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NEUROPSYCHIATRY AND NEUROPSYCHOLOGY[1]

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I. INTRODUCTION

A century ago, psychiatry and neurology shared a common scientific base. Thus the term neuropsychiatry accurately described a field of endeavor dedicated to the diagnosis and treatment of psychological illnesses that were assumed to reflect disorders of the nervous system. Two developments, more than any others, served to separate psychiatry from these early assumptions. The first of these has been the recognition that the study of behavior, verbal and nonverbal, provides powerful insights into the processes that psychiatrists encounter independent of any knowledge of neural function. In addition, behavioral techniques for modifying these processes were developed, again with no reference to the functions of the nervous system.

Second, the rapid and fruitful development of the social sciences, the study of interbehavioral processes, turned psychiatry away from its early involvement with neurology. A large number of psychopathologies could be understood in terms of the relationships with parents and peers, with family and culture, which engaged the disturbed individual. Knowledge of neurology became as irrelevant as knowledge of computer hardware is for the average programmer versed in high-level languages.

What then remains of neuropsychiatry? Is there a domain where an intimate knowledge of brain function is still relevant to the concerns of the practitioner in psychological and behavioral disorders? I believe there is, and, reverting to the analogy with computer sciences used above, the role of the neuropsychiatrist becomes obvious. Someone must be able to work with machine language, to construct the compilers, assemblers and systems programs that fit the higher level language programs for use with particular computers. I am not speaking here of the hardware specialist who constructs the computers per se. Nor do I identify the neuropsychiatrist with the neurophysiologist, neuropharmacologist, or even the psychopharmacologist. I believe there is a place in today's practice for a group of physicians, diagnosticians, and therapists equally at home in these fields and the behavioral sciences who can help match the patient's behavioral and interbehavioral activities to his particular constitution.

Surprisingly, such a group of practitioners does not exist today. Psychiatry and its younger sibling, clinical psychology, have become fragmented into disciplines, technique-bound enclaves that have all but eschewed any effort at differential diagnosis and thus an attempt at making the therapy fit the individual's disturbances. Today's patient must make such a diagnostic himself by shopping among available technicians until he finds one suitable to his constitutional needs. When the professionals are confronted with this state of affairs, their retort is almost al-

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ways: there is not enough known at the other levels to be integrated with ours.

I want to propose that over the past quarter of the century, this argument, although tenable, has become obsolete. The fantastic growth of knowledge at every level since World War II begs to be integrated in the service of the patient. Neuropsychology, which to date has restricted its interest to clinical neurology, can provide such integration and neuropsychiatry the service. The time is ripe for the establishment of groups of clinically oriented scientists and practitioners versed in the machine language that can tie the many substantial advances in the behavioral sciences to the constitutional needs of the individual patient.

II. FREUD'S "PROJECT FOR A SCIENTIFIC PSYCHOLOGY"

In order to implement this proposal, Merton Gill and I undertook a reexamination of the roots of psychoanalytic theory that has provided one of the richest sources of organized knowledge upon which current psychiatric therapy of whatever persuasion is in part based. With others (e.g., George Klein and Robert Holt) we discerned many contemporary conceptual difficulties that became amenable to analysis once we distinguished between two types of theoretical statements: those based on the observation of the verbal and nonverbal behavior of patients in clinical settings and those that refer to mechanisms. Furthermore, we became convinced that a good deal of the contemporary confusion could be traced to the statements about mechanism. When we traced these to their roots in Freud's "Project for a Scientific Psychology," we discovered operational definitions of these terms and that the defining operations were neuropsychological. In short, we found that those portions of psychoanalytic theory that were concerned with mechanism actually constituted a detailed neuropsychological theory that could be tested against current neurobiological and experimental psychological knowledge. Since much of the psychological part of the theory concerned cognitive and control processes, contemporary cognitive and control theory proved to be relevant.

The results of our inquiry will presently appear in book form (Pribram and Gill, 1976) and it may be useful to summarize the contents briefly for the audience of the present volume, if for no other reason than to pique interest. But, of course, the issue is the larger one I have been discussing: the foundation of a disciplined neuropsychiatry and the enlarging of the scope of neuropsychology to encompass the neurobiological aspects of disturbed control and cognitive processes.

