PHYSIOLOGISTS OF U.S.S.R DEVELOP PAVLOV'S TEACHINGS

By,

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Soviet physiologists have had their path blazed out for them for many years to come by the genial research and prescience of Ivan Pavlov. The great Russian physiologist broke soil on a host of virgin problems that will provide food for thought for generations of scientists.

My own work and that of my collaborators was influenced by both Pavlov himself during the last 15 years of his fruitful life and by the problems which claimed his closest attention. At this time his interests revolved around questions connected with what he called "the higher nervous activity," i.e., the highest manifestations of cerebral activity.

On more than one occasion Pavlov himself has said that the classic method of salivation could not alone reveal the essence of all the forms of complex nervous activity. Hence, an essential condition for the further development of his teachings on the higher x nervous activity to embrace the other forms was extension of the investigation methods elaborated by the Pavlov school over the course of many years.

I personally gave much thought to this question. A way out was found with the development of a method that made possible simultaneous observation of both salvation and motor reaction indicants and thus a study of the most hidden and isolated brain processes without at the same

time neglecting physiological analysis, the strong point of Pavlov's school.

When the first results of our investigations, begun as far back as 1930, were shown to Pavlov, they made a very favourable impression on him and he predicted success in future work conducted according to this method. Several dozen investigations carried out since then by my collaborators have fully justified his forecast. Regular phenomenon in the work of the brain were disclosed that otherwise could not have been. For example, it was established that the frontal lobes of the cerebral cortex possess a special mechanism which regulates and inhibits various antagonistic processes of the rest of the brain. We have likewise made big progress in clearing up the role of the mechanisms with which the frontal lobes link up the motor functions.

How important an understanding of the physiological functions of these mechanisms is can easily be seen from the numerous attempts that have been made in world literature to shed light on the manifold deviations in ailments of the frontal lobes of the human brain.

Another line of investigation we pursued involved the application of brain structure data, since any changes in cerebral activity, even the slightest, always affect electrical oscillations continually taking place in the brain cells. These changes have the property of localization; they may be confined to any area of the brain, even a very limited one. Thus if it would be possible to combine a study of the higher nervous activity according to Pavlov's method as a general behavior indicant, a record of the electrical oscillations, of

individual groups of brain cells, and a subsequent microscipic analysis of these cells - then the investigator would possess a completely ideal key to the cognition of cerebral activity.

For several years we sought the most suitable methods to satisfy these requirements. Success came when Doctor Laptyev, one of my collaborators, arrived at a procedure for studying simultaneously the electrical properties of the brain of an experimental animal and its conditioned reflexes.

First results of investigation of the fundamental brain processes inhibition and excitation in the cerebral cells - revealed that our previous conceptions of these processes did not correspond to what actually takes place in the cerebral cortex. In exactly the same way it turned out that undondtional reactions embraced considerably more extensive brain areas than had been assumed.

In conversations with his collaborators Pavlov more than once pointed out that his teachings on the higher nervous activity should be closely linked up with the latest achievements in physiology of the brain. And each one of them strove to his utmost to follow Pavlov's advice. We, in particular, already 15 years ago, undertook a study of the "plastic" properties of the nervous system, i.e., of its abitlity to adapt itself illimitably to the environment. Our work on this problem soon convinced us that a number of nerve centres which, it seemed, had been endowed with definite properties and unalterable functions once and for all, may be artificially "retrained" to fulfill other functions. With this we proved that there are no absolutely

unalterable nerve functions and that they are only relatively stable. It is interesting to note that these results of our long years of research were embodied by Professor Eichen, a German scientist in exile, in a book exposing the race theory (published in Paris, 1936).

Nerve centre "retraining" experiments have acquired particularly great significance in wartime. The war in general has taught us much. We have learned that only the physiologist can do full justice to a number of problems in treating war wounds of the nervous system.

To start with, we attempted to clear up the mechanisms of such wounds, utilizing all the achievements in the field of neurophysiology. Our first major development in this field, in my opinion, was our success in revealing the sources of error in a number of applied diagnostical methods, and, what is most important, in providing the clinic with ways and means of eliminating them.

Many types of nerve injuries, as we proved, are connected not with actual injuries to the nerve trunk, but with changes taking place in the central nervous system when a nerve is struck by a shell fragment, bullet and the like. We have termed this "central switching out". An analysis of several hundred cases of peripheral nerve injuries with the aid of a precise physiological apparatus showed that in nearly every one of them the invalidity results not so much from the nerve rupture itself as from processes - set in motion by the injury - taking place in the spinal cord and the brain.

Not long ago I had occasion to examine an exceptionally clear case of such a wound. It was caused by a mine

fragment that had grazed a comparatively small skin nerve in the arm. Yet the wounded man was brought to the hospital suffering from paralysis of the entire arm. It hung lifelessly at his side and he could neither raise it at the shoulder not flex it at the elbow.

Excitation with electrical current indicated that the nerves in the arm were completely intact. This diagnosis was later confirmed by operation, which showed that the fragment had not touched the big nerve trunk, grazing only a small skin nerve. The far-reaching paralysis this had evoked resulted only from the switching out of the nerve centres (central switching out). Facts indicate that such switchouts occur in several types of wounds, and we now stand on the threshold of big and new conceptions in this field.

As soon as the nature of these switchouts is revealed, it will not be difficult for the physiologist to evolve appropriate methods of treatment. If pathological inhibition has developed in the nerve centres and in the synaptic apparatus particularly, it is necessary to act on the brain by applying excitation treatment in order to treat an injury of the extremity. Initial experiments have shown the mehod to be effective. At the hospital with which I am closely associated I have seen serious switchout disappear quickly in patients who had been bedridden for months.

Here I would like to say a few words about another of our developments.

The complexity of nerve injuries in the present war arises from the fact that they are caused in the main by mine fragments producing extensive tissue lacerations.

As a result the ends of the nerve frequently cannot be sewn together during the operation. We advocated a method which is now being applied in dozens of hospitals. It consists in introducing the nerves of a human being or a young animal, treated with the well-known mixture of formalin and vitamin B_1, between the ends of the injured nerve. After a certain time the nerve fibres grow together in this bridge, reach the organs and thus, gradually joining, restore the lost function.

To date about 300 such operations have been performed, Moreover, in many of the cases restoration of the functions may already be observed. At present the method is being thoroughly studied and further perfected at the State Central Neurosurgical Institure headed by Hero of Socialist Labor Academician N.M. Burdenko, Chief Surgeon of the Red Army Medical Service.

We have cited here only part of the practical results which followed our theoretical investigations. There can be no question that the linking of a tremendous theoretical material with clinical investigations of war wounds will help us build up new conceptions both in the understanding and in the treatment of injured nerves.

At present I have already completed a book on the transplantation of nerves which, it seems to me, in many ways should determine a rational treatment of this important practical problem. I am also preparing for publication in American journals a number of papers on the physiological mechanisms of nerve war wounds, which are to summarize investigation carried out by myself and my collaborators: Drs. Schumilina, Alexeyeva, Novikova and

others. These clinico-physiological investigations carried out on a large number of wounded men, establish new views on the mechanisms of nerve injureies, and I will be very happy if they prove useful to my American and British colleagues.
