic objections to it. The search for morphological characters that might be correlated to the domesticated behaviour appears to be one of the possible ways. And if such characters exist with carnivora, why they should not exist with the predecessors of *Homo sapiens*. Such correlations might exist primarily in everything related to reproduction, since it is just the regulation of reproduction which is closely linked with the whole state and type of the neurohormonal regulation. It is probable that the fossil material can bring some evidence in this direction.

The human society possessed as its main advantage in the struggle for life a common exploitation of tools and hence it required from its members not only suppression of aggressiveness in relations to their fellows, but also the ability to coordinate complex actions in providing food, protection from enemies and upbringing of slowly maturing offsprings.

We can assume that some changes in the neurohormonal regulation, which appear in the phenomenon of neoteny, were related in a definite manner to change in the behaviour. At least some peculiarities of the behaviour of young mammals have been preserved in adult man, e.g. the ability of playing. Of course, in this case the connections are rather problematic, since neoteny, even if it had its share in the despecialization of ancestors of man and acted as a factor increasing the brain size, still was not specific for the last stage of sapientation.

From this point of view investigation of the biological prehistory of psychical life is of special importance. In the study of the psychical life two problems are of great importance 1. The study of the ways in which patterns of behaviour are formed which reflect space and have a determining significance in the regulation of movement. 2. The study of formation of nervous mechanisms securing the psychical regulation of behaviour and of the growth of the significance of psychical part in all life processes, i.e. the main adaptive property securing the adaptation of the given species or of a higher taxon to the environment.

During the specialization period the natural selection supports the perfection of this most important group of adaptive characters. Although many other things have changed too, these changes follow from correlation interdependences.

During the formation period of the *Homo sapiens* species the dominant group of characters was represented by those securing the adaptation of individuals to the existence in the society.

## DISCUSSION

We would like to turn to the question of terminology once again. The use of the same categories, e.g. labour, language, society, etc., for both animals and man is justified, as far as we take into account that besides identical features in both groups and besides their common phylogenetic origin there are also considerable qualitative differences. The state of development in man is much higher and qualitatively different, but most of the other features are identical with those in animals. The investigation of their phylogenetic origin on both biological and social levels is of principal importance not only in itself, it helps us to understand their very principle.

People who do not understand or do not accept the evolutionary approach refuse the use of common terms for both, separating in this way various expressions of the same higher quality and making thus human features incomprehensible. On the other hand people who do not understand and do not recognize the higher qualities identify the human features with those in animals and they are not able to grasp their principle in either case. Even in cases when common terms, such as labour, language, society etc. are used in both groups, some people understand them rather onesidedly.

We find therefore that the most useful approach is to use the same terms for both levels, both to distinguish between the actual degree and stage of the revolutionary process.

## LANGUAGE (FOR EXAMPLE)

The language is the system of signs of the communication. The development of language in the evolution of life —

1 Stage. The language is a system of signs the meaning of which is fixed hereditarily (insects, f.e. the dance of bee)

2 Stage. The language is a system of signs the meaning of which is conventional and each individual must learn of it in the process of ontogenesis (same mammals and birds with primitive behaviour)

3 Stage. The language is a system of *symbolic* signs the meaning of which is conventional and must learn it in the process of ontogenesis (some mammals and birds with complicated behaviour)

4 Stage. The language is a *combination* system of the symbolic signs the meaning of which as well as the laws of combination must be learned (man, computer).

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