(1995) In: Stránský, Z. Z. (Ed.) The University on the Threshold of the New Millennium. Vol. I. Masaryk University, Brno, pp. 83-88.

Biopedagogy: teaching and learning in the optics of cognitive biology

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1. In 1994, 2342 years will pass since the death of Plato and 2317 years since the death of Aristotle. No longer do we view the cosmos and nature as they did. On the other hand, their explanations of man and society, their ethics, politics, pedagogy continue to appear to us plausible and remain a source of our inspirations.

How is it possible? It seems obvious that these great thinkers were not able to work out a faithful description of the complexity of inanimate nature: such a description could not be accomplished by sheer contemplation. At the same time, would they have been capable to comprehend phenomena much more complex, which have emerged at the latest stages of the evolution of life? Hardly can it be so. Another explanation is more likely:

Our knowledge of physical, chemical and biological phenomena has much increased since antiquity, mainly due to the experimental method. In those areas of inquiry in which experiments and mathematical deduction have not yet substituted rational speculations our knowledge remains slight. This applies also to pedagogy. Our knowledge - or, rather, our vast ignorance - of man and society is probably not much different from that in Aristotle's time.

2. As long as humanities do not fully use methods of science, impartial observations, personal experience and empathy, and especially the transfer to them of new knowledge from science remain the main tools of the lingering progress. Of a progress consisting more in providing new questions rather than new answers. A personality, which much contributed to such a progress, was Jan Ámos Comenius, who died 325 years ago. This great man of the Czechoslovak culture has been called Galileo of didactics, Copernicus of pedagogy. His merits notwithstanding such a designation is exaggerated:

Pedagogy is still in its prescientific period. It awaits its Copernicus.

3. Finding Aristotle's ethics, aesthetics or politics plausible, we do also intuitively adhere to his physics. A layman does not comprehend physics of Newton, Einstein and Schroedinger and spontaneously conceive of physical processes in the Aristotle's manner. This is due to the property of the human mind:

The human mind has evolved by natural selection as a tool enabling survival of man in the environment in which he was selected as a biological species. It corresponds adequately only to this environment, to this ecological niche. Microworld, megaworld

and socioworld exhibit properties and behaviour that are counterintuitive to the human mind.

4. In order to understand the human mind and behaviour and the formation of the individual in the course of his development we have to know conditions under which the formation of man as a biological species proceeded in evolution. For hundred thousand years of evolution man was being selected for life in small groups of hunters and gatherers in the savannah. The evolution has shaped his main characteristics:

- Man is a shy and fearful creature.

- Man is a group animal. The groups are hierarchically organised, the authority of an individual is conditioned by his place in the group hierarchy. Individuals in a group are linked together by positive emotional bonds. Different groups coexist in antagonistic relations, potentiated by negative emotions.

- Man is dinstiguished by a great polymorphism. A number of properties, which have assured the preservation of the human genofond, are statistically distributed in populations. Every individual is unique.

- Man is a curious, exploratory animal. He incessantly explores and inspects his environment with questions: what if? what may happen? His capacity of exploration is enhanced by an important evolutionary innovation, neoteny: the adult member of the human species exhibits properties of the young. Neoteny may be the main reason why man, perhaps as the only animal species, continues to be playful in his adult age.

- Evolution has innovated human mind in enabling the substantial part of exploration to be accomplished by simulation. The culmination of simulation is the ability of thought. Thinking is an abstract motive manipulation with the environment.

- Man is a mythophil. The need to understand the environment induces not only exploration but also comprehensive explanations of the environment by myths. The myths prevent him from cognitive chaos that is a source of existential anxiety. Myths are also most efficient means of group cohesion, a group "glue".

- Among all the animals man has the largest repertory of emotions. Emotional guidance, the search of pleasure and the escape from pain, may have been the main substrate of human biological evolution in its latest stages.

- The consequence of the highly developed mind has been the emergence of cultural evolution as a new way of evolution of the cosmos.

Cultural evolution, with its main products, science, technoscience, technology and complex social organisations, generates the environment which is steadily diverging from that in which and for which man was being selected. For this new environment man does not possess adequate biological and social equipment. This statement should be the starting point of all considerations on the role and means of contemporary education.

