ABNORMALITIES OF BEHAVIOR

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The two previous reviews of abnormalities of behavior were organized in strikingly different ways. Cameron (11) organized the data under the following topics: etiology; learning; induced behavior patterns; stress; frustration; anxiety; language and thinking; and fantasy, hallucination, and delusion. Taub (59), on the other hand, after introducing the chapter by a review of general progress in psychodynamics, followed the more conservative pattern of subdividing the field into broad diagnostic categories: psychosomatics; conduct disorders; psychotic disorders; psychoneuroses; mental defect and epilepsy; and organic brain disorders. These two reviews, covering the same field from two angles, have made it unnecessary for the present reviewer to make the exhaustive coverage of the field that his predecessors made, since progress in abnormal psychology is not made equally rapidly in all directions. The present review will, therefore, deal with the four outstanding currents in the field of abnormality of behavior of the last year (January, 1950 to April, 1951). These are: (a) behavioral accompaniments of therapeutic and experimental alterations in brain structure and function (psychosurgery for relief of psychosis and intractable pain), (b) behavioral accompaniments of alterations in the internal environment (shock therapy, avitaminosis and stress—producing chemical agents, and starvation), (c) behavioral accompaniments of life stress, and (d) behavioral accompaniments of genetically based disorders. Furthermore, the review will limit itself as far as possible to quantitative studies in this field, since, in the last analysis, it is on the quantitative side that the psychologist's contribution chiefly lies. Special stress will be laid on the design, execution, and evaluation of the experimental and therapeutic procedures involved in the investigations to be reported.

ALTERATION OF BRAIN STRUCTURE AND FUNCTION

The tremendous impact that psychosurgery has made on current investigations is evidenced by the following books and monographs which were published between 1949 and 1951: Mettler (40, 41), Lewis (35), Freeman & Watts (15), Partridge (45), *Anatomie-Physiologie cerebrale a la Lumiere des Lobotomies et Topectomies*, 1950 (12), Hebb (24), Fulton (16), Greenblatt *et al.* (18), Penfield & Rasmussen (46), Richter (53), Halstead (21, 22), Porteus (51), the report on the first International Conference on psychosurgery in Lisbon (52), the Anglo-American Symposium on Psychosurgery (4), the British Medical Bulletin (29) and the symposium on the Frontal Lobes (7).

1 The survey of the literature to which this review pertains was completed in April, 1951.
It seems that just as the shock therapies served as a shot-in-the-arm for psychiatry in the 1930's, so has psychosurgery served the same purpose in the 1940's. The general aim of psychosurgery is to bring about such alteration in the behavior of the mental patient that he will be freed of the need for hospitalization. The mechanism whereby such alteration in behavior is effected remains a mystery despite much theorizing on the subject. In the process of bringing about such alterations, two types of questions arise. One deals primarily with the practical psychiatric problems involved, the other with the more scientific aspects. On the practical side arise such questions as: what type of patient is suitable for psychosurgery; what type of operation is most effective, what role do “total push” and psychotherapy play in the improvement; what is the role of the family situation in the rehabilitation process; and which patients can be benefited by operation even though they do not improve sufficiently to return home? On the scientific side, such questions arise as: what psychological functions are mediated by the frontal lobes; why do some patients who receive the same type of operation show no similarity in behavioral changes; what is the role of quantity of tissue removed or severed in contrast to the location of this tissue; why does the psychosis persist in some patients, temporarily diminish, and then return in others, and completely disappear in still others?

The mechanism whereby the operation brings about improvement is still unknown. Theories range from the postulation of a diaschisis factor to the postulation of a specific interference with fibers possibly mediating anxiety (4). There is at least one long range follow-up study which seems to indicate that the operation itself is no more effective than mere passage of time or “total push” in bringing about improvement, and that the basic factors to be considered are type and stage of the disease process in which the patient finds himself at the time of therapy (68). Furthermore, in this study, prognosis based on psychological test performance was successful in predicting outcome regardless of operation.

More light was cast on the importance of the frontal lobe in psychological function than on the mechanism of improvement from psychosis in the recent Columbia-Greystone I Study (40). However, much of the light cast was of a negative type, that is, it served to “debunk” present unfounded opinion or prejudiced belief rather than to develop new insights. Contrary to generally accepted dogma, the frontal lobes can be interfered with in diverse ways or even removed without producing detectable deleterious effects, provided the agranular tissue is left intact. Thus the general tendency of the last 50 years for neurosurgeons and neurologists to regard the frontal lobes as a “catch-all,” where any function not localized elsewhere can find a peg to hang on, has come to an end.

The only psychological characteristic that seems definitely interfered with after psychosurgery is level of anxiety, which is considerably reduced in a qualitative rather than a quantitative way. The patients still report the
presence of anxiety, hallucinations, or pain, but these conditions are no longer intractable. Certain temporary changes occur which disappear within the first several weeks or months. By the end of the third month, most of the psychological functions have returned to their preoperative level, or have even exceeded it. Other psychological deficits, some of an apparently permanent type, were noted in patients in whom the agranular portions of the frontal lobes were invaded (Brodman’s areas 4, 6, 8). A general lag in the ability to benefit from the practice afforded by the repeated application of the tests was noted in the operated patients. Whether this lag represents a basic interference with function or whether it reflects the poorer quality of registration after operation is still an open question.

