

Nobel Prize in Medicine 1904



Ivan Petrovich Pavlov

The Nobel Prize in Physiology or Medicine 1904 was awarded to Ivan Pavlov "*in recognition of his work on the physiology of digestion, through which knowledge on vital aspects of the subject has been transformed and enlarged*".

RESEARCH INFORMATION:

The medical sciences are mutually interdependent. Progress in one field is often closely associated with development in others. The rise in one branch of science can often have its origin in a recently made analysis within another sphere, and yet it may appear at the first glance that the former is of outstanding importance while the latter is apparently of secondary value. It is not always *such* progress, as immediately are useful and of benefit, which should be considered as especially important; this character can also be attributed to those which are themselves less spectacular but form the basis for the others which are then only a further development of it.

The aim of science is the acquisition of knowledge, the value of which should not be measured by the ease with which it can be brought immediately into practical usefulness. Examples of this can be seen in various accounts of scientific developments which have given their originators a prominent place in the history of Medicine. One may point to

Vesalius and Harvey. When Vesalius, in spite of the personal risks to which he exposed himself, through his masterly researches opened the way to the study of human anatomy, he was impelled by his desire to carry the torch of science through the covering veil of prejudice and authoritarian belief. When Harvey through long years of investigations and deep study was able to prove the circulation of the blood, it was his thirst for truth which spurred him on in his work; to satisfy it was his reward.

The importance of the activities of these men for the whole of Medical Science must be estimated from the contributions they gave to the advancement of knowledge - from the view which thus became established in these sciences and has stimulated them to new and vigorous development. It would be a very unjust underestimation of them, if they were judged by the *immediate* value of their work.

The man, whose magnificent intentions established the Nobel Foundation was not unfamiliar with or averse to the aims and achievements of scientific research. This can be seen from the fact that his directions about the medical Nobel Prize linked it with physiology. The study by the physiological sciences of normal life processes and associated problems is in most cases of a purely scientific nature and however important the results of research may be in themselves, it is only exceptionally and in a roundabout way that they emerge into practical use. The questions of the investigator to Nature and the yearning which fires his desire are directed in the first instance to the gaining of new and deeper knowledge. Other factors also show that Nobel greatly appreciated investigators who were seeking knowledge for its own sake without considering other circumstances.

The medical Nobel Prize has this year been bestowed upon a man whose activity falls within the theoretical branches of the medical sciences, namely, the Professor in the Military Medical Academy of St. Petersburg, I. P. Pavlov, for his work on the physiology of digestion.

In the early days opinions on the course of digestion were speculations as to what was termed as «cooking» or «grinding» in the stomach etc. So long as the digestive processes could not be observed or investigated directly in the stomach no real knowledge

could be obtained. An accident turned physiological research in this field in a direction which has later become very important. In the 1820's a young man sustained a gunshot wound in the stomach and developed a gastric fistula which to some extent permitted the gastric processes to be studied. Observations were carried out on this man by the American physician W. Beaumont. This accidental path of investigation, allowing actual observation of processes taking place in the digestive tract, was later followed by many workers using animals. Technique is an important factor in such experiments and has been perfected in a masterly way by Pavlov, whose animals remain in good health, without any injury to the function of their digestive tract, permitting observation and systematic investigation over an almost unlimited period.

These methods for the study of the physiology of digestion established by Pavlov have been taken up by various physiological institutions, but above all much important work was performed in his own laboratory. From this has followed a far-reaching transformation of our knowledge in this field which has also been enriched by new fundamental facts.

The following may be mentioned as an illustration. The digestive canal can be influenced in various ways by the nervous system. When we remember that the nervous system can induce not only the secretory processes as well as the movements of various parts of the system, but also can bring such processes to a standstill, that it controls the blood supply to these organs and that sensory nerves arise from them, we can get an idea of the complexity one encounters. The complications become still greater when it is realised that we must take into account not only nervous pathways having their origin in the brain or the spinal cord, but also the sympathetic nervous system, and that we have further to pay attention to the interdependence between the different parts of the digestive system through the nerves, so that variations in the behaviour of one may affect that in other organs.

It is in the nature of things that cognition of the scope and character of the functional interdependence of the nervous system and the digestive organs is of great

importance to the knowledge of the physiology of these organs. It is also clear that one can only hope that answers to these complicated questions will advance step by step by much research. In this respect Pavlov has acquired very great merit. He has revealed new points of view and has fruitfully stimulated the solution of these problems, and through his methods has made it possible to reach conclusive analysis of them.

Before Pavlov, knowledge in this field was in many respects very imperfect. Pavlov has corrected earlier erroneous opinions which were held even with regard to the main points within this part of physiology. He has further enriched it with significant data.

The detailed description of digestive physiology, to which we are indebted to Pavlov lies outside the scope of this presentation. I can therefore not go deeper into what we owe him with regard to the physiology of the salivary glands, nor the clarification which he has provided of the motor functions of different parts of the intestinal tract, such as the stomach, gallbladder etc. Valuable though these investigations are, I must content myself with merely mentioning them here.

Nevertheless, I will briefly sketch his far-reaching work on the physiology of gastric secretion.