III. THE REGULATORY PRINCIPLES

Our discussion begins with an analysis of what are called the regulatory principles in psychoanalysis. These principles presumably determine the control of behavior, and we therefore examine them in the light of contemporary control theory. Central to the operation of the control of behavior are such concepts as energy, work, effort, and the signals that serve the mechanism by which controls become operative. We found that Freud's Project unequivocally defines energy as biochemical and neurochemical and the controlling signals as neuroelectric. Thus, when given neurological definitions, energy concepts, such as cathexis, that pervade psychoanalytic theory, become divested of their mystery.

We found further that many specific neural and behavioral servomechanisms (negative feedback) and positive feedback processes are described. These regulate the reinforcement of behavior and the effort that must be expended in order to maintain the organism's control and equilibrium in the face of life's exigencies. Neuroelectric energy comes in two forms: (1) action currents, translated as currents-in-flow (as measured by rapid deflections of a galvanometer), i.e., nerve impulses, and (2) occupying potentials, translated as *cathexes* (as measured by slow drifts of the galvanometer needle), which today we attribute to local, nontransmitted, graded potential changes. That such a sophisticated view of neural function could be attained in 1895 when the Project was

written, initially surprised us, but on tracing its history we found it commonplace in Viennese neurology of that time (e.g., Exner, 1894).

IV. ENERGY CONCEPTS, PRIMARY AND SECONDARY PROCESSES

In the light of these statements in the Project, we suggest that it is premature to abandon energy concepts in the behavioral sciences—provided these concepts are used as they are in physics, to describe differences in the state of systems under observation. In the case of behaving biological systems, these states are biochemical and neurochemical, so any reference to the control of energy in the behavioral sciences must be anchored in the biology of the organisms comprising the systems.

Specific examples concern the operation of physiological drives. Freud's Project defines a set of chemical processes that involve neural sensitivities and "key" secretory neurons. When these processes become organized into a positive feedback loop, the resultant is called "the generation of unpleasure." In later writings, this term is used as shorthand—would it not be better in the light of present knowledge to begin to unpack the "unpleasure" circuit into its serotonergic and catecholaminergic components among others, in order to provide better comprehension of feelings of depression and elation, of lassitude and great motivation?

A distinction that arises early in the Project is the difference between primary and secondary processes of control. Freud bases the distinction on the difference between total neural discharge and more complexly organized functions of the nervous system engendered by the fact that when one neuron in a matrix discharges onto another, that neuron in turn discharges, and so on. In any network of neurons, therefore, some sort of organization develops that delays or even prevents complete discharge of the entire system.

We wondered whether the contemporary view of the nervous system as an information processing mechanism might be relevant to the description in the Project of secondary processes and found that in fact the concepts in the Project in may instances are decidedly richer than contemporary ideas. Thus the Project distinguishes sharply between primary processes characterized by discharge (such as the biochemical generation of unpleasure already mentioned, the occurrence of impulsive behavior, and the relatively unstructured association among neuroelectric events) and cognitive processes that are well organized by a variety of mechanisms that are spelled out in amazing detail.

These considerations led to a reexamination of information measurement theory itself with the consequence that information processing and error processing were distinguished. Error processing results when the familiar closed-loop feedback, servomechanism is operative. By contrast information processing occurs largely by way of feedforward, open-loop mechanisms as when computer programs run themselves off to completion. Most biological (and computer) systems combine feedbacks and feedforwards but the distinction can be most useful (see, e.g., McFarland, 1971; Pribram, 1971).

V. SOME DEFINITIONS OF PRIMARY PROCESSES

As already noted, much of the Project is concerned with neurobiological mechanisms. The following glossary gives a taste of the rich definitional matrix that makes these psychoanalytic concepts understandable—and therefore approachable and testable—to the biologists.

We have already met the definition of *unpleasure* as a biochemical circuit involving neural sensitivities and key secretory neurons. The triggering of this circuit is *defended* against by an inherent high threshold that routes nerve impulses in other directions with a multiply interconnected part of the brain—the primary brain—called ψ. This part of the brain is distinguished from cortex and from the sensorimotor systems. Therefore ψ refers to the basal, core regions of the brain and includes a nuclear portion, most likely the mesencephalic and diencephalic areas, which contain the neural elements sensi-

tive to and secretory of biochemical substances.

