Book Reviews

Textbook of Physiology. G. Y. Vladimirov, V. V. Delov, G. P. Konradi, and A. D. Slonim. K. M. Bykov, Ed. Translated by S. Belsky and D. Myshne. Foreign Languages Publishing House, Moscow, 1958. 763 pp. Illus. $10.

By Western criteria this is a poor text. Since a standard text usually reflects the state of development of a science, one might be tempted to make the same judgment of Soviet physiology. Yet, if the importance of a science can be measured by the degree of control it provides over natural phenomena, then there are two major physiological sciences in the world today. Medical physiology, particularly as developed in the West over the past three centuries, has provided the basis for profound control over physical pain and disease; Pavlovian physiology, over the past half century, has become an unprecedented tool for the systematic regulation of behavior. The one is familiar the world over; the other is so little known in the West that its appearance as an instrument in areas of political conflict has provoked an awareness of our own unjustifiable ignorance. It might be asserted that the effectiveness of Russian physiological (as the Russians view them) techniques derives more from their use in a particular sociopolitical setting than from any extraordinary intrinsic merit; yet it must be recognized that most Western scientists know very little about contemporary Soviet physiology, other than the stories of bizzare nerve grafts and heroic cardiovascular resuscitations reported in the popular press. We do not have the understanding and evaluation of the Russians' more solid experiments which are needed to ascertain precisely whence their overt successes spring.

The requisite basic information is now being provided by the systematic translation (initiated by the National Institutes of Health) of Soviet scientific journals. Unfortunately, most of the reports in current issues of these journals refer to earlier work not now available in English. Moreover, basic concepts and their attendant vocabulary are not explained, nor is there any explanation of the aims and methods of experimentation and analysis. These things are taken for granted, as they are in Western journals. Hence, much of the material now available is not intelligible in ways other than by direct comparison with Western data in those cases where the technical methods used were obviously similar, and the incorporation of these new data into Western thought depends on the existence of background information not adequately presented either in the Soviet journals or in our recent reviews. The appearance in English of a Soviet textbook of physiology provides much of this information, as well as some illuminating insights into the Soviet system as it is now being taught to future Russian physiologists.

It is immediately apparent from this text that the origins of both systems lay in 19th and early 20th century European physiology. References by name to the classic experiments of Müller, von Helmholtz, Bernard, Sherrington, Bayliss, Krogh, and others, are as frequent as references to the genuine accomplishments of numerous leading Russian physiologists. The same basic material presented in Western texts is presented here, and the sequence of chapters is strikingly similar: circulation, respiration, digestion, metabolism, excretion, endocrinology, and neurophysiology. There are copious illustrations and diagrams, excellent summaries for each section, and an adequate index. The major differences at this level are the virtual absence of bibliographic references other than to the *Complete Works* of Pavlov and a style in which adjectives such as *incorrect* and *erroneous* predominate over *improbable* and *alternative*.

The fundamental departure of the Pavlovian system (chronologically, this appears to have begun after 1920) is clearly stated in the introductory chapters. Whereas most Western texts begin with a description of cellular physiology, often as exemplified by the properties of blood, and then proceed to the cardiovascular system, the Soviet text begins with an authoritarian exposition of the Pavlovian concept of holistic physiology as the basis for behavioral analysis and then proceeds to circulation. At the outset, Western and Soviet students are presented with complementary views of living matter: on the one hand they are taught that events and processes seen in the separate organs must be related to the laws of physics and chemistry which they exemplify, and on the other hand they are taught that these same events must be related to their subordinate role in the intact, normal animal. Since both systems hold that the central nervous system elaborates behavior, it follows (in the Western view) that (i) all events in an organ are determined primarily by the physicochemical properties of their material substrates, and (ii) one cannot get a clear picture of what the nervous system is operating on unless one first "denervates" the organ under study; whereas in the Soviet view (i) virtually all observed regularities in organ function are the direct result of reflex control by the nervous system, and (ii) experiments on organs isolated from their nerve supply are misleading rather than informative.