In contrast with these specific findings, there are several reports which yield a somewhat different picture, although in the main there is more agreement than disagreement. There is general agreement that the type of operation is not as important in determining the outcome as was formerly believed, provided no incidental damage results. Thermocoagulation—destruction of selected portions of the frontal lobe by means of a heated template (41), venous ligation—shutting off the venous drainage of the external surface so as to force drainage through the alternate venous system (41); thalamotomy—surgical undercutting or destruction of the dorsal medial nuclei of the thalamus, transorbital lobotomy (15) and classical types of lobotomy, topectomy, and selective cortical undercutting (4) yield equivalent results in most of the reported studies. It should be noted that until now most of the psychosurgical operations have depended upon some type of cytoarchitectonic map. The theories of brain function emanating from response to electrical or strychnine stimulation have not yet been introduced into psychosurgical design (9a). On the basis of cytoarchitectonics alone, two divisions of the frontal cortex exist—granular and agranular. It has already been pointed out that the latter when injured produces definite deficiencies in intellect and behavior. Otherwise no localization has thus far been demonstrated for any function.

Regarding the influence of quantity of tissue removed or interfered with, less agreement exists. The Columbia-Greystone I Study (40) found little if any relationship between amount of tissue removed and psychological change or improvement. Meyer [see (53)], on the other hand, is of the opinion that there is a quantitative relation between improvement and brain injury, within certain limits.

There is general agreement that not all patients, but at least one third, seem to benefit from psychosurgery. In the case of severe neurotics (41), however, the proportion of improvement is very high.

Considerable agreement exists regarding certain transient changes occurring immediately after psychosurgery and disappearing within three months. These changes are not consistent from patient to patient, but the presence of some alteration of function is undeniable. Although there are
various ways of explaining them, it has been suggested that the hypotheses might well fall under the triad: vigilance, zeal, and anguish (34). Vigilance is the concept propounded by Head (23) and its lack would be exhibited in such behavior as sleepiness, inattentiveness, and unawareness. Zeal refers to the motivational system. The interest and enthusiasm of the patients is less readily evoked in the immediate postoperative period than in the preoperative, and follow-up, postoperative periods. Zeal seems to return more slowly than vigilance, and sometimes remains at a lower level than in the premorbid state. Greenblatt et al. (18) found that 60 per cent of their patients showed lessened initiative. Anguish reduction, however, is the one change that seems to persist, at least in patients who are regarded as improved. Whether this change in anguish is referable to the operation, or is an indirect result of the lifting of the psychosis, which in turn may or may not be related to the operation, is still a moot question.

The other changes that have been alleged to result from psychosurgery have not been established well enough to merit general acceptance. The reduction in intelligence which has been claimed by several workers [Penfield & Rasmussen (46), Partridge (45), Greenblatt (18) and Porteus (51)] is not borne out by most investigations. Partridge, who has written the most readable personal account of the follow-up of some 300 cases, seems to have concluded, despite his own evidence to the contrary, that an intellectual deficit is created in nearly all cases. The heritage of the last generation in vague reasoning regarding the associative functions of the frontal cortex is reaping a harvest of persistent prejudice even in our keenest investigators and authors. Freeman (4), too, insisted that all operated cases show some deficit intellectually, even though tests on his own patients did not demonstrate it. When confronted with the absence of evidence for intellectual deterioration, the proponents of such hypotheses retort that the present day tests are not sensitive enough to detect the defects. It is urged that creative intelligence, if not "psychometric" intelligence, is affected. Several studies on this question have been undertaken. Ashby & Bassett (6) on the basis of quantitative tests found no evidence for loss of creativity, and the present author in a similar study of the Columbia-Greystone patients (67), also failed to find any evidence for loss of creativity.

Another indication of the tenacity with which psychologists adhere to the belief that the frontal lobes are important in psychological functioning is demonstrated in the study of Robinson (54). After repeating the claims that the abstract-concrete attitude is affected by psychosurgery and that planning ability and maintenance of set and capacity for prolonged attention are affected adversely, she proceeded to develop two new tests—The Self-regarding Span Test and the Sensibility Questionnaire. The former measures preoccupation with the self, and the latter measures the degree of one's concern with the future and with the opinions held by other people regarding one's own behavior. In all three of these functions, lobotomized
patients were found to be wanting. The design of Robinson's experiment leaves much to be desired, however, because, having no preoperative data, she made comparisons with a control group of former state hospital patients who had experienced spontaneous recoveries. No data were given regarding time elapsed from date of operation (and for corresponding elapsed time for the controls, whatever the basis for such correspondence might be). Smallness of the sample, as well as insufficient evidence for the comparability of the groups, leaves one hoping that better data on these interesting techniques might some day become available. The issues may be summarized as follows:

Some patients who undergo standard “blind” lobotomies and also some in whom agranular portions of the frontal cortex are interfered with may show long-enduring or even permanent intellectual damage. This is all the existing evidence for deterioration. For the rest, it is inferred on the basis of inadequate evidence. Some of the inferences emanate from the untenable hypothesis that the operation should return the patient to his premorbid level of functioning. We do not demand that the heart of a cardiac, who has had a heart disease for five years and then undergone an operation, be as good as new. There is equal reason not to expect the mind of the chronically ill schizophrenic to be like new after operation; for example, even those patients who have recovered spontaneously show “scarving.” In summary, the evidence points distinctly to the frontal lobes as mediating anxiety, but there is no evidence for their mediation of intelligence. To be sure, the distinctions between affect and intellect may be academic only, and it may be claimed that what appears to be an emotional defect is basically intellectual and vice versa. We do, however, have tests of intellect and these, under proper testing conditions, show no defect. We do not have adequate tests of anxiety, and that may be why the issue is not resolved.

