on the whole would seem to lend support to the views expressed above (Street and Cowgill, 1939; Zimmerman, Cowgill, and Fox, 1937; Page, 1937; Wintrobe, Mitchell, and Kolb, 1938; Phillips and Engel, 1939).

There is no certainty concerning the pathological changes in the viscera in man in nicotinic acid and riboflavin deficiencies. It is just worth remembering, however, that degenerative changes occur in the heart muscle in pellagra, that the liver always shows fatty changes, most marked perhaps in infantile pellagra, while in the dog "yellow liver" is characteristic of ariboflavinosis. Scott mentions myocardial changes "with dilatation and congestion of the cardiac capillaries," and an angioma-like condition in the heart.

There is, so far as I know, no account of the post-mortem findings in human riboflavin deficiency. No case of "aribo-flavinosis" has come to necropsy in America. None of the cases described by Fitzgerald Moore and by Landon and Pallister found its way to the pathologist. I have therefore turned to the detailed pathological records by Scott upon two cases of the Jamaican disease which he called "central neuritis" but which I have ventured to suggest, in the light of present-day knowledge, may have been acute hyporiboflavinosis. I wondered whether one would find a pathological picture in the central nervous system with irreversible tissue changes, such as might be expected to follow the early reversible functional disorder that I have supposed to occur. It is not possible to deal with these here in detail, but I believe Scott's findings support my thesis.

Scott noted the many points of resemblance between his own findings and those of Singer and Pollock (1913) in pellagra, who in turn had stated that the histopathological picture in pellagra was identical with that described by Adolf Meyer (1901) as "central neuritis." This condition, later referred to by Pearson (1920), I have little hesitation in suggesting is the later stage of the functional disorder I have described. It starts, I believe, in the neurophyl as the result of the capillary dysgergia, and spreads to the cell, to be followed by changes in the axone.

The changes found in the pseudo-encephalitis of Wernicke associated with vitamin B₁ deficiency, consisting of capillary dilatation in certain areas of the nervous system—viz., the paraventricular grey matter of the third ventricle, the mammillary bodies, the peri-aqueductal region, the corpora quadrigemina, and the floor of the fourth ventricle—make an interesting comparison.

If, as I have suggested, riboflavin deficiency interferes with the normal functioning of the capillary, with the production of a tissue anoxia, it would seem of interest to compare the nervous symptoms so produced with those referable to the nervous system in chronic carbon monoxide poisoning.

C. K. Drinker in his monograph upon the subject states that headache occurs in 74%, dizziness in 50%, burning of the eyes in 32%, gastro-intestinal disturbances in 24%, drowsiness in 28%, cardiac disturbances in 18%, insomnia in 20%, faintness in 12%, neurological and mental symptoms in 17%. Among the last-named are giddiness, nervousness, emotionalism, tremors, muscular weakness, increased reflexes, neuromuscular pain, sensations of numbness and chilliness, paraesthesiae, ataxia, muscular incoordination, disorders of vision and hearing, neurotic and psychotic manifestations.

The general resemblance of these symptoms to those I have described in the syndrome here dealt with is, I think, worthy of note, especially when it is remembered that carbon monoxide and cyanide are believed to operate by inactivating cytochrome oxidase and thereby inhibiting oxygen consumption by preventing electron transfer—cyanide by uniting with the iron when in the "ferric" form, carbon monoxide when in the ferrous form. Of cyanide I shall not speak, but I might mention here that Quastel (1943) has recently analysed the evidence concerning the inhibition of oxygen uptake by narcotics, and concludes that flavoprotein is the sensitive factor.

Summary

An attempt has been made to disengage from the clinical affection we call pellagra a group of symptoms which may also be met with

as a more or less complete syndrome apart from those symptoms generally recognized as due to a nicotinic acid deficiency.

This syndrome includes a good deal more than that to which American authors have given the name "ariboflavinosis." Any differences are, however, I think, a question of the comparative intensity and duration of the underlying pathogenic process.

