The choice of our topic, which is of both exploratory and applied value, has been determined by the confluence of neurocybernetics and neurophysiology, neuropsychology and cognitology, semiotics and neurobionics (the latter as one of the directions of artificial intelligence). On the whole, the questions considered in this article fall in the domains of cybernetics, in the wide, classical sense of this term [1], and neurophysiology, at the system level of information representation and processing.

The article relies on previous publications [2-7], which have been generalized and extended.

STARTING PREMISES

In the context of thought mechanisms we distinguish between the medium as the receptacle of information (the Medium) and the thought processes in the medium that manipulate the stored and incoming information (Processes).

The Medium is memory proper, and information stored in the Medium is generalized as "knowledge." Knowledge is represented in the Medium in the form of certain static structures in the basis of neurons and their interconnections. Processes are triggered in the Medium by excitation (activation) of these structures and also by the formation of new structures under the impact of direct and indirect external influences and internal motivations.

The Medium includes the set of static information structures and the field for information-processing Processes represented by dynamic structures. Dynamic structures are temporal "patterns" consisting of excited parts of the Medium. Dynamic structures may transform into static structures through etching (creation) of permanent interconnections between neurons. The establishment of permanent interconnections constitutes learning of the Medium.

Sharing the convictions of psychologists [8], we assume that the information content of the Medium determines the global model of the world as perceived by the individual (the neural engram in the central nervous system, in physiological terms). In principle fragments of the engram may be simulated by mathematical tools of knowledge representation. The most appropriate for this purpose are the semantic networks, which are identified with the spatial location of knowledge in the Medium. Then the Processes in the Medium are also representable in the form of mathematical procedures involving identification (recognition), search, and transformation of information with the object of attaining certain goals. In what follows the Medium is regarded as consisting of a sensory system and a language system. These two systems determine thought and are respectively associated with the first and the second signal system. The term "language system" embodies the concept of "language" in the broadest possible sense.

This formulation naturally manifests a certain model approach to neurophysiology (see, e.g., [3, 5]) according to which the sensory system not only links the senses with the medium of memory (as in the alternative approach) but is also organically incorporated in this Medium, i.e., the structures formed in the sensory system by various functional neurons and their interconnections are themselves models of the outside world that arise through the action of signals received by the senses.

The sensory system thus generates and stores information about the outside world, which directly influences the behavior and operation of the particular individual. However, information from the sensory system can be transmitted to the
outside world only through the language system, which initiates the formation of appropriate signals. The transmission of this information from the sensory system requires the existence of an adequate representation in the language system, i.e., the information should be expressed by a certain code. The language system thus performs a social function supporting information exchange between the particular individual and other persons in the outside world, who are receivers and transmitters of information.

This statement encompasses only known and explained facts of individual interaction with the outside world, which also involves the neuromotor system that transmits information signals and performs certain functions receiving information signals from the outside. Information processes in these systems (as component parts of the central nervous system) are obviously affected also by the peripheral nervous systems. But the topic of this study is the medium of memory and information processes that take place in this medium. The presentation is accordingly concentrated at the level of the conceptual model of the mechanisms outlined in the title of the article.

The paradigm of the Medium as consisting of sensory and language systems unavoidably leads to the assertion that the second (secondary) system exists and functions in parallel relative to the first (primary) system. This, in particular, distinguishes our model approach to neurophysiology from the alternative approach mentioned below, in which the language system is usually treated as a superstructure over the sensory system, representing the highest levels of storage and processing of information in the human brain.

The notion of parallel existence of the language system and the sensory system follows from known facts on the hierarchical structure of each system and mutual correspondence between their separate conceptual (i.e., semantic) structures on different levels of the hierarchy according to the "images—words" principle. Not all images in the sensory system correspond to words in the language system and conversely. On the whole, these systems evolve not only through their interdependence, but also through internal processes and specific influences of external factors. And yet these external influences always penetrate the language system through the senses. We only note that the degrees of development of the language system, and the levels of abstraction of the sensory system (see below) actually determine the fundamentally qualitative difference between the thinking of man and animals.

SPECIFIC ORGANIZATION OF SENSORY AND LANGUAGE SYSTEMS

The sensory system is regarded as a neural semantic multilevel model representing the outside world [3, 7]. Selective receptors in this model correspond to simple elementary external stimuli. Quasireceptor neurons associated with receptors in