As to the non-intellectual defects claimed to follow psychosurgery, Greenblatt and co-workers (18) pointed to excessive appetite and irritability as occurring in at least 50 per cent of the cases for whom information on these points was available. Whether these were transient or not was not indicated. Other defects reported were: outspokenness, lack of initiative, restlessness, and deficiencies in insight and in calculation.

Meyer, in Perspectives in Neuropsychiatry, (53) stated it has been possible to prove that a frontal lobe deficit syndrome may definitely occur if the lesions are entirely confined to the prefrontal region and that it may persist after the wound has become quiescent and unlikely to exercise an irritating effect over adjacent or remote parts of the brain.

But such defects may well occur in spontaneously improved patients and may be the residua of the psychoses rather than the sequelae of the operations. It is also noteworthy that two of the transient sequelae, urinary incontinence and convulsion seizures, were found to occur quite frequently pre-
operatively in this group of patients. In fact, the number of patients exhibiting these defects postoperatively for the first time was far smaller than the number exhibiting them preoperatively (18).

The frontal lobes are not the only parts of the cortex to be subjected to clinical investigation by means of surgical intervention in recent years. The thalamotomy operation which attempts to destroy the medial nucleus of the thalamus directly, and thus eliminate the thalamocortical connection, has been undertaken with reportedly good results. The temporal lobe has been operated on by Obrador (42a) and by Green et al. (17a) with some reported success. In the latter study, 23 patients suffering from psychomotor epilepsy underwent a temporal lobectomy, anterior to the acoustic receptive cortex. This operation seemed to be more effective for these patients than either frontal lobotomy or gyrectomy. Of the 23 patients, 12 had no more psychomotor seizures postoperatively. On all but one of these patients, the operation was unilateral, often on the dominant side. The patient with the bilateral anterior temporal lobectomy was not changed appreciably by the procedures, except that there is now an increased "hypermetamorphic impulse to action," loss of social consciousness and increased sexual interest—a modification of the results observed in monkeys following bilateral temporal lobectomies by Klüver and Bucy. His parents feel, however, that the loss of viciousness compensates for the factors mentioned above (17a).

The role of the parietal cortex on both sides of the brain in the proper functioning of spatial orientation has been demonstrated by a number of first rate observations according to Jefferson (29). Martin has considered that man's spatial orientation depends on the lower parietal field. Lesions in the parietal area have been shown to produce not only a loss of the power to find one's way about, even in the familiar purlieu of one's own house, but a loss of power to conceive space in even two dimensions. It becomes impossible to draw the plan of a house; for instance the kitchen may be depicted as a separate disconnected object in the garden. The same lack of orientation holds for dressing if the plan of articles of clothing can no longer be perceived. Concurrently may be seen a loss of recognition of half the body as a personal property (38a).

Behavioral studies such as this one, as well as those performed on cases with occipital lesions, indicate that the observant clinician can make contributions that could have emerged neither from experiments on animals nor from purely histological studies.

Another interesting suggestion arising from these investigations is that, contrary to popular opinion, consciousness itself is less dependent on the cortex than on the brain stem. The relevant area seems to be the upper pons and lower midbrain, presumably by some suppression of afferents or effect on the upper brain stem (38a).

Alterations in the Internal Environment

Richter (53) pointed out that biochemistry has moved on from static analysis of excreta to dynamic analysis of tolerance tests for various types
of stress. The influence of stress on the internal environment has joined biochemistry to psychology by a strong bond which augurs well for the future. Glucose tolerance tests, enzyme activity tests (5), dietary factors in the production of experimental neuroses (61), inadvertent production of canine "hysteria" by use of chemical "flour improvers" (39), glutamic acid studies (60), production of psychoses by atabrine (19, 47) and by mescaline (27), are some of the direct links between the dynamics of biochemistry and the dynamics of behavior. Whether the reduction in glucose tolerance of the schizophrenic is a cause or an effect of the psychosis, and whether the experimental neuroses and experimental psychoses are identical with the classical forms of spontaneous neuroses and psychoses are still moot questions, but the observation of these relationships and their quantitative evaluation cannot help but redound to the progress of abnormal psychology and physiology.

It is well known that the human brain obtains its energy from the oxidation of glucose at a rather low temperature with the help of enzymatic catalytic agents and that fully 25 per cent of body metabolism occurs in the brain (14a, 25). The oxygen is obtained directly from outside the body while the glucose and enzymes, though not imported from outside, depend directly for their production on synthesis of ingested substances. Unlike the rest of the organs of the body, the brain cannot avail itself of all the nourishment contained in the blood stream, since the blood brain barrier excludes certain substances. The enzymes are utilized but slowly, and need no continuous source of replacement, but the glucose and oxygen are used up so rapidly that any discontinuity in the supply of these elements makes itself felt immediately in behavior. The most dramatic effect of an interference in brain metabolism is loss of consciousness, but less drastic effects in the form of lower vigilance or performance, can be detected even when the interference is not very great.

