SYMPOSIUM

ON

STRESS

(16-18 MARCH 1953)

ARMY MEDICAL SERVICE GRADUATE SCHOOL

WALTER REED ARMY MEDICAL CENTER

WASHINGTON, D. C.

SYMPOSIUM
on
STRESS

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WALTER REED ARMY MEDICAL CENTER

16–18 March 1953

Army Medical Service Graduate School

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ADDRESS OF WELCOME

This is the fourth one of these symposia that have been held at Walter Reed during the past few years. We had one on shock, one on trauma; a few months ago we had one in the veterinary field on the subject of leptospirosis which aroused widespread interest also. These symposia are being conducted under the immediate supervision of Colonel Stone in order to try to make recent advances in medicine and subjects in the field of research, particularly as it is applied to medical-military problems, available to the profession. We all know that med'cal papers today reach the editorial rooms of our medical journals in such volume that even the best ones sometimes are delayed in publication by as much as a year. These symposia are an attempt to bring the latest information on various pertinent subjects to you promptly.

The subject of this symposium, as you all know, is Stress. Stress may be regarded as the resistance of the organism to external loads. These external loads may influence the defense mechanisms of the body so they will undergo certain structural functional changes. These changes may be manifest, either through structural or chemical changes in certain specific tissues, or there may be a disintegration of the whole organism, with quick resulting death. Or, if there is a reorganization of the defense mechanisms of the body, there may be enough reorganization to make the organism compatible again with life, under certain special environmental conditions. In the latter case, medical care and treatment may restore this organism to something near normal again.

We have assembled, I believe, a very fine panel of speakers for this symposium. I know that Colonel Stone and his staff have attempted to bring the best talent available in the United States, as well as outstanding scientists from abroad. A quick perusal of the program itself, I think, will convince you that Colonel Stone has done very well. I will not attempt to go over the details of the program wih you—it is divided into three main divisions, but these will be emphasized as you go along in the symposium. I hope this symposium will be profitable and enjoyable both to all of you.

16 March 1953
WASHINGTON, D. C.

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John C. Whitehorn, M. D., Professor of Psychiatry, The Johns Hopkins University.

Harold G. Wolff, M. D., Professor of Medicine (Neurology), Cornell University Medical College.

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MONDAY MORNING SESSION

16 March 1953

MODERATOR

WALLACE O. FENN, PH.D.

INTRODUCTION AND SURVEY OF THE PROBLEMS OF STRESS*

JOHN C. WHITEHORN, M. D.

It is a pleasure and an honor to have been asked to fill the initial position in this Symposium on Stress. I am sure that I speak for all of us in expressing our appreciation of the warm welcome just given, and our appreciation of the thought and effort which has been devoted to the preparations for this conference, which holds promise of being highly informative to many of us on a wide range of related topics, and also productive of much mutual stimulation and interchange of constructive thinking. It has seemed to some of us highly desirable to attempt to pull together in face-to-face sessions, under the common title of stress the thoughts and mutual reactions of a number of workers familiar with the observations, concepts and methods which have been found useful for scientific studies in this field, together with a presentation of practical military problems. The Committee on Psychiatry of the National Research Council has particularly urged such a conference.

In undertaking an introduction and preliminary survey it will not be necessary or appropriate for me to attempt a review of published contributions nor to forecast the contributions which will be made during this symposium. The individual contributors will, I am sure, do whatever of this is necessary more adequately and with greater direct relevance to particular concepts than could be done here in an overly-general way. I wish particularly, however, to mention one person, Dr. Hans Selye, whose work has been of great historical importance in this field, who is not present in our symposium. His studies of stress and his conception of the General Adaptation Syndrome have had an enormously stimulating effect and have provoked much valuable work.

Why is it that we find the term stress a useful means of pulling together so great a variety of observations and ideas as are represented, for example, in this symposium? I do not believe that it is because we have discovered a valid general common factor which we

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isolate in abstraction and designate as stress. Rather, I think, during recent decades of biological and medical research, we have developed greater respect for the reactive potentialities of biological organisms, potentialities both for good and for ill, and we find it convenient, mentally, to unite in our consideration of these reactive potentialities by thinking of them in terms of what evokes them, which we call stress. This is a curiously inverted way to use our minds and our vocabularies.

In medical literature—clinical, physiological, or psychological—we have long been familiar with two terms, stimulus and trauma, which have meanings somewhat similar to the word stress. In all three cases—stimulus, trauma and stress—we often find it useful to use these terms in a rather vague, unspecified way, not primarily for the intrinsic meaning they carry to our minds, but because they enable us to think with greater clarity and verbal distinctness about the extremely important biological reactions thereto. To indulge in an analogy, stress is a rather broad conceptual term—like a tennis racket—with which we can manage to bat about, like tennis balls, some other concepts which are concerned with the more sharply definable reaction processes. Perhaps, in this analogy, and in the context of this discussion, you will suspect that the tennis balls look like eosinophils and so they may to some, but I did not intend to be quite so limited and specific in my analogy. What I am trying to say, in this awkward metaphorical fashion, is that we may be able to get some use out of the term stress, even if it is left vague and not very clearly defined, provided we succeed in specifying fairly sharply some of the aspects of the biological reactions to stress, in which I think we are actually more deeply interested. If we were dealing with inanimate objects, the conceptual and terminological problem would be greatly simplified, because in physics action and reaction are equal, and stress can be expressed in dynes per square centimeter; but in biology this is not so. Living organisms are specially organized to accumulate and expend energy on their own, discriminatingly, and not in exact equality to the forces acting upon them.

From the standpoint of military medicine the study of stress has great practical importance because of the loss of manpower by reason of that large group of reactions which we call neuropsychiatric casualties, overt or covert. (In some instances the men themselves are lost from the Service by psychiatric disability and separation; in other instances, while the men remain, their power is reduced through ineffectiveness; in still other instances, recovery is adequate for full duty assignments.) This is by no means the whole of the military meaning of biological reactions to stress. There are also such prob-

lems as wound-healing, recovery from burns, and somewhat more subtle problems of convalescence.

In the psychiatric literature of World War I we can read much about trauma—shell shock and psychic trauma. The mode of thought was simple and blunt, as if, in order to explain disability or breakdown, we had to think in terms of a single massive blow. In the more sophisticated psychiatric literature of World War II, we can read much about fatigue or exhaustion, implying a disabling *termination* to a long-continued strain or stress or series of stresses. In this more recent literature we find also more appreciation of countermeasures in the nature of leadership and morale building—means for reducing and managing such stresses as can be managed, and for marshaling inner emotional resources for enduring better the unavoidable stresses.

From an even earlier day, we have inherited other related terms and ideas, such as the "irritable heart of the soldier" or "neurocirculatory asthenia"—concepts which we now recognize as having something to do with stress and with limitation of the general reactions of the organism under stress, in contrast to the earlier preoccupation with presumed defects of the heart or the neurocirculatory apparatus.

In striving to attain, from a psychiatric point of view, a useful general perspective on reactions to stress, I have found myself repeatedly reminded of the importance of motivation or *effort*, both as a factor in the pathogenesis of breakdown under stress, and as a factor in the *defenses against* breakdown under stress. In regard to personal behavior in the conduct of life, it is almost axiomatic to say that, without some commitment to an objective, there is no such experience as stress. This, I suppose, is the basic reason why in colloquial speech the words stress and strain are so nearly synonymous—without motive, no effort; without effort, no strain; without strain, no stress. I speak thus as if motives were known and conscious, but the same principle seems true for motivations at an unconscious level. There are situations which regularly evoke fear and anger, almost without regard to prior commitments or purposes, but these are not exceptions to the general proposition. They are only special examples of motivation through emotional processes without much prior deliberation or intent, and they implement effort, which then determines a stress.

In military experience, when contrasted with ordinary life situations, it is even more evident that the setting of specific objectives determines effort, therefore strain, therefore stress. Indeed, one can say that the accomplishment of a military mission hinges on the management of effort—maximal short-term effort at the wisely

selected times and places, and steady, sustained, long-term effort to consolidate the gains. Military success seems to depend upon the potentialities of men for maximal short-term effort despite danger and for prolonged, sustained, concerted long-term effort.

With neatly contrived word-play of this general character, it might seem that a psychiatrist with a clever command of language could construct a scheme of psychological concepts so clever that physiology would appear unnecessary, but we all know that such is not the truth. The human organism—even granted strong motivation, clear objectives and uninhibited commitment—is still an organism with physiologically limited potentialities for effort, both in the short-term range and in the long-term range. So the psychiatrist must perforce acknowledge these physiological limitations and their variability in different individuals and under different conditions; just as the physiologist who would understand well the utilization or exhaustion of physiological resources needs some appreciation of the significance of motivation in determining the extent and pattern of effort and of stress.

Intricate neural, humoral and enzymatic mechanisms are involved in marshaling and expending energy and in restoring energy systems. The mechanisms involved in activating energy-conversions of various kinds for the exertion and support of effort are by no means foolproof. Signal systems can get fouled up and short-term reaction systems may be activated quite inappropriately. Physiological reactions well suited to support huge muscular exertion may be triggered in situations where the organism would be much better served by coolly discriminating, intellectual analysis, leading to intelligent evasive action. Or gastrointestinal reactions—vomiting or diarrhea—appropriate for eliminating noxious substances, may be set going by emotionally disgusting reactions, rather than by real substances. The human body, as an intricate system of physiological mechanisms, is, so to speak, full of unintended booby-traps for the inwardly confused, whereby physiological mechanisms, marvelously apt for certain purposes, may become destructive or even lethal.

From reports of civilian experiences in World War II we have hints of important specific differences in types of reaction to stress, and of qualitative differences in types of stress. We have stories of ulcer patients whose peptic ulcers gave no trouble in the stresses of concentration camp, and then the ulcers resumed their destructive and distressing progress upon the resumption of the patient's regular life, with its usual responsibilities, ambitions and competitions.

Such considerations accentuate the difficulty of arranging scientifically a situational scale of stresses. One man may be stressed by

a situation which provides positive pleasure to another. It all depends on what the situation means to the person, in terms of unconscious goals as well as conscious wishes. These individualistic meanings are of great interest in modern psychiatry. In colloquial terms, "It ain't what happens to you, it's how you take it that counts." Indeed, psychiatry might be usefully defined as *the science of understanding queer meanings, and the art of reestablishing communications which had become queered.* This has a lot to do with stress.

May I tell you briefly about an experiment on the meaning of stress, in which the subject was the dog called "Schnapps," now being studied in Dr. Gantt's laboratory by Dr. Dykman? Not long ago, this dog was being taught, through Pavlovian technic, to lift his leg in response to a sound signal. He had been receiving mild electric stimulation as a repeated hint to lift his leg at the right signal and he had learned his lesson well. Day after day he performed his lesson well. After some 200 such experiences, it was planned to introduce a new feature, in the form of a considerably stronger electric stimulation. We were interested in studying emotional factors in learning, and the shape of the learning curve. There was a slip in technic. The animal got a brief electrical stimulation to his leg, right off the light circuit. It must have been rather distressing, although not particularly harmful. Schnapps reacted with considerable motor activity and withdrawal, and the experiment could not be continued. Given a day's rest, he was still unmanageable for the experiment. He resisted being brought to the laboratory, except by a circuitous route. It appears legitimate to presume that the experimental room and fittings had acquired, through this experience, something of the quality of a stress to him. We may call this the "new meaning" to him of the experimental room. By much petting, gentle management and great patience, he was finally, after many days, gotten into the experimental harness, where his rapid heart rate, agitated breathing and general restlessness could be recorded. He was given a mild electrical stimulation, such as he had previously known. He responded by calmly lifting his leg. His general uneasiness subsided promptly, and he resumed the role of a well-behaved experimental subject—with certain minor exceptions, such as the preferred circuitous route between kennel and laboratory. What cured him? Apparently, the mild electric stimulation. And why? Apparently, because its mildness was reassuring and restored the earlier meaning of the situation. I feel much obliged to this dog because he provided this incident, told here to illustrate the meaning and the meaningful implications of the word stress.

Perhaps half of practical psychiatry consists in helping people unlearn the wrong meanings, and thus learn to take situations sensibly,

which taken otherwise have become intolerably stressful. It seems highly probable that in military training and in military operations, the best management of stress, particularly of phobic stress, may often consist in acquiring or restoring a commonplace meaning for what otherwise means a threat of catastrophe.

In this symposium we shall doubtless hear much about another general concept often employed in discussions of stress and adaptation—the concept of homeostasis. In physics we learned to define strain as the deformation produced by stress, and elasticity as the tendency to recover from such deformation. In physiology Cannon has taught us a high regard for those chemical, physical and biological features of organisms which serve to overcome deformation or restore favorable conditions. For the preservation of optimal or nearly optimal states in living organisms subjected to stress, these restorative mechanisms have high value, perhaps equal in importance to those mechanisms which directly subserve efforts to meet crises.

In following the course of certain definite phenomena empirically found associated with stress we may at times be in doubt whether the mechanism under observation, say eosinophil count or ketosteroid excretion, has direct relevance for emergency expenditure of energy or for restorative mechanisms. Some of these phenomena have been used as *indicators* of reaction to stress, without our knowing what sort of function they serve. It will be of great interest to see whether during this symposium we may learn more regarding the functional value of some of the reactions to stress which have often served to the investigator simply as indicators.

A considerable portion of this symposium consists of reports from active military operations. From them we should get tentative insights into problems and how they may be susceptible to more definitive study and experimentation. Some of us will have particular interest in the reports relating to replacement and rotation practices. Some of the policies which have been tried out were advocated in high hopes of reducing stresses. It will be very interesting to learn in what ways new stresses may have been developed in relation to rotation. Perhaps we shall hear something about "rotation stress" or "rotation exhaustion" just as we saw, in World War II, instances of "replacement-depot exhaustion" and even "hospital exhaustion."

One of the potentially valuable features of this symposium will lie in the opportunity afforded for the cross-fertilization of ideas which may occur in the discussion periods, between workers of very different viewpoints and approaches.

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ACUTE AND SUSTAINED HIGH ENERGY OUTPUT [1]

WALLACE O. FENN, PH. D.

My subject is high energy output, acute and sustained, and the specific mention of energy limits me automatically to the type of stress which can be applied to the organism by the excessive use of muscles. In no other location in the body is it possible for energy turnover to reach such high levels. Considering the body as a whole, the maximum rate of oxygen consumption in the steady state has been recorded as 5.35 liters per minute. With a resting rate of oxygen consumption of 250 cc. per minute this represents more than a 21-fold increase. In terms of horsepower this means an increase of 0.12 horsepower to 2.6, or an increase from 90 watts to 1925 watts. We shall consider later what this 21-fold increase in steady energy output means in terms of oxygen supply but for the present let us consider the possible increase, not in steady energy output, but in temporary or instantaneous output. In the body as a whole a 100-yard dash represents perhaps the maximum in temporary violent exercise. In this process the oxygen requirement is about 30 liters per minute, or 14.4 horsepower. In the approximately 10 seconds required for a 100-yard dash only perhaps ½ liter of oxygen could actually be burned in the muscles, so that the runner will terminate his run with an oxygen debt of about 5 liters, which is about one-third of the maximum oxygen debt possible. So far as his oxygen supply is concerned, he could run a 300-yard dash equally well but muscle fatigue or impairment would undoubtedly occur to diminish his speed toward the end.

Thus in the whole body over short periods the overall rate of energy expenditure or the rate of going into debt for oxygen might be increased from 250 cc. per minute to 30 liters per minute, or about 120-fold. In the body as a whole we obtain only a figure which is averaged over periods of contraction and relaxation and no allowance is made for the continuous energy needs of nonmuscular parts of the body. When, however, a resting isolated muscle is suddenly stimulated, there is a sudden energy explosion and during the actual contraction the rate of initial heat production may be 1,000 times as great as the rest-

[1] Presented 16 March 1953, to the Symposium on Stress, Army Medical Service Graduate School, Walter Reed Army Medical Center, Washington, D. C.

ing heat rate. In comparison to these figures for muscles, the kidney may increase its rate of oxygen consumption four times, according to old figures of Barcroft, when excretion of urine is increased by a diuretic like sodium sulfate or caffeine. No one has succeeded in measuring an increase in oxygen consumption by the brain when thinking begins, possibly because the electrical brain waves are always circulating uselessly when they are not purposefully directed. Nevertheless it is not impossible for the brain to drive the muscles so hard that the machine breaks down and the brain itself succumbs in the common catastrophe. Perhaps the classical example of this occurred after the battle of Marathon in 490 B. C. In that year, according to the story, the bronze-clad Athenian Army marched out on the plain of Marathon against the Persians. Among the foot soldiers was an Olympic runner, Pheidippides, who fought through that battle with his long spear and heavy shield. It was the same man who had already run for 2 days and 2 nights to Sparta for reinforcements, and he did not return by air. He must therefore have been in good condition for after the battle he discarded his heavy weapons and ran 26 miles the same day to Athens, only to fall dead in the outskirts of the city with the news of victory on his lips. Our annual Marathon runs still commemorate this epic feat.

An example of the death of horses from sheer exhaustion is commemorated in the poem describing how "Dirk, Joris, and I" set out on horseback to "carry the good news from Ghent to Aix." Dirk and Joris both lost their mounts after hard galloping for some 8 to 10 hours. As to Joris's horse—

> ". . . one heard the quick wheeze
> Of her chest, saw the stretched neck and staggering knees,
> And sunk tail, and horrible heave of the flank
> As down on her haunches she shuddered and sank."

Dirk's horse met a similar fate, for—

> ". . . all in a moment his roan
> Rolled neck and croup over, lay dead as a stone."

The narrator reached Aix safely but his horse collapsed on arrival—

> "And all I remember is friends flocking around
> As I sat with his head 'twixt my knees on the ground."

Certainly it requires strong motivation to run one's self to death. Under ordinary circumstances the afferent impulses from the exhausted muscles play a prohibitive role at the ventral horn cells and the efferent impulses are stopped at the barrier or some more central point. Under the influence of sufficient excitement accompanied perhaps by liberation of adrenalin this barrier is broken down and the efferent discharge may continue until the crucial oxygen supply of

the heart itself fails and collapse ensues. Before this catastrophic ending, however, much occurs of physiological interest and perhaps something can be done to forestall disaster. We must now consider what the factors are which eventually cause exhaustion and stoppage of the work.

Figure 1 shows the oxygen required per minute for running at different velocities. The curve follows the data of Sargent (1926) for velocities between about 10 and 20 miles per hour and is extrapolated to the resting rate of oxygen consumption at zero velocity. The shape of the curve indicates that the requirement varies as the 3.8 power of the speed. At 10 miles per hour, which is about the speed of a Marathon run, the requirement is about 4 liters per minute, which is about the maximum possible rate of intake for a good athlete.

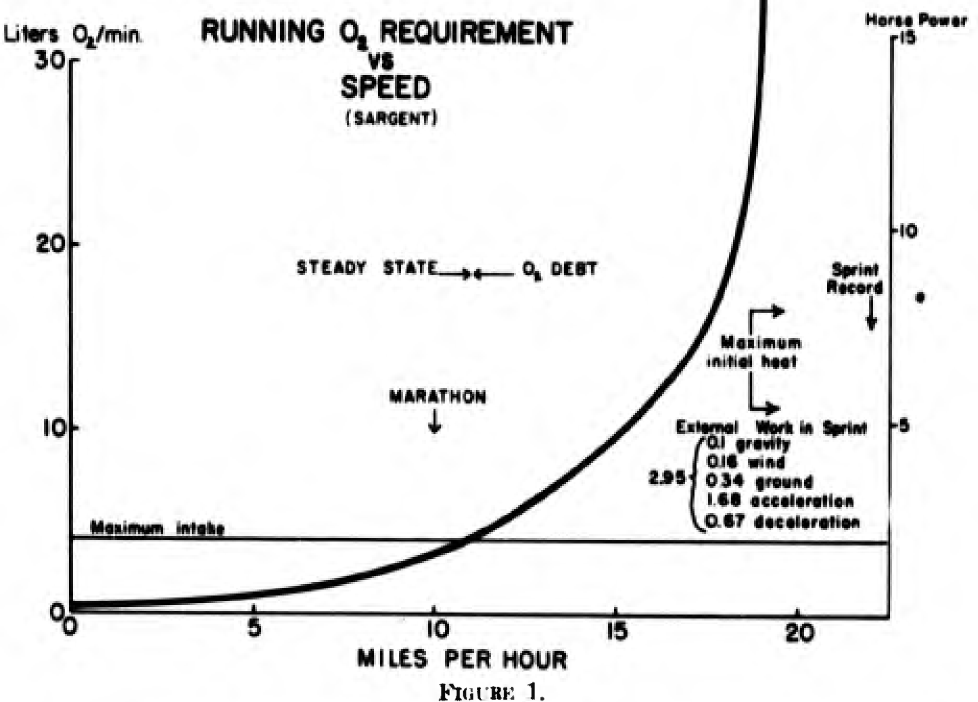

FIGURE 1.

This of course varies with the size of the man and the maximum recorded value is 5.35 liters per minute, as already mentioned (Robinson, *et al.*, 1937). Average non-athletic subjects will find 3 liters per minute a difficult value to attain.

A 100-yard dash can be run in a little over 9 seconds, which gives an average velocity of 22.6 miles per hour.[2] The oxygen requirement—or, in effect, the rate of going into debt for oxygen—is about 30 liters per minute. In 9 seconds this is only 4.5 liters, of which about 0.5 could have been taken in during the run. Since the maximum possible

[2] Note that the maximum speed attained by Sargent's runner was considerably less than this figure.

oxygen debt is recorded as about 18 liters, it is evident that in a 100-yard sprint it is impossible to reach complete exhaustion.

In my own measurements on sprinters (1930) I found a maximum oxygen requirement of 28.8 liters per minute, or 13.7 horsepower. From careful measurements of high-speed moving pictures of runners I calculated the work actually done in sprinting. The chief factor was the work of alternately accelerating and decelerating the arms and legs. Assuming that the whole race is run at top speed and making no allowance for the initial acceleration or final deceleration, I could find 3.95 horsepower in actual external work rate. This represents 21.5 percent of the total oxygen, a reasonable figure for the overall efficiency; and about 50 percent of the calculated "initial" or anaerobic energy.

The main factor which brings about exhaustion is the oxygen supply (Hill and Lupton, 1923). If this is the only factor, then it is a simple matter to calculate from data already given the maximum duration for the expenditure of energy at any rate. It is found that the external horsepower, $H_t = 0.4 + \frac{1.8}{t}$. The graph of this equation is plotted in figure 2 and should represent the endurance time for different levels of horsepower. The rectangular area under the curve at any point equals the volume of oxygen used from income or credit at exhaustion. The fraction due to the O_2 debt is indicated by shading, and that from income is the unshaded area underneath. Comparing this curve with

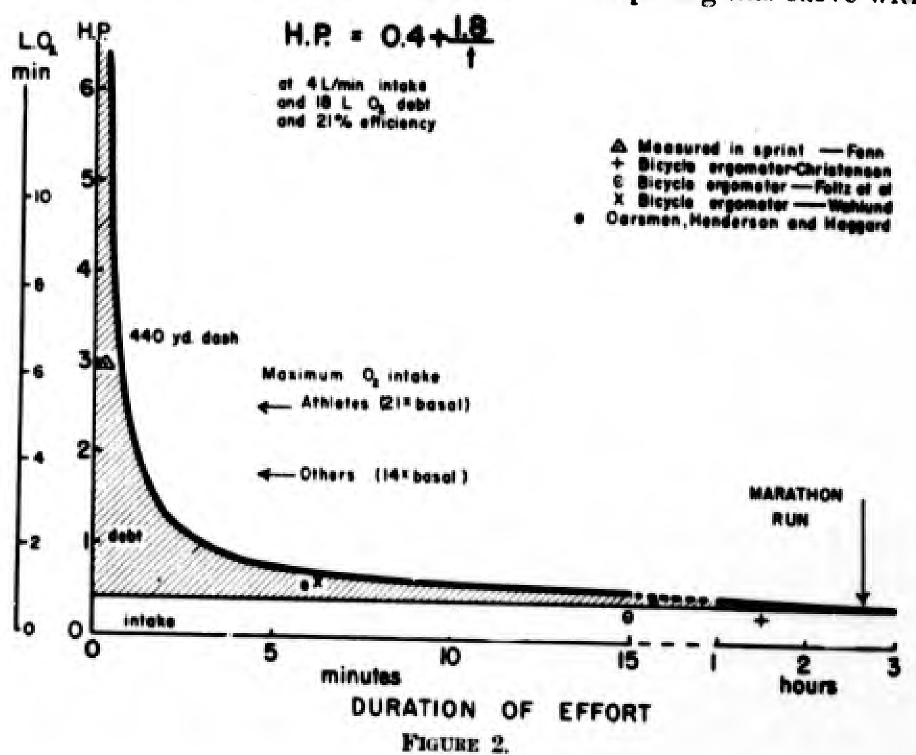

FIGURE 2.

actual experimental observations suggests that the total work measured must be less than the amount actually performed, probably because the cost of isometric contractions and extraneous body movements is not included. The calculated curve is certainly a maximum and the actual performance would be less if carbohydrate supply or the dissipation of heat became limiting factors. These will now be considered.

Carbohydrate can become a limiting factor in prolonged efforts. Assuming 1.8 percent glycogen in 28 kg. of muscles and 10 percent glycogen in the 2.1 kg. of liver in a 70 kg. man, the total glycogen is 710 gm. If only glycogen is burned by an O_2 intake of 4 liters per minute, this would last 2.2 hours or a little less than the record time of 2.6 hours for the 26-mile Marathon run. For this reason the runners sometimes take candy or drink sweetened tea on the way.

The necessity of dissipating all the heat produced in the muscles means that some blood must be used to bring this heat to the surface where it can be lost by radiation or evaporation. Assuming that 25 percent of the heat is lost by evaporation in the lungs, then the loss of heat in the skin is given by the following equation in terms of $\dot{V}_{O_2}$, the O_2 used per minute in liters, the blood flow to the skin $\dot{Q}_s$ in liters per minute, and the mean A–V temperature difference of skin-cooled blood, $\Delta T°C$.

$$\dot{V}_{O_2} \times 0.75 \times 5 = \dot{Q}_s \times \Delta T°C \times 0.85,$$

or

$$\dot{V}_{O_2} = \dot{Q}_s \times \Delta T°C \times .226$$

Here 5 is the caloric value of a liter of O_2 in kg. cal., 0.85 is the specific heat of blood in kg. cal. per liter, and 0.75 is the fraction of the total heat lost through the skin, the remainder being assumed to be dissipated by evaporation in the lungs.

For a runner consuming 4 liters of O_2 per minute and a normal mean skin temperature of 30° C. this gives a cutaneous flow of

$$4 \Big/ \left(.226 \times \frac{37-30}{2} \right) = 5.05 \text{ liters per minute.}$$

This is an appreciable fraction of the total blood flow even if the cardiac output is as great as 30 liters per minute. If, however, the day is so warm and humid that the necessary amount of heat cannot be dissipated without an elevation of the skin temperature to an average of 33° C.; then the necessary cutaneous blood flow must be 8.8 liters per minute (table 1). Much if not all of this blood would be wasted

Table 1. Cutaneous Blood Flow

$\dot{V}_{O_2} = .226 \times \dot{Q}_s \Delta T$

$\dot{V}_{O_2}$ L/min.	Temperature body	skin	ΔT	$\dot{Q}_s$ L/min.
0.25	37	30	3.5	0.31
4.0	37	30	3.5	5.05
4.0	37	33	2.0	8.8
4.0	39	33	3.0	5.9

so far as oxygen transport to the muscles is concerned and it is therefore doubtful whether an intake of 4 liters of oxygen per minute could be maintained without an elevation of body temperature. Thus the elevation of body temperature which results from severe exercise may be regarded as a compensation to provide an elevation of skin temperature without additional cutaneous blood flow. This example shows clearly how oxygen transport and heat dissipation compete for blood flow in severe exercise.

In times of stress when the oxygen transport facilities are hard pressed it is oxygen tension rather than oxygen content which limits the performance. The total oxygen tension available at sea level, PI_{O_2}, is 150 mm. This is divided into five different non-overlapping fractions with possible absolute values in mm. Hg. for rest and work, as follows:

	Rest	*Work*
1. Airway gradient, P_a	50	50
2. Pulmonary diffusion gradient P_p	10	40
3. Circulatory gradient, P_c	35	15
4. Tissue diffusion gradient, P_t	25	40
5. Enzyme gradient, P_e	30	5

These gradients may be more accurately defined as follows: The airway gradient, P_a, is the difference between ambient and alveolar oxygen tension. P_p is the difference between alveolar and the mean pulmonary capillary tension. P_c is the difference between mean pulmonary and mean tissue capillary tensions. P_t is the difference between mean tissue capillary tension and the lowest oxygen tension in the tissues. P_e is the extra tension which remains for the saturation of the oxidative enzymes in the tissues. The mean capillary oxygen tensions are averaged over the whole length of the capillary and represent the tension which would cause the same transport of oxygen if it could be maintained constant throughout the length of the capillary.

The relation between these gradients and the O_2 flux $\dot{V}_{O_2}$ is as shown in table 2. In each case the flux of O_2 is equal to the product of the

pressure gradient by a diffusing capacity, D, or a flow factor or air ($\mathring{V}_A$) or blood ($\mathring{Q}$) (both in liters per min.). The electrical analogy is Ohm's law, where current $=$ voltage $\times \frac{1}{\text{resistance}}$. The oxygen flux from air to tissues is comparable to the flow of electricity through a series of resistances. The diffusing capacities (D_p and D_t) are defined by the equations and equal the cc. of oxygen diffusing per mm. difference of pressure.

Table 2

		Airway	Lung diffusion	Tissue diffusion	Tick equation	Heat loss in skin
	$\mathring{V}_{O_2}$	$= \frac{K}{R}(\mathring{V}_A \times P_a)$	$= D_p \times P_p$	$= D_t \times P_t$	$= \mathring{Q}(Ca_{O_2} - C_{O_2})$	$= 226\mathring{Q}_s \Delta T°C$
Rest	259	$= 5 \times 50$	$= 25 \times 10$	$= 10 \times 25$	$= 5 \times 50$	$= 226 \times 0.32 \times 3.5$
Work	4,000	$= 80 \times 50$	$= 100 \times 40$	$= 100 \times 40$	$= 25 \times 160$	$= 226 \times 5.0 \times 3.5$

Numerical values given below the equations help to visualize the changes which are necessary for a 16-fold increase in the rate of oxygen intake. In the airway equation the value of K/R is taken as 1.0 which is nearly true when the exchange ratio $R=0.86$. Thus in the airway equation it is indicated that the alveolar ventilation increases in proportion to the increased rate of oxygen intake so that the alveolar composition remains unchanged. The airway oxygen gradient therefore remains at 50 mm. regardless of the severity of the stress. In the lung, however, it is suggested that the diffusion capacity increases from 25 to 100 cc. per mm. *Hg.*, while the diffusion gradient itself is increased from 10 to 40 mm. There is little direct evidence for an increase in the diffusing capacity of the lungs in exercise but it is difficult otherwise to account for a 16-fold increase in $\mathring{V}_{O_2}$. Roughton (1945, however, has calculated a little less than a 2-fold increase for a much less violent increase in work rate. An increase in the average pulmonary diffusion gradient from 10 to 40 mm. is not impossible when one remembers that at rest the blood is probably saturated with oxygen before it is more than one-third of the way through the capillary. If the blood flow increases five times, as indicated by the Fick equation, then the arterial blood is probably not quite saturated at the arterial end. In the tissues it seems probable that the increased diffusion is more easily met by an increase in the number of open capillaries. Therefore, a 10-fold increase in D_t is assumed and only a 1.6-fold increase in diffusion gradient. Between the lungs and the tissues, therefore, we have used 40+40 mm. out of the 100 mm. available in the alveoli.

Although arterial blood may bring blood at practically alveolar tension into the tissues, it seems impossible that the sum of the pulmonary and tissue mean diffusion gradients could exceed the total in the alveoli. In other words, *it is impossible to use the same head of pressure for both diffusion barriers.* There will always be some difference between the mean oxygen tension in the pulmonary capillaries and the mean tension in the tissue capillaries. This difference is the component of the total oxygen pressure which may be regarded as "wasted in the circulation." It belongs to the circulation because it is always diminished by an increase in the cardiac output. It could not decrease to zero except with infinite cardiac output. This seems to be the real reason why the cardiac output must increase in exercise. Any oxygen tension which is not used in the pulmonary and the tissue diffusion beds and is not "wasted in the circulation" will be left over to provide an adequate pressure head to saturate the oxidative enzymes. While it is a common belief that the rate of oxygen consumption is independent of the oxygen pressure as long as there is 1 or 2 mm. available, this is not certain for mammalian tissues in situ. It has been accurately established only for bacterial cells at low temperature (Warburg and Kubowitz, 1931) where the affinity of the enzymes for oxygen may be much greater than it is at body temperature. Like hemoglobin the affinity of enzymes for oxygen may vary with *pH*, temperature, salts and other factors (Kempner, 1937).

The Fick equation represented in table 2 is too familiar to require further discussion. The figures given suggest that the 16-fold increased oxygen intake is accomplished by a 5-fold increase in cardiac output and a 3.2-fold increase in *A-V* oxygen difference. For the loss of heat to the skin the example suggests that this is accomplished by a 16-fold increase in cutaneous blood flow. Unless there is some increase in blood flow to the skin the body temperature would be expected to rise about 1° C. every 4 minutes with an oxygen intake of 4 liters per minute. The rise of body temperature which occurs in exercise therefore is to a certain extent a compensation to economize on blood flow requirements, although it may become a hazard and cause of collapse if it is carried too far.

As a graphic description of the marvelous effectiveness of the lungs and circulation in transporting oxygen, we might calculate the "physiological thickness" of a man at rest and at work. Using a formula first applied to the diffusion of oxygen into nerves (ref. 12) it can be shown that 70 kg. of tissue using 4L of oxygen per minute would have to be drawn out into a cylinder 672 miles long and 0.14 mm. in radius to obtain the necessary oxygen by direct diffusion from air.

At rest a radius of 0.57 mm. and a length of only 42 miles would suffice. Such is the integrating influence of the heart and lungs.

By way of summary we may return to the tragic fate of Pheidippides and inquire into the cause of death, or, in less extreme cases, the cause of fatigue and impaired performance which results from severe energy expenditure near the limit of tolerance. In this situation the subject may be moving 113 liters of air per minute and pumping 25 liters of blood per minute. His heart rate may be close to 180 beats per minute. According to Balke (1952), any increase in heart rate above that level is a sign of impending collapse. If the heart rate can be stabilized at a given rate of exercise, according to Christensen (1931), the work can be continued more or less indefinitely. If the heart rate steadily increases, then it is evident that the oxygen tension has fallen to zero at some point in the muscles and the oxygen debt is increasing with consequent impairment in the performance. This results presumably from afferent impulses from the encumbered muscles, which disturb the neuromuscular coordination. A similar effort may be produced by a low blood sugar which may occur if the exercise has been prolonged. Meanwhile, kidney function has been depressed because of limitation of renal blood flow, intestinal motility is low, and the visceral blood flow diminished. If severe effort continues beyond the point of tolerance because of some supreme motivation, the heart rate continues to increase but the stroke volume falls, the cardiac output diminishes, oxygen supply even to the brain and heart becomes inadequate and collapse occurs. If death results it must be supposed that it is due to the heart. Hunters have reported, for example, that antelope chased to the point of death by a jeep have greatly dilated hearts. It is not difficult to see how extreme anoxic dilation of the heart could cause collapse and prompt cessation of voluntary effort but it is not so easy to see how this could cause death. It seems more probable that as the heart rate increased the refractory period shortened and conduction in the fibers slowed even though *A-V* conduction may have increased because of the action of the sympathetic. Under these conditions an extra ventricular systole may readily occur at a time when the myocardium is partially refractory so that ventricular fibrillation may be initiated. A death of this sort was well documented recently in Rochester in a patient who died from this cause while recording his electrocardiogram (Personal communication—Dr. A. M. Wedd). We may conclude, therefore, with the conjecture that Pheidippides died from overshortening his cardiac refractory period, an extraventricular systole before recovery was complete in all the cardiac fibers and, therefore, ventricular fibrillation.

What then can we expect of men under the stress of acute and sustained high energy output? I have given a simple equation from which a commander can calculate the maximum possible duration of effort at every horsepower level, provided oxygen transport is the limiting factor. On a warm day he might need a modified equation to include the blood flow required for heat dissipation. If he is worried over the fuel supply of his men and gives them candy for quick energy the blood flow requirement for intestinal absorption may force the use of still another equation. And I have left to later speakers all consideration of the important role of the adrenal cortical hormones. But even this is not all; it is not the half of it. These equations describe the machinery or the means but the motivation and morale are equally or even more important—machinery and morale, and the greater of these is morale. The practical answer to the military problem of stress comes then in the latter half of this Symposium.

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THE ADJUSTMENT OF OXYGEN SUPPLY TO OXYGEN DEMAND IN ORGANS*

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The theme of this discussion is the following statement by Joseph Barcroft (ref. 1, p. 73): "There is no instance in which it can be proved that an organ increases its activity, under physiological conditions, without also increasing its demand for oxygen." When Barcroft came to this conclusion he had enough experimental evidence (much of it from his own recent studies) to make it plausible, but his use of a negative rather than a positive statement indicates a defensive attitude and implies that he had some doubts about the general validity of his proposition. In the subsequent 40 years any such doubts have been dispelled by a large amount of evidence, obtained by many workers employing different methods and studying different species, including man. It is now possible confidently to restate Barcroft's rule in positive terms as follows: "Increase in the activity of any organ, under physiological conditions, entails a corresponding increase in its demand for oxygen."

For the purpose of further inquiry into the relation of this proposition to stress, some of the pertinent data have been assembled in table 1, which is slightly modified from a compilation made by H. C. Bazett (ref. 2). The calculations are based on a man weighing 63 kilograms and having at rest a cardiac output of 5.4 liters and an oxygen consumption of 250 cc. per minute. The values for cerebral blood flow at rest are from measurements in man but those during a convulsion are extrapolated from the changes observed in the rhesus monkey (ref. 3). The figures for the coronary circulation under the stress of anoxia are based on measurements made in dogs by the coronary sinus catheterization-nitrous oxide method (ref. 4). All the others are derived from direct measurements on man. No figures are presented for the effects of increased activity of the liver or kidney because of uncertainty as to how such increases should be brought about.

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Table 1. Relationship of Activity to Oxygen Demand

Region	Weight		O_2 Uptake		Blood flow		Effluent venous blood	
	Kg.	Percent of total	Cc. per minute	Percent of total	L. per minute	Percent of total	O_2 saturation of effluent venous blood, percent	pO_2 corresponding O_2 tension, mm. Hg.
Entire body	63.0	100.0	250	100	5.4	100.0	73	40
Liver and intestines	2.6	4.0	50	20	1.4	26.0	80	45
Kidneys	.3	.5	18	6	1.3	24.0	90	62
Brain at rest	1.4	2.0	57	23	.75	14.0	65	35
Brain convulsion			100	40	1.05	20.0	55	30
Heart at rest	.3	.5	22	9	.2	4.0	30	18
Heart anoxia			33	13	.4	8.0	16	12
Total of above at rest	4.6	7.0	154	58	3.7	70.0		
Muscles at rest	31.0	50.0	50	20	.84	15.5	65	35
Muscle exercise			3,000	95	20.0	84.0	25	16

Oxygen Requirements of Brain

From these findings a number of questions of major importance arise. First, why should the brain, comprising only 2 percent of the body weight, require 23 percent of the oxygen uptake of the whole body at rest, and why should this be increased to 40 percent during a convulsion? The oxygen presumably is used to release the potential energy stored in the foodstuffs undergoing oxidation, and this energy then is available for carrying out the functions of the corresponding cells. In the case of the heart and the skeletal muscles, these functions involve mechanical work and can be measured in appropriate units. The kidneys and the various glands elaborate a secretion against osmotic gradients and this involves an understandable and measurable amount of work. But the brain cells, as Warburg (ref. 5) emphasized many years ago, have no obvious need for free energy, since they do not contract, move, divide or grow, nor do they elaborate any secretion comparable with that of the digestive glands or kidneys. The well-known fact that the brain cells are the most sensitive in the body to oxygen-lack, and are likely to suffer irreparable injury from anoxia which the rest of the body can tolerate, indicates that the oxygen requirement of the central neurons is fundamental and indispensable. The increased cerebral oxygen consumption associated with a convulsion indicates that the former is closely related to the functional activity of the organ.

In the opposite direction, a decrease in cerebal functional activity also is known to coincide with a decrease in cerebral oxygen uptake. This has been demonstrated for anoxia, anesthesia, insulin coma and post-convulsion depression in the monkey (ref. 3), for anesthesia, insulin coma, diabetic acidosis and post-convulsion depression in man (ref. 6). The validity of Barcroft's rule for the brain, therefore, has been well established. Demonstration of parallelism between cerebral functional activity and cerebral oxygen consumption, however, does not explain the relationship. In the present state of knowledge one can only speculate about the manner in which the brain cells utilize the free energy liberated by oxidation and the relation of the energy requirement to functional activity. Attention has been directed elsewhere (ref. 7) to the possibility that synthesis of unstable chemical transmitters or amplifiers, with the acetylcholine cycle as a prototype, may serve as a partial explanation. Further discussion at this time seems inappropriate.

Satisfaction of Increased Oxygen Requirement

Granted that Barcroft's rule holds true, and that a reasonable explanation has been derived for the parallelism between functional activity and oxygen consumption, the next major question is: How is the increased oxygen requirement satisfied?

Here again Barcroft (ref. 1, p. 105) wrote a negative answer, as follows: "In our discussion of the call for oxygen we have reviewed the activity of many organs of the body, muscle, heart, kidney, secreting glands and absorbing epithelium; these organs are excited by the most diverse forms of stimulus, electrical stimuli, hormones, drugs, etc., and evince their activity by doing work of the most diverse kinds; in one respect only do they resemble one another; namely, that in no organ excited by any form of stimulus can it be shown that positive work is done without the blood supply having to respond to a call for oxygen."

This statement, like the one quoted previously, has been thoroughly substantiated by subsequent work. In table 1, examples are cited for the brain (during a convulsion) and for the coronary circulation (during inhalation of 8 percent oxygen, as in a clinical anoxemia test). In both cases the increased blood flow is brought about primarily by a decrease in vascular resistance in that particular organ. No change in the circulation in other organs would be required to bring this about. In both regions there is reason to believe that the intrinsic control is more dependent on chemical than nervous factors and is vasodilator rather than vasoconstrictor in direction.

An example in the cerebral circulation is the temporary increase in blood flow in the visual cortex produced by illuminating the eye of an anesthetized, curarized cat under constant artificial respiration (ref. 6). Such an effect might be due to one or all of the following: (1) a primary local increase in metabolic activity leading to increased production of vasodilator chemical products of metabolism; (2) involvement of vasodilator nerves (the existence of which in the brain is well established) in the nerve discharge aroused by illumination of the retina; (3) local chemoreflex mechanisms activated by the altered metabolism in the cortical cells and bringing about a decrease in tonus in the arteries supplying them. As pointed out elsewhere (ref. 6), there is at present no means for evaluating these and it is probably best to hold that all of them may be involved.

In the case of the coronary circulation the situation is similar in the main to that in the cerebral. The available evidence indicates these differences: (1) The coronary circulation is more responsive to changes in the oxygen tension than in the carbon dioxide tension of the arterial blood, whereas in the cerebral circulation the reverse relation exists; (2) the coronary arteries can be strongly constricted by at least one chemical substance, viz., the pressor fraction of posterior pituitary extract, whereas no substance capable of producing a functionally important constriction of the cerebral arteries has yet been discovered. Effects of the latter type can be produced either by decreasing the arterial pCO_2 (as by hyperventilation) or by increasing the arterial pO_2 (as by oxygen inhalation), but of these the former has proved much the more powerful in the subjects thus far studied. Neither of these changes produces an important constriction of the coronary arteries. This is fortunate because both changes are frequently encountered, and a spasm of the coronary arteries might lead to fatal ventricular fibrillation, whereas cerebral vasospasm causes only temporary disturbances (dizziness, clouded consciousness, perhaps focal epilepsy, or paresis, transient aphasia, etc.).

As far as is now known, the ability of posterior pituitary hormone to constrict the coronary arteries has no implications with respect to the normal control of coronary vascular tonus. The normal regulation presumably is dependent upon and probably is brought about by the vasodilator effect of low oxygen tension in the myocardium upon the coronary arteries (refs. 8 and 9). The possibilities are the same as those enumerated for the cerebral circulation, viz.: (1) a direct effect of low oxygen; (2) vasodilator nerve impulses carried to the coronaries from without; (3) intrinsic chemoreflexes aroused from receptors located in the myocardium and sensitive to oxygen

lack. As in the case of the cerebral circulation, it is impossible at present to evaluate these.

So far the discussion has centered around four organs (the liver, the kidneys, the brain and the heart) which together comprise only 7 percent of the body weight, but account for 58 percent of the total oxygen consumption at rest, and in so doing require 70 percent of the total cardiac output. The muscles, representing 50 percent of the body weight, under resting conditions call for only 20 percent of the total oxygen consumption and 15 percent of the cardiac output. But when the muscles become more active, as during exercise, a totally different situation is created. The oxygen consumption increases in direct proportion to the increased work and may reach a total of more than 4 liters per minute. In table 1 a figure of 3 liters per minute is assumed for muscle oxygen consumption during exercise. If the oxygen requirement of the other tissues remained unchanged, the total oxygen consumption now would be 3,154 cc. per minute, which is more than 12 times the resting level.

This could not possibly be met by the resting cardiac output of 5.4 liters per minute. Since the oxygen content of arterial blood is seldom more than 20 volumes percent, the 5.4 liters of blood could deliver at most only one-fifth this amount of oxygen or approximately 1 liter per minute. This would necessitate complete extraction of all the oxygen—a situation that would involve zero oxygen tension in the tissues. It is evident that the stress of muscular exercise necessitates an increase in cardiac output, and in table 1 an increase to 20 liters per minute is assumed. With such an increase it is possible to meet the increased oxygen requirement of the muscles without sacrificing the other tissues and with a reduction of the oxygen tension in the muscles to 16 mm. Hg.—a low but not dangerous level for this rugged tissue. The increased cardiac output presumably is dedicated entirely to the needs of the exercising muscles, which now account for 84 percent of the total.

How is this increased circulation to the muscles brought about? The situation is analogous to the respiratory adjustment to exercise. According to present evidence (refs. 10, 11, and 12), this is brought about by a complex interplay of a number of factors which are individually small but collectively large. They may be grouped in the following categories:

A. *Certain factors*, i. e., those concerning whose existence there is little doubt although they are not necessarily the most powerful. These include reflexes from the exercising limbs (ref. 13), irradiation of impulses from the cortex to the exercising muscles (ref. 14), and afferent impulses aroused in the respiratory passages and alveoli by

irritation (from deep breaths of cold air) or excessive distention (ref. 15).

B. *Inconstant factors*, i. e., those which may or may not be involved. They will unquestionably contribute to the end-result if they are involved, but can be absent without appreciably diminishing the total response and therefore are not essential to it. These include increased chemical stimulus (increased arterial carbon dioxide tension, hydrogen ion concentration or other agents) acting directly on the center; increased temperature acting directly on the center or through reflexes aroused in heat-sensitive nerve receptors; and reflexes from the carotid and aortic chemoreceptors, set up by an appropriate decrease in arterial pO_2 or pH or a sufficient increase in arterial pCO_2.

C. *Uncertain or problematical factors*, i. e., those whose existence is established but whose significance is unknown, or whose very existence remains to be determined. These include reflexes from chemo- or thermoreceptors in the exercising muscles; reflexes from the arteries (other than the carotid and aortic chemoreceptors), veins and heart; reflexes from the pulmonary vessels; unidentified chemical excitants acting directly on the center or reflexly; and totally undiscovered reflexes.

At present it appears most probable that the respiratory and cardiovascular adjustments to muscular exercise are usually brought about by factors in the A and C group, those in the B category being reserved for the second (direct action of pCO_2 or pH on the center), third (temperature stimuli) and fourth or final (carotid and aortic chemoreflexes) lines of defense in case the others prove insufficient.

Anoxia

Finally comes this question: What happens if the increased call for oxygen is not met? This is of paramount importance in the present discussion of stress, and the answer can be given in one word: Anoxia. The consequences of anoxia are manifested in different ways in different organs, but they can be summarized adequately in the words of Haldane (ref. 16): "Anoxia not only stops the machine, it wrecks the machinery." Anything that entails anoxia will therefore lead to decreased functional activity, decreased ability to utilize oxygen, and eventually to structural changes from which recovery is likely to be slow, imperfect and perhaps totally lacking.

Anoxia can be produced in one of four main ways:

1. By reducing the amount of oxygen in the blood (anoxemia).

2. By reducing the volume of blood supplying the tissue or organ (hypokinemia), either at the arterial (ischemic) or venous (congestive) side.

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3. By increasing the demand for oxygen until it exceeds the available supply even though this be normal or increased (overutilization).

4. By interfering with the activation of molecular oxygen by tissue enzymes (histotoxic).

The end-result will be the same from all, though the management will of course differ according to the cause of the disproportion between oxygen demand and oxygen supply. As far as stress is concerned, it is important to emphasize item 3, for which the term Overutilization Anoxia seems appropriate. In direct studies of cerebral oxygen consumption in monkeys it was found that the phase of depressed cerebral activity following a convulsion (produced by intracarotid injection of metrazol or picrotoxin) coincided with decreased ability of the brain to take up oxygen from the blood (ref. 3). Corresponding observations have been made on human schizophrenics in the depressed state following electro-shock therapy (ref. 17). Recovery of cerebral functions in the monkey coincided with return of cerebral oxygen uptake and the general picture was indistinguishable from that produced by hemorrhage (ref. 3), although the latter involved a pure decrease in cerebral blood flow and metabolic activity, the former an initial marked increase. These findings are compatible with the view that the depression of cerebral function and oxygen consumption following the convulsion was the result of cerebral anoxia, produced by increasing the oxygen requirement of the brain to such an extent that it could not be satisfied even by the concomitant increase in cerebral blood flow.

That the depression of function after the convulsion is related to the convulsion rather than to the direct effects of the convulsant agent is seen in the phenomena of acute cyanide poisoning. This, following intravenous injection of an appropriate dose in an intact dog, produces intense stimulation of respiration and circulation, culminating in violent, generalized convulsions, which are followed by a prolonged period of unconsciousness. In some animals (though not in all), denervation of the carotid and aortic bodies makes the injection of the same dose of cyanide completely ineffective (ref. 18). The absence of stimulation of respiration and circulation is readily understandable, but the failure of cyanide to produce visible depression of the brain when there was no preceding stimulant phase indicates that the depression ordinarily seen was due to the convulsion and not to the direct effect of cyanide on brain cells.

It is suggested that Overutilization Anoxia is a possibility in any tissue in which the oxygen requirement may be greatly increased. Such phenomena as cardiac dilation following a bout of overexertion muscular weakness or temporary paralysis after exercise (particu-

larly in the presence of restricted circulation to the muscles), aggravation of an existing diabetes by a period of hyperglycemia, and perhaps even the degeneration of anterior horn cells following the spastic phase of poliomyelitis, may be examples of this general relationship. The severity of the anoxia elicited in an organ during a period of increased activity may be deduced from the concomitant changes in the oxygen tension in the venous blood leaving it. Appropriate values are given in the last two columns of table 1.

If the oxygen tension of the effluent venous blood remains unchanged under the stress of increased functional activity, the increased call for oxygen is being adequately met. If the oxygen tension rises, the vascular compensation is relatively excessive. If, however, the oxygen tension falls, the compensation is inadequate and the organ is in danger of anoxia. As will be seen in table 1, the latter appears to be the case in every instance there cited. Further studies from this viewpoint are now under way.

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THE VISCERAL CIRCULATION IN HOMEOSTASIS*

STANLEY E. BRADLEY, M. D.

The cardiovascular system has an amazing capacity for adjustment to a wide variety of stresses. Today I would like to talk to you about some of the ways in which the individual organ circuits are integrated in these readjustments. I do not propose to consider the mechanisms by which circulatory rearrangements are brought about. The factors involved are notably diverse and for the most part uncertain. Dr. Schmidt has already spoken of some of these factors, and perhaps later on he will have occasion to enlarge upon his comments.

For similar reasons it is difficult to assess the overall determinants of circulatory change. A long experience of study with the cardiovascular system under various stresses suggests strongly that the circulatory system is geared to maintain the arterial pressure as nearly constant as possible at some point close to the base of the brain, perhaps for the purpose of assuring a constant cerebral perfusion. Whether this is more than a strong impression, I cannot say.

In talking about circulatory homeostasis, we are using a term which is perhaps not properly applicable to the situation of readjustment to stress. "Homeostasis" is a very partial concept in this connection; it is a concept which applies to the body as a whole and not to its individual parts. Under conditions of stress of various kinds, for example, the renal circulation may be almost completely excluded and the kidneys' homeostasis is completely disregarded in favor of the body's homeostasis. Perhaps "pressure homeostasis" would be preferable.

Let us consider first the manner in which blood pressures are distributed through the body. In general we think of man and of animals as "recumbent" species. "Blood pressure" in man is always spoken of as if the patient is lying flat in bed. In reality this is not the case the better part of each day. And the arterial pressures we obtain in studies of the recumbent subject do not apply therefore under most circumstances. When a man stands upright, the arterial pressure changes in every blood vessel in the body. There is one point at which the arterial pressure does not change, and to this point we often attach the term "zero reference point" (ref. 1). Immediately after a tilt into the upright position the point at which the arterial

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pressure does not change appears to lie approximately at the level of the diaphragm. Then, as vasoconstrictive readjustments occur, the point of zero reference moves upward toward the base of the neck and there we find that the arterial pressure remains the same as in the recumbent position. But elsewhere in the body the arterial pressure falls or it rises. Above the zero reference plane the arterial pressure falls; below it, the pressure rises by just so much as the hydrostatic column or pressure increases. And this we have been able to prove to our own satisfaction again and again by determining arterial pressure in the artery in man in different positions, finding that the difference between mean pressures in different arteries can be accounted for entirely on the basis of the hydrostatic differences.

In the venous system the pressures vary widely also. Figure 1 is a diagram of the pressures which one may encounter in the superior vena cava, right atrium and inferior vena cava, a system which can be thought of as a single chamber separated dynamically by the activity of the heart. Here again we run into difficulty because we tend to think in terms of the vein in which we measure the pressure. It is convenient and more accurate to relate venous pressure to "reference plane" in recumbency, which lies on a line drawn through the center of the right atrium. In recumbent man, the reference plane lies approximately 10 cm. above the back, or 5 cm. below the angle of Louis. This plane is also used as a reference for arterial pressure in the recumbent position. In the upright position the venous zero reference plane shifts, but the point at which the venous pressure does not change is different in the two different parts of the caval system. In dogs Weed and his colleagues (ref. 2) found that the supra- and infra-diaphragmatic portions of the atrio-caval system were dynamically independent. Though not separated physically, pressure changes in one were not reflected in or transmitted to the other. In studies (refs. 1 and 3) with Dr. Wilkins and others at Evans Memorial Hospital in Boston we found that this was not entirely the case in man. Thus pressure changes in the inferior vena cava secondary to elevated intra-abdominal pressure by application of a tight binder resulted in slight increases in pressure in the superior vena cava; but, on the whole, the two systems remained relatively independent, and acted independently. In recumbency the pressures in the cerebral and abdominal veins are higher than the pressure in the auricle, and blood drains into the ventricle. Thus, there is a kind of "ravine" from the standpoint of venous pressure gradients, the bottom of which lies in the right auricle or ventricle depending upon the phase of the cardiac cycle in which pressures are measured (fig. 1). In the upright position the distribution of venous pressures changes markedly. The pres-

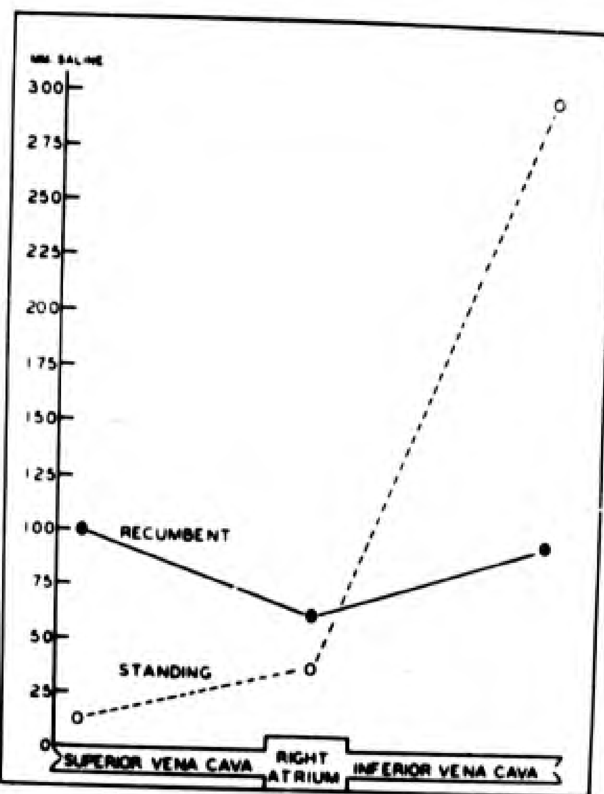

FIGURE 1. Venous pressures in the atrio-caval system in recumbent and the standing position.

These values were measured in the superior and inferior venae cavae, and the right atrium through a venous catheter. They are representative values obtained in a series of measurements (ref. 1). The superior vena cava pressure is shown immediately after tilting the patient to the upright position when the vein has been emptied of blood and almost collapsed. The pressure in the right atrium is given as the mean pressure. All values are referred to the midpoint of the right atrium.

sure in the inferior vena cava rises as a result of the marked hydrostatic shift (fig. 1). In the jugular vein the pressure may actually fall to zero with collapse of the veins, in the upright position. Nonetheless, blood continues to drain into the auricle.

In association with the redistribution of pressures in the circulatory system on assumption of the upright position there is a redistribution in the blood flow to different parts of the body, chiefly as a result of vasoconstrictive changes in resistance to flow, although the altered pressure level undoubtedly contributes. As a consequence, the initial hydrostatic shifts in arterial pressure are modified. In recumbency, approximately 1,000 cc. of blood flow through the cerebral vasculature each minute, 1,600 cc. through the splanchnic bed, 1,200

cc. through the kidneys, and 200 cc. through the heart. Thus, between them, splanchnic bed and kidneys account for approximately 50 percent of the total blood flow, or cardiac output, per minute. With assumption of the upright position, hepatic and renal blood flow decreases despite maintenance or rise in the mean perfusing arterial pressure (ref. 4). As the data presented graphically in figure 2 indicate, these changes occur in association with a fall in cardiac output. Since arterial pressure does not fall it is evident that compensatory vasoconstriction develops throughout the body. This response is evident in the arterial pressure pulse pattern. The systolic pressure tends to fall while diastolic pressure rises. The narrowed pulse pressure is clearly related to the fall in cardiac output and stroke volume. If the process progresses and compensation is inadequate, the blood pressure may suddenly fall in association with bradycardia and syncope ensues. Figure 2 (a composite of several studies) presents a typically adequate adjustment and illustrates the relative importance of the renal and hepatic circuits. The values are plotted semi-logarithmically to show the relative magnitude of change. Renal blood flow falls to approximately the same extent as cardiac output but hepatic (or splanchnic) falls much more, indicating a more marked vasoconstriction. It may be assumed that flow to the brain and other more important areas does not change very much, because it can be seen that the reduction in cardiac output is largely accounted for by the reduction in blood flow through the liver (or the total splanchnic bed) and through the kidney. The kidney and liver operate, therefore, as buffers in the cardiovascular system. Their large flows confer upon them the capacity of regulating arterial pressure by vasoconstriction and of supplementing cardiac output by diversion of blood; in general they tend to work together in performing this function.

Vasoconstriction occurring in the liver and the kidney under these circumstances may have detrimental effects on function (ref. 5). Thus, when the standing position is assumed by a patient with acute or chronic glomerular nephritis the fall of blood flow through the kidney is attended by an equivalent reduction in the glomerular filtration rate, as in normal people. This change is usually associated with a marked drop in urine flow and urinary output of sodium. These changes in urine formation tend to persist even after return to recumbency. It is possible that they play a role in the perpetuation of the abnormalities of regulation in renal disease. One may also speculate upon the relationship of the changes in hepatic blood flow to the alleged evil effects of activity upon the course of acute hepatitis. Exercise also seems to contribute to these ill effects of orthostasis and, as expected, it produces changes in circulatory dynamics. But does

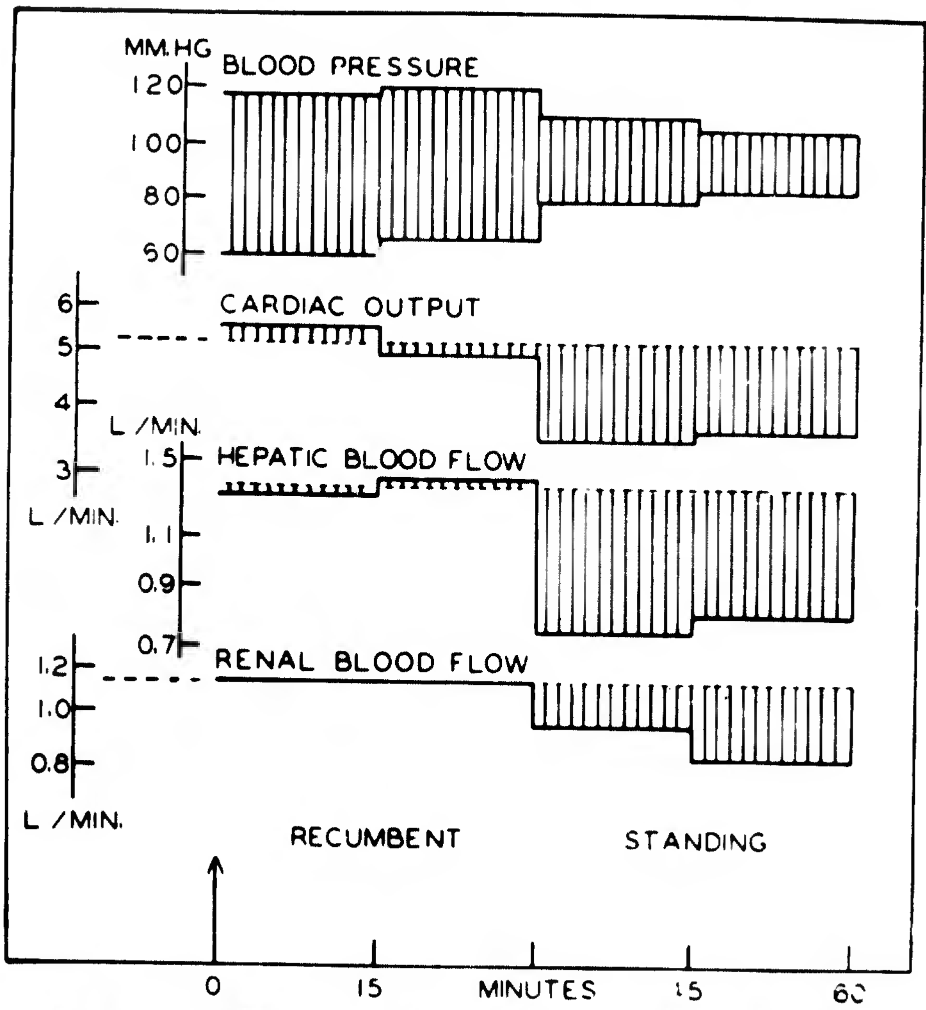

FIGURE 2. Effect of standing upright upon arterial pressure, cardiac output, hepatic blood flow, and renal blood flow in men.
From the New England J. Med. *240:* 456, 1949.

exercise alone produce a different effect than does the upright position?

This we set about examining by studying the blood flow through the hepatic vascular bed and the cardiac output (by the direct Fick method) in patients lying flat in bed, exercising in recumbency. These values presented in figure 3 were obtained in a single patient so that we are justified in calculating the peripheral blood flow as the difference from the sum of the hepatic and renal blood flows minus the cardiac output. Again, there is a nice integration of the renal and hepatic vasculature with the total body vasculature in supplementing the cardiac output and in maintaining arterial pressure at a time when there is a marked decrease in peripheral vascular resistance, presumably in the exercising muscular tissue. Blood is diverted from the

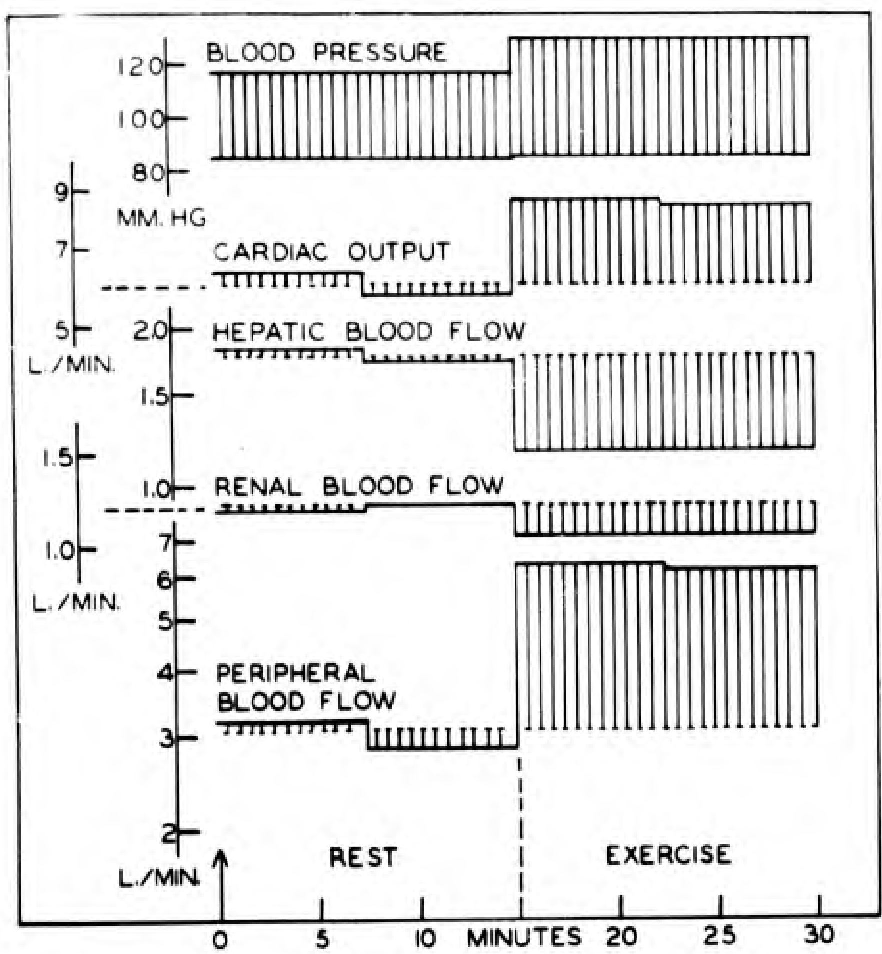

FIGURE 3. Effect of exercise (in recumbency) on arterial pressure, cardiac output, hepatic blood flow, renal blood flow and peripheral blood flow in men.
Corrected from New England J. Med. *240:* 456, 1949.

liver and the kidney. In effect, cardiac output increases as much again to provide the marked increase in blood flow which passes through the periphery.

A more striking response, which in pattern resembles that observed on assumption of the upright position or exercise, occurs during general anesthesia (ref. 6). Renal plasma flow and glomerular filtration rate fall sharply shortly after the anesthesia, cyclopropane or ether, is started, in association with a marked drop in the urine flow. Sodium ouput falls sharply and far more than can be accounted for by the change in filtration; and potassium output also decreases sharply. These changes, curiously enough, do not persist after cessation of anesthesia, although urine flow tends to remain at a lower level. The extraction of bromsulphalein by the liver under these circum-

stances did not change signficantly, but oxygen uptake did increase, and calculated hepatic oxygen consumption therefore showed no significant change.

The redistribution of pressures in exercise has not been examined quantitatively. However, blood pressure does tend to rise and it may be assumed that the distribution in recumbency is uniform as in the resting subject and governed by hydrostatic differences in the upright position. The hemodynamic changes observed during exercise indicate the importance of the relationship between the circulation and the heart in determining pressure levels. Cardiac output plays an equally important part and though attention is focused in this discussion on the inter-relationships between different peripheral circuits, we forget the role of the heart at the peril of painting a false picture. Moreover, the examples given suggest that renal and splanchnic beds operate in unison and change in the same direction, but this is not always the case. Opposing behavior of the two beds has been described (ref. 7) during the action of epinephrine, when blood flow through the liver increases, and blood flow through the kidney decreases. Under these circumstances the cardiac output rises, and the arterial pressure may rise, remain unchanged, or may even show a tendency to fall. Thus, generalizations are not easy to make.

Although these responses are compensatory and serve homeostasis, in terms of maintaining at least one pressure level, they may produce detrimental local changes. In the case of the kidney there are situations in which its function as a cardiovascular organ appears to take priority over its function as an organ of urine formation, regulating plasma and body water composition. We have already seen some tendency for this development in the patients during standing, exercise, and during anesthesia; but in circulatory collapse the reaction becomes much more profound (ref. 8). Vasoconstriction within the kidney results in ischemia, diminished filtration and tubular dysfunction. Urine flow may cease altogether and even when the cause of shock has been removed and blood pressure returned to normal, urine formation may continue suppressed or impaired. As a rule, restoration of renal function is rapid but when shock has been severe, prolonged and associated with the release of pigments or toxic materials into the blood, anuria or oliguria may persist and result in death due to uremia. When anuria lasts several days and then is followed by recovery, renal plasma flow may show a very slow return to normal values. Such secondary defects in renal function may last as long as a year or more. Similar severe disturbances of hepatic function have not been observed but much work suggests that the liver also is involved in the circulatory adjustments to collapse.

During the past year, Drs. Henry Heinemann, Paul A. Marks, and Cheves McC. Smythe working in our laboratory, have made a study of the effect of bleeding on hepatic blood flow in dogs. They have found that loss of 2 to 4 percent of the body weight in blood results in a sharp decrease in the hepatic blood flow. The renal blood flow is much more greatly affected than hepatic blood flow. Calculation of the resistances to flow revealed that a marked increase developed in the renal circuit but little or no change occurred in the liver. The hepatic arteriovenous oxygen concentration difference following hemorrhage increased, but to no greater extent than the decrement in hepatic blood flow. Hence, oxygen consumption by the liver appeared to remain relatively unchanged. More work is certainly needed along this line to prove whether such changes as may occur are significant or not. Apparently the hepatic vasculature does not participate in the generalized vasoconstrictive response to bleeding that develops throughout the body, if these data are to be interpreted on their face value. But before accepting this conclusion we must consider briefly the activity of visceral vascular beds as blood reservoirs.

The total vascular system has a potential capacity far in excess of the volume of blood which it contains, and it must maintain an actual capacity corresponding to the volume of blood that is in it, and depending upon the pressures necessary in the different parts of the circulatory system. Active muscular contraction must provide this adjustment in which active contributions on the part of the veins, the capillaries, and the arteries must operate to prevent fatal pooling of blood. In the upright position we see a perversion of this response. Blood slowly pools in the large veins of the leg, the venous valves become incompetent and at last a large fraction of blood volume becomes stagnant in the lower extremities. At this time, as the circulating blood volume slowly diminishes, syncope may suddenly supervene. In this instance, hydrostatic pressure effects overcome the local changes in tone that control the distribution of blood in the circulatory system. Possibly changes in ability to maintain tone may have a similar effect. Unfortunately the lack of methods for estimating the quantities of blood in different parts of the circulation has retarded clarification of this factor in circulatory dynamics.

During the last year Dr. Marks, Dr. Reynell, Dr. Heinemann, and I have been engaged in a study of the volume of blood held in the splanchnic bed. We have developed a method of measurement based on the determination of the amount of tracer left in the splanchnic bed during equilibration. In both dog and man approximately 20 percent of the total blood volume fills the splanchnic bed in the recumbent resting state, a volume sufficiently large to confer upon the

splanchnic vasculature an ability to operate as a reservoir. Following blood loss we have found that the splanchnic blood volume is sharply reduced. Thus vasoconstriction *does* appear in the splanchnic vasculature as it does elsewhere in the body, but here it induces a change in capacity independently of resistance to flow.

Obviously, I have failed to cover in any way the hows and the whys of these circulatory adjustments and integrations. We are only just discovering that they do occur, and it will be a long time, I am afraid, before we have an integrated picture of the circulatory responses in homeostasis.

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Discussion

Dr. Fenn. We have had the advantage of Dr. Schmidt's welcome experience above the diaphragm a little earlier; now we have had Dr. Bradley's welcome experience below the diaphragm with the circulation. I am afraid we are going to have to limit the discussion to about 5 minutes, but we have time for 5 minutes of discussion for those who have questions for Dr. Bradley. Dr. Henry?

Dr. Henry. What causes the widespread circulatory adjustments in the upright position?

Dr. Bailey. I am afraid I can only speculate. A wide variety of possibilities is available to serve as a basis for speculation. In the

upright position the arterial pressure in the renal artery changes very little or not at all because the renal artery lies very close to the zero reference point. The renal venous pressure also changes very little, so that we cannot readily attribute the renal circulatory adjustments to local changes in arteriovenous pressure. There is a marked change in pressure elsewhere in the body, and it seems very likely to me that these trigger off neural and humoral mechanisms which play a role in bringing about vasoconstriction in the kidney.

QUESTION. (Partly inaudible) . . . dogs in which the renal blood flow was charted with the hepatic refining blood flow, does he think that the slide illustrated shows that the splanchnic blood flow makes adjustments earlier than the renal blood flow? Secondly, does he believe that position in humans, the head-down position, will mobilize a significant amount of this 20 percent of the blood volume from the double capillary circuit with the liver at one end? I wonder about that, but in patients severely wounded and with high spinal cord lesions, you have an opportunity to see shock which is not so severe by virtue of blood loss, and in which transfusion is less successful than resuscitation and putting the patient in the head-down position, so that clinical observation on wounded men suggests that splanchnic blood or the blood in the vena cava and the large tributaries in the legs is returned. But to what extent is blood returned through the liver into the circulation? I wonder if he has any comments?

DR. BRADLEY. I am inclined to agree with you, that the amount of blood coming from the liver itself in the head-down position is probably small, particularly in wounded men or in shocked patients; because the volume of blood in the splanchnic bed is already greatly reduced. The causes for changes in cardiac output in the head-down position are not obvious.

METABOLIC RESPONSES IN ACUTE STRESS SITUATIONS*

I. ARTHUR MIRSKY, M. D.

The dynamic stability that characterizes the living organism is essentially a statistical concept since it is the resultant of continuous flux within molecules, cells, tissues, organs, systems, and organisms. Dependent upon the level of organization that is examined will be the particular "stability" that is perceived as well as particular circumstances that prevent such stability and thereby induce a stress.

The metabolic activity of the cell is the resultant of innumerable energy transformations which are dependent principally on the integrated activity of intracellular enzyme systems. Practically every constituent of the cell is undergoing continuous degradation and resynthesis. Energy-rich synthetic processes catalyzed by enzymes constantly oppose the effects of degradative processes and thereby prevent the cell from going into thermodynamic equilibrium, i. e., death. It is pertinent to indicate, therefore, that the concept of stress as the "resistance of an organism to an external load" can be carried to ridiculous extremes and refer to every transformation of a substrate into useful form and function. The definition of stress suggested by your committee is acceptable if we assume it to mean that loads are such as to change the intracellular flux and result in different dynamic stability.

Although physiologists before Claude Bernard were aware that the organism's apparent stability is due to constant change, he was the first to recognize and describe some of the mechanisms which serve to maintain the constituents of the body fluids at that optimal balance essential to life. These studies were expanded further by Cannon's description of the self-regulating processes of individual tissues and organs and their role in the maintenance of normal stability. This he called "homeostasis" in order to distinguish equilibrations which occur in chemical and physical systems from that dynamic steady state which occurs in the living organism as a whole. By homeostasis, Cannon referred to structured systems which, like the feed-back systems of the engineer, react to change and thereby result in restitu-

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tion to the previous state. He recognized a variety of metabolic responses to have adaptive significance in that they prepared the organism for flight or fight in response to danger.

A further expansion of the Bernard-Cannon concept of adaptation for survival was developed by Hans Selye into his General Adaptation Snydrome (ref. 1). He observed that in addition to the specific damage produced by a noxious agent, a nonspecific generalized response occurred as well. It is these responses which are common to a variety of stress-inducing situations that I have been asked to discuss.

Selye postulated that exposure of the organism to any noxious stimulus of sufficient intensity and duration produces local damage and the liberation of catabolic products which initiate the first stage of the General Adaptation Snydrome, viz., the "alarm reaction." He found that this stage is divisible into two fairly distinct phases—the shock and counter-shock phases. The shock phase is characterized by evidences of excitation of the autonomic nervous system and the discharge of epinephrine into the circulation. Concomitants are such signs and symptoms as tachycardia, hemoconcentration, anemia, azoturia, edema, decreased muscle tone, decreased body temperature, hypochlorhydria, leukopenia followed by leukocytosis, a transitory hyperglycemia followed by hypoglycemia, acidosis, and gastrointestinal ulcerations.

If the damage produced by the noxious agent is not too severe, the countershock phase develops and is characterized by a reversal of most of the aforementioned signs and symptoms. Characteristic of this stage is also an enlarged and apparently hyperactive adrenal cortex and rapid involution of the thymus and other lymphatic organs. Selye observed that with the exception of gastrointestinal ulcerations, the majority of these changes are dependent upon the presence of the adrenal cortex and the anterior pituitary gland. Consequently, he postulated that some catabolic product stimulates the anterior pituitary to discharge adrenocorticotrophic hormone (ACTH), which, in turn, stimulates the adrenal cortex to secrete corticosteroids.

If the noxious stimulus is continued, the counter-shock phase gives way to what Selye calls the "stage of resistance"; at which time there is a regression of the morphological lesions observed in the first stage. This stage is attributed to continued secretion of "glucocorticosteroids."