It is well known that ingested food undergoes chemical and physical alterations under the influence of the secretion from the mucous membrane lining the stomach. The secretion of the gastric juice and the recognition of its constituents is of great importance to the normal utilization of the foodstuffs. An elucidation of the circumstances which are significant in this respect therefore gives important information about the physiology, and thus also the pathology, of digestion.

Before Pavlov's work it was the general opinion that the gastric secretion was not influenced via the nerves connecting the stomach and the central nervous system. This conception has, however, been shown to be incorrect. Pavlov has demonstrated that the vagus nerve linking the brain with various thoracic and abdominal organs contains fibres which during their activity stimulate gastric secretion and others which have an exactly opposite effect. In this way the secretion of gastric juice is controlled by the central nervous

system and can be influenced from different parts of the body. It has also been found that by this means the gastric secretion is influenced by psychic impressions and impulses.

In this connection I will mention that Pavlov has enriched our knowledge of the significance and functions of this important nerve in other respects also. The vagus nerve paths are not, it appears, the only stimulators of gastric secretion. Pavlov has shown that it may also be influenced through the sympathetic nervous system.

Pavlov has also demonstrated another aspect of the functional association between the gastric mucous membrane and the nervous system, in the *specific excitability* of the mucous membrane itself. Before the work of Pavlov it was supposed that it could be brought into activity by almost anything within the stomach. Purely mechanical contact was considered to have this effect. Pavlov demonstrated, however, that this generally accepted view was incorrect. The reverse is true, the gastric mucous membrane having a sharply differentiated excitability for special substances with which it comes into contact. Thus there are relationships reminiscent of the specific excitability of the sense organs.

The eye is sensitive to light rays of such weak intensity that they do not exert any influence on other parts of the body. Similarly, the hearing organs are affected by vibrations in the air. Corresponding processes are observed in the other sense organs; they show a quite special sensitivity to certain unique stimulators.

It is now known, thanks to Pavlov, that a similar specific excitability is present in the mucous membrane lining the digestive tract, even though the subject is not conscious of it, and it acts by influencing the processes of secretion and of motility of the canal. This mucous membrane has in fact a unique faculty of being stimulated by certain substances present in the food or otherwise present in the digestive tract. Many other substances - among them some which in small amounts may exert a marked or even strong effect on the sense of taste or on the skin - have no or comparatively little stimulating action on secretion when they come into contact with the gastric mucosa. Still other substances exercise an inhibiting influence on the gastric secretion.

As another aspect of this specific sensitivity of the gastric mucous membrane one must consider the remarkable fact, demonstrated by Pavlov, that the amount of gastric secretion and its digestive strength show certain typical variations dependent upon the quality of the food taken.

I have so far only given a short survey of Pavlov's contributions to the knowledge of the physiology of gastric secretion and indicated a few other aspects of the physiology of the stomach about which he has enlightened us. His work also encompasses other digestive organs, in some of which he has found analogies with the stomach. In yet others he has observed differences between various organs. Also this work has been extremely important from several points of view but to delve more deeply would take us too far.

Pavlov's researches into the physiology of the digestive organs constitute a systematic series of experiments in order to shed light on this field from different angles. He thus seeks to investigate associated problems apart from those directly connected with the innervation of the digestive organs; problems related to the active constituents of the digestive fluids, thus questions of a purely chemical nature, have also been studied. Here Pavlov has given new points of view and impulses which constitute very valuable contributions to this field. Since, however, our knowledge of the substances concerned - the so-called ferments - is still wrapped in many respects in obscurity in spite of the careful work of many previous investigators, I will only quote *one* fact, first known through Pavlov's investigations. I refer to his extremely interesting observation that a certain ferment or more correctly a ferment-producing substance in the pancreatic juice acquires the qualities which permit its activity during digestion only after being influenced by another ferment which occurs in the intestinal juice.

In this we find a kind of chemical co-operation between various digestive organs. This combination has even more facets, and other forms of mutual organ-activity have been described by Pavlov. He has not only studied the isolated physiology of the different digestive organs but also the whole system which they constitute together. It can be said that the observations he has made converge to what he has called the «efficiency of the

work of the digestive tract», by which he means the organic correlations between its different parts. Through Pavlov's work we have obtained a much more extensive and clearer insight than our previous knowledge could give us. We have now a fairly comprehensive view of the influence which the activity of one portion of the digestive apparatus can exert on another; in other words how the wheels of the digestive mechanism fit together for the efficient use and advantage of the body.

If the mechanism becomes disordered, the situation can be changed, and such conditions falling within the field of pathology, have also been successfully studied by Pavlov by the methods introduced by him.

Already Pavlov's work on digestion has been found to be of great importance for the study of disease, and undoubtedly the progress made in physiological knowledge in this case as well as in others will lead to a transformation of the concept of diseases and their treatment. How great such a change will be remains so far uncertain. But this is on this occasion a question of secondary importance, for it is for his revolutionary and reorganizing work on the physiology of the digestive apparatus that the Staff of Professors of the Caroline Institute has conferred on Professor I.P. Pavlov this year's Nobel Prize in physiology or medicine.

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