I have considered the whole syndrome, for the sake of convenience, as due to riboflavin deficiency—a hypo-riboflavinosis I should prefer to call it rather than an a-riboflavinosis—but some uncertainty must still exist as to whether any other factor in the B₂ complex plays a part.

All the symptoms of the syndrome respond to treatment with yeast. It is suggested, in the absence of any knowledge on the subject, that we are warranted in making the assumption that the cells forming the capillary endothelium require all those elements needed by other cells in the body for their normal metabolism—sugar, oxygen, etc., including riboflavin.

It is further suggested that the first tissue to suffer the effects of riboflavin deficiency is the endothelium of the capillary system; that the initial result is a reversible functional disturbance of the capillaries—a "capillary dysgergia"—which at the present time cannot be more accurately defined, but which is manifested by dilatation of these vessels and impaired flow; that in turn there is an interference with the normal cellular metabolism and in consequence a derangement of tissue function by disturbance in the *milieu intérieur*; and that the derangement of tissue function is relatively greatest in those tissues which possess the highest degree of capillarity and whose metabolism is greatest.

So long as the intensity of the functional disorder be not too great and so long as it do not persist too much, complete recovery may take place, otherwise irreversible processes occur which lead to pathological changes.

The hypothesis put forward would appear to offer an explanation of the incidence of symptoms and distribution of signs in riboflavin deficiency.

The interference with tissue-cell metabolism is probably of the nature of an anoxia in its wide sense.

It is suggested that disorders of capillary function—"dysgergia"—quite apart from affections of the rest of the vascular system, may play a much more important part than has commonly been supposed in the pathogenesis of many conditions, including pellagra due to nicotinic acid deficiency.

At the risk of appearing mono-ideistic, I cannot help feeling there is perhaps a wide field awaiting investigation along such lines—a field embracing such widely separated conditions as fibrositic rheumatism, some psychoses, and neuropathies.

POST-OPERATIONAL STRAIN IN THE NAVY

BY

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The concept of an operational strain syndrome is open to criticism on a variety of grounds. There is, for example, little evidence that psychiatric breakdowns associated with operational stress differ symptomatically from those that are not. Moreover, not all reactions supposedly associated with operational stress are due to it, and in wartime there is a very real danger of over-emphasizing the dramatic, such as exposure to enemy action, when less dramatic events, such as the regimentation and frustration of Service life, separation from home, and domestic difficulties, may really possess more significance. Again, the conception of an operational strain syndrome runs the grave risk of creating an honourable as opposed to a dishonourable or at least less honourable category.

There is, however, yet another objection, to which curiously little attention seems to have been paid—namely, that the concept is descriptively misleading in that most men break down after, rather than during, a period of stress; and it is with the phenomenon of post-operational strain that this paper is mainly concerned.

Discrepancy in Sickness Rate Afloat and Ashore

There are a number of observations which are not agreeable to the view that psychiatric casualties attributable to operational stress occur during operational stress. Thus, starting with the psychiatric problems as seen afloat, naval medical officers serving in ships have not hesitated to point out to naval psychiatrists serving ashore that, although at sea evidence of fear may exist in plenty, psychiatric cases do not. On the other hand, naval medical officers serving in naval establishments ashore, such as drafting depots, are keenly aware of the size and importance of the psychiatric problem in naval medicine, and this opinion is fortified by service in a naval hospital. That there is in fact a striking difference in the incidence of psychiatric disorders ashore and afloat is amply confirmed by calculations kindly made by Surg. Cmdr. J. A. Fraser Roberts, R.N.V.R., Consultant in Medical Statistics to the Navy, although for Service reasons it is not possible to publish the relevant figures at the present time. They can be up to ten times as numerous.

This discrepancy cannot be accounted for by the accumulation and concentration of the neurotic in naval depots ashore (e.g., in one naval depot 90% of psychiatric out-patients are passed fit for service at sea). Nor is the answer to be found in the ingenuously cynical view that men reporting sick ashore with psychiatric symptoms necessarily do so with any conscious or unconscious intention to evade their draft or their duty. Again, to see many of these men should convince anybody that they are not faking their symptoms.