Himwich (25) reviewed the present status of research in brain metabolism with reference to disorders of behavior. He stated that in order to get an effective measure of brain metabolism two factors must be determined: (a) the volume of oxygen absorbed by the brain from each unit of blood entering it (the arterio-venous oxygen difference), and (b) the total volume of blood flowing through the brain per unit of time (cerebral blood flow). When these two values are determined under basal conditions (during a quiet and restful interlude), the value of the cerebral metabolic rate (CMR) can be computed. This value represents the minimal amount of energy required for maintenance of brain function. Thus far, no gross differences have been found between schizophrenics and normals in cerebral metabolic rate. An anomaly has been noted, however, in avitaminosis leading to the accumulation of pyruvic acid, one of the intermediary products of carbohydrate metabolism. Deficiencies in vitamin B, especially thiamine, result in a diminished metabolic rate which produces definite behavioral changes as reflected in the Porteus Maze score (44). When the availability of glucose is reduced
by insulin, reduction in cerebral metabolic rate of 40 to 50 percent from normal must occur before contact with the environment is impaired. The lowest level of CMR compatible with maintenance of life and return of consciousness is 25 percent of normal. Only two psychoses are found to be characterized by an abnormally low CMR—cerebral arteriosclerosis and general paresis. Lobotomy tends to lower the CMR up to three months after operation, but observations for longer follow-up periods are not yet available. The CMR is also found to be low in mongoloid idiocy and in cretinism, but not in idiopathic mental defectives. In general, the CMR can not be raised above its normal level except in fever therapy, but it is correlated with neuromuscular activity, especially with convulsive seizures.

Another advance in understanding brain biochemistry comes from the recent application of the quick-freeze method to the fixation of tissue in experimental animals by plunging them into liquid air. This method has permitted a more precise analysis of biochemical processes under conditions of sleep, narcosis, convulsions, traumatic shock, and emotional excitement. Lactic acid is found in lower concentrations in brain tissue during sleep and narcosis than during the waking state, and in higher concentrations during emotional excitement, even when the animal is immobilized (53). Nitrogen metabolism is increased during convulsive seizures and the sensitivity of the brain to ammonia may be the actual cause of the seizure (53).

The effect of semistarvation on behavior was studied by Keys et al. (33) in the Minnesota inanition experiment conducted with volunteer "conscientious objectors." In their first volume the problems of morphology, biochemistry, and physiology are dealt with, and in the second volume psychology and some special medical problems are taken up. Despite the important behavioral changes accompanying starvation and despite the availability of many incidental field studies provided by nature in the form of various catastrophes, the authors found little to guide them in the design of their experimental study of starvation. The few experimental studies that were available seemed to be based largely on "fasting geniuses" who had some preconceived idea of the benefits of fasting, and thus introduced motivational elements which were not inherent in the starvation itself. In addition, the experimental situation itself is not altogether comparable to starvation in a "natural" setting with its emotional tone, uncertainty of survival, and the accompaniments of brutality that seemed to have been an indigenous feature of starving communities during World War II. Furthermore, the voluntary nature of the experimental starvation introduces additional problems in the form of conflict and required self-control in the presence of food. Despite these uncontrolled factors, the results of field studies of natural starvation, according to the authors, do not differ radically from the experimental studies reported in the Minnesota inanition experiment. The symptoms of depression, irritability, nervousness, general emotional instability, social withdrawal, narrowing of interests, obliteration of sexual
drive, and difficulty in concentration found in the Minnesota experimental subjects are closely paralleled in men suffering from natural starvation in the field studies examined. The concentration of attention on food, slowness of speech, and maintenance of memory and thinking functions on an unimpaired level are found equally often in both types of studies. It is the authors' contention that the Minnesota study may throw light on those questions on which field reports are silent or inadequate. Plausible though this contention may be, it is, nevertheless, of doubtful validity since it assumes complete comparability between experimental and field studies, which has not yet been demonstrated.

Some of the specific findings are rather striking. The relative immunity of dream life to starvation influences as demonstrated by the absence of any increase in food-dreams during the semistarvation period and the absence of any general effect on the frequency of dreaming is quite noteworthy. One suspects that there must have been rather wide individual differences in this respect and a further analysis of these data would be of great significance for the dynamics of dream behavior. Another possibility not to be neglected is that under conditions of semistarvation dreams are sooner forgotten, or are differentiated from daydreaming less readily. At all events, the striking influence of mild food deprivation on food imagery (36) is not confirmed by the Minnesota experiment.

The expected increase in the number of complaints during the semistarvation period and its decline during the rehabilitation period unfortunately is presented without statistical tests of significance. Presumably these differences ought to be and are significant, but no quantitative evaluation of the evidence is afforded.

Another striking finding is that despite complaints of lack of alertness during the semistarvation period, no significant difference in intellectual performance was acknowledged by the authors, although the data for the CAVD tests did show a statistically significant difference between the control testing and the 24th week of starvation. One wonders why an attempt was not made, either through control data on comparable subjects or through analysis of covariance methods (e.g., holding the control level constant and comparing the 12th and 24th weeks), to determine the significance of the differences. The cavalier dismissal of the obtained significant differences as due either to practice effects or to differences in difficulty of alternate test forms is not very convincing to the reviewer. The evidence from the parallelism of the learning curves for crossing out 4's (36, p. 862) seems irrelevant to the issue of whether intellectual performance is affected by semistarvation.

The use of personality inventories with the volunteer normal subjects of the type utilized in the Minnesota inanition study seems quite appropriate and the doubts regarding validity are not as strong in this situation as they might be in such situations as screening for admission to college or in-
distry. Nevertheless, the absence of control data for testing the effect of repetition of tests is rather a severe handicap in the interpretation of the data. The utilization of the standards provided by the Minnesota Multiphasic Personality Inventory (MMPI) norms are indeed valuable, but based as they are on a rather wide sampling of individuals differing considerably in age, sex, educational level, etc., they cannot provide adequate controls for the group under study.

