

OVERVIEW OF BIOLOGICAL CONTRIBUTIONS
MADE AT THE XVIII TH INTERNATIONAL CONGRESS
OF PSYCHOLOGY

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Professors Leontiev, Luria, friends and comrades This has indeed been a historic Congress. I believe that future generations will look back on this occasion to state that here in Moscow we witnessed the emergence of psychology as a complete experimental science. I say this not only because of the full representation of the biological with the social, developmental and individual branches of psychology, though, of course, this attention to the physiological aspects of our endeavor is especially welcome to me. No, I am referring to another matter: In the recent past, the historical development of our science has shown three important faces. The first of these was behaviorism, the second cybernetics and the third, just beginning, I shall call the true emergence of psychology.

The biological contributions made at this Congress fall within all three of these categories. Behaviorism, based on the linear relationship between stimulus and response and their association emphasizes the distinction between variables inside and outside the organism. During the ascendancy of behaviorism physiological psychology was essentially concerned with the neurology and endocrinology of drive, with sensory processes and with the mechanisms of conditional association. This Congress has not been lacking in contributions which stem from problems viewed behavioristically. Professor Neal M. Miller last night presented to us a series of impressive experiments which established beyond reasonable doubt the fact that visceral functions can be controlled through the techniques of instrumental conditioning. Others at this Congress expressed the same views: Professor Asratyan, for example, reviewed the Soviet experiments which

point to this conclusion. The two factor theory of learning based on the idea that there are two physiological mechanisms, one subject to the rules of classical or Pavlovian conditioning, and the other subject to the rules of instrumental conditioning, becomes untenable in the light of this evidence. Yet the problem to which the two factor theory is addressed remains with us: viz that some forms of maladaptive response, once acquired, are peculiarly resistant to being got rid of. Professor Konorski made a contribution which may shed light on this problem once it is stripped to its essentials: he emphasizes the motor act performed in the conditioning situation though he still thinks of this as a purely elicited response.

My point is that action may determine situation, and in that sense, alter the variables involved in the psychological process—such change can not be produced by the activity of the viscera. This view is essentially that proposed by Professor Gregory Kimble who had the audacity (for a behaviorist) to use the term «voluntary» to describe some forms of action. Welcome, Professor Kimble to the current whole psychology. It is clear that many contributors to this Congress are beginning to view responses as the environmental aspects of action (as distinguished from movement). An action oriented psychology is, of course, one of the important legacies behaviorism can bestow.

Drive processes received their share of attention. Modern techniques of chemical stimulation of brain structures and the analysis of endocrine mechanisms have extended the frontiers of physiological work. But perhaps the most interesting aspect of this work for psychology was *not* presented at this conference. An old paradox has recently been resolved. The paradox was that certain hypothalamic lesions made animals eat more though they would work less for food. This dissociation of measures of drive is not uncommon when brain lesioned subjects are examined. The resolution of the paradox rests on experiments performed by Professor Grossman which show that the dissociation could be accounted for when the «affect» of the organism is taken into account. In this connection—Professor Teuber at this Congress related a case history of a man with an object floating in the midline ventricular system of his brain which would alter mood depending on where the object lodged at the moment. The importance of hypothalamic and other

midline brain stem structures in the determination of man's predispositions is thus becoming amply documented—further, the sensitivity of these areas of the brain to biochemical agents such as the catecholamines is one of the chapters of current physiological work in psychology which was but touched upon in this Congress. Through these experiments the concept of direct drive thus becomes that of predisposition—predisposition determined by neurochemical regulators and sensitive to the context in which it is displayed.

I turn now to the second main current which distinguishes today's psychology. Cybernetics, the science of communication and control has contributed immensely in the immediate past. The concepts of information measurement and of feedback are basic to this approach. Biologists have been concerned with the process of homeostasis and with the systems of transformation on the input which allow an estimate of the determinants of organisms' channel capacity. Psychologists have been busy delineating mechanisms which filter and select from the input and so narrow the alternatives from which choice is made. Professor Anokhin reviewed neurophysiological contributions which rest on this approach for this meeting, and my own work and views presented in a variety of publications including the book on «Plans and the Structure of Behavior» written in collaboration with Professors George Miller and Eugene Galanter are well known to this audience. The basic physiological fact that the architecture of the reflex is not an S-R arc but a servo, a «homeostat» feedback loop is well established. The hierarchical arrangement of such servos into plans or programs which can process information and the similarity between information processing by man and computer have by now been thoroughly explored. My own research during the past decade has attempted to uncover the neural mechanisms involved in the operations of these programs and the results of these experiments have shown some important distinctions to exist between brain and the computers now available. These distinctions lead me to the third and by far the most exciting contributions to this Congress.

Beginning with Professor Leontiev's keynote address on «reflection», the Zeitgeist of this Congress has admitted to a true psychological psychology. The objective analysis of subjectivity and of memory have held the stage. Attention and Attitude, Set and Response bias have been some of the

watchwords of the Congress. On the biological side, my own studies just referred to above, have shown that the input to the organism—even his receptor activity—is under corticofugal control and that this control emanated from the so-called association areas of the brain. This efferent control of input is not just a feedback—rather it is a feedforward, pre-setting the receptor mechanism to allow some inputs to become stimuli and others to be ignored. This feedforward is not a serial but a parallel processing device as is much of the apparatus involved in recognition. Professor Teuber also gave evidence for the occurrence of a corollary discharge which he has emphasized to account for the Helmholtz effect (viz that active and passive movements of sense organs produce different perceptions). Professors Grey Walter and Lindsley both showed data on a negative variation in cerebral potential which occurs during the anticipatory phase of problem solving. Such D. C. changes in potential are known to influence synaptic mechanisms and have also been shown to affect the rate of learning.

The very substrate of learning itself—the memory mechanism—is yielding to research. Professor McGaugh has shown that learning is speeded by injections of strychnine and related compounds even when the injection is made shortly after a learning experience. Experience can be chemically extracted from one organism and transferred to another if the reports of Professors McConnell and Jacobsen at this Congress continue to be confirmed. The responsible substances are RNA or the polypeptides and proteins induced by RNA which according to these researches turns out to be a critical substance not only for the genetic but also for psychological memory.

In addition to this and other biochemical contributions, actual growth of cerebral cortex has been demonstrated to occur as a result of experience by Professors Rosenzweig, Krech and their group of investigators. Truly neuropsychology has come of age and with this maturity psychology itself rests more secure. Cognitive processes are reliably based in demonstrable «neuronal models» established through the habituation of orienting reactions—demonstrations in Professors Luria's, Sokolov's, Lindsley's and my own laboratories at a macro and even micro-electrode level. Controversy now centers on whether these processes of expectancy are based on neuronal self-inhibition or whether late-

ral inhibition and post-tetanic potentiation are involved—a far cry from the only too recent challenge of S-R behaviorism that cognitions were but empty confabulations of the soft-headed among us.

In conclusion, let me suggest that a major lesson of this Congress is that the very presence of an active biological and especially neurological psychology makes possible the healthy wholeness of psychology which so characterizes this international gathering. The study of brain mechanism gives an independent entry into sets of variables which are not readily and directly obtained from study of the organism's behavior and environment. These neural variables are the ones that allow binding and even the reversing of time—thus allowing learning to be extrapolated into anticipation—and experience to become creation.