5. One of the most important breakthroughs in the cultural evolution of man has been the recognition that evolution at all levels of the world is ruled by a single principle: it progresses by trials, errors and selection. The essence of any evolution is the spontaneous generation of a polymorphous population of phenomena and selection from these phenomena according to specific criteria. The criteria determine the purpose of the persisting phenomena - the purpose appears a posteriori, as a result of conditionally stochastic dynamics. Such an understanding of evolution is counterintuitive. We have been selected for purposeful behaviour, and therefore for purposeful reasoning. The idea of purpose as a result of selection is as counterintuitive to us as is Newton's physics. In everything around us we search for a predetermined meaning, intention, instruction. The history of thought is to a great extent the history of refutation of the myths of instruction: the myth of creation in cosmology, the myth of social contract in sociology, the myth of scientific planning in economics, the myth of inheritance of acquired characters in biology, the myth of induced formation of antibodies in immunology, the myth of action based on the purposeful rationality in psychology.

The phenomena existing in nature, society and thought are results of selection and not of instruction.

6. The unprogrammed, more or less stochastic production of new forms and selection of the fittest of them is the essence of the evolution of life, as found out by Charles Darwin. Karl Popper is to be credited for his discovery that the evolution of knowledge is based on the same principle. Life in its entirety is a cognitive device. Biological evolution and cultural evolution are both the evolution of knowledge.

Knowledge is the product of biological and cultural evolutions. Every new piece of knowledge is a result of trials, errors and selection.

7. The selection principle should be consistently applied to the theory of teaching and learning:

- The essential knowledge that everyone of us possesses has been acquired by evolutionary learning in phylogeny of our species. It is carried by genes and present in a latent form immediately on birth. In ontogeny, during the development of the individual, this latent knowledge is being activated. The basic purpose of education is to assure this activation of the endogenously present evolutionary knowledge at the appropriate stages of ontogeny and to select from the existing repertory those components that appear advantageous for the individual in the specific environment.

- The processes which are commonly considered as learning may often be no learning at all. A classical example is provided by Chomsky's view of how a child acquires his mother tongue. The child carries in his genes a ready program of a general grammar that is common to all languages, as well as a program of notions for the description of the world. The words, which the child listens to, function as signals triggering these speech programs and, at the same time, supply them with appropriate data.

- Formation of a personality by education is substantially based on selection and not instruction. The shaping of behaviour is selection from the repertory of the existing options, from a set of possible behaviours. A bit paradoxically, this process of selection from potentialities can be called "learning by unlearning". Instrumental conditioning completes behaviour within the range delimited by the hereditary dispositions. Regarding the human polymorphism and the uniqueness of every individual, education should be extremely individualised. The idea of a standardised instruction or even of a unified school (instituted in this country by the communist regime) is a naive fiction. It is quite illusory to attempt at enlarging the set of potentialities of an individual by the elements that it does not contain.

- In analogy with learning the mother tongue it can be supposed that new knowledge that has accumulated in cultural evolution - such as the statements of science, which are to be implanted into a student by instruction - can only be anchored in his mind by intermediary of general notions which are endogenously present as products of evolutionary learning of the human species. The pieces of knowledge represent data; the system of the notions is a built-in program. Such a hypothesis may substantially affect the theory of didactics.

- The principle of selection applies to teachers as well. Teachers should be recruited from people endowed with empathy, with a joyful approach to the world and humanity, who are strong personalities. One does not become a teacher, one is born as a teacher. We do not get teachers by instruction, we get them by selection.

The main notion of pedagogy is selection: selection of a teacher; of a student; of knowledge that is to be taught. The teacher is not a designer, an engineer, he is a gardener: for every plant he selects appropriate environment and appropriate nutrients. A considerable part of learning is not cognition but recognition - sorting of latent pieces of knowledge and arranging them into consistent patterns.

8. Human nature, characteristics worked out by selection in evolution, should be the principal determinant of pedagogical techniques:

- As a group animal man learns in hierarchy, by imitating those who are placed high in the hierarchy. The teacher must radiate self-confidence, be devoid of complex of inferiority, possess a stable pattern of values, he should dominate. His social prestige should be high.

- Human playfulness, determined by neoteny, enables to exploit play as an important pedagogical tool. A heuristic tool – the acquisition of knowledge, discovery should be transformed into a joy, a play; and a motivational tool - a student should consider his success, made possible by his teacher who has correctly recognised and exploited the potentials of the student, as his winning in a social game. The presentation of knowledge should be dramatised and the students made active participants of the drama. Humour is one of the most valuable and efficient components of the pedagogical game.