The lack of sensitivity of the projective techniques to semistarvation is not unexpected, since these techniques are so deficient in reliable scoring methods that even differences that might be present would be obscured.

That the changes in personality brought about by semistarvation are primarily in the neurotic, rather than in the psychotic sphere seems a reasonable expectation, and is not contradicted by the data. Neurotic depression and apathy seem to be the chief concomitants of semistarvation. It might be well to point out at this juncture that the terms “deterioration,” “depression,” and “apathy” as used by the authors do not correspond to the usual clinical terminology in psychopathology. Since the psychopathological meaning of these terms is so well established, it is unfortunate that they have been diverted to other uses. In general, this study will stand as a landmark among studies in the alteration of the internal environment and its concomitant effect on behavior. It is regrettable, however, that insufficient control data were presented and that attention was not paid to the effect of initial pre-stress level of functioning on differences obtained during successive testing under stress of semistarvation. The regression effect involved in such comparisons has been amply pointed out in recent years.

Some of the changes that occur under starvation are apparently aimed at maintenance of homeostasis; others are definitely the result of deficiency in substances required for adequate functioning. This holds true equally well in the physiological and the psychological fields. The presence of changes whose aim is maintenance of homeostasis probably reflects the survival value of such changes through the evolutionary process.

A number of sensory functions were also examined in the Minnesota experiment. The following visual functions were investigated: visual threshold, flicker fusion threshold, and perception of fluctuations in an ambiguous figure. Of these, only the flicker fusion threshold showed a statistically significant drop under conditions of semistarvation. It is somewhat paradoxical, however, to note that the authors dismissed the statistically significant difference in flicker fusion as biologically unimportant. This tendency to minimize differences is characteristic of the authors’ evaluation of the entire project. To the reviewer, the problem of biological significance is not a value judgment to be made on the basis of preference, but a factual judgment to be based on understanding of the mechanism. Since flicker fusion has been shown to respond to alterations in brain metabolism (16a), it is quite understandable why the threshold should drop under conditions of semistarvation.
The fact that it dropped only one cycle seems to be an inadequate basis for judging its importance, since the actual biological value of a cycle has never been determined. Speed of tapping was also lowered by semistarvation, as were manual speed and coordination.

Another source of information about psychological concomitants of disturbed internal environments comes from the field of shock therapy. The psychological consequences of electric shock therapy have intrigued psychologists since the technique was introduced. Janis (28) conducted an intensive study by comparing 17 patients who received shock therapy with 17 matched controls. In previous studies (66), the influence of electric shock therapy on newly acquired (implanted) associations had been determined. Then investigations were made of the influence of shock on the free association process (65), that is, whether shock interferes with the old memories that are usually evoked by free association. Janis repeated the word association investigation, but extended his study to personal memories elicited by interview methods and to evaluation (by use of scaling methods) of the patient's anxiety, attitude toward specific disturbing memories, feelings of personal inadequacy, and other psychological symptoms. In general, although temporary changes were noted, no permanent losses of memory were found, but a definite decline in anxiety occurred. The role of the transient memory loss in the recovery process is still not determined. Theories range from regarding this memory loss as a secondary phenomenon of no possible consequence to the therapeutic process because it is not observed to the same extent in all patients, to the theory that the loss in the feeling of familiarity engendered by shock therapy may play an important role in defending the patient temporarily against emotionally toned memories.

Until comparative studies are made of memory function in improved patients who undergo other forms of therapy (psychosurgery, insulin shock, and other less drastic varieties of electric shock) as well as those who undergo psychotherapy or improve spontaneously, the role of memory loss as an explanatory principle in improvement will remain in doubt.

**Behavioral Accompaniments of Life-Stress**

The symposium on "Life Stress and Bodily Disease" (8) was a monumental contribution to the problem of psychosomatic medicine. Stimulated by Selye's hypothesis of the adrenal cortex as the central mediator of response to stress (56), spearheaded by recent developments in the adrenocorticotropic hormone (3, 50), and based on the painstaking observations of individual patients such as the case of "Tom" (63), the entire field of psychosomatics has taken on added scientific stature. According to Wolf, (8, p. 1090) in the closing remarks in the symposium:

The common denominator in psychosomatic illness is the interpretation of an event as threatening. This implies anxiety, conscious or unconscious, and the need to
formulate a protective reaction pattern. The cause doesn't necessarily matter much. Neither does the reason for the selection of the particular pattern. The important thing is to substitute a less costly and more constructive pattern, or to remove the need for it. This may be accomplished if the event can be made no longer to seem threatening, or if this anxiety producing situation can be outweighed in the mass action equation by satisfactions and securities.

Most pertinent things for future study besides mechanisms are factors which evoke and modify patterns and ways of making them unnecessary. This approach may eventually illuminate the causes.

With this particular hypothesis in mind, the influence of events perceived as threatening was investigated by various workers on the functioning of the following body systems and organs: gastrointestinal system, genital system, cardiovascular system, arterial and renal blood flow, the eye, the "airways," the skin, the skeletal muscles, and so on. Instead of the analogical thinking which has pervaded psychosomatic investigations in the past, a good number of reports in this volume attempted to present measurable data on the various bodily responses which accompany stressful situations. The result is a rather overwhelming mass of material supporting the hypothesis of threat from which the present review can include only certain selected portions.