The third and final stage of the syndrome, which appears after prolonged exposure to the noxious stimuli, is called the "stage of exhaustion" and is attributed to a failure in the adaptive mechanisms. When

this occurs, the lesions which characterize the "alarm reaction" reappear and death ensues.

Since 1936 when the "alarm reaction" was first described as such (ref. 2) many have confirmed Selye's observations in animals and extended them to man under stress (refs. 3, 4, and 5). It has been demonstrated in both animal and man that exogenous ACTH stimulates the production of corticosteroids by the adrenal cortex, that such steroids produce an increase in protein catabolism and gluconeogenesis with a consequent negative nitrogen balance and hyperglycemia; that the corticosteroids produce a reduction in blood lymphocytes and eosinophils, an infiltration of fat into the liver and so forth. It has been established also that an intact anterior pituitary gland is essential for a stressful situation to be effective in the production of these responses.

It must be emphasized, however, that there are many discrepancies between the syndrome described by Selye and numerous clinical observations by others on the responses to noxious agents. Even though many acute stress inducing situations provoke some of the phenomena described, they may not provoke others. Such discrepancies Selye attributes to what he calls "conditioning," i. e., to factors which influence the sensitivity of the anterior pituitary gland, the sensitivity of the adrenal cortex, the sensitivity of the peripheral tissues to corticosteroids and so forth. Among such conditioning influences are heredity, previous exposure and diet.

Another source of controversy concerning the metabolic responses to acute stress situations is the fact that whereas most aspects of the general adaptation syndrome are attributed to the corticosteroids, there are instances where practically the same syndrome may be observed in the absence of the adrenals. Such exceptions give adequate cause for questioning the hypothesis that the adaptive responses to stress situations are due principally to the increased secretion of one or another corticosteroid.

Relatively little is known of the mechanisms whereby hormones are effective other than that their effect is related only to an acceleration or retardation of the rates of the intracellular reactions which are catalyzed by specific enzymes. Although it is quite possible that both hormones and neurogenic factors may act directly on specific enzyme systems, Ingle and others have suggested that hormones act principally by influencing the "permissiveness" (ref. 6) or responsiveness of the cell to factors in its own environment. For example, Ingle observed that stilbestrol which produces glycosuria in normal rats, does not do so in the absence of adrenals. When, however, the adrenalectomized rat is maintained with a constant quantity of adrenal cortical

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extract, the animal responds with the hyperglycemic effect of stilbestrol (ref. 7). Likewise, the presence of adrenal cortical hormones is required for the inhibition of hair growth induced by estrogens (ref. 8), for the increased nitrogen excretion that follows injury (ref. 9), and for the depletion of muscle glycogen and increase of liver glycogen that follows epinephrine administration (ref. 10). That the aforementioned applies also to other hormones is indicated by the fact that the presence of insulin is essential to the nitrogen-retaining effect of growth hormone (ref. 11) and to the inhibition of glucose utilization by epinephrine (ref. 12). Further, monosaccharides which diffuse into the cell do so at a much faster rate in the presence of insulin, irrespective of whether they are utilized or not (refs. 13 and 14). Consequently, the corticosteroids may be essential to, but not responsible for, the metabolic responses to damaging agents.

Like hormones, the nervous system exerts an effect on the responsiveness of cells to humoral agents. Thus, sympathectomy results in an increased sensitivity of the denervated part to sympathicomimetic agents (ref. 15) while blocking the sympathetic ganglia with tetraethylammonium chloride prevents the tachyphylaxis that ordinarily develops with the repeated injection of renin (ref. 16). These and other examples suggest that the reaction to any stimulus, be it nervous or hormonal, is dependent upon the state of the cells which in turn is determined by the continuous interactions between the effects of neural impulses and the effects of hormonal agents.

The systemic changes under discussion may result not only when the organism is exposed to an agent which produces damage to tissues or which impinges on some receptor but may also ensue on exposure to an environmental event that induces psychic conflict. This has been demonstrated with animals in rage or fear. It is a frequent clinical observation that an acute emotional upset may cause an abrupt cessation of the menstrual flow, or precipitate the full-blown syndrome of hyperthyroidism. Further, much evidence can be cited to show that the activiation of unconscious psychic conflict by a meaningful acute environmental event can result in some or all the characteristics of the General Adaptation Syndrome. Nothing is so potent a factor in the precipitation of acidosis in the patient with diabetes as his response to interpersonal relationships as they are viewed through the screen of his unconscious wishes.

In order to evaluate the manner in which neurogenic and psychic stress produces systemic responses, it is pertinent to consider the mechanism whereby any agent is effective in stimulating the anterior pituitary. Originally, Selye postulated that some catabolic factor is released in response to a damaging agent and that this factor acts

directly on the anterior pituitary gland and produces an increase in the secretion of ACTH. Subsequently, Vogt (ref. 17) and Long and his colleagues (ref. 18) developed evidence that any acute stress situation which results in an increase in ACTH production does so through activation of the sympathico-adrenal medullary system and direct stimulation of the anterior pituitary gland by the circulating epinephrine.

That a direct action of epinephrine is only one of the mechanisms involved is indicated by the fact that animals that have become epinephrine-fast still respond to damage with the "alarm reaction." Further, the repeated administration of even large quantities of epinephrine does not result in an increase of corticosteroid excretion irrespective of its effectiveness in producing a decrease in circulating eosinophils. Today, both Selye and Long agree that epinephrine plays a role in the activation of the anterior pituitary but that it is not the only mechanism involved.

Since it has been demonstrated conclusively that stimulation of the hypothalamus activates the secretion of ACTH, and since there is no adequate nervous connection between the hypothalamus and the anterior pituitary gland, it has been suggested that the secretion of neurohumoral agents by the hypothalamus may be responsible for the effects of stressful stimuli (refs. 19 and 20). The studies of Sawyer and his colleagues are in accord with the existence of hypothalamic neurohormones. They observed that the ovulation which occurs in the rabbit within one hour after copulation can be prevented if dibenamine, a drug which inhibits the action of epinephrine, is administered one minute after copulation (ref. 21). The intravenous injection of atropine will also prevent ovulation if the injection begins within 15 seconds and ends within 30 seconds after coitus (ref. 22). Although the intravenous or intracarotid injection of epinephrine is ineffective in producing ovulation, the direct application of this hormone to the anterior pituitary is effective (ref. 23). The effects of dibenamine and of atropine suggest that stimulation of the peripheral afferent sympathetics and the consequent activation of hypothalamic centers may result in the local production of cholinergic and adrenergic agents which are transported to the anterior pituitary.

The studies of Harris and his colleagues (refs. 19 and 20) suggest that a neurohormone may be secreted in the median eminence of the hypothalamus. Others, notably Scharrer and his colleagues (ref. 24), suggest that the paraventricular and supraoptic nuclei of the hypothalamus are made up of cells which secrete an agent which migrates along the axons of these cells to the posterior pituitary where the neurohormone is stored. The neurohormone secreted by these nuclei

resembles in many respects the antidiuretic hormone that can be extracted from the posterior pituitary. Exposure of an animal to some noxious stimulus not only results in an antidiuretic response but also in a decrease in the content of an antidiuretic substance in the hypothalamus (ref. 25). It is quite possible that the hypothalamus is capable of secreting a number of agents which are either carried directly to the anterior pituitary through the portal system of the veins or carried to the anterior pituitary via the general circulation, as suggested by Hume and Wittenstein (ref. 26). It is possible also that the pitressin-like antidiuretic substance (ADS) of the hypothalamus may be identical with the cholinergic agent proposed by some. Such an inference is permissible in view of Cushing's demonstration that instillation of pitressin into the third ventricle produces generalized effects which can be attributed to stimulation of parasympathetic centers (ref. 27).

In order to put some of the aforementioned possibilities to test, a procedure was developed which permits the assay of relatively minute quantities of ADS in the blood (ref. 28). We then utilized a 9-minute period of ischemia of the arm as a stressful stimulus. With but few exceptions, a marked elevation in the ADS content of the plasma of healthy subjects was noted in from 1 to 5 minutes after the cessation of the pain (ref. 29).

There are many reports that patients with hepatic ascites or with the generalized edema of congestive heart failure excrete abnormal quantities of an ADS in the urine. Since the methods that have been utilized in the past were neither precise nor sensitive, we studied the plasma ADS concentration of patients suffering with a variety of clinical conditions (ref. 30). It soon became apparent that there is no relationship between the existence of ascites or edema and the concentration of ADS in the blood. Attempts to correlate any specific physiological factor with the augmented ADS failed. The only common factor appeared to be the reaction of the patient to the existence of the physiological derangement, i. e., to anxiety.

In an attempt to learn more about the mechanism whereby a painful stimulus or anxiety results in an increase in plasma ADS, we studied the effects of adrenal insufficiency. Seven days postoperative adrenalectomized rats showed extremely high concentrations of plasma ADS. Since there is evidence that the various effects of adrenal insufficiency may be due to a decreased blood flow (ref. 31), it was postulated that an increase in blood flow should also produce a diminution in the plasma ADS concentration. Since CO_2 inhalation is the most effective method for increasing cerebral blood flow, adrenalectomized rats were exposed to 90 percent O_2 plus 10 percent CO_2 for 10 minutes and the

plasma ADS content was determined immediately thereafter. In every instance, the CO_2-treated rats showed a marked diminution in plasma ADS. Thus, both acute stress situations and adrenal insufficiency produce the same increase in plasma ADS, presumably through stimulation of the paraventricular and supraoptic nuclei of the hypothalamus with the subsequent release of ADS into the circulation.

One of the most common characteristics of the response of rats to noxious agents is the development of gastrointestinal ulcerations. Likewise, small gastric erosions are a frequent result of exposure to a variety of acute stress-inducing life situations (ref. 32). Selye noted, however, that the production of gastrointestinal ulceration was independent of the presence of the adrenal cortex. In view of the aforementioned observation that a noxious stimulus results in a rapid release of ADS into the circulation and of Cushing's demonstration that the instillation of pituitrin into the third ventricle may result in gastric erosions (ref. 33), it is possible that the gastrointestinal derangements of the "alarm reaction" are due to the release of ADS in the hypothalamus and the consequent activation of parasympathetic centers.

In view of the preceding, it may be postulated that the metabolic responses to acute stress-inducing situations are the resultant of: (*a*) the secretion of ADS in the hypothalamus and the consequent activation of the autonomic nervous system, and (*b*) the secretion of ADS into the circulation, stimulation of the anterior pituitary gland, the secretion of ACTH and the consequent stimulation of the secretion of corticosteroids.

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MONDAY AFTERNOON SESSION
16 March 1953

MODERATOR
LIEUTENANT COLONEL FRANK L. BAUER, MC

METABOLIC RESPONSES IN CHRONIC STRESS SITUATIONS*

RACHMIEL LEVINE, M. D.

When Colonel Stone's letter arrived, inviting me to speak at this symposium, the title read as given in the program: "The Metabolic Responses in Chronic Stress Situations." At that time the subject sounded innocuous to me, and I therefore accepted the invitation. However, there came a time when I had to prepare, and I looked at the title again and began to translate it into English. Adding together the definitions of metabolism, responses, chronicity, and stress situations, my task was clearly defined. It was to discuss all the conceivable chemical changes in the body which may result from persistent disturbances in the environment. This is such a tall order that even the monumental volumes on stress would not do it justice.

When a noxious stimulus is applied, the first reaction is known as the "alarm reaction." You have heard about some of the acute changes in Dr. Mirsky's presentation. When the stimulus persists, the organism, if it does not succumb to the stress, must adapt. What does the word "adapt" mean in these circumstances? It means that many of the previously described disturbances in metabolism, for example, are no longer visible to us. For the sake of review, I shall simply enumerate the responses in the acute stage (alarm reaction). There is increased nitrogen excretion or a negative nitrogen balance, an increased potassium excretion, retention of sodium, hyperglycemia, and a diabetic type of glucose tolerance curve, etc.

During the adaptation stage, we no longer see these disturbances or their expression is considerably damped. At what locus does adaptation take place? The possibilities are that the receptors are now adapted; that is, the stimulus is halted at the beginning and no longer gets to the regulatory centers. Or the central and peripheral nervous systems and the endocrine glands may no longer be in a position to react to the stimulus. Finally, the peripheral effector organs may not respond despite the fact that the stimulus has been transmitted to the centers. These in turn have sent the message to the peripheral autonomic nervous system and the endocrine glands, but the liver, the

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peripheral organs or tissues no longer respond in their pristine fashion.

Can we make a guess as to what happens in a chronic stress situation, during the so-called stage of adaptation? I do not think there are sufficient data to be able to settle the problem of the locus where adaptation occurs. There are some hints available from older experiments. For example, total removal of the sympathetic chain brings with it acute defects, that is, the body no longer reacts "normally" as it did to changes, let us say, in blood pressure, or to changes in blood sugar. However, in time, as is evident from the experiments of Cannon and his school, there occurs an adaptation to the change despite the fact that there is probably no regrowth of the peripheral autonomic outflow. It is usually thought that there are local autonomic centers in the effector organs, although that has never been completely proved. When one removes the adrenal glands one gets acute defects, that is, an acute inability to adapt to many perturbations. Then, adaptation occurs: and it has been shown by Ingle, by Selye and his school, and by others, that adaptation can occur even in the absence of the adrenal glands. You remember some of the older experiments in which adrenalectomized animals were subjected to trauma of a revolving drum. Adrenalectomized animals could not withstand the mechanical trauma which a normal control could. They succumbed to peripheral vascular collapse. However, if the introduction of the adrenalectomized animal to the mechanical trauma was gradual, i. e., if the number of drum revolutions were raised from 10 to 15 and then to 20 and 50, etc. per experiment, one could, in a week's time, get the totally adrenalectomized untreated animal to withstand the shock which he would not otherwise be able to bear. Therefore, if in the absence of a large section of the autonomic nervous system and in the absence of the adrenal medulla and the adrenal cortex, one can under certain conditions adapt to stimuli and react to them in the same way, exhibiting the same kind of changes that one sees in the normal animal and not succumb, then the adaptation seems to be at least in large part in the peripheral tissues rather than in the transmission and mediation systems. In other words, it would seem that the cell ultimately is the main adaptive system of the body, although if we remove the main mediators or the main receptors of the system, it seems at first as if the total adaptive capacity of the body lay within the autonomic nervous system and the glands. Actually, chronically it seems to reside where it really should, from an evolutionary standpoint—in the cell itself. The autonomic system and the neurohumors and the endocrine system form the top layer, so to speak,

and by removing them one can see the adaptive capacity of the body as a whole.

In a chronic stress situation, if the stress persists, one or another vital function may not be able to adapt further and the disintegration of the organism ensues. Exactly what the mechanism of that disintegration is and whether it all depends on the exhaustion of a single system like the adrenal cortex is not too clear at the moment.

What are some of the chronic stresses in which we have some evidence of a metabolic reaction to these stresses? One that has been studied from time to time for many years, is fasting or undernutrition. What happens in fasting? Fasting represents a stress insofar as the entry of nutrients to the interior milieu of the body is halted from one source, namely, from the gastrointestinal tract. Therefore, in order to provide energy for all its cells and organs, the body is forced to use the accumulated reserves, or if it has no more reserves, to use parts of itself in order to support other parts. Usually those parts are supported to the last which are considered, in an evolutionary sense, most vital to the organism. The stored food material that the body possesses is primarily fat. This fat represents not only fat taken in as such, but also the carbohydrate which has not been utilized. It also represents, as a matter of fact, excess carbons from protein which have not been utilized.

The second reserve is a portion of the protein mass of the body which cannot be definitely designated as "storage" protein. It is a labile portion or at least a part of the proteins of the tissues are sufficiently labile to break down in the acute phase of starvation. This was shown by Addis and has been shown recently using isotope markings. There is, therefore, a protein reserve which we cannot call "storage," because it does not have the simple storage functions of fat but which can be readily utilized in fasting. There is also a store of carbohydrate, glycogen. The total glycogen of the body of a well-fed animal at the point of stopping its food supply will not be able to sustain the energy requirements of that animal for longer than about half a day. Therefore, quantitatively it is not important even though (because of the early history of the field of metabolism) most emphasis was laid on glycogen as a reserve food material, rather than on fat.

In the fasting animal you will see continued nitrogen excretion, but a nitrogen excretion which is falling. There is very little change in the blood glucose for many days, until the terminal stages of starvation, despite the fact that the peripheral tissues of such a fasting animal, at any point which one examines them by removing the liver, take up glucose very rapidly. They probably take it up continuously.

Therefore, this glucose level must be maintained at the expense of the glycogen stores, the fat stores, and the protein reserve; in other words, there must by gluconeogenesis. This is stimulated despite the fact that we do not see it in the form of an increase of blood sugar above the normal value, because it is utilized at a good rate and there is no lack of insulin to catalyze its transfer into the peripheral tissues.

Gluconeogenesis, therefore, is very active and it comes from both fat and protein. The fat and protein, however, have to get from the periphery to the liver, a process known by the general term of fat and protein mobilization. Fat and protein mobilization seems to depend on the adrenal cortex, and in starvation at least in the first period of fasting, there is good evidence that the pituitary adrenal cortical axis is increased in functional capacity, that the adrenal actually increases in size and that this may help to stimulate gluconeogenesis by providing fat and protein from the periphery. A "stress" reaction occurs. If the adrenals are removed, and saline or desoxycorticosterone is given to the animal in order to maintain the electrolyte balance, this whole fasting situation changes in the sense that the animal is not as capable of mobilizing fat and protein as he was when the adrenals were present. The question arises, however, whether it is necessary to have the increase in adrenal cortical activity which occurs and from the bulk of evidence at the present time, it would seem that it is not necessary to have an adrenal cortex which springs into a hyperfunction upon fasting in order to get the increased mobilization and gluconeogenesis. This is an example of what Ingle has called permissiveness (ref. 1) and what Dr. Mirsky before has called the responsiveness of the tissue. In other words, the C–11 cortical steroids are necessary for the cells in the periphery and perhaps in the liver to respond to the stimulus of fasting.

This has been shown, for example, by Levin and Farber (ref. 2) a few years ago, when they found that the mobilization of fat by pituitary factors can be achieved in the adrenalectomized animal, provided that a maintenance dose of adrenocortical extracts were given. We have recently done a similar experiment on fat mobilization, using adrenalin. If one gives normal rats ethionine, fatty livers are produced. The fat in that liver comes from the periphery. Ethionine serves as a competitive inhibitor of methionine. If ethionine is given, there is a rise in the liver fat from about 5 to about 15 percent. If the animal be adrenalectomized, no rise in the liver fat results following ethionine. If adrenalin is given, a mild rise occurs in the liver fat of the adrenalectomized animal given ethionine. If cortisone is administered, a mild rise in liver fat may occur. If the

animal is maintained on cortisone, and then given adrenalin, the fat in the liver increases to 15 percent.

The adrenal cortical hormone was indirectly responsible for fat mobilization by conditioning the tissues to respond to other factors. Previously, this conclusion was reached by Ingle in the case of stilbestrol-induced glycosuria, and in the case of the increased nitrogen excretion following trauma.

During the early phase of starvation, a diabetic type of glucose tolerance curve is usually seen. This has for many years been called hunger diabetes and attributed to a progressive lack of insulin. Actually, there is no definite evidence that lack of insulin is responsible for this phenomenon. If taken in conjunction with the stimulation of gluconeogenesis, discussed before, it is another sign of adrenocortical stimulation. If the fasting is continued, reverse changes occur and they are heralded by a drop in blood sugar, by a tolerance curve which is no longer diabetic, by a minimal nitrogen excretion which may suddenly increase (the so-called pre-mortal rise), and by pituitary failure. The nutritional deficiency that has gone on for weeks or months, depending on the type of animal used, has finally produced pituitary deficiency. This sequence of events has been seen, of course, clinically, in man as well.

These phenomena are demonstrable in an exaggerated form in the depancreatized animal. In 1930, Soskin (ref. 3) took depancreatized dogs and gave them small feedings of meat every day. They became chronically undernourished. At first they showed a worsening of the diabetes and ketosis, but as time went on the blood sugar fell, the ketosis disappeared, the respiratory quotient changes became normal, etc. These signs were then correctly interpreted to mean that there was a deficiency in fuel, especially in fat, which decreased gluconeogenesis, but I think that in the light of our 20 years' experience, we would add that a nutritional hypopituitarism was produced and contributed to the amelioration of the diabetic state.

Let us now consider another type of chronic stress—obesity. It is known that obese individuals more often develop cardiovascular renal diseases and certain metabolic disorders such as diabetes, and that their longevity in general is diminished. This chronic load has a definitely deleterious effect over a period of years. Obesity is associated at one stage with a disturbance in glucose tolerance in the same direction as that of starvation; that is, a diabetic glucose tolerance curve. Fat metabolism is increased and there is some evidence of an increase in the size of the adrenals and perhaps an increase in adrenal functional capacity. However, the continuation of this stress does not lead to the same end results as does the continuation of the stress of fasting. It

usually leads to an exaggeration of the diabetic tolerance, to a large percentage of actual diabetes developing in such individuals. In other words, it looks as if in contrast to the chronic situation of fasting, pituitary failure does not result. What does result is a relative failure of the pancreatic or insulin side of the endocrine balance, rather than of the pituitary counterweight. Thus, even if both stresses begin with evidence of adrenocortical hyperfunction, increased gluconeogenesis, and increased fat metabolism, the end results are certainly not the same.

A third form of chronic stress is that of cold. In the first phases of exposure to cold, there is evidence of the co-called stress reaction, adrenocortical hypertrophy and hyperactivity. However, cold, unlike fasting and unlike obesity, seems to have some specific relationship to the thyroid function rather than either to insulin or the adrenal cortex.

The reason for emphasizing the divergences in reaction to stressor agents is the feeling that perhaps we tend to forget the specific changes which tissues and organs and the body as a whole undergo as a result of specific stimuli, in favor of a generalization which we have termed and accepted as "the" stress reaction, acute and chronic. The stress reaction is defined as the set of nonspecific reactions which are elicited by a variety of different stimuli. Such a generalization has a most inviting ring. It has stimulated a good deal of valuable work, both in the experimental and in the clinical domain. However, I should like to ask the following question: Have we, in pursuing this generalization of the stress reaction forgotten that, in the disorders we see clinically or in situations that we produce experimentally, there are many important reactions with which an individual organ or tissue responds to a stimulus, which seem specific to this type of stimulus and which give a specific character to the type of disorder which arises? Are not these specific changes as important as that group of bodily reactions which we sum up under the term stress?

At this point I would like to offer for discussion the question, whether a "metabolic" change seen during the course of a stress reaction, is primarily metabolic or whether in many instances such changes are secondary and may not be due to a set of factors nonmetabolic in nature. As an illustration, consider some data obtained in our laboratory a few years ago (ref. 4). Sustained muscular exercise is a stress stimulus. Many years ago, Reiss showed that hypertrophy of the adrenals follows severe muscular exercise. The discovery of the group of corticoids which seemed to affect the metabolism of foodstuffs (the so-called glucocorticoids) and the well-known muscular weakness characteristic of Addison's disease and of the adrenalectomized

animal, were given as evidence that the muscular weakness following adrenalectomy is due to a change in muscle metabolism induced by the lack of the C–11 oxysteroids. We used muscular exercise as a stressor agent. The normal animal maintains during the exercise a steady state measured by blood pressure and other criteria However, the adrenalectomized animal with a normal initial contractility exhibits fatigue after 1½ to 2 hours of stimulation. This was, of course, well known for many years, especially through the work of Ingle.

If one measures the blood pressure simultaneously with the measurement of the height of contraction, it can be seen that the blood pressure falls before fatigue begins. If stimulation continues, the blood pressure goes down to zero, and the animal dies in peripheral vascular collapse. The diminution of the height of contraction occurs soon after the blood pressure has reached a point below 70 mm. Hg. If one restores the blood pressure temporarily, the height of contraction returns to normal again. If a muscle is excised from an adrenalectomized animal at the point of fatigue, it shows normal contractile power *in vitro* as long as it is supplied with a suitable nutritive medium. Muscular contraction and the course of carbohydrate metabolism are of course so thoroughly linked in thought, that this type of fatigue was always considered to be due to a metabolic defect. Actually it is a consequence of a circulatory defect. Peripheral circulatory adaption is defective in the adrenalectomized animal in the absence of C–11 steroids.

In conclusion, then, I should like to reiterate the questions which need some discussion:

1. Has too much attention been lavished on the nonspecific generalized reactions to a variety of stimuli, at the expense of looking for specific responses which characterize the reactions to a particular stimulus, and which may serve to distinguish them? Are stresses siblings, rather than littermates? and,

2. Are many of the metalobic consequences of stress due in the first instance to disturbances of metabolism proper?

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THE RESPONSE OF THE PITUITARY ADRENO-CORTICAL SYSTEM TO ACUTE SITUATIONS EVOKING STRESS*

GEORGE W. THORN, M. D., DALTON JENKINS, M. D., AND JOHN C. LAIDLAW, M. D.

Quantitative studies on the participation of the pituitary adrenal system in the physiological responses of man under stress have been carried out. These studies have been greatly facilitated by (1) the availability of highly purified preparations of ACTH and crystalline adrenal cortical steroids, both of which may be administered by the intravenous route, and (2) recent technical advances which have considerably facilitated the quantitative measurement of adrenal cortical steroids and their metabolic end products.

Based upon the assumption that all activation of the adrenal cortex occurring during exposure to stress is a consequence of the release of the adrenocorticotrophic hormone from the anterior pituitary, quantitative dose-response and time-response curves of adrenal cortical activation have been established in normal human subjects. For this purpose it is essential to administer ACTH by the intravenous route in order to simulate as closely as possible the endogenous secretion of ACTH.

For the purpose of calibrating various levels of adrenal cortical activation resulting from the administration of ACTH, suitable quantitative indices of the rate of adrenal cortical secretion are mandatory. The indices employed in these studies have consisted of (1) changes in the level of circulating eosinophils and (2) changes in the concentration of urinary 17-hydroxycorticoids.

The latter method has been devised in order to provide a comparatively simple and relatively rapid means of measuring urinary adrenal cortical steroids and their transformation products. The limitations of interpreting the urinary excretion products in relation to hormones released by the adrenal cortex are fully appreciated. It has long been recognized that corticosteroids are found in the urine largely as conjugates and therefore the measurement of total urinary corticoid content appeared to be more logical than the determination by standard

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measurements of the small quantity of unconjugated free steroid fraction. Butanol has therefore been employed as the extracting solvent. The resultant extract is purified with solid sodium carbonate, dried with anhydrous sodium sulfate, and colorimetric measurement of the extracted corticoids performed. For the latter purpose the phenylhydrazine-sulfuric acid reaction of Porter and Silber has been applied to the butanol extract (refs. 1 and 2).

The method described possesses the following advantages: (1) Its rapidity in comparison to standard methods recommends its use in clinical studies. (2) The phenylhydrazine-sulfuric acid reaction employed has been demonstrated to be comparatively specific for those corticosteroids possessing an hydroxyl function at the 17-carbon atom of the steroid nucleus. The latter compounds are represented chemically by cortisone and hydrocortisone (Compound F). This is particularly fortunate since hydrocortisone is currently considered to be the primary natural secretory product of the adrenal cortex. (3) By extraction of urine with cloroform prior to butanol extraction, it is possible to measure simultaneously both the free and conjugated fractions of the total urinary corticosteroids. This is obviously useful in the study of those metabolic reactions involved in the conjugation of adrenal cortical hormones.

In order to evaluate adrenal cortical activation by endogenous ACTH under conditions of stress, varying quantities of ACTH have been administered intravenously to normal subjects and the magnitude of adrenal response measured by changes in the level of circulating eosinophils and changes in the urinary output of 17-hydroxycorticoids. A 4-hour period of ACTH infusion was selected arbitrarily to correspond with periods of stress of approximately similar duration. These studies have led to the following findings: (1) There exists a maximal quantity of ACTH which can effectively stimulate the adrenal cortex within the 4-hour period of study. A near maximal adrenal cortical response is produced by the intravenous infusion of ACTH at a rate of one to two units per hour. On the other hand, an increase in 17-hydroxycorticoid output and a significant fall in circulating eosinophils has been consistently observed when only 0.25 unit of ACTH per hour was administered (fig. 1). These studies would suggest that when a fall of approximately 50 percent in circulating eosinophils is observed *as the result of adrenal cortical activation* a significant rise in urinary 17-hydroxycorticoids should occur. On the other hand, if a fall of 50 percent in circulating eosinophils occurs in the absence of an appreciable rise in 17-hydroxycorticoid output, one is justified in assuming that the eosinopenia is mediated at least in part by factors other than an augmented level of

FOUR-HOUR EOSINOPHIL AND CORTICOID RESPONSE TO INTRAVENOUS ACTH

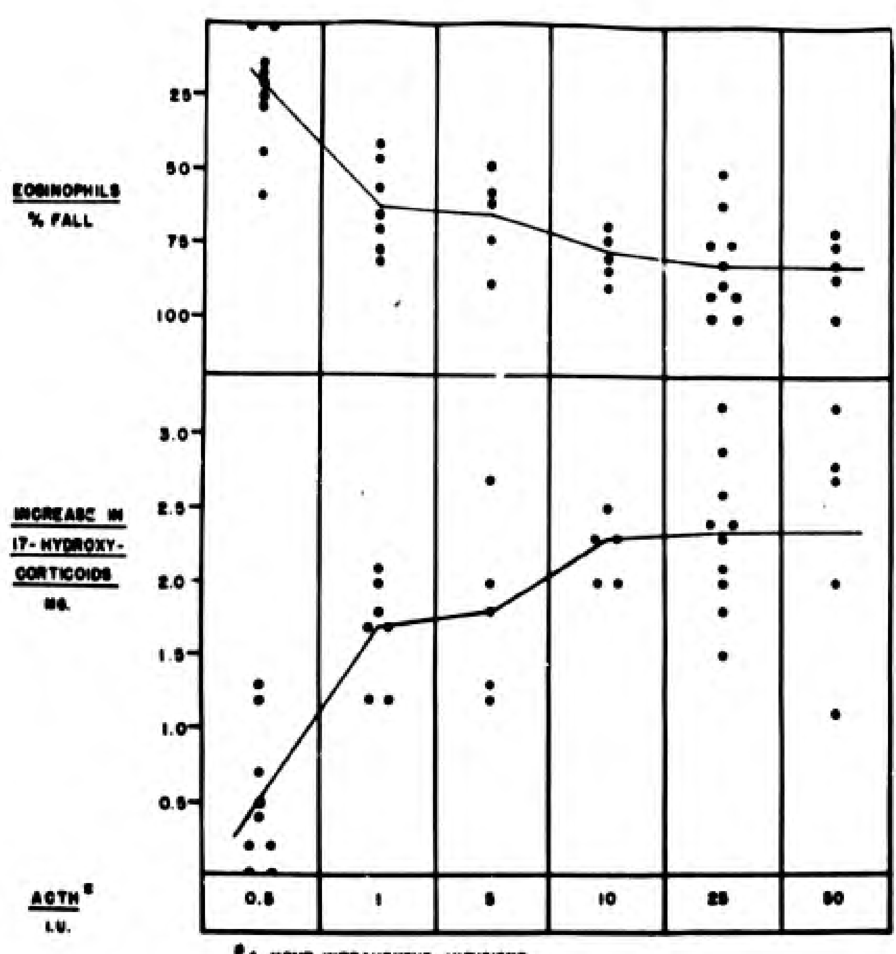

FIGURE 1. Eosinophil and 17-hydroxycorticoid values represent changes occurring during 4-hour intravenous infusion of ACTH.

adrenal corticosteroid secretion. (2) The duration of adrenal cortical stimulation is of primary importance in determining the ultimate level of adrenal cortical hormone secretion. Thus the intravenous infusion of 15 to 20 units of ACTH over a period of 8 hours or longer produces near maximal activation of the adrenal gland. This is important since it signifies that relatively small quantities of ACTH secreted continuously for a prolonged period may elicit a far more intense level of adrenal cortical secretion than even massive doses of ACTH acting for a brief interval. For this reason one might anticipate that a moderate but prolonged stress would produce a greater increase in adrenal secretory processes than a more intense stress of relatively short duration.

The administration of epinephrine to normal subjects is capable of producing a significant degree of eosinopenia. It has been postulated that the eosinopenia induced by epinephrine is mediated via the pituitary-adrenal system. That the adrenal cortex is not essential for this reaction is demonstrated by the frequent occurrence of a significant degree of eosinopenia following the administration of epinephrine to patients who have undergone a complete bilateral adrenalectomy. This is confirmed by the consistent observation that the fall in eosinophils resulting from the administration of epinephrine is not accompanied by a significant rise in the urinary excretion of 17-hydroxycorticoids (ref. 2). It must therefore be concluded that, in man at least, the eosinopenia produced by epinephrine is not dependent upon an increase in the level of adrenal cortical hormone secretion.

It is of interest to note, furthermore, that certain significant physiological differences between the production of eosinopenia by epinephrine and ACTH may be demonstrated. In normal subjects, for example, epinephrine is most effectitve in eliciting an eosinopenic response when infused rapidly intravenously. A prolonged inf sion of an equivalent dose, on the other hand, may fail to induce a significant fall in the level of circulating eosinophils. These observations contrast with the studies on ACTH described above.

It is also of interest to note that whereas the eosinopenia produced by ACTH and epinephrine are additive, the combined infusion of the two hormones produces no greater rise in urinary 17-hydroxycorticoid excretion than that obtained with ACTH alone. This may be considered further evidence that the fall in eosinophils produced by epinephrine is not mediated via increased activation of ACTH. However, these experiments do not eliminate the possibility that part of the epinephrine effect may be brought about by enhancement of the activity of adrenal steroids themselves.

It is therefore clear that mechanisms for producing eosinopenia exist which do not depend upon an increased level of pituitary adrenal function. On the other hand, adrenal cortical stimulation as evidenced by a rise in the urinary output of 17-hydroxycorticoids is consistently accompanied by a significant degree of eosinopenia. The significance of these conclusions may be illustrated by the results obtained when normal human subjects are subjected to graded levels of exogenous stress. (1) The exposure of normal human subjects to anoxia culminating in a brief period of unconsciousness at an approximate altitude of 27,000 feet, has been demonstrated to result in an average eosinophil fall of 30 percent, without an appreciable rise in urinary 17-hydroxycorticoid content. Therefore, in spite of the intensity of this brief exposure to stress and despite the occurrence of an

eosinopenia of borderline significance, it is evident that the equivalent of 0.25 unit of ACTH was not secreted as the result of the stress. (2) The exposure of normal human subjects during a 4-hour period to an environment of 4° C resulted in a fall of eosinophils of almost 50 percent, approximating that produced in many normal subjects by the 4-hour intravenous infusion of somewhat less than 1 unit of ACTH per hour. No significant rise in the output of urinary 17-hydroxycorticoids occurred, however, and it must be concluded that the eosinopenia was produced by mechanisms other than a measurable increase in the level of adrenal cortical secretion. (3) Patients undergoing major surgery have consistently exhibited an almost complete disappearance of eosinophils from the circulation and a marked rise in the level of urinary 17-hydroxycorticoids approaching that produced by the continuous intravenous infusion of ACTH in quantities known to produce near-maximal adrenal cortical activation. Thus under conditions of major stress unequivocal evidence for adrenal cortical stimulation may be elicited.

Finally, it is of major interest to consider the potential fate of adrenocortical hormones under normal conditions and during periods of exogenous stress. Therefore, in order to ascertain whether a significant degree of "utilization" of circulating adrenal cortical hormone occurs under conditions of stress, the following procedure has been employed. Patients with Addison's disease, in whom no endogenous source of adrenal cortical hormones exist, have been studied during conditions of stress while receiving a constant dose of crystalline cortisone or hydrocortisone by continuous intravenous infusion. In repeated studies no appreciable difference in the urinary output of 17-hydroxycorticoids under control conditions and during surgical operation has been evident. While alternative explanations are possible, the imposition of exogenous stress need not materially alter the normal pathway of adrenal cortical steroid degradation and disposal.

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Discussion and Questions on Papers by Dr. Levine and Dr. Thorn

Question. I would like to ask Dr. Thorn about those experiments in which individuals were exposed to cold and to rain. How were they conducted? Was the control period early in the morning and then the stress period the next 4 hours immediately following that?

Dr. Thorn. Yes, the 4-hour control period in those particular experiments was earlier in the same day as the experiments. We do have measurements of many of those individuals and of others in the corresponding 4-hour periods throughout the day, and have made observations of the expected variation that we would get with this method over successive 4-hour periods. There is a diurnal variation. One can control this type of experiment in two ways; either getting a large enough change following the 4-hour control period to make us feel it was significant, or running the control and test in the same period on the same individual on subsequent days. It is true that in some instances where we failed to show a rise the diurnal trend might have been downward during that period, but I still feel that if we had good adrenal activation, it should have resulted in a measurable increase.

The method that we have been using for the measurement of 17-hydroxycorticoids is dependent upon splitting the corticoid before making the measurement, and then carrying out the chromatography to further purify the extract. There is a rather definite diurnal variation in these steroids, something which we have also reported. We find when we determine blood levels of 17-hydroxycorticosteroids that during the first 4 hours after awakening, when the person is first getting up and moving around, the blood levels of 17-hydroxycorticoids are approximately twice what they are during the rest of the day. Therefore, if you find levels which are about in proportion, it probably means that there was not much additional stimulation resulting from the experimental procedure.

Dr. Levine. I would like to emphasize something from my own experiments on dogs which is along the line of Dr. Thorn's work on the eosinophils and epinephrine, perhaps with a different interpretation. Bilaterally adrenalectomized dogs maintained on desoxycorticosterone were, on the day of the experiment, acutely given epinephrine, and the eosinophils were followed every 2 hours. Epinephrine did not lower the eosinophils of the bilaterally adrenalectomized dog maintained on desoxycorticosterone, or at least if it did lower them the decrease was within the 20 to 25 percent which we consider insignificant. The initial eosinophil levels in these animals varied somewhere between 600 and 1,000, so there was a good count. Four hours later an intravenous injection of hydrocortisone or cortisone was begun at a level which by itself did not lower the eosinophils at all significantly. If during this period of intravenous administration of hydrocortisone, at least after the first hour, adrenalin was given at any point, the eosinophils promptly dropped 60 to 75 percent. I wonder if you would agree that rather than having two mechanisms, there is

a possibility that the eosinophils fall because of responsiveness to a combination of cortisone and an effector system which is either adrenalin normally, or something else, or many such neural hormones together. I believe this is a cooperative effort rather than two separate systems acting to depress the eosinophils.

DR. THORN. I agree. You notice that I very carefully said that our interpretation was that there is no evidence that epinephrine produces eosinopenic action by increased ACTH output or by increased liberation of steroids. Certainly our epxeriments confirm yours of the additive effect. It is extremely difficult to do very much epinephrine work in an Addisonian or adrenalectomized patient without cortisone, and I think we have nothing to date that would exclude an additive mechanism in this eosinopenic effect.

DR. DORFMAN. I would like to refer to two points that have been raised by Dr. Thorn's excellent talk. First, on the question of the positive response with respect to the eosinophils and the negative response with respect to the corticoids determined essentially by the method of Porter and Silber, I would like to suggest that compounds of the type of cortical steroids which may have an effect on eosinophils would not be determined by this procedure. So this would be an additional explanation for this peculiarity in response. Further, it is theoretically possible also to get no change in eosinophils, but a change in the corticoids by this method with substances of the type of compound F. Now of course at the moment we give compound F a minor role, but we do not know what modifications in production with respect to the various constituents may occur under different conditions.

Secondly, I would like to talk about the subject of the 17-ketosteroids being an index of adrenocortical function. Dr. Thorn has shown that after cortisone or hydrocortisone relatively small changes in 17-ketosteroids occur. However, as I take it, that was in normal subjects that had adrenals. Under such conditions it is entirely possible that the metabolites of cortisone or hydrocortisone of the 17-ketosteroid variety are, in effect, produced in relatively large amounts, but that the total value does not appear to increase greatly because of the original endogenous production. However, in our experiments we have demonstrated that the endogenous production, as measured by the C–19 compounds no longer having oxygen substitution at 11, essentially ceases. Therefore, a new type of 17-ketosteroid appears and actually may be an excellent measure of corticoid production of particular kinds. Thus, by having a differential analysis of 17-ketosteroids, one cannot only get an indication of the total amount but of the type of compounds being produced by the adrenal at any particular moment. In other words, the adrenal cortex produces a variety

of compounds. We have compounds of the $C_{19}O_2$ variety which produce in metabolism a group of substances—two, in effect, androstone and etiocholanotone—which have $C_{19}O_2$ metabolites. On the other hand, we have from cortisone and especially from hydrocortisone one compound—11-oxygenated etiocholanotone—which is in effect a more specific measure of the cortisone and hydrocortisone produced in the organism. A small amount of this originates from $C_{19}O_2$ compounds, but in the main the metabolism of cortisone and hydrocortisone is reflected in a change of excretion of this particular C_{19} compound. I believe, as we go along in time, when the individual ketosteroids are analyzed we will be able to get a better measure of the endogenous production of these compounds.

Dr. Browne. First of all, I agree with Dr. Levine about the necessity for, after having made a synthesis, now thinking of re-analyzing that synthesis; in other words, in terms of the different effects, as well as the common effects, which occur in the body under stress.

Secondly, with regard to Dr. Levine's statement that in prolonged starvation in experimental animals, the fall of blood sugar and the terminal nitrogen rise may be associated with pituitary failure, we have only one observation in man which seems to me, in this particular instance, perhaps not to agree with that view. This was a patient who had a carcinoma of the stomach with recurrence and obstruction; he had lost a large amount of weight and was down to 67 pounds. He showed a terminal rise of nitrogen at relatively constant nitrogen intake of intravenous amino acids, but he also showed a very marked rise of gluco- or 17-hydroxycorticosteroids and of his ketosteroids, paralleling this rise in nitrogen. There one would certainly feel that the adrenal had been activated, but it is hard to see how that could happen in the presence of a nutritional destruction of the pituitary. That, however, is only one instance.

Dr. Thorn's excellent paper brings to mind a point which Dr. Levine raised, which Dr. Ingle has emphasized so much, with regard to what could be called the permissiveness, or as Dr. Mirsky puts it, the responsiveness of cells to a "maintenance amount" of the adrenocortical hormones. I would like to unite that with Dr. Thorn's closing remark about utilization, and to express the view that while it is true that the cells are primary and can do these things in the absence of the regulatory mechanisms of the endocrines, or in the presence of a very small amount of them, it is not true that they cannot do them more readily in the presence of an increased amount. Furthermore, with regard to utilization, Dr. Thorn has shown pretty clearly that there is no alteration in the excretion products which he measures, and has clearly stated that there is a 60 percent amount which is not detectable. I

would also point out that with regard to the word "utilization," perhaps it might be better, as he did a little later, to think of this as the same pathway as metabolism. In the case of progesterone-pregnanediol, we used to think that the conversion to pregnanediol was an indication of "utilization" in the sense that cells of the uterus or whatever it was had been occupied or influenced by that material. It is perfectly possible that the adrenocortical hormones act upon the cells without necessarily altering the pathway of metabolism which would lead them to be detected as 11–17–hydroxysteroids. I would like to emphasize, as Dr. Thorn said in the last part of his talk, that because there is no demonstrable alteration in 17-hydroxycorticoid excretion, this does not mean that there is not an area of increased requirement at certain periods of time during these stress procedures. With experimental data one can show that metabolic performances can go on in the absence of such changes in metabolite excretion. Therefore we should not jump to the conclusion that because these studies show quite clearly that in certain stresses these alterations do not occur, under certain circumstances there is not necessarily an increased requirement for the hormone by whatever way it is used up.

Finally, I would like to ask Dr. Thorn if there is any evidence of synergism between the 11-17-hydroxysteroids and adrenalin in their action on eosinophils? Can you show that the two together quantitatively have more effect than either one alone?

Dr. Thorn. Our experiment was a little different from Dr. Levine's. We gave a dose of epinephrine intravenously that was not great enough to cause an eosinophil fall, and adding that to a standard dose of ACTH, obtained a much greater fall than the ACTH alone would produce. I would assume that that was synergism or additive effect, since the amount of hormone administered itself did not produce that change.

I would like to say with reference to Dr. Nelson's earlier remark, that I think his methodology is probably more sensitive than ours. I would certainly agree with him that one can show some increase in some of these stresses, my only point being that an increase for the stress in terms of the magnitude of our previous thinking just did not occur. In terms of ACTH and cortisone, as we have used them clinically, we would expect to find a really good increase in these measurements, and when we do not it makes us a little cautious in interpreting the quantitative aspects of participation.

EXPERIMENTAL STUDIES ON THE PITUITARY-ADRENOCORTICAL SYSTEM IN SITUATIONS EVOKING STRESS*

HUDSON HOAGLAND, PH. D.

In a study of 250 normal men and 250 normal women ranging in age from 20 to 92 years, Pincus and his collaborators at the Worcester Foundation have shown that while resting 17-ketosteroid excretion falls fairly steeply from the fourth decade on, the output of corticoids maintains a remarkably constant level through the eighth decade. While the diurnal rhythm of steroid excretion flattens with age, adrenal responsivity to stress and to injected ACTH measured in terms of percentage changes from resting levels of urinary 17-ketosteroids, corticoids, Na, K and uric acid and also percentage changes in lymphocytes display relatively little decline with advancing years. Adrenal unresponsivity thus does not seem to be an important factor in the normal ageing process.

Studies carried out during the war by a group of us at the Worcester Foundation have demonstrated that a variety of work-a-day stresses enhance the output of hormones from the adrenal cortex. Thus we found in an investigation of a group of Army pilots quantitative relationships between fatigability as measured by prolonged pursuitmeter performance and increases over control resting levels in the excretion of 17-ketosteroids, brought about as a result of the stress. In the course of these studies we found that the least fatigued and most competent performers display the smallest percentage increase of 17-ketosteroid output. Excessive percentage outputs of 17-ketosteroids following the stress were found to be associated with the less adequate performers in these tests. It was as if the efficient performers needed to call upon their adrenals to a much lesser degree than the less competent performers.

A recent investigation has confirmed these findings. A study by Austin Berkeley was made on men undergoing a frustrating psychological task. Those men whose aspiration level of performance was most realistically adjusted to their actual performance levels showed

*Abstract of paper presented 16 March 1953, to the Symposium on Stress, Army Medical Service Graduate School, Walter Reed Army Medical Center, Washington, D. C.

minimal adrenal stress responses compared to others undergoing the test.

We have also found that adrenal cortical activity is enhanced by flying airplanes, by the taking of oral or written examinations, the operation of machines requiring precise psychomotor coordination, and submarine escape practice using the Momson lung. A method is described for comparing the stress of different kinds of tasks in terms of adrenal responsivity.

The paper concludes with a discussion of variables reflecting adrenal function in relation to stress tests. We consider that percentage changes in urinary potassium and to a lesser degree in sodium, determined by flame photometry, may serve for rapid and useful assays of adrenal responsivity where more elaborate analyses are not expedient. These conclusions are based on the comparative effects of injected adrenal cortical extract, of injected ACTH, and of stress tests on a number of the variables reflecting adrenal cortical stimulation.

ADRENALIN AND NORADRENALIN IN VARIOUS KINDS OF STRESS*

U. S. von Euler, M. D.

The relations of adrenalin and noradrenalin to stress may be regarded as primarily concerned with:

1. The possibility of a release of ACTH and cortical hormones by the catechol amines.
2. The eosinopenic response to catechol amines, independently of ACTH.
3. Alterations in the production of catechol amines in conditions of stress.
4. The interrelationship between formation and actions of ACTH, cortical hormones, and catechol amines.

Selye introduced in 1937 the fundamental concept that a large variety of stressors act over a final common path, represented by the pituitary-adrenocortical system. How this system is activated is still incompletely elucidated. An important approach to the solution of this problem was made by Vogt (ref. 1) who found that adrenalin was capable of releasing cortical hormones and by Long and Fry (ref. 2) who showed that this effect can be mediated by the primary release of ACTH.

In the rat the capability of adrenalin to activate the liberation of ACTH seems to be considerable and the unusual sensitivity of this mechanism has been pointed out by Gerschberg, Fry, Brobeck and Long (ref. 3). They found that even a dose of 0.04 mcg./kg./min. in the rat was effective when administered intravenously for 60 min., while 0.08 mcg./kg./min. was adequate to cause a considerable depletion of adrenal ascorbic acid and cholesterol as a sign of release of cortical hormones when given for half that time or when infused intraperitoneally for 1 hour. This action of adrenalin was absent in hypophysectomized animals, indicating that the effect was due to a release of ACTH.

Increased amounts of ACTH in blood or body fluids after adrenalin have also been demonstrated directly (refs. 4 and 5).

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The depressant action of adrenalin on the number of eosinophils in the blood (ref. 6) was at first thought to indicate a release of ACTH since this agent causes eosinopenia (ref. 7). Since the adrenalin eosinopenia also occurred in Addisonian patients and in bilaterally adrenalectomized man (ref. 6 and 8) it appeared less likely that this effect was mediated by a release of ACTH. Hence the eosinophil count seems to be of limited use for obtaining information about the activity of the anterior pituitary, as pointed out recently (ref. 9 and 10). Also on other grounds the capability of adrenalin in physiological doses to release ACTH in man has been questioned (ref. 11, 12, and 13). Although Wolfson (ref. 14) obtained striking clinical improvement with doses of adrenalin of the order of 1 mg. per hour of a long-acting preparation in combination with a sympatholytic agent in several cases where large doses of ACTH were necessary to cause similar effects, he doubts that endogenous adrenalin may act in this way. The failure of adrenalin to increase the 17-hydroxycorticoid excretion in urine in doses of 1 to 3 mg. over a period of 4 hours, (ref. 12) which is readily achieved by small doses of ACTH, is obviously difficult to reconcile with the idea that adrenalin is an important factor in releasing ACTH in man.

The effect of noradrenalin on the ascorbic acid of the suprarenals was first studied by Nasmyth (ref. 15) in the rat. From his figures it can be seen that noradrenalin has only about one-fifth of the activity of adrenalin. This finding has subsequently been confirmed by others (refs. 16, 17, and 18). Also with regard to the eosinopenic or lymphopenic effect noradrenalin was found to be many times less active than adrenalin in man, rat and mouse (refs. 19 through 23). In a case of pheochromocytoma of the noradrenalin type a complete absence of blood eosinophils was observed, however (ref. 24).

Most of these authors have expressed the view that noradrenalin probably plays an insignificant role in releasing ACTH biologically.

Although the eosinopenic effect of adrenalin and noradrenalin is apparently no reliable indicator of an ACTH release as believed earlier, it may well be related to the eosinopenia observed in stress.

The eosinopenic response to stress (ref. 25) might therefore result as a consequence of release of both ACTH and of catechol amines, in the latter case even independently of ACTH. Spiers and Mayer (ref. 26) found that adrenalin caused no eosinopenia when given to adrenalectomized mice, but after hypophysectomy, both stress and adrenalin can elicit some eosinopenic response, though smaller than that caused by ACTH. After hypopyhsectomy in man, however, Luft and Olivercrona (ref. 27) did not find eosinopenia after 0.3 mg. of adrenalin; ACTH in these cases produced a varying response.

After stalk transaction in mice the ACTH-releasing effect of emotional stress stimuli or 0.6 mcg. adrenalin intraperitoneally, studied by the lymphopenic response, was temporarily abolished but returned within 2 weeks corresponding to the regeneration of hypophysial portal vessels (ref. 27). A direct effect of adrenalin on the ACTH-producing cells in pars distalis was not observed.

Under certain conditions the anterior pituitary still seems to respond to adrenalin when devoid of its nervous and vascular connections with the hypothalamus. Thus McDermott, Fry, Brobeck and Long (ref. 28) showed that subcutaneous injection of 0.02 mg. adrenalin per 100 gm. rat in hypophysectomized animals with the hypophysis grafted into the anterior chamber of the eye caused a conspicuous fall in the eosinophils (46 ± 3 percent), but not after removal of the grafted eye. In this case it would seem that adrenalin directly stimulated the cells of the anterior pituitary to release ACTH. Similar results were obtained by Fortier (ref. 29). On the other hand, Vogt (ref. 1) maintains that adrenalin may stimulate the adrenal cortex directly.

Simms, Pfeiffenberger and Heinbecker (ref. 30) state that complete denervation of the neurohypophysis in dogs abolished the eosinopenia after adrenalin. They offer an elaborate theory for the explanation of these results, involving inhibition of the neurohypophysis, which in its turn should induce the anterior hypophysis to increased activity. These experiments, however, do not exclude the possibility of adrenalin acting on some parts of the hypothalamus from which the effect is mediated humorally as suggested for emotional stress by Groot and Harris (ref. 31).

It would be hard to accept the hypothesis of Simms, *et al.*, unless it can be shown that interruption only of the nervous paths in the infundibular part of the neurohypophysis abolishes the eosinopenic response after adrenalin. In their experiments the denervation also includes an interruption of the neurohumoral connections, the importance of which have been emphasized by Groot and Harris.

Colfer, Groot and Harris (ref. 32) reported that while emotional stress produces lymphopenia (ref. 33) via the hypophysis and the suprarenal cortex, adrenalin injected intravenously in rabbits did not have this effect in the majority of animals. This is in some contrast with the recognized observations in other animals and man. On the other hand, the results from adrenal denervation clearly show that the suprarenal medulla is not necessary for producing the release of ACTH as a result of emotional stress.

That repeated stimulations with adrenalin result in a progressively diminished eosinopenic response has been noted (refs. 30 and 33).

Also the response to adrenalin can be blocked by a sympathicolytic, dihydroergotamine (ref. 34).

While adrenalin apparently can exert a direct stimulatory effect of the anterior pituitary cells releasing ACTH, at least in certain animals, a mediation by some structures in the hypothalamus might also come into play. This is indicated by the electrical activity in the posterior hypothalamus after adrenalin and stressful stimuli as found by Porter (ref. 35) and by the experiments of Groot and Harris (ref. 31) who elicited signs of ACTH release after electric stimulation of the posterior pituitary.

The eosinopenic response to stress appears to be elicited in more than one way. Fortier and Selye (ref. 36) thus have shown that severance of the hypothalamo-hypophyseal pathways does not prevent eosinopenia resulting from surgical trauma or cold (confirmed by Barrnett and Greep) (ref. 37), while the effect of immobilization or sound (ref. 29) or emotional stimuli (ref. 31) depends on a connection between the hypothalamus and the anterior pituitary. In demedullated animals insulin histamine and cold (ref. 38) or emotional or surgical stress (ref. 39) still may release ACTH as measured by the fall in adrenal ascorbic acid.

On the other hand, hemorrhage, general excitement, and insulin coma did not cause a lymphopenic response in adreno-demedullated rats (ref. 40). The authors concluded that under these stress conditions an increased secretion of adrenalin is normally produced, followed by an increased discharge of adrenocortical hormones. Hypoglycemia appeared to induce some ACTH secretion even in the absence of the adrenal medulla. Also after artificial increase of body temperature in rats it was found that the suprarenal medulla was unnecessary for the development of eosinopenia, lymphopenia, and neutrophilia (ref. 41).

From this and other evidence it appears that stress may release ACTH and cortical hormones by a nervous mechanism independently of the suprarenal medulla. Whether noradrenalin liberated from the nerve endings might contribute to the eosinopenia, etc., in the absence of the suprarenal medulla does not seem to have been satisfactorily proved or disproved. According to Groot and Harris, ACTH can be released by neural control via the hypothalamus and the hypophysial portal vessels of the pituitary stalk. The nature of the transmitting agent is, however, unknown.

The finding by Hume (ref. 42) that extracts of the hypothalamus are capable of producing good eosinopenic responses in normal animals and also in animals whose hypothalamic lesions render them incapable of responding to any of the stressing agents tested, may be

explained by the presence in this part of the brain of adrenalin or noradrenalin. This has in fact been shown by Vogt (ref. 43) and confirmed by Euler (ref. 44). Also the hypothalamus contains histamine (ref. 45) and substance P in high concentrations, as shown by Pernow (ref. 46). It is not yet possible to make any statement as to the physiological significance of these findings, but it seems worth while considering locally liberated noradrenalin as a candidate for the hypothetic transmitter.

Figure 1 is an attempt to illustrate some of the possible pathways for the release of ACTH, cortical hormones and catechol amines in conditions of stress.

Selye states with regard to the principal pathways of the stressor effects that they act, in part, directly on the target and, in part, indirectly through the pituitary and adrenal. The pathway by which the stressor stimulus travels to the anterior pituitary and causes a dis-

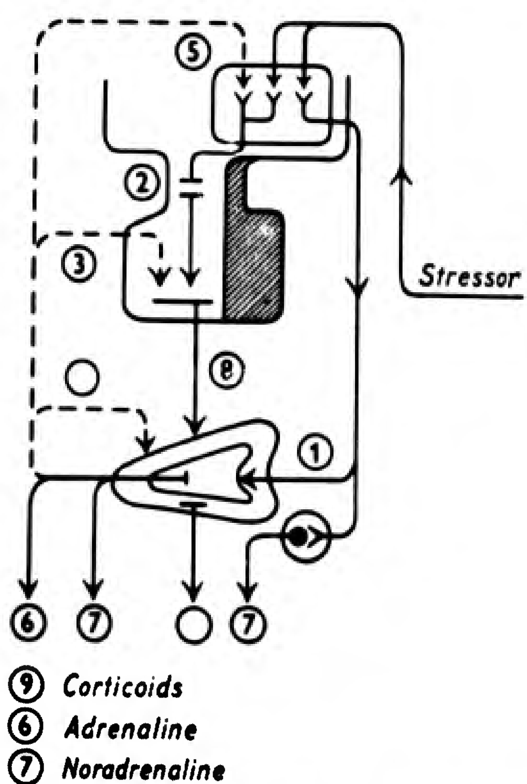

FIGURE 1. Stressing stimuli may release catechol amines (refs. 1 and 7) and ACTH (ref. 2) via hypothalamic structures. Noradrenalin is released from adrenergic nerve endings (ref. 7) and/or from the adrenal medulla (refs. 6 and 7); adrenalin (ref. 6) is released from the adrenal medulla. The catechol amines may on some occasions act on the adrenal cortex (ref. 4), the ACTH-producing cells in pars distalis (ref. 3), or hypothalamic structures (ref. 5). Corticoids (ref. 9) are released by the ACTH (ref. 8).

charge of ACTH is described as unknown. Of the possible mechanism for this signal Selye mentions adrenalin discharge, release of histamine-like toxic tissue metabolities, nervous impulses or metabolic deficiencies such as hypoglycemia.

Long and Fry were the first to point out "that many of the circumstances associated with the release of ACTH are those which for many years have been known to be also associated with an increased degree of activity of the autonomic nervous system and a concomitant release of epinephrine. It was suggested, therefore, that epinephrine is an important factor in the activation of ACTH secretion and may well serve as the trigger mechanism by which adequate amounts of adrenal cortical hormone are rapidly made available for the bodily needs of the moment." Though adrenalin may not cause any appreciable release of ACTH in man, as indicated by recent observations, the question still remains whether adrenalin and noradrenalin are part of the defense mechanism active in conditions of stress.

In order to find an answer to this question it is apparently of primary importance to have some method to measure the production of these catechol amines. The adrenalin and noradrenalin concentrations in blood can, with the methods available at present, only be determined in exceptional cases, such as in pheochromocytoma (ref. 47). However, in animal experiments it can be determined in the suprarenal venous blood, even without anesthesia.

Using the method of assay of catechol amines in suprarenal venous blood, it has been shown that during certain afferent stimuli (ref. 48) and during hypothalamic stimulation (ref. 49) the secretion of adrenalin is greatly increased.

Even for noradrenalin the secretion under stressful stimuli may be considerably increased. If the resting noradrenalin secretion of the cat is estimated at 0.06 mcg./kg./min. (ref. 50), the secretion under stressing stimuli may be readily raised to 1 mcg./kg./min.

Using the indirect method of estimating catchol amine excretion in urine (ref. 51) it has been possible to compare the output in conditions of stress and the excretion figures obtained from constant infusion at known rates of adrenalin and noradrenalin, the action of which can be directly tested.

Some data are available from such determinations pertaining to histamine injection, heavy muscular work, surgical trauma, hypoglycemia, myocardial infarction, and pneumoencephalography.

The following table shows the urinary excretion of adrenalin and noradrenalin during varying conditions of stressful nature, and for comparison, the output after infusions of adrenalin, noradrenalin, and histamine in man.

Table 1

Condition	Adrenalin output in urine mcg./min.	Noradrenalin output in urine mcg./min.	Reference
Normal, rest (basal)	0.002	0.02	(44)
Infusion adr. 15 mcg./min	0.15–0.30	n	(52)
Infusion adr. 7 mcg./min	0.10	n	(52)
Infusion noradr. 15–"–	n	0.30	(53)
Heavy muscular work	0.10	0.40	(54)
Insulin hypoglycemia	0.03–0.09	n	(55)
Surgical trauma	Irregular	0.05–0.10	(56)
Myocardial infarct	n	0.05–0.15	(57)
Histamine 0.5 mg. s. c.	0.05 (max.)	n	(58)
Pneumoencephalography	0.03 (max.)	n	(59)
Pilots during flight	0.01–0.04	n	(44)

n.=approximately normal.

From the table it is apparent that during certain conditions of stress the adrenalin output is of the same order as during infusion of an amount of adrenalin (0.1 to 0.2 mcg./kg./min.) which is known to produce eosinopenia and other responses characteristic for stress. A continuous excretion of 0.03 mcg. adrenalin per minute may be taken

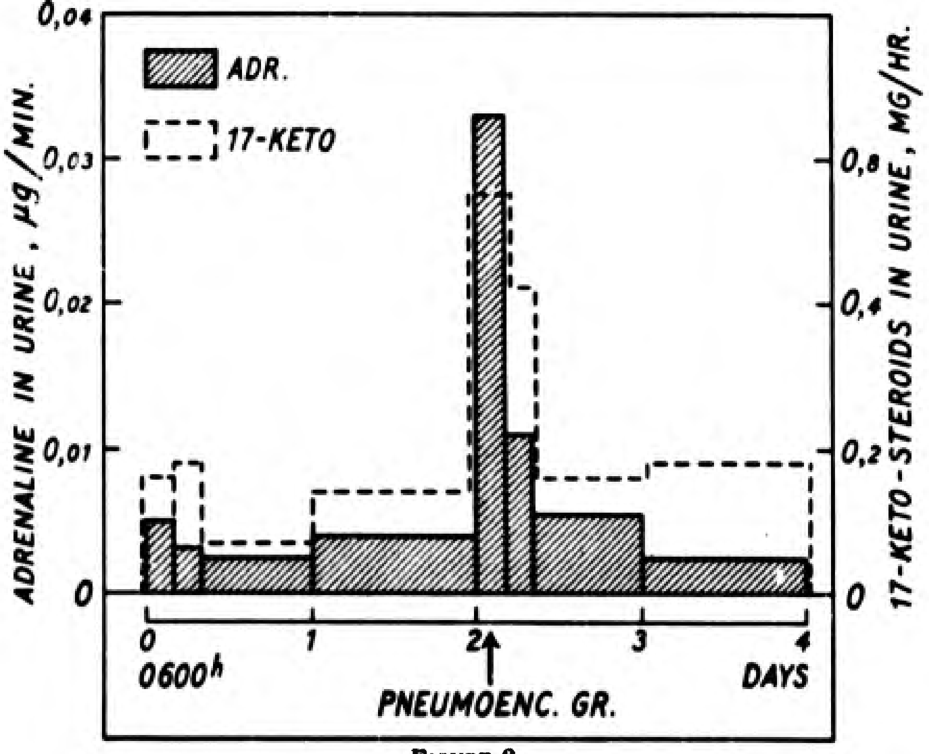

FIGURE 2.

to correspond approximately to the threshold infusion of adrenalin in blood capable of inducing stress responses. As shown in figure 2, a certain parallelism is observed in the urinary excretion of adrenalin and 17-keto-steroids in pneumoencephalography (ref. 59).

Whether noradrenalin would occur in blood during stress in such concentrations as to cause eosinopenia is less clear, but this hardly seems to be the case except in conditions involving cardio-circulatory stress. If it be assumed that a concentration five times higher than that of adrenalin is needed in order to elicit an eosinopenic response, an output figure of 0.15 mcg./min. might be considered as the threshold. One might thus conclude that during heavy muscular work and myocardial infarction the noradrenalin concentration in blood can be high enough to elicit some kind of alarm reaction. Therefore, although noradrenalin is much less active in this respect than adrenalin, it might, by virtue of its higher concentration in blood, be an active factor in certain stress conditions.

Since heavy muscular work has been found to be accompanied by a rather high output of adrenalin and noradrenalin, this particular form of stress might call for some comments. Muscular work is not followed by an increased catechol excretion under all circumstances.

Wada, Seo, and Abe (ref. 60) were able to demonstrate that the catechol amine secretion from the suprarenals in the unanesthetized dog was not increased as a result of running unless the animal showed marked signs of fatigue. The amount of work was not in itself the determining factor. These findings agree with the results of Euler and Hellner (ref. 54) who measured the urinary output of adrenalin and noradrenalin in various degrees of muscular work in man in which the oxygen consumption was measured, and found, like Wada and co-workers, that there was no increase or very slight increase of the output if the work did not cause severe fatigue. In a trained subject the urinary output rose sharply only when the work caused an increase in the oxygen consumption up to about 4 liters per minute. In untrained subjects the output was markedly increased already at lower degrees of work, causing a similar state of fatigue.

A practical implication of this seems to be that subjects with different capacity for work, although otherwise healthy and in good condition, may develop greatly different degrees of stress from a given amount of physical work. This is of some interest, for instance, in military training and similar activity where there is sometimes a tendency to let all individuals do a uniform work. Since there are reasons to believe that repeated conditions of severe stress are harmful to the organism, this problem should be watched also from the

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point of view of public health. The increase in urinary output of catechols in heavy muscular work may increase to about 10 times the normal, which holds for adrenalin as well as noradrenalin.

It is known from experiments on the effects of insulin hypoglycemia in man (ref. 55) that an output of adrenalin corresponding to that in muscular work causes not only markedly circulatory change but also considerable metabolic changes and, in all probability, a release of ACTH and subsequently of corticoids. Heavy muscular work is also attended by signs of cortical hyperactivity.

The origin of the catechol excreted in urine is partly the suprarenals and partly the adrenergic nerves. This inference is drawn from experience on adrenalectomized patients, who stop secreting adrenalin but continue to secrete noradrenalin (ref. 61). Since the noradrenalin output in muscular work is about 5 to 10 times as much as the adrenalin, it appears likely that even the noradrenalin exerts definite actions, for instance on the blood cells.

In order to allow decisive conclusions as to the role of catechol amines in stress, it will be necessary to collect more data on the action of known infusion rates of adrenalin and noradrenalin and to determine the production rate during varying conditions of stress. In this way it might be possible to find a way of exerting some control of the stress response in addition to knowledge of the degree of stress during various conditions. Apart from heavy muscular work, it is of interest that surgical trauma, severe hypoglycemia, and pneumoencephalography are accompanied by high excretion figures, conditions which are known to be accompanied by eosinopenia in man (ref. 62).

The effect on ACTH on the catechol amine distribution in the liver and the heart of the intact rat has been studied by Hökfelt (ref. 63) who found a decrease of noradrenalin in liver but an increase in the heart. Adrenalin, on the other hand, increased in the liver and decreased in the heart.

Luft and Euler (ref. 64) observed that the noradrenalin excretion after daily administration of ACTH in man (rheumatoid arthritis) was considerably lowered while the adrenalin output was unchanged or increased. A shift in the same directions was noted also after cortisone but not after DCA.

The importance of corticoids for the response of various organs and functions to adrenalin and noradrenalin has been studied in some cases. Thus Kurland and Freedberg (ref. 65) found a striking potentiation of the blood pressure response to noradrenalin within 24 hours after administration of 90 to 180 mg. ACTH daily or

150 to 200 mg. cortisone daily. This potentiating effect disappeared within 36 hours after the omission of the hormone treatment.

In prolonged conditions of stress an inadequate production and release of corticoids may exert an unfavorable effect on the vasoconstrictor system, which normally acts by liberating noradrenalin.

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BEHAVIORAL REGULATION OF HOMEOSTASIS*

CURT P. RICHTER, M. D.

What are the behavioral mechanisms that maintain homeostatsis? I am sure many of you asked yourselves that question when you saw the title of this paper. Let me try to explain.

I shall go back to Claude Bernard (ref. 1). In 1859 he first spoke of the "constancy of the internal environment," a now thoroughly familiar concept. He pointed out the relative constancy of the salt, calcium, sugar, and water content of the blood and lymph, as well as the narrow limits within which the body temperature of healthy mammals is maintained. But Bernard could not be very explicit concerning the physiological mechanisms involved in this control. Cannon (ref. 2) developed Bernard's ideas, in accordance with the newer knowledge of physiology and biochemistry; it was he who invented the term "homeostasis." Like Bernard he was also a physiologist and his major interest centered in the physiological mechanisms involved, such as the significance of the parathyroid secretion in determining the calcium level of the blood. Stimulated by his knowledge of the bodily changes in fear and rage and by his studies on thirst and hunger, he became increasingly interested in the role of the animal itself in maintaining its own well-being. In his classical book, "The Wisdom of the Body," he was mainly concerned, however, with the underlying physiological mechanisms, especially the influence of the autonomic nervous system.

In more recent years, Selye (ref. 3) has extended the ideas of Bernard and Cannon into a concept of his own that now appears as the foundation for an all-inclusive enterprise called "Stress." His interest is strictly physiological. He concerns himself with such stressors as hemorrhage, trauma, burns and shock, and the changes that they produce. Further, he believes that these various stressors may either produce disease or be integrated constructively into the adaptation of the animal to its environment; the actual outcome in any given instance being largely determined by the capacity of the adrenocortical secretions to meet the emergency.

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Wolff and his co-workers (ref. 4), have also studied the reactions of the body to stress. They investigated not only the immediate responses of the various organs, but also the long-term responses and the possible consequent production of bodily disease. In contrast with Selye, who is interested specifically in cellular injuries, these workers were primarily concerned with the consequences of overwhelming total-life situations; their studies have laid the foundation for much of the work that has been done in this area of psychosomatic medicine.

All of these workers have concerned themselves primarily with the bodily changes that result from the breakdown of homeostasis as a result of stress, whereas we propose to contemplate some of the mechanisms involved in the effort made by the individual to maintain a constant internal environment under stress. In other words, we will consider the behavorial mechanisms involved in either avoiding or counteracting stress.

To illustrate such mechanisms let me give a brief review of some of our own earlier studies made on rats (ref. 5). Needless to say, it is far easier to control the stresses confronting a laboratory animal than those in the lives of human beings. In these studies we investigated the rat's efforts to maintain homeostasis in the absence of various of the physiological regulators normally involved in this process.

For example, it is now well known that the sodium content of the blood is regulated by secretions from the cortex of the adrenal glands. When salt intake is low these glands become more active and so conserve salt; when the salt intake is high, they secrete less actively, allowing more salt to escape in the urine. When the adrenals are surgically removed, the urine contains excessive amounts of salt; blood sodium falls; and the animal promptly develops the manifestations of adrenal insufficiency. In the rat, death follows in 4 to 18 days if the food intake is limited to the stock diet and the fluid intake to water. However, if the rat is given access also to a 3 percent solution of salt, it will voluntarily consume large amounts and thus maintain blood sodium at its normal level and remain free from symptoms of insufficiency. Figure 1 shows typical records for adrenalectomized rats (A) without access to salt, and (B) with access to a 3 percent salt solution. In other words, after the physiological mechanism for regulating the sodium content of the blood has been eliminated, the whole animal takes over the regulation. The specificity for sodium by this means of regulation was seen in experiments in which the adrenalectomized rats had access to an assortment of electrolytes in addition to sodium: magnesium, potassium, and calcium. They consistently increased their intake only of the sodium solution.

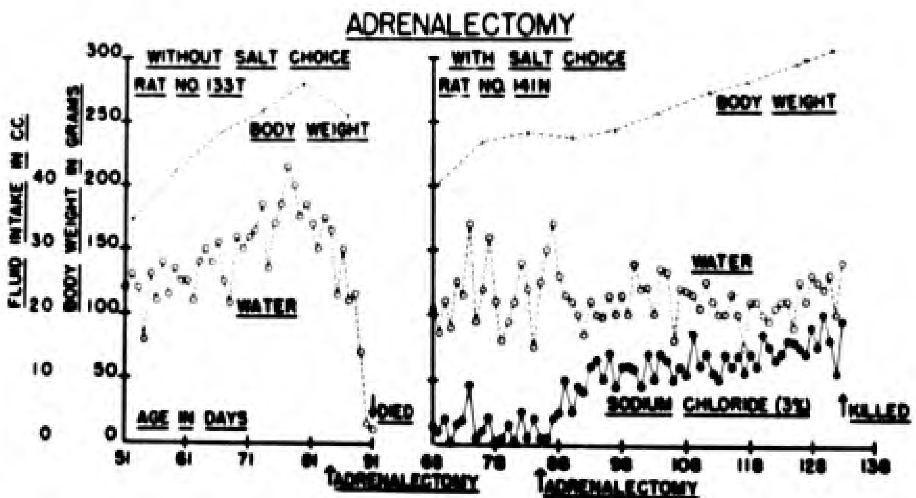

FIGURE 1. Typical records showing (A) that when an adrenalectomized rat does not have access to salt, it loses weight and dies in a short time; and (B) that when it has access to a 3 percent salt solution it continues to gain weight and remains free from symptoms of insufficiency.

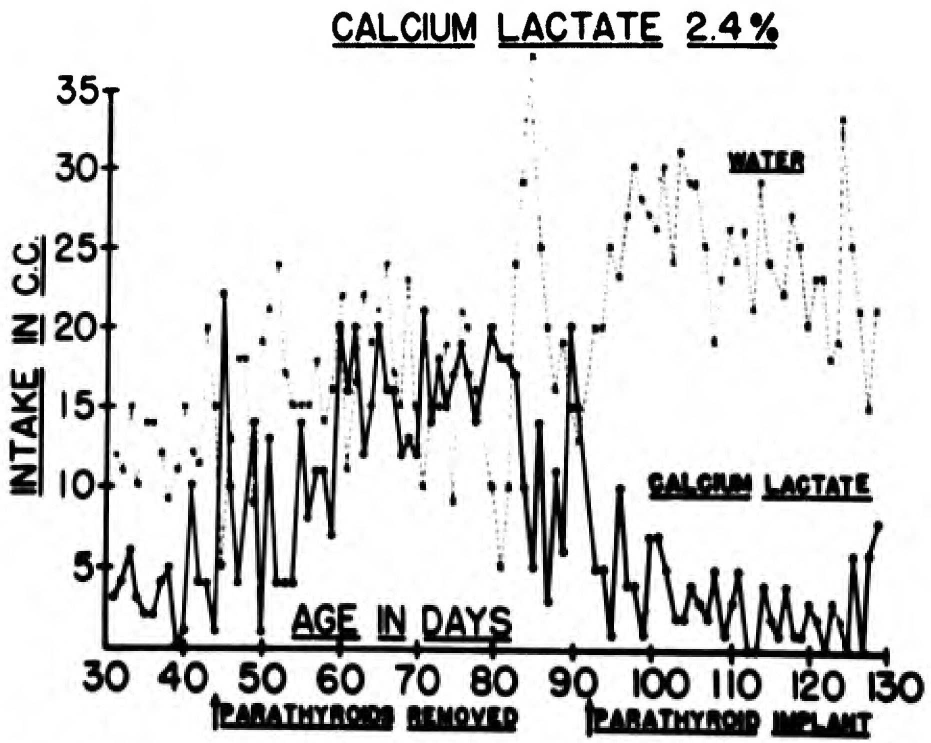

FIGURE 2. Typical record showing increased intake of calcium lactate (2.4 percent) solution of a rat after parathyroidectomy and decreased intake after implantation of a parathyroid to the anterior chamber of the eye.

Our next experimental example deals with the metabolism of calcium and phosphorus. It is well known that the calcium and phosphorus content of the blood and lymph are regulated by secretions from the parathyroid glands. Removal of these glands results in a prompt decrease in blood calcium and an increase in blood phosphorus. If rats are kept on a low-calcium diet with access only to distilled water, they develop tetany and often die within 1 to 2 days. If, however, they are given free access to a calcium solution, they promptly start drinking large amounts and consequently live and remain free from tetany. Figure 2 gives a typical record of the calcium lactate (2.4 percent) intake of a rat before and after parathyroidectomy.

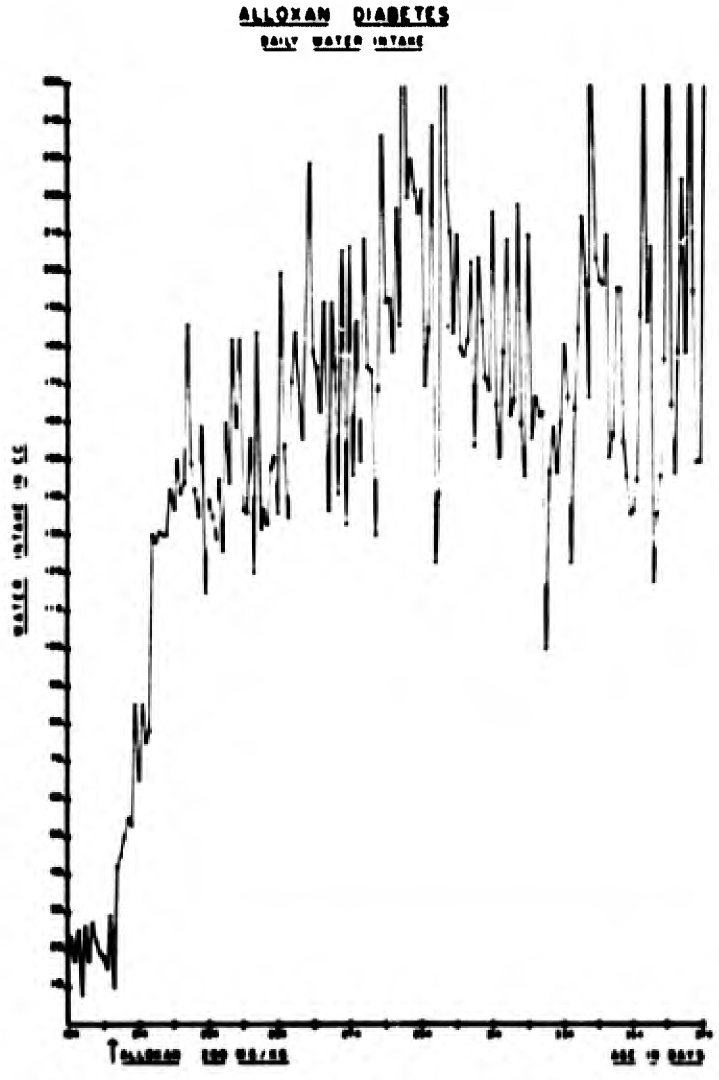

FIGURE 3. Typical record showing greatly increased water intake of rat after an injection of alloxan (200 mg./kg.).