Development of Post-operational Strain

It is submitted that *reduction* of "tempo" on coming ashore from sea is a potent factor not sufficiently recognized as a cause of symptom development. Men seem to develop a need for the stimulation to which they are accustomed, even if it is unpleasant. Alteration or reduction in the accustomed stimulation is a frequent cause of men reporting sick. It seems reasonable to regard the process as analogous, in slow motion, to the normal experience of feeling worse after danger than during it: the reaction after any excitement is often more disturbing than the excitement itself, especially if opportunities for a satisfactory outlet or distraction are lacking.

The state of physiological anxiety or tension is a condition of heightened responsiveness and preparedness, associated with well-known somatic accompaniments. At sea this increased responsiveness and readiness is not merely acquired passively by "conditioning," but is actively taught and fostered, both individually and collectively; for the safety of the group may depend on the degree of its development. Far from being pathological, it acquires the quality of a virtue which all should share, and is both necessary and completely appropriate. Some permanent degree of tension is thus established and maintained at sea as a biological necessity in order to cope with the emergencies that may at any moment arise; but after an initial relatively short-lived period of adaptation it obtrudes into consciousness only as the result of a special increase or decrement. A partial analogy may be drawn to the initial awareness of the noise of the dynamos on going on board, which then fail to be noticed until their cessation may once more call attention to their previous presence.

When a man goes ashore the increased tension that he has acquired at sea does not disappear immediately; the time required for it to do so varies considerably and is seldom less than a few weeks, although in some it may continue for months and even occasionally for years. During this individually variable period the increase of tension, which at sea was appropriate and necessary, is now incongruous. If a man starts violently at a sudden or loud noise he becomes aware of this incongruity, for sudden noises possess a much less ominous significance than they did. Further, he is aware of the discrepancy between his behaviour and that of his mess-mates, and he may become the object of their gibes. From the subjective standpoint, the increased tension that he has acquired is unpleasing and uncomfortable because it is inappropriate to the reduced tempo of his life; and objectively he shows the clinical signs of an anxiety state. The extent to which he will interpret his condition as evidence

of an illness will depend upon his intelligence and personality and many other factors, and strong reinforcements may exist or develop to regard it as an illness, owing to unrecognized motives of an unworthy kind.

To recapitulate: Men at sea develop a condition of tension, resulting in increased responsiveness and readiness that are physiological and appropriate; but on coming ashore this tension state may become pathological, because it is inappropriate or unnecessarily intense having regard to the altered and reduced tempo of the life. The greater the lag that is shown in adjusting to the tempo that is suitable to the new environment, the more does the state that was previously within normal limits and physiological stand out as being abnormal and pathological. The basic reaction should be regarded as a psycho-biological occurrence, with a good deal of emphasis on the biological component, although more purely psychological determinants (of an impure or even unworthy kind, perhaps) may, and often do, come in secondarily.

Confirmation is readily forthcoming that the sequence of events described above is the correct one for many cases. Thus, when seeking for evidence of an objective kind about a patient's previous condition, it is not uncommon to hear surprise expressed by a shipmate that he should have fallen sick. There may be excellent testimony that the man was apparently normal and aroused no suspicion of disability on board, and equally good testimony of inefficiency and altered behaviour ashore. Again, men with first-class personalities not infrequently develop the symptoms of a severe anxiety state after admission to hospital for treatment for some incidental physical ailment. A careful history will also often disclose that the onset of anxiety symptoms coincided with in-from-sea leave. In this connexion it is noteworthy that the story of onset dating from a previous experience of enemy action is frequently quite inconsistent with the facts and is a retrospective falsification.