Defenses are initially primary, in that the routing of nerve impulses, called current-in-flow, through ψ leads to muscular discharge and behavior. Thus the baby cries, flails about when stimulation from inside his body or from outside exceeds a certain amount. However, in the presence of a caretaking person, more specific interactions occur. The caretaking person knows how to relieve the excessive stimulation (e.g., by feeding the baby). Thus certain interactions between internal and external stimulation take place, mediated by the infant's own behavior and terminated satisfactorily by the offices of a caretaking person. (The passages in the Project that describe this process could as well have been written by Sullivan as by Freud.)

Repetition of this sequence of events (that constitute defense) lays down a memory trace in ψ. This occurs because synaptic resistances are *facilitated* by use. An important insight is now attained. Facilitated pathways in the nervous system guide behavior. Therefore, each memory trace also serves as part of the motive structure that directs behavior. The Project proposes a neural memory based theory of motivation that gives internal stimulation (drive—usually translated as instinctual drive) an important but limited role. External stimulation can trigger the memory-motive structure (e.g., as when pain produces unpleasure). Perhaps more important, the composition of this memory-motive structure is seen to have three sources: drives, feedback from the organism's own muscular efforts, and the crucial presence of the caretaking person.

Thus the psychoanalytic concepts of a drive based *id* and a societal based *superego* are seen as equally primitive in the make-up of the defensive memory-motive structure which comes to be defined as a *wish*. For the most part, wishes become aroused by drive stimuli that accrue gradually. When an external event triggers the memory-motive structure, the sequence of events is usually more abrupt, leading to sudden neural discharge which is called *affect*. Affect is neither pleasant nor unpleasant but may have pleasurable consequences (lasting discharge) or lead to unpleasure (the biochemical positive feedback).

VI. COGNITIVE SECONDARY PROCESSES

So far we have encountered only primary processes. Note, however, that these primary processes already have considerable structure. For the most part, however, the structure is closed-loop feedback or else leads rather quickly to indiscriminant discharge. To prevent this, Freud invokes an executive neural process that inhibits and delays discharge. In the Project this mechanism depends on developing neural pathways lateral to the main paths of facilitated conduction. Neural inhibition had not as yet been discovered, nor had the inhibitory functions of the frontal and limbic forebrains been detailed (see Skinner and Lindsley, 1973; Saureland and Clemente, 1973; and Pribram, 1973).

In the Project these executive processes that manage the memory-motive mechanism are called *ego* functions. The formation of the ego depends on another mechanism that involves *attention*, *judgment*, and *reality testing*. Whereas memory-motive and ego process describe neural mechanisms that ordinarily operate without awareness, attention and reality testing involve the cerebral cortex which is assumed to be the locus of perception and consciousness.

The Project distinguishes between quantitative energy concepts and the qualitative concepts of perception such as color, melody, and harmony. This distinction rests on a difference in the neural mechanisms involved as does every definition in the Project. In this case the configuration and connectivity of the ψ system that organizes the quantitative concepts as we have thus far described them is contrasted with the organization of the sensorimotor projection systems called ϕ. The ψ systems, as we noted, are composed of networks of short fine-fibered neurons with many branches. By contrast the ϕ systems are made up of long parallel fiber tracts containing few synapses. Furthermore

these ϕ systems are directly connected with the sensory receptors and thus subject from birth to much excitation. This operates to lower the synaptic resistance in the few synapses that are present until, very shortly, there is practically no resistance in the ϕ paths of conduction. The ϕ system is then able to transmit the patterns, the periodicities, the frequency patterns of excitation originating in the receptors. Thus sensory quality is a function of the undistorted transmission of frequency patterns that occur in the cortex at the terminals of the ϕ system. To appreciate the contemporary ring of this proposal, compare it with those of Lashley (1942), Hebb (1949), and Pribram (1971). When one realizes that only a century earlier, perceptual and intellectual functions were localized in the spirits of the brain's ventricular system, the advance in neuropsychological conceptions portrayed in the Project is doubly striking.