After parathyroidectomy, rats reduce their intake of phosphate solutions.

Another example deals with the maintenance of blood sugar levels within a relatively narrow normal range. The sugar content of the blood is regulated by the secretion from the Islands of Langerhans in the pancreas; removal of this gland results in a prompt and marked increase in blood sugar. Pancreatectomized rats or alloxan-treated rats, limited to their regular ration of water, quickly die. However, when given free access to water they drink huge amounts, thus enabling them to excrete large amounts of glucose and remain in good health. Figure 3 shows a typical record of the increased water intake that follows a single injection of alloxan. If instead of a mixed diet, pancreatectomized rats are offered fat, carbohydrate, and protein in separate food cups, in contrast with the intact controls, they take very little of the carbohydrate, meeting their energy needs through an increase fat consumption. Such rats drink less than rats not operated on, and are able to maintain blood sugar at levels compatible with life (ref. 6).

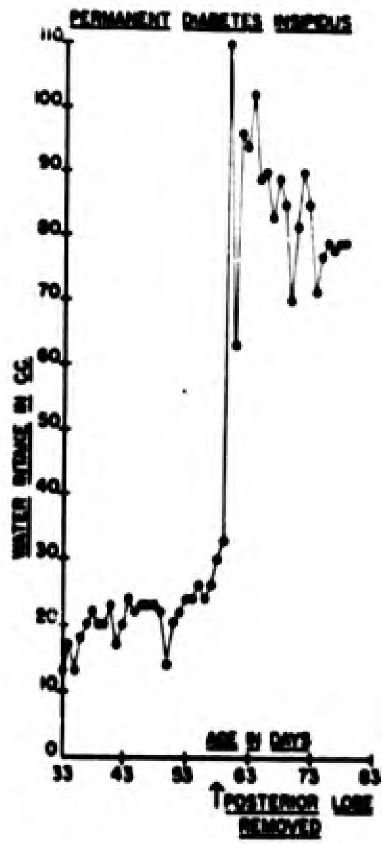

FIGURE 4. Typical record showing greatly increased water intake after removal of the posterior lobe of the pituitary.

A further example concerns the regulation of water metabolism by the secretion from the posterior lobe of the pituitary gland (ref. 7). Removal of the posterior lobe is always followed by a marked polyuria, and by death in a few hours if the rats are not given free access to water. When, however, they have free access to water, they drink very large amounts, in some instances twice their body weight per day, thus preventing dehydration and enabling themselves to survive a normal life span in good health. Figure 4 shows a typical record of water intake of a rat before and after removal of the posterior lobe.

That the temperature of the healthy body is kept within a very narrow range is well known. After thyroidectomy the temperature falls even when the room temperature is only slightly lowered. Reducing the temperature by as little as 10° F. below the normal level may result in a body temperature too low to maintain life. When a thyroidectomized rat of either sex is given access to a roll of paper, it will pull off hundreds of feet for building a nest in which it is protected from heat loss. Thus, a thyroidectomized rat can survive in even a quite low temperature. When body temperature is increased again as a result of feeding dried thyroid powder or injecting thyroxin, rats build only small nests, or no nests at all.

A quantitative study of nest-building activity was made by means of the cages and devices shown in figure 5. A paper roll (absorbent

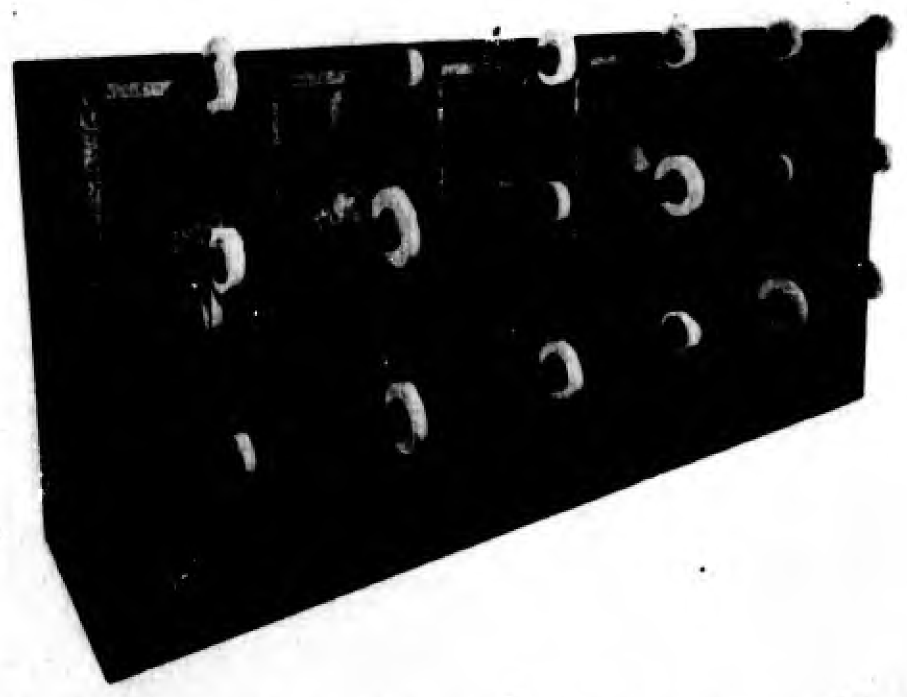

FIGURE 5. Photograph of cage and device used in measuring nest-building activity.

paper with a high degree of tensile strength) ½ inch wide and 500 feet in length, moves freely around a metal axle, supported on an iron yoke. Each revolution of the roll was recorded on a cyclometer. Since the length of paper per revolution decreases as the diameter of the roll decreases, a scale was devised showing the length of paper for each revolution of the roll as the paper is dispensed. The end of the roll of paper is fed into the inside of the cage through a glass tubing. Figure 6 shows a drawing of this apparatus in use. It shows how the rat builds itself a nest with the paper.

The cyclometers are read every 24 hours and at the same time all paper is removed. This means that the rat has to build a new nest each day.

At ordinary room temperature a normal rat will use about 500 to 1,000 cm. of paper per day and then usually makes just a flat nest on which it can sit. Figure 7 shows a typical record. Here the ordinates show the length of paper in centimeters, the abscissas time in days. The ordinates also show room and body temperature. At a room temperature of 80°F. the rat used 750 cm. of paper on the average. When the temperature was dropped to 40° to 50°F. the rat used almost 6,000 cm. or about eight times as much as at room temperature, and the rat crawled inside of the nest and so covered itself on all sides with a thick meshwork of paper. Figure 8 shows a typical record of the rat's reaction to the threatened lowering of body temperature that follows thyroidectomy. Before thyroidectomy it used 700 cm. of paper per day, afterward it used about 4,000 cm. After feeding thyroid powder and so removing the threat, the rat quickly reduced the size of its nest to a normal size again.

FIGURE 6. Drawing showing side view of cage and measuring device, and of a rat engaged in building a nest.

Body temperature regulation is also under the influence of the hypophysis, probably indirectly through its control of the thyroid. After hypophysectomy the body temperature of a rat drops sharply and the animal dies when exposed to even moderately lowered room temperatures. However, if given access to nesting paper, hypophysectomized rats, like the thyroidectomized rats, construct nests for themselves in which they can maintain body temperature levels that are at least compatible with life.

Figure 9 shows a typical record of the nest building activity of a rat before and after hypophysectomy. The ordinates show centimeters of paper, body temperature, and body weight in grams; the abscissas time in days. Preoperatively this animal used about 800 cm. of paper on the average; postoperatively it used over 3,000 cm. Despite the protection from loss of heat made possible by the large nests that the rat daily built for itself, body temperature was not maintained at its normal level. However, that the animal did succeed in conserving enough heat to keep itself alive is shown by the

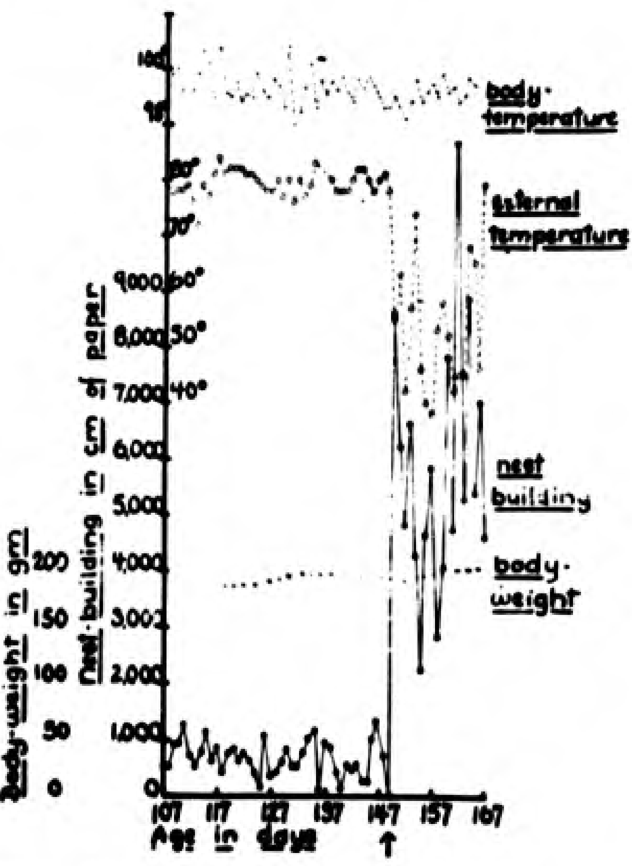

FIGURE 7. Record showing increase nest-building activity produced by a drop in external temperature.

observation that when nesting paper was no longer made available, body temperature dropped to a low level and the rat died.

Some of the thyroidectomized and hypophysectomized rats used the entire roll of paper of 500 feet each day, and built such large and well constructed nests, much like an oriole's, that the entire nest could be picked up intact simply by inserting a finger in the entrance.

Many other similar observations could be presented, but these should suffice to make clear what is meant by behavioral mechanisms for the maintenance of homeostasis.

In an intact animal both behavioral and physiological mechanisms must operate, supplementing one another. For instance, when an animal finds itself in an environment that offers limited salt, the adrenals will secrete more salt-conserving hormone, while at the same time the rat will seek salt or food containing salt. When a rat or other animal finds itself in a cold environment, its thyroid will become more active, increasing the rate of metabolism and thus producing more heat. Various other mechanisms for producing and conserving heat will also come into operation; and at the same time it will seek either to escape from the cold or search for means of conserving as much body heat as possible by covering itself with paper or other materials. The maintenance of homeostasis is thus doubly insured.

Various experiments can be made on the basis of this concept. For instance, we are now studying the reaction of rats to cold temperatures—using blood ascorbic acid levels as measures of cold stress. Comparisons are being made between rats that do and do not have access to nesting paper.

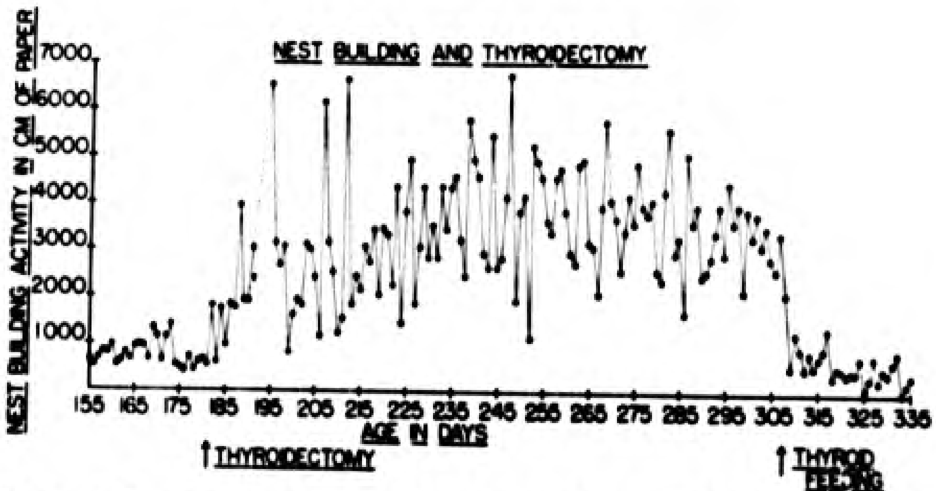

FIGURE 8. Record showing increased nest-building activity of a thyroidectomized rat.

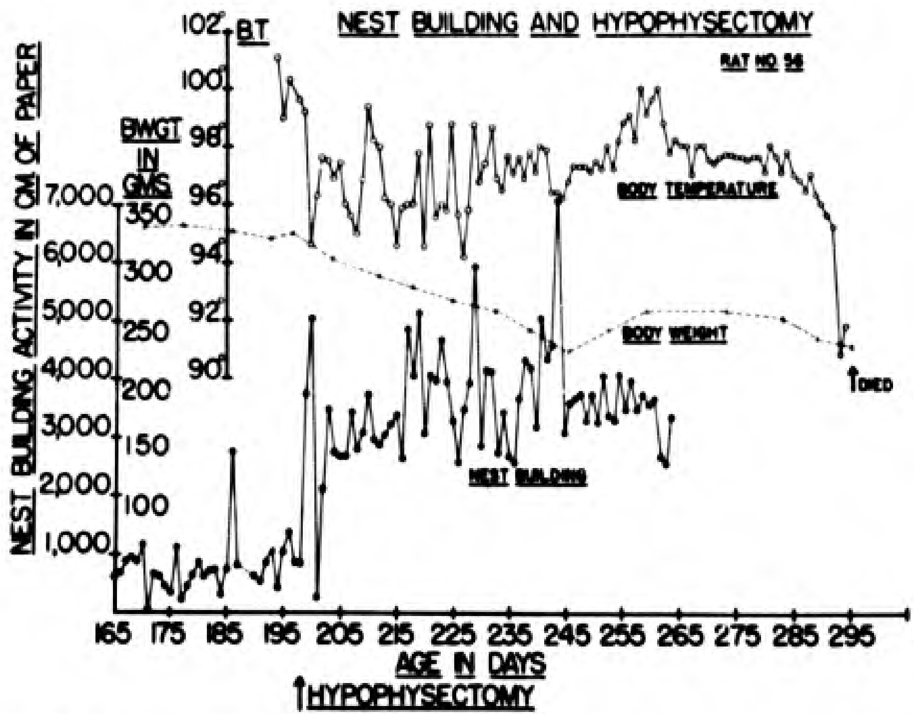

FIGURE 9. Record showing increased nest-building activity of a hypophysectomized rat; also the failure of rat to survive after paper was no longer available.

Cannon observed that the various physiological processes can be overwhelmed; they can age or become hyper- or hypo-active. Selye has greatly elaborated this aspect. Behavioral mechanisms undoubtedly also are subject to breakdown changes with age as well as through other pathological influences. From our dietary self-selection experiments in rats we can list a number of different ways in which behavioral mechanisms may fail:

1. *Sensory Defects.* When the ability to taste is eliminated by sectioning of the taste nerves, adrenalectomized rats do not drink more salt solution than before operation. Presumably they cannot distinguish between plain water and the salt solution, and consequently die in 5 to 18 days, as they would have without access to the added salt. Intact rats can readily be killed with poisons that have no taste (ref. 8).

2. *Habits and Conditioning.* After rats have become accustomed to finding given solutions or foods in definite places in "self-selection" cages—and over a long period of time—they may persist in their habits even after the substances have been shifted, sometimes making faulty, harmful choices as a result.

3. *Fear and Suspicion.* Fear of poisoning can be induced in some trapped wild rats by making them very sick on a sublethal amount of

a poison having a very faint taste and then subsequently by putting the same poison in their food at irregular intervals. These rats will ultimately refuse all food, poisoned or unpoisoned, and so starve themselves to death (ref. 9). Wild rats trapped from the streets are so fearful of new foods that they may literally starve themselves to death when offered an assortment of chemically purified nutrient substances from which tame and trusting domesticated rats make beneficial selections.

4. *Brain Lesions.* Destruction of certain parts of the hypothalamus apparently abolishes the control of appetite to such an extent that rats eat so voraciously as actually to produce great obesity and in some instances early death.

5. *Nutritional Deficiencies.* Although rats kept on experimental deficiency diets of various kinds ordinarily make beneficial selections of needed food-stuffs when these are offered, they may lose this capacity if the deficiency has become too severe before the missing supplements are made available.

From these experiments on rats we have learned how many diverse activities that at first glance would not be suspected of having anything to do with the maintenance of homeostasis actually play an important part in this process; we have also learned how the mechanisms involved in these activities can be broken down.

What do these results tell us about activities of man in the face of stress? It may be that many activities, if closely scrutinized in the light of the results of studies on rats, will likewise turn out to be efforts of the whole person to maintain homeostatis. Numerous instances have been cited (ref. 5). The results of these studies should also be of help in understanding how these behavioral mechanisms can be broken down, and in what way the breakdown can be avoided. It is not improbable that in man these mechanisms may be broken down in much the same way as in rats by—

1. Sensory defects. For instance, when exposed to cold, a man may get frostbitten because his sensations have not given him proper warning of the cold.
2. Individual habits and conditioned responses.
3. Fears and suspicions.
4. Brain lesions and defects.
5. Extreme nutritional deficiencies.

and in addition by—

6. Group and cultural beliefs and practices. Failure to regulate food intake—over-eating would be an example of a faulty operation of a behavioral regulator. Group or cultural practices and beliefs about the amounts of food needed might make a man over-eat, and

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so in my mind produce one of the most severe and common forms of present-day stress—overweight.

7. Psychotic or neurotic conditions.
8. Motivation and effect.

These are just suggestions since this field has not been systematically explored except possibly by cultural anthropologists. For the most part, research in the field of stress has been focused on men in whom homeostasis has broken down, men with bodily diseases. It would seem to me that a fruitful field of research here would be the study of men who have successfully withstood situations of severe stress. How did they do it?

In summary, it is hoped, then, that a fuller knowledge of the operation of these behavioral mechanisms, which are seen so clearly in rats, will be of help in arriving at a better understanding of reactions of man to stress and in aiding man to meet stress with greater success.

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TUESDAY MORNING SESSION

17 March 1953

MODERATOR

John C. Whitehorn, M.D.

THE PROBLEM OF STRESS IN THE COMBAT ZONE*

COLONEL ALBERT J. GLASS, MC

The phenomenon of situational stress is perhaps most clearly illustrated by the reactions of soldiers subjected to front line battle conditions. Combat is a unique experience in that the mental and physical hardships inflicted upon its participants are of an identical nature, although of varying intensity. This uniformity of environmental trauma makes it possible to recognize more readily the resistance process to an external load. Observations of these defense mechanisms that sustain men in combat form the basis of this report. It should be realized that such impressions represent only a gross or macroscopic portrayal of stress components. However, it is believed that this information may prove of value in indicating areas where further research may increase our understanding of stress in battle and thus facilitate the task of the Army Medical Service in its mission of conserving fighting strength.

The following manifestations of failure in combat will not only delineate the magnitude of the problem of battle stress, but as in other types of pathology also serve as an approach to causation. First are the combat failures contained in the non-battle casualty category. Non-battle casualties exceed the battle casualty rate in increasing proportions the longer a unit remains in active combat. Examination of non-battle losses reveals a considerable number (over 50 percent) in which a breakdown of defenses against external trauma is readily apparent, namely: (1) Persons with minor organic disease or injury which is only mildly, if at all, incapacitating. This group includes pes planus, scoliosis, scars from previous injuries or wounds, chronic prostatitis, minor sprains and contusions, and the like. Experience with these cases makes it abundantly clear that the medical condition only thinly disguises a psychological breakdown. (2) Individuals with subjective complaints and negative physical findings. Representative symptoms are headache, backache, anorexia, excess sweating, urinary frequency, diarrhea, weakness, muscular aches, joint pain, giddiness, night blindness, palpitation, and weight loss. Here it is plain the usual bodily discomfort endured by the combat soldier is put

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forth as an illness in a conscious or unconscious attempt to flee from the traumatic situation. (3) Self-inflicted wounds and other non-battle injuries that are at least due to carelessness. These phenomena represent another faulty adaptation to battle. Such a defense is well understood by men in combat as evidenced by a roadside sign erected by the Military Police during March of the first discouraging winter in Korea. It read as follows:

Never fear, rotation is here
Accidents unnecessary. Drive carefully.

(4) Broken and lost spectacles and dentures, that for a brief period cause a removal from battle. (5) Combat psychiatric casualties that are an undisguised breakdown in combat adaptation.

Second are the combat failures, as manifested by disciplinary offenders involving purely military crimes directly connected with the battle situation, such as desertion, misbehavior before the enemy, insubordination and disobedience of a direct order. Straggling is a minor form of this overt psychological failure.

Third, and perhaps most important from a numerical standpoint, there are the many riflemen who remain in combat but contribute little or no fire power. This aspect of combat failure has been noted by many observers of front line fighting and has been thoroughly studied by Colonel S. L. A. Marshall, who surveyed hundreds of infantry companies during World War II. In his book "*Men Against Fire*" Colonel Marshall stated that only from 15 to 25 percent of rifle company personnel actually fire upon the enemy or exhibit appropriate aggressive activity during battle. While this may be a low estimate for fire power participation in the Korean Campaign, no one can deny that the large number of such passive combat personnel constitutes a serious obstacle in the overall battle performance of troops.

A common denominator in all of the above manifestations of combat failure is an apparent inability to assume or continue an aggressive role against the enemy. This defect is not the direct result of enemy action, such as an incapacitating wound, nor does it arise from unavoidable battlefield conditions that may produce a disabling injury such as frostbite or an incapacitating illness such as infectious hepatitis. Rather, it stems from forces within the individual that seemingly bind or restrict the function for which he has been trained and equipped. It will come as no surprise that the ubiquitous phenomenon of battle fear is primarily responsible for producing this inhibition of aggressive action. The crippling sensations of fear are experienced by almost all combat participants. Indeed, it has always been considered good military strategy to weaken enemy resistance by intensi-

fying or otherwise utilizing the sounds and other stimuli which provoke fear. The bugles and cymbals employed by the Chinese Communist forces in Korea are but an ancient application of this principle.

Time does not permit an adequate discussion of the origin and mechanism of fear. Certainly it can be granted that fear is a basic biological faculty that warns the individual of impending danger or catastrophe. The greater the extent to which one believes that his existence or the values held essential for existence are threatened, the more intense is the feeling of fear. In battle, fear varies in direct proportion to the real or imagined danger from the enemy. From a quantitative standpoint it can be measured by the intensity of enemy fire power particularly when the effect of that fire power is confirmed by the grim evidence of nearby casualties. Thus the incidence of psychiatric casualties, the most direct manifestation of combat fear, regularly rises and falls with the battle casualty rate. The influence of fear is more indirect in non-combat casualties, yet their frequency increases with the length of time a unit remains in battle. The most striking effect of fear, as reported by Colonel Marshall, is the failure of riflemen to fire their weapons in combat, although no such inhibition is present on maneuvers · other occasions when battle fear is absent.

In its effect upon combat personnel, fear can be compared to the action of a virus or other infectious agent. If the dosage is sufficiently large, almost anyone may be overwhelmed and rendered helpless. Similarly, when a smaller but constant dosage of fear is administered over a prolonged period of combat, even the superior soldier will slowly but surely become ineffective. Like infectious agents, fear may be contagious but it spreads far more rapidly than they, since there is little or no incubation period. Unlike infectious organisms, however, fear does not confer an immunity upon its victims. One may learn to adapt better under fearful conditions, but there is no diminution of the painful and paralyzing action of fear as a result of repeated exposure. This fact is responsible for the recognition of rotation as the only method of preventing the inevitable breakdown of veteran combat personnel.

Despite the adverse effect of battle fear, combat participants may not only function effectively, but often perform feats of bravery involving extraordinary aggressive behavior. Moreover, the influence of fear in battle is uneven. Its effect varies even in the same individual. Personnel of some units may consistently perform more effectively in battle than members of other units, despite similar stressful conditions. It is clear that there are successful adaptations in combat.

If it is granted that the crippling tension produced by battle fear is the primary cause of combat failure, then three basic types of defense are possible, namely: (1) attempts to decrease or nullify the strength of fear stimuli, (2) efforts to increase the capacity of individuals to contain or tolerate fear, and (3) use of methods that employ appropriate activity for the discharge of tension. In actual practice, combat participants may utilize any or all of the foregoing measures of defense against fear. However, the best antidote to the poison of fear is purposeful action. Even speech is helpful in battle, but aggressive action, as in firing and coordinated movement, gives the most relief from combat tension. The same warning signal of fear that grips the mind also presses the bodily mechanism for action. Action, therefore, drains tension whereas inaction fosters the damming back and building up of tension. This is exemplified by the many occasions in combat when external activity is impractical or impossible. The increase of painful tension produced by such an immobilized state under fire and its accompanying somatic effects are well known to combat personnel whose expression "sweating it out" is an apt description of their experience.

While resistance against combat fear includes one or more of the fundamental defense methods previously stated, this simplified version fails to indicate the complex interaction of somatic and psychic elements that make it possible for the combat participant to adopt and maintain successful mechanisms of defense. In other words, resistance against combat failure must be translated in terms of a psychosomatic process in order to provide the information needed for preventive measures.

A basic component of the psychosomatic resistance against combat failure is the role played by individual personality structure. Obviously persons vary in their ability to control fear. Several character traits are pertinent in this respect, the most important of which is passivity. A marked degree of passivity is manifested by dependence on others, avoidance of external conflict, and helplessness when confronted by danger. It is a product of conditioning that banned any aggressive behavior by threats of retaliation or withdrawal of affection. Such persons repress all aggressive drives as being dangerous and evil. In combat, they are quite vulnerable to fear because of their impaired ability to discharge tension by action. The severely passive person demonstrates in an exaggerated form the problems of almost all combat personnel since they too possess some degree of passivity. This is not surprising since our culture demands obedience in the formative years and deplores physical acts of aggression except under specified conditions, such as in some of the sports. Later so-

ciety enforces this attitude by realistic threats of retaliation and social ostracism. It is difficult to change from the passive habits of peace to the death-dealing aggressive action required in war. Yet under conditions to be discussed, such a transition has been shown to be quite possible, if the degree of passivity is not marked.

Another personality facet that bears upon combat adjustment is the self-critical faculty or conscience. This internalized representative of the rules and standards of society forces the individual to conform to duty and other social obligations by threatening a withdrawal of self-esteem. In combat, conscience may serve as a powerful lever, forcing the soldier to remain in battle and to tolerate fear lest he suffer the pain of self-condemnation. Individuals with small or permissive self-critical faculties have no counter threat toward utilizing manifestations of combat failure. In essence, conscience functions as an internal policeman. It may not force the soldier to fire his weapon, but it does curtail tendencies to flee the painful battle situation. Persons with harsh or severe conscience faculties have an added burden of tension while in battle because they also suffer from fear of exhibiting fear.

A third personality trait relevant to combat adaptation is the universal characteristic of self-love, or the egocentric component of the person. Varying degrees of this character trait determine the extent to which an individual can love or be concerned for persons other than himself. Usual quantities of self-love do not prevent devotion to family and friends, with lesser degrees of feeling for more remote society groups, such as the state and nation. However, it is rare to find individuals comparable to the historic Nathan Hale, who regretted that he had only one life to give for his country. In battle, persons dominated solely by self-love are considerably more affected by fear, since their entire interest is in the self, whereas the average soldier is able to displace some quantity of self-love into concern for the safety and welfare of his buddies.

It is hoped that the foregoing discussion of personality traits does not convey an impression that they play a fixed or static role in combat adjustment. Such an impression might warrant the conclusion that only by the selection and removal of vulnerable personnel could combat failure be prevented. Nothing is further from a practical solution of the problem. Firstly, there are no available methods that can correctly estimate the degree and strength of the various personality constituents. Secondly, the many imponderables in battle make any estimation of personality structure of doubtful value. Truly the battle is the payoff where men may perform feats of bravery and endurance that neither they themselves nor others can predict. It is

only when marked passivity and/or intense self-love are present in an individual that change to a more effective adaptation in combat is not possible.

Attention can now be directed toward the less structured elements involved in combat adjustment. Of obvious importance in any psychosomatic defense concept is the physiological status of persons who struggle against battle fear. Weakness in the somatic sphere automatically diminishes ability to perform the activity required for aggressive action. An individual with lessened physical powers is temporarily like the severely passive soldier who can only absorb fear. It has been repeatedly confirmed that undue fatigue, deprivation of food, and lack of sleep or rest produce a sharp rise in the manifestations of combat failure. The increased bodily tension caused by fear adds a further fatigue component to the other physical deprivations that are inherent in the battlefield situation. For these reasons, combat units must be placed in reserve at appropriate intervals for recuperative purposes. Intercurrent illness, such as diarrhea, fevers of various types, malaria and hepatitis, masked by the usual discomforts of men in battle, produces a similar physiological breakdown in the defense against fear. In Korea, during the summer and early fall of 1950, even soldiers with Japanese B encephalitis were evacuated for combat exhaustion because their initial symptoms indicated disabling tension. Not only does a lowering of physiological function interfere with aggressive ability, but such a state also decreases the capacity to contain or tolerate fear.

Related to physical status is the influence of training. A realistic training program increases physical stamina and prepares the soldier to endure the hardships of combat. But even more important, training produces the technical information and practice in the use of weapons that make possible the employment of appropriate aggressive action in battle. Indoctrination in combat tactics decreases the strength of fear stimuli by facilitating an objective awareness of danger and the protective measures that are best employed. Despite these advantages, newcomers to battle have an increased incidence of all types of combat failure. This is especially true of new units or replacements that are suddenly thrown into active combat. In part, at least, this defect of new troops lies in their over-evaluation of battle stimuli because of inexperience and the necessary time required to acquire suitable patterns of aggressive behavior. For the foregoing reasons, in Korea a battle indoctrination period for new replacements of from 7 to 14 days has been successfully utilized in all infantry divisions. Any method that permits the replacement to become acquainted with the members of his combat group, enlarges his knowl-

edge of enemy tactics and allows him to become familiar with his weapons, will surely diminish the first impact of battle and aid in building defenses against fears.

Perhaps the most effective mechanism in resisting battle fear is the powerful support that can be obtained from the group or combat unit. This sustaining force, called group identification or group unity, refers to the emotional bond that develops among individuals who share common hardships and dangers. It has been repeatedly demonstrated that positive group unity is the distinguishing characteristic of successful combat units who endure severe battle losses with a minimum of individual combat failures.

Group identification spontaneously arises as a defensive measure by two or more persons in response to a common menace. Nowhere is there a greater need for such an alliance as in battle, for, as well stated by Colonel Marshall, "the battlefield is the lonesomest place where men may share together." In this situation men move toward each other both figuratively and literally for actual protection and emotional warmth. When group unity proves by battle test to have value, strong friendships are rapidly formed and intensified by the mutual exchange of protection.

This intense emotional relationship forged in the crucible of battle exerts a profound influence upon character and behavior. First, there tends to be a displacement of quantities of self-love to concern for the welfare of other group members. Less fear is then felt for the self and the consequent decreased inhibition facilitates aggressive behavior that can be used in behalf of others. Such a mechanism accounts for heroic deeds in battle by individuals who seem heedless of personal danger because they are intent only upon securing the safety of their friends. Second, this attitude toward others reinforces the strength of conscience faculties to include the ideals and standards held by the combat group. The individual is compelled to abandon selfish desires or else not only suffers self-condemnation but risks losing the actual and emotional support of the group. Even the poorly motivated person is literally forced to adopt the prevailing group attitude since the battle situation is hardly a place to be left alone. Third, there is the effect of the group upon the character trait of passivity. The passive person identifies with the strong group and is induced to adopt their aggressive attitude. This behavior not only decreases tension but also gains group approval. It is sometimes amusing to note the recent replacement to a veteran unit who not only talks and acts like the others but assumes the entire past history of their exploits and vicissitudes. Even a severely passive person can perform effectively in combat, if bolstered by a strong buddy.

The result of favorable group identification for the individual is a lessened vulnerability to battle fear, a greater ability to contain or tolerate battle tension and an increased tendency toward aggressive behavior. Its benefits are strikingly revealed when group unity is suddenly disrupted or destroyed in battle. The remaining members, stripped of their support and figuratively alone are suffused with fear and many become temporarily ineffective.

Unfortunately, not all units form favorable identifications. Some groups, for various reasons, do not develop an emotional unity. Their combat efficiency, if any, is solely due to the work of a few aggressive individuals. Such groups are merely collections of soldiers in a military unit. Other groups may have the cohesiveness and other characteristics of group identification but are poorly motivated for the combat mission. Members of such a group may support each other in condoning manifestations of combat failure. Newcomers to such a unit readily adopt the negative standards of the group.

Because positive group identification plays such a basic role in the formation of defenses that prevent combat failure, any event or condition that contributes toward this goal is of major importance. For this reason leadership has been recognized as a vital force in the success of combat units since the recorded history of warfare. Leadership in battle is a spontaneous and necessary phenomenon because the hazardous situation produces a strong demand for guidance and help. The leader who fulfils this need becomes beloved like the good parent and can exert extraordinary influence upon the attitudes and behavior of his men. On the other hand, inability to perform adequately in combat and to protect the group, as well as callous or unfair management, will almost certainly provoke negative group motivation. The combat leader also symbolizes authoritarian military pressure; if he is well regarded, the combat mission is viewed as necessary. There are many writings on the attributes and qualities of leadership, all no doubt pertinent and important. But it is far easier to detect errors in leadership than to point out positive characteristics, except in general terms, because individuals of widely varying temperament and using a variety of methods may be efficient combat leaders.

In the further consideration of factors that effect group identification there has been a growing recognition of the value of communication. In combat units, talk literally links individuals together. It not only prevents loneliness but the information transmitted facilitates aggressive behavior. Without knowledge as to the whereabouts of others and the purpose and nature of the battle mission, the combat participant has no realistic method of determining when and where to be aggressive. The result is inaction with its consequent damming up

of tension and decreased effectiveness when called upon to move and fire. Moreover, fear stimuli gain strength when their source or significance is obscure. Even methods of communication become important, since the choice of words and the manner in which they are spoken or transmitted may convey different meanings or degrees of urgency.

Another sphere pertinent to formation of proper group motivation is the management of rewards and punishments. Because the combat group is deprived of gratification, both in material comforts and their usual objects of affection, further deprivations considered unwarranted by the group are met with marked resentment which, if continued, may alter or prevent positive motivation. No matter is too small in this respect. For example, during one period of the Italian campaign in World War II, cigarettes sent to the combat troops were not of the so-called "name" brands. Vigorous resentment arose because it was believed that better cigarettes were being distributed to rear troops. Food is an important factor of this type. Similar difficulties arise in the distribution of mail, beer, clothing and "PX" supplies. However, deprivations and hardships known to be unavoidable are quite well tolerated. It should be emphasized that the foregoing discussion does not refer to so-called "griping," because all too often matters of this kind may be summarily placed in that category and are even believed to be a sign of mental health. The combat soldier is well aware of the difference between his griping and the occasions when his legitimate needs and requests are denied for insufficient reasons or inefficiency. It should be apparent that to front-line soldiers ordinary comforts and even what are considered civilian necessities, such as a bath, a can of beer, and a letter from home, are magnified to extraordinary pleasures. A similar emotional attitude pertains to promotions, decorations, rest leaves and the like. The combat leader must be scrupulously careful to avoid any unfairness. Punishments in a combat group should be prompt, firm, and in accord with the situation or group opinion will consider that illegal behavior is not only condoned but rewarded.

This report would be incomplete without a discussion of several rather well known abstract defenses against fear that are commonly employed in the combat zone. They constitute an attempt by the individual to erect mental barriers designed to lessen or remove the effect of fear stimuli. First are the types that employ the concept of fatalism. Here the individual tries to convince himself that anxiety is of no value. He rationalizes that "if your number is up, there is nothing you can do." It is plain that a conscious effort is made to remove the painful warning anxiety by conceding the worst possible eventuality. Second are the defenses that employ the so-called "myth

of invulnerability." This is a somewhat less conscious mental mechanism that attempts to deny realistic danger by magical over-evaluation of the omnipotent self. It is akin to the feeling "it can't happen here." A similar mechanism is utilized by those persons who attempt to view the battle situation as a spectator, in order to avoid the tension of participation. Other magical defenses include superstitious devices that ward off danger, such as the carrying of certain objects and the repeating of phrases and rituals.

The foregoing abstract defenses are of limited value because they deny reality. At best, they may aid in decreasing anticipatory fear. Once in battle there is usually a rapid collapse of such shaky resistance by the impact of realistic danger.

Somewhat more effective is the defense of apathy. This is an effort to block entry into consciousness of all unpleasant internal and external stimuli; thus preventing any increase of tension. It is commonly adopted by many veteran combat soldiers who may give the external appearance of being oblivious and disinterested. However, when enemy fire or other realistic fear stimuli occur, the mask of apathy is rapidly transformed into alert purposeful activity.

To summarize briefly, it is the contention of this paper that individual adaptation to the stress in the combat zone is determined by the outcome of a struggle in which the sustaining properties of personality, physiological status, training, group unity and leadership are opposed to the crippling effect of battle fear. This approach to the causation of combat failure points to logical measures for prevention since defects in any of the foregoing sustaining powers render the combat participant vulnerable to the inroads of fear.

It is believed that efforts to prevent individual combat failure are well within the province of field medicine and should be the especial concern of battalion, regimental, and division surgeons. In their role as staff members, these medical officers can enhance their value by providing the technical information needed either to initiate methods of improving the efficiency of troops or to correct errors that are causing combat failures.

A major prerequisite for field medical officers in assuming this additional role in preventive medicine is a reorientation in viewpoint, and in their duties and functions. The medical officer should appreciate that he need not restrict his talents to the relatively narrow realm of treatment and evacuation. He is also a staff officer with a major responsibility of advising his commander on all matters that will conserve effective manpower, whether it be in the prevention of organic disease, psychological failure, or combinations of both. In such a function, the medical officer should not believe that he must be

equipped with the technical knowledge of a psychiatric specialist. He understands the emotional reactions of combat soldiers far better than most psychiatrists, because he is intimately associated with combat personnel and is personally identified with the battle situation. As illustrated by this report, much of the psychological data required by the field medical officer is available and more will be forthcoming in the future from research projects that are now underway.

In order to perform this staff function, battalion and regimental surgeons cannot seclude themselves in their aid stations and play a, passive role of waiting for casualties. They should visit the various units, consult with the company officers, and demonstrate interest in all manpower problems. When information gained on these visits is combined with data obtained from patients, the medical officer, particularly the Battalion Surgeon, is in an excellent position to indicate problem areas and, perhaps, their causation as well.

Line officers also should be taught all the information we have in this field of prevention, including the fact that their medical staff officers can be of considerable aid in supplying both information and technical advice.

It is the writer's belief that if attention is focused on this aspect of preventive medicine by both medical and line officers, benefits in combat efficiency are as inevitable as the advantages that followed attention to prevention of organic disease. Both situations involve the vital principle of first recognizing that a problem exists, then of evolving the methods of prevention which logically follow and which can be developed further.

For the medical officer, work in preventive psychiatry can be especially gratifying. It will broaden his outlook and make him truly a specialist in conserving the fighting strength. He can better keep abreast with his civilian colleagues who, more and more, are utilizing a psychosomatic approach to the prevention of failure in civilian life.

Summary

This paper has attempted to present the problem of stress in the combat zone with special emphasis on the defense mechanisms utilized by the front-line soldier. It is postulated that combat adaptation is determined by the outcome of a struggle in which the resistant properties contained in personality structure, physiological status, battle training, group identification, and leadership are opposed to the crippling effect of battle fear. It is hoped that the gross picture of defense mechanisms as set forth in this paper will indicate the pertinent areas where further investigation may yield more exact information. The information now available is sufficient to implement an effective program of preventive psychiatry in the combat zone.

Discussion

DR. WHITEHORN. I hesitate a little in opening discussion for Colonel Glass' paper too broadly, because I know there are many present with extensive combat experience, and we do not want to turn this into a general testimonial meeting. I would like, therefore, in asking for questions or comments, to suggest that you direct them rather pointedly to the effort which Colonel Glass has made to pull together in a systematic way some of his impressions and conclusions.

DR. VON EULER. I would like to ask Colonel Glass whether any quantitative determinations have been made of the output of adrenalin in combat. The pioneer experiments of Cannon indicated, of course, that fear would be one of the most effective measures to release adrenalin. It is well known by anyone who has had an injection of adrenalin that it produces something which is at least superficially like excitement or fear. Therefore it might be of interest, perhaps, to see whether there is any quantitative relationship between the degree of fear measured by the psychiatrist or psychologist and the adrenalin output.

COL. GLASS. Measuring the various constituents like adrenalin would be very helpful and instructive, but most of us neither have the technical ability to do that nor the necessary apparatus and facilities. I believe that ultimately we should try to objectivize and quantitate our data and either prove or disprove their value. They may be of no value whatsoever. We are attempting to measure some of these reactions under battle conditions. So far we have no outstanding measuremen.s that would implicate a difference in individuals that we could not readily discern otherwise. Measurements are being made, for instance, on battle casualties to determine just how much stress they are under at the time of injury. We do have such measurements, and we are attempting to make them also on other categories but the information concerning those is not yet available.

DR. CLAUSEN. I wonder whether we have any evidence from Korea as to the importance of belief in mission as one of the factors that affects the way in which fear is handled in battle.

COL. GLASS. I take it that you are speaking of a wide rather than a narrow range of motivation. Motivation is not a complex word the way I use it, it merely means that the individual is willing to stay there and fight regardless. Unfortunately, I would say, our motivation seems to be rather narrow. People fight for what is immediately present around them. They fight for their unit, for their officer, for their buddies. Belief in mission is not as important as one would think. For example, during World War II, I quizzed 750 replace-

ments to an infantry division as to their motivation, asking the question, "Why do you think that it is right for you to be fighting Germany over here in Italy?" Half of them said, in typical fashion, that they did not know anything about things like that—they were drafted, and they were just fighting to go home. They looked rather blank and said, "Well, I do not know what it is all about." A quarter of them very definitely expressed negative motivation—this was a capitalistic war, they had no business in it, they were not mad at anybody. About a quarter of them expressed positive motivation—said that it was their business to be there, they had to do this, and so forth. I checked on their combat efficiency, and I found that those who had indifferent motivation did, by and large, somewhat better even than those with professed good motivation. I decided that to profess good motivation was apt to indicate some sort of an over-reaction, perhaps like protesting too much. Those with poor motivation did worse. So we are not so much worried about belief in mission. What we are worried about is whether or not the individual is capable of being welded into a unit, capable of being favorably affected by his fellow men close by. I think we get along all right with that.

Dr. Elmadjian. I would like to ask how the fear of loss of comrades affects this group identification feeling. Does it present a difficulty?

Col. Glass. Yes, it is a very difficult problem. The grief and mourning when a man loses his buddy is identical to that which is seen after the loss of any loved one. This sometimes goes so deep that an individual refuses to have a buddy because he feels so badly after having lost one. Such a loss may precipitate a breakdown in the passive individual who is being supported by a strong buddy. If the buddy gets killed, the survivor comes down with some form of combat failure. The loss of buddies, the loss of men who support and love each other, is a "powerful" factor. Actually some of the resultant difficulties continue after the battle.

Dr. Elmadjian. In reply to those who have asked about some physiological studies on combat men, I would like to say that I was a member of a team that went to Korea from August to December 1952 under the auspices of Operations Research Office. We examined over 200 men for 17-ketosteroids, potassium, sodium, lymphocytes, eosinophils, uric acid, cholesterol, etc.—in all some 13 determinations. These men were involved in trying to take Triangle Hill in the early part of October. They included psychiatric casualties, individuals with combat fatigue, as well as those who received slight wounds, severe wounds, and no wounds at all. In the near future the data from these studies will be available.

PSYCHOLOGICAL TRANSACTIONS IN SITUATIONS OF ACUTE STRESS*

JOHN P. SPIEGEL, M. D.

What we commonly call stress is a process which threatens the individual with a loss of some significant aspect of his relationship with his environment. The adaptive process, whether at a somatic or psychological level, is concerned with maintaining the organism-environment system at an optimum equilibrium. The threatened loss inherent in the stress results in a disturbance of this equilibrium which is registered as a strain within the organism. Stress and strain are terms which refer to the external and internal poles, respectively, of disturbed organism-environment system, but they both refer to the same process which can be denoted as a transaction between organism and environment. There is some advantage to be gained from focusing on the process itself—on the transaction—although the terms of everyday speech as well as scientific concepts habitually break up the unitary process into its external and internal components.

Psychological transactions, as Jurgen Ruesch has pointed out, are symbolic communication processes—both within the individual and between two or more individuals constituting a group—which operate to maintain equilibrium. Even in solitary thought the individual takes the role now of one person, now of another, and thus maintains the group oriented and communicative nature of all phychological processes. Since the individual's participation in group behavior is through his role in the group—whether the group is a family or a football team—I will attempt to describe the psychological transactions operative in acute stress situations in terms of its chief role determinants.

A role is a culturally patterned mode of maintaining relationships between individuals, groups, and impersonal objects. From this point of view, stress can be characterized as a process which interrupts or destroys the system of reciprocal roles which is necessary for the maintenance of equilibrium. Whether the threat is to the life of the individual, to his marriage, to his wealth, or to his reputation, the common denominator is the same. Loss of life is, of course, the limit-

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ing case, but in all other cases some aspect of the roles necessary for the maintenance of optimum equilibrium and security in the relation with people and objects is lost.

If loss of role is the method used for characterizing the stress in a situation, then the psychological transactions which are invoked to cope with the stress can be characterized in terms of the chief communication areas of the situation. These are evaluative, perceptive, affective, and instrumental or problem-solving communication areas. For the individual, they deal with the following questions for each category. How much do I care about this role? What is threatening it? How does it make me feel to endure such a loss? What can I do about it? For the group these communication areas are expressed in more abstract terms. The evaluative area in group communications is concerned with selective standards and cultural values. The perceptive area deals with specific detection mechanisms, warning signals, and broadcasting systems. The affective area is concerned with propaganda mechanisms, public relation systems, etc., while the instrumental area includes executive decisions and the allocation of stress or emergency roles to the various individuals composing the group.

With these categories as a frame of reference, let us begin by looking at the evaluative transactions. It is obvious that not all individuals are involved in the same way in the same stress situations. One man's meat is another man's poison. The role which is threatened has to be a highly valued one, or no particular sacrifice is involved. For any one individual the range of group-determined or personally-determined criteria of value varies enormously. This is what makes the difference between the conformist and the individualist. But for all but the most deviant or sick there is some group anchoring of the values assigned to threatened roles. For example, a middle class male trained in the need to achieve will be more threatened by a loss of a job or failure in his occupation than a working class man who is not so stigmatized in being fired and down to his last cent. On the other hand, the middle class male will not be nearly so threatened by separation from his home and family as the working class or rural individual who is trained in intense loyalty to an extended family and has been encouraged to stick close to home. Such cultural evaluative criteria could be endlessly multiplied for ethnic, regional, and occupational groups, and will, I am sure, be dealt with by others in this symposium.

The personal or internal anchoring of the attachment to given roles is subject to wide variation according to the state of the intrapsychic economy of the individual. The variations take place in response to the current level of maturation or regression of which the individual

is capable. It is one of the phenomena of acute stress that as a threat to mature roles intensifies, and the transactional equilibrium becomes increasingly disturbed, the integrative mechanism of the individual tends to substitute less and less mature roles to replace those threatened with loss. This regressive process is undertaken in the attempt to preserve equilibrium, but it is likely to meet severe resistance and conflict both from within the personality and the group. Many emergency psychotherapeutic "supportive" procedures and mental hygiene devices are concerned with offering the individual alternative, temporary, "stop-gap" roles to avert regression. Such roles have to be given group value, and must be tailored ingeniously to supply some of the gratifications of the "lost" mature role and some of the satisfactions of the potential "regressed" role. In military operations and in civilian disasters, evacuation to temporary "Rest Centers" supplies such roles to victims of the acute stress. In bereavement, which is a severe civilian stress situation, the role of "mourner" functions similarly to permit the individual to maintain a temporary regressed and fantasied communication with the lost love object which approximates the lost role and yet maintains mature aspects of responsibility and communication with the adult civilian community. When regression cannot be staved off, the individual becomes a "casualty," is assigned the role of a sick person, and must be dealt with accordingly.

Another indispensable aspect of the definition of a stress situation concerns the perception of the threat. As with the evaluative area, the communication problems in this area are dealt with by transaction between individual and group. Here the general form of the problem consists of the detection of the threat, the estimation of its direction and intensity, and the prediction of the probable target. The transaction between individual and group is accomplished by means of detection and multiple checking mechanisms, conventional warning signals which are sensory cues having a universal "meaning" or "interpretation," and some system for broadcasting the information and distributing it throughout the individuals in the group.

Perceptive processes are so interwoven between individual and group that of all the psychological transactions under stress these are the most difficult to separate into the two internal and external poles. There is much more permission for irregularity and variance in evaluative than in perceptive transactions. We apparently need to perceive our world in the same ways and nothing is more provocative of anxiety than the individual who stubbornly insists on seeing reality differently from others.

Where stress is concerned, the perception of the threat is not usually so difficult as determination of its intensity, direction, and target. I have recently returned from participating with a multi-disciplinary team in a survey of the effects of the East Coast floods in England on the British community. We were especially interested in the organization of warning, rescue, and rehabilitation mechanisms. One of the great difficulties in all the communities we studied was the problem of when to sound a general warning. High tides were a very frequent affair in those communities and a little water in the streets of the town near the sea wall could cause no great harm. Those responsible for estimating the danger and broadcasting the warning repeatedly erred on the side of caution. They performed their roles in what could have been characterized—after the fact—as an obsessive manner. They spent too long on reconnaissance, repeatedly inspecting the sea walls and waiting for more definite evidence of flooding, while water was already at the top of the walls. When the sea walls suddenly gave way, the warning came too late, and many lost their lives that could otherwise have been spared.

The group anchoring of perceptive transactions is maintained by putting together a mosaic derived from bits of information gathered by individual observers and mechanical receptors, radar, photographic equipment, etc. This assembly of information cannot take place without maintenance of maximum communication. When the communication process breaks down—as it often does in emergency situations—then the stress and strain in the system accumulates rapidly. In the English flood disaster a common type of strain was a failure of feedback in communication circuits. Messages were sent out over crowded circuits requesting aid, rescue equipment, etc., but those who received them were too busy or unable to respond indicating that action was being taken. Action was being taken, but the victims did not know it until hours later when the equipment arrived. Similarly, communications were very difficult to maintain during the actual rescue operations. In the black of night, with all electricity cut off and a howling wind raging, victims could only signal their potential rescuers by shouting. Often they were trapped in their houses and their cries could not be heard. They had to wait many hours until daylight brought their situation to the attention of rescuers.

The intrapersonal anchor of perceptive transactions varies in accordance with many factors such as fatigue and illness, intelligence, level of maturation and others which cannot be discussed here. There is one principle, however, which can be dealt with briefly because it parallels closely the perceptive process in the group. This is what Thomas French calls the integrative span. It refers to the number of

informational items which the individual can perceive and correctly relate to one another at the same time, or, to put it differently, the width of the observational field which he can encompass.

Two variable elements connected with integrative span are important to psychological transactions designed to preserve equilibrium. The first is that the integrative span varies inversely with the degree of affective pressure. The greater the pressure for action from within or without the organism, the fewer informational items can be collected, assembled, and reassembled. Thus as stress accumulates, the individual must act on more and more inadequate information. For this reason, he becomes more and more likely to err and his accumulated mistakes increase the threat and internal strain. This is part of the vicious circular process which may end in panic—the giving up of all organized role activity in favor of disorganized flight.

The second variable connected with integrative span is the relation between the number of items assembled, the warning system, and the instrumental role adopted. In perceptive transactions, a perfect assembly of informational items exactly corresponding with the transactional field is possible in theory only. Both at the group pole and at the individual pole of the transaction, some items are bound to be missing, so that communication gaps exist at all times. Ordinarily these gaps are filled by reconstructions based on past experiences, and we ordinarily refer to this process as guessing. The variability at the intrapersonal pole has to do with the amount of reconstruction of missing items which takes place before the warning system is set off. In some individuals, the warning system signals a threat on a very narrow integrative span. It takes only a minimal number of informational items plus a large number of reconstructed items to sound the warning which signals the adoption of a role to avert stress. This is the process which occurs, with varying implications, in paranoia, hypochondria, and in the war neuroses. In all three of these conditions the threat, its intensity, and its target are incorrectly identified because of the much narrowed integrative span, and the pressure for action on minimal information.

On the other hand, there are individuals whose warning system will not be set off, and no stress role adopted, until after prolonged attempts to gather maximum information. During this time information collecting roles are all that are possible. This corresponds to the situation of the obsessive-compulsive who has no tolerance for communication gaps and ambiguity. The point for behavior under stress is that a case can be made for both of these situations; in other words, they are both logical under the circumstances. Certainly the ideal leader is he who can give the warning, and signal for appro-

priate stress roles on the minimum necessary information. But this is only an ideal, and in practice mistakes are made continuously on the side of both rashness and caution. To which side of this range the individual leans will depend upon his previous experiences under stress.

It is now necessary to consider the psychological transaction concerned with affective communication under stress. The perceived threat to valued roles and the associated disturbed equilibrium sets off a series of transactions in both individuals and group which can be described as altered distributions of energy in somatic and symbolic communication circuits, and this process is denoted as emotional. The three principal distributions of energy patterns—at the individual pole—are hostility, fear, and apathy or exhaustion. Our discussions of this communication area are greatly troubled by semantic difficulties such as the distinction between hostility and aggression, fear and anxiety, and apathy and depression.

I know that using a set of new terms—as I have been doing here—contributes little to immediate clarification. My hope is that in the long run it may lead to a new way of looking at the processes involved which will locate the essential difference more precisely. The semantics are especially confused with respect to the difference in emotional transactions in acute and chronic stress. In my opinion if we study the transaction itself, and avoid the use of concepts dealing with pre-set internal, automatic arrangements such as instinct and drive, we may ultimately clarify the difficulty.

Transactions in acute stress are characterized by great rapidity of tempo, by precise location of the threat, and by relatively short duration. In chronic stress the threat is paced more slowly, and this fact is almost necessarily associated with greater difficulty in gathering information about it. The threat to essential roles is therefore perceived with much greater difficulty. It is usually unconsciously perceived—or only at the periphery of consciousness—and can thus be accurately communicated only with the greatest difficulty. Thus the whole apparatus of warning systems and of the roles to be assumed to avert the stress, even though similar in principle, differ much in detail. Similarly, in the affective area the rapid appearance of the threat, and its specific localization, produces a different clustering of energy than in chronic stress, even though the energies available to the organism are always the same. The terms by which we refer to these clusters of energy—such as anxiety, fear, hostility, etc.—really denote the roles through which they are communicated rather than the patterns of energy themselves. It seems to me that it is this

failure to separate the expressive social role from the pattern of energy that confuses the semantic issue.

Three interrelations between affective transactions and other transactions under stress should be mentioned. One—the relation between integrative span, rising energy levels pressing for action, and warning systems—has already been dealt with. Another is the relation between altered energy distributions and other somatic systems—especially when the energy cannot be communicated through social or interpersonal channels. This is the subject of much psychosomatic research and will be taken up by others participating in this symposium. I will comment, therefore, only on the third, which is the communication of altered energy patterns through appropriate roles in the group. It is this process which brings the altered energy distribution into the psychological frame of reference.

Cultural patterning distinguishes hostile roles from anxious or fearful ones, and either permits or denies expression. If permissible role channels of communication do not exist in the group for the communication of the energy, then internal defenses are set up to inhibit their expression. General Patton, during the last war, attempted to banish all roles expressive of flight patterns, even purely verbal ones such as the admission of fear. Thus affective transactions between individual and group consist of continuous, reciprocal exchanges which pattern or modify the expression of the energy into permissible channels. As this process takes place in situations of acute stress, a secondary danger develops which reinforces the original stress. This danger is that the energy levels of specific individuals will reach such heights as to force them into deviant roles, not permissible in the group. For the individual this means his exclusion from the group. The very thing he has been attempting to avoid—his loss of essential role relations—has come to pass through his efforts to cope with his disturbed equilibrium. He suffers from an internal enemy—so to speak. For the group this means a thinning of ranks and a possible spread of deviance through contagion.

Because of this new stress many of the processes inherent in affective transactions are designed to avert this situation. The method by which it is avoided is the creation of systems of reciprocal roles through which the energies can be expressed. These systems conform to general models which can be modified to suit the occasion. The basic models are systems of combatant roles like the military defense, the legal defense, etc.; rescue systems such as doctors, nurses, Red Cross, social service workers, etc.; and recreational systems which allow the expression of the affective energies in symbolic form. It is true that to some extent these role systems are designed to deal with

the original threat, and thus are part of the instrumental area of psychological transaction. But the affective aspect of such role systems cannot be overlooked in any planning for acute stress situations. For example, the fear of any one individual in a civilian or military stress situation is diminished to the extent that it can be shared with others who see themselves as victims in relation to leaders, doctors, first-aid personnel, clergymen, etc., who will accept and understand their feelings. The modifications for this basic plan by which the affective isolation of the individual can be avoided are multiform; we have just heard from Colonel Glass regarding some of the recent innovations in military psychiatric planning for combat stress. When affective isolation is unavoidable, and communication in normal or stress roles can no longer be maintained, then the individual must be treated specifically as disturbed, or sick, with appropriate psychotherapeutic technics.

The fourth and last aspect of the psychological transactions to be discussed is the instrumental or problem-solving area of communication. This involves the integration of evaluative, perceptive and affective transactions within roles designed to avert the stress. In this area, as in the others, maximum communication between individual and group is of the essence. The function of the warning system between individual and group is to signal a transfer from usual social roles to stress roles. Stress roles are group-oriented behavior patterns in which each individual has his specific function. The mobilization of everyone into specific instrumental roles greatly increases the internal cohesion of the group and results in the marked elevation of morale which is so characteristic of stress situations. But this can only happen when the stress roles are clearly known in advance. It is for this reason that training procedures are so important for stress situations—whether in military operations, in civilian defense, or in ordinary disaster situations such as fire, explosion, or flood.

One complication in the carrying out of stress roles must be especially noted because of its influence on variability in behavior under stress. Current stress roles become associated by transference processes with the situations of chronic stress in which the individual was involved in childhood. For this reason, current roles in relation to leaders and comrades in the acute stress situation are likely to be confused with former relations members of the individual's family. If these happened to be characterized by much chronic stress, old psychological conflicts which had been partially mastered are now revived and reinforce the strain in the current situation. Thus the prolonged and intense neurotic or psychotic responses to acute

stress are always associated with old conflicts which act like an Achilles' Heel of vulnerability and precipitate a pathological condition in spite of all that group supportive measures can accomplish. In such cases the regressive substitution of immature roles, and the affective isolation of the individual require specific psychodynamically oriented technics for their resolution.

Up to this point the discussion has centered about transactions operative during the period of acute stress. Before closing, I want to comment on the aftermath, or long-range aspects of these situations. Our continual interest in pathology, which is the incentive to most of our research, results in our having a good deal more information on specific cases of maladjustment than on the general patterns of integration and adjustment in acute stress. A broader view of the psychological transactions between individual and group, however, reveals a pattern of turbulence which is likely to be ignored, especially in planning for stress, because of the dramatic appeal of immediate pathological reactions and our habitual interest in the individual. In this pattern the initial result of the stress, if it is not overwhelming, is an increase in integration and feeling of well-being, both in the individual and group. The individual experiences heightened alertness—a tonic speeding up in all somatic and psychological systems. The group strengthens its cohesive bonds. Conflicts between individuals and sub-groups are forgotten in the general emergency. The tuned-up facility in communication and breaking down of barriers is registered as an increase in morale.

This process is familiar to students of military psychology and it was quite evident in the English flood disaster. There, in spite of extremes of exposure to water and chill wind, in spite of injury and doubt of rescue over many hours, the heightened resistance to physical and emotional illness was characteristic of all but a few. But this initial response to stress is reversible, and does not long survive the emergency period. It is replaced—during the return to normalcy—with a drop in morale and an increase in general irritability ranging to outright illness. In part this reversal may be due to a compensatory reaction of conservation of energy after the tremendous expenditure of energy during the stress period. It would thus parallel all cyclical and phasic somatic and psychological processes in the organism. But it appears to me that it is also due in part to a discontinuity between stress behavior patterns and normal civilian roles. The transition is too abrupt and many cling stubbornly to their stress roles, unable to find role patterns which will ease their transfer to the civilian community. Even in the relatively brief stress of the English floods many were unable to return to their homes but lingered in Rest Cen-

ters. If this common difficulty actually results from an absence of adequate transition roles, then it would seem that our planning to meet stress situations in civilian and military defense should take this communication gap into account by devising technics and institutions to speed the transition.

Discussion

DR. STANTON. I would really like to address my question to both the two previous speakers because I have found their presentations inviting all sorts of inquiry. For instance, I wonder if Dr. Spiegel and Colonel Glass would agree that in the treatment of flat feet and of the heart syndrome which Colonel Glass dealt with, it would be possible to say in Dr. Spiegel's terms that what the psychiatrist is actually doing is altering the social role of illness. He is simply saying this is not illness. Under these circumstances would it be correct to say that whatever the motivation and whatever the social position of the patient's illness, one might expect that there is still a reason why the patient is consulting the psychiatrist with these complaints, and that the psychiatrist's intervention, as Colonel Glass indicated, has a last question to it—what is wrong since this is not it? This perhaps brings to the patient a reformulation of his problem and possibly the vision of an alternative role. I ask the question because, if this is a translation into Dr. Spiegel's language, it would indicate that Dr. Spiegel has offered a frame of reference in which it is possible to analyze these matters systematically in terms of alternative roles. That is, it would emphasize also the extreme importance of differentiating between something happening in the body, something we might speak of as illness or physiological disturbance, and a social disturbance which is to be distinguished from the social role of illness.

DR. SPIEGEL. I would certainly agree with the answer suggested by Dr. Stanton that one of the very important aspects of the psychiatrist's function in a military situation is exactly in the definition of the role of the sick, especially of the emotionally sick but also to some extent of those who are physically sick. It seems to me that the psychiatrist mediates between command and the individual because of the technical aspects of what it means to be sick or what defines the sick person. Therefore, the psychiatrists generally carry on this function. They define the role of the sick person in such a way that he can as much as possible still be included in the group. He does not need to be separated off by being assigned a role which segregates him, whether it is because of flat feet or anything else. So, it seems to me that the medical officer then functions by fashioning this role and giving it some name. Operational fatigue was a term that was used in

World War II to designate a role which does not split the person off from the group, but maintains the bond. It seems to me that this is a large part of the mental hygiene, or preventive, aspect that Colonel Glass was discussing.

COL. GLASS. I tried to make it clear that we do not attempt to differentiate too sharply between various forms of combat failure. When the individual comes in with flat feet or something else as evidence of failure, we recognize that the mere presenting symptom is not so important. We also recognize that the tremendous mass contagion becomes culturally important. For example, in the first winter of Korea we had a lot of frostbite. Erected and grafted upon this undoubted frostbite there arose a parasitic disease or syndrome which I labeled the syndrome of the cold feet. Now, these people had undoubted cold feet. There was no question about it. All you had to do was to walk around and you would have them. But they had the symptoms of cold feet and a lot of them felt that this was a disease, that it was important, it was cultural, it was fashionable, etc.

In the same way, this parasitic addendum frequently happens with other things which cause many casualties. In World War I, for example, numerous cases resembling gas casualties sometimes resulted because of a shell landing somewhere in the vicinity and someone spreading the rumor of gas. These people had all the symptoms of gas poisoning. In one recorded instance 500 cases occurred in a veteran division in a very short period of time.

In industrial psychiatry we have to define the roles as pointed out. We recognize that there are factors that are making this individual come in, that are causing his failure and in this aspect we want prevention to be directed at these people as well as at overt psychiatric casualties. Our realm is not the narrow realm of overt psychiatric disorders.

DR. STANTON. My second question relates to the matter of mission. In Dr. Spiegel's terms, I suppose you would say that an Army and any other social group, for that matter, has actually built into it a structure of roles. From this I would guess that the feeling of coherence, of sense of mission, a priori would seem to be one of the primary organizing principles. Even, for instance, one who regards a war as capitalistic exploitation nevertheless has it categorized and somehow making sense, which is quite different from the person who sees it as a completely chaotic situation. I am thinking, of course, in terms of an overtly mentally ill patient, but I wonder if in that sense the coherence with which the mission is regarded may not actually be very important to all, even though the men are not particularly articulate about it. It also would explain the contradiction between the

denial of the importance of mission, substantially on the basis of the interviews, and the very common experience that a group which is functioning at high morale impresses all outside observers with a most intense sense of mission.

DR. SPIEGEL. Well, I think Colonel Glass has already indicated his opinion that the sense of mission does not play a very large role, at least so far as combat success or failure is concerned. I have no settled opinion about it. It seems to me an extremely complex sociological or social psychological matter. The matter of the mission is one of the large number of matters before the nation which does not make sense. Our whole foreign policy, our whole stand as a nation vis-a-vis other nations seems to me to fall into the realm of ambiguity. How much one deals with it depends to a certain extent upon one's tolerance for ambiguity. It seems to me that in this situation what happens is that individuals try to narrow their value field and their observational field because this large matter is too loaded with problems. Therefore, one tries to identify with a group which seizes upon only one part of the problem and does not have to deal with the whole. I would assume that this explains what Colonel Glass tells us, that when operating in a military situation the individuals and the group itself cannot deal with these larger issues very successfully. They have another problem in front of them. Probably it is sufficient for their purposes just to resolve the problem that faces them, without having to settle something that no one else can settle either.

DR. WHITEHORN. I think this last question has touched on an important angle of the transaction of dynamics, and that is the difficulty in verbalistic formulation of roles. The concept of roles has been a tremendous addition, I think, to our conceptual scheme of organizing psychodynamics. It runs a risk of committing one to necessarily defining in sharply delimited verbal form the variety of roles which one is talking about, but this runs exactly contrary to the nature of human beings because they do not verbally define their roles so sharply. The roles have to be more or less vaguely inferred from the mode of behavior. Certainly, Dr. Spiegel pointed out the difficulties in the emotional aspects of transactions with which as clinicians we are extremely familiar, that is, the extraordinary resistance people have to an inept categorization of their emotional roles. There is a tremendous amount of conventionalized resistance to characterizing one's emotional behavior in certain unpopular terms. The question whether one is resentful will serve as a reminder of these difficulties; for example, the wide range of feelings between hurt, resentful, angry, agressive, hostile, etc., indicates a territory in which people are extraordinarily finicky about the verbalistic formulation of their

roles. This greatly complicates our efforts to devise useful terms for separating our conceptions in this field. I am not going to ask Dr. Spiegel really to answer this question. I threw it in as a comment, partly to ease what seemed to be a divergence of feeling or tension growing here. If Dr. Spiegel would like to make some comment, I would be glad to have it.

Dr. Spiegel. I agree with Dr. Whitehorn that this is a problematical area, and one which we cannot begin to solve at the present time. Our categories are too naive. Almost every man has his own pet way of describing things, and I think the fancy verbal attitudes that we fall into are merely symptomatic of the general problem. However, we cannot avoid the difficulty; we each have to invent our own jargon, so to speak, and I think that only after some period of time will we settle these stylistic matters in a way which will impose some agreed-upon convention in our terminological communications.

Col. Glass. Despite my zealousness to emphasize the fact that even without a good appreciation of the mission we could operate quite well, that we have done so in one war and one campaign that I know about, I would like to say that we would prefer and would be much better off to have a good appreciation of the battle mission and a belief in it. I pointed out that those who had this did better than those who did not, and I believe that. The only trouble is that, as Dr. Spiegel has pointed out, this is such a difficult subject, with the country torn as to belief in the mission, that I think it would be wasted effort to pound at the troops about it. I am afraid we would only exhaust our resources on something from which we could extract very little. So while I believe in it and I would love to see us have it, I want to point out that we can work without this deep belief in mission if it is not present, and we do.

SYMPOSIUM ON STRESS

CHRONIC SITUATIONS EVOKING PSYCHOLOGICAL STRESS AND THE COMMON SIGNS OF THE RESULTING STRAIN*

THEODORE LIDZ, M. D.

Chronic situations provocative of stress cover an indefinite range and may be considered to include the life of contemporary man. However, I believe that the topic can be reasonably limited to consideration of circumstances for which persons do not have adequate mechanisms, or patterns of defense which will buffer the blows without producing shifts in equilibrium that change the organism. When stress is chronic rather than acute, the adaptation is sufficiently successful to ward off incapacitation, at least for a time, but eventually the adaptation and restitutive efforts so alter the individual that new experiences impinge on a changed person who is either less sensitive or more vulnerable. In some ways, the changes permit toleration of experiences that would have overwhelmed prior to the adaptation. However, in other ways the accumulation of stresses and the efforts at restitution make the person less adaptable, for if a remaining defense, built up to help withstand the stress, is lost, the balance topples.

What constitutes stress varies with the individual and the meaning of his experience. This problem will be bypassed in this presentation, which is concerned with group or mass phenomena, with interest in individuals primarily as members of organizations, subjected to common situations and displaying many common reactions to them. The material, concerned with oversea military experiences, contains other inherent differences from data usually studied in civil life in a democracy. The individual could not remove himself from the stressful situation, nor overcome it through individual effort or decision. He was not free to alter his situation and the need to adapt was forced upon him. Deprivation, including the absence of gratification (as important a constituent of chronic stress as positive trauma) did not stem from intrapsychic forces; nor did the craving for affection (a bottomless well) stem from inability to form the desired attachments. Furthermore, to an extent rarely encountered in civilian life,

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these men were not reacting to a single prolonged major stress but to a constant heaping up of insults against a background of deprivation. However, the sharing of experiences not only differentiated these situations from the usual civilian problems but was a major factor in making adaptation possible, and often it was when the individual began to consider his own problems as unique or to differentiate himself from his group that maladjustments became serious.

Leaving abstractions, I will try to depict two general situations which were extremely stressful but of markedly differing intensities: the plight of the Americal Division in Fiji early in 1944 and the chronic but constantly acute circumstances of the First Marines on Guadalcanal in 1942. Other chronic situations with which I had personal familiarity form a background, particularly the insidious decline of garrison troops during three monotonous years on isolated Pacific islands.

The position of the Americal Division early in 1944 is of particular interest. These were seasoned troops who had withstood the acute and chronic stresses of 5 months of intense combat, suffering only a relatively low psychiatric casualty rate. When they later returned to combat on Bougainville they suffered few psychiatric casualties, but while recuperating on one of the world's most beautiful islands, they were losing personnel rapidly from a combination of malaria and psychoneuroses (ref. 8). The memory of the past few years and contemplation of the next few years constituted major stresses. These were largely National Guard troops, called up a year before the outbreak of hostilities, and the first division sent into the Pacific. Scattered in jungle outposts they had provided the thin defense against any further advance of the enemy, knowing that their positions were basically indefensible. Then, after 8 months, they had been sent to Guadalcanal at the low ebb of the battle and experienced the end of the worst phase of that campaign. After 5 months, worn and ill with malaria, they arrived at Fiji for rehabilitation and reorganization.

The planned few months of rest lengthened into 10 as the Medical Corps sought ways to overcome the malaria that had infested about 95 percent of the men. After 2 years overseas the war had not yet started. They could look forward only to endless battles for islands far from Japan and farther from home. There was no escape except through illness. They had all been in the hospital many times and often could not see why the man in the next bed had been sent home while they were sent back to duty. Hopes rose and fell with rumor. Often they believed they were about to return to combat and about as often they believed they were to be sent to the States.

Beyond the specific circumstances of the division, they shared a set of stresses common to troops isolated in the jungle, cut off from the mainstream of the war. It is necessary to consider briefly the void in the lives of these men. A person develops in a setting and his surroundings are part of him. His habits have developed against a background. His evenings are part of him and they are evenings with his parents at dinner, at the bowling alley with the gang, driving around with the girl friend. This is his life and this is the soldier as much as the body he carries overseas. At home he knows who he is and where he stands. Above all, he has sources of affection and recipients of his affection. He is not constantly judged on his merits. The sulfuric has those who overlook his outbursts, the shy has shelter, the sensitive has room to escape. He has often found a life that supports his defenses. Induction is not without stress for the familiar is lost and the future is unknown. The transition is aided by the need to learn new ways of living and the formation of bonds to the men who share the transition. A sense of belonging and purpose replaces the loneliness and compensates for the frustrations. New experiences stimulate and the adventure is enjoyed. Life in the United States or in any civilized country provides ready substitutes for the familiar.

Although the Fijis are beautiful islands with some of the amenities of civilization, life on them and on other similar islands was devoid of the familiar, of meaning, adventure, excitement, attachments. There was little liquor, few women, no change. Two years had passed, girls had married, friends had stopped writing. The inability to recall what the girl friend looked like and even more what she felt like, was frightening. The men began to wonder about their own feelings for people they had loved and in turn doubted the fidelity of those at home. They were uneasy because life at home was changing and they were not part of it. Everyone was possessed by a deep yearning for a meaningful existence. This need seemed to be the core of the vitiating condition lightly termed "Golden Gate Fever" but more productive of casualties than the enemy or the Anopheles mosquito. This existence for the average soldier was not part of his life. It was an hiatus and life would resume when the war was over. Militaristic nations may have had soldiers who would have regarded this period as the culmination of their lives. To our soldiers it rarely appeared part of growth. It was exile. After Guadalcanal, all concepts of the joy of adventure had been removed from war.

In the lonely setting there was all too much time for rumination. New stresses accumulated. It is not possible to discuss them, and I

must resort to giving an impression of the situation from a table. (See table 1.)

Table 1. Negative Factors Influencing Morale of Americal Division

I. Fear of another "Guadalcanal."
  A. Capture.
  B. Insanity.
  C. Cowardice.
  D. Death.
II. Recurrent Malaria.
  A. Unfit for stress of campaign.
  B. Fear of permanent ill-health.
  C. Impotence from illness or from atabrine.
  D. Hospitalizations relate to men going home.
III. "Fed-up."
  A. Monotony.
  B. Absence of gratifications.
  C. Meaningless existence.
IV. Nostalgia.
  A. Loss of "feel" of home.
  B. Projection of loss of love.
V. Food and Climate.
  A. Inability to eat "C" rations.
  B. "Tropical Neurasthenia."
VI. Resentment of "Deal."
  A. Broken promises.
  B. No recreation after combat.
  C. Complacency of home front.
VII. Fear of Suicide and Insanity.
VIII. Loss of Buddies.
  A. Through illness and neurosis.
  B. Separation from unit.
IX. Absence of Chance for Promotion.
X. Absence of "Way-out."
  Overseas till wounded, insane, chronically ill or dead.

There were the fears of the future, for all jungle combat was contemplated in terms of the experience on Guadalcanal, a dim prospect, particularly when weakened by repeated bouts of malaria. The men were extremely resentful of the "deal" they had received, the broken promises, the rehabilitation in an area without provision for recreation or change, and the large share of the burden of the war placed on their shoulders because they had patriotically joined the National Guard. The food and the climate cannot be discounted as stresses. Even though the food was more than adequate, the monotony of amplified "C" rations, prepared by cooks who had been cab drivers, is difficult to describe. Men could no longer eat cereal when the mold surpassed the wheat content, nor continue to relish bread habitually seasoned by imbedded weevils. Powdered egg, powdered milk, spam, and stew

baffled the imaginations of the cooks. Men lost weight and visions of meals replaced fantasies of girls. Tropical neurasthenia is not just a matter of climate, but it would be erroneous to disregard climate. The atmosphere during the rainy season became a leaden blanket which had to be lifted each morning upon arising, and the almost endless rain brought despair. The dry season was usually remarkable and was awaited eagerly. The men were promised a climate second to none. Unfortunately, when this dry season came it somehow rained for 75 days in succession.

Into this general situation a new and ominous stress was introduced when a small epidemic of suicides broke out. Word of each suicide spread with the supersonic speed of rumor through the confined areas to fall on minds prepared by the ruminations concerning the impossibility of continuing such existence, and amplified by local knowledge (whether real or but rumor) that 17 or 27 Marines had suicided in a month on Samoa.

With the passage of time, those factors which had offered support were undermined. The attachment and loyalty to the group began to waver as buddies and officers were sent home because of ill health. Then men were found unfit for further active combat and were transferred out of their companies to headquarters and found themselves with a strange group. Finally, resentments were heightened when an order forbade men who had suffered more than a certain number of attacks of malaria to win promotion. This made it necessary in some units that new and untried replacements be made non-coms who were to lead in combat. These many stresses could often be carried despite the weight of the burden. Though it may seem strange, an impression was gained that incapacitation often followed the addition of a stress involving disruption of relationships with home, which robbed the men of a future which would compensate for present trials. This trend has been portrayed in "Dry Rot," one of the less romantic "Tales of the South Pacific" (ref. 4).

Against these and many other factors which undermine the determination to endure, there were positive influences (table 2). These were sometimes intangible but sufficiently powerful to keep about half the troops motivated—the desire to stay with one's buddies, with whom one had shared and upon whom one could rely; the pride in the unit and being part of it; and even more, the pride in oneself which said that one could take as much as anyone. There was hope too, particularly the hope that someone would have the good sense to realize that one more campaign was all they could take, and the determination to go through it with the outfit. At times the positive motivation was dubious, such as the feeling that it would be better to return

to combat, rather than endure the monotony of life in Fiji in a non-combat outfit. Finally, and most important, was the rotation policy which materialized at the end of the period under discussion. Even though greeted with disbelief as another pretext to keep them going, for the first time, one heard really positive demands to be permitted to continue with the infantry.