Wolff (64), who organized this symposium, pointed out that there are two main sources of threat to the integrity and well-being of individuals: (a) the physical environment (other forms of life or cosmic forces), and (b) the internal symbolic environment (threats of danger arising from past experience, dependency feelings, and conflicts between drives). It is important to realize that not only actual threats, but potential threats may serve to mobilize the individual's defenses. Hence, not the "real" universe, but the "perceived" universe is the source of the threat. Once a threat appears, defense mechanisms are set into action involving both bodily preparations and certain feelings and attitudes. Usually one organ or system becomes characteristically involved in this defense action, and it is the continued involvement of this organ long after the threat episode has disappeared that constitutes the psychosomatic problem. Why one organ rather than another becomes involved is still unknown.

The studies reported in this book range from an examination of the developmental life history of the patient, à la Adolf Meyer (42), to a minute investigation of the organ involved in the particular psychosomatic condition under investigation. The entire armamentarium of the clinical psychologist, psychiatrist, and physiologist was brought to bear on the question of psychosomatic deviations. Fluctuations in the course of the psychosomatic illness were correlated with events, attitudes, emotions, and behavior of the subject. Whenever a positive correlation between the course of the illness and some complex situation became evident, a short term experiment was carried out to determine the quantitative manner in which the affected organ
responded to the life situation in question. This experiment was repeated after a suitable control period of relative relaxation to see whether the event or episode would again evoke the deviant activity of the bodily organ.

The specific procedure of the analysis was as follows: Whenever a life situation seemed to be associated with say, a gastric disturbance, it was in a subsequent period retested by bringing up the suspected conflicts for discussion. If this maneuver reproduced a gastric disturbance, and if it could be turned off by inducing relaxation in the subject by strong reassurance, the validation of the suspected relationship between the emotional disturbance and the gastric disturbance was considered settled. One wonders whether the rapidity with which the changes occurred are reflections of rapid change in mood and attitude or of some other factors which intervened. It hardly seems likely that the rapid changes reported could actually be concomitants of psychological changes in the individual.

It should be noted, however, that life stress alone, or its reduction, is not the only agent which can bring about alterations in body functioning. Some hyperfunctioning or hypofunctioning of an organ, regardless of how it arises, may regain its proper level of functioning spontaneously without, or in spite of the intervention of life situations. To expect that every waxing or waning of organ functioning would depend upon or be responsive to life situations, or that there is a rigid connection between the two, is at the present time merely a wishful hypothesis rather than an established fact.

The relative importance of unconscious and conscious processes (38, 62) in producing conflicts that affect the functioning of bodily organs was also discussed. The notion that only unconscious conflicts are effective in producing bodily changes does not seem to be tenable since, at least in the case of "Tom," stress and conflict that had the most significance was of the variety that was the most threatening to the individual regardless of whether it was at the conscious or unconscious level. To be sure, it has been claimed that conflicts that have become unconscious are of greater significance to the individual, but the fact of lack of awareness per se is not the important factor in producing a bodily change.

Following the psychodynamic principles proposed by Alexander (1) regarding the role of emotional factors in gastric dysfunction, data are presented to indicate that there are at least two contrasted patterns of gastrointestinal reaction to stress: (a) gastric hyperfunction in which the subject behaves as if he were about to be fed and (b) an ejection-dreadance pattern in which the subject behaves as if he had been poisoned, reacting with sudden cessation of gastric digestion, nausea, and vomiting.

Feelings of anger, deprivation, longing for emotional support, or need of being cared for, give rise to hyperfunction of the gastrointestinal system in about the same way that hunger evokes such hyperfunctioning. It is suggested that these aggressive patterns have become conditioned to gastric hyperfunctioning as a result of the early aggressive patterns that manifest them.
selves in the infant when he is hungry. The feelings of threat arising from food deprivation may later arise or be stimulated when any other threatening situation hovers over the individual. The conditioned response of salivation and gastric activity which originally was associated with this aggressive hunger-behavior pattern may therefore lead to hypersalivation and hyperfunction in later life when threatening situations occur. This gastric hyperfunction is usually associated with increased blood flow, motility, and acid secretion rendering the mucous membrane quite fragile. That there may be cortical structures involved in this type of activity is also suggested by the work of Davey, Kaada & Fulton with monkeys and dogs (13).

The ejection-riddance reaction involving the large bowel, stomach, and duodenum, which have the protective purpose of ejecting from the body undesirable agents such as noxious foods or poisons, may also operate when the individual is under the influence of certain undesirable emotional situations, even when no noxious agent of the physical variety is present. Studies of this reaction have indicated that there are two patterns of gastric hypofunction: (a) a pattern associated with overwhelming catastrophic feelings of fear, terror, horror, abject grief, depression, and despair, in which practically all gastric function comes to a standstill since gastric productivity is futile in the face of the overwhelming catastrophe and (b) a pattern associated with feelings of disgust and contempt, in which gastric function is also reduced, but mucous production is increased, as is also duodenal motor function and the concomitant skeletal muscle contraction which leads to vomiting. Here the organism behaves as though the noxious incident inadvertently “ingested” could be diluted, neutralized, and ejected.

Protective reaction patterns to threats designed to mobilize the entire organism for action are often associated with constipation, since during such bodily preparations for action, emptying of the bowel seems useless. It has been noted that situations evoking sadness, dejection, or cheerless striving inhibit the gastro-colic reflex, induce nonpropulsive phasic contractions in the sigmoid, and interfere with the mass reflex.

It is as though the individual, unable to face and grapple with the threat, but nevertheless firmly holding on, is tensely waiting for an attack which is indefinitely delayed. The animal so poised is not in the state optimal for defecation (2).