An example is the Soviet handling of Starling's law of the heart, the familiar statement that the force of a contraction of the ventricular myocardium is proportional to the degree of ventricular filling by venous pressure preceding the contraction. In Western thought this property is regarded as fundamental to the coordination of cardiac output with venous return and within limits obtains without participation of the nervous system. Since the relationship is abolished by perfusion of the coronary arteries with solutions containing procaine, the Soviet view holds that this property is a neural phenomenon, that it is subordinate to nervous control by autonomic fibers present always in the "natural" state, and that it is at best a subsidiary mechanism and at worst an epiphenomenon. In this view, cardiac output is reflexly regulated by stretch receptors in the great veins which are activated

by changes in venous pressure, acting principally through changes in heart rate.

There are genuine weaknesses in the Western point of view: "denervation" does not necessarily remove all neural tissue from the myocardium or its surrounding connective tissue; and there is, as yet, no firm biochemical explanation of the basis for the relationship between initial length and developed tension. But these are not the basis for the Soviet rejection; rather it is the general postulate that neural control is omnipresent. The weakness of their view lies in the lack of clear comprehension of the physical dynamics of the circulation. The relationship between pressure and volume and the elasticity of the arterial reservoir is nowhere clearly defined. The concept of peripheral resistance as a viscous force (Starling's major contribution in this area) is not mentioned; arteriolar resistance is ascribed to the high rate of blood flow in these vessels—thus thoroughly confusing resistance with perfusion pressure gradient (page 109) —or described with Sechenov's dictum that the arterioles are the "taps of the vascular system"—thus leaving it to the nervous system to turn the handles in response to appropriate stimuli (page 149).

Since Soviet physiology grew up in the context of the behavioral rather than the medical sciences, there is a striking emphasis on the application of measurements of the various organ systems as indices of activity of the nervous system but relatively little discussion of medical applications. As a result those two systems (the gastrointestinal and the circulatory) best suited to behavioral correlation are most adequately covered (perhaps by historical accident, since they were also the two fields of major research by Pavlov). The descriptions of the lung, the kidney, and the endocrine glands are grossly out of date. Inaccuracies are common —the roles of renin and hypertensin, for example, are reversed; the adrenal cortical hormones are given half a page; thyroxin is discussed without reference to intermediary metabolism; water and electrolyte metabolism is presented in conjunction with vitamins and trace minerals rather than with clinical disorders of fluid balance.

In view of the emphasis placed on the contribution of the brain to the function of these several systems, it is remarkable to find the sections on nerves, the brain, and the sense organs in their traditional place at the end of the text. Here there is presented a clear, well-organized description of nervous function as determined by means of the conditioned reflex technique. As in the preceding sections, the elemental organization and content are similar to those used in Western texts, with one major exception—much of the behavioral data is omitted by Western physiology texts and, instead, is found in psychology texts, but the analysis and interpretation proceed along different lines.

Because of their emphasis on the function of the intact, normal animal, the Russians subdivide the brain into a series of longitudinal columns, the motor and sensory "analyzers," rather than into the series of hierarchical segments that form the basis of the Western view. The term *analyzer* includes not only the sensory or motor organ, but also the fiber paths, intervening nuclei, and cortices upon or from which each organ projects; the term *center* does not mean a locus in the brain, but a functional set of structures irrespective of shape or location (page 525). Scant discussion is afforded the properties of spinal, decerebrate, thalamic, and decorticate preparations, apart from emphasis on the common deficits resulting from loss of the cortex. As a result there is no clear picture of how these preparations differ from one another, or of the subcortical mechanisms with which the cortex is operating. By Western standards, discussions of the function and properties of the brain are grossly curtailed in the following areas: the cerebellum; the reticular formation; the tegmental, thalamic, and hypothalamic nuclei; the corpora striata; the rhinencephalic and limbic structures. Closely allied to these elisions is a lack of concern with neuroanatomy. In order to follow the Pavlovian description of brain function, one need only know that the basal ganglia lie between the sensory receptors and the cerebral cortex. No serious attempt is made to describe the cell types or patterns of organization, even in such critical structures (for the Russians) as the neocortex.