Table 2. Positive Factors Influencing Morale of Americal Division

I. Unit Morale.
   A. Mutual support from buddies.
   B. Sacrifice for unit.
II. Need to stay with unit.
   Early in war—fear of reassignment.
III. Pride in self.
   Family pride.
IV. Rather be killed than stay in Fiji.
V. One more campaign.
VI. Patriotic Motivation.
VII. Revenge (specific individuals).
VIII. *Rotation.*

Although the picture described and the feelings of the men were bleak, it would be erroneous to give the impression that the units were at the end of their rope. Somewhat over 50 percent of the men remained in reasonably good spirits and health (ref. 8). Neurasthenic symptoms affected almost everyone, but fatigue, lassitude, irritability, and tenseness were accepted by most as a part of the life. When neurasthenia reached proportions that brought the soldier to the hospital, it appeared as if it were an admixture of depression and anxiety states. The neurasthenic picture often reached proportions that would be ominous in civil life but here seemed to reflect the absence of motivation in a situation from which the individual could not extricate himself, whereas in civil life similar absence of motivation would indicate profound personality disorder. Headache, of a tension type, was perhaps the most frequent additional symptom, and usually a certain indication of resentment. Anorexia and upper gastrointestinal disturbances were also rampant and led to hospitalizations for weight loss. Strangely, in an area where dysentery was common, colitis was relatively uncommon. Intolerance of the heat or sun was a frequent complaint and study of these cases led to the impression that only the climate of the United States would be considered healthful. Combat neuroses were not uncommon, even months after departure from combat. A crackup had occurred in combat but the soldier had recovered his grip and fought to retain his stability. The months of waiting and worrying about the ability to manage further combat led to reactivation of severe anxiety states.

Much of the difficulty arising from the stresses of the situation was expressed in incapacitation from malaria. The debilitating effects of the disease were exaggerated in the soldiers with low morale and prevented them from continuing at duty. The asthenia of chronic malaria and neurasthenia could not be clearly differentiated (ref. 8).

The serious signs that the soldier had passed his limits of endurance were depression, often marked by obsessive rumination about home that could not be shaken, but paradoxically the inability to write home any longer was also ominous, probably because it indicated a need to blot out memories that were no longer tolerable. Contemplation of suicide and its reflection in reactivation of repetitive nightmares of combat demanded emergency attention (ref. 2). When a soldier soured on his unit, and particularly when all of the men he had been with were castigated, the soldier's self-esteem had usually fallen dangerously low. There were similarities between the stresses that produced slow dissolution of half of the Americal Division and the obvious and dramatic stresses of months of almost constant traumata that produced the most serious psychiatric casualties of the war among the First Marines on Guadalcanal, but in one case deprivation was in the foreground and in the other the frantic struggle for survival.

I cannot attempt to describe again the situation of the Marines on Guadalcanal (ref. 1) concerning which Commander E. Rogers Smith wrote, "We believe . . . that never before in history has such a group of . . . well-trained men been subjected to such conditions. . . . The strain and stress experienced by these men produced a group neurosis that has never been seen before and may never be seen again. . . . These men . . . do not exaggerate their trials . . . but in their composite story they give a picture of physical and mental strain that combines the best of Poe and Buck Rogers. . . . This was not the quickly terminated but terrific rape of Pearl Harbor, not the similar acute days of Dunkirk. This was the worst of both of them, prolonged seemingly without end" (ref. 7). The stories and descriptions which I heard were about a month fresher than those recounted to Commander Smith and given the stamp of veracity by the appearance and behavior of the staunchest. It was an experience unique in our military annals.

The First Marine Division, reinforced, was engaged in the first land offensive of the war without respite from August 7 to December 9, 1942, virtually cut off and without reinforcements until an Army regiment was landed in mid-October. This was the first battle and the turning point of the war in the Pacific. Although the history and nature of the campaign are essential to understanding the extreme

stress, it must suffice to say that this was the most desperate campaign ever fought by the Marines and their situation was considered hopeless for a prolonged period of time (refs. 4 and 5). The period of particular interest to us was mid-October. After 2 months of annihilating one Japanese force after another, and with men worn from fatigue and disease, the bottom seemed to drop out when, with supplies exhausted, gasoline siphoned from the bottom of the barrels, almost all planes wrecked by naval shell-fire, the Japanese were landing a fresh division and more Japanese reinforcements were known to be off the coast. There was no way out except fighting until the end.

Virtually all of the Marines evacuated at this time would have been considered incapacitated from "combat fatigue" an any later campaign. The psychiatric casualties displayed symptoms of an intensity that were not seen again in the Pacific. It seems particularly significant to me that casualties evacuated a month later, who had endured even more, were not nearly so disturbed. There is ample reason to be fairly certain that this was not because the first evacuated were the less stable. In the ensuing month, the tide of battle had begun to turn, morale had risen, and the men had rebounded. Psychiatric casualties occur in inverse relation to the morale of the unit. The morale of the First Marines was almost fanatical, but in October it was extremely low—perhaps to a great extent expressing only a unity of desperation.

A number of destructive forces (table 3) were sapping the physical and emotional vitality of the troops.

Table 3. Factors on Guadalcanal Disrupting Morale

1. Lack of Army and Navy support.
2. Absence of promised relief.
3. Inexplicable absence of reinforcements.
4. Exhaustion of weapons, supplies and planes.
5. Disease.
6. Semi-starvation
7. Lack of sleep.
8. Overwhelming odds.
9. Incomprehensibility of situation.
10. Strangeness of jungle combat.
11. No quarter given.

When the Marines landed in the southern Solomons on August 7, they understood that in Marine tradition, they were to secure various small islands, capture the airfield on Guadalcanal, and were then to be replaced by Army troops. Unknown to them, the Navy suffered a major disaster on the night following the landings. The four cruisers covering the operation were sunk in a matter of a few minutes

by a surprise attack from a Japanese fleet. Control of the approaches to the southern Solomons was lost and the position of the entire operation became so precarious that neither of the two Army divisions guarding the entire South Pacific area could be risked. What had started out to be a relatively minor engagement became a major encounter involving some of the largest naval battles in history (ref. 5). The Japanese holding the neighboring islands were able to sneak in reinforcements repeatedly despite tremendous losses suffered in the process. The Marines could not understand the absence of supplies, support, reinforcement, or the promised relief. Fighting in an extremely confined area, they were subjected to incessant shellings, bombings, and naval bombardment, while hemmed in on all sides by the enemy. There was no area that afforded reasonable rest or shelter. In the absence of any malarial control measures, the troops were rapidly infested as well as plagued by dysentery and numerous skin ailments. The perimeter was very thinly held and was subject to being broken by massive assaults concentrated in one spot by the Japanese. Several such assaults were driven back, but fortunately the Marines did not remain on the defensive. They were constantly making sorties and major assaults, annihilating Japanese regiments and even divisions, constantly breaking up the massing of troops before the Japanese could launch a major assault. In this life, the Marines soon became completely exhausted. The strangeness of jungle combat against Japanese veterans of the Malayan campaign was particularly arduous. The frightening aspect of the strange situation was markedly heightened when it soon became apparent that the Japanese were not taking prisoners and were torturing the few men who were captured before killing them.

There were many other stresses, but in this general situation a series of internalized stresses arose (table 4)—the emotional counterparts of the external events.

In mid-October the conviction of the inevitability of defeat and death which permeated all ranks was heightened after a point-blank naval shelling, which left the entire area a shambles, destroying the few remaining planes and supplies of gasoline. It appeared as if the chips were down and the balance between concerns over impending death and the willingness to sacrifice for the good of the country was put to an extreme test. Preoccupation with the past and what would happen to families filled the minds of everyone.

The soldier who relinquishes the direction of his own life needs to feel that the officers and the command are acting in his best interest, so far as possible. Because the situation was so incomprehensible,

Table 4. Emotional Counterparts of Situational Factors

I. Conviction of inevitability of defeat and death.
  A. Preoccupation with impending death.
  B. Frustration of utmost efforts.
II. Loss of personal support.
  A. Loss of faith in high command.
  B. Loss of buddies and trusted officers.
    1. Loss of interpersonal bonds.
    2. Loss of feeling of invulnerability.
    3. Mourning and guilt.
  C. Loss of interpersonal relations at home.
III. Anxieties.
  A. Fear of suicide.
    1. Suicide before capture omnipresent thought.
    2. Unable to endure more.
    3. Example.
  B. Fear of cowardice.
  C. Fear of insanity.
    1. Misinterpretation of anxiety and depression.
    2. Witnessing stolid friends crack up.
IV. Resentments.
  A. Projection of personal inadequacies.
  B. Quality of weapons.
  C. Complacency of home-front.
  D. Carrying entire burden.
  . .
  . .
  . Ad Infinitum.
V. Guilt.
  A. Related to loss of buddies.
  B. Cowardice.
  C. Miscarried responsibility.

faith in leadership sank extremely low. It could not be directed to the general commanding the operation, as he was sharing the tribulations of the men, but was directed to the commands in New Zealand and in Washington. The loss of buddies through death, disease, and wounds was thinning the ranks and the men lost any feelings they may have had that they were invulnerable or that they could emerge unscathed. As has been amply discussed elsewhere, the soldier gains a considerable part of his support from the meaningful relationship with his comrades, with whom he counts as an individual and who will look after him if necessary. In addition to the loss of such support, many men were filled with feelings of mourning and guilt over the death of their best buddies. Into this situation came the occasional mail, bringing to some good news that reawakened memories, and to others concerns over changes at home—the loss of girl friends, difficulties in the family—which undermined determination.

Concerning the anxieties listed, the prominent position of fear of suicide may seem strange, but in this situation there were few men who did not have at least some fleeting thought that one might as well end one's life and forego further suffering. Almost everyone had seen someone who had walked out to perform some heroic last gesture. Fear of cowardice was high in this unit with such excellent morale and the fear of insanity, of course, was marked in this first battle when the notion of psychiatric casualties was extremely strange and everyone had seen good friends suddenly "blow their tops." As everyone was feeling extremely jittery and depressed, these signs were easily misinterpreted by the men as evidence of impending and lasting insanity. Concern over homicidal impulses, which has been stressed by some writers, was present, but the incapacitating impulses did not concern killing the enemy. The danger came from homicidal impulses directed toward one's officers or comrades.

Resentments were all-pervasive and many of them may well have been projections of feelings of personal inadequacy. O. , needed someone or something to blame. There seemed to be so many good reasons for resentment, which ranged from the complacency of the home-front while they were sacrificing their lives to rage at the inadequacy of untried line officers. Up to a certain level, the resentments formed a protective outlet but when increased by frustration after frustration, as the men felt helpless to change their lot despite their most extreme effort, they reached explosive intensity. The men were concerned with guilt about many matters, including past relationships at home, which had impelled them to join the Marines, the guilt of officers and non-coms when patrols they sent out never returned, or when some command miscarried as it was bound to do in such a campaign.

It is necessary to emphasize that none of the factors listed impinged upon the Marine singly, but worked upon him collectively with varying degrees of intensity, together with the pounding to which the island was being subjected. The illnesses he was suffering and the repeated narrow escapes from death were the lot of everyone, to which must be added some particularly acute stresses to which many were subjected. For example, here is a note: "After more than a month of intensive combat, 'A' became jittery after his company had been landed behind the Japanese line in an encircling maneuver. They were erroneously put ashore on the wrong ridge and were subjected to intense shelling by our own destroyers and land artillery as well as from the Japanese, who surrounded them. 'A' was one of the few survivors. Later, while out on patrol, he was blasted by mortar fire and fell unconscious into a ravine, awakened alone and frightened in

the jungle, but managed after several days of hiding out from the Japanese to infiltrate back into our lines, to learn that the blast had probably saved his life, as again he was one of the few survivors. Hospitalized, he could not regain his grasp, for the hospital tents were repeatedly bombed, but he only became extremely ill when the destroyer on which he was being evacuated was bombed and he was again unconscious from blast and awakened deaf and coughing blood, surrounded by the dead and dying."

What were the signs of strain in these men? There could have been very few Marines who were not gravely affected. The men in the 164th Infantry, who were the first "outsiders" to enter upon the scene, were rather unanimous in their report that the Marines were all crazy. Relatively few remnants of social living and civilized behavior remained. In October there were no smiles and a wisecrack might start a fight. Weary minds had wandered far from the battle to the homes that they would never see again. Men stood on the shore scanning the horizon by the hour for a speck, or watching the sky for enemy planes, which led to the typical far-off stare. They were resentful, embittered, hypercritical, so disillusioned they tried to believe nothing. The antiaircraft crews that had stuck, firing to the last moment, scurrying for shelter after they saw the bombs released from planes, began to break with the final alert. On the lines, the men were increasingly trigger-happy.

The overt neuroses overtook some gradually. Concern became preoccupation, which led to apathy and depression; the habitual tightness in the throat became a sob which, as days passed, turned into uncontrollable crying. Inability to eat turned to vomiting and with sleep wrecked by nightmares, in addition to the alerts, the men became emaciated and worn; many simply failed to recover from dysentery or from malaria and remained dull and listless, or slowly the jumpiness to sounds increased until the trigger was pulled at the slightest noise and they were more of a menace than a help.

The acute onset, precipitated by the mortar shell bursting along the trail or by being caught without shelter during a strafing raid, was usually a sudden panic followed by a brief amnesia. These breaks were only apparently sudden. With rare exceptions, careful anamnesis revealed that the soldier had been fighting against cracking for days and weeks, trying to conceal his frantic feelings. He had stopped eating. He spent more and more time by himself not to show his anxiety. He felt he had reached the breaking point but he could not retreat, feign illness, or even capitalize on real illness and retain any self-respect. There was no escape but he could endure no longer and the panic, with the blotting out of awareness, was the only solu-

tion. It would be erroneous to consider that the prodromata were unconscious.

These men arrived at the Army General Hospital a few days after evacuation. They presented an unforgettable sight. They were bedraggled, tattered, and emaciated youths with frozen faces and far-off stares who bore little resemblance to the picked men who had been landed in New Zealand a few months before. These well-trained men had lost from 20 to 40 pounds. They suffered from anxiety and depression in varying proportions but quantitatively so different from that described among the Americal Division as to be a totally different matter. Anxiety varied from severe tension symptoms to recurrences of intense panic; depression from preoccupation and despair to inert disregard of the surroundings. Headaches, anorexia, frequency, abdominal pains, marked tremors, Parkinsonian facies, palpitations, insomnia, and nightmares were individual symptoms or virtually all present in a single individual. Paucity of conversion symptoms was surprising. When they were present, they failed to control the anxiety appreciably. The numerous somatic complaints were rarely offered as a primary complaint and were readily accepted as part of the anxiety. The men knew and admitted that they were extremely anxious.

The disruption of conditioned defensive patterns noticeable in most combat neuroses reached extreme forms. A sudden loud noise would bring the entire ward to its feet, ready to dash to safety. A peal of thunder produced reactivation and reliving of some combat experiences that had produced panic in a few. The men were uneasy at being indoors, preferring the open but shunning the sight of the ocean, which brought fear of shellings. They could not accept the concept of safety.

All day long the wards were filled with noisy chatter about the fighting, with grousing and arguments. It was a slow process for normal social trends to return to these minds so long immersed in killing, waiting for death, abandonment of hope, distrust. However, this was not all residua of combat, for the news from Guadalcanal was bad and they were mourning their lost comrades, seeking to hide the guilt at having escaped. Amidst the bedlam, a few lay depressed, others would wander off to sit with their thoughts or trail into the swamps pondering suicide. Every now and again someone would become acutely jittery, fearful he was about to "blow his top." The nights were more trying and each night some would refuse to go to bed, fearful of the thoughts that would come with quiet and the nightmares that terrorized sleep. They would be "good guys" and go to bed, but soon would be pacing the grounds, for it was safer to be awake, ready to dash for a slit trench. The hum of the hospital

generator penetrated sleep as the drone of an airplane. When the ward was finally settled, the calm was soon shattered by a terrified yell of a patient suffering from a nightmare and with everyone fighting the mosquito bars to get outside.

The nonpsychiatric wards were calmer, but here too the nights were frightening, broken by nightmares, and each day more men lost their grip and the N-P Section added beds.

I cannot tell about the subsequent course of many. Most of the N-P casualties were returned to the States and were thought to be in shape so that the trip could be recuperative rather than a continuation of the intense period of anxiety. Some were returned to duty and it was known that a few remained in combat a year or more later. Some of the sickliest patients wrote and apparently were reasonably well adjusted in civilian life the following year. My experience with later troops whom I saw in the United States would lead me to believe that a pseudo-psychopathy is apt to set in in such troops which confused the psychiatrists in the States. This condition seemed to consist of a state of "not giving a hoot," compounded of guilt, bravado, and deep resentment over the complacency and lack of sacrifice of the people in the United States who could never understand the score and whose sympathy seemed hollow. No one could understand, and for a long time the strings of attachment were still with that only unforgettable reality and the only true bonds were with the men who had shared it.

I would like to say a few words concerning the ultimate in chronic situational stress. I do not feel qualified, and others here may unfortunately be more qualified, but the experiences and the lessons gained from them cannot be left out. These were the experiences of the unfortunates in German concentration camps, and to a slightly lesser degree, of our troops imprisoned in Cabanatuan in the Philippine Islands (ref. 6). For these people, the effects of chronic severe starvation intermingled with and confused the picture produced by the intolerable emotional stress. I can here only call attention to the brutalizing effects of hunger and humiliation; the defensive nature of the apathy and blunting of emotions that reached extreme forms in the effort to shield oneself against the unbearable existence; the memory defects which may have, in part, been due to nutritional and vitamin deficiencies, but which were also surely due to the need to blot out memories of home and family; the importance of strong motivation to survive despite all pain and torment, and when it failed, the ability of the human to die of apathy. I have been assured by physicians who were prisoners in German concentration camps that what I have heard from the patients from Cabanatuan was correct, that men who were still relatively well-nourished but who were over-

whelmed by the brutality and misery around them, simply lost interest in their surroundings and faded away within a few days.

The enduring results of such prolonged experience require further study. It is the impression of those familiar with such people that a high proportion have remained strange. Most noticeable is a flattening of affect and blunting of responsivity to others. It would seem as if the defensive and restitutive structure erected to endure had not been removed completely, even after these many years. In addition, neurasthenic and hypochondriacal complaints remained and a passivity that is frustrating to those closely related to them.

Discussion

The stresses imposed upon the two units which have been discussed were vastly different, but still certain common features are apparent. I wish now only to comment upon a fairly obvious difference. The First Marines were subjected to incessant threats to their lives and, while deprived of basic necessities—food, sleep, rest while acutely ill—fought desperately for their lives. There was little opportunity to establish restitutive patterns. The resultant signs of strain involved, to a great extent, excessive mobilization of physiologic defenses against danger as well as hyperactive aggressivity. Without any chance for escape, panic was a frequent desperate solution of the opposing pressures to live or die. The Americal Division encountered a serious obstacle in regaining satisfactory motivation because of the need to contemplate an indefinite future of more Guadalcanals, and could also find little satisfaction in daily existence. Defenses involved efforts to blunt thoughts and feelings about the future, which required need to forget the past as well as requiring ways to diminish the intensity of current resentments. The restitutive efforts led in the direction of depressive and neurasthenic forerunners of apathy.

Opening a path into a conceivable future was requisite to preserve the integrity of both units. The Marines needed some hope that they had a chance to survive and this came with reinforcements and the focusing of the entire Pacific Theater upon winning Guadalcanal, which had by then shaped into a decisive struggle. The Americal Division took a new lease on life with the announcement of the rotation policy, for they would be the first to return home, and when they learned on Bougainville that not all jungle combat need be a repetition of Guadalcanals.

I have sought to present situations and the general reactions of the participants. It is not possible now to discuss the lessons learned from them. Such comparison of military situations for stressful and sup-

portive factors seems to me to be extremely important, not only for the Military, but to enhance knowledge of the forces at play in the emotional equilibrium of people in general. Here, the difference between individuals or the need to consider the individual's background and development is canceled out by the shuffling of men into organizations and we can concentrate largely upon how differing circumstances provoke differing reactions. Here, too, we are fortunately forced to consider that area which concerns the strength afforded the individual when he is capable of submerging his own fate to that of the purpose of the larger group. It is a necessary source of strength in military life, but also applies in civil life, though we have had difficulty in seeing just how.

I have discussed groups and not individuals, but I do not wish to close leaving the impression that combat or military psychiatric casualties are to be understood in these terms alone. It is the filter of personal experience and the meaning of the situation to the continuity of the life of the individual that renders an episode incapacitating or casual. The understanding of the individual combat neuroses is as complicated as the understanding of the civilian neurosis, but in military life the setting not only precludes utilization of many defenses and balancing gratifications, but also can produce stresses that provide a common background that tests the adaptability of all involved.

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SYMPOSIUM ON STRESS

LIFE SITUATIONS, EMOTIONS AND BODILY DISEASE [1,2]

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Man is exposed to assaults by other living forms that aim to invade as parasites or to destroy; by meteorological and climatic crises that pass sometimes predictably and often whimsically over the earth's surface; by other physical forces that operate upon man merely in terms of his mass and volume; and by elements of the earth's crust which man often dangerously manipulates for his sustenance and fulfillment, comfort and delight, or to vent his passion for destruction.

Man is further vulnerable because he is so constituted that he reacts not only to the actual existence of danger, but to threats and symbols of danger experienced in his past which call forth reactions little different from those to the assault itself. Since his adaptive and protective capabilities are limited, a man's response to many sorts of noxious agents and threats may be similar, the form of the reaction to any one agent depending more on the individual's nature and past experience than upon the particular noxious agent evoking it. Moreover, because of its magnitude and duration, the adaptive-protective reaction may be far more damaging to the individual than the effects of the noxious agent *per se*.

Finally, and most important, man is a tribal or group creature with a long period of development, dependent for his very existence on the aid, support and encouragement of other men. He lives his life so much in contact with men and in such concern about their expectations of him that perhaps the greatest threat of all is his doubt about his ability to live the life of a man. He is threatened by those very forces in society upon which he is dependent for nourishment and life. He must be part of the tribe and yet he is driven to fulfill his own proclivities; because of his sensitive organization he is often pulled two ways at the same time.

With an awareness of the importance of the *direct* effects of climate, microorganisms, terrain, chemical and physical forces in disease, it

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[1] For a full statement, see "Stress and Disease," published by Charles C Thomas, Publisher, Springfield, Ill., 1953.

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has been shown that alterations within the human host stem from exposure to sudden and relatively rapid changes of many varieties; from disruptions of customs and habits as well as familial and social structures; from the deprivation of basic human needs (interpersonal and esthetic) and the failure to fulfill personal proclivities. Also, alterations result from *threats* to life, *threats* of deprivation of the basic needs and of opportunities to fulfill potentialities. Because they are ubiquitous and omnipresent, these threats rank high in importance.

Protective reactions are *not* "chain" reactions in which the individual first "feels" (fear, anxiety, hostility, etc.), following with altered bodily function (gut, heart, skeletal muscles, etc.) and ultimately with abnormal behavior. Indeed, altered feeling, bodily adjustments and behavior occur at the same time in varying relative amounts. However, one may prevail to such a degree as to hide the others and this dominance may shift from one to another in any sequence. For example, a man in reaction to a situation in his family that caused him to feel humiliated and to develop ulcerative colitis, was ostensibly tranquil, inactive, and cooperative as a patient. Then, still in the same setting, with exacerbation of bad relations with his family, the colitis abruptly ended, he became extremely restless, deeply depressed, uncooperative, and attempted suicide.

Yet protective reactions in a given individual are predictable as to dominance and order of occurrence during stress and economy of reaction is usually exhibited. In other words, protective devices are not casually related ("anxiety causes dyspepsia") but are separate, though interrelated, adjustment patterns.

The thesis of this presentation may be stated as follows: The stress accruing from a situation is based in large part on the way the affected subject percieves it—perception depends upon a multiplicity of factors including the generic equipment, basic individual needs and longings, earlier conditioning influences, and a host of life experiences and cultural pressures. No one of these can be singled out for exclusive emphasis. The common denominator of stress disorders is reaction to circumstances of threatening significance to the organism.

The particular adaptation pattern evoked by a noxious agent or threat is the resultant of past life experience which conditions individuals to react in specific ways. Hence, "etiology" in disease becomes a function not merely of a precipitating incident and setting but largely of the past of the individual and his stock.

Repeatedly in these demonstrations, protective patterns are evoked in given individuals by threats of highly particularized significance. These threats or situations evoke entirely different responses in different persons, although when a threat evokes a particular protective

adaptive pattern, the reaction includes specifically related attitudes, feelings, states, and behavior.

Mucous membranes participating as they do in man's bodily reactions to impact, may exhibit engorgement, ischemia, hemorrhage, edema, erosion, increased friability, modification in secretion, faulty absorption, ulceration, altered reaction to chemical agents, modification of cellular components and inflammation, with lowering of the pain threshold. Such alterations, sometimes combined with the effects of direct noxious forces, may become the basis of further and irreversible tissue damage.

These arrangements represent adaptive patterns involving, notably, portals of exit and entry. In addition, there are patterns that involve the circulation and equipment for general mobilization. So may be viewed the responses of the man with arterial hypertension who is meeting what he considers an emergency by being alert and ready for any danger, a bodily response which is never actually put into proper use. The heart overworks, the peripheral resistance augments, the blood vessels to important organs constrict, parts run short of nourishment, the blood becomes sticky and coagulates too readily, the fluid and electrolyte balance is disturbed, the head aches severely, the muscles of the back "cramp." In other patterns, fundamental metabolic processes involving the use of carbohydrates and nitrogen may be ominously implicated. Thus, man in reacting to threats concerning interpersonal relations as though to assault, uses inappropriately, over long periods and to no end that they can meet, patterns appropriately serving short-term and phasic needs.

Not only do forces and individuals that jeopardize the life and love of a human being constitute major threats, but also do those which interfere with the fulfillment of his needs, the realization of his aspirations and the development of his potential.

A considerable part of the human equipment has to do with meeting emergencies, dealing with crises, satisfying nutritional and metabolic needs and promoting reproduction. The patterns of reaction thus set in motion are adaptive and protective and phasic in action. Those utilized depend upon the individual's nature, his past experience, and the stimulus situation. In operation, these adaptive reactions, when appropriately used, are more or less effective, though costly.

Some of these patterns represent widespread mobilization to provide extra blood and energy for vital parts of the organism. Others, notably those having to do with anabolic and reproductive processes, are regional. Offensive and defensive, general and local adaptive devices may operate together and separately. Along with these conspicuous bodily preparations go certain behavior, feelings, and atti-

tudes which, stemming from the same needs, have the same goals. The organism may sacrifice at such times some functions and capacities while promoting others more important in meeting adverse situations. Although there is a degree of specialization in the sense that one or another protective arrangement is dominant, discrimination is not exact. In a threatened man it is common to find a variety of protective reactions, some of which are extremely pertinent, others less so, and still others minimally effective.

Owing to training and cultural pressures, an individual develops a more or less fixed idea of how he is expected to appear, behave, react and even feel. A man's reactions to what he perceives as dangerous are often out of keeping with his conception of what he "ought" to do. The threat and the subsequent conflict, often not fully recognized, thus persist and unsuitable protective reaction patterns may be evoked unwittingly.

Such inadequate processes of defense and offense may lead to disastrous changes in function and structure. Furthermore, the continuing effort to achieve homeostasis through the use of unsuitable protective and adaptive patterns may lead to the destruction of the individual.

It may be argued that an adjustment that is destructive in its effects and which may cause death, cannot truly be termed either adaptive or protective. Homeostatic reactions, *appropriate in kind*, being pertinent to the stimulus, are constructive unless faulty in amount. Disease as a sequel is an epiphenomenon. Homestostatic reactions, *inappropriate in kind*, being *not* pertinent to the stimulus, are rarely and only incidentally constructive. Destruction and disease as a sequel are usual. Integrated to be used and spent for a specific purpose, they become sustained when the adaptation the organism aims to achieve cannot be made through their use. Yet, in the main, both appropriate and inappropriate responses are adaptive and protective in that they are goal-directed.

Claude Bernard saw "disease" as the outcome of adaptation to noxious forces in which the responses, though appropriate, are faulty in amount. In this concept, the individual is damaged through the wrong magnitude of adaptive response, whether too much or too little. For instance, the presence of microorganisms in the lung evokes vascular and cellular responses which serve to meet invasion, and indeed do so. Yet the magnitude of the responses may lead to pulmonary congestion and pneumonia.

Defenses may be extremely costly, as with pulmonary tuberculosis. Cellular and humoral defenses destructive to acid-fast bacilli may ultimately lead to cavitation, the feature of phthisis. Moreover,

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through the liquefaction and elimination of the contents of such cavities, a few surviving organisms may spread the infection to a non-infected area of the lung, leading to further destruction. Yet, despite catastrophic tissue damage, protection of the host may be effected.

The view elaborated in this essay develops the concept further and suggests that the responses which result in disease may be qualitatively as well as quantitatively inappropriate. A patient with ulcerative colitis used his bowel, when his prestige was challenged, as though to rid himself of a noxious agent inadvertently ingested. The protective reaction serves the latter purpose and was inappropriately used, and, being inadequate to meet the danger, persisted. Since resolution cannot be effected through its use, the unsuitability of the reaction pattern as well as its magnitude and duration, especially endanger survival.

In all events, there is help in our knowledge, since now we begin to know what price we pay for a way of life. There are many things more important than comfort and a few even more important than health. But a man should appreciate what his actions and goals are costing him. Then, if he chooses, he may pay for them in pain and disease. Often he will decide that his values are poor, that he has been confused, and thence change his direction and pace.

Discussion

Dr. Whitehorn. I am sure we all appreciate the opportunity to have Dr. Wolff present in so cogent a way his observations, inferences, and formulations based on a very large body of experience and reflection. I hope that the discussion and questions will be oriented toward the more significant questions that he has brought out.

Dr. Lidz. I would like to direct my remarks to Dr. Wolff's statement having to do basically with overactivity and the use of the best organs as means of defense. I do not quite see the use of the strongest organs. But more to the point, I want to ask him what he thinks, following the general theory of homeostasis, of the concept that the autonomic nervous system, which carries the stimuli in a number of these tractions, serves two masters. It has to do with basic homeostatic mechanisms in preserving the internal equilibrium of the organism, and secondly it has the function of defending the body against external danger which is also necessary for survival. It would seem to many of us that where things go wrong is not so much in over-reactivity to the stress, as in the fact that things get mixed up when the individual is reacting to danger or to the feeling of resentment and also trying to perform the physiologic function of maintaining the internal equilibrium at the same time.

Dr. Wolff. I have never been able to help myself by thinking of these reactions in terms of parts of the nervous system—sympathetic, parasympathetic, cholinergic, adrenergic—or in terms of special endocrine combinations. To be sure, the pituitary and the adrenal are integrated in a very significant way and we are becoming increasingly aware of the fact that they can bring about changes that are independent of nervous actions. For example, after vagotomy the stomach is still capable of responding to considerable amounts of ACTH when it is used appropriately. Now what I am saying is that I prefer not to take this out in terms of parts of the nervous system but rather in terms of integrated patterns, patterns which have been found to be useful in the past when meeting certain threatening situations. A pattern which is integrated to meet a given situation may be mis-applied when the individual is facing a threat having to do with interpersonal relations. Let us consider the gut, for example. If croton oil is put on the mucous membrane of the large bowel, it gets red, becomes overactive, hypermotile, and the croton oil is ejected. That is a suitable reaction and can meet that situation very well, but when one of our patients with ulcerative colitis felt that his sister-in-law threatened his position in the family, endangered him, humiliated him, he used his large bowel, which we could observe because it was externalized, to meet that threat as though he had croton oil on his mucous membrane. Of course, there was no possible way to get rid of the sister-in-law situation by that device. To be sure, there are occasions where direct threats and those which arise from interpersonal situations combine to produce a given end. I think that in many instances colitis might be prolonged by a combination of an infectious agent and an abnormal reaction to some situation in the environment. But I think we can dissect out evidence that the patterning may be quite inappropriate to meet the threat, or a pattern suitable for phasic, short-term effects may inappropriately be used too long without resolving what it is designed to do. The organ which has to meet the increased load, as indeed in the case of the heart in hypertension, becomes strong and effective in meeting threats, but ultimately breaks down through its prolonged overuse. It was in that sense that I substituted for myself the view that it is the stronger, the most useful parts that the individual is apt to call upon when he is in trouble, and that it is often in these that we see the damage—not necessarily in a tissue which is inherently weak, inadequate, or poor. Focusing on the organ seems to be a mistake. Seeing it in terms of patterns of defense opens the vista for me.

Dr. Spiegel. I would like to ask Dr. Wolff whether these defense patterns now so inappropriate for adult life might once have been

effective during childhood for somewhat similar or analogous kinds of threat.

DR. WOLFF. I think it is entertaining to consider that when infants have an upper respiratory infection, they have a much more diffuse reaction than an adult, including, for example, diarrhea, vomiting, fever, and changes in hemodynamics, seemingly as an overall response to that threat. Only as the individual matures, ripens and enables himself to focus on the portal of entry or exit, do we see the special reaction known as the coryza. To that extent, then, I think the child represents more what the adult is doing under the circumstances of inappropriate response.

I do not think that these are fortuitous responses. At any one time in life they are integrated in meeting a certain threat in rather specific terms. They may change from time to time; an individual may alter his defensive or adaptive patterns, but he is apt to be more or less focused and to use a given pattern repeatedly. That may be abandoned for another pattern if the circumstances alter or the individual perceives his danger in another light.

DR. WHITEHORN. Dr. Wolff, I thought I detected in Dr. Spiegel's question another implied one—whether you saw some possibility that in infancy the bowel function might be used as the instrument of interpersonal transactions?

DR. WOLFF. I have always thought that our communications were universal; we use all of our parts in connecting. I think it unfortunate to distinguish emotional communications from any other. I think we are as emotional when we are discussing mathematical formulae as when we are discussing our parents. The threats may be just as serious. Therefore I would expect that at all times in infancy and later in life, communication would include the body in an overall way. I would hate to have this reduced to some verbal form; I do not know how to express that. I would merely suspect that the attitude that the individual gets himself into at the time when he perceives a threat would somehow have its repercussions on his entire equipment, and he would use one or another part in a response which might be read by someone else.

DR VON EULER. May I ask one short question? Would these reaction patterns also occur in adrenalectomized men? I think Dr. Thorn would be willing to supply some but it would be interesting to know whether such patterns are mediated by a purely nervous mechanism, or also by endocrine pathways.

DR. WHITEHORN. Before asking Dr. Wolff to reply, perhaps Dr. Thorn could contribute some clinical observation.

Dr. Thorn. I do not think I can answer that question but I am impressed by the speed with which these reactions come on and turn off. This would indicate to me that they must almost certainly be mediated by neurogenic influences on blood vessel supply, etc., and that any hormonal influence would have to be that of epinephrine or of a similarly rapid-acting type of substance. Certainly it could not be anything like adrenal cortical hormone in which the secretion once initiated would carry along within a few minutes and persist for some time, unlike the way in which these patterns are abruptly turned on and off.

Dr. Wolff. Certainly in subjects with complete sympathectomies many parts of the adaptive mechanisms fall out or are perverted, hard to recognize indeed. But the overall adjustments still go on. I would feel that both neurogenic and endocrine factors are integrated in a way to bring about these patterns. I would suspect that after the vagus, for example, ceases to be operative in the stomach, the effect of ACTH perhaps would go on—it might be a question of time and duration. For example, to answer the question in part, if one cuts out the vagus then the stomach cannot react; but I have no knowledge as to what happens when the pituitary is taken out, so I do not know whether such an individual could still respond by vagus. My guess is that these patterns have both neurogenic and endocrine elements.

Dr. Fox. I just want to say another word about this question of inappropriateness of response, which is a very important issue. It seems to me that the main feature of this has been missed. Of course, it is true that people get into difficulties when their responses are inappropriate to the present situation, but the essence of the inappropriateness would appear to me to be that they carry over into the present situation infantile patterns which were appropriate at one time. I think that is what Dr. Whitehorn was aiming at. The obnoxious person, such as the sister-in-law who was mentioned, would be perceived by an infant in an entirely different way than by an adult. She would be perceived actually very much the way croton oil might be perceived by an adult. The practical implications of this for methodology seem to me to be very great, because it brings in the whole question as to whether or not it is important to differentiate conscious from unconscious responses to stress. The person who is talking about mathematics may become quite emotional about it, not only because of easily accessible conscious reasons having to do with prestige, but because in his reaction he includes responses which have to do with his infancy which he has not outgrown. If we want to understand what is happening in a person, it is necessary not only to get a conscious report of how the patient regards stress or to be satisfied with our own picture of the kind of stress that we think we are applying, but we also have to get some

understanding of the way in which infantile responses and perceptions are carried over unconsciously into the present response to what is happening.

Dr. Whitehorn. Our question seems to have rebounded here—Spiegel to Whitehorn, to Fox, to Wolff. Would you like to comment further, Dr. Wolff?

Dr. Wolff. No, I think these conceptual things are working theses. If one can make them work, that is certainly his privilege. I find such theses less helpful than the one which I formulated.

Dr. Lidz. I want to go back again to the first question. I do not think I made quite clear what I meant, which is that the perception is one thing and the way of responding to something that is potentially dangerous is another. The physiological way of responding to danger has not been changed because man has become civilized. We substitute a different set of dangers which are involved and these come in conflict with the other physiological purposes. It does not seem to me that they are inappropriate in the sense of Tom's stomach blanching when he is frightened. An animal's stomach blanches when it is frightened and we presume that in the preservation of the species this had some function, mainly that the blood supply was diverted to the muscles in the face of danger. So today if a man's stomach blanches when he is threatened with losing his job, it is just a question of substitution of symbols. But I wanted to come back to a military problem involved, and ask if Dr. Wolff has some answer. Colonel Glass asked this and it is very puzzling. For example, in the last war we had very little neurocirculatory asthenia. (I think there is such a thing as "effort syndrome," though we only see it in wartime.) Our feeling was that this was because we kept the anxiety diffuse and it never became meaningful to the soldier. First, the anxiety was kept diffuse and never focused on the heart, and second, effort syndrome and other disturbances lost their reward value to the soldier. It did not do him any good, as Colonel Glass pointed out, to have gastrointestinal disturbances or effort syndrome and so on. Yet it is rather puzzling, when one thinks about it, how by changing the war we have changed the physiologic response from isolation of the symptoms to a diffuse, nonspecific reaction. I wonder if your work in the laboratory gives us any idea of how this occurs.

Dr. Wolff. I do not think I have anything to add to that. I wish Colonel Glass would make some comment.

Colonel Glass. I certainly know that in the war it is very obviously so. A syndrome from anxiety may well have started with a diffuse

response and then become nurtured into a more specific syndrome. I think we tend to do that every now and then. For instance, people over the whole area are informed about infectious hepatitis. How does this thing work? They know that it means 3 months of very fine living in Kyoto, Japan—which is a very lovely town. Just how does one obtain this illness? Does one look yellow enough? Those who have it are continually punching themselves on the side to see if their liver is larger and many of them are convinced they cannot eat fatty foods or perform any exercise. What starts out as a diffuse response of anxiety and tension, may well be iatrogenically and otherwise culturally elaborated into a syndrome.

THE COMMON PSYCHOLOGICAL DEFENSE TO STRESSFUL SITUATIONS AND THE PATTERNS OF BREAKDOWN WHEN THEY FAIL*

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I think I will take my cue from the last remark that Dr. Lidz made and talk to you today more about the individual than the previous speakers have done. I would like instead of giving you a picture from the outside in to take you inside and give you a picture out. But before I do that I would like to explain myself and what experience I have had because I am sure that each one of us has had experience so varied that we both overlap and do not overlap at all. My experience has been confined almost entirely to fliers. I spent my entire war years with fliers both in the training command and in the 8th Air Force in England. I think that you can readily see that the situations might be extremely different and they were.

There are several things about air warfare that separate it from other types of warfare. Just a few of those might well be mentioned. England was a rather nice place to live in. It certainly did not provide the terribly monotonous trauma that Guadalcanal and the Fiji Islands did. There is an extraordinary fact about air warfare—its irregular intermittency. It is amazing to think of a boy putting on his pinks in the morning in order to fly a mission so that he will not waste any time when he comes home in getting to London for a date. This kind of experience, I think, has both its advantages and its disadvantages. One is constantly being keyed up and let down and yet one also has a respite from danger.

England too was a remarkable place as a laboratory. Communications were excellent within it, and there was really no danger except in the air. The buzz-bomb danger was pretty much disregarded by all the Americans; most of the buzz-bombs did not constitute a threat to most flying stations. As a consequence, the whole danger was focused in the aircraft. As a matter of fact, this is very much true in flying in general. The aircraft becomes the center of the danger; it is the danger that can kill you and it is the weapon that can save you.

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I think a striking observation that anyone new to the Air Force makes as soon as he goes on any Air Force station is the constant closeness to death to which these young men suddenly come. You hear in the first few hours more tales of buzzing, near death, and escape than you could possibly remember, and this becomes a steady diet for your ears. It is remarkable how danger is never considered whole but is broken up into little bits and little events. An example is the way a near accident or a real accident is constantly turned over and over in a person's mind as if he were trying the situation again and again for better means of handling it, for better methods of conducting himself if he ever gets into such a situation. It is clear too that this is helpful and right to do. In several rest homes there was an attempt to cut this off, so that everybody that mentioned combat, for instance, had to put a certain amount of money in a pot. This practice quickly broke down, the pot overflowed, and the plan was quickly discarded as completely impractical. The rumination on danger is a sign of health. The sick people, the people who have broken down in combat, cannot stand to listen.

We ran a little experiment that runs counter to many people's opinion or rather, the results of which run counter to many people's experience in this regard. We took a lot of broken-down fliers, most of whom knew they were going home (and everyone else knew they were going home, or at least out of combat), put them in the midst of 550 healthy ones sent for a rest. We had 110 of these sick men. The idea that opposed us in this was that as soon as the healthy men saw these disturbed ones and knew that they were getting out of combat, they would quickly follow suit, the panic would spread among them and nobody would go back. It was quite the reverse. What happened was that sick men were far more traumatized by the talk of the healthy than the healthy were bothered by them. As a matter of fact, the healthy usually overestimated tremendously the amount of trauma that the sick had suffered and regarded them as something a little apart, were very protective of them, and quite distinctly said, "He has had it, I have not."

This leads me into some of the things that we found were extremely important within the individual. Very few people go to combat with any realistic view at all of what they are going to. They go with the very unrealistic view that states, "It is going to be the other man that is killed, not myself." And as a matter of fact, it is not a bad war if you go to it in that frame of mind—if you go to it with a firm belief in your own immortality, with a firm belief that you are going to return well, decorated, and honored. Of course, there are certain things that work against this unrealistic view. The realities of war

itself tend to undermine it. From the individual's point of view, it is the undermining of this particular defense that is the beginning of trouble.

I would also state that the things that undermine this particular defense are extremely specific for the individual. As many of the others have indicated, I would like to emphasize again and again the fact that stress by itself is a pretty meaningless term when it comes to an individual. Stress does not mean much to an individual. It is the strain that he suffers, and people are extraordinarily different in what bothers them. Some people are bothered tremendously by mud, by all kinds of discomfort; other people are not bothered by it at all. We would be less than realistic if we did not regard the individuality of people as enormously important, when we try to look understandingly into the reason for their breakdown or for their not breaking down. I felt after a long study (and we were fortunate in this way in that we had an opportunity to spend a long time with a few individuals and to see several thousand more casually), that there was always a specific reason, a specific point at which a man broke down, and that this could be understood quite well when one understood what was going on in his mind at the time.

Take this for example. Here is a young man who comes into my office and sits down and says, "I do not know what is the matter with me, doctor. I have a yellow streak up my back a yard wide and I have never had it before. As soon as I get into that airplane I go to pieces and I am worthless." The doctor who sent him to me knew him and his family well, and sent him with the remark, "This is the last man I ever expected to send to you." What had happened to the boy was this. He had been close to a roommate. The roommate and he were students in an observer's school when one night the patient came back to find that his roommate had been killed in a midair collision. Being the boy's best friend he was selected, most unfortunately, to accompany the body home. This was a long and harrowing tale. There were no seats on the train, he had to sit on the coffin for 2 or 3 days. Upon arrival the parents of the dead man played along with a fantasy that you could easily imagine yourself having. They said, "You are our boy now, you are going to have to take his place." There were a great many unfortunate incidents. A chaplain had said he had given the boy the last rites and the parents were at a loss to understand how the chaplain managed to do so. They were anxious also to open the coffin and see him, when there was not much in the coffin except sand.

These trying details finally worked against the patient's defenses and one could see how, sitting there in the train and going through the

ceremony, it was most natural that he thought, "What would it be if this were myself in the box, and my friend were taking me home?" An identification with the dead friend was well on its way. Upon his return to duty he went up in an aircraft at night without any feeling of trepidation. After getting up in the air he was seized with a panic, began throwing various pieces of equipment around, shaking in terror, hiding his head, and so on. I encou[illegible]ed him to talk further and it turned out that although he was extremely fond of his best friend there were certain things about him that he did not like a bit and as a matter of fact he had found himself extremely guilty ever having the thought, "Thank goodness it was my friend that got it, not myself." The two men had gotten mixed up with the same girl, and his friend's death cleared the patient's path rather nicely. He had to admit certain advantages. This, then, very specifically acted on his conscience, saying, "If that boy died and I have had these thoughts about him, I deserve to meet a similar fate." And as a matter of fact it became very clear that in the aircraft when he panicked he had the distinct realization that he was about to be hit by another plane. This kind of a pattern is remarkably monotonous.

Another man came in for the following reason: He was sent by his instructor who kept him out of the air, because he was looking around too much when he came in for a landing. I think most of you know the common chant of the instructor in early training, which is, "Keep your head and eyes moving, look around." The instructors chant this because a young pilot is apt to be so fixed on one or two parts of flying that he does not look out for the traffic around and runs into other people. This bothers the instructors. This pilot came in violently protesting that his instructor was insane, that he loved flying more than life itself, that he was only being sensible. I could not make much out of this so I called up the instructor, who said, "Listen, if you want that boy to fly you are going to have to fly with him because he looks around so much that he pays no attention to the ground which is coming up at him." As you might expect, his closest friend had just been killed in a midair collision 3 weeks prior while coming in for a landing. In other words, it is a remarkable example again of a man identifying now with a situation of a friend who had been killed and thinking suddenly that this same situation would happen to him. He now is looking at his flying from an entirely different view. No longer is he a young and happy airman about to win great victory for his country but he is a young man going out to die in the exact replica of the way that a friend has died. Always behind such an identification lies some angry thought against the dead man. As a matter of fact,

you could make this into a rule because it does make scientific sense. Why, otherwise, identify with a man that is dead?

Ordinarily, if it is a friend that has been killed and if you are free from aggression against him, you will react with great anger and it will drive you to try to avenge his death. Many men are so stimulated. I think this is one of the most important things about motivation and morale. I feel very strongly the way that Colonel Glass mentioned that you do not need to worry so much about the higher conceptual side of morale. People find all kinds of motivation and this motivation shifts tremendously with their experience. If you have a friend killed you do not have to wait around figuring what the United Nations are doing or what the State Department is going to do. You want to get the man that killed your friend or you want to get the man who is going to get you next. You do not need to worry so much about those other things because the experience of combat and the danger to which you are subjected is motivation enough for a great many people. I do not say this other is not nice or even helpful. It is helpful, but by and large it is amazing how people find their motivation to go out and kill and fight. They find it without too much trouble, when the odds are not too bad. But again to come back to the pattern about which we were talking before. In each one of these boys it was not hard to find the angry thought or the selfish thought that gave them satisfaction in their friend's death. And once this satisfaction was known to them, once they had spoken it, they often improved enormously, lost their identification with their friends and felt considerably more at ease about continuing their task.

Here are two examples of the relief afforded by this approach. A 19-year-old boy from Brooklyn was the first pilot in a B–24. He flew to Kiel on his twelfth mission and on this mission he ran into a great deal of difficulty. By the time his plane got over the point where the bomb run begins and no evasive action can be taken, one motor was on fire. They dropped their bombs and got a bad lead right through a wall of flak. This boy, battlewise, knew that he should not continue in this direction and called to the pilot flying on his right, "Move over. I am coming through you." The pilot on the right, flying his first mission, was most unanxious to move and refused. The patient said, "I will shoot you down if you do not get out." And he told his gunners to turn their guns on the other ship. The two planes met the wall of flak together; the one on the right went up in flames and all of the crew burned. The patient's ship lost 6 feet off its left wing, another motor through fire, all the control cables were cut, rudders were shot off, radio and oxygen were out, the nose was taken off, the shoulder was taken off the navigator, and the head off one of the waist gunners.

The plane fell about 28,000 feet. The dive put out the fires, and the engineer spliced two cables which turned out to be the elevator cables. The pilot pulled out of the dive at 1,000 feet, using only the elevators and the trim tabs and then started on home. Debating what he was to do, he had a considerable decision to make as to whether to bail out right there, go to Sweden or come back to England. The bombardier came up from the nose and told about the navigator and somebody came from the waist and told about the waist gunner. He could not quite believe the news and went back to see. The waist gunner's brains and blood were all over and the pilot said aloud, "You are dead. You have had it." He continued toward the nose where the bombardier had panicked and could not give the navigator morphine. The pilot gave him morphine and came back deciding that the navigator would get better care in England than he would in Sweden and that he had better go there.

In this connection, it is interesting that his brother was a navigator flying out of Italy and had sustained a very severe wound in combat. One wonders if this had not something to do with his decision. In any case, he flew home turning by controlling the propellers because he had no rudders, and landed. Upon landing, the plane disintegrated. People ran up to him and told him he could not fly a plane like that. He agreed and immediately paid attention to his navigator. Then for the first time he felt a little jittery. He was sent to a rest home for a rest but was not a patient at this time. He then went back to combat, and flew four more missions. On the last of these he was flying a milk run over northern France where there was no danger. A little piece of flak came up way to the left of the formation—completely harmless—and without a moment's thought or hesitation he dived his heavily-loaded bomber out of formation. As a matter of fact he did in this inappropriate situation exactly what he had wanted to do at Kiel. This was possible because on this mission he was flying in the outside position of the pilot who was killed at Kiel. A certain number of his crew objected to this maneuver. His co-pilot hit him and flew back into formation, and the pilot then continued the mission. On his return, the pilot flew down to see me, whom he had met casually before. He was at a loss to explain his serious error and at first spoke of his tour of duty as purely routine.

It was not until after some time and some pentothal that the story of the rather impressive mission at Kiel was forthcoming. Two missions before this severe one he had been flying deep in Germany and he had noticed the bomber in front of him explode. A big piece of debris came back toward him. What he thought was debris turned out to be the tail gunner. The body hit his number 2 propeller and

splashed all over the windscreen. He had to borrow a knife from his engineer to scrape this fellow off. As he said, "It was a very unpleasant sight and I felt a little nauseated." This experience seemed to upset him not at all and yet one might think it very traumatic. After the mission at Kiel it came back to haunt him but there was no doubt that Kiel was for him the turning point. Another striking finding in this man was that even during this disastrous mission to Kiel he was not in the least bit afraid. He was clear as crystal that he did everything correctly and that it was not until later that he showed the slightest bit of inefficiency. It shows how a healthy person exposed to danger is able to distribute his energy. He can take the energy that is available to him and use it at his discretion with considerable sense. It is only when he is not healthy that he does not have this control over his energy. At a time of real danger energy is mobilized from all parts of the mind and used for those mental processes that guard against external danger.

The observations that are made under such dangerous circumstances are appallingly acute. You might say that a formation of planes is described rivet by rivet. Everything that is seen is deeply engraved. The observations may go into the most amazing detail and include the readings on 20 or 30 gauges; every tiny observation that could help in choosing a form of action or to take some sensible protective measure is used in this way. Observations are necessary to provide a basis for sensible action and it is a sign of health when one can condense all energy to observing and action-taking function without anxiety. A sick person cannot do that. A sick person does not have the control over his energy in this way—he cannot order his energy, he cannot divert it entirely to external observations or to doing external things. He is so bothered by internal preoccupations that he may disintegrate into panic.

Now I would like to change the topic and speak of two other aspects of panic that are frequently neglected. One is chance and the other is the time factor. I do not think anybody can understand any of these breakdowns in combat no matter under what circumstances unless consideration is given to both chance and time, time perhaps as a variant of chance. It would be very hard indeed to regard selection in some overall way which in effect says, "I want to pick a man who will not break down in combat." After all, combat is enormously different for different people—some men I knew flew 35 missions without ever seeing flak or fighters. I know others who were exposed to one catastrophe after another.

How can you select people who will not break down in the conditions that I have been mentioning? As a matter of fact, you would

have an entirely unhealthy people who could remain well adjusted in such circumstances.

Chance determines to a great degree the danger to which a person is exposed. For instance, the closeness to a harrowing scene is of utmost importance. It is far more impressive and far more disturbing to be sitting next to a badly mangled man than it is to have the same catastrophe occur at some distance. This closeness is often critical. How can we select the men who will not sit next to those who will get their heads shot off? I would like to show two slides which bear upon the close relationship of danger to breakdown and which touch upon chance in an indirect way. Figure 1 has to do with the effect of danger upon breakdown. In England we had access to very accurate information in all the categories illustrated (mission frequency, aircraft missing, number of anxiety reactions) over a considerable period of time. The activity of the Air Force is shown by the number of credit sorties. There was an enormous increase in activity from less than 100 missions per month in August 1942 to 33,000 per month at D-day. The dashed line is the number of aircraft missing in action. In other words, this is the danger to which these men were subjected. Because they were subjected really to no other danger from a war point of view. They experienced considerable discomfort from time to time but that is all. Third, is the actual number of men

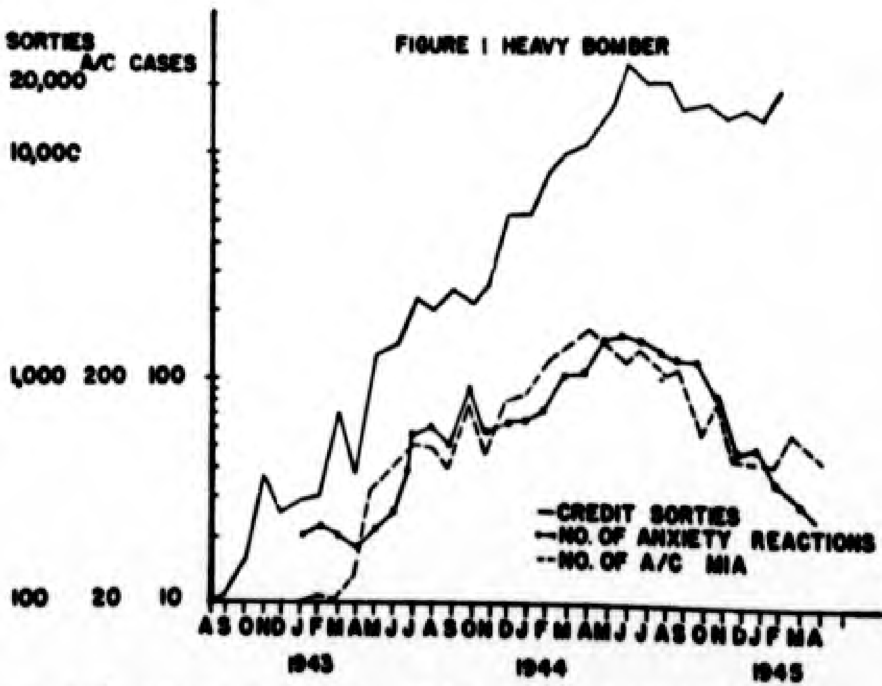

FIGURE 1. From Bond, D. D., The Love and Fear of Flying, International Universities Press, Incorporated.

that broke down. It is clear from the graph that the number of people who broke down followed the number of aircraft shot down with considerable accuracy. As a matter of fact, the coefficient of correlation of these curves is plus 0.75 with a significant validity.

Figure 2 illustrates the number of people who were fatigued. The same dashed line represents the number of aircraft shot down, in other words, the danger. The solid line shows the number of people who were tired. We define fatigue as a state from which recovery could be expected with rest of 3 or 4 days' duration. It is apparent from the comparison of this graph with the last that while the number of those who broke down neurotically followed the danger accurately, the curve representing the number of fatigues does not follow the danger. It is interesting to examine the circumstances which caused the peaks on this graph. The early peak was an experiment conducted by the 8th Air Force in order to see how much the crews could take. The men flew 6 out of 7 days. Many of those missions took 13 hours. The very high peak in June 1944 represents the air activity in support of the landings on D-day. Many crews flew three or four missions a day. While there was great activity at these times, the danger had diminished sharply. From these studies we concluded that fatigue is very closely tied to activity, while neurosis is tied to external danger.

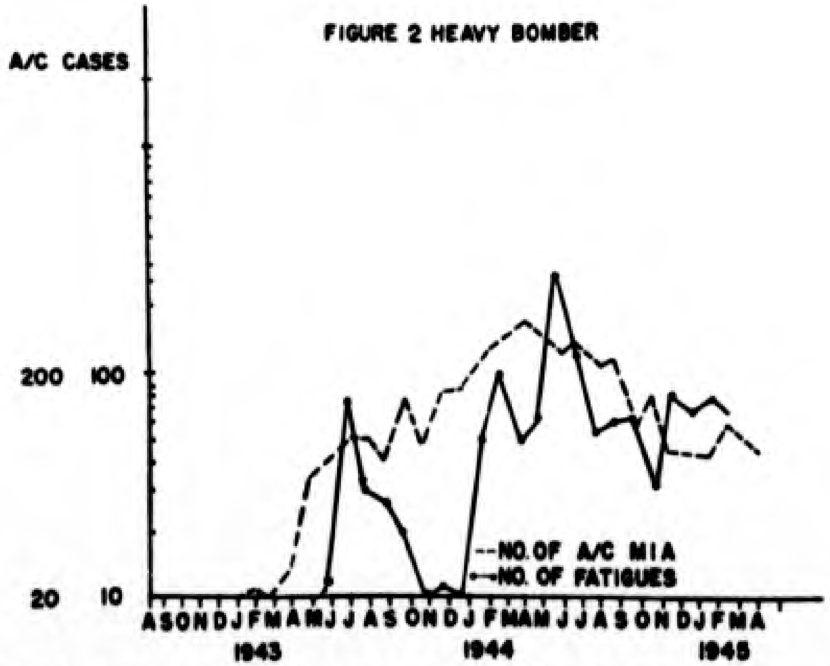

FIGURE 2. From Bond, D. D., The Love and Fear of Flying. International Universities Press, Incorporated.

I think that this is an important difference theoretically because we have spent too much emphasis on how fatigue leads to breakdown, and not enough on separating fatigue from neurosis.

Before closing this discourse I would like to mention one more example because it shows clearly some more of the internal anatomy of these breakdowns and a favorable result. The story concerns a first pilot in a B–24, who was a large friendly man known to his crew as "Pop." He was a happy-go-lucky, rough-and-ready type. On his fifth mission he was over Friedrichshafen. There was one motor on fire and they were beset by enemy fighters. During the fight, the top turret gunner left the top turret in a panic. Upon completion of the mission, the pilot spoke to the gunner, telling him that he could no longer fly in combat. The gunner finally was successful in his pleading. The pilot relented and let him fly one more mission. On the sixth mission, again deep in Germany, the plane suffered very severe damage. By the time they crossed the French coast on the homeward journey only two motors were functioning properly. Unfortunately, they flew directly over a flak emplacement here and were hit again so that by the time they were over the water only one motor was partially serviceable. They were rather high and the pilot thought that he might be able to glide to England. This, however, became clearly impossible when the fourth motor gave out about half way over the Channel. They descended rather rapidly. The pilot kept his head very well and he landed the B–24 in the Channel, the first person to ditch a B–24 without cracking it in half. It floated for 1½ or 2 minutes, more than adequate time for everybody to get out. Everybody got out and went right forward to the dinghies, except for the gunner who had panicked before. He panicked again and went back instead of forward, clung to the tail surface screaming, "Save me, save me." This could not have lasted long. It sounds very long when you hear all the things that were in the pilot's mind when this was going on, but it could not have lasted over 60 seconds. Then the plane went down and the panicked boy went down with it. Following this, we got a fair number of the crew, each I might say for his own somewhat individual reason but each stemming from this incident. The bombardier was trapped under water for a little while, which impressed him unfavorably. While they were sitting in the dinghies, they were bitter at one another for not having gone to rescue the gunner. They were finally picked up after an hour or two.

I saw the pilot 3 months later. He was morose, fearful, alcoholic, arrogant, touchy. It was difficult for him to speak about flying without crying. He refused to wear any decorations or his wings. He said openly, "Why should I wear decorations for killing one of my

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own men?" He was beset by the unhappy problem of being unable to write the dead boy's mother. He would attempt it, get drunk, sit down, get a pen and paper and nothing would come, so he would go to a bottle again. Under pentothal this man had a remarkable reaction, which is not at all infrequent but I think shows rather nicely the kind of spread of these reactions. The first interview was senseless—nothing but diffuse, anxious, guttural moaning. The next time he talked remarkably coherently until he came to the mission of importance. In other words, his anxiety was now confined to the mission. Then he could talk about the mission itself until he came to the point where the plane was coming into the sea when the fourth motor failed. I brought him in the next interview to this point four times only to have him veer off to another subject. Finally I said, "Crash, you are in," and there he broke down. At last he could talk about all of this completely rationally until he came to the gunner's death. And from there he went to pieces again. Here was the nucleus of his trouble, which at first was confined and then gradually spread out to many related areas.

To end this story quickly, the thing that made this boy enormously better was the following. He was talking about the gunner's death. I said to him, "I know you resent him for dying." He burst out, throwing himself over in bed, "I am glad he is dead. The son of a bitch would not fight to live, he would not give us a chance, he ruined everything I hoped for, dreamed, and made. I am glad he is dead!" And then he said, "I do not mean that," to which I responded, "Do not apologize. That is the way you felt." Having got rid of the anger he got rid of almost all of his symptoms. Spontaneously, he was able to write the gunner's mother a nice note. The anger and guilt concerning his friend had made him sure that he was to die in punishment. When he was made aware of these feelings he was freed from his depression.

In closing, I would make a plea that these individual factors are extremely important if we are going to get a whole view of this very difficult problem.

TUESDAY AFTERNOON SESSION

17 March 1953

MODERATOR

David McK. Rioch, M.D.

THE INTERPERSONAL COMMUNICATION OF ANXIETY*

JURGEN RUESCH, M. D.

A discussion of the communicability of anxiety may conveniently begin with a consideration of the *alarm reaction.* This is a total organismic reaction following the perception of (*a*) stimuli which are known to be dangerous; (*b*) stimuli which are very intense and approach the tolerance limits of the organism; (*c*) stimuli which are unknown and strange.

The alarm reaction prepares the organism for action, and in the course of this process a change in the intra-individual communication system occurs inasmuch as the reorganization of the flow of neural and chemical signals tends to produce a closer relationship between the function of perception-evaluation and the effector system (ref. 10).

The alarm reaction may be accompanied by essentially three different psychological states (ref. 9):

In *fear*, the human being consciously identifies threatening objects or events; in this evaluation of the situation, he feels that avoidance of these objects or events is desirable. Flight consummates the alarm reaction and alleviates fear to a certain extent.

Anger is the result of the human being's conscious or unconscious identification of interfering objects or events. In the evaluation of the situation, he feels that he can overwhelm or destroy the threatening object or event. The ensuing action usually relieves anger.

Anxiety (refs. 3 and 6) is a state in which the human being is unable to act, either for internal or for external reasons. This immobilization may be the result of:

(a) overloading of the organs of perception, evaluation, or transmission which leads to a jamming of channels of communication; when the load exceeds the biological capacity, concerted action becomes impossible;

(b) the organism's awareness that there is something wrong in its interpretation of sense data, without the ability to correct its conclusions;

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(c) the organism's awareness of erroneous expectations regarding the results of action, without the ability to correct such expectations;

(d) the organism's inability to correct its own implementations in response to stimulation.

Anxiety transmitted from person to person has to be distinguished from the anxiety which arises endogenously in an individual because of the nature or the intensity of stimuli. This distinction, as Sullivan (refs. 13 and 14) pointed out, is based upon the fact that some human activities are geared to insure satisfaction of bodily needs while others are aimed at establishing security through acquisition of ability and power. In our civilization, anxiety transmitted from person to person usually is related to problems of security and power and much less to frustration of bodily needs. But regardless of its nature, prolonged anxiety eventually leads to disorganization of the individual and of the group and therefore profoundly alters a person's relationship to his fellow human beings. In a state of anxiety an individual needs the help of others and at the same time threatens these very same persons by the overflow of confused and contradictory messages.

The patterns for the interpersonal management of anxiety are set from the first day of life when the *neonate*, in his helplessness, has to rely upon the support of others. When the baby is provided with that which he needs, the sensation of pleasure is mediated through the presence of the other person. Babies smile when they have learned that the approach of the mother will relieve discomfort, furnish food, and provide company. In the growing child, then, social interaction with adults eventually leads to affective patterns which are intimately interwoven with physiological functions. These psycho-physiological patterns are more than anything else responsible for the sensation of pleasure or the feeling of anxiety.

Childhood rearing conditions are optimal when contact with the mother or mother substitute is continuous, when her behavior is consistent and she provides for the physical needs of the infant at the proper time and in the proper amount, when she does not interfere with the expressions of autonomy of the growing child, and when she herself is not an anxious person. Removal of the mother—for example, through death or imprisonment—without proper substitution, leads to a type of apathetic exhaustion with displeasure in living and mental retardation (ref. 12). Conversely, mothers who are present but are inconsistent or who willfully interfere with the autonomy of the child can produce reactions varying from mild tension to fits of rage. But most disturbing of all to the child is the anxiety of the mother. Not only does an anxious mother transmit her

disturbance to the child, but in addition she is incapable of alleviating the anxiety of the infant. At best, she can be anxious together with the child. These and other observations clearly point out that the gratification of bodily needs is only one factor in child development. The other factor deals with the affective components of physical sensations, which can be elaborated upon in a social context only. The pleasure which arises out of interpersonal contact and the anxiety which can develop when give and take do not function properly are the two principal factors governing human relations; they are the prime movers of social behavior.

Some of these conclusions have been recently documented in the field of *animal behavior.* Liddell (ref. 4), for example, showed that a kid goat subjected to periodic exposure to electric shock could be made to tolerate the stress of the rigid time schedule much better when the mother was present. The twin goat, conditioned in isolation, fared much worse. Other observations bearing upon the transmission of anxiety from animal to animal, the creation of anxiety in the animal by man, and the alleviation of anxiety between animals are scattered well over the literature. However, from the viewpoint of communication, the work of Lorenz on birds (ref. 5), Frish on bees (ref. 2), Richter on rats (ref. 7), and the reviews by Schneirla (ref. 11), and Birch (ref. 1) are most pertinent.

Turning back to the consideration of *adult human beings*, we can distinguish several basic social situations which give rise to anxiety and promote its transmission:

1. There are social situations in which most participants experience anxiety because of interference with their bodily functions; e. g., combat, hunger, exposure to the elements, or being trapped in a mine. The effects of anxiety are elaborated upon in interpersonal contact.

2. There are other social situations in which the majority of the participants experience anxiety because human contact has been reduced or severed; e. g., children in hospitals or orphanages, prisoners in solitary confinement or in concentration camps, patients in isolation wards, people in isolated outposts.

3. We find social situations in which one or more persons are afflicted with anxiety and the others are not; e. g., the therapeutic interview, the person who escaped a catastrophe. Through communication, the affective components of the experience can be elaborated upon. Anxiety then is either reinforced or attenuated.

4. There are social situations in which one or more persons intentionally or unintentionally fail to communicate. Although physically near each other, the failure in communication produces a result which is similar to physical isolation.

Table 1. The Communication of Anxiety in Two-Person Situations

Output of person A	Output of person B	Interpretation of person A	Interpretation of person B	Effect upon system
1. Output of anxiety signals.	Output of anxiety signals.	He sees it too; it must be dangerous.	He sees it too; it must be dangerous.	Maximization of anxiety of A and B.
2. Output of anxiety signals.	Relaxed at first, gradually being infected by anxiety of A.	He believes it; it must be worse than I think.	There must be something to his anxiety.	Reinforcement of anxiety of A. B progressively more anxious, losing control.
3. Output of anxiety signals.	Response to incidental messages of A; anxiety ignored.	I must repeat	I must ignore	Maximization of anxiety of A; increase of control of B.
4. Output of anxiety signals.	Output of signals of well-being; acknowledgment of anxiety of A.	It cannot be as bad as I think.	What is the excitement about?	Attenuation of anxiety of A; B somewhat the same; perhaps exhausted, but not anxious.
5. Output of anxiety signals.	Serious but not anxious	He will help me to undertake concerted action.	I respect your feelings, though I do not share them.	Planned action; reduction of anxiety of A.
6. Output of anxiety signals.	Control of all affective responses.	It's hopeless	I shall not be moved	Resignation or breakdown of A; isolation of B.

5. Finally, one can observe social situations in which the anxiety of a few people spreads and infects the whole group; e. g., panic in the wake of catastrophe.

Obviously the above sketched situations do not exist in isolation from each other; they merely constitute landmarks in the process of scientific observation, characterizing the interpersonal feedback circuits which maximize or minimize anxiety. Each person, through elaboration, reacts to the input of stimuli with an output of signals. Depending upon the evaluation of the input signals, the output may vary: It may reinforce, attenuate, or alter the original message. The person who responds to an emergency signal of another person thus controls to a certain extent the behavior of the anxious individual. The technicalities of this process are contingent upon the observation of effects which can be sketched as shown in table 1.

Anxiety is not only transmitted from person to person, but under conditions where all the participants are at ease it also *can arise anew.* In situations where no physical interference exists and where the whole interaction consists in exchange of verbal and nonverbal signals, anxiety can arise as a result of differences in assumptions made by the participants. It is generally known that people feel friendly toward each other when they know that they make the same assumptions about life, people, and things. However, when people are aware that they make different assumptions, they begin to feel uneasy. Disputes and heated arguments seldom develop because of differences in the conclusions reached; as a matter of fact, it is easier to tolerate different conclusions in view of similar assumptions than to tolerate similar conclusions in view of different assumptions. To detect the assumptions made by other people and by oneself is a complicated procedure which involves the making of a great many inferences. In flexible communication, expectations are set tentatively, subject to later correction. In rigid communication, expectations cannot be corrected and this results in anxiety. Flexibility thus implies the correction of expectations as well as versatility in action—attributes which neurotic and psychotic patients do not possess.

Thus there are people who suffer from *contact anxiety:* When they approach others they anticipate failure and show great alarm at the prospect of meeting somebody. They usually anticipate being rejected. Even if the other person is friendly, they seem to have difficulty in correcting their expectations.

There are others who suffer from *separation anxiety*, being unable to take leave or to separate themselves from others. They anticipate that disaster will befall them and they seem to be unable to correct this anticipation.

In *status anxiety*, differences of prestige and the consequences which may arise from such perceived differences are anticipated. Both the status superior and the status inferior seem to be ill at ease with the other person because they assume that their assumptions about life are totally different. They seem to have difficulty to ignore status differences and to emphasize those assumptions which they have in common with others.

Homosexual anxiety and panic may ensue when people anticipate that they might be tempted in fantasy or in action to proceed with a tabooed activity. They are unable to correct their anticipations and see themselves involved in homosexual activities. These people carefully avoid testing out their homosexual leanings in reality lest they be disappointed.

Impotence or *heterosexual anxiety* may result from the anticipation of failure in the sex act. This anticipation prevents such people from successfully interacting with the members of the opposite sex, inasmuch as they usually assume that the prospective partner does not have similar apprehensions.

In the course of daily living it matters little whether anxiety arises within a given social situation or whether an anxious individual infects the group. When one or more persons are anxious, their alarm is conveyed to others. Aside from the intensity and the strangeness of the stimuli which may arouse anxiety, there are certain *classical signals* which convey to others that all is not well (refs. 8 and 9). Throbbing pulsations, blanching, blushing, sweating, tensed muscles, strained posture, rapid acceleration or deceleration of movement, forced motions, twitching, tremor, general restlessness, fatigue, sighing, and rapid shallow breathing are all signs of an alarm reaction which can be observed visually. Speech and associated manifestations such as high-pitched, shrill, loud, or tremulous voice; a rhythmic alteration between high and low pitch; sudden spurts, outbursts, or rushes of words; overtalkativeness, lack of periods, pauses, and silences; unfinished words and sentences; interruptions of other speakers; snapping off words; sudden variations in speed; repetition of words; and forced or inappropriate laughter are auditory signals which communicate uneasiness. Conversely, long silences, faltering speech, pauses between words, and the tying together of unrelated sentences likewise communicate to the listener the uneasiness of the speaker. Although the content of a message may forewarn others of the apprehensiveness of a person, it is the nonverbal visual or auditory signal which contains the clues to another person's anxiousness. I have shown that sound recordings of interviews with anxious patients can be played back to a professional group of listeners and succeed in

considerably disturbing such an audience, while the reading of the verbatim protocols of such sessions did not produce such an effect (ref. 9).

Nonetheless it can be shown that in such protocols an increase in the number of words referring to feelings, personal pronouns, and subjective qualifications tends to be interpreted as a state of excitement and self concern. Numerical reduction of subjective qualifications and of personal pronouns with simultaneous increase in the use of concrete nouns and objective qualifications seem to be perceived as a more relaxed attitude, denoting an objective rather than a subjective emotional state of the speaker.

So far we have discussed the fact that anxiety can be transmitted or evoked in other persons either because of the content of the message or because of the ways in which the message is expressed. There exists, however, a third factor which can be responsible for the spread of anxiety—namely, the *characteristics of the network and the feedback circuits.* In general, it can be stated that uncertainty increases the anxiety of an individual. Though the tolerance for uncertainty varies from person to person according to the need for control, all people want a certain minimum amount of information about the situation in which they are involved. Generally speaking, certainty increases and the interpretation of a message becomes easier when it can be traced from its origin to its destination, when the instructions for its interpretation are clearly given, when the message is coded in a way which is understandable to both sender and receiver, and when there is a possibility for checking errors. Uncertainty increases when either the origin or the destination of the message or both are unknown. In rumors, for example, the origin as well as the destination of the messages are unknown; check and correction are usually impossible, and people feel ill at ease. In authoritarian groups where there is no provision for asking questions, for checking the meaning of messages, or for correcting the central person who emits the messages, uncertainty increases. In brief, whenever the feedback systems are either unknown to the participants or are known but cannot be utilized for correcting and checking, uncertainty increases and people are more likely to become anxious. This state of mind is the result of people's inability to set expectations appropriately and to correct these if necessary. Panic, thus, is the result of a mutual reinforcement of anxiety by alarmed people in absence of well established feedback circuits. The prevention of panic is accomplished through leadership; leadership, in turn, is characterized by the ability of one or a few people to structuralize the communication network in such a way that origin and destination of messages become known, that in-

structions for action are simple and clear, and that, in case of doubt, messages can be checked upon. True leaders emit messages that are unambiguous and appropriately geared to the expectations of the receivers.

In *military life*, a great deal of time and effort is devoted to the task of keeping communication channels open. In contrast to an unorganized group, the military organization establishes a variety of command posts which constitute information and decision centers. In case of emergency, one center can take over for the other. Thus emergency circuits are prepared before the emergency arises. Soldiers thus can endure stress situations without developing manifest anxiety as long as their communication networks, both large and small, operate appropriately. But as soon as communications are severed and the smaller unit cannot reorganize as an autonomous entity, morale breaks and anxiety develops. In military life, great reliance is put upon these officially established communication networks; in private life, in contrast, reliance is put upon the ability to create informal networks and constantly to alter these networks as the need arises. Anxiety in a civilian group is likely to arise when the opportunity for change is blocked. Anxiety in military groups tends to develop when there is too much change in personnel and rules of communication. "Red tape" refers essentially to official communication channels; "Personal contact" implies the privately established networks. In a healthily functioning society, an optimum between official and unofficial channels is maintained. If things get to be too "bureaucratic" or too "fluid," the organization falls apart.

In an *ideal organization*, therefore, any single individual must possess a number of interpersonal contacts which serve the purpose of mutually reinforcing or attenuating anxiety. Through sharing and correction of information, these individuals are enabled to function optimally. In addition, individuals are organized in groups and groups communicate with other groups through their spokesmen. Here communication begins to be more organized; opportunity for feedback and correction diminishes; thus not everybody can talk with high government officials, inasmuch as their schedule would be overloaded. These physical limitations of group communication necessitate that anxiety be handled privately at the interpersonal level, even though the cause of the anxiety may be found in the messages of group or social leaders to whom the individual citizen cannot reply. Therefore, the essence of a well functioning social structure is bound to the details of efficient interpersonal communication. It constitutes the safety valve for failure of communication at the group and societal levels. If communication does not function interpersonally, no

amount of government or military organization will suffice to check the flood of unattenuated anxiety of thousands of people.

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Discussion

Dr. Sells. I was very much impressed with the many elaborations you developed about the channels of communication and their importance in anxiety but I was somewhat surprised that you did not make any mention of the content of the communications that take place. And in this connection an experiment was done recently at the University of Illinois by Dr. Fiedler in which he studied sociometric patterns of high school boys on basketball teams. He found the need for communication and the nature of the communication channels were quite different in those teams that had high standings in the league as compared with those that were down at the bottom of the list. In the teams that were very successful there seemed to be a much greater

emphasis upon skill in performanace and in those who were unsuccessful there was much more emphasis on fellowship and good interpersonal relations.

DR. RUESCH. There are thousands of varieties of content. It is impossible to treat content scientifically. One of the reasons that in communication one tries to study the forms of communication is to reduce this multitude, and one can do it because there exists a correlation between the content and the form of communications. I go so far as to say that any variation in content of the message goes together with the variation in the form. Form in this sense would mean the channels, or any other network characteristic that you can operationally define. Therefore, I omit purposely the content because we get into the problm of meaning, etc., and that can only be studied actually in a single individual and not in a network. There are no meanings for groups. There are averages, yes—if you study 10 individuals, you may say that they agree in the meaning. However, in the science of communication we try to get away from content, we try to get to these more scientifically accessible features.