Another psychosomatic focus is found in the circulatory system (49). Usually, the augmented response of the circulatory system to the standard exercise situation dies off in about 2 min. but in cases of individuals under stress, the response persists much longer. Thus, normal individuals who are confronted with tasks which they do not relish or which they are convinced they cannot perform successfully, exhibit in response to the standard exercise test a striking increase in blood pressure and stroke volume and a decrease in ventilatory efficiency. This augmented response may persist for 48 hr.
Life stress in individuals with essential hypertension is capable of producing changes in the direction of renal ischemia which may eventually lead to renal damage.

One of the most speculative and yet intriguing hypotheses proposed in this *Life Stress and Bodily Disease* volume is that of Hinkle (26), who suggested a psychosomatic basis for diabetes. In cases of starvation, it is well known that the body generally tends to limit itself to a noncarbohydrate metabolism, reserving the available carbohydrates for brain and cord metabolism, since the latter cannot utilize any other source of nourishment. Arguing from this fact, Hinkle suggested that not only actual starvation, but also threats of starvation arising from removal of mother love and bodily security may give rise to a limited carbohydrate metabolism. In later maturity, some individuals respond to stresses involving withdrawal of love and security as if they were threats of starvation. For short durations such responses may be harmless, but if continued for a long time irreversible changes characteristic of diabetes may occur.

Similarly, psychosomatic involvements of the "airways," of vascular changes producing headaches, and other deviant functioning of bodily organs can be explained on the basis of the threat-response hypothesis.

The severest stricture that can be drawn up against the threat-response hypothesis in psychosomatic disorders is that such stressful events probably occur in the life experience of most individuals, yet everyone does not develop a psychosomatic illness. It seems as if a predisposing factor is essential before the illness will take root. Whether this predisposing factor is a genetic one, or whether it is derived from life experience, cannot be determined at present.

A suggested confirmation of the threat-response hypothesis is provided by the dramatic disappearance of psychosomatic illness when a new threat, overshadowing the former threats arises. Since it is the response to "perceived" rather than to "actual" threat that is the important basis for the development of the illness, it becomes explicable why migraine headaches, for example, were completely lost in missionaries incarcerated in a Japanese concentration camp.

An interesting effect of culture on psychosomatic conditions is afforded by the suggestion that each culture provides anxiety-reducing agents or institutions which mitigate the threat-potency of a given event (57). As long as the individual adheres to his cultural mores his anxieties are reduced by the institutions created for his protection. When, however, as a result of a breakdown in his cultural allegiance he ceases to adhere to his mores, he is more prone to become subject to psychosomatic conditions, since the threat-potency remains while the anxiety-reducing agent loses its effect. This is a plausible argument, but one in need of factual verification, since, for example, occidentalized individuals come under closer medical scrutiny than primitive individuals, and the greater frequency of psychosomatic illness in
the westernized individuals may be based merely on fuller information and
greater contacts.

The association between urticaria and resentment (17) was demonstrated
in 30 unselected cases. In the discussion, however, Sulzberger pointed out
that, in his experience, lasting skin lesions produced by psychogenic mecha-
nisms alone never occurred. In most instances it was the patient’s rubbing
or scratching the spot on the skin that seemed to precede the occurrence of
the lesion. Only in rare cholinergic conditions does a lesion appear without
scratching or rubbing.

Direct evidence bearing upon the specific involvement of a given organ
in stress is afforded by the investigation of the stress situation produced by
the Hardy-Wolff-Goodell pain stimulator, which can yield quantitative de-
gres of thermally-produced stress (37). Recordings were taken simultane-
ously of muscle potentials of the left side of the neck, of heart rate, and
of respiration. The results of this study indicate that there is considerable
specificity in the effect of a stress situation and that those organs concerning
which the patient complains seem to be the ones that are more sensitive to
stress. Thus, patients with cardiovascular complaints show deviations from
those without cardiovascular complaints in mean heart rate and its variabil-
ity, and in the median respiratory variability, while the patients whose
symptoms included complaints of head and neck pains showed higher muscle
potential scores than those who had no such complaints. On the other hand,
considering patients with cardiovascular complaints, as opposed to those who
had no cardiovascular complaints, no difference was observed with regard to
muscle score. Similarly, patients whose chief complaints were head and neck
pains, as contrasted with those who had no such pains, showed no difference
with regard to heart rate or respiration scores. The authors concluded that
psychiatric patients with somatic complaints tend to manifest increased
physiological responsiveness in the related physiological system or mecha-
nism upon exposure to stress. This holds true even when the subjective
symptom that the patient complains of is not experienced at the time of
stress.

An attempt was made to relate such well-known emotions as anxiety,
tension, resentment, depression, and elation, with the blood content of the
individual undergoing these emotions (14). The method consisted of deter-
mining through psychiatric interview the type of emotion experienced. A
blood sample was taken during the interview, and the effect of this blood
on isolated animal tissue of known reactivity was determined. The results
indicated that blood taken during an interview in which tension was the
most characteristic emotional state seemed to have effects on the tissue
indicators similar to that produced by acetylcholine. Resentment was found
to resemble atropine in its effects (i.e., atropinized tissue is refractory to ac-
tylcholine) and anxiety was found similar to epinephrine. This is an interest-
ing attempt at getting a diagnostic method for determining the type of
emotion present. It is, however, still questionable whether the type of emotion observed psychiatrically can be sufficiently well diagnosed to be reliably labeled. It is likely that until we are able to elicit genuine emotions to order in the laboratory, the problem of finding the correlates of a given emotion will remain unsolved. Nevertheless, the fact that consistent differences are obtained between blood samples of people who allegedly are undergoing different emotions does indicate that the foregoing attack may in the end prove to be very fruitful.