It may also be observed that certain men of a good type with persistent anxiety symptoms will ask to return to sea despite clinical signs that might appear prohibitive, and this endeavour to make the environment fit the state and to banish the sense of incongruity is often successful. The uneasiness of some combatant officers away from the front line and the desire of certain fighter pilots to spend their leave either spotting in the Channel or at sea in a destroyer appear to be of somewhat similar origin, and it detracts nothing from the courage of these gallant men to interpret their behaviour as being the expression of a biological need to sustain tension. The difficulties and breakdowns that occur in civilian life on retirement are perhaps examples of the same principle. Finally, the modicum of success which followed "conditioning" by providing psychiatric patients with some of the experiences of war (e.g., artificially produced sounds of dive bombers) may have been due to the manufacture of an artificial environment that was appropriate to the tension which these men experienced. It was soon recognized, however, that a return to duty was equally effective and more economical of manpower.

It seems plausible to postulate that reactive depression is often reactive to reactive anxiety. Reactive depressions pre-eminently occur in men of good personality after long periods of stress, and the affect is appropriate to a sense of having failed to run the course and of having succumbed to an illness bearing a stigma of shame. A belief of having been found wanting in "will power," a sense of impaired efficiency, lack of confidence, and a fear not so much of further enemy action as of experiencing again the tension that it produced, all contribute to the production of these states. The implicit teaching that underlies morale is such that few men fail to experience some sense of insult and guilt when pathological anxiety is experienced, and this may be why a measure of depression is so often mingled with anxiety states. This sense of guilt is less common in civilian life, and depressive accompaniments of anxiety states are also less frequent.

Prediction and Selection

The fact that those who finally succumb to stress form only a small minority would seem to constitute a weighty argu-

ment in favour of the rejection or early elimination of the vulnerable. There is no doubt whatever that those who do succumb show a high concentration of certain ominous points, such as a poor work record, compared with those who do not. According to certain investigations that have been made in the Navy, the proportion showing these ominous points amounted (with the technique used) to roughly 60% of psychiatric in-patients and 50% of psychiatric out-patients, as compared with only 15% among "normal" sailor controls. Yet naval psychiatrists keep 9 out of 10 of the men referred to them as out-patients at duty and send back to duty 2 out of 3 of their in-patients. Moreover, the relapse rate as judged by readmission to hospital does not seem unduly high. Thus, according to an investigation made last year, psychiatric cases were being returned to duty from hospital at about 5 times the rate that relapsed cases were being readmitted, and about half of these relapsed cases had remained outside hospital for more than 6 months. Finally, of those that are invalided for psychiatric disorders, two-thirds have survived in the Navy for over a year.

The significant thing about these findings seems to be that although a high proportion of those who break down not only give a past history which suggests their predictability as bad psychiatric bets, but also show that they were bad bets by having broken down, yet it is still possible to send the majority of them back to duty and to retain a relapse rate that seems reasonably small. This is, of course, not to doubt the desirability of selection procedures. The standard adopted for rejection or early elimination must naturally depend upon the available man-power; but a number do remain who should be rejected, no matter what the man-power position may be. It seems doubtful, however, whether in the Navy the proportion that should certainly have been rejected or eliminated amounted at most to more than 1 to 2%. This may seem a small number, yet the trouble these men cause is out of all proportion to their actual numbers, when considered in terms of hospital treatment, inefficiency, letting down others, and impairing morale. A great stand-by in the Navy has doubtless been the self-selection consequent upon men expressing a naval preference at the time of their call-up, for reluctant dragons do not make the best fighting material.

It seems reasonable to conclude that many "bad psychiatric bets" give very fair service before they break down and are also capable of giving further fair service after they have done so. These facts should counteract any undue pessimism that may exist as to the capacity of the neurotic to stand up to the stress of war. There can be little doubt that an additional factor inducing unwarranted pessimism is the abnormal or at least different situation that occurs in shore establishments, and particularly in hospital, compared with life afloat. The picture seen in hospital is especially misleading, and makes a correct assessment extremely difficult.