- The motivational efficiencies of pleasure and displeasure are asymmetrical: displeasure immobilises and depresses, pleasure is a strong motivational motor. Hence, education should consist in praises and rewards and not in punishment.

- Since thinking is abstract motility, learning and teaching should be based on motor behaviour as much as possible. Teaching should be guidance to solving problem situations, it should consist in playing out and simulating the situations. Practical works and action seminars of the students rather than lectures and explications of the teacher should be the principle activities.

Cognitive biology places the ideal of kalokagathia into a novel perspective: the care of the body and of its motor adequacy is the care of correct thinking.

The knowledge of evolutionary biology of man is as important part of the propedeutics of a teacher as is the mastery of psychology and didactics.

9. Some human characteristics, shaped by selection and appropriate for life in the savannah, have now, in conditions of the contemporary civilisation, nonadaptive or counteradaptive features. They should become the main targets of modern education. These characteristics cannot be removed from human nature. In linking them with other characteristics they should be appropriately canalised:

- The group nature of man, combined with his mythophilia, is responsible for animosity toward people of alien groups and toward different views. It is a biological basis of xenophobia, nationalism, religious fundamentalism. The education for tolerance should be based on cultivating empathy and on instigating a player's attitude toward the disparities of views and controversies. The need of group identity should be blunted in dispersing it by identification with a larger number of groups of different characters.

- As man is a frightened creature, his aggression is mainly due to frustrations. Education should aimed at removing feelings of incertitude, inferiority, dissatisfaction, emotional

insufficiency. Benign forms of aggression should be canalised into sports, creativity and intellectual competitions.

- Insatiable human curiosity, quick accommodation to constant stimuli and hence a continual search for new stimuli is becoming an ever increasing problem in conditions of over-supply of all kinds of data. One of its counteradaptive expressions are feelings of lack of time and of rapid life race. Living under time pressure is turning into a form of modern slavery. Accordingly, contemporary education gets some new tasks: to teach methods of selection of knowledge and its hierarchical sorting; to teach methods of evasive behaviour with respect to useless even though exiting data; to teach manners of selective forgetting.

- Habituation to constant stimuli and incessant search for new sources of satisfaction and pleasure were adaptive properties in conditions of human existence in the savannah. They propelled one to a continual exploration of the environment by observation and motive activities. Nowadays they have a counteradaptive consequence - raising thresholds for pleasant stimuli and the necessity of more and more intensive stimulation. Another counteradaptive consequence of the easy access to enjoyment is the pathologisation of pleasantness into the form of "short circuiting": in the same manner as in the case of drug dependence, simplified, "tailor-made" stimuli from the environment arouse neurochemical responses of the brain "pleasure centres" without inserting purposeful motive actions between the stimuli and subjective experience. Approaching is a dangerous Golem of "synthetic" pleasures offered by technology of virtual reality.

The accelerating turmoil of the impression of high life speed, caused by the flood of data, and the menace of mass pathology of "short-circuited pleasures" seem to be the principal challenge for the theory of education at the threshold of the third millennium.

10. With the upsurge of science, cultural evolution has brought forth another, different cultural phenomenon: technoscience. While science aims at understanding, technoscience blindly exploits scientific achievements for technological applications. An infectious disease from technoscience is infiltrating science: instrumental thought. Manipulation, not inquiry and contemplation, has the priority. Gene manipulations are a paradigmal illustration of this phenomenon; psychological and social manipulations may join them in the near future. Success is being gauged by instrumental proficiency, by achievements in manipulation and only slightly depends on deep knowledge. Many a scientist draw satisfaction from social success and not from internal joy in finding order and harmony.

Segregation of scientific research from university education intensifies this pathological process. It is the mutual contact, interaction of the experienced researcher and the young novice in science which enable both of them to deeply penetrate into the comprehension of events and assure growth of scientific endeavour as an attempt at understanding of the world. Survival of man, a too successful biological species, existing in conditions vastly different from those for which he once had adequate biological equipment, depends on this understanding.

The requirement of the inseparable unity of scientific research and education, which was the ideal of the classical university, is not a nostalgic dream about the restoration of universalism of university education. It is a requirement substantiated by cognitive biology.