In a study of patients suffering with reflex sympathetic dystrophies, characterized by vasomotor instability and having causalgic (agonizing or burning pain) symptoms, Ruesch & Prestwood (55) found that these patients suffered from a primary disorder in communication. Their mastery of verbal expressions and gestures was found to be inadequate and concrete, and their interpersonal communication was replaced by intrapsychic or self-referred communication. This tended to make these patients appear immature and "difficult" in therapy. One wonders whether the particular type of immaturity found in these patients is specific to the disease or whether it is a general characteristic of psychosomatic illness. Until adequate psychological tests are administered, one may even question the basis for attributing their faults in communication to the disease process. The smallness of the sample casts further doubt on the hypothesis. Nevertheless, it is intriguing and worthy of follow-up.

Persky, Greuber & Mirsky (48) found that the excretion of hippuric acid is related to "free" anxiety, rising with increase in anxiety and dropping when the anxiety level decreases. This relationship was found to hold true only of patients and not of normal students anticipating an examination. They also found that sympathomimetic substances (atropine, ephedrine, and 1-norepinephrine) lower hippuric acid secretion. The authors claimed that psychosurgery tended to reduce hippuric acid secretion in two patients suffering from anxiety (agitated paranoid schizophrenia and recurrent psychotic depression) and elevated it in two patients showing withdrawal (catatonic schizophrenia and paranoid schizophrenia). A careful examination of these data (48, Table 33) as well as of those on the effects of psychotherapy (48 Table 30) and of drugs (48 Table 31), casts doubt on the validity of the claims, since there is quite a distinct regression effect. Those of high initial level show a drop and those of low initial level show a rise. Until patients with equal initial levels in the contrasted groups are examined, no conclusive results will be available. Despite this shortcoming, the data presented are provocative, and the quest for a biochemical analogue for anxiety is brought a step nearer to its solution.

Genetically-Influenced Disorders

Most clinical delving into the past of an individual stops at the womb, as Slater (58) pointed out, and at least an alleged explanation of his life history
can often be found without resorting to genetically based factors. The elimination of genetic factors from a consideration of man's behavior, however, would tend to single him out as unique from the rest of the animal world.

The controversy between hereditarians and environmentalists is fast disappearing as a basic issue. Only one distinction still separates the two camps. While the environmentalists regard all human beings as potentially susceptible, hereditarians insist that only those who have a predisposition for a given mental disorder will develop it. Thus, while everyone will admittedly respond with a temporary seizure if a sufficiently strong electrical stimulation is applied, only the basically epileptic may continue having seizures after the electrically induced stress is no longer operative.

The techniques which have been evolved for answering the question of the relative importance of heredity and environment consist essentially of the following procedures: (a) investigation of the incidence of a given disease in blood relatives and in pairs of identical and fraternal twins, separated into those reared together and those reared apart (31); (b) investigation of the incidence of disease in blood-siblings as contrasted with foster-siblings (10); (c) investigation of the role of intercurrent disease during pregnancy and other prenatal rather than hereditary factors (9); (d) study of the rate of myelination and its effect on resistance to disease (32); (e) investigation of the developmental history and of critical junctures in this development (42); and (f) studies in genetic linkage (20). The work of Kallmann in the investigation of twins, at least one of whom is affected by a given disease, is too well known to require introduction. He has recently (30) extended his methods to the investigation of suicide, for which he finds no hereditary factor, to manic depressive psychosis, and to diseases of the senium. Critics of his methods may point to possible selective factors in diagnoses, or appeal to the importance of early life deprivations of a physical or mental variety; nevertheless, his data are overwhelmingly convincing of the importance of genetic factors in the causation of mental disorders. Furthermore, his plea for a study of the environmental differences operating in cases of identical twins who are found discordant with regard to schizophrenia is well taken and such studies ought to cast considerable light on etiological factors.

Among the newer trends in research is the attempt to map the genes on each chromosome in man in the same way that such mapping has been carried out in the fruit-fly (20). There are now about eight chromosomes which have easily identifiable markers—sex chromosome, several blood factors, and taste for phenylthiocarbamide. Slater suggested that if linkage could be established between any of these easily identifiable markers and a given disease, e.g., Huntington's chorea, prediction of the occurrence of this disease, even before it became evident, would be possible (58).

Perhaps the most thorough study of the claims of the environmentalist in the causation of personality disorders was made by Orleansky (43). After reviewing 149 studies in this area, culled from the publications of psychol-
ogists, psychiatrists, and anthropologists, he concluded that most of the evidence for the influence of infant care on adult personality forces one to a negative conclusion. Apparently other factors in addition to mere infant experience are important in the development of the adult personality. Among these, the role of genetic factors and still undetected physiological and biochemical factors in growth and development loom large. One wonders whether the type of material care given an offspring is not itself also relatively independent of the care which the mother received as an infant, and more dependent upon the genetic, physiological, and biochemical structure of the mother herself. The recent investigations of the relationship between the Rh factor and mental deficiency, rubella and mongolian idiocy, and nutritional deprivation and subsequent maldevelopment may lead to the isolation of disease-producing factors for illnesses which now are still in that unhappy borderline between psychogenic and physiogenic theory.
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