Treatment

Apart from the real, though limited, place that exists for pre-selection, probably the most that would be desirable prophylactically would be a warning to survivors and others going on leave from sea that anxiety would be experienced temporarily and should not be misinterpreted as illness. The vast majority of men, however, deal with their experiences quite adequately without outside help, and certainly any prophylactic "pep talks" of the above kind should be given by executive officers and not by medical men.

Once a pathological tension state has become established it must be dealt with either by reducing the tension or by raising the tempo. The latter can be accomplished by an early draft to sea before habituation, including doubts about future capacity, has occurred. Failure may result if the ship lies in harbour for too long a period.

Reduction of tension can be produced by sedation, and the barbiturates are eminently suitable for this purpose. Tremulous agitated patients should be put to bed, and 48 hours' sedation will make discharge to hospital unnecessary in the overwhelming majority. The average case seen as an out-patient in a naval depot shows a steady decrement of tension at a rate which is extraordinarily consistent. The administration of pheno-barbitone in three doses of half a grain daily for one week,

followed by the same dose twice daily for two weeks, usually brings about clinical recovery. With the other factors in treatment and management this paper is not primarily concerned. It may be worth noting that what medical men now effect with barbiturates humanity has accomplished for hundreds of years with the aid of alcohol. It is a sobering reflection that humanity was abreacting its pent-up emotions in parties with the aid of alcohol long before narco-analysis and group therapy were introduced for the same purpose.

"All theories are crutches, not sceptres or wizards' wands," and it is not suggested that the concept of post-operational strain that has been outlined is the whole story, but merely that it is perhaps a somewhat neglected part of it. Numerous other factors obviously help to make stress more tolerable and hence affect the incidence of neurosis, such as discipline, leave, mail, and the rapid solution of what are felt to be inequalities of treatment—to mention only a few. The Navy is, moreover, singularly fortunate in having a tangible object which is also a home around which group loyalty can centre—namely, the ship. An airman or member of the Tank Corps cannot feel about their contraptions in quite the same vividly personal way. Yet the life of a closed community, as in a ship, has its special dangers. Interesting browned-off (what the sailors call "chocker") paranoid reactions, rather similar to those seen among prisoners, may occur when the commission is too long or the ship is not a happy one. Dr. Johnson's dictum may be recalled: "No man will be a sailor who has contrivance enough to get himself into a jail; for being in a ship is being in a jail with the chance of being drowned." The rest of the quotation—"a man in jail has more room, better food and, commonly, better company"—is perhaps less acceptable.

There can also be little doubt that the group spirit and loyalty that exist on board ships are most potent factors in sustaining morale and that, conversely, the lack of this same group spirit and loyalty when a man leaves his ship and goes to a drafting depot is a most important factor in precipitating the breakdowns that occur there with so much greater frequency.

Summary

An endeavour has been made to show that psychiatric casualties attributable to operational stress occur most commonly after rather than during the stress.

Thus it has been pointed out that the psychiatric sickness rate is very much greater ashore than afloat.

The thesis is submitted that this is often due to a persistence of the physiological increase in tension developed at sea and rendered obtrusively uncomfortable by the suddenly reduced tempo on coming ashore; the reaction being analogous, in slow motion, to the normal experience of feeling worse after danger than during it.

While unworthy motives play an important part in perpetuation, their role in producing the state can easily be over-estimated.

While pre-selection has a definite value, the practical importance of selection procedures is much modified by the fact that a substantial majority of psychiatric casualties can be returned to full duty.

Symptomatic relief often follows reduction of tension by sedation and increasing the "tempo" by early draft to sea before habituation has occurred.

SCHICK REACTIONS IN RECENTLY CONFINED WOMEN AND THEIR INFANTS

BY

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It is now generally recognized that the resistance of newly born infants to diphtheria depends chiefly upon the passage of maternal antitoxin through the placenta during the latter part of gestation. So readily can this antibody enter the foetal circulation that at birth its concentrations in the serums of mother and infant are almost equal. From early childhood onwards any insufficiency in the concentration of circulating antitoxin to ensure immunity to clinical diphtheria may be readily demonstrated by a positive reaction in the Schick test.