My listing these omissions should not be construed as adverse criticism, for above all, the text is comprehensible and achieves its express purpose: to impart an understanding of the Pavlovian view. In this sense, the book might serve as a model of simplicity in handling a complex subject. However, the text can and should be criticized for failing to make clear the shortcomings and inconsistencies which inevitably accrue to such a one-sided, conceptual development. As in the preceding sections, most of the difficulties can be traced to the lack of a serious attempt to base physiology in physics and chemistry rather than in Pavlovian doctrine.

The salient example of this can be found in the treatment of central inhibition, a concept which must lie at the core of any systematic discussion of neurophysiology. The Russian interpretation is based on the phenomenon of Wedensky's block. Sustained or repetitive stimulation of a peripheral motor nerve, by whatever means, leads to a stable, nonpropagated, nonfluctuating state of excitation (called "parabiosis") in the nerve along with submaximal muscular tetanus. In this parabiotic state additional stimuli are found to cause a paradoxical decrease in the force of muscular contraction ("block"), whereas reduction of the intensity or frequency of the sustained stimulus will cause an increase. These paradoxical reactions have been adopted as the basis for the concept of inhibition, which is therefore a suppression (literally a braking) of an excitatory process by superadded excitation (page 544). This block is not regarded as a form of fatigue, but as the result of an incompatibility between the rate of stimulation and the natural cycles of excitability of the structures being stimulated. Every excitatory process carries in it the potentiality of being inhibited by further intensification. This has been elaborated and broadly applied to interpretation of the cortical contribution to the conditional reflex. For example, the suppression of an alimentory, conditioned reflex by an irrelevant stimulus is ascribed to the superposition of the additional stimulation on the sustained excitatory state induced by the conditioning situation. Satiation is ascribed to the development of a parabiotic state due to the prolonged stimulation of feeding, such that further alimentary stimuli produce a reduction rather than an increase in response. Sleep is attributed to the "irradiation" (one of many specialized terms defined in this text) of sustained, hence potentially inhibitory, stimuli over the cerebral cortex, especially when unopposed by excitatory stimuli (for example, unexpected events evoking the orienting or what-is-it reflex), and specifically not to a periodic rise in the activity level of a diencephalic nucleus or sleep center.

In contrast, one Western view of inhibition (stemming largely from Sherrington's work) is based on the hypothesis that two types of nerves or synaptic terminals abut on the somata of motoneurons (or other central neurons) with diametrically opposed effects. Direct evidence for this has been found in the form of electrical recordings from microelectrodes placed in single motoneurons. Excitation has been found to cause a nonpropagated reduction in transmembrane potential ("depolarization") which, if sufficient, initiates a propagated spike, whereas inhibition causes an increase ("hyperpolarization"). Wedensky's block has been associated with a stable reduction in membrane potential resulting from prolonged stimulation, injury, anoxia and so forth, accompanied by both a lowered threshold of activation and a lower margin of safety for spike initiation (since reduction of membrane potential below a critical level will prevent propagated spikes from occurring at all). It is generally regarded as a type of fatigue. These concepts have been elaborated in a variety of conditions and preparations, both vertebrate and invertebrate, leading to the accumulation of a large body of physicochemical data in their support. None of these data are described or even mentioned (page 553). The long discredited Bernstein hypothesis of membrane potential is briefly discussed (page 508) with the valid reservation that semipermeable membranes have not been adequately demonstrated to exist in cells; in other respects, the treatment of electrophysiology is about 25 years out of date.