DR. SELLS. I think that the range of content is undisputed. However, the problem of content can be approached in many ways. For example, the effect of the message is related to content, the satisfaction that the individual gets from what takes place, the effect of the operation whether it is successful or unsuccessful. We have heard already in the symposium about the effect of combat operations on anxiety, how the number of people getting anxious goes up with casualties, and so on. I just wonder whether we should say that the effect of content is impossible to study or merely regard it as an important area for further investigation. Do you have some evidence to support this generalization that the scientific study of content is impossible?

DR. RUESCH. Well, if you have many thousands of contents or if you want many thousands of messages, there is one way to handle it, that is to abstract. Abstraction is a one-way street. As you proceed with the process of abstraction you lose information so you can choose between two evils. Either you stick to the specific message and have multiples of that, or you abstract, as evidenced from the desk of an efficient administrator. He has a one-page notice and must get some first-hand illustrations of what this whole thing refers to. So these are the choices and those are the limitations.

I think that if you deal not with theory but with practice you will find that human activities are geared to specific things. Today we talk about apples, and tomorrow we talk about pears. If we confine it rigidly that way, we may get some sort of agreement as to the con-

tent but again it is limited and you have to choose between two evils. I would like to call your attention to the fact that this is a complementary relationship. The more you know about the form of communication, the less you know about content. The more you know about the content, the less you know about the form. The more you have abstracted notions, the less concrete information you have. The more you know concretely, the less you know about abstraction, and so on.

Dr. Rioch. However, Dr. Ruesch, would you say that particular cultures and sub-groups have favorite contents that they like to use? I have rather felt that psychiatrists have favorite contents and neurologists have other favorite contents.

Dr. Ruesch. The only convenient way to treat content is in terms of the expectations of an individual or of a group. As Dr. Rioch said, there are favorite contents which mean, in terms of the individual, favorite expectations. The favorite expectations can be, if you want to use a machine analogy, compared to certain frequencies to which a receiver must be tuned. I mean, the receiver must be tuned to the sender, otherwise you cannot understand it. And in terms of human communication the expectations must be geared somewhat to the forthcoming message, otherwise communication is not understandable. And content, therefore, if you treat it culturally, is a statement about the expectations of people in a given area about certain things that they are likely to encounter.

Dr. Caudill. I think that the form itself may be culturally determined to some extent. The analysis you have used of treating formal communication rather than content is of course one that is used in formal linguistic analysis. In this way a language can be broken down into morphemes, phonemes, and syntax in attempting to make a completely formal analysis. For instance, the time concept which is built into a particular language may vary from one language group to another. In English we think of past, present, and future and cannot say anything in the formal structure of our language without placing it in past, present, or future. Other languages are not like this. You can say things that are part past, part present, and part future, as, for example, in the formal structure of Hopi.

Dr. Ruesch. Just one thing. By formal I do not mean language, or linguistic formal characteristics. Form is a bad word, it is derived from nineteenth century systematology. Instead of "form" we ought to use the "operational characteristics of the network."

SITUATIONS EVOKING STRESS IN HUMAN GROUPS AND THE GROUP BEHAVIORAL CHANGES DENOTING STRAIN[1]

ALFRED H. STANTON, M. D.

It will be the purpose of the present paper to try to apply the concepts of stress and strain as characteristics of integrated *systems* in general, rather than merely of organisms, and in particular we will discuss their utility in dealing with phenomena in human groups. Before doing so, it is well to mention certain difficulties. We all tend naively to personify human groups—such folk phrases as the head of a group, and technical usage such as the group mind must forewarn us again of dangers to clear thinking in such an attempt to find a generalized analytic concept, dangers which have perhaps contributed to the avoidance of recognition of group process which has characterized psychiatric history. A second difficulty is inherent in the novelty of the analysis. While there is an enormous literature bearing upon social tensions and social pressures, little of it, so far as the writer is aware, presents the systematically analysed observations which are needed for an equally systematic analysis in terms of stress and strain.[2] A third difficulty is similar to that encountered in psychology. We naively know so much that is unsystematic about human groups that it is hard to distinguish the usefully "known" from purely personal types of "knowledge" which either do not articulate with other facts in such a way as to lend themselves immediately to analysis or are demonstrably incorrect. For although reporting human beings are extremely sensitive indicators of strains within the group, they are both ambiguous and quantitatively unreliable as indicating instruments.

In spite of these difficulties, there are advantages in the analysis of human groups as systems in relative equilibrium which share characteristics with other systems—biological or physical. We shall

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[1] Presented 17 March 1953, to the Symposium on Stress, Army Medical Service Graduate School, Walter Reed Army Medical Center, Washington, D. C.

[2] However recent literature lends itself to this type of analysis; see Parsons, Falcott, *The Social System*, Glencoe, Free Press, 1951; Parsons, Talcott and Shils, Edward A., editors, *Toward A General Theory of Action*, Cambridge, Harvard University Press, 1952; and Stanton, Alfred H., and Perry, Stewart, editors, *Personality and Political Crisis*, Glencoe, Free Press, 1951.

indicate certain of these advantages to prepare the way for discussion of the recognition and analysis of stress and strain, since it is in such terms that such a discussion must be couched.

1. *The system is always a part of a larger system, from which it can be separated only for purposes of discussion.* Thus, a stress considered as extenal from one point of view may be regarded as an internal strain within the larger system. From the standpoint of the psychiatrist, an external stress to which a patient is subjected will usually be found to be only one cause of frequently recurring internal strains in the social system of which the patient is a part, a matter of very great importance in the military services, the mental hospital, or in other partly manageable social systems.

2. *The general knowledge of the functioning of the whole system permits a degree of reliable guidance in its management without a detailed knowledge of all its components.* It is only because of this character of systems that we can do anything at all either with social groups, or the practice of physiological medicine. The frequently expressed nihilistic criticism that it is impossible to understand social groups because of their extreme complexity is equally applicable to biological study. And just as the understanding of the general principles of organization of the body—gross anatomy and physiology—led to cumulative understanding, it may be expected that grasp of the principles of group functioning may permit its progressive understanding.

3. *No single part of a system is the "cause" of any other single part of it.* It is sterile to think of the shape of an epithelial cell as caused by the shape of those around it; it is equally sterile to think of mental illness as either caused by the social group in which it occurs or as causing disruption of the group. Both are simply features of the social organization examined either from the point of view of the social system or of the personality system, depending upon the interest of the investigator.

4. *Finally, central to the concept of a system is that of an equilibrium—that any action tending to produce change in its structure elicits restorative conservative processes.* In social systems as in others we find that blind efforts to effect change are likely to be defeated, that stresses are likely to produce apparently remote, unrelated effects, and that such stresses are likely to highlight the fact that the system has a *structure.* Human groupings are not, even the very small ones, amorphous aggregations any more than are the cells of the body, but are composed of people arranged, organized, in a describable way—structured if you will. But here we must leave the analogy between the organism and the social system; the structure of a social system

must be described in very different terms from those used about the body or physiological processes.

For unlike the structure of the body, group structure can be planned within very wide limits. Although it is probable that the range of possibilities of group structure is not infinite, there is nevertheless much more latitude of variability for humans than in the variations of physiological structure. There is no group phenomenon corresponding to organismal death except in the most superficial way. Groups may cease to exist without significant stress because of finishing a job, for instance. The many different types of groups which exist, all with different structures, include a pair of lovers, the people who gather at an auto accident, a committee, a group therapy session, a small institution such as the mental hospital, a tribe, nation, or organization of nations. They range from groups from which it is impossible to resign to the most fleeting of voluntary associations, and groups like the family where there is the greatest closeness of face-to-face contact to groups of international correspondents who may never see each other.

But within each of these social systems there is an organized structure. Each has: (1) certain shared purposes, understandings about a division of labor or other apparatus for achieving these shared goals, and an apparatus for appraising success in the mutual effort; (2) if it is persistent in time, an apparatus for meeting the institutional needs for supplies—new personnel, materials, money, etc.; (3) a system of communication; and (4) a system of decision-making and enforcement.

Certain aspects of the structure are recognized by the institution or group; others are not recognized but can easily become so—all of these we shall speak of as the formal, explicit, or official structure. This formal structure is always incomplete, and often contains incompatible parts; consequently, to fill it out there is always an *informal* structure not recognizable at first glance. We shall illustrate in more detail by using only one of the many types of social structure we mentioned—the mental hospital—and in doing so will illustrate group strain, remembering that a grasp on group structure is as necessary for this purpose as is the knowledge of anatomy for dealing with strain in the organism.

Not only will we narrow our consideration to one type of institution, but we shall largely limit our discussion to the internal strains in the organization. This restriction is justified by the great relative importance of internal structure. There is much evidence—anecdotal but very convincing nevertheless—that granted an adequate internal structure, human institutions can withstand or triumph over external

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stresses which are incredibly severe; conversely, living with others in an institution may be extraordinarily difficult even at times when the external stresses upon the group are relatively mild. Under the latter conditions, internal structural problems may furnish the cue to corrective action.

We will start like the anatomist, with a pedantic listing of the purposes of the mental hospital; these include the protection of the public from the patients, the meeting of patients' general needs such as food and shelter, the more specific psychiatric treatment of the patients, education of the hospital personnel and perhaps the community, research, and perhaps, profit. These purposes are listed in approximate order of their priority—as indicated by the actions of the personnel when any two of the purposes come into conflict.

But when members of the staff were asked the purposes of the hospital, they ordinarily gave only one, and it was rare for conflict between two purposes to be dealt with clearly and explicitly as such. Rather the unavoidable compromise was often made only after its being converted into a conflict between two people each of whom supported one purpose in an extreme form. For instance, it was common for a pyhsician to demand a particular freedom for a patient upon the grounds that it would contribute to his improvement, while another physician would oppose it as if he were the agent of the community, or of the patient's relatives. In another hospital, serious problems arose in a research organization because they felt that the clinical staff was blocking research upon the basis of their conviction that the research procedure interfered with the clinical care of the patients.

The special point of note here is simply that in each case the interpersonal conflict was not foreseen, nor was experience gained after the conflict, because of general ignorance of the complexity of the formal purposes of the hospital and of the fact that conflict was possible. More than this, there were strong reasons for actively fighting off the recognition that there might be incompatibilities among the purposes of the hospital; the conflicts were solved in fact, not in the formal conferences where the conflict found open expression, but usually *informally*. One of the most frequent informal solutions, for instance, included the expressed belief that there could be no conflict of interest between the patient and his relative—a statement so amazing that it can only be understood as a rationalization; its function was to facilitate the informal resolution of an unrecognized problem in institutional purposes. Or the psychiatrist might come to the opposite and equally untenable conviction that the patient was "right" and the community "unreasonable." In both these cases, common-

place as they are in mental hospitals where the interests of patients are known and taken seriously, the psychiatrist can be counted upon to abandon his extreme position—again informally and often quietly—after the tension of the conflict eases.

When the conflict is not open to discussion, a more serious strain exists. Dr. Schwartz and the speaker[3] have described the fact that probably all of a series of patients suffering pathologic excitement were in direct contact with two staff members who held a secret, personally important disagreement about the patient's management, and who avoided discussion of the disagreement between themselves although they were formally expected to discuss such matters. We found, quite regularly, that the excitement greatly diminished or disappeared within a few hours of the discussion of the disagreement between the two staff members, without the patient's knowing that such a disagreement existed or that such a discussion had occurred. (I can now state from my own experience that a difficulty similar in all essential respects can occur in a quite different type of hospital.) But we could not describe precisely how to intervene more actively until we had worked over our data systematically. For, although it was easy to say that the two conflicting staff members should be identified and brought to discuss their differences between themselves, we had never actually proceeded in this straightforward manner, nor could we be sure that it was possible to do so.

It was only later in the study that we were able to analyze in any general way how the restoring elements in the hospital's organization led to the identification of the covert conflict; we could do this *only after the formal communicative network of the hospital as a whole had been reduced to a diagram which indicated its unity as a system*—that each individual could be thought of not only as an individual but as occupying a particular place in the structure.

Two facts were recognizable from this analysis which had previously escaped observation. First, if two staff members fail to report information directly to each other when they are expected to do so, *the information nevertheless proceeds from one to the other, but through other people*, and therefore with inevitable editing and distorting. Stated differently, an informal channel of reporting replaces a nonfunctioning formal channel, with some loss of efficiency. The person who should report to the other "spontaneously" begins talking *about* him off the record to certain other people either on the staff, or among the patients; he believes himself to have chosen the other people "spon-

[3] Stanton, Alfred H., and Schwartz, Morris S., *Management of a Type of Institutional Participation in Mental Illness.* Psychiatry 12 : 13–26 ; 1949.

Ibid. *Observations on Dissociation as Social Participation.* Psychiatry. 12 : 339–354 ; 1949.

taneously" but they were nevertheless very frequently strategically placed in the institutional network to function as a go-between to the other person. We may note parenthetically that this happens when the person doing so seems to be quite unaware even of the existence of an affectively important conflict between himself and the other staff member. The other person, to whom the gossip seems unconsciously addressed, does similarly—and both become particularly alert to gossip which may stem from the other person. The gossip quite generally contains easily identifiable references indicating the disagreement about management—the information which formally should be directly conveyed—but it is now mixed with a heavy underbrush of generalizations, moral principles, high psychiatric theory, ad hominem "analyses" of the other, derogation of the institution and the like. What is important to emphasize here is that the gossip includes important restorative elements; it is manifestly functional and useful, albeit inefficiently; the analogy to ataxia springs unavoidably to mind.

The go-between requires special attention. Not only is he usually selected on the basis of the aptness of his position in the institutional system; if for some reason such as absence from the institution, he fails to perform as an intermediary, another intermediary is, at least occasionally chosen. (Perhaps always, but our records are incomplete on this point.) The intermediary suffers rather predictable types of emotional unrest. If lower in the prestige hierarchy, he is likely to show perplexity, uneasiness, signs of divided loyalty. If higher in the hierarchy, impatience or even contempt, preoccupation with institutional structure, and discouragement are frequent. All such states of mind imply tendencies to action directed toward reestablishing the formal communication structure, mixed, of course, with other tendencies. Manic, hysterical, and even schizophrenic excited states were found in our series to be three of many possible ways of a person's participating in such a simultaneously disintegrative and reintegrative institutional process, and as such were indicators of institutional strain.

To carry our analysis one step farther, it seems probable that this is only one special example of the generally recognized (though unproved) tendency for patients, and personnel, to get worse and to improve at the same time. The apparent tendency for emotional disability to occur in clusters in the military services is matched by the simultaneous regression, each in his different way, of patients in the mental hospital ward. We observed several such periods of general disturbance, and again found that analysis was helped by considering the whole system.

Several authors have thought of mental illness or collective emotional disturbances from the point of view of "contagion," by analogy

with bacterial diseases. Such analyses have found difficulty in accounting for the extreme rapidity with which the spread of excitement may occur in closely knit groups, and in understanding the difference between the times when emotional disturbance occurring in the group remains the experience of only the one person, and the other times when it spreads "like wildfire."

Dr. Schwartz and I [4] found in our study that there were always evidences of considerable tension among the *staff* before the collective disturbances involved the patients. Although not obvious at first glance, the tension was quite apparent when notes were kept on staff interaction simultaneously with notes on the patient group; these staff disturbances integrated closely with the disturbances among the patients. No particular details can be isolated from the total description without losing their meaning, but it must suffice to say here that in addition to the disorganization of the communicative structure which we have just described, collective disturbances were also associated with a change in the formal structure of decision making—such as the abdication and usurpation of power. Here also there was evidence of disintegrative and reintegrative processes at work simultaneously.

It must be clear that in the discussion above we have been dealing with the problem of "morale" from a structural point of view. In this frame of reference, morale is a particular type of informal organization of the institution, occurring at those times when there is a high degree of coherence within the formal structure among, for instance, the goals, the arrangements for division of labor, and the systems of rewards, sanctions, communication, and decision-making. Under these circumstances people quite generally may be counted upon to give service above and beyond the call of duty because they are interested in the problem. This is not a pious statement of an ideal; states of exciting shared interest and satisfaction in pursuing approved goals do occur in fact, and fairly frequently. While it would be ambitious indeed to try to specify all the important preconditions for such states, it is coming to be possible to sort out certain factors which interfere with them.

We found that the particular problems associated with collective disturbance had been conspicuous several weeks before the disturbance among the patients; they had occurred among those high in the hospital hierarchy and involved sharp disagreement about a broad financial policy. This itself had arisen because of inadequacy in the

[4] The Structure of Collective Disturbance in a Mental Hospital Ward—Alfred H. Stanton and Morris S. Schwartz. Paper read before the American Psychoanalytic Association December 1951. Details to be published.

system of cost accounting; when the latter was improved, the periodic disturbances ceased. While we do not know enough of the mechanisms involved to establish a relation beyond doubt, all the internal evidence we did have supported the relationship. Such a finding is also consistent with those of Lewin[5] and his students, and in particular of Rothlisberger, who specifically made the point we are emphasizing. The loss of morale while having certain generalized manifestations can best be studied by seeking a particular focus of trouble, without immediately trying to blame some individual. Such a particular central difficulty can often be located without undue expense in time and effort, and after understanding it, "diagnosing it" one might say, something can be done more effectively than by such generalized efforts as appeals for "better communication" or for "loyalty," or the like.

The analogy to physiological medicine will help to clarify our present position. States of demoralization are characterized by certain general "symptoms" or manifestations, together with conspicuous or inconspicuous indicators of the localization of the trouble, just as fever indicates illness and particular signs help the physician identify and localize the ailment. But our present knowledge of group functioning is largely practical and intuitive; the general principles of organization and functioning which will permit more detailed and valid generalizations about group disturbance are only now beginning to be developed in usable form.

While it would be inappropriate, then, to press too far toward details, we can at least describe certain of the general manifiestations of changes in the level of satisfactory functioning.

It is useful to distinguish three levels of institutional behavior—the collaborative, the cooperative, and the disintegrative.[6] It will be clearer to describe the cooperative level first since it is the standard, at least in the hospitals studied. *Cooperative* mutual activities are carried out as in fulfilling a tacit contract, usually smoothly and usually *impersonally*. For instance, in the mental hospital a nurse was somewhat disturbed over whether she should continue working; a superior urged that she be supported in staying, adding that she was useful to the hospital. But in a period of generally cooperative functioning many people change, often as if taking a distinct step to another level, to a *collaborative* way of working or living together. Here activity is much more broadly applied to the collective goal—all

[5] Lewin, Kurt: *Resolving Social Conflicts*. Harper, New York, 1948. Rothlisberger: *Management and Morale*. Harvard University Press, Cambridge, 1941.

[6] The writer owes the concepts to Sullivan by personal communication. They are developed, however, in a somewhat different way.

sorts of contributions, new ideas, extra periods of work are given to the task, freely; indeed many such contributions could not possibly be ordered. Relationships are distinctly personal in flavor—the interests of the others are included in one's own interests. Such groups often appear at first glance to be extremely informal but this is not because formalities do not exist; the formalities are so generally accepted that they are taken for granted and are so useful in organizing behavior that they do not become conspicuous by being challenged, even tacitly. The group seems—to all concerned—to be an institution within which and by which one's own goals can be approached. Communication not only includes that which is formally required, but additional background is sketched in over coffee or beer while one talks shop outside of working hours. In such a situation the question of a nurse's leaving, if it arose, would be considered from the point of view of her best interests also, not only those of the hospital. Such group states are, unfortunately, usually transitory but are no less real and important for this reason. As is now well known, they tend to occur and perhaps are facilitated by external stress—by a difficult or emergency job, provided the formal organization is reasonably adequate. They do not, however, require an external enemy for their existence.

The *distintegrative* types of group functioning have already been described. This description has been given entirely in group structural terms—terms which indicate types of personal interaction rather than types of personality. Study of the relationship between group functioning and personality disorder offers practical possibilities for a new systematic approach to the clinical problems of therapeutic and preventive psychiatry. (It must be suggestive to many that a transition from a collaborative to a cooperative and then to a disintegrative group structure seems to state in a different way the same phenomena treated in usual psychiatric language as withdrawal of cathexis.)[7] But it is important not to oversimplify—there is a close relation between strain in the group, and strain in the person, but it does not approximate a one to one relation; indeed it is banal to emphasize that conflict between people may lead to considerable strain in the group, but to diminishing strain in the persons engaged in the conflict, and that novelty which promises benefit to many in the group may mean considerable group strain. In other words, much empirical gathering of facts is needed to clarify the details of the relations.

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[7] Kris and Leites, noting such a relationship, spoke of "privatisation" and differentiated it from narcissistic withdrawal, but the criteria separating them are not entirely clear. See Kris, Ernst and Leites, Nathan: Trends in Twentieth Century Propaganda in Psychoanalysis and the Social Sciences, Roheim, Geza, editor. International University Press. New York, 1947.

RESPONSES TO DISASTER IN AMERICAN CULTURAL GROUPS[1]

JOHN W. POWELL, PH. D., JEANNETTE RAYNER AND
JACOB E. FINESINGER, M. D.[2]

I should like to present the results of several studies on disaster carried out in our department during the past 3 years by a group consisting primarily of John W. Powell and Jeannette Rayner. This work was undertaken in collaboration with the Army Chemical Center to study the behavior of individuals and groups in situations characterized by overwhelming stress. More specifically, we were interested in describing the patterns of individual and group actions and interactions during stress and relating these patterns, if possible, to the usual patterns of the individual's behavior, to events in his past history, to his personality structure, and to psychological mechanisms. As our studies progressed, it became clear that one of the first tasks was to describe the sequence of events which we call disaster. Once such a scheme was established, it could serve as a frame upon which we could superimpose or into which we could fit other data in a more meaningful way. Tyhurst attempted the same thing from a somewhat different point of view. He recognized at least overlapping phases in the pattern of individual reactions to acute disaster, emphasizing as far as we can tell the subjective reactions of the participant.

We preferred in our scheme to describe the events primarily from the point of view of the observer in an attempt to get a broader conceptual map.

This presentation will include the description of several types of disaster studied, with an analysis of the phases that could be distinguished. We also shall include some of the more general reactions observed. We have made observations in eight civilian disasters occurring in the United States during the past 2½ years. These include the mass poisoning in which nearly 50 people were killed or blinded by wood alcohol in a shipment of bootleg whisky in Atlanta, Georgia; a plane crash at Elizabeth, New Jersey, the third within 8 weeks; two tornadoes in Arkansas, one in which the inhabitants saw

[1] Presented 17 March 1953 to the Symposium on Stress, Army Medical Service Graduate School, Walter Reed Army Medical Center, Washington, D. C.

[2] We should like to thank Dr. Maurice H. Greenhill for his assistance in this study.

the tornado coming, and one in which the inhabitants were taken by surprise; two chlorine gas leaks spreading chlorine around industrial plants; a neighborhood evacuation because of dense choking smoke from a chemical plant fire; and several minor incidents—a bleacher collapse, and a small fire in the hospital. The observations in all these instances were made by our own staff working at the disaster site. In three incidents the staff was supplemented by local investigators, usually psychiatrists, psychologists, social workers, and local medical school or university personnel employed and supervised by us.

After the poisoning incident in Atlanta, the plane crash in Elizabeth, and the tornadoes in Arkansas, follow-up studies were made at varying time intervals. In three studies we were fortunate to have access to the findings of another group of investigators who were studying the same situation. Our data were primarily obtained by interview from persons in the affected area. Most of these interviews were with the survivors. Many were with participant authorities who were in the disaster and knew the local history and folklore. In all of these incidents it was necessary to explain our purpose to local civic and rescue authorities in order to be able to do any study at all. Belonging to a department of psychiatry turned out to be a liability. Representing a medical school was more helpful. Being able to develop an appropriate relationship with local relief organizations and painfully learning to respect their proprietary rights was most helpful. In addition to interviewing, repeated observations were made on a group of children in Arkansas and a group of adults in Elizabeth, New Jersey.

For the collection of information, we used a standardized goal-directed, open-ended type of interview, wherever possible with a minimum of direct questions and other verbal activity. This was designed to obtain the greatest amount of participation from the respondent. We attempted to obtain similar information about specific topics in all cases. The order of the topics usually was determined by the respondent who was encouraged to talk in the areas in which our interest was focused. In a few cases it was possible to have several interviews with the same person, but this was the exception rather than the rule. In most instances the interviews were recorded on tape, and content and interaction were studied by various methods. I shall now read a few episodes from our data.

At 5:25 on a March afternoon, Tom Leonard was standing at the back door of a store in a small town in Arkansas. An unusually black column of cloud loomed just beyond the edge of town and Leonard felt the air blow past him out the door. Winds blowing

towards the cloud meant a tornado. He closed the shop, drove home, picked up his wife and drove out of the path of the funnel that was now whipping and dancing up the street carrying houses, trees, and cars with it. When it passed, he went back to the store and said, "Come on boys, get some blankets into the truck. Let's go to see who needs help."

At 5:25 of the same day Mrs. Long was sitting in her store with her 12-year-old son beside her. With a gust and a roar the front door blew in. She grabbed for the boy but it was too late. The wind ripped him out of her grasp and carried him through the ceiling. The tornado was suddenly gone and the boy's body lay on the sidewalk outside. When Mrs. Long's neighbors ran over to help her, she was standing out in the rain taking off the last of her clothes and saying, "I must get out of these wet things."

Mr. Drew was alone in the house with his teen-age daughter when the trees began to dance in the front yard in a roaring wind. He called, "Run," and dashed out the front door, leaving his daughter in a dead faint in the yard behind him.

The first warning Mrs. Stevens and her daughter had of the tornado was when the window panes crashed outward and the house began to rock. They ran to the bedroom where they would feel safer but when they opened the door, there was no bedroom. They crouched in a corner clinging to each other. The daughter was whimpering, "Mother, I love you," and suggested that they had better pray. Mrs. Stevens asked, "For what shall we pray?"

"Let's pray for Daddy," the daughter said. Daddy was downtown at the store.

"I think your father can take care of himself," Mrs. Stevens said. "Let's pray for us."

Predisaster Conditioning

As we learned about the behavior of people under such stresses, we found it necessary to pay attention to the *patterns* of disaster as well. The stages through which a disaster situation passes must be clearly distinguished because behavior responses may differ at different points along the progression of events. The *duration* and *combination* of these stages add up to different *types of disaster profiles* with possibly different characteristics of response. In one area for any given disaster there is a local history and folklore relevant to that particular form of danger (fig. 1). In Arkansas, people have lore about tornadoes; in Georgia, people know the effects of wood alcohol; and in mining towns, disasters are almost an accepted part of the culture. Other conditioning factors are the habits and training related to the

given threat, such as fire drills and the training of ambulance crews and telephone operators. There are also factors of cultural pattern among the people hit by a disaster, such as their group cohesiveness or isolation, their leadership expectations, their attitudes towards property, towards authority, and towards each other. Finally, there are the individual personality structures that have developed or have been brought in by individuals. All of these may have direct bearing on what people do under stress. All of these are factors in predisaster conditioning. The patterns of the group as to leadership, responsibility, and the way in which the individual develops defense mechanisms are intangibles, but they are there nevertheless. Our problem was to see if we could correlate some of these factors with what we could observe in disaster situations.

PREDISASTER CONDITIONING

KNOWLEDGE OR FOLKLORE ABOUT A GIVEN DANGER AND ITS EFFECTS

HABIT, TEACHING OR TRAINING IN PREVENTION, RESCUE, ETC.

COMMUNITY AND GROUP PATTERNS OF LEADERSHIP AND RESPONSIBILITY

INDIVIDUAL PERSONALITY DEVELOPMENT: DEFENSE MECHANISMS

FIGURE 1.

There is a second set of variables that have to do with the nature of the destructive agent involved. Of the characteristics that might be selected for study, three appear in our data to have the greatest bearing upon response patterns. One of these is the *type of injury* produced: burns, impact traumata, suffocation, and poisoning, for example. Another series has to do with the individual's *responsibility* toward the disaster—whether the danger can be avoided at discretion, as with contaminated food, water, or whisky, or in an epidemic, or whether the involvement is involuntary as in hurricanes, explosions, or the unwitting ingestion of toxic substances on a mass scale. Then there is the *symbolic meaning* of the destructive agent.

In one sense, the disaster is only a series of accidents happening at the same time; but, to have the character of disaster, we believe that more is required. We think of disaster as the whole period surrounding the incidence of a force capable of destroying human life

and community resources for survival on a scale large enough to disrupt normal behavior, attract public notice, excite public alarm, and threaten or disrupt group and community patterns of cooperation and control. Thus, when the third plane fell on Elizabeth, it was the people of Elizabeth and not the passengers in the plane whom we studied. The passengers had had a collective accident. Elizabeth had suffered a disaster.

Stages in Disaster

Figure 2 lists the stages through which a single disaster situation may pass. The core concept, following Tyhurst's lead is that of *impact.* Impact is the collective description covering the entire period of destructive activity by a given agent. It is the period of maximum danger, whether it lasts a few seconds or days. The actual blow may fall on different individuals at different moments within the total period; as in an epidemic some people fall sick much later than others. In a stricken area, however, be it a factory, a block, or even a city, impact begins when the first victims fall and public alarm is focused on the danger; and it lasts until the last victims have fallen or the last people have taken flight—"people," because impact *is* on people, not on things as such. Impact refers to a single agent. An explosion may be followed by fire, but that is an impact of a different character. However, there may be repeated impacts from the same source, and this in fact constitutes a major type of *prolonged* disaster. The duration and succession of impact are prime factors in determining the nature of the disastrous situation and the responses to it.

Preceding impact we recognize two stages which may or may not appear in a given disaster. The first of these is *warning.* By warning I mean that the presence of a given danger is anticipated, but the exact time and location of its incidence is not known. Warning may be by communication, as in the case of storm signals. Descriptively, warning is constituted by *the occurrence of conditions indicative of a certain kind of danger.* Behavioral response to warning takes the form of precautionary measures—small craft may start for shore or children may be kept at home. The prevailing mood is one of anxious expectation. Figure 2 indicates the various stages on the left, and the corresponding activity occurring during these stages on the right.

The next stage, *threat,* is differentiated by the acuteness of the stress felt by those under the threat. This period may grow gradually out of the first, or may occur suddenly. In either case, it is constituted by *a change in conditions indicating the imminence of danger.* Dan-

STAGES IN DISASTER

STAGES	ACTIVITY
1. WARNING	PRECAUTIONARY ACTIVITY
2. THREAT	SURVIVAL ACTION
3. IMPACT	"HOLDING ON"
4. INVENTORY	DIAGNOSIS OF SITUATION AND DECISION ON ACTION
5. RESCUE	SPONTANEOUS, LOCAL, UNORGANIZED EXTRICATION AND FIRST AID; SOME PREVENTIVE MEASURES
6. REMEDY	ORGANIZED AND PROFESSIONAL RELIEF, MEDICAL CARE, PREVENTIVE AND SECURITY MEASURES
7. RECOVERY	INDIVIDUAL: REHABILITATION, READJUSTMENT; COMMUNITY: RESTORATION OF PROPERTY AND ORGANIZATION; PREVENTIVE MEASURES AGAINST RECURRENCE.

FIGURE 2.

ger now is localized and personalized. It is *my* house the plane is falling on, my block the tornado is approaching, or my street the fire has reached. In prolonged disaster, such as a contamination of the food or beverage supply, threat occurs when I learn that it was the restaurant where I ate whose customers are falling sick, or that the man with whom I was drinking has died of methanol poisoning. The normal response to threat is survival action: "fight, flight, or taking cover." In disasters comprising a brief single impact, threat *precedes*. In prolonged disasters, however, threat may last throughout the period of cumulative impact.

These first three stages are all primarily stages of the *objective situation*, though they obviously depend on human awareness for their effect and for their elaboration. The stages that follow impact are stages in the *development of activity*, from the first spontaneous ef-

forts to find out what happened to the gradually increasing control by the constituted authorities.

Inventory is the first activity required of those who have suffered impact. This is the period, be it seconds or hours, in which people are finding out what happened, what is left, and what must be done. For the individual this is an acutely crowded period, involving recognition of what is happening, appraisal of new dangers, restructuring of the perceptual field in terms of action possibilities, option scanning, and decision. Collectively, what we call public inventory covers the diagnosis of the situation; its entry into public awareness through perception, rumor or the press and radio, and the emergence of decisions about what to do. Where there has been prior warning, even though impact has been brief, inventory is shortened by the foreknowledge of the event. Rescue and remedial measures may have been prepared in advance, the hospitals alerted, etc. Where there is no prior warning or threat, inventory may take longer. In prolonged disasters, however, public inventory is usually made early and becomes part of the public knowledge, so that individuals succumbing one at a time can identify their experience with the public inventory and take more appropriate measures more quickly.

The complexity of the inventory process offers many avenues for further study. The way a person perceives what has happened may have widely varying consequences in action. For example, in the chlorine-filled factory a workman had just pulled a plug out of the base of the smokestack when the gas hit him. He assumed that he was letting the gas out of the stack and spent precious seconds trying to force the plug back in. Several men decided that the plant needed fresh air and opened up the double doors—right in the stream of gas coming from a leaky outdoor tank. Dozens of people in Elizabeth, as in many other explosion episodes, heard the explosion, thought "atom bomb!"—and dashed out to look. Some reacted with mechanisms of dissociation and denial under the acute stress of making the emergency inventory: a few people in Elizabeth looked right at the burning plane and refused to believe that it was there.

Individuals with prior experience of similar disasters appear in our data to handle inventory more quickly and appropriately, though a few report that anxiety is reawakened from the earlier experience. After impact and inventory, and sometimes in a prolonged disaster while these are still going on, *rescue* begins. This is the spontaneous, unorganized, individualized activity of extracting one's self and others, giving reassurance, looking for help, perhaps fighting small fires or taking other preventive action against further destruction. Leadership emerges in this stage. Usually, it is spontaneous and may not

have been predictable from earlier periods. This is a period of volunteer effort, a great deal of which is motivated by the guilt of surviving while others die. Also, doing something discharges energy and affect not released during impact. Leadership at precisely this point is one of the most important requirements for an orderly issue from the disaster. It is in the inventory period, in which many people are immobilized by a combination of neurochemical overloads and perceptual ambiguities, that panic can occur or stampede be initiated. There is also a widespread incidence of apathy from psychological or physiological shock. Above all, the rescue period in large-scale disasters of brief impact is characterized by numbers of dazed, bewildered, wandering persons for whom rescue means leadership and reawakened self-direction through association with others in simple tasks. In a prolonged disaster, this wandering response takes the form of clustering in silent crowds or groups and abandoning normal duties. Here again, leadership of a volunteer sort is of great use in redirecting energy in simple but useful channels.

The rescue stage shades over into the period of *remedy*, or remedial action. Organized and trained people begin to take over responsibility and leadership. The Salvation Army, the Red Cross, firemen, police, nurses, ambulance crews, etc., create a marked restructuring of the situation when they enter it. Behavior changes, reassurance and hope begin to be felt and wandering becomes a purposeful search for lost family members or friends. Finally, remedy, the last stage in the acute emergency, shades into *recovery*, which may be a slow, perhaps years-long, returning to the normal business of living; healing the injured, restoring property, and rebuilding the organized structure of the community and the group.

Profiles of Disaster

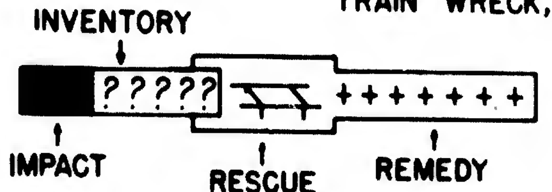
Figure 3 is a combination of the various stages and presents a profile of two tornadoes studied in Arkansas last year. These were the simplest patterns we found. They consist essentially of the results of a single brief impact *without* warning in disaster 1, and a single impact *with* warning and threat in disaster 2. This is a common type. Undoubtedly, the same pattern was shown in the recent tornado in Texas. The same pattern applies also to the episode in which a train plowed up Washington's Union Station some weeks ago. The warning and threat periods in that case were only seconds. In the train crash, two groups were involved for whom the threat had different meanings—the passengers and the people in the station. We have attempted to schematize the various phases of disaster, im-

PROFILES OF DISASTER

A. SINGLE BRIEF IMPACT

1. SINGLE IMPACT WITHOUT WARNING

(E.G. EXPLOSION, TORNADO, TRAIN WRECK, ETC.)



2. SINGLE IMPACT WITH WARNING AND THREAT

(E.G. HURRICANE, FIRE, ETC.)

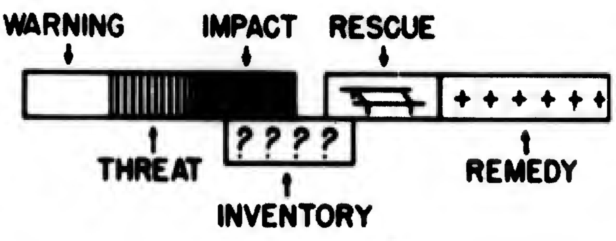


FIGURE 3.

pact followed by inventory, rescue beginning while inventory is still going on, and remedy.

In the single-impact type with warning and threat, inventory occurs a good deal sooner. It is obvious that the existence of a warning and threat period is of considerable importance in making survival possible. If the warning and threat periods are of long duration, rescue can be quicker because people already know the destructive force. Remedy is more prompt because prior knowledge has already alerted the organized forces responsible for remedial action.

In the second type of profile the bahavior of the individual immediately before impact is determined in part by the *ratio* of time-available-before-impact to the time-necessary-to-get-away. In order to survive without guilt, one needs time to get home and get one's family to safety. In the tornado disaster the threat was the visible approach of the wind funnel. Most people who saw it got home and away, blowing their horns to warn others who might not have seen it. The only deaths were among those who had no warning, who did not see the

threat. One of the first rumors picked up was that someone from the "white" side of town (the town had both white and Negro population) had run over to the Negro section and warned them. However, no one had; and actually, all the deaths were in the Negro neighborhood.

Behavior during the 10 to 15 minutes under the threat varied in interesting ways. From the sample of our interviews one would judge that most of the men went home for their wives, and most of the women tended to go home to their mothers. One man drove parallel to the funnel in his car taking pictures of it. Another estimated the limits of the funnel, held onto a pole across the street, and let it pass by him. Nearly all of the people had been praying. A notable exception was the Methodist minister who had 1 minute in which to act, and an oak table in his dining room. When the church steeple came down through the roof, all the family was under the table. The duration of the warning and threat periods determines in part how much survival action is possible. Many survivors in discussing these periods felt guilty that they had not done more or assumed more responsibility when something could have been done to help. Two people who showed depressive reactions during the remedial phases revealed that they had acted helplessly during the threat and impact phases. This behavior had mobilized guilt feelings—and also defenses against guilt. Mr. Leonard, for example, showed embarrassment in discussing this phase. When he went home to get his wife out of the storm's path, she resisted going because their boy was not home and she felt she had to stay in the house for him. Leonard's mother, two houses down the street, heard them arguing in the yard and came over to scold him for "yelling at Neddy like that." Leonard explained that he had to get her away from the storm, and finally got his wife into the car and drove off. At this point in the interview he looked sheepish and said, "Gosh, I never thought to put my mother in the car too."

In the profile with warning and threat, inventory is shortened and rescue and remedy occur more rapidly. In the town that had no warning, inventory was slower. The diagnosis of the situation was delayed and inaccurate. Each person thought that only his house was hit. Rescue was delayed while people began to realize what had really happened. That seemed to be true also in the reports from Hiroshima and Nagasaki.

Figure 4 is the type of profile seen in *prolonged* stress, such as with the methanol poisoning in Atlanta and the airplane crash in Elizabeth. With this special sub-type there is *continuous impact*. The usual quantities of bootleg liquor were consumed over the weekend in

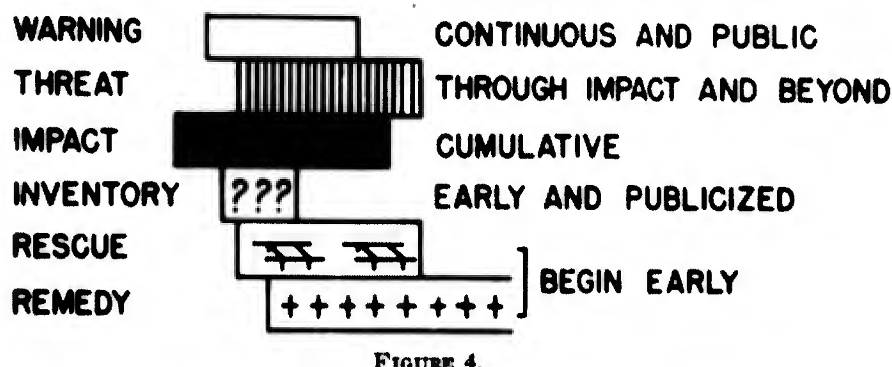


FIGURE 4.

Atlanta. Sunday night two victims died in the hospital without the source being recognized. Monday a flood of victims hit the emergency clinic. The press and radio headlined the cases and hundreds of people suddenly knew that they had drunk something that might kill them. The impact, collectively speaking, continued through Thursday with additional deaths. The story of the poisoning was made public on Monday, though some individuals still did not know about it. On the whole, however, the threat was known. In this situation, each individual knew that he might have been poisoned and might die. He was not sure. Most people stopped working and waited, clustered in silent groups throughout the neighborhoods. Some made use of magical defenses. "It cannot hurt me." A few seemed to deny their danger, and after treatment at the hospital went home and finished the bottle. Others responded to irrational fears and reported symptoms without even having taken the poison. They seemed to identify with the victims by getting sick in the same way. The threat and impact phases existed side by side. Inventory was confused by hope and fear. As the situation was prolonged, however, rescue became speedier and remedy became more standardized.

The recovery phase also presented significant features. This was a case of a danger from which many sections of a city were immune. As higher sections of a town escape flood, so do the richer, more stable elements of the population avoid bootleg whisky. The agent was one that was avoidable at discretion. The Vocational Rehabilitation

staff reported that many of these victims were depressed and had a tendency to withdraw and to resist rehabilitation.

In the prolonged disaster, the earlier response to impact is what we think of as "explosive": excited milling activity, such as crowding around the focus of danger. As the crisis became prolonged, the tension mounted and disturbing rumors spread. In Atlanta, by the third day the rumors were that people were being beaten to death by the white police instead of dying of poisoning, that victims were being buried before they were dead, and—most interestingly of all—that the Negro victims turned white when they died of this poison. It seemed as if these rumors represented suppressed terror, with a hint of a wish fulfillment. The characteristic comments on these rumors were, "I knew it could not be so, but I was horrified. I just had to go down and get into the morgue to see for myself."

The airplane crash in Elizabeth illustrates a different type of profile that is a little more complicated (fig. 5). Certainly the principles are the same. There is a crash and a few weeks later there is another crash which is followed by periods of inventory, remedy, and recovery. However, the fact that there was one crash begins to have special meaning. People are on the lookout for another, and it becomes another threat. Then there is still another crash which has a series of consequences. Therefore, in this type of profile where there are repeated impacts the situation becomes much more complicated and it is very difficult to sort out various elements involved. There were two crashes of large passenger planes on the way to and from Newark Airport within a period of 4 weeks. The continued presence of heavy

PROFILES OF DISASTER
B. PROLONGED IMPACT
2. CYCLICAL TYPE
CRASH III = IMPACT II
THREAT
INVENTORY I
CRASH I
CRASH II = IMPACT I
RESCUE
REMEDY
RECOVERY
DEC. JAN. FEB. MAR.

Figure 5.

planes so close overhead that they shook down plaster and flooded bedrooms with landing lights constituted a chronic warning. Of the 50 people interviewed, most of them stated that the two crashes were a rare coincidence and that the third was statistically almost impossible. Still they felt acutely threatened during the weeks that followed the second crash.

In appraising the nature of the threat resulting from the two previous crashes, we were impressed with the lack of clarity in the survivors' description of their attitudes toward the threat and the impact. No one could tell when the next blow would fall and no one was sure that it would fall, yet several people had an emotional certainty that it would. At this time a common expression around Elizabeth was, "Everything happens in three's." Several subjects reported that they felt the danger to be localized and personalized—my house, my family could be the target. We had reports that people were calling home whenever there was a loud noise or explosion in the industrial neighborhood. Although the subjects felt the personalized threat of the next crash, they knew that it was unusual, unreal, and irrational, and took no active measures for protection or survival. Only a few people raised their insurance coverage. This we learned from those who said that they did not because even though they feared the planes, they thought it unrealistic to increase their premiums. There were a few cases of family flights from Elizabeth at this time, but very few. One might characterize the mental state of the survivors at this point as uncertain, ambivalent, but capable of observation and rational thinking if not completely free from irrational fears.

A third plane did fall only 3 weeks after the second. Several subjects stated that in addition to the realistic and horrible experience, they felt shaken in their rational beliefs; the fact that reason was wrong was an additional personal trauma. The threat from the planes rose to such heights that if the authorities had not promptly closed the airport, hundreds of people were going to march on it and destroy it. In the inventory phase, decision was difficult and rescue was hampered by dissociative states affecting some of the police and firemen. One police officer, for example, developed paranoid ideas, was immobilized by a voice saying that this was a punishment for his own adultery. This time, threat was so acute that some families fled Elizabeth the next day, and others said that they would leave if the airport reopened: "The next plane will have our address on it for sure," one person said.

One of the most interesting facts about the study—at least, to the psychiatrists—is that among the 50 persons on whom we have data, 14 suffered mild, moderate, or severe disturbances. We found

a greater incidence of psychiatric disturbance in Elizabeth than in any other disaster we have studied. Five persons required psychiatric assistance, and one was in a mental hospital for some weeks. All the disturbances were incapacitating for relatively brief periods. Obsessions, phobias, paranoid states, and hysterical paraplegia seemed to occur in the inventory phase. Phobias and depressive reactions persisted throughout the remedial period. Guilt took two forms—it motivated some of the heroism among the rescue workers, as expressed in their own words, and persisted among others as a magical feeling that they were somehow responsible for the crash by some word or act of theirs preceding the disaster. Hostility, which in Arkansas turned the people against the outside relief authorities such as Red Cross, in Elizabeth became focused on the Port Authority controlling air traffic. The Authority became the common focus of conversation. The people complained that the Authority did not care for them. Some turned to the idea that their Congressman was the powerful figure who would take care of them—though this notion tended to be held in considerable doubt even by those who voiced it.

Activity During Disaster Periods

There is another aspect of our study which I should like to mention briefly. From our records and observations we have attempted to define various levels of response that characterize the behavior of any individual at any stage in the disaster (fig. 6). We found, for

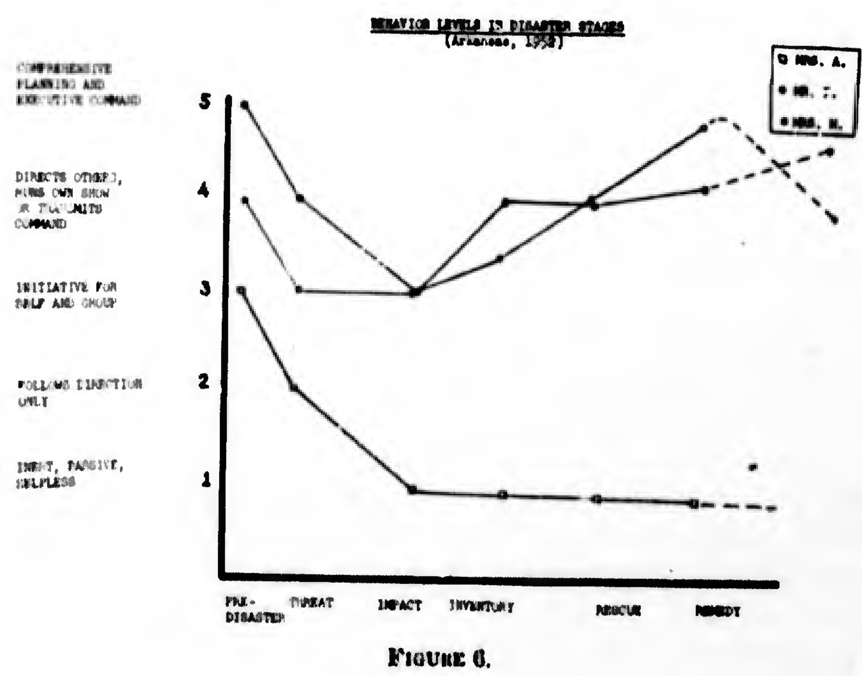


FIGURE 6.

example, that in terms of leadership and followership, or initiative and helplessness, if one wants to set up a dichotomy of that kind, the same person may be rated at different levels of performance at successive stages of a disaster. In the dimension of leadership we have set up five levels ranging from total inactivity and lack of initiative to leadership performances, executive planning and group direction. In this figure we have plotted the periods of disaster along the horizontal axis and the scores of the characteristics dealing with leadership performance along the vertical axis. A person with a score of 1 is passive and helpless; he may be inert, or he may just run away. Level 2 acts only under continual direction and support, but can help himself and others under direction or carry out given tasks. Level 3 takes initiative in helping himself and his immediate group, such as his family. Level 4 directs others in specific paths of rescue or prevention; he can assist and transmit directions, or he may run a private show in a restricted area. Level 5 sustains executive responsibility for planning and managing collective action.

In England, Arkansas, the threat lasted about 10 minutes while the people watched the black funnel hover around the edges of the town and then move across the northern edge. Mr. F., who had been an executive community leader showed leadership during the threat period only for his own group and dropped to level 3 during the impact; then he directed a rescue team. At the end, he was resuming his old level of command. Mrs. M. had operated at level 4, before the storm, as a church committee head. During threat and impact she acted for herself and family only; but by the remedial stage she was helping to run the town, including all five churches. Mrs. A., a housewife, remained at level 1 throughout most of the disaster.

We are in the process now of plotting our data on all subjects studied in the same way. We are working on rating-scales along other dimensions, such as group reference, reality reference, and duration and intensity of affect and symptoms. Although we have not completely worked up our data, it is our preliminary impression that an individual's performance at any level would correspond to his behavior level or other gradients during the same phases of the disaster. This mode of analysis has already reinforced the hypothesis that leadership is a *function*, rather than a permanent role. We have also been impressed with the function of leadership in *bringing about the change* from one phase to another. For example, the release of inventory into rescue action is often triggered by decisive moves on the part of one person; the change from rescue to remedial organization is effected by the entrance of trained leadership.

TUESDAY AFTERNOON SESSION

Summary

Our studies have led us to consider a disaster as the whole period surrounding the incidence of a force capable of destroying human life and community resources on a scale large enough to disrupt normal behavior, to attract public notice, to excite public alarm, and to threaten or disrupt group and community patterns of operation and control. The stimuli emerge from the background of pre-disaster conditioning and recede into a period of recovery which can last indefinitely. The course of our own study has helped us establish a conceptual framework concerning the stages of disaster. This framework has enabled us to isolate specific elements out of which can be derived certain generalized profiles of disaster, each of which can then be subjected to various kinds of study. Within this framework we have made a start at correlating observations of individual and group behavior in terms of the sociological and individual factors that can intensify or mitigate the destructiveness and devastation of disaster.

Discussion

Dr. Bolocan. Was there any evidence during the period of warning of considerable pleasure in the mounting excitement and was there any evidence that the effects of the disaster were aggravated or prolonged by any such pleasure?

Dr. Powell. The answer is no.

Dr. Sells. Dr. Finesinger, in the case of the poisoning, did the newspaper and radio facilities increase the fear among the public? In San Antonio last year we had two incidents. One involved a laughing maniac and the other a black leopard. The black leopard was seen by about 500 people over a period of a month and hunting parties went out looking all over for it. The hunt was dropped when an authority said that it did not exist. The laughing maniac incident started about 2 months later. It lasted about a month and there were a good many newspaper articles about him. He was the subject of almost daily radio commentary.

Dr. Rioch. Dr. Finesinger, you might include the Orson Welles "Invasion from Mars" with the black leopard and the laughing maniac incidents.

Dr. Finesinger. This is another instance in which it is very hard to know if newspapers do any good or not. There is no doubt that they do advertise these things, but it is very difficult to gauge what the impact is. Dr. Powell can say more about this. We had a recent experience in New Hampshire where the newspapers got involved too. The thing that impressed me was that in Atlanta people that

did not take the bad liquor had read about it came for an examination.

DR. POWELL. From the 433 clinic sheets which I examined, of every 10 who were treated in the emergency clinic at Grady Hospital, 4 were negative to the test which the hospital was using, 2 frankly said, "Doctor, I do not know whether I had it or not. Please check me over," and only 4 apparently justified treatment in the eyes of the medical staff. I would say directly to the question that this is an inevitable factor in disaster of any prolonged duration where there is an attempt to warn people against whatever the danger is. The authorities do take action through the channels of widespread communication, especially by emphasizing the number of people who are dying from day to day, as in Atlanta. I think that 17 people died on Monday. The toll rose to 39 by Thursday or Friday. This created a tremendous public focus of concern. I do not know whether I would be too far afield in guessing that for those 4 days, everybody in Atlanta ardently loved the people who were dying, so to speak. It seemed to me and to the people with whom I checked that there was an increased tendency on the part of some individuals to dramatize themselves into that picture by getting the symptoms. There was one case which is really unexplained but to me it had some collateral significance. A young Negro boy who did not have any bootleg liquor got a bottle of what they call "government whiskey," drank it, and then went out and lay down on the railroad tracks: This was at the height of the public excitement.

DR. MICHAELIS. Was there any difference between the Negro and white groups? I ask this question because I was once in a disaster. It happened in England where a city was practically pulverized by the explosion of an ammunition depot and the local newspapers magnified this disaster further by publishing hour-to-hour accounts. One of the headlines I remember very clearly was that in a few hours the city would be blown to bits. Nonetheless, there was a perfect calm and no excitement among those I met. There was no concern but just an observation of what the newspapers had to say. On the basis of this experience and what Doctor Finesinger has said, I should like to know whether you had any observations as to racial, economic, age, or sexual differences, because I feel that it is very important.

DR. FINESINGER. Again I am sorry that I cannot answer your question, Dr. Michaelis. I got the impression that we expected more primitive reactions from Negroes when the tornadoes struck the "Bible Belt." I am not sure if one can expect more primitive reactions than that from that area. On the whole, though, going over the material, I have the impression that there was not very much difference.

DR. POWELL. Yes, I think that is true. Perhaps the essential point

of difference in a situation in which disaster is expected is whether or not people actually die. You remember the Public Health study in Donora, Pennsylvania, where about one out of three residents fell ill between Wednesday, when a smog started, and Friday night when the cases were at their height. There were about 4,500 cases of illness. No deaths occurred until Saturday. The alarm in Donora did not become prevalent until Saturday night. In the meantime, everyone had turned out for parades and football games. The alarm became prevalent Saturday night but the smog cleared on Sunday. Looking back, I was impressed by the fact that tremendous threat was present among them, but was not felt as threat in the sense of survival until so late that the threat was removed before the alarm could get mobilized.

Dr. Finesinger. When Dr. Brody went back to England, did he find any difference in the Negro versus the white population?

Dr. Powell. I can't think off-hand of any data that would suggest that. Of course, he went back 3 months later. He did find that some persons who had performed magnificently during the crisis broke down very badly a month or two later. He also found that a good deal of retroactive hostility was growing up among the people who had collaborated during the crisis and who were no longer speaking to each other because of what they thought each had done at the time. His interviews, I think, were mainly concerned with the white population, largely on the leader level, so I doubt if there are data there relative to that one question.

Dr. Goodrich. I was interested in your description of the pathological behavior breakdown such as depression, anxiety, dissociation, and the occasional calling on unexpected personality resources such as leadership from people who had not been leaders before. Dr. Richard Loenberg has described humor as a part of the reintegrative process after a disaster. After the earthquakes at Bakersfield, California, people used the pun "Quakersfield." Have you found humor an important reintegrative pattern during the recovery phase?

Dr. Finesinger. I am not aware of it. I do not believe that there were any manic episodes. They were mostly on the depressive side and there was an increase of psychoneurotic symptoms, phobias, and obsessions. That brings up a very interesting problem. We were fortunate in that two people who happened to be in the disaster area in Elizabeth were undergoing intensive psychotherapy with a doctor from New York. We gathered some interesting information as to their free-associations when they returned to their doctor. One apparently had an hysterical paralysis from the waist down which she had never had before, and her material and the material of the other

patient pointed out that in these people, at least, the actual symbolism of the destructive agent itself was very important in their preoccupations and associations.

DR. RUESCH. I would like to ask Dr. Finesinger and Dr. Spiegel a question. Within what you call the rescue period, the improvement of functioning is due to the awareness that the group communication channels are open. We had several comments stating that it does not matter what the newspapers say, as long as the people know that communications are functioning. I wonder whether that takes precedence over the evaluation of whether the action undertaken is correct or not?

DR. SPIEGEL. This was certainly true in the British flood disaster. The rescue operations started at night and it was still very dark. The rescuers could not see well enough to locate survivors, yet just the knowledge that they were making an attempt to reach them was enormously reassuring for the victims. We heard statements from many people to the effect that their anxiety died down and their morale increased just at the knowledge that rescue operations were started. They had to wait 12 hours, often under terribly disadvantageous circumstances, but they were not bothered because they knew that they would be picked up. Apparently, the establishment of communication between the victim and the rescuer is enough to ameliorate the anxiety.

In answer to the question about humor, it was a very important sign of reintegration. It was the only way in which some of the personal aspects of the disaster could be alleviated. These people were in their night clothes and many of them did not have clothes on at all, or hurriedly threw on some light garment. For the British population, this departure from form was quite a stress. It was handled by the police, the firemen and the other people who gradually came into the rescue operation, by continuously joking about the advantages of this kind of a disaster, about the contact between men and women, etc. This assisted in bringing them into one new reintegrated system of victims and rescuers.

DR. FINESINGER. I can see no reason why the mechanics of communication cannot also have meaning to people. Its existence or nonexistence can be very important. I can readily see how the existence of avenues of communication can be a supporting factor. At the same time, I believe that content can do the same thing. In our work with the interaction chronograph we gained some information about content versus interaction; content cannot be overlooked. In other words, I can see no reason why these things must be mutually exclusive. While the avenues of communication can have a supporting effect, certain kinds of content can have a disturbing effect or increase the

strain, whereas knowledge of other types of information can have a supporting effect. Basically, I think that we are dealing with an equilibrium between support and strain factors. When this is disturbed you get untoward reactions until the equilibrium comes back again. Many factors can play a role in shifting that equilibrium.

CULTURAL PERSPECTIVES ON STRESS[1]

WILLIAM CAUDILL, PH. D.

Cultures vary widely in their response to such stress-provoking conditions as epidemics, wars, drastic technological changes, and other economic and psychological deprivations. The "defense mechanisms"[2] which cultures provide for meeting such stresses will be phrased in terms of the dominant institutions and values emphasized by the culture—whether these lie in the areas of kinship, religion, technology and economics, and so on. Equally, men as cultural animals are peculiar in that they actively seek change and stress: they are not content to limit their lives to the reduction of tension and the achievement of integration.

Whatever ways men use to defend themselves against stress, or to seek it, the nature of such ways will reflect their culture's answers to a limited number of basic human problems. Florence Kluckhohn (ref. 16) has discussed five such problems to which any culture must provide answers: (1) What are the innate predispositions of man, (2) what is his relation to nature, (3) where does he place his emphasis along the time dimension,[3] (4) what personality type does he most value, and (5) what is the modality of his relations to other men? She suggests that Anglo-Americans see themselves as evil but perfectible, exercising power over nature, oriented to future time, valuing a "doing" personality, and individualistic in their relationships. Contrastingly, Spanish-Americans see themselves as a mixture of good and evil, subjugated to nature, oriented to present time, valuing a "being" personality, and emphasizing lineal and collateral ties in their relationship.[4]

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[1] Presented 17 March 1953, to the Symposium on Stress, Army Medical Service Graduate School, Walter Reed Army Medical Center, Washington, D. C.

[2] Since the conceptual plan for this symposium is phrased in the biological terms of the stress, strain, defense mechanisms, and breakdown in organisms, caution is necessary in speaking of cultural "defenses" and we must avoid pushing any analogy between cultural and organic "functioning" too far. It is true that cultures are integrated, but there is a looseness of fit permitting the incorporation of new traits, elaboration in various areas, and ability to change, that is far beyond the potentialities of organisms in these respects.

[3] Our own language gets in our way here. Dorothy Lee (ref. 20) has pointed out that other cultures may not even conceive of "time" along a lineal dimension.

[4] Dr. Kluckhohn (ref. 16) also emphasizes that in addition to such dominant value orientations, every culture also has a number of variant orientations which are equally ascertainable and functionally necessary to the culture. Strodtbeck (ref. 42) has empirically demonstrated the existence of such orientations in husband-wife interaction in three cultures.

These values become readily apparent in the defenses brought into play under such a condition of stress as death. Spanish-Americans react to death fatalistically, as man subjugated to nature, and little attempt is made to save the dying one. There is a great dramatization of death as high tragedy, with much ritual, open mourning, and reaffirmation of extended kinship ties. Anglo-Americans (ref. 25), on the other hand, cannot deny death as a part of nature beyond their control, but they can, and do, suppress their thoughts and emotions concerning it, de-emphasize it by reducing ritual and mourning to a minimum, disguise the corpse to make it "lifelike," and ask such questions as "why can't they 'do something' about that disease," or "wouldn't it be better for her (or him) if she found someone else soon?"

While we will have occasion to return to this problem of ways of meeting death, the fact remains that problems of stress have seldom been the specific focus of studies in cultural anthropology. Particularly is this true if one has in mind attempts to study—using such concepts as Selye's general adaptation syndrome (ref. 38) or others—the physiological and psychological defenses of individuals under stress as these might vary from one culture to another. This would seem to be so partly because, as yet, there has been little collaboration between physicians and cultural anthropologists, and while medicine has shown steady progress in the systematization of its residual categories, culture and society *as systems* have not yet been incorporated into its theoretical thinking. The movement has been from the study of separate organs to the study of the body as a system with emotions as important but residual; thence to the systematic inclusion of psychological factors in psychosomatic medicine with cultural facts as important but residual. This being the case, an attempt to phrase these relationships somewhat differently, and with reference to their meaning in terms of stress, might suggest new research questions. Such questions need to be raised, and because of the lack of actual cross-cultural studies, the following remarks are perforce of a theoretical nature supported by illustrations from anthropological and sociological material.

In broadest terms, we can think of culture as man's way of meeting stressful situations, including the inevitable problems of procreation, hunger, shelter, and death. Since culture is such a powerful tool, few groups of people have devoted more than a fraction of their time to such problems, and have gone on to the development of art, religion, kinship, government, and science. Culture operates through the symbolic communication of patterned habitual ways of acting,

feeling, and thinking, so that a group of people come to share both cognitively and affectively a system of ideas and ideals on explicit and implicit levels of awareness (refs. 17 and 18).

Under conditions of potential stress and strain the fact that culture provides for the communicating and sharing of ideas and feelings becomes crucial. Culture thereby enables a group to anticipate problems, to distribute the load, and to plan ahead. Indeed, a culture, and especially the social structure it has developed, can be thought of as a particular patterning of communication networks (refs. 6 and 36). The efficiency with which the networks operate will determine to a considerable extent how well the group as a whole, and individuals within the group, will meet a stressful situation.

For example, Janis, in speaking of the effect of bombing on civilian populations, says: "Mental breakdown, panic, and mass demoralization—the triple psychological threats that dominated so much of the thinking in official quarters—rarely materialized during World War II . . . . the dire predictions . . . failed to take account of the psychological stamina of the average citizen" (ref. 14). We would add that the predictions failed not only to take account of "psychological stamina" but also the ability of the populations to work out cultural defenses in terms of revised social structures and communication systems. Again, in an experimental stress situation, the individuals making up French's (ref. 8) organized groups (composed of athletic team members who had played and lived together for over a year) showed *more* fear in response to the threat of a fire while they were locked in a small, dark room than did the individuals in unorganized groups composed of persons who had never met before. But, the organized groups also showed more leadership and more quickly evolved a plan of direct action than did the unorganized groups.

Margaret Mead (ref. 26) has noted that under conditions of rapid culture change, during war or revolution, and at other times when strain has been so severe as to result in breakdown of the group's cultural defenses, an individual is robbed of his usual means of reducing tensions and is forced back upon his own body and its immediate extensions in the environment in order to work out his conflicts. Implicit here is the linkage of a series of interrelated, but separate systems (all of which besides the cultural system are, in the case of man, in some degree influenced and interpenetrated by the culture): (1) culture, (2) society—both in its over-all institutional and primary group aspects, (3) the personality system, and (4) the physiological

system. These are all dimensions of every human situation,[5] but it is important to mention that they are not different orders of abstraction if one's eye is on the organization of parts; they do arrange themselves according to principles which are not reducible, without real loss, to principles of another system. Through the work of psychosomatic medicine we are already familiar with some of the systematic relations between the body and the personality.[6] We are also familiar from work with lower organisms that "cooperating" aggregates have definite survival value: Allee (ref. 2) has shown that 10 goldfish in 1 liter of diluted colloidal silver live roughly three times as long as isolated fish because the slime secreted by the 10 fish precipitated much of the silver; overcrowded *or* isolated mice grow more slowly than aggregates of optimum size; etc. So on through other organisms which arrange themselves in structured societies rather than aggregations: ants, bees, birds, monkeys, and apes. Brody and Rosvold (ref. 4) have recently reported on the interesting shifts occurring throughout the social structure of a monkey colony of four females and two males when, one by one, three of the animals were lobotomized. Of most interest for us were the significant changes in behavior of the non-lobotomized animals. Brody and Rosvold speculate on the implications of this for the human family, but note that the effects of psychosurgery on interpersonal relations within the structure of the family have not yet been ascertained.[7] If the small society is a survival mechanism for higher mammals, it is even more so for man whose life is carried out entirely within small primary groups (refs. 13 and 39) which are ordered into larger social structures (refs. 17 and 31). It is surprising, therefore, to find so little published work in either psychology (ref. 19) or medicine (ref. 5) where the social structure of groups of individuals under stress has been varied and analyzed for possible differential physiological and phychological effects.

With the development in man of a larger cerebral cortex, upright posture, opposable thumb, etc., man came to possess two extremely powerful and adaptable survival mechanisms: tools and language. Concomitant with the ability to communicate symbolically, *culture*

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[5] There is theoretical disagreement in social science as to whether these dimensions are also "levels" which are to some degree emergent, but this is not in question here (refs. 17, 18 and 31). My present personal position is that they are dimensions if one is studying actual human interaction. If, however, the focus is on long-range historical patterns, Kroeber (ref. 17) feels the term "levels" is more appropriate.

[6] I do not mean to raise the old mind-body problem here, but I do feel that personality, coming into being as it does through interaction with human and other objects in the particular social settings of a culture, has a conceptual validity in its own right.

[7] Brody is one of the principal investigators in a study of the effects of lobotomy on family interaction patterns carried out in the Department of Psychiatry, Yale University, and now being prepared for publication.

came into being and permeated (since it exists at explicit and implicit levels of awareness in the group, and on conscious and unconscious levels of the personality) man's *society* through the ways he ordered group life, his *personality* by the ways he reared his children, and perhaps even his *physiology*.[8] The obvious examples for the latter are cultural variations in nutrition and body manipulation (trephining in Peru, binding of feet in China), but even more subtly, as Mead (refs. 26 and 27) has suggested, in cultural attitudes toward injury and disease of the body which are deeply embedded in the personality, so that what is considered a trivial injury in one culture may be a significant trauma for an individual from another culture. For example, in New Guinea, attitudes toward cuts and wounds are very casual, and the problem is to make the wound close up as soon as possible; in Bali, where there is an extreme fear of any mutilation or injury to the perfection of the body, it is necessary to keep the smallest cut open for several days with continual wet dressings to combat early closing and festering.[9]

The main problem, as Mead says, is not to think of the effects of culture solely "in terms of a generalized raising or lowering of thresholds so that few or many individuals will succumb to a disease condition . . . but as the *pattern* of interaction between the psychosomatic functioning organism and the cultural system" (ref. 26). It is possible that, upon investigation, such a pattern might be found to have a specificity similar to the sort of pattern found in the study of the individual psychodynamics of particular illnesses.

All of these interrelated systems—culture, society, personality, physiology—can, and usually do, respond adaptively under conditions of stress, and stress can first become manifest in any of the dimensions.[10]

By way of illustration, let us look at a few of the many paths through these systems, while at the same time moving back and forth between the implications for culture and society and for the individual. A useful focus for this task is the stressful problem of chronic illness.

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[8] No dogmatic cultural determinism is meant. What is meant is that culture definitely does affect, with varying degrees of importance and as only one of numerous factors, the nature of the other systems.

[9] It is a speculative, but interesting and possibly testable, idea to wonder the extent to which American and North Korean soldiers show varying emotional and perhaps physiological "shock" reactions to wounds of comparable severity which might be related, in some part, to differing cultural feelings about damage to the body, and the necessity for immediate and technically proficient medical attention. Certainly there are very different expectations for, and hence attitudes toward, medical care in the two cultures. The extreme rigors of combat conditions, and other factors might, however, serve to override the possible effects of such cultural differences.

[10] Fortunately for man stress usually occurs initially in only one or two of the systems; if severe stress leading to disorganization and breakdown were to occur in all the systems at once, the result would be catastrophe.

There are many reasons to believe that the upsurge (ref. 32) of chronic illnesses in recent years is significantly related to cultural and social stresses in our life, as well as to such factors as increased life-expectancy and control of communicable disease. The socio-economic distribution of coronary disease, hypertensive disorders, and gastric and peptic ulcer is not the same as that for tuberculosis and pneumonia. Nor can the former illnesses be as easily linked with the physical environment in terms of bad housing and unsanitary conditions. While physicians from epidemiology and public health are concentrating on the broader aspects of chronic illness, and intensive studies of small series of cases are being made by workers in physciatry and internal medicine, there has been, as yet, little factual or theoretical interchange directed at establishing connections between insights from intensive research and epidemiological statistics. A few pioneer studies have been made by Ryle, Halliday, Pearse and Crocker, Richardson, and Ruesch (ref. 5).

Ruesch's (ref. 35) investigations of social class, social mobility, and acculturation as significant variables in delayed recovery and psychosomatic diseases suggests that conflicting cultural values are a source of considerable stress. Such a conflict in cultural values exists in America between demands for competitive individual accomplishment and the dearth of sanctioned outlets for the satisfaction of passive dependent needs. Such needs are related to the structure of the American family [11] and its close ties to the occupational system. Our family has, for example, been stripped of the economic function carried out by the family as a unit in agricultural and peasant groups. It has been pruned of generational and collateral kin to enable it to be more mobile—both socially and geographically. All of this is adaptive in terms of adjustment to an urban, technical and industrial, occupational system. But they are side effects. Because of its small size and the frequent breaking of community ties through mobility (both kinds), emotional relations between all members are greatly intensified. Since our culture emphasizes independence and personal accomplishment, the child's close attachment to the mother must be resolved. This is difficult, and more than likely to activate deep-seated dependent longings, and this process is not a change, but a culturally patterned occurence.

Our culture provides few defences for this stressful problem beyond suppression of the need. Alternatively, an individual can withdraw from the main stream of competitive life into religious, artistic, or academic spheres. He can become downwardly mobile. At a less

[11] We are here speaking of the family in urban middle class life; and, indeed, most of the remarks on American culture in this paper apply most directly to the middle class.

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sanctioned level, he can participate in such sub-cultures as the criminal, the sect, and the homosexual.

Parsons (ref. 29) has suggested that our culture is increasingly sanctioning another alternative solution to such a problem: an individual can become sick. In the values of any culture, illness is always more than a somatic or psychological "condition" of the body. The illness must be legitimitized; as in the case of "ague" in the Mississippi Valley during the latter part of the nineteenth century (ref. 1) it is quite possible to die of an illness without ever having been accepted by the community as sick. As Parsons points out, the "sick role" is in many ways a useful and advantageous defense mechanism in stressful situations not only for the individual but *also* for the society. The individual who is sanctioned as sick by the society (and it would be of little defensive use to him if he were not so recognized) is thereby brought into contact with forces of social control exemplified by the physician, and is bound by the "contingent" legitimization of his illness to "try and get well." Such immediate therapeutic social forces are not available to society if an individual chooses, rather than through illness, to defend himself by taking the role of criminal, eccentric, hobo, etc.

If our culture, under the stress of modern life, exhibits strain by shifting its values so as to legitimize illness as a defense, this shift might well have the result of placing certain sectors of the social structure under stress. This, indeed, seems to be happening. More individuals may be choosing illness as a defense, but the American family structure cannot meet the problem. Since the family is small and emotionally "tight," the illness at home of the father disrupts the mother-child relationship, illness of the child makes it more difficult for the mother to meet the needs of the father, and if the mother is sick, the whole family is emotionally "under-supported." As suggested by Parsons and Fox (ref. 30), the growth of hospitals, particularly to their present strategic importance, is not solely a matter of advances in medical knowledge and its application in an increasingly expensive and exacting technology, but is also a response to a shift in family structure which is itself linked to the occupational structure. It is not too inappropriate to speak of the growth of hospitals, along with health insurance plans, as a defense mechanism developed as a result of strain in the family structure which was under stress because of shifting adjustments to strain in the cultural value system.

Until fairly recently, hospitals, as specific sub-structures in the society, reacted to the greater pressure placed on them by increased technical attention to the "disease entity" rather than to the patient. If the patient was, however, in the "sick role" in terms of the foregoing

discussion, his actual "disease" was but one of the many needs focused in his role. It is this problem that Elton Mayo (ref. 24) is discussing when he speaks of "frightened people" and the need of the physician to make two diagnoses: one of the organic ill, the other of the need of assurance. In our study [12] of a small psychiatric hospital we felt that there were at least five places to which a patient would look for satisfaction of his immediate needs upon entrance to the hospital. These were: his physician, the nurses and aides, the use of the physical space of the ward in a way he found most comfortable, the other patients, and his own body. We felt that the patient often used his own body and the other patients because he could not obtain sufficient assurance from the other three places during his first few days in the hospital.

Dr. Stanton's paper in this symposium has shown us some of the ramifications of strain in a hospital. I wish to cite one example from our own work as it illustrates a point of great importance. At one period of our observations, there was considerable confusion over the policy to be followed in administrative and therapeutic procedures. This confusion lasted for several months. During this time, each of the four main groups making up the hospital—senior staff, resident staff, nurses, and patients—began to withdraw its full participation, to intensify its intra-group interaction, and to erect sharper boundaries between itself and the other groups. While each group was consciously aware of what it was doing, and there was much discussion of this between group members, there was an amazing lack of awareness on the part of any one group that the same thing was happening in all the groups throughout the system. It is obvious that an adjustive process of defense and stress reduction was taking place *within* each group: the senior staff gave up their insistence on certain administrative matters and withdrew from the daily work of the hospital; the residents cut down on their time with the patients and lost much of their emotional interest in training; the nurses increased the formalization of their routine and fell silent at daily conferences; the patients intensified their clique relations and assumed greater control of recreational and other activities making up their daily life. Thus, looked at from the point of view of each primary group, stress was *reduced* by the defenses used; but, looked at from the point of view of the system as a whole, stress was *increased* as all groups were still part of the hospital.

Such processes are not unique to a hospital, and almost exactly the same sequence has been reported by Rice (ref. 33) for a factory. One

[12] Now being prepared for publication.

interesting aspect of these processes is that they seem often to go on below the level of conscious awareness, and to cause considerable administrative difficulty and confusion when the attempt is made to carry on the conscious daily work of the organization as usual. A second aspect of importance is that what is adaptive for the primary group may not be adaptive for the system of which it is a part. It is all the more necessary to emphasize this because of the truly *basic* importance of primary group interaction as a defense against stress. Homans (ref. 13) has excellently presented this point by showing the importance of, and similarities in, small group processes in as diverse a range of societies as a bank-wiring room in an industrial plant, an Italian street-corner gang, and a Polynesian community. Grinker and Spiegel (ref. 11), Lidz (ref. 22), Shils and Janowitz (ref. 40), Stouffer (ref. 41), and others have all delineated the importance of the primary group for morale in combat situations. The soldier's motivation to fight is derived much more from his need to protect his primary group and to conform with its expectations than it is from any striving toward strategic or political goals.

The great importance of the primary group must not, however, blind one to the significance of extra-group determinants of behavior both within the primary group itself, in terms of the personality structures of its members, and beyond the boundaries of the group, in terms of the social structures of which it is a part. The goal stated long ago by Mayo for industrial research is crucial here: we must learn more about the incorporation of the primary group within a structural setting so that the ends both of the larger structure and the primary group will be served simultaneously.

If the alternate stresses and strains in the culture and the larger units of the social structure place too great a load on primary group integration and breakdown ensues, then the individual is indeed thrown back upon his own personality and body.

We have traced a number of problems seen mainly in system terms. Turning specifically to the individual, let us take the stress situation brought about by premature or unexpected death in the family. The bereaved person experiences both cognitive and emotional problems—not only is his familial role drastically changed, but there is a shifting of his social roles in many other areas of life. In any society the bereaved must go through the emotional process of "grief work" (ref. 23). Such grief work is inevitably painful, and the individual is helped both to begin the process and to hold it within bounds by ritual mourning and institutionalized aid from the society. A great many societies formalize the replacement of the lost person, often by offering as close as possible a substitute—for practical and emotional rea-

sons— as in the levirate (marriage to husband's brother) and sororate (marriage to wife's sister). As Murdock (ref. 28) has shown in an analysis of 250 societies, these forms are preferred in 127 groups, occasional or absent in 58, with no data on 65 others.

As mentioned earlier, our society mainly holds out to the bereaved individual only the cultural defenses of suppression, denial, and the suggestion that the loved one is probably easily replacable—though formal methods to accomplish this are not offered. It would be interesting to relate the incidence of delayed grief reactions (and attendant problems) in our society with the cultural emphasis on suppression and denial. Equally, any role transition involves unsettlement and hence a period when regressive needs come to the fore. Some expression of these needs is helpful, and is aided but held in check by ritual—as in the wake. Our society frowns on the open expression of emotional needs, and we tend to suppress them.