But this is not all. Perception is not simply achieved. The Project details a match-mismatch mechanism organized in the cerebral cortex that must be activated in order for perception to occur. The activation, called primary attention, originates in the ψ system from the memory-motive structure, the wish, and produces a pattern of lowered threshold in the cortex. When an input from the ϕ system matches this threshold, a report of the match is fed back to the ψ system, which then in turn produces, by way of secondary attention, perceptual images or images of action in the cortex. Thus a double feedback, the mechanism of attention, is necessary for the activation of perception and/or action. When a mismatch results, one of two other possible mechanisms becomes activated. Either the organism moves so as to change the input to ϕ – this is called *reality testing* – or he alters his wishes to conform with the ϕ input, a process called *judgment*. Repetition of the judgmental and reality testing processes until match is produced is called the cognitive or secondary process and requires the delay mechanism, the inhibition produced by ego processes. When the cognitive process leads to action that produces prolonged satisfaction, i.e., appropriate discharge, the action is called specific or *willed*. Thus *will* or *intention* is a secondary process to be distinguished from wish, the primary memory-motive process that operates in the absence of inhibition by ego mechanisms.

Cognitive processes make up thoughts that can be actualized not only by activities of the larger muscle of the body, but by speech. This thought and speech can, under the appropriate circumstances, provide implicit acts, tests of reality which have lesser consequences in the expenditure of effort (work, energy) than would the action itself. This conservation of effort is made the basis of psychoanalytic therapy where the consequences of acting out and working through occur in a controlled situation and can therefore be attempted with safety, that is without the total disruption of his cognitive processes, the expenditure of his defenses that would leave the patient at the mercy of his biochemical positive feedback, the accruing spiral of unpleasure.

VII. RELEVANCE TO NEUROPSYCHIATRY

Such total expenditure of defenses occurs only in psychosis. But more organized primary processes become manifest in other situations. Thus during sleep, the cognitive process based on a functioning ego is temporarily out of commission so that primary associations among memory-motive structures occur. Dreams represent therefore the operations of wishes in the absence of attention, perception, and reality testing. Reports of dreams can therefore be used to investigate a person's wishes.

Wishes, i.e., memory-motive mechanisms, can also become manifest when the organism has developed inappropriate cognitive processes. The impropriety leads to perceptions and actions that do not match the wish, yet the wishes fail to become modified perhaps because they have become overly entrenched through previous experience. Cognitive controls, ego functions, must therefore become excessive in order to prevent their breakdown – the total expenditure of defenses. The resulting

conflict between cognitive controls and frustrated unmodified wishes leads to repression, the failure of the memory-motive structure to contribute its share to the patterns of lowered threshold in the cortex. This type of conflicting primary-secondary process functioning is called *compromise formation* and is seen in *neurosis*. It is to such problems that psychoanalytic therapy with its thought and talk in controlled situations is addressed.

To conclude, this brief summary of the Project does not of course do it justice. The reader cannot for himself gauge the accuracy of my interpretation without reference to quotations from the Project. Those interested can find such quotations (Pribram and Gill, 1976; Strachey, 1966).

Why should anyone today be so concerned with a document published in 1895, three quarters of a century and more ago? I believe as stated in the introductory remarks of this chapter that the time is ripe for a neuropsychologically based neuropsychiatry. This proposal does not envision a primary process eclecticism but a cognitive effort that leads to specific actions after adequate reality testing has taken place. Neuropsychiatry thus conceived should be able to furnish a diagnostic based on psychoanalytic cognitive and control theory as set forth in the Project and continuously brought up to date in minute detail. This diagnostic should determine whether pharmacologic, analytic, or social group therapy, or some combination is indicated.

Neuropsychology and neuropsychiatry so conceived ought to heal the schisms, the disciplinary encapsulations within psychiatry and clinical psychology that now make it mandatory for the patient himself to choose his own therapeutics. The Project, by furnishing a Rosetta stone that allows operational neuropsychological definitions of so many of the concepts that have guided psychosocial psychiatry, can help bridge the gap between organicists and behaviorists, between biological psychiatrists and analysts, between neurologists and cognitive experimental psychologists, between psychopharmacologists and social therapists. The Project has been in the public domain for a quarter of a century and as yet has found little perusal even in psychoanalytic institutes. Obviously its time had not yet come, probably because neuropsychological and neurobiological data had not yet matched its early insights. This is no longer true. The time appears now to be ripe for renewed study of data that integrate brain function, experience, and behavior with a practical therapeutic purpose. The suggestion of this chapter is that such study will be enriched by reference to the Project which constitutes a useful "Preface to Contemporary Cognitive Theory and Neuropsychology."

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