Pavlov achieved considerable success in describing operational types of inhibition (for example, extinction, differentiation, and delay) as well as stages in the inhibitory process—that is, the "equalization," "paradoxical," and "transmarginal" phases—but his followers seem to be unable clearly to distinguish these types from fatigue (page 554) or from each other: "Not every manifestation in the cerebral cortex can be regarded as transmarginal inhibition, otherwise each extinguished or differentiated stimulus, because of its nonreinforcement, would have to be considered as exceeding the strength limit. . . . But this in no way means that the various cases of inhibition differ in nature and that transmarginal inhibition is a very special state. Pavlov was inclined to regard all cases of inhibition, in their essence, as manifestations of a single process inseparably connected with the process of excitation" (page 638). Inhibition is conceived in some cases as "protecting" nerve cells from fatigue, an unusual instance of introjection of a value term, but one used by Pavlov and, hence, sanctioned.

In view of these multiple omissions, one may well ask wherein the undoubted effectiveness of such a limited system might lie. The answer seems to be that the conditioned reflex technique is a means of precise description and prediction rather than of understanding. It is a symbolic language used to describe behavioral patterns without recourse to theory. On the one hand it does not lead to the joining of physiology with physics and chemistry, which ultimately must afford the basis for explanation. On the other hand it does not require the use of tenuous behavioral concepts such as motivation, reward, punishment, emotion, or memory in order to describe complex patterns of somatic and visceral activity. These and related concepts have alienated many physiologists and have contributed to the present schism between Western physiology and psychology, although they have been productive in the laboratories of those wise enough to use them carefully, and doubtless some day will constitute a valid premiss in the argument between objective and subjective experience.

The roots of this over-simplification would seem to lie in the naive epistemology Pavlov bequeathed to his collaborators, which, apparently, has not been altered in any way in the 24 years since his death. The study of physiology involves the attempt to answer the question about an organ, "How does it work?" To a Soviet physiologist this appears to mean, "What is the observed correlation (law) of events?"; whereas to his Western counterpart it more often means, "What is the major premiss (law) by means of which one event can be said to follow logically from another?" For example, if asked, "How are the eyes moved in nystagmus?," a Western physiologist might attempt to describe a putative imbalance between the vestibular, cerebellar, and oculomotor nuclei, whereas the Russian answer appears to be simply "back and forth" (page 696). Each answer has its virtues. The persistent application of the notion of causality in a simple pragmatic sense has permitted the Russians to amass a vast and consistent literature emphasizing the correlations of input with output of the body. The Cartesian mechanistic approach in the West has produced an equally vast literature emphasizing the effects of direct manipulation of the brain (stimulation, ablation, and application of drugs), marked as much by its variety and flexibility as by its uncertainty and confusion. Essentially, we have not found the physicochemical principles of neural activity, whereas the Russians have not seriously sought them. However, the current 7-year plan for physiology as presented in a recent editorial by D. A. Biriukov in the *Sechenov Physiological Journal of the USSR* calls for precisely this goal. Moreover, this text does not adequately reflect the exceptional vigor and technical competence displayed by Soviet neurophysiologists in their recent publications. Their work will merit careful appraisal in coming years, and this text provides an essential basis for that study.

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The Rites of Passage. Arnold van Gennep. Translated by Monika Vizedom and Gabrielle L. Caffee. University of Chicago Press, Chicago, Ill., 1960. 198 pp. $4.50.

Although van Gennep, one of the original group of Durkheimian sociologists, lived until 1957, this book, originally published in 1908 but not previously translated into English, is the sole basis for his considerable international reputation as a theorist in the field of comparative religion.

Van Gennep saw the life of any individual in society as being marked by a series of transitions from one social status to another: from youth, to maturity, to old age; from single to married; from childlessness to motherhood; from life to death, and so forth. And for each of these events there are, in all societies, special ceremonies whose function it is to enable the individual to pass successfully from the status he is leaving to the one he is attaining.

Such rites of passage—birth ceremonies, marriages, initiations, funerals, rituals of arrival and departure—can, in turn, all be analyzed in terms of their three major subphases: rites of separation, symbolizing abandonment of the old status; rites of transition, symbolizing an interregnum, "social death" period during which the individual is