It is one of the discontinuities, one of the areas of potential stress, in our culture and society that we offer little help to the bereaved person although our family structure, as we have seen, is such that it intensifies the emotional importance of members for each other. In terms of practical assistance, the impersonality of our culture is shown in the development of life insurance, inheritance laws, etc. In terms of emotional assistance, we have few formalized aids, and hence the individual does not have a definitely known "map" or "path" to guide him through his anxiety.

Because of strain, then, in our culture and society which offers inadequate defenses, the bereaved individual is placed under heavier stress and thrown back on his own personality and its defenses. At the extreme, this may mean that he solves his conflict through psychological incorporation, and assumes much of the behavior of the lost one. If too great a strain is placed on the personality defenses—and incorporation is dangerous because the lost one was in all probability not only loved but hated in some respect—then the solution may shift to the physiological system as Lindemann (ref. 23) has suggested for some cases of ulcerative colitis. As he has said, the key question to ask the ulcerative colitis patient is, "Did you want to be like him?" The answer is usually a variant of, "For God's sake no!"

The general problem of "separation reactions," not only of death, is one with many military and civilian implications in the world today. A cross-cultural study of how other societies meet the problems of death, grief, and separation would be likely to yield much of real value—especially if it were possible to correlate the extent of individual pathology with the adequacy of the cultural and social defenses. One index of the adequacy of these defenses might be the

comparison in various societies of the survival rate of bereaved persons. Another study might be to compare the adjustment of war widows in several countries.

From all the foregoing material it can be seen, either for the culture or the individual, that as one moves through the linked systems of culture, society, personality, and physiology, the defenses to strain are at each step deeply influenced by cultural values and patterns. Another way of saying this, placing the emphasis on structure, is: What is strain (and defense) for one system is stress for another. This is not made explicit in the conceptual plan we have been given for this symposium. In this plan factors internal to the organism (and for this paper the "organism" could equal the body, the personality, the society and its subdivisions, or the culture) are seen as a system (stress leads to defenses, to strain, to change and breakdown), but the "external load" or "external environmental conditions which are more or less supportive" are left as relatively undifferentiated factors. The attempt here has been to show that the external load and supportive environmental conditions are themselves parts of other systems, and that all these systems are intimately interrelated. These ideas are close to those expressed by Ryle (ref. 37), Galdston (ref. 9), Halliday (ref. 12), and other writers on social medicine[13] where the etiology of disease is seen as a function of "the nature, structure, and operation of the total milieu into which the individual is born, in which he grows and lives, and wherein he reproduces his kind" (ref. 10).

A basic idea of this paper is that just as the processes of the body and the personality are natural processes, so also are culture and society a part of nature (ref. 17), and all are systematically linked together. There are many real therapeutic possibilities in the natural forces existing in culture and society. Such an approach means vastly more than manipulation of the environment, situational care, or the prescription of attitudes. Maxwell Jones (ref. 15) has recently shown us the beginnings of what might be done with "therapeutic communities."

It remains to raise the question under what conditions a given external load is, or is not, a stress. On the psychological side there is the problem of motivation, and as Lazarus points out: ". . . because people differ in motivations and in the ways they deal with them, it is never really possible to define a general stress situation. . . . Stress, therefore, is really a secondary concept, built upon the relationship

[13] A term obviously not to be confused with "socialised" medicine which occurs in a very different frame of reference (ref. 34).

between a primary concept, motivation, and the situation in which motivated behavior appears" (ref. 19).

As Lazarus emphasizes motivation (which is determined in part by culture), we must equally emphasize that cultural values and social structure will play a major part in whether an external load becomes a stress. Stouffer's concept of "relative deprivation" (ref. 41) is illuminating here: he found, for example, that contrary to popular expectation a minor but significant proportion of Negro soldiers preferred to be stationed in Southern camps because *relative to* Negro civilians, the Negro soldier had a higher status in the South than he did in the North.

An example of another sort, showing culture as a variable, is the differential response to great psychological and economic deprivation among the Plains Indians late in the nineteenth century. A revivalistic movement, the Ghost Dance, emphasizing the return of all dead Indians and the removal of the whites, swept through the Plains tribes in 1890. But, for the Sioux the Ghost Dance became a battle cry to war, for the Pawnee it led to a peaceful renaissance in culture, while the Navaho rejected the dance as their values included great fear of the dead, and the return *en masse* of all dead Indians was viewed with horror.

Again, one could point to the very different response to internment camp life on the part of Japanese Americans in the United States when contrasted with Americans in Japanese camps in the Philippines. As Leighton (ref. 21) shows, leadership among Japanese Americans in the camps emphasized community guidance through a council of elders and avoidance of individual responsibility; whereas leadership developed by Americans emphasized the vigorous individual who, after popular election, assumed personal responsibility. Such differences led to much misunderstanding between the governors and the governed in both the United States and the Philippines (ref. 43). Finally, the Japanese nation reacted quite differently to the stress of occupation than American popular opinion had conceived it would. Benedict (ref. 3), however, writing before the close of the war, was able to predict the reaction which did occur from a study of Japanese culture.

The ideas presented here have been speculative and illustrative, but future collaborative research between social science and medicine need not be so. Operationally, empirical studies of the cultural and social context of stress and illness could be carried out: (1) with families in real life; (2) experimentally by varying the social structure

of small groups placed under stress; (3) in specific sub-structures of our society such as the Army, hospitals, and factories; and (4) by following the health and illness of communities over time in our own and other cultures.

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Discussion

QUESTION FROM FLOOR. One question has been on my mind almost all afternoon and I think this last paper may perhaps highlight a possible answer to it. It has to do with communication of anxiety, the spread of panic and disaster. I can point up the question by a visitor's view of a minor wood alcohol disaster seen in a small hospital in Germany during the period just after the Ruhr had been taken. Some displaced persons had in a moblike way broken open a tank car of methanol. A number had died, the rest were in the hospital. It was observed that among the people in the hospital who had drunk the alcohol there was very little evidence of anxiety, while in the staff of the hospital there was a great deal of excitement. It seemed as if the communication of panic or anxiety was lacking among these patients although they were seeing each other die on either hand. It occurred to me that one of the reasons for this might have been the unstructured character of the group, that they had had no team activity, no means of identifying with common roles, or through imaginative participation in each other's roles. In effect, they had no particular role. The remark that Dr. Caudill made with regard to the greater apprehensiveness raised in a team accustomed to work together might have great pertinence in studying the avenues of spread of anxiety or panic in times of disaster.

DR. CAUDILL. I think that is a very important and valid way to approach the problem; that is, culture including the organization of the group, enables people to distribute the load anticipated ahead. This means that they get anxious faster, but they are also able to develop methods of handling it. If you know an air raid is coming, you are anxious and you can do something about it. If you do not know it is coming, you do not get anxious but you may get killed.

COL. GLASS. I would like to corroborate what Dr. Caudill has said, that if the doctor shuts off the casualties, or someone shuts them off, they come out in all sorts of odd and bizarre forms. We have had a lot of experience with that in the Service and are quite aware of it. For example, I ran into a battalion surgeon who felt that, "as long as I have got to stay here, they have to stay here too." He evacuated none except battle casualties, treated fevers of 104° by giving them sulfa, and then sent them back to the foxhole. It was amazing, in looking over the battalion in the epidemiologic manner, that he had very little illness. There were no NP cases but a lot of self-inflicted wounds, and a large disciplinary rate in that battalion. We also find that with troops like, let us say, the Korean troops. They may not have NP casualties, but there is a large desertion rate. I am willing to subscribe to that entirely. We cannot "shut off" the casualties.

THE RECIPROCAL RELATIONS BETWEEN INCENTIVES, MOTIVATION, AND STRAIN IN ACUTE AND CHRONIC STRESSFUL SITUATIONS*

HENRY W. BROSIN, M. D.

The other speakers in this symposium have furnished numerous examples of the reciprocal relations between motivation and strain in both acute and chronic conditions. Indeed, it is probably difficult to describe a situation involving social pressures in an army setting without bringing in these concepts, at least by implication. The working dynamics of leadership, morale, endurance, battle fatigue, combat exhaustion, unit loyalties, group cohesiveness all involve some assumptions which are now more clearly recognized. I will limit myself to examining a few of the basic assumptions in the hope that this exposition will assist an understanding of an army unit be it a squad or regiment, a bomber, submarine crew or an artillery battery.

Reciprocal Relations Between Internal and External Pressures in the Etiology of Neuroses and "Combat Exhaustion"

Since Freud described some of the reciprocal relations between external precipitating events and the readiness of a person to be affected by them by means of the familiar diagram similar to the parallelogram of forces (▱), many writers have stressed the complementary relation between these sets of relations (ref. 8). We now assume the organization of the personality, both internal and external, to be an equilibrium, more or less stable, but dependent upon current events for its relative stability. Much as we would like to think so, we now know that few men have an identity as stable as a rock, but rather we now see that, like a fluid, we can govern much behavior by providing the proper pressures and proper outlets. Traffic control may be a good model. A good soldier is not merely created by encouragement, or even by being permitted to be one under handicaps; he must be given the wherewithall so that he can be one

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at all. It is an old Army saying that an order is not an order unless the facilities for accomplishing the mission are available. Hence it is incumbent upon leaders to provide recruits the means to be good soldiers. The concept of the complementary relationship between external stress and internal disposition has immediate relevance to the training and maintenance of the health of soldiers because it has helped us examine both more closely. It is well known that some men are so markedly predisposed to neurotic symptom-formation, acting-out or somatization that they are highly vulnerable to even minor assaults upon their integrity. We need not here take time to wonder about the origin of this fragility. It may be due to inheritance or early training, or both, without markedly altering the military problem of how to get maximum duty from them. Insofar as possible, the processes of selection, adequate training, proper assignments and reassignments, leadership and unit loyalty can be used to build up the external supports and fill the internal needs of the vulnerable soldier. It is surprising how many men can do good duty with these supports until either overwhelming strain and fatigue and/or a specific blow to ego integrity causes a breakdown. Both Colonel Glass and Dr. Bond have given us examples.

Probably one of the important lessons we learned from World War II was that even after men with massive physical and psychiatric incapacity had been selected out at some early stage of training, it was not easy to predict how long or arduous a service a man could give before he failed. The studies of Ivan C. Berlien, using several induction stations as controls, supports the thesis that if a man is willing (or well motivated) and has reasonably good supports from his unit, he may perform excellently up to and including prolonged combat, even though he has had a fairly marked neurotic adaptation from early life on to the time of induction (ref. 45). Although I cannot cite specific references in the literature, I have seen at least three or four men myself and have heard references in conversations with officers to others, for example, Colonel Glass's, where a soldier has been actively hallucinating and schizophrenic in at least some of his thinking, but has continued to perform duty in an approximately conventional manner. As you know, this is not an uncommon finding among seamen or itinerant workers. Obviously we must revise our concepts of the nature of the neurotic or psychotic adaptation or "way of life" to include these observations. Stress differs both qualitatively and quantitatively when acting upon a man in an individual setting. We will learn most about the reciprocal relationships by close individual study of each man in his unit if we really want to get at many of the problems under discussion. There is no doubt that ques-

tionnaire methods of inquiry and sociometric analysis of data from large groups furnish us with much interesting material (ref. 16).

Dr. Caudill also mentioned the works of Janis in addition to Stouffer. This material may help us support more logically the need for more and better propaganda at optimally selected stages of training, or improved rotation and replacement policies, but it is doubtful if it will help us understand the more intimate details of a soldier's ability to perform duty during various stages of his career. This seems to me to be illustrated by the more recent Korean studies of the "cold injuries" and the "self-inflicted wound" casualties. Insofar as the internal pressures of a man in his unit exert the prepotent influence in his failing adaptation, it is essential to understand more of his background, his past successes and failures with significant people, his conscious and unconscious fantasies and dreams. The external event which is described as the "trigger" for his failure may only be a symbol for other more important forces, or may be only a rationalization of substitution phenomenon. Where the trigger event has a high specificity for a particular man, often after he has been under prolonged or considerable strain thus depleting his reserves for building up defenses, it is known as the "Achilles heel" phenomenon (ref. 14, p. 52). Although this use of the term "trigger event," i. e., a specific event which had the ability to cause disorganization, is well known, it is worth calling attention to it in order to differentiate it from the quantitative concept of a significant event usually described as "the straw that broke the camel's back" (ref. 14, p. 51). In the latter situation it is assumed that a well organized man becomes depleted and worn through prolonged duty until his defenses, which have up to this time served him adequately, now no longer function well enough to protect him against even small insults. This sequence of events is familiar to everyone who does not lead a thoroughly protected life because fatigue states with characteristic symptomatology are plentiful, especially in a highly competitive society and in some homes with children.

Close examination is often required to determine accurately the reciprocal relations existing in the trigger event between the specificity (Achilles' heel) and the quantitative burden (the straw). Although this audience does not need the caution, you can all remember the time when only the quantitative aspects of stress and strain were given any credence by many physicians. The fact that a relatively common event acted as a detonator fuse, such as fulminate of mercury, to set off a large charge of emotional dynamite was not commonly accepted before 1918 or even 1940. This is comprehensible since it required some speculative attention and ability to piece together bits

of information into a meaningful mosaic pattern, a process usually called interpretation, in order to understand in what ways the man was vulnerable and how the insult, however commonplace, was able to set off a spectacular disorganization.

This type of interpretation is also essential in order to define more precisely the true meaning of acute or chronic stressful situations in keeping with introductory statement furnished us by the sponsors. The defense mechanisms undergo certain changes in structure or function with increasing external loads, and such changes may be regarded as "Strain." It is also pointed out that whereas the first part of the symposium is devoted to the physical defense systems, the second part is designed for "clarification of the nature of the load and the reciprocal relations between the load and the defense functions inherent in the predictive or anticipatory nature of psychological processes." The third part displays the "interaction of different categories of load—such as trauma plus the anticipation of death—and the significance of such interaction for medical care."

If the observer has little or no ability for seeing the defenses utilized by various men in a military unit, or changes in their quantity and quality, he will not be likely to know that sudden displays of unusual conduct *are not* irrational visitations without much apparent cause, whereas these outbreaks have really been building up for a long time. An example is furnished by the corporal who has strong needs to receive more recognition from his parent-surrogates than his siblings. His insatiable greed motivates him to work hard at times even though he could not always sustain this effort at high levels. His competitiveness causes him to be unpopular and his lieutenant sensed the difficulty including the corporal's wish to rival him also in the eyes of the captain. This uneasy equilibrium is maintained by means of various defenses until they are in combat, when the corporal must face up to the fact that the lieutenant can send him to his death. The long smoldering hate, not evident in previous estimates of morale and efficiency reports, erupts and the probability is high that this would be described as an acute reaction to combat *due principally to* external stress of the immediate battle situation, whereas it might better be described as an *acute* decompensation following from a long-standing chronic condition of stress in the unit and made possible by the early rivalry patterns of the corporal.

The "problem of the observer" as it is known in physics, or the "counter-transference" of the therapist in psychoanalysis enters into such descriptions of an acute versus a chronic maladaptation, whether a given set of defenses are normal or abnormal (and these must be defined more carefully), and whether the specificity of the traumatic

event is high for a given man or relatively minor. We may recognize easily that the loss of a significant strong supportive father-figure, or of a buddy may reflect various grades of specificity in an individual but some of the variants on the theme are often unclear. The degree of erotization, of his feelings for his buddy, the feeling of responsibility to the mother of the buddy to safeguard him, the secret wish to marry his wife or the dreadful thought that "I'm glad it was him and not me," are samples of the complexities. I think Colonel Glass and the men who followed him in Korea have done notable jobs in educating the line to this. There is a good deal of interest shown by the hard working line officer in this type of observation.

The effort has been made to define such concepts as acute and chronic stress and strain, the reciprocal relations between internal and external pressures, and the problem of the observer of interpersonal relations in a military unit. Inherent in this discussion are several concepts which can be examined more thoroughly.

Changes in Reciprocal Relations Between Incentives and Stress at Various Stages of a Soldier's Career

Many writer's have emphasized the need to view the soldier as an individual with his own needs and means of satisfying them, who is placed in a series of situations more or less related to each other by virtue of military necessity. To discuss a soldier's defenses when he came into the Service, how they must necessarily be altered in order to live comfortably, *what the gains* and *losses* of such alterations may be, and how he may become vulnerable to a new set of interpersonal traumata, it is necessary to keep in mind the *man's individual differences* and the *specific nature* of the military units in which he was a part. It is, as it were, a moving picture of an organism making changes from moment to moment in order to survive. The progress of adaptation can best be followed if it is seen in different phases of organization (refs. 1, 12 and 14). Although adaptation is highly individual there are enough similarities present in the more frequent patterns to make a description worthwhile. Simmel in 1921 and 1945 described characteristic changes in ego functions of a recruit in training, while Bartemeier, Kubie, Menninger, Romano and Whitehorn in 1945 expanded this concept to describe various social and psychological forces affecting the recruit which are important to him in his development into a combat soldier.

The cultural background of the American young man does not provide strong motivation for him to fight the enemies of his country. At best he has only the wish to comply with requests made upon him,

but our leadership has not stressed the urgent need to defend ourselves against aggression nor have we the motivations of hate, fear and revenge taught to other nationals, or the evidence from being invaded with its attendant destruction.

> "The American [youth] has been brought up to demand respect for his own individuality and independence, to assume his right of self-expression without limitation of caste or authority. He has been taught a code of behavior characterized by what is called 'sportsmanship'; he believes in fair play, he does not hit a man who is down or one who is weaker; he does not 'hit below the belt.' He has grown up in a period of disillusionment. He has lived through years of economic depression and social change, a period in which war, patriotism, atrocity tales and world peace organizations were repetitively debunked and depreciated. Finally, he has lived in a country which for a number of years has evaded facing realistically and directly the gathering momentum of world disorder" (ref. 1, p. 364).

This description is in most respects as true now as when it was written in 1945. It illustrates the reason for a relatively low motivation from the very outset of his career as a soldier, and it is not improved by the bitter fights among our leaders, both civilian and military, which are so well advertised or even accentuated by the newspapers. It is not easy for a young man to find a stable father-image in whom he can have complete confidence and thus build up the internal strengths to be an aggressive soldier who is enduring hardship and risking his life for a worthwhile cause under leaders who give him a fair chance to come home alive. Dr. Bond and Colonel Glass defended what I think is a monumental observation. I have no doubt that reasonably compliant young men can be trained to be good soldiers once they pass a crucial phase in their early training. If they can get "over the hump" by tailoring their intake and output to those of the group, they will gain a new identity which is incorporated into the group and sustained by it. However, it seems to me, that better motivation from the national leadership, either verbalized or unverbalized, would be a very real help to get the inductee over this hump.

I am merely reiterating a truism which I first had occasion to understand clearly when I entered the Army in January, 1941, and tried to make succinct at that time. It would be very helpful to the Armed Services if the various branches of the Federal Government concerned with policy directed those agencies responsible for dissemination of information to work out and utilize better methods to admit consciously that we are at war and that public and private encouragement be given

to young men to do their duty. This, of course, would entail some civilian sacrifices beyond payment of high taxes and giving small amounts of blood to the Red Cross, and is therefore probably not to be expected. It would be useless, however, to discuss the reciprocal relations between motivation and stress without pointedly commenting on the fact that the American is expected to make a highly complex change in his personal identity from civilian to soldier with a minimum of soc . supports. The job of the Army to train these otherwise splendid men to become combat soldiers is made much harder because of the lack of strong civilian presure. It is not easy to induce a man to surrender his old identity when he carries within him a continuous scepticism about the value of the war, the interest of civilians in his welfare, and the corroding thought that many of his countrymen are waxing fat at the cost of his life. The Army leaders have accomplished a great deal to keep a fighting army in the field in spite of the enormous obstacle presented by the low level of civilian motivation for war. This apparently becomes possible because a man in becoming a soldier gradually gives up many of his old ties and takes up new ones. He learns how to get at least some satisfactions for his own essential needs by acquiring a new identity in a unit. Leadership of such a unit demands that all possible skills and devices be used to foster and maintain this new identity, i. e., a new defense against trauma and new ways of negotiating between his needs and his conscience. Time does not permit a description of this transition period during training, although a few of the principal changes may be mentioned:

> "This requires the exchange of new love objects for old, male objects for female, regimentation for initiative, subordination for independence, group unity and purpose for individual identity and purpose and the substitution of new beliefs for old. . . . Destructive goals are substituted for constructive goals, and new illusory devices are utilized. . . . It is a new and strange life which imposes severe deprivations in exchange for fewer, different and more restricted gratifications. Hence, for most men, adjustment to it requires either a constant sense of pain and discontent, or a repression of this with exploitation of the available secondary gratification, or both" (ref. 1, p. 365).

Time does not permit a statement about the continual change in adaptation required at all other stages of soldier's careers such as advanced training, the staging area, embarkation, oversea training and the many periods of suspense, waiting and unexpected movement until they get into combat. These topics will be covered in part

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by other speakers. All of these adaptations at different stages illustrate the thesis that there is a reciprocal relation between motivation and strain. Everyone knows that a winning team does not exhibit its fatigue or bruises very much. In the same way a winning army has less "combat exhaustion." Colonel Glass informs me that it was unusual to see an artilleryman in a psychiatric treatment center when position warfare was stabilized. Such concrete examples illustrate the guiding principles to be utilized whenever possible.

Teaching Model, for Ego Functions

Although analogies are notoriously fallacious and space-occupying models of various ego functions will come to grief if pushed too far, it may help some of us to teach the operations of the defenses by using the Freudian model (refs. 7, 9 and 10). Such metaphors as depletion, exhaustion, intake, supplies, substitution, give us a graphic visual picture of psychological operations which may not be as easily grasped otherwise. They usually help also in studying such adaptive processes for *reducing the external* pressures or effects from them: *Denial*, *avoidance*, *repression*, *amnesia*, inhibitions, emotional detachment, failure of an organ, renunciation of control (as in obsessional thinking of divided thoughts), projection (blaming others), wit, clowning, rationalization and self-vindication. Maslow and Mittleman describe the following devices for reinforcing internal defenses: dependence, desire to be cared for, submission, obedience, ingratiation, self-abasement, turning against oneself, defensive hostility, need to control or dominate, self-aggrandizement, reaction-formation as in overcleanliness, elation with denial of reality threats, gratification of bodily urges as a solace as in overeating, denial of danger by recklessness or "tempting fate," use of superstitions, ikons, and religious beliefs. Other means of attempting to reach goals in spite of obstacles include: compromise, limiting goals, doing and undoing to alloy guilt, rigid regulation, substitution and displacement, giving vent to occasional violence and partial self-injury (ref. 13).

Bartemeier and his colleagues summarize the ways in which a soldier meets the increasing stress of combat with its attendant physical lowering of resistance to trauma, the impaired interpersonal relationships, and the insistent emergence of the more primitive motives as follows:

"On the other hand, there does seem to be a group of normal defenses against these noxious factors and an even larger and

perhaps more important group of abnormal defenses. Among the former one must list:

(1) the significance of group unity in which the factors of group esteem and group idealism are quite independent of personal attachments;

(2) the positive personal attachments to the individuals of this group with whom he shares the dangers;

(3) the inner disapproval of 'quitting' or being 'licked' with the danger of incurring group or parental censure;

(4) the assumption of confidence in leadership and command;

(5) the habit of obedience and disciplined behavior resulting from his military training, particularly strengthened when there is military mastery of the tactical situation in his Army (adequate air cover, artillery support, replacement, communication and supply) and finally the increased psychological and physiological vigilance and preparation for aggression stimulated by the excessive excitement and danger" ref. 1, p. 368.

Dr. Therese Benedek wrote a book shortly after the war in which she describes the vicissitudes of women who have lost their husbands to the war. Actually I found that a good many soldiers and civilians have found this a valuable guide to study interfamily relations (refs. 2 and 3). The whole theory of interfamily relations is covered by Dr. Spiegel's work. His report is in a preliminary form now; I hope it will appear soon as a publication of the Group for the Advancement of Psychiatry. It is one of the most important additions to methods of studying groups of people in intimate family relations. In addition to the works mentioned by Stanton, Schwartz, and Caudill, there are other useful studies by social anthropologists and social psychologists. I think that psychiatrists will have a very real contribution to make for Army purposes by showing what the primitive relationships and interactions are in the family setting. Dr. Bond gave enough examples this morning to illustrate how there is an immediate carry-over. If you know more about how the various siblings act in the family pattern, you will be able to deal more satisfactorily with this pattern when you recognize it in the adult soldier who has been under pressure.

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Discussion

DR. BOND. I would like to say one thing before we close. We should not think of combat and war only as stressful situations for the soldier. Many people enjoy war. Many people enjoy combat. They enjoy the regressions which are forced upon them. Many people love to leave their wives and children and responsibilities. Many love to find other wives, children, and responsibilities in other sections. Many people love shooting and killing; they get a great satisfaction out of this. I think we should not overlook this fact, because I think it is a fact. I cannot think of any better illustration than being in a fighter group headquarters or in a fighter group when the group comes back from a big kill. You do not see a lot of depressed and anxious people at all, you see some very heady folk who are feeling in tip-top shape. It makes you have a rather cautious view of the human race when you see what an enjoyment combat can be. I know another man, an outstanding ace, who knocked down five German planes one Easter morning. This man was far from having a bad time that morning; he was having a wonderful time. He was the first to tell everybody and it was very impressive.

One other little observation is that I would like to echo what Colonel Glass and Dr. Brosin mentioned, that the people most successful in

combat were far from most successful in civil life. I think we ought to remember that there is a big difference between being a warman and a civilian. It might take entirely different qualities. We should not expect that people who are happy homebodies would be the natural people that we would want to send out to be our warriors. Very frequently they are just the reverse and I think it is a most important consideration. There was a 19-year-old fighter pilot who had finished two tours and he had had a very happy time of it. I asked him, "What would you do with these boys that get afraid to fly?" He said, "Gee, doc, maybe they do not like it, why don't you give them something they would rather do?" This shows a remarkable attitude. I think we should take many of these things into account or we will get a little off base as to how horrifying and how stressful war is all the time.

COL. GLASS. In the ground forces there is quite a quantitative difference. We recognize what Dr. Bond says and it is quite true that combat flying, particularly with fighter planes, is really quite enjoyable for many men. We see less of the enjoyment of combat among the ground forces. As a matter of fact, the same gentlemen that enjoyed combat in World War II complained bitterly when recalled for the Korean campaign. Somehow or other they had gotten over a certain phase. I would also like to point out that the ones that we find really enjoying ground combat are somewhat odd people. They may or may not be psychotic. Every once in awhile we see one of them who has successfully done a job; he has a battlefield commission and all of the medals and honors. Recently, in San Francisco, one of them calmly proceeded to shoot the cab driver in the head for no particular reason that we could find. Recently, I saw one who somehow or other got depressed about it after he got back home. But he did not seem to be depressed about the killing, because once he got over explaining that, the person that he killed did not seem to make much difference. His depression was somehow or other connected with some other problem that he had. So I think it is true that a lot of people like to leave their homes, go overseas and find new families, new wives, and so forth, but in actual combat itself the ground forces have relatively few people, as the Air Force does, who literally enjoy it.

DR. LIDZ: I would like to come back to remarks of Dr. Bond because I think they are extremely important. I am old enough to remember the first World War when people had great patriotic fervor and, not knowing very much about war except that people got to be heroes, they had to prove themselves. There were a number of men who were out together fighting and apparently enjoyed it. We did not see too much of that spirit during the last war, probably because of the state

of the nation at the time of going into the war, which in turn resulted from disillusion about war in the 1930's. I do think, however, that the New Zealand troops, at least in the early part of the war, had this great fervor and considerable liking of going into combat. To go to a somewhat greater cultural extreme, I might mention the Aegean Scout who was one of the best fighters in the Pacific. He could not have enough of combat and showed little combat fatigue. His great fear was that he was not going to be able to get into the fighting soon enough. I think it is necessary in almost all of these studies and considerations to differentiate between the inductee and the man who makes a career out of Army life because, as Dr. Bond just intimated, not all of us are cut out to be soldiers; some of us are homebodies. The man who goes into the Army as a career often finds the integrating positive life by being in the Army, and totally identifies with the unit and motivation of the Army. This is something that we can almost never expect to achieve in most inductees, but I think we might get confused in some of our studies of groups unless we make this clear differentiation between the two types of soldiers.

Dr. Sells. One thing about aerial combat that should be stressed is that it has a great aspect of impersonality. The problem of putting the bomb on the target, or getting your gunsight on another plane is quite different from the hand-to-hand experience. I think that, with that in mind, there is really not any contradiction between Dr. Bond and Colonel Glass.

WEDNESDAY MORNING SESSION

18 March 1953

MODERATOR

COLONEL WILLIAM S. STONE, MC

PSYCHOLOGICAL ADAPTIVE PROCESSES IN LIFE-THREATENING INJURIES*

CAPTAIN DAVID A. HAMBURG, MC

Many of the stressful life situations so far described in this symposium have been ones in which the individual's life is in danger. Considerable attention has been given to the combat situation, in which the person may be severely injured at any moment. Now let us consider the situation in which severe injury has *already* occurred. It is hard to imagine a life situation more universally stressful than this. Here the man's life is not only *potentially* in danger, but is clearly in actual, *immediate* danger. He may be in pain or shock; he may see the extreme concern of others over his condition; and he may be largely helpless.

The question naturally arises, from a psychological point of view, "How does he cope with it? How is a person able to adapt to such a stress?"

The behavior of the severely injured man provides us with one of the best opportunities for studying adaptive responses to conditions of extreme stress. This paper will therefore deal with adaptation, and particularly with the integrative functions of the central nervous system which are involved. An attempt will be made to present some of the common responses observed in a variety of psychiatric studies of such patients. The types of patients included in our own studies in Army hospitals are those with the following conditions: severe burns (refs. 1 and 2), organic heart disease (ref. 3), severe hypertension (ref. 3), post-surgical crises (refs. 16 and 21), and brain injuries (the latter from the studies of Weinstein and associates) (refs. 4, 5 and 6).

These observations have been augmented by other reports from recent studies in civilian institutions, including these conditions: severe poliomyelitis (ref. 7), cancer (refs. 8, 9 and 10), a variety of neurological disorders (refs. 11, 12 and 20), coronary heart disease (ref. 13), and others (refs. 14 and 15). In addition, observations of severely wounded battle casualties in Korea are available (refs. 16 and 17).

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Whenever we consider the extreme cases in any of these groups—i. e., the critically ill, we are dealing with patients in whom there has been some alteration in brain function. For example, where there is high fever, toxicity, large blood loss, direct brain injury, high concentration of morphine, or any diffuse impairment of brain function, the conditions under which the integrative functions operate have been changed significantly, even if only temporarily. These changes, which often lower the level of consciousness, impair complex intellectual functions; but they have other effects which appear to be distinctly helpful to the injured man.

The alteration in brain function seems to facilitate *a delay in recognition* by the patient of the serious nature of his condition. Rather than being hit all at once by the impact of grave injury, the patient *slowly* comes to realize how sick he is. Of course, if he loses consciousness completely, then he does not perceive the stimuli which would inform him of the danger. However, even those who do not go into a deep unconsciousness usually report, when looking back at the critical period, that realization of injury was slow to develop. The patient very often says, "I was too sick to know what was going on" or, "I just didn't realize how sick I was" or, "A few days after the worst was over, I suddenly realized how sick I had been, and I really got scared for the first time."

It should be noted that this reaction does not always *require* a serious alteration in the state of consciousness. It is seen very commonly in milder form in response to all sorts of disaster situations, including those not involving personal physical injury. The nervous system seeks to have a readily-available mechanism for holding off the impact of a threatening situation by delaying realization of its severity. This is usually the first in a series of mechanisms by which the organism avoids overwhelming, disintegrative panic.

The changes in brain function seem to make it easier for the patient to *restrict his awareness, to decrease pain perception* (ref. 19), and generally to *perceive only those elements in his environment that he wants to perceive.* But what does he want to perceive? What, above all else, does he want to believe? It is perhaps not too hazardous to state that, in these circumstances, most individuals want to feel that they will get well, and indeed that they are already on the way. The primary task of the integrative functions, under these conditions, is to make some resolution of the threat of death on the one hand, and the desire to live on the other. For most patients, this can only be done by minimizing awareness of the dangerous situation and/or by holding to a minimum their own emotional responses to the situation. Translating this attitude into its verbal equivalent, the severely in-

jured patient says, in effect, "I prefer to believe that I am not seriously sick at all; but if I must recognize that I am seriously sick, then I do not want to think about it; or, if I must think about it, I will not let myself have any feelings about it. Perhaps somehow it will come out all right."

Surveying all of the recent studies bearing on this topic, one may reasonably classify defensive psychological reactions to severe injury according to the way in which the person attempts to handle the threat of death. Three broad, somewhat overlapping, categories of defensive reactions are suggested by the observations to date.

Type 1. Processes which tend to make the patient feel that his life is not really in danger. The verbal equivalent of this orientation is, "I am not sick at all." Or, "It is only a minor injury, it is nothing to worry about."

Type 2. Processes which tend to make the patient feel that, even though his life *is* in imminent danger, it does not really matter—that is, he is not concerned by his impending death. Thus, he says, in effect, "Yes, I am going to die, but it does not bother me."

Type 3. Processes which tend to make the patient feel that, even though his life is in danger now, it will not remain in danger—there is something that can be done to correct the situation. He says, in effect, "I know how sick I am, but I think I will get over it."

It is important to note that a given patient is not limited to any *one* of these defensive responses, but may show different ones at different times, or combinations. Furthermore, these responses may be aimed either toward *combating the illness itself* or *combating the fear derived from the illness.* They involve not only conscious thought and voluntary action, but also, to a large extent, *automatic, nonconscious processes.*

Now let us consider some of the specific reactions seen in each of these three types of processes. Perhaps the most striking example of purposeful alteration in perception occurs in *denial of illness.* This refers to behavior of the first type, in which the patient simply does not recognize that he is seriously ill, even though he is quite capable of recognizing many other equally complex facts of his environment (ref. 1).

Denial of illness is well illustrated by the case of Mrs. B, a 28-year-old woman who died 2 weeks after being very severely burned. A few days after her injury, she developed the attitude that she was not seriously ill at all, but practically well. She was able to recall

clearly the circumstances in which she was injured, although she preferred not to think of it; she also recalled having been afraid of dying immediately after her injury, particularly when she first went to the operating room, but said that when she had survived this ordeal she knew that she would be all right. She felt sure then that she was practically well, that she would require little further care, and would very soon be back to a normal family life.

There are studies which describe similar denial of illness in a wide variety of neurological conditions. Weinstein (ref. 4), in studying patients with brain tumor, reported as follows: "A number of general patterns were observed. First, the patient might state that he was perfectly well and deny any sign or symptom of illness. Second, the patient might deny the major disability but lay stress on some trivial aspect of his condition (such as constipation) . . . Third, the patient might express some awareness of illness but attribute the manifestations to a benign cause . . . (such as a simple sore throat). Fourth, the patient might project the defect onto someone else. Thus, a patient denied that the paralyzed limbs were her own and claimed that they belonged to the nurse . . . Finally, a patient might state that the defects existed in the past, but that he was well at the present."

Weinstein concludes that "there is a reorganization of brain activity in which the patient denies whatever he feels is seriously wrong with him, whether it is a hemiplegia, a craniotomy, or a sense of inadequacy. . . . It may be better described as the manifestation of the patient's drive to be well, appearing in a new pattern of organization in the damaged brain."

Another interesting illustration of this phenomenon is the postoperative denial of amputation among battle casualties. Army medical personnel with extensive experience in caring for casualties of the Korean war report that it is quite common for postoperative patients who have just had amputations to wonder why the doctors did not take off the extremity when they had said they were definitely going to do so (ref. 17). Usually the realization that an amputation has actually been done begins to sink in within a few hours after the patient comes out of the anesthetic, but sometimes the loss of the limb will be denied for several days or a week (ref. 16).

Some patients, however, not only reject recognition of illness, but most or all of their current environmental situation as well. They appear to be largely out of contact with reality. They seem to be living, for the moment, in a new reality, in which they mobilize powerful protective forces in fantasy (ref. 1).

An illustration of this type of reaction is provided by a 19-year-old Army corporal who was severely burned in Korea. During the first several weeks after injury, he experienced a series of vivid hallucinations. In each of these he would first find himself in the midst of some terrifying catastrophic situation, only to be rescued by the intervention of a powerful God-like figure—with great relief following.

Thus the disoriented or delirious patient says, in effect, "I am not in this situation at all, but in a much better one—a more pleasant, familiar situation, or one that I mastered in the past, or one in which I am well-protected against all dangers."

Now let us consider the second type of response to severe injury. This is the case of the patient who recognizes the nature of his current situation, including his illness, and concludes from this that he is going to die. As other speakers in this symposium have pointed out, the patient's interpretation of any stressful situation depends not only on the actual nature of the situation itself, but on the previous life experience and personality of the individual concerned. Thus, patients who assume that they are going to die following severe injury seem to be in the minority and their expectation of death often appears to be determined in part by unresolved problems from past life. Whatever the source of this expectation, the expectation itself constitutes a severe stress and activates anticipatory behavior designed to deal with the threat. Here again, the physiological changes initiated by the injury may have a beneficient side effect on psychic function. For it is often observed that the seriously ill patient, tired, weak, in pain, comes to feel that what happens to him does not really matter. At the moment it may seem to him that to die is only to rest quietly and escape from his current suffering. This is sometimes seen in its most extreme form in severe battle casualties (refs. 16 and 17). When a wounded soldier is being brought back from a front-line outpost to the battalion aid station by some of his buddies, with great difficulty, he sometimes becomes overwhelmed with pain and exhaustion, and simply wants to give up. He tells them to put him down, to leave him where he is, and just let him rest. He doesn't care if he dies, it's better than going on this way. This is an instance of behavior that is *adjustive* for the individual[a]—that is, it makes him more comfortable and momentarily solves the most distressing part of his problem—but it is *not* biologically *adaptive*, since it may well lead to the death of the organism (ref. 22).

Another instance of the acceptance of and preparation for imminent death is that in which religious feeling plays an important part. Certainly this needs no elaboration for a military audience. Since many soldiers come from religious backgrounds, it is not too difficult for

them, in time of emergency, to mobilize powerful feelings of God's protection. While this is most often directed toward God's protection in keeping them alive, it sometimes accompanies the anticipation of imminent death, and in this instance its impact might be verbally expressed as follows: "I'm not afraid of dying because God will take care of me *after* I die." These two aspects of the use of religious feeling as an emergency defense often go together; that is, the patient feels that God will probably protect his life and let him avoid death, but will also take care of him in case he should die. Thus he is prepared either way, for whatever may happen.

We now come to the third and probably most common type of response to severe injury—in which the patient feels that, even though his life is in danger now, it will not remain in danger. That is, something can be done to correct the situation. The psychological mechanisms which accomplish this for the patient appear to have two major aspects—one having to do with processes going on *within* the individual's own mind, and the other having to do with processes going on *between* the patient and other people. At first, the patient is in danger of being overwhelmed by emotionally painful stimuli, and he usually handles the problem within himself by thinking about the situation only when he must do so, and even then allowing himself to have little or no feeling about it. He often seems indifferent, unemotional, perhaps even apathetic.

He may also have a memory loss for much or all of the traumatic life experience. Sometimes the memory loss is quite selective, excluding from recollection the most painful, threatening circumstances, but including memories of a few reassuring episodes that occurred during the crisis (refs. 1 and 16).

Virtually all patients, at one time or another, clearly demonstrate the type of thought process in which *a conscious effort is made to avoid thinking of an unpleasant experience.* This suppression of unpleasant thoughts and feelings is one of the commonest and most consistent observations in all categories of severely ill patients (refs. 2, 3, 8, 10, 15, 16, and 17).

A special form of suppression has frequently been observed in women with cancer of the breast (ref. 8). Surgeons in the audience are probably quite familiar with the history of a woman who discovers a lump in her breast, thinks of the possibility that it might be a cancer, but dismisses it from her mind for weeks or even months as if to say, "If I don't think about it, maybe it will go away." This is another example of a defense mechanism which is adjustive but not adaptive—it makes the individual more comfortable for the moment, but it may endanger her life.

Now let us consider briefly the processes going on between the patient and others which lead the patient to feel that, in spite of current danger, he *will recover*. Probably the essential feature of these processes is the mobilization of the feeling of hope (ref. 1). This seems to be an extremely powerful motivation, to the extent that prominent elements of hope are often present in situations where there is little justification in reality for such a feeling, such as in patients with far-advanced cancer (ref. 10). Perhaps the essential element in the mobilization of hope is the feeling that something *can* be done to correct the situation of illness, either by *himself* or by *others*, and that this is already under way.

Since he is likely to be relatively helpless, let us first consider his outlook about what others can do for him. For a medical group it is particularly important to consider the patient's view of what the medical staff can do for him. This aspect of psychological adaptation to life-threatening stress is of such great practical importance that Captain Reiss will present a detailed consideration of it in the next paper, based on his extensive experience in caring for severely burned patients.

Something to correct the situation may also be done by the members of the group in which the patient finds himself. For example, the patients who are together on a hospital ward truly *live* together in the closest sense. For most patients, the experience of being together, of sharing these difficult days, of seeing that others have similar injuries and are recovering, seems to have a powerful encouraging effect (refs. 1 and 2).

The importance of group relationships in psychological adaptation is nowhere clearer than in the battle casualties (refs. 16, 17 and 18). Colonel Glass has already pointed out the powerful supportive, protective influence of the close bonds within the combat unit. Since these exist prior to injury, they provide a kind of ready-made defense. The soldier knows that his buddies will do everything humanly possible to save him if he is wounded, and to get him to a medical unit where he will receive all-out medical care. And he would do the same for any of them. He is not alone in this; they are all together. It is therefore not too surprising that the wounded soldier often inquires first for his buddies. In addition to the other protective effects of the group, the patient is also enabled to project some of his concern away from himself, onto the others. "I am more worried about my buddy than myself."

The use of humor is particularly important. In a study of severely burned patients in an Army hospital (ref. 1), it was noted that almost every patient used humor to some extent, not only in establishing re-

lationships, but in a variety of tension-relieving ways—e. g., to make light of something which might otherwise be disturbingly serious; to express irritation indirectly without running the risk of retaliation; to make the listener admire the courage of the patient; to mobilize sympathy; or to encourage himself or other patients.

Observers of severely wounded battle casualties in Korea have commented on an attitude of many soldiers which is usefully carried over from the prewounding combat situation. This is a way of making light of the extremely serious situation, which is reflected in the language of the GI, especially in his slang and in his humor. The most serious things are referred to in familiar, earthy, derisive terms. Also, many soldiers are never too sick to joke. A man who is clearly too sick to have any sexual contacts for a very long time, if ever, may nevertheless manage a wolf whistle when he sees a nurse in the MASH unit. W. L. White (ref. 17) says of the wounded American soldier in Korea, "If under stress he transposes everything into sturdy Anglo-Saxon, calling his ambulance a meat wagon or his abdominal trauma a gut shot, it is not that he wants to shock (anyone). It is only his way of mustering courage, of thumbing his nose gaily at pain and death. And he has need of this."

But what can the patient do for himself? The relief of tension which comes from an opportunity to take direct action in solving a distressing personal problem is well known. This widespread characteristic of human behavior appears to hold true also of the severely injured man. Of course, the adaptive value of such action is crystal clear in the case of the man who saves his own life by closing off a bleeding artery with his fingers. In the hospital, however, the patient's own role in his recovery, and the psychological value which this has for him, may readily be overlooked. Captain Reiss will also deal with this aspect of the problem.

Summary

In summary, then, observations of patients with a variety of severe injuries and illnesses indicate that several types of psychological defenses are activated in response to such life-threatening stress. These may be classified in three general types: those which tend to make the patient feel that his life is not really in danger; those which tend to make him feel unafraid of impending death; and those which tend to make him feel that he will recover. All of these emergency defenses are usually facilitated by the diffuse impairment of brain function often associated with severe injury. This impairment makes it easier for the patient to restrict his awareness, to perceive only what he wants to perceive, and to delay recognition of the threat to life.

These defensive processes make it possible for the organism to avoid overwhelming, disintegrative panic. Under optimal conditions, they not only facilitate relief of fear but preservation of life and recovery from illness as well. In extreme forms, however, they may be biologically maladaptive, since the organism sometimes abandons its long-range life-preserving functions in favor of momentary relief from discomfort.

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Discussion

COL. STONE. Dr. Weinstein has a few remarks that will be quite pertinent at this particular moment, before we open the paper for discussion.

DR. WEINSTEIN. Dr. Hamburg has referred to our work with brain-damaged patients at the Graduate School. In such patients it is helpful to divide the disabilities into two main groups—deficits that come from focal lesions such as aphasia, hemiplegia, etc.; and the so-called general symptoms which are referred to as confusion, disturbances in consciousness, and so on. For the purposes of this group, it is useful to think that these latter are what happen in normal people, only in an exaggerated and durable form. What is meant by a disturbance of consciousness? Well, a neurologist is apt to think of a sleepy patient, and a psychologist is apt to think of a patient who uses a new system of symbols, such as one might use in a dream.

The patient who denies some catastrophic situation, such as having a paralysis, being blind, or having lost his parent, does not go through, I think, the type of mental process that Dr. Hamburg describes, where he reasons it out. This is an immediate thing; the patient has, I think, what can best be described as faith. He really believes that his arm moves. We had an interesting example of this in a patient on whom we were doing an arteriogram. Suddenly the patient's left side became paralyzed, and immediately the patient reached over to the examiner, patted his arm, and said, "Oh, don't worry, Doctor; it's gonna be all right." This happened momentarily; it is an example of the projection of the defect to someone else. This is not just a lack of something; it is a marked drive of the patient to preserve his integrity, and the particular form in which it will be shown depends in great degree on the level of brain function—of this phenomenon of misnaming—neurologists call it paraphasia—in naming an object in terms of one aspect of its structure or function which suits the patient's particular need. Thus, a patient will call a hypodermic needle a tie-pin; and much slang, much profanity has this function of a valuable symbolic defense against stress.

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"Phantom limb" patients are interesting. I am particularly conscious of Dr. Hamburg's remarks of how they deny it for the first 4 or 5 days while there is probably still some impairment of brain function, the shock of the anesthetic and so on. That leads to a principle that we have found very helpful, particularly in the study of patients with head injuries—the so-called withdrawal syndrome. Now we are all familiar with the so-called abstinence syndrome in drug addicts, where, when a drug is suddenly removed, the patient becomes very anxious and agitated. Well, much the same thing happens at the removal of a brain tumor, or after a rapid recovery from a head injury. Here the symbolic system that the patient has used in his disturbed state of consciousness suddenly does not operate any more. In the present milieu of brain function, the patient cannot successfully use the same delusions or symbolic forms and we have what we call an anxiety. In an effort presumably to restore a satisfactory state of brain function, there is frequently a convulsion. Surgeons recognize this, in fact, when they give sedatives to patients from whom they remove a meningioma.

Our feeling too is that the various psychiatrogenic procedures—electroshock, prefrontal lobotomy, and so on—operate largely in producing a milieu of function where the patient can deny what is wrong with him. Interestingly, we have observed in studies of head injuries that patients who can use a symbolic system over a long period of time do not get the disturbing incapacitating so-called post-concussion syndrome. We saw an interesting example of this in a boy who was wounded in Korea and insisted that he had never been wounded. He never showed any sign of anxiety or disturbance, and insisted that he had never been wounded. One day they came around to give him a Purple Heart, and he said "No, you must have the wrong person; I never had a wound." Then, about 3 months after his injury, one day he came in and he said, "You know, Major Patterson told me that I was wounded; he showed me my X-ray." Well, Patterson had been telling this fellow he was wounded every time he saw him in the hall. These symbolic forms—disorientation, paraphasia, reduplication, and other phenomena—are very useful symbolic forms in the preservation of a person.

Col. Stone. Dr. Hamburg's paper and Dr. Weinstein's remarks are now open for discussion.

Unidentified Speaker. One point of real significance to me is that all individuals who clinically manage the severely injured have realized that the attitude of the patient, his ability to respond to treatment and to recover, is influenced greatly by the personnel who are handling him, as well as the unit from which the individual came. I

think this is exemplified by some of the happenings in our kidney treatment center in Korea, where the very severely injured are brought for treatment of anuria. Some interesting remarks early came to my attention from a group of youngsters who were trying to treat these anuric patients, both by dialysis and by use of cationic exchange resins and physiological supportive means. Two of these individuals had had the opportunity of training at the Peter Bent Brigham Hospital and had subsequently gone to Korea to support the Injury Center there: They said, "Well, now, when working at the Brigham, most of the patients we had to treat were individuals in the latter part of life who had more or less lived their lives. While we realized that we could help them a little bit from day to day, we couldn't see that our efforts, either for the individual or for society in general, were rewarded by any long-term results. These individuals, however, that we are treating here are like ourselves; they've got families, growing families, and they want to live. We can't stay away from the place; we've got to do everything we can to see that they do live." That particular attitude on a hospital staff—the attitude of the desire to live, the purposefulness of life—really has quite an influence.

In a reflex way, this also has quite an influence on the actual battle participants. It is really quite remarkable the number of instances in which the unit from which this man, or these particular individuals came, sent a representative down to see how they were getting along. We were told by the doctors of the units that the fact that these individuals with very severe injuries were surviving and were apparently coming along all right had a profound influence on the respect of the men in the unit from which they came; so that for morale effect forward, as well as on the actual patient, and even on the staff of the hospital, what can be done is of real significance. Dr. Thorn, would you give us an idea of how you think this possibly works physiologically, particularly from our knowledge of ACTH?

Dr Thorn. This seems to me an important place where we might tie up some of Monday's discussion with yesterday and today. I was very much interested in Captain Hamburg's analysis of the psychological reaction of the severely injured individual. Since all of us are interested in mechanisms and how these psychological adjustments come about, it is fortunate that we now have available crystalline steroid preparations for intravenous use. One can administer 100 mg. of cortisone or Compound F in an hour or two. When such infusions are given to individuals in civilian hospitals who are severely but rather more chronically ill, perhaps during a phase of the reaction when their defense mechanisms have either subsided to some extent or the intensity of the reaction is not so great, a tremendous

change occurs in the patient's physical condition, as well as in his outlook on the disease or terribly disturbing situation with which he is dealing. After study of a number of individuals in these situations, one wonders whether this is not a small toehold in a difficult problem. I do not believe for a minute that this is the only mechanism involved, but it is a mechanism which allows for experimental study. And one cannot help but feel that if one infused a large amount of hormone suddenly into a patient with denial, as described by Captain Hamburg, his whole response to his disability would be quite greatly modified. If this occurs at the higher centers, it seems pretty obvious that in terms of the patient's interpretation of what he has, it may be that he actually does not feel the pain or discomfort that we think he should feel with that same amount of injury. Thus I think we have a mechanism for studying at least part of the altered response of the psychological adaptation in severely injured individuals.

Dr. Cleghorn. During the war I had opportunity to observe a number of battle casualties in Italy, and there were two instances which I think may add to this morning's discussion. One was a case of oliguria. The man was dying of uremia; 5 minutes before he died. he vomited and apologized. It seems that his standards of behavior were maintained despite his urea and potassium levels, etc., right up to the moment of death. He was not particularly sedated, as I remember, and I was quite struck by this type of behavior.

The other instance to which I want to refer was the most extreme degree of anxiety I saw in a man who was dying. He had a bronchopleural fistula and was extremely anoxic and was terribly dyspneic. As he sat there in an erect position and grasped onto the sides of the bed, he uttered imprecations in German—he happened to be an SS trooper—and finally he said, "Ich bin kaput, gestimmt!" and he was.

Dr. Rioch. Dr. Thorn tied these observations in with the observations on endocrines; I would like to call just brief attention to tying them in with group problems, because I think that some of the past methods used in medicine have been quite wrong. Our tendency is to tell the family of the patient with incurable cancer that the patient is going to die, but to tell the patient that he is all right, that he has just an inflammation or something. I have had some experience with this and routinely found great relief when you tell the patient that he is going to die, provided you can do it without being too disturbed yourself. The best answer to a patient that I ever heard was that of an old country family physician, who told the patient, "Old man, you've got cancer and you are going to die, but nobody needs to know about it but you and me." The family was told that the patient had some inflammation. What the patient is faced with is, so often putting

on the right kind of front; the family is faced with putting on the right kind of front, and one has—well, let us just call it a mess. More direct dealing with these severely injured and understanding that a lot of their symptomatology is just the symptomatology of defense and does not refer to the wonderful doctor, or to the inadequate doctor or nurse, is terribly important in handling these problems.

COMPREHENSIVE CLINICAL MANAGEMENT OF SEVERE INJURIES*

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My discussion will be confined to the treatment of thermal injury, the form of injury with which I have been most intimately concerned during the past 2½ years. It is likely that many of the conclusions drawn from our studies of burns will, to some extent, hold true in other forms of severe trauma. The principles of approach and management, at least, should be applicable to many forms of trauma.

Burns are among the severest physical insults known. The effects of severe physical stress, as they are commonly measured, are regularly observed after severe burns. Evidence of one or more of the three classical signs of nonspecific stress (hyperplasia of the adrenal cortices, lymphoid involution, and gastrointestinal ulceration) is almost always seen.

Increased adrenocortical activity is reflected in changes in the circulating eosinophil count, in steroid excretion, and in the mineral and electrolyte balances. In Figure 1, fluctuations of the eosinophil count are recorded in 15 critically burned patients, most of whom died within 2 weeks. The solid line represents the pattern of change in a typical severe burn, characterized by an early depression of the count and an increase to normal levels 7 to 14 days after injury. Additional stress in the form of wound infection or septicemia can, and frequently does, delay the rise in the count. This effect is shown by the arrow in the dashed line, which illustrates the delayed return to normal in a patient in whom septicemia developed. Failure of the eosinophil count to rise within 2 to 3 weeks is a grave prognostic sign, as has recently been pointed out by the burns study group at the Massachusetts General Hospital. In Figure 1, death occurred in all patients whose count remained depressed. Our interpretation of this is simply that septic and other complications, which can depress the count, are most com-

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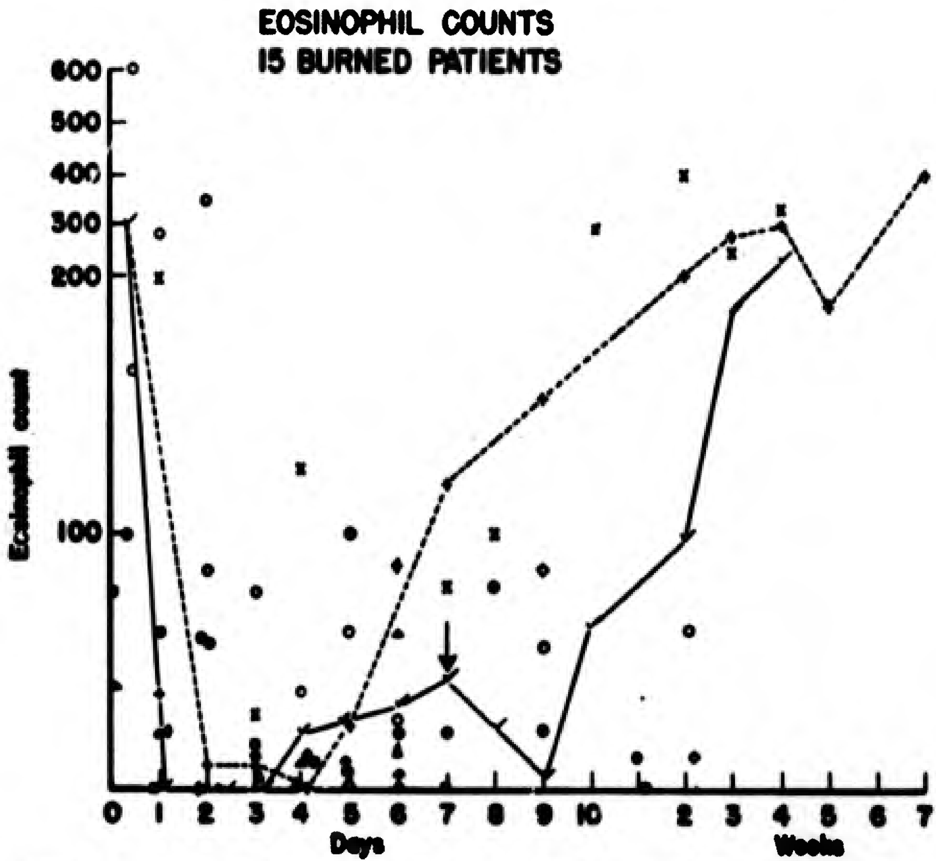

FIGURE 1. Broken line depicts characteristic changes of the eosinophil count in a patient who recovered. Solid line shows that stress, in addition to the stress of burning causes a delay in the rise of the count. The complicating stress in this instance was septicemia. Death occurred in the patients whose counts remained depressed.

monly responsible for the death of patients who survive for more than 5 days.

The excretion of 17-ketosteroids is characteristically increased at first and depressed in the later phases of the disease, while corticoid excretion tends to remain high until wound closure has been largely achieved. In the early postburn period nitrogen excretion is high, potassium excretion tends to be high, and sodium balance is positive. Although these changes are probably mediated, at least in part, through increased adrenocortical activity, their explanation solely on the basis of endocrine changes is probably not justified. Our studies show with increasing clearness that the metabolic response to wounding is not merely the result of a series of nonspecific, endocrine-induced alterations from the normal. Wounds are an integral part of the metabolic response that they incite—a truism that has apparently been overlooked in some discussions of this subject.

An unusual documentation of the effects of stress is furnished by a case report on a 3-week-old baby who was seen at a small Air Force base station hospital 4 days before she was burned, because of marked respiratory distress. Roentgenologic examination revealed a distinct enlargement of the anterior mediastinum. Fifteen hours after the baby incurred severe body burns, the mediastinal mass could not be demonstrated any more; it reappeared after convalescence. The mass probably represents thymus that was lysed by the release of adrenocortical hormones, initiated by the stress of burning.

The problem of gastrointestinal ulceration after burns is too complex for adequate discussion here. Contrary to Harkins's impression that the incidence of gastrointestinal ulcers is definitely decreasing, we have personally observed 7 instances of ulcerations in 27 patients who died on our service during the past 2 years. It is not known whether Curling's ulcers are the same as the ulcers occurring after nonspecific stress, or whether they are the specific result of something peculiar to burns. To avoid confusion, all or nearly all of the following characteristics should be noted before the label "Curling's" is attached to an ulcer: (1) it must occur within 2 to 3 weeks after burning; (2) it must be an acute ulcer; (3) it must be large (at least 0.5 cm. in diameter); and (4) it must be located in the first part of the duodenum. While this description does not help us to understand the causation of these ulcers, it may avoid some distressing semantic confusion. A typical Curling's ulcer is depicted in Figure 2.

So much for the purely physical aspect of the problem. For some time, we have been aware that psychologic factors can complicate physical stress, but the overwhelming magnitude of physical stress has tended to focus our attention exclusively on this aspect. It was not until Captain Hamburg carried out his detailed and systematic study on our service that we fully realized the importance of emotional factors as an integral and important part of the patient's adjustment to serious injury. Although these factors cannot be adequately quantitated, their importance to the over-all clinical picture is real, and the physician's awareness of their existence is essential to adequate therapy. Two short case histories will be used to illustrate the complex interrelations of physiologic and psychologic factors.

The Burn Team of the Surgical Research Unit was consulted for treatment of a woman who had sustained burns over 40 percent of the body surface. When the members of the Team first saw the patient 12 hours after injury, she was maniacal and four strong attendants were required to restrain her. Large doses of morphine failed to quiet the patient. She was salivating profusely and had been

FIGURE 2. Large, acute ulcer in the first part of the duodenum of a patient who died of extensive body burns on the tenth postburn day. An ulcer of this type can be called "Curling's ulcer."

anuric for the past 4 hours. After the infusion of 200 cc. of 3 percent sodium chloride solution, the patient became quiet and completely rational. Additional treatment with balanced isotonic electrolyte solutions and whole blood resulted in the establishment of a good urine flow and a decreasing pulse rate so that the patient could be evacuated to Brooke Army Hospital without much difficulty. Sodium pentobarbital, given intravenously in two small doses during the evacuation, adequately relieved pain and apprehension.

This patient illustrates, of course, the syndrome of water intoxication which was induced, in this instance, by the administration of excessive quantities of water not containing electrolytes at a time when the patient was losing large volumes of electrolyte-containing fluid. In less extreme cases, inadequate fluid therapy can cause restlessness and disturbed behavior, which ought to signal the need for intensification of therapy rather than for the administration of sedative drugs. Failure to recognize this can be disastrous.

The second patient illustrates how both physical and psychologic factors can contribute to the over-all clinical status of the patient.

A white man, 31 years of age, incurred mixed second and third degree burns over 45 percent of his body surface when a butane stove exploded in his trailer. Severely injured though he was, the patient transported his wife, who was burned in the same accident, for a distance of 3 miles to the nearest hospital. He refused treatment until he had been thoroughly reassured that everything possible had been done for his wife and that the treatment of his own injuries would not detract from the medical attention that his wife was receiving. Before the patient was evacuated by the Burn Team to Brooke Army Hospital, he was told that his wife had died. The patient accepted this without showing any signs of emotion. He was quiet and cooperative in every way and, from our point of view, was a model patient during the first 72 hours after injury. On the fourth postburn day, the patient suddenly became irrational. The pulse rate, which had been between 100 and 120, increased to 150, and the temperature, which had previously been below 101° F, increased to 103.6° F. On blood culture, a coagulase positive hemolytic Staphylococcus was recovered. After institution of appropriate antibiotic therapy, the temperature and pulse receded to the levels at which they had been before the onset of septicemia. Respirations were irregular in depth and rate, but physical and roentgenologic examinations of the lungs failed to reveal anything abnormal. Repeated blood cultures taken after the antibiotic therapy was instituted, were negative. The patient, however, remained disoriented for a month. There was a great temptation to call this a "toxic psychosis," though objective evidence of a bacterial or burn toxin was completely lacking. This patient, far from being an exception, represents a commonly encountered, true psychosis that is not directly related to the physical effects of injury. A thorough search for a physiologic basis of the psychosis must obviously be made in all instances, but it is wise at the same time also to make an inquiry into the patient's background and past behavior. It was learned from this man's father that the patient had always been quiet and submissive. His relationship with the father had been one of complete dependence in all respects. His wife had been domineering and, though the patient resented his wife's aggressive nature, he submitted to it quietly, preferring to give in to her whims and fancies rather than to make a scene. During the 35 days of psychotic behavior, the patient consistently denied knowledge of his wife's death. That he may have experienced a feeling of guilt about actually being relieved by the death of his Xanthippe, was suggested by some of the things that he said while receiving intravenous pentothal during dressing changes.

The emotional overtones associated with the accident may at first be more distressing to the patient than the actual physical discomfort. It is in this early period that the attending physician must convince the patient of his competence and sincere interest in the patient's welfare. Seriously injured patients are utterly dependent on those who care for their injuries. They can and must be made to feel more secure by the expression of genuine reassurance. The attending physician, not the psychiatrist, is responsible for the total care of the patient, and this includes caring for the emotional as well as the physical ills. The need for expert psychiatric help arises but rarely, and when it does arise, it usually means that the simple prophylactic psychotherapeutic tools that are available to everyone have not been properly utilized. A few minutes of friendly reassurance several times a day may prevent nights of screaming and other expressions of regressive behavior, drug addiction, and all the other signs of failure to care for the patient's emotional needs.

If possible, only one physician should be responsible for all phases of the patient's treatment. Routine venepunctures, blood transfusions, dressing changes, and other operations, as well as psychotherapy, should be the responsibility of one person. It is easy to secure the patient's confidence since most of the seriously injured have a strong desire to impute to their physician some magic healing powers. This childlike faith can be a valuable therapeutic tool, but it is easily shaken if the patient learns that he has been deceived. Predictions as to complete functional recovery, the success of skin grafts, duration of hospitalization, and so forth, should therefore be made cautiously.

Having secured the patient's confidence, the physician is in a splendid position to discover his special adaptive problems and to help him in his adjustment. It is usually not difficult for the nonpsychiatrist to learn which of the many adaptive problems is most troublesome for a particular patient. Some patients are most disturbed by the fear of disfigurement or functional impairment, while others are more affected by some immediate problem, such as their physical helplessness or dependence on others. The types of problem encountered and their seriousness depend largely on the patient's psychologic make-up before he was injured.

During the difficult months of repeated grafting and painful dressing changes, the patient is particularly in need of reassurance and encouragement. At the Burn Center, we are aided by the presence on the ward of patients in all stages of healing. Seeing those who have recovered is a source of real comfort to patients who must look forward to the dreary months of skin grafting. Unfortunately, it is

frequently difficult to secure the cooperation of convalescent patients: they try to forget the time when they themselves were in pain and helpless, and close contact with the suffering of others reminds them of the very experiences they strive to forget. Convalescent patients who were especially troublesome from an emotional point of view, at the time of their acute illness, have a particular aversion toward the acutely ill. Those who at one time had shown the most marked regressive behavior later become incredibly intolerant of similar behavior in patients who are going through the same difficult period of treatment. If convalescent patients are not on the ward or their cooperation cannot be secured, it is often helpful to show, to the acutely ill patients, photographs of similarly burned patients at the time of injury and after full recovery. A little cheating by way of showing one's best results is considered to be consistent with ethical medical practice.

The harmful adaptive mechanisms of self-pity and regression can frequently be prevented by the application of simple psychotherapeutic measures. Outstanding among the useful adaptive mechanisms is what the psychiatrists call "direct action," which includes everything that the patient can do for himself. The patient's capacity for direct action, though very limited at first, increases steadily as wound closure progresses. Since the maintenance of nutrition is a crucial part of therapy, it should be suggested to the patient that eating the prescribed diet and supplemental feedings is one way in which he can materially aid his recovery.

It has been our observation that patients who have made good psychologic adjustments generally do better than those whose adjustment is poor. It is true, of course, that the patient whose treatment progresses satisfactorily has less reason to be discouraged than one whose progress is slow. Nevertheless, there is a group of patients in whom improved morale appears to precede physical progress, and though we do not have any statistical data to prove this point, it is, as far as our group is concerned, a clinical fact. It is hardly worth while in this discussion to describe in detail the psychotherapeutic regimen that has been evolved on our service as a result of Captain Hamburg's study. In brief, the crux of the matter is prophylaxis of emotional problems by the application of common sense measures. Perhaps it is the obviousness of the proper approach that makes it so easily forgotten in the day-by-day treatment of patients. To the surgeon, the growth of a graft may be much more intriguing than the patient's emotional adjustment, but it cannot be emphasized too strongly that the rapidity with which wound closure can be achieved is intimately connected with the patient's morale.

In closing, I should like to mention a problem of the greatest practical importance, which illustrates particularly well the interdependence of physical and psychologic factors. I refer to the management of pain and the need for the administration of sedative drugs. The treatment of severe burns entails some pain and a great amount of minor physical discomfort for a long period of time. However, physical pain is not nearly as common as it is generally believed to be and, contrariwise, emotional pain is a much more serious problem than is generally recognized. Patients are frequently unable to distinguish between physical pain and emotional tension and report all discomfort, regardless of origin, as pain. It is of the utmost importance to realize that the patient needs not only relief of pain, but relief of fear as well. If, as frequently happens, all of the patient's complaints are treated with narcotics, the patient may rapidly become addicted, at least emotionally. There is no better way of making a patient completely unmanageable than to give frequent injections of narcotics for the relief of emotional pain. In patients whose emotional needs are neglected, regressive behavior with childlike crying and moaning is all too common. If the process of regression is not halted, behavior may become more animal-like than human. I speak from bitter experience, having recently spent many a night at the bedside of a screaming patient whose emotional needs I had neglected. And I speak from experience too when I say that this patient's difficulty and similar difficulties in other patients can and must be prevented. There are no shortcuts in this aspect of the treatment of the injured patient as, indeed, there are no shortcuts in any other aspect. The axiom, that whatever is best administered is best, holds as true in the psychologic as in the physiologic phase of therapy.

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Discussion

COL. STONE. Captain Reiss' paper is now open for discussion. I think the last comment on the difference between the psychological and the physical basis for pain is of extreme importance in battle casualties.

DR. LIDZ. In regard to Captain Reiss's comment about the difference between psychological pain and physical pain, I think this is a difficult differentiation to make, particularly as we are not at all clear what we mean when we talk of emotional pain. Really the problem, as I have been able to see it, is that pain unaccompanied by anxiety is never—or rarely—very severe, at least not for a long period of time. It is not the pain perception itself, it is the anxiety provoked by it and the fear of what is going to come that makes it so intolerable. I think that to some extent, although I do not know how much evidence there is in that direction, morphine does not simply relieve pain, but somehow causes a dissociation of the pain from its emotional impact. I remember a personal experience of my own after an operation, waking in the middle of the night and being rather surprised that the wound was not painful. Then when I thought of it a moment, I realized that the wound was painful but somehow it was not affecting me at all, having received morphine before. This, of course, is also what happens in cases of lobotomy for pain, and I wonder if that is not the effect of morphine.

I think all of us who have had to take care of patients suffering extreme pain have seen very marked improvement of the condition as soon as the anxiety was alleviated by the fact that everything possible was being done. We can all experience this. For example, we may have a toothache and think that this indicates that the tooth must be pulled. Then, as soon as one is reassured that this is not a very serious matter, even though the pain cannot be relieved, the pain is no longer so very disturbing and we can go on about our business.

DR. WEINSTEIN. I was interested in Captain Reiss's remarks about the psychosis that developed in that patient and then the search for the toxic agent. When patients have the greatest disturbance of brain function, they are apt to seem the least psychotic. A patient with a complete denial is a very easy patient to take care of; he lies in bed, he generally has a smile on his face, he feels fine. It is only when you question him that he tells you there is nothing the matter with him, that he shows this disorientation, and so on. Actually, in such a case a disturbance in the patient's behavior is a sign that his brain function is getting better and not worse. We see this frequently; in the first stages a patient is euphoric; then as he gets better he becomes paranoid, and finally when he should be best of all and his incapacity is least, he becomes quite depressed.

Now about this matter of poorly adjusted patients showing denial, and well adjusted patients not showing it—I do not know if it works that way. We have been investigating personality background, and everybody shows some form of denial. We originally referred to de-

nial as the drive for self-preservation, as the drive to life, but that does not quite explain it. For instance, the Japanese kamikaze pilots had this drive and that certainly was not a drive to life; it is much more of an acculturated symbol. I do not think that the idea of one's integrity of self can be expressed in just physiological terms.

Captain Reiss brought up an important point, that not all patients under conditions of great stress show this kind of denial. They fall into various groups. Patients who do not verbally deny—say "I am all right, there's nothing the matter with me"—are apt to use other mechanisms. One of them is humor, as has been mentioned. Another is an intense paranoid attitude where all of the disturbances have grown in someone else. Other patients are apt to be very drowsy. This is an interesting kind of drowsiness because the sleep often appears just in the interview when the patient feels under stress, and when some other stimulus comes on that does not affect the patient's integrity he may be quite alert. Another group of patients who do not show any of the verbal forms have marked disturbances in sexual behavior; they become very agitated and have delusions about sex and sexual advances. So it seems that whether the patient uses denial or not is not a question of whether he is well adjusted; it is largely a question of what kind of mechanism occurs in reaction to stress.

Dr. Bolocan. Is this humor that everyone is mentioning confined to military casualties, or is it seen in civilian casualties as well?

Capt. Hamburg. I do not have much experience on that, although from the small amount of material available from civilian institutions, I think it is not at all limited to the Military. The instance I mentioned earlier was one in which certain ways of expressing a humorous communication have been formed in the pre-wounding combat situation, and so it is perhaps somewhat easier to use that kind of tension-relieving mechanism. I should think that this would be seen very commonly, and that it is a very widespread tension-relieving mechanism.

Dr. Bolocan. I was going to suggest that in military patients to be wounded is often a relief and accompanied by euphoria, because it means getting away from further exposure to dangerous stimuli. This also often relieves a great deal of guilt, and that was why I was wondering if it is commonly seen in civilian patients.

Capt. Reiss. Our patients are so severely injured that I think combat duty would be preferable to being in the state in which they find themselves when they come to us.

Col. Stone. The type of burn cases Captain Reiss is talking about, of course, are mostly the result of gasoline fires occurring around airfields and things of that nature.

PRINCIPLES OF RECONDITIONING SEVERELY INJURED MEN, WITH PARTICULAR REFERENCE TO THE MANAGEMENT OF PARAPLEGIA*

L. GUTTMANN, M. D.

There can hardly be any condition in human pathology more associated with paramount changes in the whole organism leading to alarm reactions and stress, on the one hand, and specific or systematic adaptation reactions on the other, than a transection or severe injury of the spinal cord. It is beyond the scope of this communication to present a detailed description of all those effects following spinal cord transection, which in turn give rise to profound deviation of large regions of the body from their normal resting state and functions, but I feel that, in a Symposium on Stress and for a proper understanding of the principles of reconditioning in the spinal man, it would be an omission not to mention at least that intense reaction which results from visceral activity—in particular, visceral distention in the paralyzed parts of the body on the autonomic system, especially the cardiovascular apparatus of the whole organism.

Effects of Bladder Distention on the Autonomic System

An example, par excellence, to study all the phenomena of the autonomic mechanisms resulting from visceral distention is the bladder in spinal man. In the following paragraph, a short summary is given of the results obtained from systematic studies which my team of co-workers and I have carried out since 1944 and which have been published elsewhere (Guttmann and Whitteridge, 1947; Guttmann, 1953).

Distention of the bladder in all complete lesions of the spinal cord sets up reflex responses of the autonomic mechanisms which are dependent, in constancy and intensity, on the level of the lesion. The basic reflex response to bladder distention in all complete lesions above L.2 with intact, isolated cord is vasoconstriction of the toes, which is not limited to the skin and is mediated by the lowest part of the sympathetic outflow. Since, in these low lesions, there are large areas of the vascular bed left, which can be utilized for vasomotor regulation, the vasomotor adaptation response to the vasoconstriction in the toes

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is vasodilatation in parts above the level of the lesion, especially the fingers. Hence, in paraplegics with low thoracic lesions, there will be no increase of blood pressure, and in those with lesions of the mid-thoracic region only insignificant rise. It may be noted that, in these cases, increase of blood-flow occurring in the upper limbs, as the re-adaptation response to its decrease in the lower limbs, also involves the vascular bed of the muscles. In paraplegics with lesions at or above T.5/6, where the whole splanchnic outflow is involved, and in cervical lesions where the whole sympathetic outflow is involved, conditions are different. In these cases, vasoconstriction in the toes, due to visceral activity, is accompanied by vasoconstriction also in the fingers and a very large rise in blood pressure occurs. During the period of raised blood pressure, a steep fall in pulse volume in toes and fingers occurs (fig. 1). Pulse rate shows a marked drop and changes of rhythm are noted, and the electrocardiogram may show increase in the size of the U-waves (fig. 2). These findings indicate that an increase in the load on the heart must occur at the height of bladder activity, due to distention, and this was proved by X-ray studies of the chest in correlation to cystometrograms. It was found that, at the height of visceral activity in upper thoracic and cervical lesions, the heart shadow may show an increase by several centimeters (fig. 3). However, even in these high lesions, certain adaptive mechanisms are mobilized to counteract the effects of vasoconstriction of even so large an area of the vascular bed. There is a marked vasodilatation in the upper trunk, shoulders, face and neck of patchy type, associated with congestion of the naso-pharyngeal mucosa, resulting in blockage of the nasal air passage. However, in lesions at T.1 or C.7, when the blood-flow is measured it is found that the blood-flow in the vascular bed of the muscles of the forearms is greatly increased, although in the fingers the vasoconstriction is so prevalent that the blood-flow through the vascular bed of the skin of the finger almost ceases. These cardiovascular effects in high lesions are associated with profound outbursts of sweating in face, upper trunk and arms.

All these are remarkable findings, which are not in accordance with the accepted views regarding vasomotor innervation. In these high lesions, as far as the sympathetic innervation is concerned, the upper limbs, face and neck are all situated below the level of the lesion. Therefore, one would expect vasoconstriction during visceral distention not only in the fingers but also in the whole of the upper limbs, face and neck—the more so as sweating occurs in face and neck. However, face, neck and arms show marked vasodilatation.

