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Editor's Page

SOME PRELIMINARY COMMENTS ON VLADIMIR M. KOVALZON'S LETTER TO EDITOR "ORIGIN OF SLEEP"

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Considering the vast reference data on the mechanisms of sleep-wakefulness cycle and their assessment in the evolutionary aspect, V. Kovalzon, in the concluding remarks of his paper (Kovalzon 2002), proposed very interesting hypothesis, which establishes that the state of waking ("neowaking") and SWC originates in evolution simultaneously with homoiothermia, at the same time PS represents the state of "arche-waking", the result of evolutionary transformation of the primitive waking state of poikilotherms.

Quite a positive side of this hypothesis, undoubtedly, is the fact that within analysis of the sleep-wakefulness cycle the paradoxical phase occurs for the first time in the warm-blooded animals. Considering a large number of experimental data, collected mostly in the second half of the 20th century, a number of more or less confirmative suggestions could be proposed with an aim to further clarify the hypothesis, in a case if the author finds something valuable for consideration. First of all I would like to note that, as the impression is, this hypothesis has been formulated under the influence of such classics of the sleep-wakefulness neurobiology as Kleitman (1963) and Jouvet (see Jouvet 1962, 1972). As far as I can understand, according to Kleitman the paradoxical phase of sleep in the warm-blooded animals is an analogue of the cold-blooded animals' active state, while the rest state, probably, could be considered as the forerunner of the slow-wave phase of sleep. Jouvet, however, named the paradoxical phase of sleep the "arche-sleep", because its triggering brain structures are located in the pontine region, which is phylogenetically older brain structure as compared to the structures, activity of which presumably triggers the slow-wave phase of sleep-wakefulness cycle. The Kleitman's notion is somewhat supported by the fact that overall activity of the brain during PS reaches and, sometimes, exceeds an activity of the active wakefulness, while the slow-wave sleep provides for conditions resembling the general rest. Therefore, the so-called arche-waking, characteristic of the cold-blooded animals, in the warm-blooded animals is transformed into the arche-sleep and attains not only a paradoxical place in the sleep-wakefulness cycle of these animals, but also some other new function as well. It should be noted that in the "rest-activity" cycle characteristic of the cold-blooded animals, the organism's interaction with outer space alternates quite regularly. Particularly, in the activity phase an animal more clearly perceives a character of environment, i.e. it establishes active contact, endeavors to respond adequately, while in the rest phase both perception of environment and realization of adaptive forms of behavior do decrease. Certainly, the rest phase realization requires an absence of dangerous factors in the outer space. In this respect, the rest phase in the cold-blooded could be boldly attributed to the prerequisite of the slow-wave sleep of the sleep-wakefulness cycle of the warm-blooded, because in these animals an active link with the outer space decreases gradually just along with deepening of the slow-wave sleep. Within the evolution such a trend of dynamics of the organism's interaction with environment, in regard with the latter's character, could substantiate formation of more perfect forms of activity and rest, i.e. the wakefulness phase with its different levels, and the slow wave sleep phase with its different stages. Obviously, within the progress of "rest-activity" cycle, the function of the slow wave sleep increases and complicates as well. Insofar the metabolism of the brain during wakefulness is maintained at the high level, therefore, difficulties for the further functioning may occur, these metabolic alterations may serve as the slow wave sleep triggers on the background of cutter; the antihomeostatic factors will be hence eliminated successfully. Thus, the optimal conditions for the brain functioning during the wakefulness and fulfillment of adaptive acts by the organism, are created. As to the PS phase, a number of current data certify that it may occur in the evolution process as a result of perfect sleep-wakefulness cycle formation. In the meantime it is known that one of the major functions of the slow sleep (along with above maintenance of the brain homeostasis) is triggering and further maintenance of the PS, i.e. the causal relation between these does exist, which is executed by the two factors at least: 1) The mechanisms regulating the slow wave sleep, along with increased activity, stepwise decrease an activity of the wakefulness mechanisms and at certain level of this process the inhibitory influence of the wakefulness system on the PS system is abolished, and the latter phase is being triggered. This implies that the PS system stays under strict control of the wakefulness system and only exceptional weakening of this control allows the PS to evolve at its proper place in norm, i.e. on the background of the deepest slow wave sleep. 2) It has been well proven that internal need for the PS is formed just in the process of the previous slow wave sleep. These facts certify that occurrence of the PS in a form, which is common in the warm-blooded animals, without development of the slow wave sleep, is impossible, and that biphasic sleep in these animals is an indivisible phenomenon, holding mutually causal evolutionary origin.

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Archaic character of the PS could be hardly proven by the fact that its triggering brain structures are localized in the pontine region. According to Magnez at al. (1961) and Moruzzi (see: Moruzzi 1972), the primary triggering structures of the slow wave sleep may be found even lower, in still more archaic structures. The fact that the slow wave sleep and, especially, deep slow wave sleep are triggered with an aid of preoptic region and basal part of the forebrain, does not speak again in favor of the notion that the slow wave sleep is a novel phylogenetic phenomenon as compared to the PS. Development of the perfect PS, with its psychophysiological processes, does not occur without participation not only of such limbic structures of the brain as septo-hippocampal and septo-enthorhynal, but also without involvement of the cerebral cortex. It could be claimed that the major function of the PS is regulation of just those psyhophysiological processes, which ensure acquisition and retention of the vitally important skills in the long-term memory, as well as morpho-functional integrity of the brain structures highly activated during the PS.

However, these comments by no means diminish the high importance of the Vladimir M. Kovalzon's hypothesis, considered in "Origin of sleep" (Kovalzon 2002) and the author of these comments will be glad if his ideas will be of useful.

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