Although details of the mechanism involved in this vasodilator response in high spinal cord lesions are by no means fully understood,

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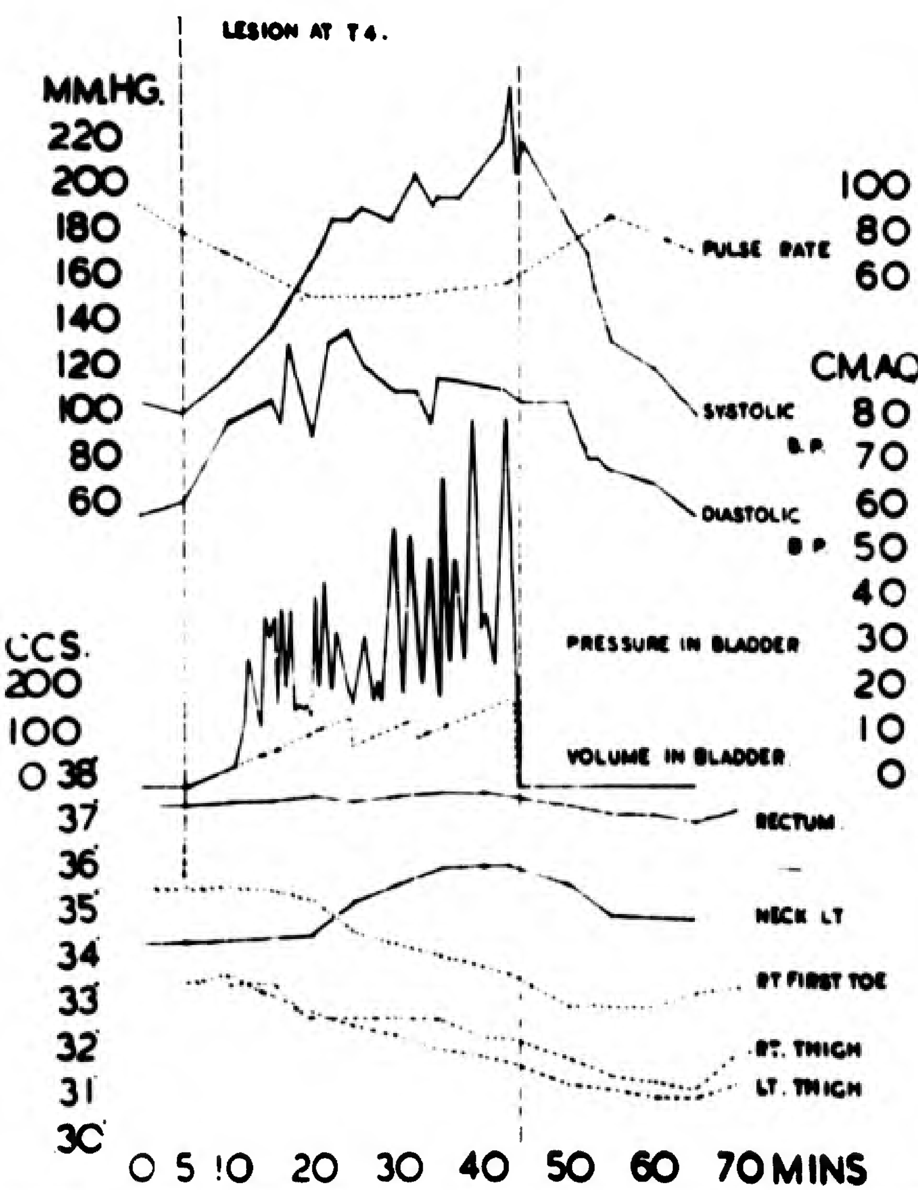

FIGURE 1. Effect of bladder activity, due to distention, on blood pressure, pulse rate and skin temperature, above and below the lesion, in a case of complete transverse spinal syndrome below T.4, following gunshot injury. The effect of distention during the experiment is demonstrated by the chart between the interrupted, vertical lines.

it shows to what extreme a re-adaptive vasodilator response can be mobilized to compensate stress in the cardiovascular system, set up by vasoconstriction of large areas of the vascular bed. Some of the phenomena indicating stress in the autonomic system, such as outbursts of sweating and patchy vasodilatation, can be diagnosed simply from facial appearance. They may be associated with subjective

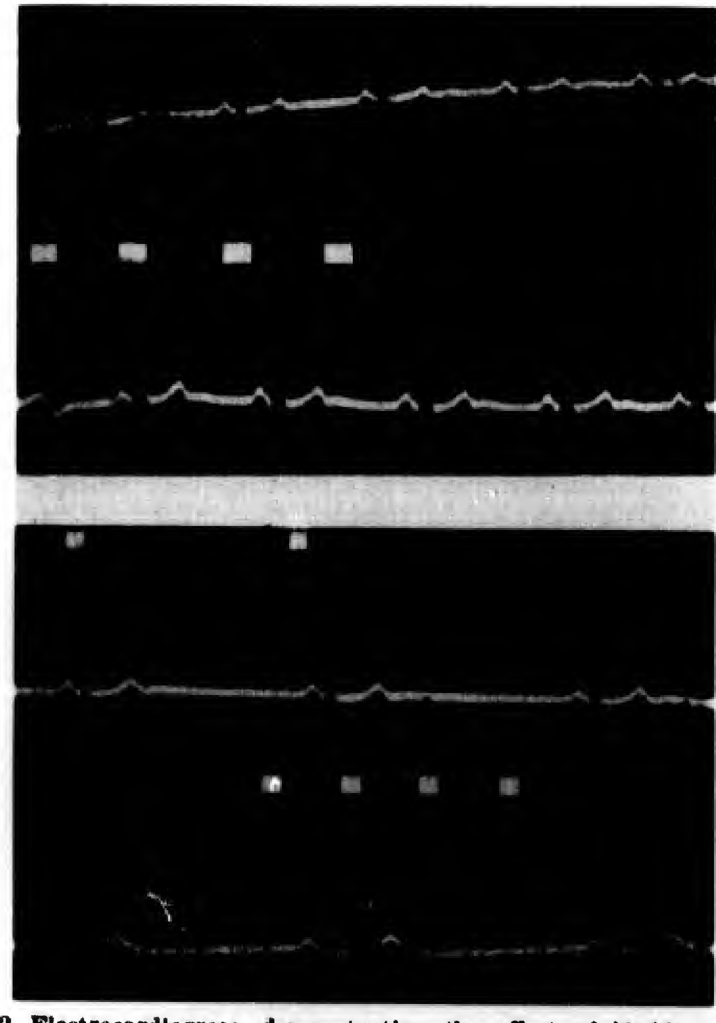

FIGURE 2. Electrocardiogram, demonstrating the effect of bladder distention before and during the experiment. Note the marked bradycardia and increased U-waves in the lower picture.

phenomena, such as ascending sensations in the midline of the body, choking feeling in the throat, head-fulness, and headaches. From a clinical point of view, knowledge of these phenomena is important, as they represent an alarm reaction of excessive activity by a viscus in the anesthetic area of the body, and they may be the only indicator of impending abdominal catastrophe. On the other hand, the awareness of some of these phenomena, such as flushing, feeling of heat, can be utilized for the re-education of the paralyzed bladder and bowels and even sexual function.

The recognition of the adaptation and readjustment forces is also of paramount importance for counteracting and overcoming stress in other functions of the organism, as the result of spinal cord transec-

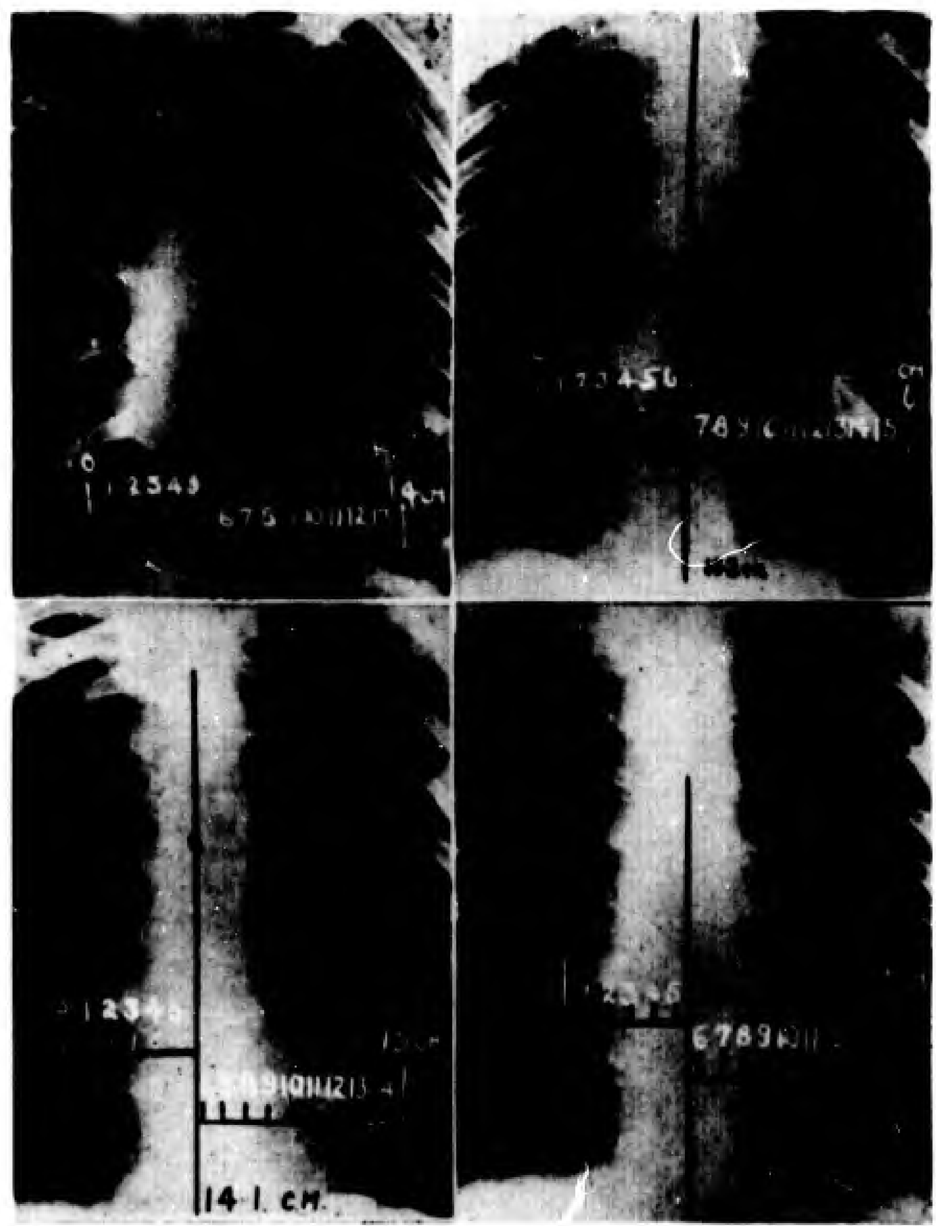

FIGURE 3. Effect of bladder distention in high thoracic lesions on the heart shadow. Note the increase in the shadow in the right upper picture and left lower picture, in contrast to the condition before distention of the bladder (left upper picture) and after emptying the bladder (right lower picture).

tion. This catastrophe in human life immediately and completely throws out of gear so many essential functions—such as motor and sensory functions, control of bladder and bowels, control of sexual function—that one could really despair of any hope of functional recovery. In fact, in the past, a spinal paraplegic was considered

as a hopeless cripple, and most members of the medical profession were convinced that little or nothing could be done for him. However, during the last decade, our ideas of treatment and rehabilitation of paraplegics have undergone a fundamental change. Not only has the expectation of life for these patients been greatly improved but a degree of functional recovery has been achieved, which a few years ago would have seemed impossible. There is no doubt that the systematic evaluation of the many adaptation and readjustment forces in mind and body of the paraplegic has resulted in their utilization for the development of a new pattern of innervation, which enables the paraplegic to start and shape an entirely new scheme of life on which his independence and return to useful social activities depends. This conception of the importance of the natural forces of adaptation and repair has consequently led to a more critical and selective approach toward surgical procedures.

The principle of adaptation pays a fundamental part in the physical rehabilitation of the paraplegic by training of certain mechanisms in normal parts of the body, to compensate for the loss of the paralyzed parts. This compensatory training is directed to the pursuit of three main objects: (1) Overdevelopment of trunk and, in distal cord lesions, also of abdominal muscles: (2) reorientation and restoration of postural sensibility and coordination mechanisms; (3) readjustment of vasomotor control, which is of particular importance in the physical rehabilitation of higher cord lesions.

1. *Overdevelopment of trunk and abdominal muscles.* From the start, emphasis is laid on exercises of those muscles which are essential for the patient's upright position, especially those with attachment to the pelvis. The most important muscles to be exercised in spinal cord lesions above T.7 are the latissimus dorsi, trapezius, teres major, serratus anterior, pectorals, and triceps—and for distal cord lesions, also the abdominal muscles. The latissimus dorsi in particular, with its segmental supply as high as C.6, 7 and 8, bypasses the spinal lesion in any transection of the spinal cord up to C.7, and thus connects the paralyzed portion of the body with the remaining normal parts. While, in normal circumstances, the latissimus will adduct, retrovert and internally rotate the humerus, it will exert a pull on the pelvis in an upward direction, if the shoulders are fixed by arm crutches or parallel bars, as then the mobilizing part of this muscle is transferred to its insertion points on the thoraco-lumbar portion of the spine, the sacrum and, most important of all, the posterolateral rim of the ileum. Moreover, as the gluteus maximus, like the latissimus dorsi, has its insertion points on the lumbar fascia, the upward pull of the latissimus dorsi consequently results in extension of the hip by fascial stretch.

In spastic lesions, this stretch effect set up by the action of the normal parts of the body in turn promotes reflexly an increase of the tone of the extensors of hips and knees. This I was able to verify in electromyographic studies. The reflex response set up by the upwards pull of the latissimus dorsi on the paralyzed muscles was found particularly striking in the quadriceps. The trapezius and other trunk muscles help in this action, and thus overcome the sudden lapses which tend to recur and interfere with the standing position of the spinal man. The more distal the spinal cord lesion the greater the number of muscles available with attachment to the pelvis, especially rectus abdominis and obliques internus, to co-operate in the team-work to restore stabilization of the pelvis and thus postural adaptation in the spinal man. In due course the systematic training of these normal muscles results in their marked hypertrophy and increased power, which enables the paraplegic to become more and more independent of artifical aids, such as corsets, in keeping his upright position and even regaining his standing and walking capabilities, to a certain extent. The training of the abdominal muscles in distal cord lesions is also of great importance in the re-education of the bladder in paraplegics. It must be remembered that, in these lesions, voluntary as well as reflex micturition is carried out, with the help of pressure on the abdominal wall. It is obvious that the stronger the power of the abdominal muscles the sooner and the more effective is the voluntary micturition, and in cases where suprapubic cystostomy has been carried out, the sooner can this undesirable form of bladder drainage be abandoned. The same principles apply to the restoration of bowel action in paraplegics. Finally, the training and overdevelopment of the abdominal and back muscles have also proved to be of value in the sexual rehabilitation of patients with low thoracic and cauda equina lesions.

2. *Reinnervation and restoration of postural sensibility and co-ordination mechanisms.* It must be remembered that, in complete transverse lesions of the cord, the loss of postural sensibility in the hip joints, among the other sensory disturbances in the paralyzed parts of the body, represents a serious complication, for it makes the paraplegic unable to keep his balance. Therefore, new afferent impulses subserving postural control have to be developed. This is done by balancing exercises with arm raising in various directions in a sitting position in front of a mirror, where the patient at first can compensate for the loss of postural sensibility by visual guidance. Later on, owing to the fact that proprioceptive impulses arising from any movement of the pelvis are transmitted centrally along the afferent pathways in the latissimus dorsi and other back muscles and the insensitive part of the body is thus connected to the central apparatus subserving

postural control, the patient is enabled to develop gradually a new pattern of postural sensibility. This enables him to keep his upright position without the aid of visual guidance, and eventually he can even sit, keeping his arms raised, with his eyes closed and without any artificial aid. In further stages of the restoration of posture, the patient is taught to keep his balance by throwing and catching a ball or heavy objects, such as sandbags, and finally by vigorous punch ball exercises, which comprise repeated alternation between free movements and movements against resistance.

3. *Readjustments of vasomotor control.* Maladaptation of the blood circulation to change of posture, resulting from interruption of the splanchnic control in all spinal cord lesions above T.5, is another obstacle to the physical rehabilitation of paraplegics, which has to be considered. This maladaption of paraplegics suffering from high lesions to the vertical position results in rapid and uninhibited accumulation of blood in the abdominal area and lower limbs, with resulting decrease in the supply to the central veins and consequently insufficient cardiac output. The blood pressure shows rapid steep fall, the pulse rate is raised to highest level and syncope follows in a few seconds or minutes. In some cases, it was found that the pulse rate may slow down before syncope occurs. The obvious explanation of this postural hypotension of paraplegics with high lesions is to be found in the inability of the blood vessels in the viscera to constrict, because of deprivation of control of the roots of the splanchnic nerves. However, it was found that this disturbance can be overcome by exercises which enable frequent change of postures, such as swinging in slings and breathing exercises, to such an extent that these patients can keep the upright position, as can the able-bodied person, without fainting. In the beginning, the adaptation to the upright position can be facilitated by the use of an abdominal binder or belt, which prevents blood from accumulating in the lower part of the trunk and legs. Care must be taken not to apply the binder too tightly, as this would prevent venous return.

It is beyond the scope of this lecture to go into the technics of the methods used to accomplish the physical rehabilitation and independence of the paraplegics, but mention may be made of the importance of dressing exercises at an early stage. The paraplegic is taught and encouraged to dress himself in the minimum of time, and this procedure includes hoisting himself from his bed into his wheelchair, either with or without the aid of a chain and handle fixed over his bed. It has been found that a well-trained paraplegic, paralyzed from the waist downwards, should be able to dress himself in about 5 minutes; with higher lesions, between 8 and 18 minutes. This in-

cludes transfer from bed to wheelchair. Another important independence exercise is getting off the chair onto two crutches, and vice versa.

Recognizing the great value of sport, not only as a recreational measure but as the most natural and effective form of reeducation, to promote neuromuscular skill and endurance, games are included in our training programme from the very beginning. Already in 1944, I introduced wheelchair polo, as the first team game for these patients, and, indeed, as a form of applied physiology. Using their wheelchairs in place of horses and a disk in place of a ball, when playing in the gymnasium, or a weighted ball when playing in the open, and shortened mallets, these patients soon became so expert that they invariably beat any team of able-bodied players who challenged them. Gradually, interest in sport amongst paraplegics deepened, and later on, when I included archery, wheelchair basketball and javelin throwing, as well as table tennis, it was evident that organized sport amongst paraplegics had come to stay. Today, it would be difficult to find a more sports-minded community than the patients of the Spinal Centre, Stoke Mandeville, or its affiliated units and settlements.

Of all the sports introduced for paraplegics, archery has proved to be the ideal. In the first place, it is of immense value from the physical therapeutic point of view, as it develops just those muscles of the upper limbs, shoulders and trunk, on which the paraplegic's well-balanced upright position depends. The amount of strength required to pull a 36- to 42-pound bow is obviously quite considerable, and as the patients in this Centre are trained to shoot a Columbia Round—i. e., 24 arrows at a distance of 50 yards, 24 arrows at 40 yards and 24 arrows at 30 yards—it will readily be realized that the total effort is quite enormous and that such a contest represents an endurance test par excellence. Secondly, archery has a great fascination, as the archer accomplishes everything by his own judgment and strength, and nothing is mechanized for him. Thirdly, archery is a sport in which the paraplegic can be so trained that his disability is no handicap in competing in a Columbia Round, for instance, against able-bodied people. He can learn at 50 yards or even more to shoot with the same degree of accuracy from his wheelchair as can the able-bodied archer from the normal stance position, and the knowledge that he can compete in matches on exactly the same terms as a member of any archery club has a tremendous psychological effect on the patient. Not only do these patients join archery clubs, but in one instance, two paralyzed coal miners, who, before their admission to Stoke Mandeville Centre, had spent many years after their spinal in-

juries as hopeless and helpless cripples in hospital or at home, actually started an archery club for able-bodied people in their own village.

Since 1948, annual Sports Days have been held at Stoke Mandeville, where paraplegic sportsmen from all over the country compete in their sports. We started with 26 competitors, and in 1952 we had over 120 competitors and there were 15 teams taking part in the archery competition alone. One glance at the comparative winning archery scores will reveal the great improvement in the standard of the paralyzed archers (table 1). An increase of standard was also seen in javelin throwing from the chair (table 1). But, the most remarkable achievement of all was to be seen in the table tennis competitions. These were divided into three classes: (*a*) for cervical cord lesions, (*b*) for high thoracic cord lesions and (*c*) for lower cord lesions and cauda equina lesions. The patients in class (a) were, of course, much more severely handicapped than those in the other two classes, as in these high cord lesions not only are the lower limbs and

*Table 1. Stoke Mandeville Games**

Archery

Year	Number in team	Winning teams	Score	Highest individual score
1948	8 archers	Star & Garter	(1) 1821	352—Twiss (Star & Garter).
		Stoke Mandeville	(2) 1590	
1949	4 archers	Star & Garter	(1) 1208	408—Pye (Chaseley).
		Chaseley	(2) 1167	
1950	do	Penley	(1) 1338	404—Ruszke (Penley).
		Star & Garter	(2) 1337	
1951	do	Penley	(1) 1417	462—Pye (Chaseley).
		Star & Garter	(2) 1405	
1952	do	Chaseley	(1) 1791	498—Nowak (Penley).
		Penley	(2) 1699	

Throwing the javelin

Year	Winning team	Distance thrown	Longest individual distance
1950	Stoke Mandeville	80 feet 3½ inches	46 feet 1 inch Thompson (Hexham).
1951	Hexham	89 feet 8 inches	56 feet 11 inches Thompson (Hexham).
1952	Chaseley	98 feet 9½ inches	58 feet 2½ inches Johnson (Chaseley).

*Demonstrating the increased standard in archery and javelin-throwing in subsequent annual sports tournaments.

the trunk affected but also most muscles of the hands and fingers so that the patient must have the table tennis bat strapped to his hand. Yet, two of my patients with cervical cord lesions, following fracture dislocation of the cervical spine, entered each class in the table tennis tournaments and were the winners in each class. This achievement alone, which is quite phenomenal and beyond all medical expectation, shows best to what extent the remaining adjustment forces, even in such high spinal cord lesions, can be mobilized by systematic training to overcome stress and extreme handicap, and there is also no better evidence of the development of a new pattern of innervation in the paraplegic than his achievement in the field of sport.

However, a satisfactory and full rehabilitation of paraplegics—i. e., the restoration to useful and socially accepted citizens—can only be achieved if physical and psychological readjustment goes hand in hand with their readaptation to work adjusted to their permanent disability. This principle was observed at Stoke Mandeville Centre from the start, and emphasis has been laid on early vocational training.

Rehabilitation by work in paraplegics can conveniently be classified into two stages:

1. *Rehabilitation in the early stages.* When the patient is still immobile, because of his active pressure sores and urinary infection, work first takes the form of simple handicrafts, as taught by the occupational therapist. However, the purpose of this therapy is by no means merely occupation as a diversional measure, with the underlying idea of preventing the patient from being more of a headache to the hospital staff than he might have been. It is used immediately to restore lost power of concentration and to revive initiative, in order to shift the psychomotor capabilities of the patient from the paralyzed to the normal parts of the body. This type of work has the great value of developing the mobility and dexterity of the fingers and arms, upon which the future vocation of a paraplegic depends and thus represents already the first step in the paraplegic's industrial rehabilitation. In certain cases, already in the early stages, specific pre-vocational training was introduced, at first by correspondence courses in commercial arts, accountancy, banking, and law.

2. *Rehabilitation by work in later stages.* When the patient is able to get up, he attends daily at one of the workshops and the work is graded and correlated to the physical improvement of the patient and, of course, his intellectual ability and personality. Regular reports are given by the instructors and sometimes it is necessary to switch the patient from one occupation to another. Naturally, it cannot be expected that everyone will make full use of the various

facilities offered. In numerous cases, especially with those who had long spells of sepsis and those admitted in later stages from hospitals or institutions, where they had been kept in prolonged, enforced inactivity, it took a considerable time to arouse the patient from out of the stage of frustration, apathy and inertia into which he had resigned himself. Such patients need unremittent guidance and encouragement by the medical officer, as well as the instructors, to ensure steady progress. Factors such as education, temperament and individual inclination towards work have to be taken into consideration, and obviously a spinal cord injury does not necessarily change a previously work-shy man into a first-rate worker. However, from all experience gained in over 9 years, I can now conclude that early vocational training has proved invaluable in restoring activity of mind and is a most important step towards the social rehabilitation of paraplegics.

Already in 1944, before full facilities for prevocational training had been made available in Stoke Mandeville Centre, an experiment was carried out by arrangement with a local factory, whereby several paraplegics took up regular work while still inpatient at the Centre. They were transported to and from the factory by hospital ambulance. This experiment proved, beyond all doubt, that paraplegics could be successfully placed in factories, side by side with able-bodied people, and it became the basic stimulus to the Ministry to build a special hostel and convalescent home in an industrial area in Greater London for the final employment of paraplegics in factories in that area. Another experiment has been carried out, with the assistance of the Ministry of Works. Several patients, who had taken prevocational training in draughtsmanship in this Centre, were accepted by the Training College of the Ministry of Works at Worcester to continue their training there. Several patients passed their final examinations with flying colors and some of them have been employed as draughtsmen in offices.

Domestic and Industrial Resettlement

1. *At the paraplegic's own home.* The majority of our paraplegics have so far returned to their own homes to live there with their families, in the old environments. This achievement no doubt represents the ideal and most satisfactory form of domestic resettlement for paraplegics and should be aimed at as much as possible, in the future. In evaluating the type of industrial resettlement, several groups can be distinguished, some of which may be mentioned here.

a. Men who, before the injury or disease, had already been em-

ployed as skilled or unskilled workers and have succeeded in getting back to their former trades, in spite of their severe disability. The very first patient of this Centre is an example of this group. He was wounded in Italy in 1943 and admitted to Stoke Mandeville on 3 February, 1944, with a high cauda equina lesion L.2/L.3. There was a suprapubic drainage and deep pressure sore over the left buttock, and he developed, in due course, a paravertebral abscess, which had to be dealt with. Before joining the Army, he had been employed in a factory as glovemaker. As a preliminary to his industrial rehabilitation, he started leatherwork, for so long as he was confined to bed. Later on, he became a member of that working party mentioned in connection with our first factory experiment. As soon as our workshops were opened, he took up cobbling. On discharge home on 2 March 1946, he returned to his former job almost immediately, and the factory provided him with proper facilities to enable him to carry out his work from his wheel-chair. He has worked full time since; absences since 1946 total only 4 days.

b. Paraplegics who, owing to their permanent disability, were unable to return to their former jobs but succeeded in getting a different job in their former trade or occupation. The following example may be given. An officer in a Borstal Institution, aged 42, was involved in a train crash and sustained a fracture dislocation of the 10th thoracic vertebra, resulting in a complete transverse lesion below T.11. He is now employed as a teacher for illiterate Borstal inmates at the same institution.

c. Paraplegics who were unable to return to their former occupations, such as bricklayers, coal miners, regular soldiers, etc. They are now employed in a great variety of skilled and unskilled jobs. As an example, a former bricklayer, with a cauda equina lesion below L.5, following gunshot wound in 1944, took up cobbling in this Centre. After discharge, he continued his training in a training center and has been employed full time since 1947 in the Boot and Shoe Repair Department of his local branch of the Cooperative Society.

d. Paraplegics who, at the time of their injury, were totally untrained and who have taken up training since their injury. As an example, a young man with a transverse myelitis is quoted, who was trained at the Centre in draughtsmanship and soon so satisfied his supervisors that the Ministry of Works agreed to train him in their training college at Worcester. In 1948 he passed all examinations and since 1949 has been employed as full-time draughtsman in one of the offices of the Ministry of Works in London, driving several miles in his own car from his home to his office.

In 1950, he became engaged to a paraplegic girl, another graduate from Stoke Mandeville, with a complete transverse lesion below T.5, following fracture dislocation, whom he met at the same office after she, too, had been trained in draughtsmanship and employed as a tracer in the Ministry of Works. They are now married, live in a bungalow and continue their daily work.

e. Paraplegics who are doing housework, including cooking, while their wives are employed on outside work. In this connection, it may be mentioned that several married female paraplegics have resumed housework, after returning home, and are able to look after their families, in spite of their disability.

2. *At special temporary or permanent residential settlements.* There are paraplegics who are not able to return to their own homes or prefer, for one reason or another, to live in institutions or permanent residential settlements of colony type. Several of these institutions are now at our disposal: Star & Garter Home, Richmond; Chaseley Convalescent Home, Eastbourne; Duchess of Gloucester House, Isleworth; Lyme Green Hall, Macclesfield, Cheshire; Kytes Settlement, Watford. The next two tables (Tables 2 and 3) give a summary of the domestic and industrial resettlement position, as at 1 October 1952, of 621 paraplegics who have been discharged out of 800 from the Spinal Injuries Centre, Stoke Mandeville, to their own homes or other permanent settlements.

In conclusion, all these facts may suffice to prove the fundamental change which has taken place in the whole conception of the treatment and rehabilitation of paraplegic patients and to show the extent to which stress, produced by this profound disablement, can be overcome

Table 2. Domestic and Industrial Resettlement of 800 Patients Treated at Stoke Mandeville Hospital Between 1944 and 1952

Home		454
Permanent settlements		167
Chaseley	25	
Duchess of Gloucester House	57	
Lyme Green Settlement	24	
Kytes Settlement	30	
Star & Garter Home	20	
Thistle Foundation	4	
Sir Oswald Stoll Mansions	6	
Princess Christian Home	1	
		621

(Remaining 179 cases include 90 patients still receiving active hospital treatment in Stoke Mandeville Hospital, 17 transferred to other hospitals and 72 deaths.)

*Table 3. Domestic and Industrial Resettlement**

	Cases
Total material	621
Less those too old for work	19
	602
Number of workers	429 = 71%
(Full-time—319 = 74%)	
(Part-time—110 = 26%)	
Number not working (including 14 cases we were unable to trace)	173

Classification

Home: Number of workers = 287 out of 454 cases.
Chaseley: Number of workers = 21 out of 25 cases.
Duchess of Gloucester House: Number of workers = 50 out of 57 cases.
Lyme Green Settlement: Number of workers = 24 out of 24 cases.
Kytes Estate: Number of workers = 25 out of 30 cases.
Star & Garter Home: Number of workers = 13 out of 20 cases.
Thistle Foundation: Number of workers = 4 out of 4 cases.
Sir Oswald Stoll Mansions: Number of workers = 4 out of 6 cases.
Princess Christian Home: Number of workers = 1 out of 1 case.

*Further analysis of data from table 2.

by the forces of adaptation. Perhaps the most gratifying result achieved is the complete change in the mental attitude of most of these disabled people towards work and the realization that regular work is an important factor for both physical fitness and human happiness. The same men, who, only a few years ago, were considered as outcasts of society and hopeless cripples, are, by their work, repaying society for the assistance given to them in their endeavours to become once again useful and respected citizens. Medical science has provided the foundation for this achievement by a synthesis of physiology and practical medicine and has thus made another important contribution to mankind.

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WEDNESDAY MORNING SESSION

THE ROLE OF THE LEADER IN THE PREVENTION OF DISEASE*

Colonel Eugene R. Inwood, MC

This discussion of the role of the leader in the prevention of disease will be limited to the military leader. Specifically, we are concerned with the activities of various leaders in an infantry division.

All military leaders have certain common requirements. These include strong motivation, a certain level of physical capacity, adequate intelligence, and the ability to communicate their thoughts, opinions and ideas to others and to relay certain orders down the chain and information up the chain of command. They must be able to evaluate men, military situations and the capacity of their own unit, as well as the enemy, to perform assigned tasks. This includes making decisions and taking action which may merely reinforce or carry out policies or it may mean minimizing and even ignoring certain facts and policies.

This, of course, varies considerably at different levels. In higher echelons, the ability to climb a mountain is not so important, but it is vital that the high echelon leader be able to evaluate information which he cannot obtain for himself.

For example, a platoon leader can see what is happening to his unit. He is on the ground and sees for himself; although he may have to extend himself physically, he gets most of his information first-hand. He also knows his men personally and can, generally speaking, see what they are doing. At the company level, much of this remains true but more depends upon the platoon leader's report and less upon his own observation. When necessary, however, the company commander can make his own evaluation by visiting the platoon and getting first-hand information. At the battalion level and above, it is not routine for the leader to know all of the men or to secure all of his information personally. This dependence upon transmitted information increases at each higher echelon until at the relatively remote Army or Theater Headquarters, there is practically no first-hand observation.

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Thus the ability to evaluate situations and to make decisions as a result of this evaluation is of prime importance. Leadership is very dependent on communication. As information goes up the command chain, so do orders come down from unit to unit. Each of these has to be perceived, evaluated and acted upon by the leader of each unit in the channel. This provides an opportunity for problems in communication at every relay point. Each individual receiving a communication will evaluate it and act on it one way or another. He may pass the message on without any change but it is more likely that he will in some way modify it. Written communications, therefore, have some values which verbal ones do not have. The basic idea remains fixed without change throughout its course. Verbal communications can be changed at every relay point sometimes without the knowledge of the individual transmitting the message.

Since all the factors are never known in a military situation and since the situation itself is constantly changing, the evaluation must mean that certain factors have to be ignored so that other factors more vital to the leader may be stressed in that particular unit.

In the military service, the commander has full responsibility for the performance of his command. This responsibility is universally accepted in our Army. It should be noted that particularly in higher commands where policies are determined, success is the criterion by which good leadership is judged. The higher the leader, the more often he is likely to be removed if his unit is not successful.

We have traced some of the problems involving leaders from small to large units and back again. Let us now examine the picture from another viewpoint. At high military levels certain types of decisions and policies are made.

Included within this group of decisions are those pertaining to the health and welfare of the troops. For example, since it is accepted that sick men cannot fight, a leader does not want his men to be sick. He cannot, however, give the order that members of his command will not get sick. In order to reduce sickness to the minimum, he will accept the counsel of his medical staff officer, the unit surgeon, as to what can be done to prevent sickness.

Since past experience has shown that many illnesses can be prevented by vaccination or prophylaxis and this experience has been set forth in Army Regulations, it is apparent at once that certain preventive measures are mandatory. These include smallpox vaccination, typhoid inoculation and other well known measures for control of disease.

However, some conditions are not so easily controlled. Some, like malaria, can be controlled only by continuous dedication; others, like trenchfoot, by daily prophylactic measures.

The surgeon is dependent upon the leader to reinforce and support his recommendations for the prevention of these conditions.

Let us examine briefly what happens when an order is received. It is immediately evaluated. It may be considered important or unimportant depending upon the personal knowledge, experience, and ability of the leader. He may decide to follow it willingly, or he may at his own risk, decide to ignore it. Frequently the answer is somewhere in between. Such factors as the manner in which the order was given are important. Was he called to higher headquarters to receive it? Was it routinely circulated in writing or transmitted by telephone? Did it receive local reinforcement or was it treated indifferently? All of these factors figure in the evaluation.

Also the matter of relevance has bearing. A routine order stating that personnel in rear areas will wear neckties when on pass is of little importance to a platoon leader engaged in a patrol operation.

We have all received orders which we ignore—at our own risk. For example, there are several bars in Washington which have been declared "off limits." Yet most of us could not name a single one. The medical officer with no command responsibility and no interest in such places can pretty safely ignore this notice when he reads the daily bulletin. Yet it is an official order. All orders pertaining to medical matters are given in the name of the commander. Some of these may not seem important to certain leaders and may be immediately recognized as vital by others.

The commander who has seen his unit knocked out by mass food poisoning, will be concerned about mess sanitation. Another without this experience may look upon a sanitary order as "spit and polish."

The medical program depends upon the evaluation of the leader of each unit for its effective support. At the division level, this may be a published order or memorandum from the Commanding General or a member of his staff, the surgeon G1, G4, or Chief of Staff, depending upon its nature and its importance to the command. Or the commander may be by-passed if the matter is routine and pertains to some medical detail in which it is presumed he would have little interest. For example, a directive is received that a medical item is unsatisfactory and no longer will be used. The division surgeon on receipt of this directive would ask for distribution to all units having surgeons and if, in his opinion, more action was called for, he might call the major unit surgeons and discuss it with them. In addition, if it were considered to be an emergency, he might send the Division Medical

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Supply officer out to pick up all stocks of the item in the division area.

If the directive would in any direct way affect the activities of the troops, it would have to be handled differently. For instance, if an additional physical examination for all the command was ordered, a great deal of coordinating with various commanders would be required. It would be necessary to prepare a plan, get it approved and published with a schedule for the examinations.

This is mentioned only briefly because it is not our purpose today to discuss staff operation.

At the regiment level, one commander may consider a matter important and reinforce the directive—telling his staff the matter is urgent and directing full cooperation and a report on progress and completion. Another may pass an order along in a routine way without any show of interest. The first regiment will adhere strictly, the other will go along but somehow the idea that this is not so important filters through.

An example from World War II in relation to trench foot will demonstrate how the ambivalence of one regimental commander influenced the incidence of trench foot in the unit and how it compared with the other two regiments:

> "In the fall of 1944, this division was alerted for oversea movement. The unit had been training for more than a year but progress through the unit training stage had never been accomplished because individual replacements in all grades were constantly being transferred oversea. A short time before entering the staging area, a series of training inspections was carried out. During these inspections, it was discovered that some of the new men were completely unaware of the difference between trench foot and athlete's foot. A series of pictures on trench foot in all its stages, with emphasis upon early detection and treatment, was shown to the entire command. When the unit left for overseas, every man knew what trench foot was and that it was a dangerous condition, which, if neglected, could mean the loss of a foot. A few weeks later, however, when the three infantry regiments were in combat in France, with the temperature several degrees below freezing, the men began reporting back with early or suspected trench foot. It became apparent then that overemphasis had been placed on the early detection of the condition and that the earlier training which had dealt with prophylaxis had been forgotten.
>
> "On 14 January 1945, at a conference between the division surgeon and the corps surgeon, it was determined that something had

to be done to control trench foot. After 22 days of combat, one regiment had 41 cases; another, 172; and the third, 84. The methods of prophylaxis were reviewed and the following recommendations were made to the Division Commander:

"1. All men who were constantly exposed to freezing weather were to take their shoes and socks off once each day and rub their feet for 10 minutes.

"2. Each soldier was to be provided with an extra pair of socks to carry on his person between his undershirt and his O. D. shirt so that he would have available one dry pair for a daily change. An effort was to be made to send up clean socks each day with the rations, but if this became impossible each man would still have the extra pair of dried socks which he carried on him for emergency wear.

"3. Unit leaders were to supervise such procedures and were to set an example by complying themselves.

"4. Unit surgeons were to inspect the men being sent to the rear more carefully, evacuating only those who were definitely incapacitated. They were to visit all units down to platoons and give necessary instructions and advice. Thse visits were to be made as frequently as possible—preferably daily.

"The plan was approved by the division commander and regimental commanders were asked to come to the command post that same day. The G4, present at the meeting, agreed to arrange for laundry service and to send clean socks along with the rations. The commanding general issued explicit instructions endorsing the plan and stressing the need for such a program. He emphasized the fact that the unit had to conserve the men it had, that replacements were in short supply and often were completely inexperienced.

"Two of the regimental commanders were enthusiastic in their support. Following the general's remarks, the third regimental commander said that: (1) It was a good but impractical idea; (2) his men, only the day before, had captured two Germans while in the act of rubbing their feet; (3) his men were too busy looking for Germans to take the necessary time out; (4) his men would not carry wet socks next to them until they dried; they would not put on dirty socks; and he doubted if there were any clean ones available to be sent up with the rations.

"These objections were met with the following explanations: Men in foxholes would cover each other while taking turns rubbing their feet. Thus they would not be caught the way his men had caught the German soldiers. Men in other units were carrying their socks in the directed manner and were not objecting to it. The general

further pointed out that there were bound to be periods at some time in each day when even the busiest men would have time to carry out this method of prophylaxis if the unit leaders worked on the plan and set a good example themselves. The reluctant commander agreed to try it, but it was evident that he still had some misgivings.

"Following the inauguration of this plan, there was an immediate drop in the incidence of trench foot (table 1). The program of prophylaxis was wholeheartedly supported by medical officers throughout the division. Inspections, down to the platoon level, were made daily by unit surgeons or their assistants. The commanders of the first and second regiments were enthusiastic about the project but the commander of the third regiment believed it could not be effective. In all units the medical officers made a sincere effort to carry out the program. All three regiments were engaged in the same type of defensive combat, in the same type of terrain, and under the same weather conditions.

Table 1. Number of Patients With Trench Foot in Three Regiments

1945	Regiment 1	Regiment 2	Regiment 3
Prior to 15 January	41	172	84
16–31 January	3	3	17
February	6	16	78
March	12	8	46
Total	62	199	225
Number of new cases after instituting control measures	21	27	141

"In February, the regiments continued in the same tactical situation. On 17 February, a limited attack was made by all three regiments. The weather was cold, the terrain hilly, and the ground was covered with a varying amount of snow. Again the first and second regiments had only a few cases as compared with the third regiment whose commander had completely lost faith in the plan (table 1). He believed that the attack was the important thing and that his men were too busy to care for their feet. He did not continually emphasize the matter as did the other commanders. The medical officers in all three units were unanimous in their support and showed about the same degree of diligence in their part of the program.

"In March, similar results were noted (table 1). The weather was warmer and the temperature above freezing much of the time, but this was offset by certain other factors. The first and third regiments had been attacking for several days across a flat area where the foxholes had a tendency to fill with water. At night the water froze. It was impossible for the men to keep themselves dry if they had to remain in foxholes. The second regiment was on higher ground where the foxholes did not fill with water. No new cases were reported after March. The comparative results in these three regiments of the same size and operating under similar circumstances reflected the attitudes of the regimental commanders and showed how effective a control program can be with command support. In some situations it is difficult to obtain the full support of the commander and such a unit will be less successful in maintaining the health of the troops than when the commander offers his full support. The unit surgeon can do much to assist in developing this cooperation."

In this instance, it is apparent that the commander of regiment 3 was not impressed by the need for this program. The directive was set forth clearly. The situation was considered to be an emergency by all other participants at the conference on 14 January. Yet he did not evaluate this directive properly from a medical viewpoint. He gave some clue as to his feelings at the conference and finally appeared to be convinced. He made a demonstration of support during the first 2 weeks of the program and then lost interest. As a result, when weather conditions were appropriate his regiment had a few cases of trench foot almost daily. The losses to his regiment were not sufficient at any one time to impress upon him the need to support the program actively. Yet in 2 months, he lost more riflemen than he had in two of his nine rifle companies. As a result, the program in that regiment was ineffective. In other regiments, the incidence was certainly minimal. These commanders were impressed by the need for the program by being called to the division command post for a conference about it.

In conclusion, it can be stated that the effectiveness of the prophylactic program reflects the attitude of the leader. The leaders of the small units in regiment 3 did not carry out the thorough daily inspections as in the other regiments. So for that one regiment, the program failed. The leader's ambivalence was reflected through the entire unit even though he did not openly oppose the program.

SYMPOSIUM ON STRESS

THE ROLES OF FOOD, REST AND ROTATION AS DEFENSE AGAINST PSYCHOLOGICAL STRAIN*

HYAM BOLOCAN, M.D.

Food, rest and rotation as usually met with in the military situation are factors which by altering the external load may affect the ego defenses, either by permitting what has previously been repressed to come forward, or by further strengthening already existing defense mechanisms. It is the absence (or presence, as the case may be) of any one or all three which may represent, so to speak, "the straw which breaks the camel's back," that increased load which finally results in the altering or disorganization of the defense mechanisms leading to a state of psychological strain. Furthermore, the result of such increased load is likely to vary with the individual depending upon his previous character structure and personality make-up. A dual role is played by each factor, namely the "real" value in terms of the physiological needs of the organism plus the symbolic value. The symbolic value is based usually on past infantile experiences and plays an equally great role in the determination of the behavior of the organism.

In times of stress there is a tendency to regress to earlier levels of phychological development, particularly if the satisfactions achieved at such stages of development acted as defenses against anxiety and helped maintain a feeling of security. In addition, if the outlets for normal adult satisfactions are cut off, the individual may return to earlier infantile sources of gratifications. The oral level of development of course represents the one in which the helpless infant is dependent on the mother for food supplies needed to stave off hunger and starvation. Together with this supply of food goes the emotional relationship whose nature sets the tone for future relationships and responses. The soldier suddenly separated from family and friends, often facing the unknown, may once more feel like the helpless infant. The symbolic role of food is once more enhanced. There is a close tie between food and the one who is responsible for the provision of food. The Army authorities are strongly identified with the omnipotent parent. Diminution in the quality or quantity of food may be inter-

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preted as an abandonment, or else that the authority is no longer all-powerful. This increases anxiety that proper protection will not be provided in battle, and there may be a marked decrease in morale. It should not be forgotten that the converse is also true. A succession of defeats which destroys the aura of omnipotence surrounding the leaders may result in criticism regarding food and rest. If on a realistic level, diet has been excellent and rest has been adequately provided, then one may hear that the men have been allowed to become "too soft." The men themselves will come to believe that the "good" leader is the one who hardens and toughens them, one who teaches them to get along on a minimum of food and rest.

The term "rest" is defined here in its military connotation. When it is said that troops are to be given a "rest," one usually means that they will not be asked to perform undue physical labor and that they will be moved to an area of lesser exposure to dangerous external stimuli. This is not necessarily synonymous with the term "rest" as used in the physiological sense. Men removed from battle and returned to a rear area do not necessarily achieve that muscular relaxation one normally associates with the state of being at rest. Internal stimuli are important. It is the shift in the "balance of power" in the forces involved in psychic conflict that is usually responsible for breakdown. Conversely, in order to make a man fit for duty, it is not necessarily required to resolve the conflict but rather to restore equilibrium in the "balance of power." The practical aspects of this involve such problems as when is the most opportune time to tell a man he is returning to duty, and the effect of such a decision upon a man's ability to achieve muscular relaxation. For example, cases of true combat exhaustion when given a decision as to future disposition are almost immediately able to achieve some degree of relaxation even though the decision given is not necessarily the one consciously desired. On the other hand, those cases in which the decision is held in abeyance show little or no improvement. There is no simple solution to the problem of the optimum time at which a rest period should be given and the optimum length of time of such a rest period. These are influenced by various factors involved such as terrain, weather, and type of fighting. It is the author's opinion that because of the large number of variables involved, no pat answers can be given to these problems at this particular time. The most important factor in arriving at the solution in a given situation is direct observation of the men by someone thoroughly familiar with what is the normal "combat-reaction."

Rotation is important from the standpoint of providing a clearly defined goal personally meaningful to the individual soldier. This

is particularly valuable in the Korean war where such questions as just how much territory must be taken or exactly who must be defeated before the war may be called successfully concluded, have not yet been answered. Thus without rotation there is no concrete goal about which a man can build his idealistic phantasy of home, the reach of which promises an end to the painful and dangerous external stimuli to which he is constantly exposed. However, "rotation" brings its own evils. The anxiety engendered by approaching rotation may be so overwhelming in some cases as to make a psychiatric casualty of a man who previously has been an excellent soldier. The difficulties are due to the conflicts revolving about the unconscious meaning of rotation. Soldiers may be troubled by unconscious guilt over buddies left behind to face further danger and death. The fear of punishment for unconscious aggressive wishes is often projected onto fate with a resultant sense of impending doom which mounts in intensity as the desired goal is approached. In practice this has apparently been lessened by letting the men know the approximate time but not the exact date of their approaching rotation. It is felt that the difficulty could be greatly reduced if the policy were based upon the rotation of whole units rather than individuals. This would tend to lessen feelings of guilt, and would permit a mutual sharing of the anxiety which would thereby likely become more bearable.

It must be emphasized that symptomatology has to be evaluated within its proper frame of reference. Symptomatology which in civilian life might be considered pathological may represent part of the "normal combat reaction." For example, some degree of nausea and vomiting, must be considered normal, and may represent a primitive mechanism of "spitting out" that which is dangerous. Inability to relax may be a desirable phenomenon in a situation in which maximum vigilance is often the price for safety. Nightmares with resultant insomnia may represent attempts of the ego to master through repetition the anxiety engendered by the traumatic situation; under combat, such symptoms are not necessarily abnormal. Medical officers should be cognizant of these facts, as otherwise unnecessary evacuation of patients occurs with resultant fixation of symptoms.

PERSONNEL SELECTION, CLASSIFICATION, AND ASSIGNMENT IN RELATION TO STRESS*

SAUL P. SELLS, PH. D.

Introduction

Research on selection of military personnel with particular reference to performance under stress is new. The problem involves prediction of behavior in future situations from data obtained by examination of individuals prior to their exposure to those situations. As used here, stress tolerance refers to the ability to maintain efficiency of performance and to control emotional reactions under stress. Progress in this area has been affected both by the multitude of variables which must be considered and by the lack of suitable tests and technics of measurement.

At the USAF School of Avation Medicine we are conducting in-service and contract research on the development of psychiatric screening of flying personnel. Research of a related nature is also being done by the Army, on a number of combat specialties; by the Navy, on naval aviators and submarine personnel; and by the Marine Corps.

This presentation will analyze the problems of method and research design for stress selection and summarize recent progress. We will first consider the broader issues of personnel selection as a phase of the total problem of conservation of manpower.

Personnel Selection and Conservation of Manpower

If the United States were to become involved in a great, total war, speedy and efficient mobilization of all manpower resources would be an immediate requirement. The military establishment would be expanded and extensive relocations of personnel would follow with competing pressures to staff even the most essential supporting activities. Conservation of manpower and elimination of wastage would be major strategic issues.

Waste is a problem in many ways. If shortages exist to perform more demanding or more critical jobs and qualified persons are as-

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signed to lesser jobs, this is waste. If time and money are spent to train unqualified individuals, the resulting attrition is was :. If trained personnel fail to accomplish their missions because of unanticipated defects or because of bad planning or management, this is waste.

Among the most critical and demanding jobs of a nation's defense organization are certain combat specialties requiring specific and exacting physical and psychological qualifications for the achievement of high technical efficiency under combat stress. Such specialties may readily be identified in the air crew, aboard submarines and naval vessels, and in the ground forces.

The problem of conservation of manpower for all of these combat specialties has many common factors. Each has its share of attritions in training and of failures in subsequent operations and in combat. Each has similar problems of personnel administration, leadership, and morale which affect individual and group effectiveness in similar ways. Efficiency may be increased or impaired by the quality of training, by the amount of practice in emergency procedures, by the effectiveness of design and maintenance of equipment, by soundness of leadership, by flexibility and intelligence of management, and by operational success or failure. These interrelated factors are all based on the utilization of available personnel.

Selection measures are concerned with the quality of personnel made available and in this respect may place upper and lower limits on the effectiveness of the other measures discussed. Selection is not in any respect an alternative to the other measures and would be a poor substitute. But added to effective leadership, management, and administration, it can make an important contribution. This can be illustrated by the results of an experiment in 1943 in which the elimination rate in pilot training was reduced from 75 to 36 percent by selection (ref. 4). An unselected sample of 1,003 men were permitted to enter pilot training in the Army Air Forces after passing a physical examination, but regardless of scores of aptitude selection tests. Seventy-five percent of the total group (physical examination only) washed out. One sub-group of the 1,003, consisting of 90 men, qualified according to selection standards in effect prior to World War II; namely, they passed a physical and psychiatric examination and had completed 2 years of college. Of this group, 61 percent was eliminated in training. Another sub-group of 356 men qualified according to the selection standard of November 1943, with the physical examination, a qualifying test score (Air Force Qualifying Examination) of 180, and a pilot aptitude score of 5. Of this group, 51 percent was eliminated. Finally, 153 men qualified according to the

standard of November 1944, with a physical examination, a qualifying test score of 180, and a pilot aptitude score of 7. Of this group, only 36 percent failed. Since all four rates are derived from the same population, it is likely that improved quality of personnel was an important factor in the results.

Selection and Classification Programs

The design of a selection program for a particular specialty depends both on the critical requirements for success in that specialty, and on the selection job to be done. In a period of mobilization, involving rapid processing of large numbers of people, streamlined large-scale procedures are as important as validity of the technics used.

Critical requirements for each specialty can be classified into three separate, but related categories. These may for convenience be labeled: (1) Physical, (2) Aptitude, and (3) Predisposition, or Psychiatric. Physical requirements generally include specified standards of medical, sensory, physical, physiological, and anthropometric tolerances. Aptitude requirements include aptitudes and skills. Predisposition factors include personality, character and dynamic traits which predispose a person to impairing emotional reactions beyond the normally accepted limit when undergoing operational and combat stress. All of these are based on the stresses and performances required by the job. Analysis and research on the field performance of the job are crucial to the discovery, definition, and evaluation of the human characteristics designated as critical requirements for selection.

The value of a selection program may be judged empirically in terms of its contribution to successful operations. Assuming constancy of other factors, if the proportion of individuals successful in training or in combat is higher as a result of selection than otherwise, the gain in efficiency can be calculated and evaluated. However, this requires means of defining and measuring successful performance. The definition of critical job requirements facilitates test construction and selection. But test validity cannot be assumed and must be determined empirically in terms of accuracy in predicting job success. The development of satisfactory criterion measures has been and remains the most baffling problem in this complex field. It is generally believed that an efficient predictive battery can be developed to measure almost any human performance if the performance itself can be accurately measured. However, if the criterion is unreliable or the measures of it not acceptable, these factors place limits on

efficiency of prediction. Much research effort is being devoted to criterion problems by all personnel research laboratories.

As a general principle the proportion of qualified individuals in the population varies inversely with the stringency of the critical requirements for a job. Hence, as the qualifying scores on selection tests are raised, the number of applicants necessary to yield a given quota of acceptances will also increase. However, if the selection tests are valid, then the higher the qualifying score the higher will be the quality of personnel accepted and correspondingly the rate of failure will be reduced. Thus improvement of quality through selection is achieved at the cost of screening and rejecting large numbers of applicants.

Since selection batteries, however useful, will fall short of perfect validity, a degree of error must be expected. Hence, a portion of those rejected might be expected to be successful. Therefore, in practical application the personnel administrator must balance the supply of manpower, the cost of selection testing and the need for utilization of those rejected against the cost in time and dollars of failures expected in the group accepted. He may reduce failures by raising standards, but only if he has an adequate supply of applicants and can afford to reject a certain number who might succeed.

It is apparent that unless the manpower supply is rich and selection measures precise, selection for a single specialty at a time may be administratively wasteful. On the other hand, if a single battery of medical, aptitude, and psychiatric screening tests were so structured that it could yield differential predictions for a wide range of different specialties, the administrative efficiency of such a program would be superior. This multiple selection is called classification. Classification is concerned with fitting each individual to the job for which he is best qualified, thus making possible maximum assignment efficiency of the entire manpower resources.

Classification is thus an extension of the basic problem of selection. Differential prediction, upon which it is based, requires that critical requirements vary significantly between jobs and that this be reflected in the criterion measures. If the criteria defining performance in two jobs do not differ, they cannot be predicted differentially.

There is today much interest in the problem of classification. The Air Force, Army, and Navy have developed efficient aptitude classification batteries for enlisted personnel. However, the progress from selection to classification is still largely a challenge to our personnel research people. This is particularly true of psychiatric classification. Research is presently in progress on a few specialties and positive results for selection of these are not yet fully confirmed. Psychiatric

classification will depend on our success in establishing psychiatric selection, which we will now consider.

Psychiatric Selection Research

In terms of the general concept on which this symposium was based; namely, that "stress is regarded as the resistance of an organism to an external load," all three areas of selection—physical, aptitude, and psychiatric—are related to stress. These three areas are as interrelated as the functions which they measure in the integrated behavior of the organism. Historically, physical selection was first developed. With modest beginnings in World War I and tremendous acceleration in World War II and since, aptitude selection made impressive practical contributions. Psychiatric selection is not yet a practical reality, but is in a state of active research. In the discussion of this problem I shall consider primarily the selection of Air Force pilots, but generalization to other specialties can be made.

Some work on this problem was begun by the Army Air Forces in World War II. In a reference to this reasearch, Flanagan (ref. 4) in 1948 expressed several opinions concerning the problem. The points he made were: "(1) That there do exist individual differences in ability to undergo combat stress without exhibiting emotional reactions beyond the normally accepted limit. (2) This factor appears to be definitely secondary in importance in causing breakdowns in comparison with other factors in the situation, including leadership, amount of stress, and administrative procedures used in the combat situation. (3) This predisposition is minor, but not negligible. And (4) (that) It can be predicted. . . ." Unfortunately the termination of the war brought about a premature end to these studies and no valid predictors of stress tolerance were completed.

A new project to continue investigation of this problem was initiated at the USAF School of Aviation Medicine in 1949 at the direction of General Armstrong. The need was recognized to supplement the ARMA (Adaptability Rating for Military Aeronautics), a psychiatric interview procedure performed by a flight surgeon, with an efficient objective battery of group tests. The design and progress of this project have furnished the basic material for the present report.

This project includes a number of research contracts and in-service research involving the development and validation of three batteries of experimental tests. The first battery of 12 experimental tests was administered to over 2,000 student pilots on entering training at Randolph Field in 1949 and 1950. The battery is adapted in part from clinical and projective personality approaches and includes several tests developed in World War II. All students were permitted

to enter regardless of test performance. The tests were stored until all had graduated or had been eliminated and criterion data for training collected. Preliminary validation studies were then begun, testing the predictive efficiency of the scores against these criteria.

A second experimental battery, requiring 10 hours and consisting of 104 performance tests of personality devised by Professor R. B. Cattell of the University of Illinois, was given in 1951 to 1,000 student pilots at Greenville Air Force Base, Mississippi, following the same plan. These tests are now being factor analyzed by Dr. Cattell in preparation for validation studies.

A third 10-hour battery, based on revision of successful tests in the first battery and a number of new tests, is presently being administered to another group at Graham Air Base, Florida.

Concurrently with the processing of these data a systematic follow-up of all students' records has been made and independent research on the criterion measures has progressed. The important issues in this research can best be described in relation to the experimental design.

Three important aspects of the research design are: (1) the criterion; the measure of adjustment to stress which is to be predicted; (2) the critical job requirements, in terms of individual personality characteristics, which define the predictor traits entering into the measure of predisposition; and (3) the development of predictors, tests, and technics of measurement. Let us review briefly each of these in relation to the present problem.

The Criterion. The assumption is made that psychiatric success or failure depends upon both the intrinsic personality resources of the individual to adjust and the press of the total environment on the individual. If this assumption is accepted, the research design must meet two conditions. First, the experiment should be limited to situations in which the objective environmental factors pressing on the individual are homogeneous, involving a reasonably uniform level of exposure to recognized hazard and traumatic experience. Second, the level of exposure should be one which most combat fliers are expected to endure routinely. The latter condition recognizes the fact that selection cannot predict all combat psychiatric failures, since combat stress frequently may assume proportions of severity beyond most human endurance thresholds. If the experimental design can minimize variation in degree of exposure to external pressure and at the same time maximize variation associated with intrinsic personality factors, then predictions based on reactions to selection tests can be studied. Such predictions would be limited quite properly to cases which are attributable primarily to predisposing factors within the

individual which cause him to be prone to break down under circumstances to which the successful fliers are expected to adjust.

The prediction of human behavior rests also on the assumption of continuity of the individual personality and of the life space or circumstances of his life. In a period of mobilization these are most likely to remain reasonably constant for the period during which the results are required. However, the experience of the Air Force last year with involuntarily recalled reserve officers demonstrated clearly that when significant changes in individual lives occur, such as being inactive for 5 years, getting married, having children, or building a business or profession, drastic changes in motivation and attitude may occur which may alter materially a previous assessment of an individual's combat fitness. This point has implications also for policies concerning the recall and assignment of reserve personnel. The present research did not include any reserve officers.

Criterion measures are desirable at the training and intermediate levels as well as the combat level. Although combat is the final and critical criterion, it is desirable to conduct preliminary research and development on training data. The effort and expense of obtaining combat validation should be undertaken only on instruments with some demonstrated validity.

A review of the literature (ref. 10) disclosed that over a long period of time research on prediction of pilot success by means of personality measures has consistently used as a criterion, graduation versus elimination in pilot training. Virtually all of this literature reported negative results in prediction. In view of these persistent findings it is of much interest that the Air Force studies of World War II (ref. 6) demonstrated that this pass-fail training criterion is determined chiefly by ability factors. It is not appropriate for psychiatric prediction. Apparently the negative results indicated that the personality tests are not valid predictors of flying aptitude.

A more appropriate psychiatric criterion for training may be called purified pass-fail. This conforms with pass-fail, which is an administrative reality, but uses only part of the data from the pass and fail groups. Controlling aptitude experimentally by matching on aptitude scores, it selects from the pass group those individuals who manifested evidence of positive adjustment and from the fail group those who were psychological failures. It excludes from consideration pass cases of unsatisfactory adjustment but superior aptitude, fail cases with satisfactory adjustment but defective aptitude, and other anomalies. Clinical assessments, buddy ratings, medical records, grades, and other administrative data are assembled to make a terminal assessment classification of each individual student. In a preliminary study

in 1951, this type of purified pass-fail training criterion correlated significantly with combat criterion ratings on a small number of Air Force pilots (ref. 11). Although this type of criterion measure does not make use of all cases tested, it permits effective preliminary validation prior to verification against combat data.

The combat criterion involves problems which have already been pointed out. Data must be reported on combat exposure, reactions to stress, and performance under stress. Exposure cannot be measured reliably by number of missions. It must take into consideration the complete combat record of the individual, his unit, and related units. Operational success or failure and group morale, as demonstrated by Reid (ref. 9), Hastings (ref. 8), and Grinker and Spiegel (ref. 5), are important determiners of exposure. Stress, being a subjective variable, requires careful psychiatric assessment of the individual in the field. And finally, performance cannot be measured by planes shot down or ground targets hit. This would place too much weight on opportunity and on skill. The problem requires evidence on efficiency, which takes into consideration individual differences in skill level. At present this is estimated principally by carefully designed ratings by peers and superiors.

An interesting, though complicating, aspect of criterion research is related to those individuals who after completion of training adjust to stress by leaving the field. This problem has become apparent in our present efforts to obtain combat criterion data. Although our analysis of the data is not completed, we find that a significant number of pilots in our experimental group, trained in 1950 and 1951, have never reached combat. While for most there appear satisfactory explanations, there is evidence suggesting that a substantial, though small, group has secured safe jobs as a means of defense. The identification of this type of failure is as essential to a prediction study as is that of the failure in combat.

In the SAM research program, criterion data have been collected in accordance with the foregoing discussion. At the present time a team of three officers, consisting of a psychologist, a psychiatrist, and a flight surgeon, is following up one experimental group in the Far East.

Critical Requirements for Adjustment to Stress. Since psychiatric selection is a prediction of future adjustment prior to the applicant's experience in combat flying, the concept of predisposition is prognostic and depends on latent rather than manifest behavior signs. The ideal procedure to discover such characteristics would be a longitudinal research, in which the same individuals are studied first as applicants and subsequently as combat fliers. By identifying successful and un-

successful performers in the criterion situation, it would then be possible to investigate critical differences between such persons in the role and status of applicant. The concept of latent characteristics emphasizes their reference to the personality of the applicant.

Such a longitudinal plan is a long-range undertaking. Although it is intrinsic to the design of this project, provisional hypotheses were formulated, as a point of departure, on the basis of studies of attrition in training and psychological and psychiatric reports of combat experiences of American and British Air Forces in World War II. The work of Hastings, Wright, and Glueck (ref. 8), Grinker and Spiegel (ref. 5), Shaffer (ref. 13), Reid (ref. 9), and Symonds and Williams (ref. 14) was relied on heavily. Haggard's (ref. 7) contribution on stress in submarine warfare provided a basis for numerous analogies between the flying and submarine situations.

These provisional prediction hypotheses have been published in detail (ref. 10). Briefly, they emphasize three broad and interrelated categories of psychological description: (1) Motivational structure, (2) character integration and emotional stability, and (3) tolerance of frustration and anxiety.

Motivational structure includes the entire range of interests, wants, needs, attitudes, and values of the individual. According to our formulation a successful applicant would be one who has demonstrated a long-time interest in flying and aviation, supported by overt experience and satisfaction, who applied for pilot training with a realistic acceptance of his military role and status, who accepts the prospect of hazardous duty and combat as integral to the job, whose religious, political, social, and moral values are consistent with those of the organization and of the group with which he must identify, whose deeper interests and needs find satisfaction in masculine, aggressive activities, and who is outgoing and sociable.

Character integration and emotional stability involve sense of duty, responsibility, and self control and restraint. Positive traits include realism in facing life's problems, control over inner emotional problems and outer susceptibility to temptation, power to show loyalty, honesty, self control, and inner needs to be reliable, conscientious, persevering, and hardworking. The principal aspect of his factor is control.

Anxiety and frustration tolerance are complex traits. Published reports indicate that while nearly all fliers experience some anxiety before and during combat, the intensity of this experience varies greatly. Furthermore, under strong emotional tension some individuals are capable of more effective control of behavior than are others who soon become badly incapacitated. These observations point to

two factors in anxiety tolerance: first, *liability* or susceptibility to emotional arousal and second, *control* or ability to function adequately in the face of emotional arousal. Both factors appear to be intimately related to motivational or ego involvement. An individual who is highly motivated to meet certain standards of performance will be more quickly and strongly aroused by the threat of failure and will, at the same time, strive harder to maintain control.

Development of Predictors. Unfortunately, there were few ready-made tests to employ for testing these hypotheses. Building suitable tests is a major developmental aspect of the program. This has proceeded along two lines: first, basic research to develop new tests related to these prediction hypotheses, and second, adapting existing procedures, approaches, and tests to the requirements of the selection problem. In this phase of the research there is frankly a great opportunity for ingenuity and creative genius.

Our basic research contracts have already produced several devices which have useful validity against clinical and laboratory criteria. One of these is a measure of anxiety proneness based on the conditioning and extinction of the galvanic skin response to electric shock (ref. 3). This is now being field tested. Another is a measure of anxiety proneness based on electronically analyzed EEG response and subjective sensations in response to flickering light (ref. 16). Arrangements are being made for the early field testing of this technic.

At this time research is in progress on the following types of tests and devices: (1) *Biographical and developmental inventories*, directed at sociological background factors, character development, attitudes toward authority, interest patterns, emotional development, self concepts, and ideals, and certain specific problems suggested by the literature, such as food aversions. (2) *Projective technics of personality study.* Significant validities against training criteria have been obtained for a group Rorschach test (ref. 12) and a sentence completion test (ref. 15). Other projective approaches, such as an Air Force thematic apperception test, a modification of the Sargent Insight Test, and the Rosenzweig Picture-Frustration Test, are being studied. Studies of the Draw-a-Person and Szondi Tests have thus far been negative. (3) *Questionnaires.* The Cornell Selectee Index (ref. 1) and Cornell Word Form (ref. 2) have been tried out with marginal, but significant validity on training criteria. Field studies are in progress on the Saslow Screening Test, the Minnesota Multiphasic Personality Inventory, a public-opinion type questionnaire, designed to measure motivational attitude toward the Air Force and the Kuder Interest Scale. (4) *Stress tests.* Several laboratory studies are in progress which are concerned with the ef-

fects of simple stress stimuli, such as anticipation of shock, cold pressor, pain, and a falling hammer on autonomic reactions and on mental and psychomotor performance. We are field testing the McKinney Stress Test, which measures the effects of time pressure and razzing on a simple perceptual performance. Although conceptually the stress test is intriguing, we must still reserve judgment concerning its validity. The difficulty appears to lie principally in creating a realistic threat within the limits of propriety of a test situation. I personally think Hastings' observation that "the only test of combat is combat itself" is too pessimistic, but the difficulties of stress testing encourage pessimism for this approach. (5) *Autonomic and physiological measures.* In addition to the work already mentioned, research is in progress based on improved methods of recording and analyzing autonomic responses to a variety of stimuli. (6) *Performance tests of personality.* In addition to the Cattell tests which are ingeniously structured to measure a system of personality traits on the basis of attitude, memory, perceptual, intellectual, and motor performances, other performance tests, of mirror drawing, psychomotor tracking, complex reaction, perseveration, and rigidity are included in the third battery.

From the recital of the range of approaches used, it is apparent that virtually every possible technic is being tested or investigated.

Summary of Research Progress

This work is still far from complete. On occasion it has appeared to test the stress tolerances of its investigators as much as its subjects. However, some of the preliminary results on the Randolph Field Battery have produced positive validities which are both statistically and practically significant. While each test, by itself, contributes only a relatively small increment of validity, it is their combination in a selection battery which may be of practical value to the Air Force. Combinations of some of the Randolph Field tests, mentioned earlier, have been analyzed on the basis of the preliminary validities reported for training criteria. From these data it appears that predisposition scores, based on combinations of such tests as the Rorschach, Sentence Completion Test, and Cornell Index may correlate between 0.3 and 0.5 with purified pass-fail. If the other research in progress should produce a reasonable number of tests with comparable validity, the prospect of a composite prediction at this or a higher level is good. Actually the development of a battery of tests must await the completion of cross-validation on additional samples and verification against combat criteria which are being collected. At this time sci-

entific conservatism suggests that we withhold judgment as to the final outcome, even though the preliminary findings appear encouraging.

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WEDNESDAY AFTERNOON SESSION

18 March 1953

MODERATOR

Brigadier General Rawley E. Chambers, MC

PSYCHOTHERAPY IN THE COMBAT ZONE*

Colonel Albert J. Glass, MC

Superficially, psychotherapy in the combat zone may be regarded as a rather brief procedure that utilizes simple technics and in no way is unusual except for the special environment in which treatment is performed. This viewpoint is quickly altered by practical experience in the therapy of acute psychiatric casualties, for then it becomes evident that the task involved requires a high degree of discriminatory sense, demands a practical knowledge of the combat situation and extracts a heavy toll from the emotional resources of the therapist. An understanding of the concepts and technics currently employed in this type of psychotherapy perhaps can be best appreciated by detailing the vicissitudes that characterized its historical development.

Although mental disorders which were associated with or were secondary to combat had been noted by military surgeons prior to World War I, their great frequency during this conflict made necessary the first serious medical effort to salvage the large manpower loss that was produced. Effective treatment was gradually developed by the trial and error method. Early in World War I, the British and French medical services became aware that the location or level in respect to the battle front where therapy was given was of crucial importance. When mental casualties were evacuated to rear hospitals, resistance to improvement was the rule. Symptoms became fixed and chronic disability resulted. This was in sharp contrast to the striking results obtained in or near the combat zone, where 60 to 75 percent of acute war neuroses were restored to full duty by brief periods of therapy that did not exceed 7 days. It was further established that best results were obtained by simple treatment methods that included rest, food, encouragement, suggestion and persuasion.

The entry of the United States into World War I found the American medical service fully aware of the British and French experiences with the war neuroses and prepared to apply the principles of forward psychiatric treatment. Logistical difficulties hindered their early efforts but steady progress was made toward

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instituting an effective psychiatric program, which in the latter months of the War contained the following three levels of treatment: (1) therapy of mild cases in the combat zone by division psychiatrists; (2) close support for psychiatric evacuees from the combat zone by provisional neurological hospitals situated at field army level; and (3) special neuropsychiatric base hospitals located in the forward communication zone that provided the more prolonged treatment needed in severe or resistant cases.

American psychiatrists confirmed and extended the concepts and methods developed by their allied colleagues. Together with many of the British and French psychiatrists, they came to consider war neuroses as primarily a psychological disorder and discarded the organic theories of causation that were contained in the term "shell shock." Supporting the psychological concept were the following observations: (1) the rarity of war neuroses among the wounded and prisoners who had also been exposed to mechanical shock or blast; (2) the fact that severe brain and spinal cord injuries were not accompanied by symptoms similar to those of "shell shock" in which injuries of a lesser degree were assumed; (3) the clinical resemblance of war neuroses to civilian neuroses in which the element of injury was lacking; and (4) the rapid improvement following brief psychological treatment at forward areas. All allied observers agreed that war neuroses provided escape from an intolerable situation which wounds solve happily for most men. This explained the mild exhilaration so often seen among the wounded. American psychiatrists, in particular, emphasized the concept that battle stress acted upon the total resources of the combat participant. They saw mental breakdown in battle as a failure or decompensation of resistance forces that sustain the soldier against the various situational traumata of combat and they identified the major elements of this defensive system to be individual personality traits, physcial status, group loyalty and leadership.

The American psychiatrists stressed and elaborated another basic principle of combat psychotherapy in addition to the previously mentioned level of treatment and brief simplified methods. They believed that the creation and maintenance of a proper therapeutic atmosphere in the treatment environment which aimed at stimulating and maintaining what was conceived to be an inherent desire of patients with war neuroses to return to their combat units. This emphasis upon fostering positive motivation through milieu therapy arose from observations of the gain in illness manifestations so prevalent in the combat zone and a belief that persons in the early stage of war neurosis were highly suggestible and thus readily swayed by

various environmental influences. In establishing a proper therapeutic atmosphere, the attitude displayed by the psychiatrist toward patients was considered of primary importance; but also deemed vital for success was the need for all other personnel in the treatment facility to consistently convey a similar attitude by their manner, speech and behavior.

Following World War I, the manifestations and problems of the war neuroses took on an entirely different aspect. The fluid reversible acute psychiatric casualties were replaced by chronic neurotic syndromes that either represented a continuation of the combat breakdown, were a recurrence of a wartime neurosis, or arose in individuals who had no record of previous nervous disability during the war. The neurotic war veteran separated from the dynamic elements of the combat situation seemed to have combined or integrated battle trauma with the neurotic elements of personality to form a fixed psychological disorder which reacted to usual difficulties as if they were battle stimuli. In effect, they fought the battle of civil life with the wartime symptoms of tension, noise sensitivity, explosive outbursts of rage, helplessness and battle nightmares. Observers were impressed by two features of the chronic war neuroses. First was the ubiquitous gain in illness mechanism that was tenaciously used by most patients. Second was the severe intrapsychic crippling that apparently operated in all spheres of endeavor. It seemed as if the trauma of battle had permanently constricted ego function, much like the trauma of early childhood which may produce a limitation of emotional development.

Because of these characteristics the neurotic war veteran posed a difficult problem in treatment. The total impact of the chronic war neuroses upon psychiatric thought was to place emphasis upon intrapsychic pathology and to paint a gloomy prognosis for victims of psychic battle trauma. This concept all but obscured the importance of various realistic elements of the combat situation and the more favorable recovery prospects of acute psychiatric casualties.

At the onset of World War II, American medical service was curiously unprepared to implement a program of forward psychiatry, despite the well documented psychiatric experiences of World War I. Psychiatrists had been deleted from assignment with combat divisions and there were no provisions made for special psychiatric treatment units at the field army level or in the Communications Zone. Reasons for these apparent deficiencies are not clear. Perhaps it was believed that war neuroses were a characteristic phenomenon only of the static trench warfare of World War I and would not be produced by the rapid movement tactics presumed for World War II. At any rate,

the inevitable occurred. The winter and spring battles of the Tunisian campaign in late 1942 and early 1943 and the first large-scale land fighting by American troops brought forth large numbers of psychiatric casualties. As in the early phase of World War I, these patients were evacuated hundreds of miles to rear hospitals whose psychiatric facilities were insufficient to handle the unexpected case load. There resulted a fixation of symptoms and the formation of chronic disabling syndromes. Relatively few psychiatric casualties were recovered for combat duty and many were evacuated to the United States as unfit for further oversea service.

The dramatic clinical pictures exhibited by the war neuroses at rear hospitals in North Africa deeply impressed the early psychiatric observers as they so commonly fascinate the newcomer to combat psychiatry. Patients appeared overwhelmed by the stress of their recent battle experiences and presented many changeable manifestations of so-called "free-floating anxiety" along with varying degrees of personality disruption. Since the florid symptomatology dominated the center of attention, all therapeutic efforts were directed toward their alleviation. Methods of treatment arose that aimed at the discharge of anxiety, for it seemed that large quantities of this noxious agent were choking the patient's function and were responsible for his distressing symptoms. Under these circumstances, the therapeutic principles of catharsis and abreaction were applied in several treatment methods, the most common of which utilized the technic of barbiturate interviews to obtain the desired discharge of tension. The use of barbiturate interviews in the treatment of war neuroses was first introduced by British investigators. It was later elaborated by Gringer and Spiegel and became the instrument of choice for the uncovering and relieving of partially or completely forgotten traumatic battle episodes. Along with the benefits derived from the immediate release of anxiety by the process of abreaction, the repressed battle experience was restored to consciousness, thus losing most of its previous potential to evoke anxiety.

Despite the undoubted improvement obtained by the technics of catharsis and abreaction in many of the war neuroses, only rarely could such patients be recovered for combat duty. During the abreaction procedure patients pleaded or insisted that they not be sent back to combat. As the therapist participated with his patient in the dramatic reliving of battle scenes, he almost invariably identified with the distress and needs of the patient and was therefore impelled to promise relief from future battle trauma. Thus it seemed that uncovering or abreaction methods were applicable mainly in severe or resistant cases where the therapeutic goal was either recovery for non-

combat status or the relief of regressive or other grossly incapacitating symptoms, although some psychiatrists believed that these technics would be more effective if applied earlier, before time and distance had caused a fixation of symptoms. However, another therapeutic approach was being made during this period. In the spring of 1943, Hanson and Tureen, working at a forward evacuation hospital with fresh psychiatric casualties, were able to restore 50 percent of their received patients to combat duty by a 4-day period of rest, food and encouragement, and thus re-established the value of the treatment methods that were developed in World War I.

The foregoing experiences of the North African Campaign clearly indicated the need for improving existing psychiatric facilities for the next combat phase. Accordingly, during the Sicilian Campaign that began in July 1943, psychiatrists were assigned to all evacuation hospitals and a special neuropsychiatric hospital was established at Bizerte, North Africa. However, the evacuation hospital psychiatrists could not function effectively because battle casualties and disease occupied almost all of their available beds and caused the evacuation of most mental casualties to the special psychiatric unit at Bizerte. Although patients were received at this hospital within 24 to 48 hours after their breakdown, a disappointing number, approximately 15 percent, were salvaged for combat duty. Again, barbiturate interview technics caused varying degrees of improvement but rarely produced sufficient recovery for combat duty. Indeed, any therapy, including usual interview methods that sought to uncover basic emotional conflicts or attempted to relate current behavior and symptoms with past personality patterns seemingly provided patients with logical reasons for their combat failure. The insights obtained by even such mild depth therapy readily convinced the patient and often his therapist that the limit of combat endurance had been reached as proved by vulnerable personality traits. Patients were obligingly cooperative in supplying details of their neurotic childhood, previous emotional difficulties, lack of aggressiveness and other dependency traits, or any information that displaced onus for the current combat breakdown to remote events over which they had no control and therefore could not be held responsible.

The difficulties encountered in recovering patients for combat duty and the passive dependent character structure so readily displayed in most cases at this level of treatment influenced many of the psychiatrists, including the writer, to place undue emphasis upon predisposition or personality as a major etiologic agent in the war neuroses. The well known formula, "stress plus personality equals reaction," was seized upon to provide a simple rational basis for explaining the cause

of psychological breakdown in battle. It became a familiar World War II theme that everyone had his breaking point, depending upon the amount of battle stress inflicted and the degree of individual vulnerability.

Unfortunately, the stress personality concept tended to produce a defeatist and fatalistic approach to the problem of the war neuroses. From a practical standpoint neither the amount of external trauma nor the strength of various personality constituents can be measured with the accuracy required for the operation of the stress personality formula. Even if external stress is equated with the number of combat days experienced, it would be necessary to differentiate the various types of combat. But even more important are the many imponderable elements of battle, such as an inspiring leader, a strong buddy, group unity, and the quality of communication and physiological status, all of which complicate any measurement of external stress. In estimating personality one faces even greater difficulties, for the only source of information, the patient, too readily accents past inadequacies and problems in an effort to explain both to himself and others that the reasons for his current failure stem from remote or past causes which are beyond his control. When the incomplete quantitation of external stress is considered with the imperfect data of personality, it becomes evident that any practical utilization of the stress personality equation is misleading, even though such a concept may be basically correct.

In retrospect, the adoption of such a simple operating viewpoint during this period can be understood when it is realized that the psychiatrists present were remote spectators of battle rather than forward observers. They possessed no first-hand knowledge of defenses successfully employed by combat participants but only saw and heard from their patients highly personalized and exaggerated accounts that emphasized the horrors of war and the personality inadequacies to withstand such external stress. It should be stated, however, that the psychiatric personnel assigned in North Africa and elsewhere in the theater were not satisfied with the results of their efforts. They were aware that the level in which they functioned made impossible the use of one of the basic tenets of combat psychotherapy, namely, that the best results of treatment are obtained in or near the battle zone.

An opportunity to expand and improve the psychiatric program came in November 1943, when a psychiatric treatment unit was established in the Fifth Army, which was then slowly fighting its way up the Italian Peninsula against strong opposition. This was a provisional field type medical facility to which psychiatrists were added. It was located at evacuation hospital level and permitted psychiatrists

to become acquainted with some of the environmental conditions under which men fought. A f...her impetus to the psychiatric effort occurred in Decem' ...43, when the War Department authorized the assignment of ...vision psychiatrists. They became operational in January 194... and thus were reestablished the three levels of psychiatric treatm...t that had existed in World War I. With psychiatrists functioning within the divisions and in the Army area, pertinent observations and reliable data concerning the combat situation were made available. As a result, it became more and more clear that psychological breakdown in battle was not a simple phenomenon, but rather a complex resultant of multiple physical and psychic forces that struggle for emotional control. Of special significance was the growing awareness that the stimuli of battle itself evoked a defensive process that sustained men in combat. This mechanism has its origin in the fact that the lonely, fearful battle environment forces individuals to join together for protection and emotional support. As they continue to fight and survive together, what began as mere instinctive huddling is crystallized into a powerful emotional bond of love and concern for comrades that deflects fear from the self and creates a compelling internal motivation for remaining with or rejoining the combat group.

The recognition of this sustaining mechanism, termed group identification, made it possible to understand the favorable results obtained by simplified brief forward psychiatric treatment. The acute phase of combat psychiatric breakdown is an amorphous and reversible condition due to a temporary disruption of the individual's defenses. As noted in World War I, such cases are highly suggestible because of a struggle between two conflicting desires, one of which motivated by the ties of group identification insists on rejoining the combat unit, while the other driven by fear for the self, seeks withdrawal from the painful battle situation. Brief treatment in the combat zone succeeds because time and distance have not yet dimmed the powerful inner devotion to the group, whereas evacuation to a safe and comfortable rear hospital reinforces the demands of self-preservation. Simple methods of psychotherapy that stimulate and encourage positive feelings for the group are far more efficacious than any complex or time-consuming treatment which inevitably promotes self-needs and brings forth dependent character traits. The benefit of a proper therapeutic atmosphere or milieu therapy is also understandable as a further step toward influencing the attitude of patients in the direction of group motivation.

In essence, the repeated success of brief forward psychiatric treatment demonstrated the need for repressive or suppressive therapy

rather than uncovering technics, for it became clear that the goal of treatment for the purpose of return to combat duty was the restoration of previous defenses instead of attempts to alter or reorganize personality structure. Based upon the foregoing considerations, there were evolved in the latter half of World War II various intradivisional treatment regimens which contained measures for the relief of physical factors, such as food, sleep and rest, combined with brief therapeutic interviews that were directed almost solely at the feelings, experiences and attitudes of the patient in regard to the combat situation. Usually, only superficial technics were employed, which included ventilation, reassurance, persuasion and firm suggestions to the patient that he would rapidly improve and in several days be ready to rejoin his combat unit. The treatment facilities were simple tent units in which was provided a therapeutic atmosphere, implying to the patients that combat exhaustion was a logical and rational consequence of battle wear and tear and required only a short period of recuperation and relief from battle to produce recovery and return to full duty. Patients deemed unsuitable for combat duty were evacuated to the second level of psychiatric treatment at Army level. Here, similar therapy methods were instituted, but usually the goal of treatment was salvage for noncombat duty. Not infrequently the previous defensive mechanism of group identification produced guilt reactions which required special handling by discussion and reassurance. In such cases, as in many others, the insistence of the psychiatrist that the patient perform noncombat duty was a necessary therapeutic measure to counteract feelings of failure and loss of self-esteem that continue symptomatology and more or less plague most psychiatric casualties who are evacuated out of the war zone.

The end of World War II found Army psychiatric facilities operating at a high level of effectiveness and in the process of investigating efforts to further improve the psychiatric program.

The lessons of combat psychiatry learned during this conflict were not forgotten in the postwar period. Through appropriate regulations, training manuals and other official military publications, the principles and methods of World War II field psychiatry were incorporated into the doctrines and dogma of Army Medical Service. Beneficial results from this preparatory work were soon demonstrated, for, despite the abrupt onset of the Korean campaign on 25 June 1950, division psychiatry became operational within 6 to 8 weeks after the beginning of hostilities. By October 1950, three levels of psychiatric treatment were established and both the methods and effective performance of psychiatry in the latter half of World War II had been duplicated. From this point, further gains in combat psychotherapy

were achieved mainly by a displacement forward of the treatment site for mild psychiatric casualties to the battalion and regimental level. It had long been suspected that the simple technic of forward psychiatric treatment could be adequately performed by general medical officers if they were properly indoctrinated in such a function. This utilization of battalion and regimental medical officers as front-line psychiatrists was gradually implemented, beginning in December 1950. Under this plan the division psychiatrist functioned more as a consultant and less as the treatment specialist to whom all psychiatric problems were evacuated. He regularly visited all battalion aid stations and regimental collecting points in order to instruct in methods of combat psychotherapy and assist in the evaluation of doubtful cases. Treatment at the battalion and regimental level was limited to mild cases in which the patients could be returned to duty within 24 to 48 hours. Those with more severe cases were evacuated as previously to the division psychiatric unit, located in one of the clearing company platoons. The advantages of the more forward psychiatric program were immediately apparent, not only in increased number of soldiers recovered for combat duty, but in the lessened anxiety of patients who were returned to their unit by this method. Treatment at the more forward level preserved to a greater degree the all-important emotional ties with the combat group and nullified the inevitable gain of illness that was stimulated by evacuation to the safe clearing station, even though this facility was situated within the division and technically, at least, within the combat zone. It should be realized, however, that psychiatric treatment at battalion or regimental level is not a practical procedure during withdrawal or other unfavorable tactical situations.

Another development of psychiatric interest involved the reclaiming for combat duty of earlier psychiatric casualties in the Korean campaign, who had been assigned to noncombat positions in Japan. All such cases were reevaluated after 3 or more months of such limited assignment. Approximately 40 percent were considered sufficiently recovered to warrant their return to combat duty. Relatively few instances of recurrent disability were noted. Perhaps the apparent favorable result was secondary to rotation, since combat status gave increased credits toward this goal. However, many observers received a distinct impression that many of the individuals concerned more or less welcomed an opportunity to regain the self esteem that had been lost since their removal from the combat group.

The frequent changes of division psychiatrists in the Korean campaign due to various types of rotation crystallized another basic prin-

ciple of combat psychiatry that was noted in both World War I and World War II. This concerned the emotional reactions and attitude of the psychiatrist who deals actively with acute psychiatric casualties. It had been previously observed that the insecurity of psychiatrists in the handling of patients noticeably lessened as they moved from a rear assignment to one in the combat zone. Moreover, with continued function in forward areas there was even further increased efficiency in his management and treatment of psychiatric cases. Part of this improvement undoubtedly stems from the practical experience obtained and a greater knowledge of the combat situation, which allows for an increased skill in discriminating between disabling symptoms and mere complaints. However, many of the young psychiatrists involved strongly felt that the greater security that followed continued function in the forward zone was due to an alteration of their attitude toward patients. Most newcomers to combat psychiatry and those psychiatrists who operate in rear areas are prone to identify with the needs and wishes of the patient. They were therefore readily made insecure when deciding that a patient was fit for return to combat duty, even though aware from a technical and intellectual standpoint that such a decision was correct. Because of anxiety from over-identification and from conscious feelings of guilt for the seeming responsibility of sending a patient to hazardous duty, the psychiatrist vacillated in his clinical judgment, which impaired his usefulness. But as the psychiatrist worked in the combat zone, observed men who adjusted to battle situations, noted the usual discomforts of combat participants and decreased his own feelings of guilt by participation, an inevitable emotional reorientation occurred. The division psychiatrist became identified with the welfare of the group rather than with the wishes of the individual. With this change the psychatrist loses anxiety and guilt when making decisions because he becomes convinced that it is for the best interest of the individual to rejoin his combat unit, for in no other way can the patient regain confidence and mastery of the situation and prevent chronic tension and guilt. This attitude of the division psychiatrist, due to participation with the combat group, makes it possible for him to assume the traditional psychiatric role as an exponent of reality, which insists that the individual continue functioning despite anxiety rather than allow withdrawal or a disabling neurotic compromise. This attitude of the psychiatrist has a far-reaching effect for it is communicated to both medical and line officers of the division and serves to diminish the mysticism and high values for helplessness caused by psychiatric symptoms.

Summary

Effective technics of combat psychotherapy have been evolved through experiences gained in World War I, World War II, and the Korean campaign. They include the following basic principles:

1. The location or level where treatment is performed should be as close to the battle front or combat group as practicable, preferably at the level of the battalion aid station.

2. Best results of treatment are obtained by methods that combine simplicity of procedure with brevity of time. Repression and suppressive technics are more effective than uncovering procedures.

3. Psychiatric facilities function more effectively if all assigned personnel make consistent efforts to create a therapeutic atmosphere which reflects positive motivation.

4. Success in therapy is largely determined by the degree with which the psychiatrist identifies with the needs of the combat group, as opposed to participation with the desires of the individual.

CERTAIN STRESSFUL STATES: THEIR MEASUREMENT AND THE INFLUENCE OF DRUGS ON THEM*

HENRY K. BEECHER, M. D.

Background

Dr. Winternitz of the National Research Council has said that the problem of this age is the problem of stress, but that we don't yet know very much about how to attack it. If Dr. Winternitz means that the stresses of this age are greater than those of most other times, I am not at all sure that he is right in the first part of his comment. Surely in the early days of New England when every bush held the possibility of an Indian lurking there with a tomahawk, when a neighbor could testify that you were possessed of an evil spirit and have you hanged or burned alive, when more babies died than survived, when death came early for nearly all men, surely those times were full of stress. Nor can one conclude that stress is necessarily and entirely bad. We have only to recall a major thesis of Toynbee, which I discussed in a Lowell Lecture on "The Relief of Suffering":[1] If I understand his meaning correctly, one of the major themes of Toynbee's *Study of History* is simply that soft countries invariably breed soft men[2]—and hard countries, hard men. It "was only after Adam and Eve had fled from their Eden lotus-land that they and their descendants set about inventing agriculture, metallurgy and musical instruments".[3] ". . . soil, climate, transport facilities and the rest—it is impossible to deny that the original colonial home of the New Englanders was the hardest country of all. Thus North American history tells in favor of the proposition: the greater the difficulty, the greater the stimulus"[4] (unless it be overwhelming). Suffering provides stimuli that lead either to extinction or to mastery of the difficulties, with either disappearance or growth of the individual or race. There are indeed naturalistic justifications for suffering.

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[1] Beecher, H. K.: The Relief of Suffering. In: The Hospital in Contemporary Life. Cambridge, Harvard University Press, 1949, pp. 70–107.

[2] Herodotus, bk. IX, ch. 122, quoted by Arnold J. Toynbee, *A Study of History*, Somervell abridgment (New York: Oxford University Press, 1947), p. 86.

[3] Toynbee, A. J., *Study of History*, p. 87.

[4] Toynbee, A. J., *Study of History*, p. 99.

Within limits, stress may be good for the nation and the race; but every physician knows that "laudable" stresses easily become evil as far as the individual is concerned. Somehow a solution must be found for the dilemma that what is good for the race is bad for the individual. In our Western World the individual is getting a lot of attention. One need not search very far to find excesses in this direction, such as the demands of irresponsible unions, long dole lines of able-bodied men and women in prosperous times, and so on. As thoughtful citizens we cannot escape a primary concern with such matters, but as conscientious physicians and scientists we must put as our first problem the relief of stress whenever it causes suffering, whenever it harms the individual.

And now, to come back to the second half of Dr. Winternitz's brief comment: Do we know how to attack the problem of stress? Surely in the 3 days of this Symposium we have heard much sound and promising work along this line. If we are going to find ways of lessening stress or of relieving it, we have to be able to recognize it. We are, so to speak, in a descriptive phase. Some stresses we can recognize fairly well, but we are far behind the morphological pathologist who neatly describes his specimen in terms of color, consistency, weight, shape and surface area. In the field of stress we are only beginning to measure. Selye and his alarm reaction, the work of Thorn, our own work in quantifying subjective responses, the papers of this Symposium—these and others are all essential components of an eventual description of stress. Before treatment and healing can come in any satisfactory way, there must be accurate recognition. The components of early recognition are a knowledge that gives the power to describe and measure.

Boundaries of this Field

For a number of years we have had a keen interest in subjective states. So far we have worked in a quantitative manner with some 27 such subjective states. In a practical sense the most important of these are pain[*] (Denton, Keats, Lasagna), nausea, euphoria (Lasagna). We have also been especially concerned with two phenomena which are closely related to and greatly influenced by subjective considerations, cough (Devloo, Gravenstein) and sleep (Brazier). In still another group of related studies we have dealt with matters of judgment, discrimination, memory (Goodnow, von Felsinger). These conditions of course are the consequences of many

[*] Associates in this work are listed chronologically in parentheses. References, in so far as the work is published, are given in the paper on "Experimental pharmacology and measurement of the subjective response," referred to below.

forces. Because of the imponderable nature of these highly important states, quantification can be introduced only if dynamic situations are available or can legitimately be created. Just as quail in a thicket may be invisible to a hunter until they move, so change in a subjective state can be used to appraise it. For example, pain is measured as it is relieved, in terms of its relief. This is, to be sure, indirect, but no more so than the determination of the acidity of a solution by how much standard alkali it takes to neutralize it. We have produced change in subjective states by the administration of drugs. And for a number of years we have been concerned with understanding and establishing the nature of the controls that are necessary for sound work in this field.[6]

Experimental pharmacology in the past has dealt largely with phenomena that can be measured objectively in response to drug administration, with changes in heart rate, rises or falls of blood pressure, neuromuscular action, and so on. Such experimental studies have usually been carried out in animals, and the basic controls have been observed in most cases. On the other hand, relatively little attention has been given to the nature of the controls that are essential in order to elicit true and clear information concerning subjective responses to drugs.

Subjective responses reflect stress. The definition of stress as the state resulting from the action of external forces has never seemed to me to be a very good definition even in the physical sense. When we adapt this word to use in describing a condition of the mind, we are obliged to add that it is a consequence of *internal* as well as external forces. The internal state on which stress is exerted certainly influences the result. Stress influences mood, and the preexisting mood influences stress, and so on.

Our own field of interest and of competence in the study of stress is quite specific and quite limited; namely, measurement of the effects of certain drugs in certain stressful situations. It seems clear that dependable advances in *this particular aspect* of the stress problem can come only through tedious and painstaking effort of the kind I am about to describe for you. First, however, it will be necessary to consider where material can be found for such work.

The General Hospital as a Rich Source of Material for the Study of Stressful States in "Normal" Individuals

Of the three sources of knowledge—observation, experimentation and reasoning—observation has been the principal source of learning

[6] Beecher, H. K., Experimental pharmacology and measurement of the subjective response. *Science*, 1952, *116:* 157–162.

within the hospital. Reasoning of course has not been neglected; but reasoning comes into a luxuriant flowering only when experimentation has risen to a really important place. In an elementary sense, every time a physician prescribes a new drug or uses a new dosage of an old one he is experimenting. I am not speaking at the moment of this often empirical, hit-or-miss pursuit of information, for so many centuries a part of life within the hospital. I wish now to speak of the use of man as an experimental animal, where he will be the *sole* source of necessary data, where experiments upon his body and his mind must be far more thoughtfully and carefully planned than animal experiments generally are, because this subject is not expendable, because blunders here will lead to a limitation or even a loss of man as a subject. And in this loss certain areas of knowledge can be sealed.

We know a great deal about what can be learned from animals as experimental subjects. In general, we know how to surround such studies with the proper controls. Is it too extreme to say that we know little about how to utilize man as an experimental subject? I suppose this is too strong a statement when we limit it to studies of objective phenomena which are apparent to another individual, phenomena which can be mechanically recorded such as physical signs for which we already have yardsticks of proved value. Nevertheless, we do not yet know well how to utilize man as a subject in the area of subjective phenomena. Subjective phenomena are symptoms; they are sensations within the patient which can be transmitted to another only through a cooperative statement by the individual experiencing them. In this area man is not merely the animal of choice, man is the animal of necessity.

If we are to understand the mind of man—and no one in this room needs to be informed as to the importance of such understanding not only in dealing with mental health and disease, but also in dealing fully with physical health and disease—we shall have to develop dependable yardsticks in the elusive field of subjective responses. We have already learned that the mathematician is essential here. The mathematician must enter the hospital if the field I am discussing is to grow, not just to grow soundly, but to grow at all.

You may say, of course, sound experimental design is necessary, but why emphasize the importance of the mathematician *within* the hospital? The answer is quite simple: much of the subjective response material we are concerned with exists only inside the hospital, or at least only within the sick room. We have learned already that to study most of the problems of pain, for example, we must use pain of pathological origin. We are learning that to study even a quasi-

subjective matter like cough we must use cough that originates in disease to find out which agents will suppress it. Our work on the measurement of euphoria, the effects of drugs on euphoria, and the relationship of personality type to the power of chemical agents to produce euphoria, has important meaning only in the presence of severe stress, stress found generally within the hospital. I suspect that in time we shall be able to make some very broad generalizations as to the essential use of "real" (pathological) phenomena as opposed to contrived (experimental) material.

The point I am working toward is that the hospital provides a vast amount of such material, material quite different from that obtainable anywhere else, material which can be utilized to make basic (and I use the overworked term in a fundamental sense) advances in the basic sciences of physiology and pharmacology and neurophysiology as well as in the fields of psychology and psychiatry, to name a few places.

A moment ago I spoke of the difficulties we have had in trying to study certain stressful states, pain and cough experimentally. Large doses of morphine, doses which are highly effective in depressing pain of pathological origin, are completely ineffective in treating the much milder pain of experimental origin. The same apparently is true in current work on cough and antitussive agents. Is it true of stressful states in general? I do not know. But I do know that any investigator who makes an easy assumption that what he learns from experimentally contrived stress is directly applicable to naturally occurring stress is heading for trouble.

The sick bed with all of its implied threats against earning power and economic security, against health, against the pleasures of life, against life itself—these things cannot be adequately reproduced in the laboratory. I suspect this fact also holds in less self-evident stressful situations.

One need not neglect all experimental stress, of course; some of it may have validity. The situation is a tricky one. My plea is that wherever possible naturally (i. e., spontaneously) occurring stresses be used for study.

An Example to Indicate the Type of Approach Utilized in our Current Studies and the Degree of Precision Obtainable With Adequate Controls

In the course of our work on pain as a stress-producing and stressful state we set ourselves the problem of testing the degree of precision obtainable with our methods. The technics employed and the neces-

sary controls are described elsewhere[7] In short, we had a disinterested party prepare two series of unknown solutions, six in each series. The problem was to find which solution in one series was nearest the equivalent of the other in pain-relieving power in man against pain of pathological origin. Unknown to us at the time, morphine was used in both series. The flasks of one series all contained 10 mg. morphine per ml. of solution. In the other series, varying concentrations of morphine were contained in the several flasks. (See table and graph.[7]) In the end we found that we had equilibrated 10 mg. morphine against 10.8 mg. morphine, an 8 percent error. When a statistical study is made of the regression lines involved, the error is found to total 10 percent. Thus, with the proper controls, one can deal with subjective responses about as accurately as with objective phenomena.

Because of the limitations of time for this presentation this example will have to suffice. Comparable data could be provided from work in progress on cough, on the persisting effects of barbiturates in small dose as they impair the mind, and on euphoria.

[7] Keats, A. S., Beecher, H. K., and Mosteller, F., Measurement of pathological pain in distinction to experimental pain. J. Appl. Physiol., 1950, *1:* 35-44.

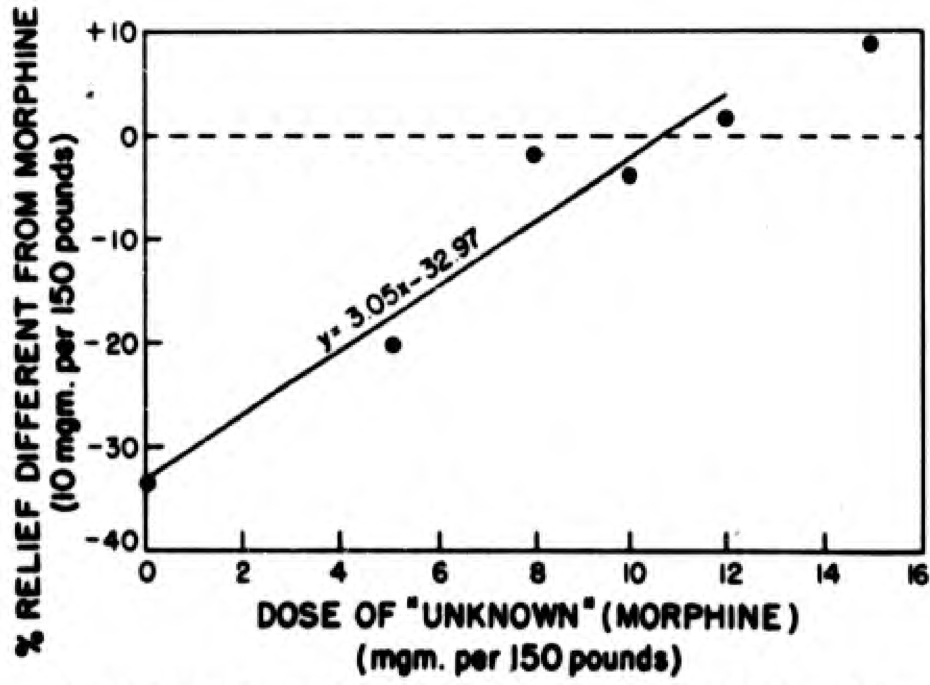

FIGURE I : Comparison of Analgesic Potency of Unknown Drug (Morphine) and of Morphine.

Table 1. Analgesic Potency of Morphine at Various Dose Levels When Treated as an Unknown [1]

Number of patients	Unknown Drug (Morphine)				Morphine				Unknown minus morphine relief (percent)
	Dose mg. per 150 pounds	Total doses	Relief doses	Percent relief	Dose mg. per 150 pounds	Total doses	Relief doses	Percent relief	
32	0[2]	54	27	50.0	10	54	45	83.3	−33.3
32	5	49	30	61.2	10	49	40	81.6	−20.4
38	8	49	36	73.5	10	49	37	75.5	−2.0
34	10	49	36	73.5	10	49	38	77.6	−4.1
36	12	55	39	70.9	10	55	38	69.1	+1.8
30	15	42	35	83.3	10	42	31	73.8	+9.5

[1] From Keats, Beecher and Mosteller, loc. cit.
[2] Saline solution.

Summary of Established Principles and Practices

The principles and practices that have been established are few, and in several instances they may seem obvious to the casual observer. That they have not been obvious to the majority of individuals working with subjective responses can be demonstrated by examining many reports of investigations in this field. In summary, here are the principles and beliefs involved and the unquestionable essentials for most work of this kind.

1. Subjective responses are the resultant of the action of the original stimulus and the psychic modification of that stimulus.

2. Man is the essential experimental subject for a definitive answer to questions in this field.

3. The investigating staff is constant during any given series of experiments.

4. The "unknowns" technic is employed throughout. The agents tested and the time relation in which they are tested are unknown, not only to the subjects, but to the observers as well. This requires the use of placebos, also as unknowns.

5. When a new agent is to be compared with the agents of past experience, and this is nearly always the case, a standard of reference is required. (Morphine in standardized dosage is used as the standard for analgesics, etc.)

6. Randomization of new agent, placebo, and a standard of reference is essential.

7. Significant comparison of side actions of agents can be made only on the basis of doses of equal strength in terms of their primary therapeutic effect.

8. Mathematical validation of a supposed difference in effectiveness of two agents is necessary.

9. The subjective effects of drugs can be quantified accurately and rapidly in certain situations only when placebo reactors are screened out.

10. Appraisal in this field requires, when the effectiveness of a given agent is to be determined, a dynamic state, a change in response to the use of the agent.

Matters for Further Study

The following unproved "principles" can be indicated as questions as well as any other way. There will be partisans for and against each. A good deal of evidence, not yet conclusive, can be marshaled to give an answer to each question.

1. Can the intensity of any of the subjective responses referred to here be satisfactorily quantified? The answer seems to be "yes" for pain.[8] If it can be, which factors predominate in influencing intensity: the original stimulus, the reaction to it (psychic modification), or both?

2. Can one generalize that maximum subjective effects are produced rather early by the effective agents and that no real increase in effect is produced by increased dosage? (Example: morphine produces nearly its maximum pain-relieving effect at about the 8 mg. dose. The dose-effect curve breaks sharply at this point. Larger doses will, at great risk, produce anesthesia and unconsciousness, but these effects are beyond analgesia.) We are checking this for cough and for euphoria.

3. What is the usefulness of animals for the study of subjective responses to drugs, except as screens for organic toxicity? The question of the validity of animal screening methods has enormous importance to manufacturers.

4. What is the place of subjective responses that are produced experimentally as opposed to those that arise in pathology? We must determine whether, as seems likely from a study of pain and of cough, subjective responses arising in disease are mandatory for all studies that deal with the therapy of the subjective response. We do not yet know how inclusive this requirement is.

5. How does the essential nature of the real situation differ from the experimental, or contrived, situation? It is difficult to overemphasize the importance of studying naturally occurring stress. It is doubtful if it can be soundly contrived in an experimental laboratory.

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[8] Beecher, H. K., A method for quantifying the intensity of pain. In press.

Conclusions

We have shown what conditions are necessary for proper evaluation of a number of drugs the therapeutic effects of which are subjective, and we agree they are complex and exasperatingly time-consuming. We wish it were not so annoying as it is to fulfill the necessary conditions.

Tedious as these conditions are, we insist that they are *not* more costly than the empirical method. Actually they are far less so. They do permit accurate results to be arrived at more rapidly than did the old-fashioned method of simply distributing drugs to practically everybody and gradually, by trial and error, arriving in decades or centuries at an approximation of the truth.

To take an example, after all the centuries morphine (or opium) has been used, "common sense" in this country has arrived at a dose that is twice as large (15 mg.) as the one that gives essentially maximum pain relief (8 mg.) when used for pain of ordinary intensity. It is true that in the common-sense method the cost of the evaluation is borne not by the manufacturer but by the public. It is also true that in the case of morphine (opium) the correct result was approximated in hundreds of years. I believe we can and should do better than this.

There is a great field for study here, but it is a field where there are many obstacles: legalistics to hamper the investigation; ignorance of the relationships between chemical constitution and biological action to slow him down; chance or coincidence to be forced into the open only by intricate and laborious statistical methods. Painstaking and tedious work is necessary. It is a costly field, but one that promises to yield on cultivation an astonishingly rich harvest. A sound attack on stress and on certain stressful situations requires that we work in quantitative terms. Our therapeutic measures can be only empirical until measurement is added to description. This addition rounds out the pattern that has been common to the growth of all science. It is essential in the study of stress.

THE EXPERIMENTAL EVOCATION OF STRESS [1]

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STANLEY H. KING, PH. D.
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Attempts to screen out individuals who are prone to break down under the stress of combat have been a concern of various branches of the Armed Forces for a long time. A great deal of experimental work utilizing various psychological technics has been carried out in an effort to establish measures which would be predictive of success or failure in the handling of stresses incidental to military service, with particular emphasis upon combat. Although psychiatric interviews, psychological tests, performance tests, physiological testing, anthropological measurements, and many other methods have been tried, none has as yet proved to be a very fine prognostic agent.

As pointed out by many investigators, one of the problems in this particular area is that "breakdown during combat stress" is a product not only of the individual's own proneness to break down, but also of the severity and quality of the external forces to which he is exposed. It is obvious that no screening test may take into account external forces such as the morale of the outfit in which the man serves, the type of leadership, the quality of the food, the length of time that unsupported service is required, the number of casualties in his outfit, and other factors making for severity of combat stress. Then, too, a basic factor which has to be considered is the type of clinical psychiatric picture presented by the soldier when he becomes a psychiatric casualty. It is undoubtedly true that breakdowns in combat which come within the first few days present quite a differ-

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[1] Presented 18 March 1953, to the Symposium on Stress, Army Medical Service Graduate School, Walter Reed Army Medical Center, Washington, D. C.

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[2] Research Fellow, National Institute of Mental Health.

ent clinical syndrome than those which come after prolonged arduous stress. We do not have a clear picture of the various syndromes which occur in combat, so that proneness to the different types of "breakdown" might be studied. Some of the reactions are undoubtedly a lighting up of anxiety neurotic reactions in basically neurotic personalities. One of the things that the first author noticed in his work in the South Pacific was that the majority of the reactions which occurred later in tours of combat seemed to be closely allied to what we know in civilian life as depressions. The Rorschach studies of Ax and Alexander (ref. 1) on flying personnel in the Eighth Air Force would bear this out. A person who was prone to a depressive reaction during stress would be a much different person from an individual who was apt to have a neurotic type of stress response. So in studying "proneness" to break down during stress we must take these factors into consideration. Despite our incomplete knowledge of the types of psychiatric entity seen in the soldier who has to be evacuated from combat, and the many external factors (the stressor) which bear on him and over which we have no control, the individual's own personality structure is an important factor. While basic personality studies cannot supply the whole answer to the problem, it should be possible to work out methods of screening which could decrease the number of psychiatric casualties by a significant percentage. A good review of this subject may be found in a publication of the U. S. Air Force School of Aviation Medicine by Saul B. Sells (ref. 3).

On theoretical grounds, it would seem that the use of a laboratory stress-inducing situation in which the reactions of a man during stress were studied should be a feasible way of understanding his reactions when exposed to real-life stress-inducing situations. This carries the assumption that his reaction in the real-life stressful situations will be similar, although in greater degree than that which is observed in the laboratory.

The use of laboratory stress-inducing situations to study individual proneness to break down under stress has had but limited application in military services. Many studies have been made in laboratories of various so-called stress-inducing situations, but there has been, as far as I know, no correlation with later emotional difficulties. The Armed Services have used situations which are somewhat similar to real-life stresses, but how carefully these have been studied or related to later emotional disturbances is not known by us. Among these may be mentioned the methods used by the OSS assessment program, the submarine escape technic taught at New London, and the use of live firing in the infantry training.

In this paper, although their importance in regard to stress situations is realized, the theory of frustration and the question of motivation will not be discussed. Rather, experimental work illustrating the specific problems involved and the related principles dealt with in studying laboratory stress-inducing situations will be discussed.

For the past 2 years, under the auspices of the U. S. Air Force School of Aviation Medicine, Randolph Field, Texas, we have been engaged in a research project, the purpose of which is to develop laboratory stress-inducing situations which can be used to determine those individuals who are apt to develop incapacitating reactions during stress. The studies have been carried out with college students as subjects.

The first problem to solve was the development of reliable means of inducing stress in the subjects in the laboratory. When we had accomplished this, we began studying experimentally the important factors related to such situations. The basic research in this field had not yet been done, and it was thus necessary to design experiments to clarify many different aspects of laboratory stress-inducing situations. The problem is multidimensional because it is possible to study so many of the facets of personality in such a situation. Four of the major principles which have emerged from our experimental work are the following:

1. The importance of constructing the laboratory stress situation in such a way that it can be used as a projective test.

2. The importance of grading the test on at least three levels, the psychological emotional level, the physiological level, and the performance level.

3. The importance of repeating the laboratory stress-inducing situation on at least three different occasions.

4. The importance of good statistical analyses.

Description of the Project

The project is an interdisciplinary one involving psychiatrists from the Department of Psychiatry, Harvard Medical School, Dr. Robert R. White, supervising Ph. D. candidates from the Department of Social Relations, Harvard University, and Drs. Hugo Muench and Jane Worcester, supervising graduate students in the Department of Biostatistics, Harvard School of Public Health.

The experimental studies which will be used to document the above four principles were carried out on 70 Harvard College students who were chosen at random from the list of juniors. Almost all agreed to take part in the experiments. The only requirement was that they

were in good physical health. The group ranged in age from 20 to 22 years. Each student received approximately 15 to 18 hours of testing. Motivation in the students was good, as we represented authority figures to them. The project can be divided into two parts:

1. The study of the subjects' immediate reactions to laboratory stress-inducing situations, graded on psychological, physiological and performance levels.

2. The study, by means of psychiatric interviews and psychological tests carried out under non-stressful conditions, of the basic personality factors of the subjects, with the object of finding measures which will be predictive of the manner in which the subjects react during laboratory stress-inducing situations.

1. *The Importance of Constructing the Laboratory Stress Situation in Such a Way That It Can be Used as a Projective Test.* When a laboratory stress-inducing situation is constructed, it is perfectly possible to construct one to which almost all subjects will respond in a similar manner. For example, if a lion is brought into the room, almost everyone will be frightened. If one slaps all the subjects in the face, they will practically all get angry.

Ax and Greenblatt (ref. 2) contrived one laboratory stress-inducing situation whose purpose was to elicit fear in subjects, and another one whose purpose was to elicit anger in the same subjects. They were successful with the great majority of their subjects in eliciting the emotion for which the situation was designed.

However, we wanted our situations to be such that the reactions of the subjects would be characteristic of their methods of reacting during real-life stresses. In other words, the laboratory stress-inducing situations should be such that the individual's own subjective habitual method of responding during stress would be elicited. This meant that the stress-inducing situation should not be overloaded in the direction of frightening or angering the subjects, but should allow for freedom of the individual's own personality reaction to take place. Thus, ths stress-inducing situation should be similar to material used in a projective test.

We have developed two stress-inducing situations: (1) The "problem-solving" situation, and (2) the "sound machine" situation.

a. "Problem-Solving" Situation: In this situation the subjects were given problems which looked easy but which were difficult to do without pencil and paper. They were not given sufficient time to solve them and were chided about their failure to do them correctly.

b. "Sound Machine" Stress: This was a frustrating situation in which stammering was induced.

The criteria used in determining that the laboratory situations induced stress were that they produced subjective reports of psychological emotional changes, physiological changes, and decrements in performance in the subjects. Both of the above situations satisfied these criteria.

It was first necessary to determine whether or not success had been achieved in developing a projective test, that is, that the stress-inducing situation induced a variety of responses in the subjects. This could be determined by the spectrum of responses to the situation induced in the subjects. Table I shows the psychological emotional responses to the "problem-solving" situation when it was given as a first stress-inducing situation.

Table I. This shows the psychological emotional responses to the "problem-solving" situation when it was given as a first stress-inducing situation

Dominant emotion: anger directed outward	15
Dominant emotion: anger directed inward	28
Dominant emotion: anger directed equally outward and inward	2
Equal anger and anxiety	8
Dominant emotion: marked anxiety	8
Dominant emotion: mild anxiety	1
No emotion reported	3
Miscellaneous	5
Total	70

Comment

It can be seen that there was a good distribution of the various types of emotional response given by the subjects during the stress situation with no overloading in any one direction. Similar spread was found in the physiological data and the performance data obtained during the same stress-inducing situation.

The data obtained in the "sound-machine" stress-inducing situation also showed a wide variation in the types of psychological emotional responses, in the physiological changes induced and in the decrement in performance scores.

It can thus be concluded that we have been successful in constructing laboratory stress-inducing situations which were projective in fact and which allowed for good discrimination between the subjects.

2. *The Importance of Grading the Test on Three Levels.* In grading each individual's reactions during stress it was apparent that grading upon one particular level, that is, psychological, physiological or performance level, was not going to yield sufficient information. If one graded the subjects on a *psychological emotional level* alone, only

one facet of the personality's reaction was graded. While such data were easy to classify qualitatively, they were difficult to quantify. An additional source of error here was that the subject might not report his feelings accurately. On the *physiological level*, data were subject to more objective measurements and errors were less likely. If correlations at a highly significant level were established between the psychological and physiological data, then one would act as a check on the other. The physiology lends itself easily to qualitative analysis of patterns and to quantitative analyses of intensity, duration, and variance with further analyses of their relation to each other possible. In regard to the *performance level*, it is a long held hypothesis that severe anxiety is disruptive of performance in most individuals. However, some individuals can experience a great amount of anxiety with marked accompanying autonomic physiological activity without disruption of the personality or failure in performance. In marked contrast to this, some other individuals, when experiencing mild anxiety with mild autonomic physiological activity, will show marked disruption of the personality with marked failures in performance. Thus the use of performance tests gives important information as to how well a man performs during stress, and on a theoretical level gives indirect measures of personality integration and may give indications of ego strength.

When subjects were graded on three levels simultaneously, immense technical problems immediately became apparent. For example, if the subject was interviewed to determine his psychological reaction while the physiology was being recorded, the tension-reducing effect of speech and the mechanism of speech itself affected both the physiological readings and the psychological responses. The interview's influence on the psychological responses of the subject was also important. Doing performance tests in turn had a marked effect on the psychological and physiological reactions of the subjects. Despite these difficulties, by experimentation we have arrived at methods which we feel largely surmount these problems and obviate most of the difficulties.

It would be expected that important correlations would be found between the data obtained on these three levels. A few of the more important correlations which we obtained were the following:

a. Correlations between the psychological emotional responses and the physiological changes during stress. Many statistically significant correlations were obtained between the type of emotion reported by the subjects and the physiological patterns obtained during the same stress situation. The physiological measurements of blood pressure and certain cardioballistographic indices were compared on the

basis of the emotional responses of the subjects. The physiological patterns obtained in the group of subjects whose emotional response during stress was scored as "anger directed outward away from the self" were different from those of the group of subjects whose emotional response during stress was scored as "anger directed toward the self." The physiological patterns obtained in the group of subjects scored as "anger directed outward away from the self" were also different from the physiological patterns obtained in the group of subjects scored during stress as reporting "anxiety." These differences in the four cardioballistographic measures were all statistically significant, most of them at better than the .01 level. A comparison of the physiological patterns obtained in the group of subjects scored as "anger directed toward the self" with the physiological patterns obtained in the group of subjects scored as "anxiety" showed a similarity of pattern, except that the "anxiety" group showed a greater intensity of response.

The physiological patterns obtained during stress in the group scored as "anger directed outward away from the self" were similar to those which can be obtained by the intravenous injection of nor-epinephrine in subjects not under psychological stress. The physiological patterns obtained during stress in the groups scored on the psychological emotional level as "anger directed toward the self" or "anxiety" were similar to those which can be obtained by the intravenous injection of synthetic epinephrine in subjects not under psychological stress.

This work has many implications in that it shows that Cannon's "Fight-Flight" reaction is separable into different components on both a psychological and physiological level, provided the direction of emotion is taken into account. Should it be validated that "anger directed outward" is associated with an excessive secretion of nor-epinephrine and that "anger directed toward the self" and "anxiety" are associated with excessive secretion of epinephrine, it would have important implications for medicine in view of the known different physiological effects of the two substances secreted by the adrenal medulla, especially in regard to the secretion of ACTH by the anterior pituitary.

b. Correlation of memory scores and the type of emotion experienced during stress. As a test of performance, a memory test which was an integral part of our testing procedure was used. Memory scores were obtained on all of the subjects under non-stressful conditions, and then later during the stress-inducing situations. The difference in the number of errors in memory made during non-stressful conditions and during stress was compared with the type of emotion

experienced by the subjects during stress. It was found that a sharp increase in the number of errors in memory occurred when subjects were scored as reporting "marked anxiety" during stress. In striking contrast to this, there were fewer errors in memory when the subjects were scored as experiencing "anger directed outward," "anger directed toward the self" or "mild anxiety." These comparisons were significant at better than the .01 level.

These results were reported for groups of subjects. However, there were a few subjects who during stress showed improvement in memory despite "severe anxiety" and a few who showed decrements in memory with "anger." To be able to select such individuals from the sample was another evidence of the importance of scoring the subjects on different levels.

3. *The Importance of Repeating the Stress-Inducing Situations.* Without experimentation, one of the theoretical criteria laid down by many psychologists for a successful laboratory stress-inducing situation was that the reaction of the subjects during the situation would be the same on repetition of the situation. This hypothesis was one of the first we explored. The stress-inducing situations were administered on three occasions, in the following order:

Stress I—"Problem-solving."
Stress II—"Sound machine."
Stress III—"Sound machine."

It was found that whenever a laboratory stress-inducing situation was repeated the reactions of the overwhelming majority of the subjects changed. Whereas the most common response to the first stress-inducing situation was anger, either directed outward or directed toward the self, the most common feelings reported during the second stress-inducing situation were either "anxiety" or "no emotion reported." With the third stress-inducing situation there was a further shift with a smaller number of subjects reacting with "anger" and a larger number reporting either "anxiety" or "no emotion."

The physiology also shifted but the high correlation of the specific psychological emotion experienced with a specific physiological pattern held. For example, the group of subjects who showed "anger directed outward" during the first stress-inducing situation and then "anxiety" during the second stress-inducing situation showed the physiology associated with "anger directed outward" in the first stress-inducing situation, and the physiology usually associated with "anxiety" in the second stress-inducing situation. Those who showed "anxiety" in the first stress-inducing situation showed the physiological pattern associated with "anxiety," whereas if they shifted

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in the second stressful situation to "anger directed outward," the physiological pattern also shifted to that usually associated with "anger directed outward."

The psychological variable "source of difficulty," was a measure of whether or not the subject felt that the cause of his difficulties during the situation lay principally outside of himself or within himself. This characteristic of the subject's reaction seldom changed, no matter what the shift in emotion.[3]

A method was then worked out for classifying the over-all reactions of individuals during three stress-inducing situations, thus giving a longitudinal picture of the manner in which each subject handles stress. The classification was—

a. Those whose reactions during the first and succeeding stress-inducing situations were interpreted as indicating *mastery* of the situation.

b. Those whose reactions during the first and succeeding stress-inducing situations were interpreted as indicating handling of the situations in an *unchanged* manner.

c. Those whose reactions during the first and succeeding stress-inducing situations were interpreted as indicating *recovery* in later stress-inducing situations from a severe reaction in the first stress-inducing situation.

d. Those whose reactions during the first and succeeding stress-inducing situations were interpreted as indicating *deterioration* in terms of a more severe reaction to each repetition of the stress-inducing situations.

Each subject was classified using the above criteria on a psychological emotional level. Statistical experiments are now going on in which it is hoped that a method for scoring the subjects on a physiological level and a performance level in a similar manner can be found. Correlations have been found between the psychological emotional responses and the physiology using this schema, and the performance data at the present time are being analyzed in a similar manner. This would allow for the following experimental design for obtaining a profile on each individual.

For the success of this method we would depend upon finding a statistical method of handling the physiological and performance

[3] Since the stress-inducing situations were given in a certain order, the question arises as to whether or not these shifts in emotion are properties of the different type of stress-inducing situation used as Stress I and Stress II, or whether they are the property of repetition of a laboratory stress situation. Experiments designed to answer this question are now under way and preliminary results point to the repetition of stress being the more important factor.

Table II. This shows an experimental design for obtaining a profile on each subject

	Mastering	Unchanged	Recovery	Deterioration
Psychological level				
Physiological level				
Performance level				

data. Using this method would give a fairly complete picture of this aspect of the way an individual reacts during stress, and places emphasis on repetition of the stress-inducing situations, on at least three occasions, as being of supreme importance in determining the manner in which an individual reacts during stress. Until these data are correlated with the later real-life history of individuals during military service and/or combat, we will not know whether or not this classification carries over to real-life stress-inducing situations. However, we would offer the hypothesis that if a method can be found which will give a multidimensional view of these subjects through three situations on three levels, correlations between the laboratory stress-inducing situations will be more probable than with a less sophisticated manner of statistical analysis of data.

4 *The Importance of Good Statistical Analysis.* The statistical problems involved in such a complex grading scheme are enormously complicated. The statistical technics in this project have been devised by Margaret Drolette under the supervision of Hugo Muench and Jane Worcester of the Department of Biostatistics, Harvard School of Public Health.

It is important to score as many factors as possible because in this way "all of one's eggs are not in one basket," and one cannot be sure which measure may later correlate with the manner in which individuals react during real-life stresses. The following analyses should be undertaken of the physiological reactions during stress:

a. Intensity:
- (1) Mean intensity.
- (2) Over-all intensity.
- (3) Intensity of each variable.
- (4) The most discriminating system.

b. Pattern analysis:
- (1) Similarity to injections of epinephrine and nor-epinephrine.
- (2) Classification of over-all reactions into mastering, unchanged, recovery, and deterioration.

c. Variance:

(1) Overall-variance in one stress situation.

(2) Over-all variance in three stress-inducing situations.

(3) Variance of individual measures.

d. Analysis of "anticipatory" readings.

e. Duration of the reaction.

Since analysis of intensity, duration and pattern are so commonly used, the problems incidental to these will not be discussed. However, two important aspects of the analyses which are often neglected are the analysis of variance and of the "anticipatory" readings. These will now be discussed.

Analysis of Variance

This is an extremely important variable and our methods allow for three types of analysis of variance. Two examples of our results were:

1. *The relationship of variance to intensity.* The first example is that of the relation of variance to intensity. Two individuals whose mean intensity of reaction in a stress-inducing situation were approximately the same, that is, 1.20 and 1.10, showed, a variance of 41.1 and 8.6 respectively. With this additional information, a quite different picture of the reaction to stress is thus obtained, and another meaningful dimension is added.

2. *Variance of a specific variable.* An analysis of variance was made on the height of the cardio-ballistographic IJ waves during the emotions of "anger" and "anxiety." A greater amount of variance was found when the subjects experienced "anxiety" than when they experienced "anger." This difference was significant at better than the .01 level.

3. *An analysis of the "anticipatory" physiological readings.* An analysis of the so-called "anticipatory" physiological readings is of importance. For classifying purposes, the following example is given. In these experiments, after the subjects had been lying supine for 20 minutes, basal physiological readings were obtained and then the procedural instructions were given the subjects. When the instructions had been completed, and just before the subject began to retell the story into the "sound machine," physiological readings were obtained which we have termed the "anticipatory" readings. This factor has been dealt with by many investigators as a problem which complicates experiments. However, we would offer the hypothesis that this is an extremely useful measure, and that the greater the "anticipatory" readings with each repetition of the stress situation,

the more prone the individual is to difficulties during stress. Let the data from two cases be cited as examples:

Table III. This shows the relation of the pulse during basal conditions, during anticipatory conditions, and during stress.

Physiological variable: *Pulse*	*Basal reading*	*Anticipatory reading*	*During stress*
Subject A:			
Stress I	70	80	90
Stress II	70	76	88
Stress III	70	70	80
Subject B:			
Stress I	70	80	100
Stress II	80	100	110
Stress III	90	120	123

It can be seen that these two individuals can be compared from the standpoint of their basal records and " anticipatory" records on both vertical and horizontal bases. This necessitates not only calculating the differences between the basal and "anticipatory" readings in each situation, but also in relation to the previous stress situations. Marked physiological activity in anticipation of the repetition of a stress-inducing situation may well indicate difficulties during real-life stresses as compared with individuals in whom this marked activity of physiology in anticipation of the repetition of a stress-inducing situation does not occur.

Comment

With the many complex factors involved in studying individuals during stress, it is of extreme importance that research in the field of the statistical handling of these problems be forwarded. It is in this way that progress may be rapid and the understanding of stress be put on a more solid experimental basis.

Summary and Conclusions

1. Two laboratory stress-inducing situations have been developed which produce stress in most individuals. The criteria used to indicate that individuals were experiencing stress were induction of marked changes in the psychological emotional reactions, the physiology, and the performance of the subjects by the experimental situations.

2. Some of the more important principles needed in a good laboratory stress-inducing situation were discussed. These were:

a. The importance of constructing the laboratory stress situation in such a way that it can be used as a projective test.

b. The importance of grading the test on three levels, the psychological emotional level, the physiological level, and the performance level.

c. The importance of repeating the laboratory stress-inducing situation on at least three different occasions.

d. The importance of good statistical analyses.

3. Some correlations of importance established were that a different physiological pattern occurred during the emotion of "anger directed outward" than when anger was "directed towards the self." The physiological pattern occurring during "anxiety" was similar to that experienced when the emotional reaction was "anger directed towards the self" and different from that experienced when the anger was directed outward. Correlations also showed that there was a marked decrement in memory when the subjects were scored as experiencing "severe anxiety," whereas when the subjects were scored as "anger," either directed outward or inward, or "mild anxiety," there was an improvement in memory.

4. Many facets of the personality can be studied during a laboratory stress-inducing situation. An outline of the factors which are being studied, not all of which can be touched on in this paper, are:

I. *During Laboratory Stress*

1. Psychological Reaction Pattern
   - *a.* Emotional pattern
   - *b.* Direction
   - *c.* Object
   - *d.* Intensity
   - *e.* The conceptualization of the self in relation to the reaction during stress
2. Physiological Reaction Pattern
   - *a.* Pattern
   - *b.* Intensity
   - *c.* Duration
   - *d.* Disorganization
   - *e.* Variance
3. Performance
   - *a.* Memory
   - *b.* Motor
   - *c.* Abstraction
   - *d.* Other
   - *e.* Variance

II. *Effect of Repetition of Stress*

Individuals should be classified in a manner which takes into account the effect of being exposed to a laboratory stress-inducing situation on at least three different occasions.

III. *Recovery From the Three Laboratory Stress Situations*

1. Method Used
   - *a.* Motor activity
   - *b.* Verbal activity
   - *c.* Insight
   - *d.* Other
2. Psychological and Physiological Patterns Used
   - *a.* Same
   - *b.* Reversal
3. Duration and Intensity of Psychological and Physiological Reactions
   - *a.* Return to homeostasis quickly
   - *b.* Long-sustained with failure of homeostasis
   - *c.* Sustained with reversal of pattern

IV. *Relation of Basic Personality to Above*

This would include standard psychiatric interviews and standard psychological tests.

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Discussion

UNIDENTIFIED SPEAKER. Throughout the entire symposium the word stress has of course been used very freely. It seems to me that in experimental studies of stress it is most important that we have a clear definition of the word. I submit that an operational definition of the word stress in civilian life or in the defense setting is the most important. In short, I would like to see, instead of mild shocks or a needle as the stress-producing agent in experiments, rather realistic criteria for stress isolated and experiments devised on the basis of those.

The second part of my question or statement concerns Dr. Funkenstein's study as a whole. I did some experiments in England that closely paralleled this work. It is rather interesting as a sidelight on the study that those personnel who tended to attack me and the experiment as a whole aggressively also were apt to show physiological tendencies of tension or disequilibrium. There was a rapid rise in physiological indices of tension. On ventilation of this aggression the tension rapidly dissipated and they returned to homeostasis. In the very unstable neurotic group the tension also rose rapidly, in many cases they failed to ventilate this aggression, and at the termination of the experiment the level of tension remained at a relatively high level. The three groups were a delinquent, a neurotic and a stable control group. Both the delinquents and the neurotics were markedly and significantly different from the stable control group. I am most interested in whether (particularly with pulse) Dr. Funkenstein expects, in those who internalized their aggression or shortened the externalization of it, that there would be a good chance for the acceleration of pulse rate to continue for some time past the end of the experiment.

Dr. Funkenstein. First, I am glad you brought up the definition of stress, because that worries us quite a bit. Since we have produced changes in the subjective emotional responses of the subjects, changes in the physiology, and decrements in performance, we would interpret that as indicating that the individual was experiencing stress. As to the fact that we have not yet analyzed our findings as to duration, Malmo and Shargas in Montreal have been able to show, as you know, that the chief difference between neurotics and other individuals is that the alteration in physiology is longer sustained, not that it is more intense. In some individuals, the stress lasts quite a long time. In some it lasts only a few minutes, until the interview is over. Other individuals have said that it has bothered them all week. We try to find out when they come back. Among the ones that it seems to bother, there are a few individuals who get very angry during this stress and during the psychiatric interview within 5 or 10 minutes, but they will repress in front of your eyes. They will say to you, "Doctor, I was not angry, I was just nervous. I was not angry, I have never been angry in my life." They will leave, and will often call you up at home at night or the next day and say, "I want you to tell every one on that project that I was not angry." This particular repression in these individuals is very striking. If we see they are too much upset, then we try to keep them for an hour or so and let them ventilate, which is very successful. Every once in a while we get someone who does repress and we are not successful, but

we can count on him even coming over the next day because he does not want anyone to think he was angry.

QUESTION. I do not know whether I misinterpreted something in the last part of the paper, but I believe that you said that the "anger in" and the "anxiety" people reacted the same way physiologically but that the "anxiety" people and the "anger out" people had much in common psychologically. Was I incorrect in my interpretation?

DR. FUNKENSTEIN. No you are not incorrect. The physiology of the "anger in" group and the "anxiety" group is similar. The "anger out" physiology is different. On the raw shock, the "anger in" group and the "anger out" group are different but the "anger out" group is similar to the "anxiety" group. In our psychiatric interviews, the individuals who had anxiety were those whose hostility was almost entirely in safe areas—universals: "I do not like my car, I hate war." Therefore we felt that these were individuals who were probably set for hostile responses to raw shock material, which is mostly unconscious material, but were blocked because of the fact that they could not express emotion towards persons. They had to express it toward universals and objects. In the people who respond with anxiety, not only hostility, but also love and almost any emotion we measured was substituted away from persons over into the safe areas. This was very striking. So we felt that these individuals were all set to react as if they would get angry at people but they developed a lot of anxiety and used substitutive behavior because this placed them in a safe area. I think that sounds logical.

DR. RUESCH. Dr. Funkenstein brought up a very interesting point about the similarity between the symptoms in "anger in" and "anger out" with regard to actions of infusion of norepinephrine on the one hand and epinephrine on the other hand. This might possibly have something to do with the distribution of these catechol amines in the suprarenal glands of certain animals. It is well known that in the cat, for instance, the suprarenal catechol amines consist about 50 percent of noradrenalin and 50 percent of adrenalin, whereas in some of the typically "anxiety animals" like the rabbit or the guinea pig there is 85, 90, or even 100 percent epinephrine. That might possibly have something to do with ability to secrete this substance and now the question comes whether that has anything to do with their behavior under stress. Dr. Goodall of our laboratory was interested in the question so he went down to Africa and chased a few wild animals and got hold of a lion and some apes. The lion, I believe, contained about 60 percent norepinephrine, and about 40 percent epinephrine. I think it is the same with all these cat animals which one might possibly—I do not know if it is correct from a psychiatric point of

view—classify as "anger out" animals in comparison to the rabbit which is certainly not an "anger out" animal. This might sound very superficial in a way, reasoning from just the content of the suprarenal one or the other of these compounds, but it seems from some of our recent experiments that these two hormones can be activated by different mechanisms. For instance, in stimulating the hypothalamic centers it is possible in some cases to get an output of practically only noradrenalin, and in other experiments to get practically only adrenalin. So it seems possible that the organism has ways and means of pouring out one or the other of the two catechol amines which might also influence behavior.

Dr. Funkenstein. A friend of mine who works with animals has found the same thing. He found that the aggressive animals tended to have an excessive secretion of noradrenalin, the animals who were more frightened (this was in various species of dogs) had more epinephrine. I do not feel that these findings have much to do with behavior. I think they are secondary indicators. I think that they go along with the psychological phenomena and that we happen here to have a means of measuring something. I believe that these things are psychologically determined, because of the fact that if an individual gets very angry he will get a norepinephrine pattern. The next time he comes in, if he gets very anxious, he gets an epinephrine pattern. If he gets very angry in the first part of a psychiatric interview, there will be a norepinephrine pattern but the minute the patient starts to blame himself, he will retroflex the anger on himself. These changes are lightning fast, and the second they occur the physiological pattern alters also. A good deal of work that we have done with mentally ill patients shows that the paranoid, in whom anger is directed out, shows an excessive secretion of norepinephrine in the absence of stress. In contrast, the depressed individual, without stress except his own inner stresses, shows an excessive secretion of an epinephrine-like substance. In other words, this corresponds to what these people do under stress, and gives us some idea that psychotic patients are under constant stress because we can produce these patterns transiently in normal individuals. The fact that "anger out" and fear are different is also shown by the work of Dr. Bord at Hopkins who has produced fear by means of stimulating small electrodes on the anterior hypothalamus. When the posterior hypothalamus is stimulated, anger is produced. It would be very nice to measure these different types of secretions in such animals, but we do feel that in anger directed out, the direction of emotion is different and that the object also is important in understanding the reaction. That is exactly the way that Freud classified emotions.

DR. CAUDILL. I would like to ask Dr. Funkenstein whether he plans in future work to vary the structure of the groups of people; that is, putting groups of people under these stresses and then composing the groups differently. It seemed to me that this might be very important in future field trials, because as Colonel Glass has indicated, the small primary buddy group that the individual goes back to is extremely important.

UNIDENTIFIED SPEAKER. I would like to ask Dr. Funkenstein if any attempt will be made to vary the intensity of the stress-producing condition. This is the only thing that I can think of that he has not varied as yet by selection or control. Far from making the interpretation more complicated, it seems to me that it might make it more simple because then one might be able to equate individuals on the basis of their performance before running the statistical analysis.

DR. FUNKENSTEIN. This of course depends largely on individuals. These individuals have a certain story which they have to tell back as rapidly as they can. Now in some of the men blocking becomes very slow, some are extremely rapid; they will skip lots of it and we do not think we can control the amount of stress because that is a function of the individual. We tried to set it up that way.

UNIDENTIFIED SPEAKER. The question was whether you would try and set it up another way where you might be able to control it, for example, to set the pace for the subject and then consider that if you set a faster pace this would be more stress, if you set a slow pace it would be less stress. That is the type of procedure which we are using now at the Naval Medical Research Institute on stress problems, and it seems to help us.

DR. FUNKENSTEIN. This has taken a long time. We now have the instruments and we would like to know something more about such things as families and the relationship of various factors in which we happen to be more interested than in that particular sort of thing. I think that is very worthwhile doing, but maybe someone else will do it.

DR. SELLS. I would like to mention just one caution about stress test research. We have some work going on in Texas in which we are using about 25 different stress tests on a population of 125 ROTC cadets. This has not been completed; some factor analysis work is going on at present, but I do know that the intercorrelations are not high and that the same people do not react in the same way on all of the tests. The point that Dr. Funkenstein made about the necessity to check results against a field criterion should be kept in mind. I think we have a long way to go in research in this area. It is important to be able to test how people will react in combat or in

other realistic situations by experiences to which we expose them in the laboratory; it will be a very important thing but the mere fact that we have related emotional reactions to some impairment of performance has to be looked at very cautiously until we know more about just what we do have. I think Dr. Funkenstein will agree with that.

DR. FUNKENSTEIN. Yes, I repeat for the third time that I have no idea whatsoever as to whether or not this has any carryover to individuals in the Service, or in other real life situations. I hope that this will be given a field trial, and I also hope that somehow, maybe every 5 or 10 years we can write to the subjects we have had and try to find something about what has happened to them as they go through life. I think it is a big jump from a laboratory over to what goes on in real life. The only way that can be tried is with a field test and then we will know; we have no way of knowing at the present time.

THE IMPLICATIONS OF STRESS IN PSYCHOLOGICAL WARFARE*

C. D. LEATHERMAN, PH. D.

Modern warfare is said to be composed of four basis types: military (air, sea and land), economic, political, and psychological. We have not yet reached the stage of push button warfare in the atomic age. We still need soldiers to fight. But some of our concepts about warfare are changing. We, today, will deal with only one aspect of psychological warfare, but a very important aspect, namely, the *Implications of Stress in Psychological Warfare.* Psychological warfare is one of our family of weapons. Some speak of shooting paper bullets, others of words, confetti, etc. Perhaps the most popular expression used today about modern warfare is that of the "Cold War." Whichever of these concepts you accept, the underlying principle is, that we are attempting to influence the minds of other people.

General McClure, Chief of Psychological Warfare for the Army, has on a number of occasions described psychological warfare by using the first letter of each word, as follows: "P"—to produce psychological propaganda, and "W"—to wage war without weapons. This is an easy way to remember the basic principles underlying psychological warfare. As you can see, psychological warfare attacks the mind and the heart of the individual. It creates fear, sows suspicions, causes doubts, spreads confusion, underscores hardships, emphasizes intolerable situations, or, in support of military operations, mentions overwhelming fire power. In short, *psychological warfare creates stress.*

One of our major efforts in psychological warfare is to weaken the will to resist. We might say, then, that propaganda is an organized attempt to influence people's thoughts and actions in a specific way and for a specific purpose. In a military situation, psychological warfare is the use of planned propaganda against the enemy so as to break down his morale and destroy his will to resist.

It is readily apparent that there are many kinds of propaganda, such as:

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Strategic propaganda—directed toward the home populations of enemy countries.

Consolidation propaganda—aimed at the civilian populations in an area or country which is occupied by a military force.

Tactical propaganda—directed principally against enemy troops in the field, in support of localized military operations.

Overt or so-called *white propaganda*—issued for a recognizable source, usually an agency of a government and may include military commands.

Covert, also called *black propaganda*—ostensibly originated from secret radio stations within one country but actually broadcast from another country.

Counter propaganda—the refutation of a specific point or theme of enemy propaganda.

Divisive propaganda—designed to sow suspicion and doubt about the loyalty of one ally to another.

In all of these kinds of propaganda one must remember that propaganda can be good or bad and the important point is to determine which purpose is intended. You can recognize and determine which kind of propaganda is meant by getting the facts, finding the source, maintaining a critical attitude, being objective, and becoming propaganda conscious.

I believe we all recognize that America has a national policy of spreading the truth. The *New York Times* emphasized this point in a series of articles by calling this whole problem "the battle for men's minds."

Our topic today centers around the basic problem of *stress in psychological warfare*. The implications of stress obtain whether we think in terms of our own or enemy propaganda. Stress for the purpose of our discussion today implies pressure, strain, anxiety states, the painful emotion of fear, nervous discontent, etc. The word stress, as you know, tells us that something is being overburdened, strained, overtaxed or is constrained; in other words, pressure is being exerted on the individual's mind or body. Anxiety implies a painful uneasiness of mind or the pathological condition occurring in nervous or mental diseases.

Certainly it would be useful for all military personnel to have some understanding of the kinds of mental reactions which may be expected under extreme stress. The physiological and psychological symptoms are fairy well known when they result from the emotion of fear or continued severe stress. Three categories have been emphasized in the Department of the Army *Bulletin on Combat Psychiatry*, as follows:

1. Psychological reactions to severe stress or fear may include heightened sensitivity to loud or unexpected noises, irritability, insomnia, resentment, anticipatory anxiety that increases gradually in the face of recurring danger; or loss of interest, initiative, or the ability to concentrate.

2. Psychosomatic reactions which may be expected normally as a result of severe stress include excessive perspiration, hot or cold sensations, loss of appetite, diarrhea, increased muscular tension, consciousness of irregular heart beating, vague abdominal distress, faintness or giddiness, marked physical fatigue, and generalized muscular weakness.

3. Abnormal reactions may be expected in either of the two categories above. Under some circumstances, functional disorders such as partial paralysis, contractures, blindness, deafness, or organic incapacitating difficulties such as tremors or shakes, fainting, continued insomnia, etc.

It would be unfair for me to intimate, or for you to assume, that psychological warfare leaflets or broadcasts cause all of the stress reactions which were indicated above. The important factor is that each individual has certain primary needs or basic desires such as the physiological needs of the body, i. e., hunger, thirst, sex, rest, activity and self-protection. In addition, there are secondary needs or desires such as the desire for approval, gregariousness, self-expression, pre-eminence, and philopedic (the Greek word for parenthood and implying parental love).

Whether the drive is a primary drive based on the physiological needs of the body or an acquired (or secondary) drive as a result of the environment, each of these is a basic and underlying factor in motivation for the individual. Let us assume that the man is in Korea and that he is hungry, cold, tired, ten or ten thousand miles from home and loved ones, and that he has had a minor but painful injury from a shell fragment. Now, regardless of whether this man is an American, represents one of the United Nations Allies, or if he is a North Korean, Chinese or Russian, he is faced with many possible mental conflicts. For this hypothetical example, the man's motivations force him to be aware of his basic drives—hunger, fatigue and physical discomfort, and his secondary drives of loneliness and nostalgia. The mere absence of these factors plus the unusual strains imposed on him in a battle situation tend to augment his nervous discontent and the resultant effect may be organic or functional disorders. Obviously, in a military situation, this simply means a battle casualty. But add to this picture a carefully worded broadcast or an effective

leaflet, and either would draw his attention to these mounting mental strains or physical difficulties.

This man as a soldier has already made many personal adjustments. In fact, he has faced a continuous series of problems as a soldier which require either personality adjustment or some mental adjustment on his part, which in turn, could affect his personality. In addition, other conflicts would arise when his desires differ from the demands of his environment. His normal emotion of fear might make him want to run and hide, whereas his strict military discipline makes him stay and fight. Faced with these conflicts he may give vent to neurotic expressions such as unreasonable attitudes, depressions, defeatism, anxieties, or many other types of irritations. According to many of our medical authorities, mental sickness like physical sickness is evidenced as a matter of degree or intensity. One man succumbs to a germ, gets physically sick and may be hospitalized; he is treated by one of our miracle drugs and more than likely recovers. Another man gives in to an environmental stimulus or conflict and gets sick mentally and may need to be hospitalized; he too can be treated and usually recovers.

Three terms, with which you are familiar, should be mentioned at this juncture.

Psychoneurosis is a functional disorder which is less fundamental than a psychosis. This term includes a whole group of functional disorders of the central nervous system so far as they involve or are caused by mental factors or functions.

A *neurosis* is a functional disorder of the nervous system for which no actual lesion is found. Current psychiatric usage tends to confine this term to psychogenic disorders and to use the term psychosis for major disorders involving the total personality. The terms neurosis and psychoneurosis are frequently used interchangeably.

Psychosis, of course, is the most serious mental disease of those mentioned and covers real insanity cases. You may recall that separations from the Army during the period 1942–1945 totaled 54,523, or 6.4 percent for psychosis, whereas psychoneurosis which is a less serious and minor form of maladjustment accounted for 30.5 percent.

Statistically, the records indicate that more than 20 percent of all battle casualties were caused by psychoneurosis. Much of this manpower loss could be attributed to a lack of understanding on the part of many officers and men as to the real reasons why one man differs from another, the important part motivation plays in any normal man's life, the very powerful influence which emotions play in our everyday duties, and a lack of training. A more thorough knowledge of mental hygiene, and as many prefer, preventive psychiatry, could

have at least salvaged or prevented a large percentage of this wasted manpower.

In thinking of preventive psychiatry, several factors loom important—they are: educational measures such as lectures, discussions and films; motivational methods involving entertainment, magazines, mail, newspapers; and environmental manipulation involving rest camps, flexible training programs, rotation of troops, etc. All of these help to lessen the stress factors which operate on the soldier's basic personality structure. First, the soldier has these internal stresses which are augmented by his unusual environment and each of these imposes additional strain or stress on his basic personality structure. It is perfectly normal for the soldier to have fears of physical mutilation or death; to resent such factors as isolation, deprivation or extremes in climate, and as a result to have peculiarly developed attitudes or incentives. In any one of these situations, we have factors which contribute to mild or perhaps even intense neuropsychiatric reactions.

As we all know, the soldier's conscious mind controls his voluntary behavior. It acts as a logical governor for the mental processes and makes our normal behavior meaningful in terms of consciously recalled relevant experiences from the past. The subconscious mind sends powerful impulses or drives to his conscious mind for acceptance or rejection in terms of social behavior. It is equally apparent that the subconscious mind sometimes gets out of control and runs rampant. Personality changes may be the result of the conflict between his subconscious influence and his conscious effort or desire to work with or be a part of the group. It is this series of conflicts on which psychological warfare must play its important role. We might call this conflict situation, the individual's Achilles' Heel. This weakness or vulnerability, whether it be for an individual or a group, becomes the basic factor on which psychological warfare must operate.

Now let us deal with a specific case which will illustrate some of the weaknesses or vulnerabilities which we have just mentioned.

One leaflet, for example, prepared by the Chinese Peoples Volunteer Forces, emphasizes the following points:

"Follow us, we will guarantee your safety.

"We have thousands of your fellow soldiers—they have peace and safety—you will see them soon.

"We will not harm you since we do not mistreat our prisoners, nor do we take their personal belongings.

"If you are wounded, you will get good medical treatment.

"You will be able to write home and tell your folks you are safe.

"You will certainly be freed and get home in the end."

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The other side of this leaflet shows four happy and smiling prisoners with adequate meals and with good medical attention. Please note, in particular, the number of drives and internal pressures which this one leaflet illustrates.

Another leaflet, to illustrate the point, portrays what appears to be an authentic letter written by a private with his name, rank, serial number and signature. This letter goes into details which I will brief for you:

Written in the first person, it describes the wounded soldier hit by a shell and crawling along a road. He is cold, scared and in pain; a Chinese soldier takes his weapon, thinking him dead. He has been told previously that he would be mistreated and probably shot if captured. He then describes his fears for his life. A nearby buddy, delirious and nearly dead, is screaming. Two Chinese soldiers are curious and come to see what is happening. He plays dead but being so scared he shakes like a leaf; consequently, the Chinese notice the shaking, laugh at him and then help him to his feet. He goes on in detail to describe an excellent meal, the best he had ever eaten. He loses his fears; he is taught how to roll cigarettes Chinese style and to his surprise, the Chinese do not regard him as an enemy, but rather as an individual to be helped. He learns a lot about the people of Communist nations, that they really do not hate him but rather the Wall Street financiers and the rich capitalists. He is given new Chinese winter clothing and when he leaves the excellent Chinese hospital, he is filled with sadness because he has found many new friends. He comes away from the hospital with a desire to learn more about the heroic struggle of the people of China, to learn about their new way of government—their new way of life. The punch line is—"Why don't you come over to 'our side' before you are wounded?"

Each of these leaflets has a ring of truth to it unless one has learned otherwise by bitter experience.

Rather than go through leaflet by leaflet let me illustrate a random sample of these Chinese communist forces or North Korean leaflets which are sent to the UN forces. The following are the kinds of drives or stresses which are emphasized:

One sample leaflet accentuates nostalgia through what appears to be an authentic letter from Sally to Ken telling him how much she loves him, misses him, and fears that he will be killed. Her basic question is—"Why can't we stop all this fighting, what's the use of it, what are we fighting for, etc?"

Another leaflet shows a photograph of happy prisoners of war, provides a safe conduct pass, and says—"When you see one of us, lay down your gun and shout 'TOW SHONG' which means surrender."

Another leaflet, which appears to be an actual photograph, shows a happy reunion of soldier and sweetheart or wife and says—"You too belong back home, leave Korea to the Koreans."

Another leaflet appears as a personalized letter from an American soldier to his buddies in his previous unit begging them to lay down their arms for a useless war. The punch line in this instance is—"We are now free from the terrible fear of death, we are safe in the rear, and we are being treated warmly."

Another one emphasizes Christmas in America and says—"Why are you here in Korea shivering and so gloomy?" The other side of this same leaflet shows Santa Claus passing out Christmas presents to the family, but this Christmas a skull is given as the present.

Another leaflet uses typical American slang and says—"Don't be a last-minute sucker, stop the war now." The other side gives the number of American and United Nations casualties on a weekly basis and says—"Why risk your life when big business rakes in the dough?" In this particular instance a cleverly drawn cartoon shows a buxom American matron and across the table from her is her equally fat Wall Street husband. The caption reads—"John dear, it says we are suffering terrible losses in Korea." His answer is—"Nonsense, I'm making millions there every week."

Another leaflet emphasizes a UN soldier ravaging the wife of a North Korean soldier.

As many of you have heard, Orientals are quite adept at imitating. Since the United Nations has dropped more than two billion leaflets thus far during the Korean war, they have a great many examples which they can imitate. The language, particularly the slang, is used in most unusual ways and is recognized immediately as being faked. Fortunately for us, much of this enemy propaganda follows the party line from communist headquarters. With rare exceptions, leaflets received by our troops are read with amusement and kept as souvenirs and not for the purpose of providing a safe conduct pass for surrender purposes.

Now let us see the various ways in which these fears, suspicions and doubts may be created. Visualize in your mind's eye a leaflet which shows a picture of an over-sized Communist war lord sitting back on an enormous throne while at his feet many miniature Korean people pile food. This concept is portrayed on one side of the leaflet whereas on the other side is a word picture and drawing depicting a desperate farmer looking over his empty rice field. This leaflet emphasizes two themes since by design the leaflet; (a) discredits the Communist regime of Korea because it betrays the people through land reforms which are only paper land reforms and (b) the leaflet

emphasizes hunger and the uselessness of farming since the Communist war lords take all the food that is grown.

This leaflet illustrates strategic propaganda since the North Korean civilians have been told their lives will be better but what happens is that they must work many hours overtime to eke out a poor living.

Among the frequently exploited secondary desires is that of "approval." This desire may be shown in many ways but the old statement—"When in Rome do as the Romans do," typifies the basic principle. A related desire of man is to excel in some endeavor such as athletic events, business, or any given skill. By excelling he thereby gains the approval and the cheers of his fellow men. Another related desire is for self-expression. This desire may include two which were mentioned earlier, namely, activity and rest. In this instance the desire for self-expression could be shown in many different ways such as vocations and avocations. We often hear "the busy soldier is a happy soldier," which is simply another way of showing innate desire to be active. In each one of these examples, a leaflet or a radio broadcast could sow the seeds of suspicion, doubt or dissension by emphasizing the absence of any one of these desires.

Now let us consider a few additional basic vulnerabilities which are important in the propaganda field. One of the basic ones is fear or fright. Either one of these concepts could cause panic, in which case, on the battlefield at least, the man would run. He would look for cover or he might dash about aimlessly and expose himself to additional dangers. Two other weaknesses are related also, namely, tension and insecurity. However, the basic emotion in each instance is fear. Tension when accompanied by insecurity increases the expression of fear, which in turn, may result in panic.

When a group is tense or insecure, when there is imagined danger or a state of mass insecurity, the people involved are susceptible to well-planned propaganda simply because their thinking processes are fuzzy. When you have mass insecurity you have many individuals with inner anxieties. One of the easiest illustrations of soldier fears is fear of the unknown, which in a military situation simply means that the soldier lacks knowledge about natural or social phenomena, or adequate information about the enemy. The well-known Well's broadcast of "The Martian Invasion" could serve as an example here. Thousands of people heard the broadcast and even though frequent announcements were made during the broadcast that "This is only a radio program," the end result was the same. Near panic was produced and the roads were clogged with people fleeing for their lives. This illustrates fear of the unknown and the cumulative or contagious effects of fear which can result in panic.

It is well known that fear is a common, normal reaction in the face of danger. However, even death may occur solely as a result of extreme fear. In a combat situation, preventive measures should be taken so that each soldier knows that: butterflies in his stomach, wet clammy hands, low back pains, or any of the other typical symptoms are the accepted and normal reactions to fear rather than the unusual. Now let us see how this emotion could be exploited in the propaganda field.

Our "psywar" tactical and strategic radio allows the combat propagandist to cross the enemy operational lines and reach many people with a message that is understandable and believable and at the same time has an emotional punch. Can you visualize an enormous pile of skulls and bones, emphasizing the simple concept of death? The enemy's normal reaction is that simply by surrendering he can save his life.

Now let us illustrate the physical or harmful side. In this instance for our example we will use a leaflet or a radio broadcast which emphasizes a North Korean soldier who has come across to the United Nations lines and is having his frostbitten foot treated and bandaged. His personal message to his friends is simple—"I will not lose my foot, nor will I die. I am in safe hands and receiving good medical treatment." Several physical conflicts are emphasized in this leaflet since frostbite is common for the Oriental, normally resulting in the loss of limbs and many times resulting in death. Although we as Americans expect the best and for the most part get it, the Oriental for many years has known that good medical supplies are in extremely short supply. In this example, then, we have created a conflict in the Oriental soldier's mind. He has few if any medical supplies and he needs medical help. His feet and hands are cold and for all he knows they may be frostbitten, but with American medical supplies his feet or hands could be saved. Each of these ideas has created conflicts in his own mind as well as those of his buddies. They may result in his laying down his arms and surrendering.

Actually one of our real problems is to provide the individual enemy soldier with practical and understandable tips on how he can "get lost from his unit long enough to surrender." This is done through surrender leaflets which in some instances look exactly like his paper money and can be easily hidden on his person. On other occasions an actual surrender route is broadcast in every detail.

One other example I believe will amuse you. In Korea, we had a huge loudspeaker mounted on a C–47 plane. This is known as the Voice of the United Nations. This Voice plane was on a mission accompanied by two fighter planes. Along a Korean road, the plane

crew spotted an enemy truck hauling supplies. The loudspeaker boomed a warning to the truck crew to turn around and head south immediately or it would be subjected to attack by the two fighters. The truck driver apparently got the idea because he followed instructions and headed for the U. N. lines. Simultaneously, the plane crew was amazed to see two more trucks and some 300 communist troops move on to the highway from their camouflaged positions and join the procession. The Voice plane herded this hopeless bunch South until they made contact with and surrendered to a U. N. patrol group. This story is an excellent illustration of combining propaganda technics with persuasive forces into a very good combat team. In this example, not one shot was fired.

In summary, we must conclude that psychological warfare can and does capitalize on the enemy's weaknesses and vulnerabilities. Primary and secondary drives, when they are unfulfilled, can cause anxieties and create severe stress, not only for an individual but for the group as well. Mass communications are accomplished through various propaganda media. However, in order to reach our audience and have them understand us, we must know a great deal more than we do at present about their likes and dislikes, habits and customs, fears and superstitions, etc. In short, we must know our audience. We have been somewhat slow in starting but it is to be hoped that Americans will learn a great deal more about our potential friends and enemies internationally.

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