

On the basis of the theory or hypothesis here advanced a new classification of bacterial infections suggests itself. We may make two great classes:

A. The productive infectious diseases, characterized by cellular proliferation.

B. The non-productive infectious diseases, not so characterized.

To the first class belong tuberculosis, typhoid fever, and pneumonia.

In pneumonia the cells of the exudate may not be all newly formed. They may have been called forth from the cell depots in the blood and elsewhere. They are, however, new in their pulmonary site and in the Abderhalden sense are out of place.

To the non-productive bacterial diseases belong diphtheria and tetanus.

A closer study of this classification reveals an extremely interesting point, namely, that the infections classed under A, that is, the productive infectious diseases, are all due to bacterial endotoxins, or, in the sense of Vaughan, to split proteins, while those in Class B, the non-productive infectious diseases, are due to the soluble toxins and not to poisons contained in the bacterial bodies. Whether this is a general biologic law, I do not know.

In conclusion, I beg to express the hope that men devoting themselves to research, if they find anything suggestive in the hypotheses advanced, will test them by the experimental method.

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SOME OBSERVATIONS ON THE NERVOUS AND MENTAL SYMPTOMS OF HEART DISEASE

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In all our studies of disease processes it is imperative that we remember that we are always dealing with an organism and not with a mechanism, that this organism is a morphologic and physiologic unit, and that, therefore, there can be no change of a pathologic nature in one part which does not produce deviations from the normal throughout the whole. Particularly must it be borne in mind that pathologic processes, before they are discoverable by any physical sign, may, and generally do, produce marked changes in the nervous system of the patient. It is quite probable that the first effect of a nascent disease is the production of a nervous reaction which tends to inhibit the further development of the process. Indeed, one of the chief functions of the nervous system must be the overcoming of pathologic tendencies here and there and the maintenance of that fundamental equilibrium which constitutes health, in the face of the mechanical, chemical and biologic agencies which are constantly tending to disturb the perfect balance of physiologic forces. While, as yet, we are not able to understand them, we are compelled to believe that there are many nervous reactions, preserved and developed by natural selection, which are set in motion by those stimuli, which tend to produce a disease process, that these nervous reactions are of a conservative nature, and that without them the organism must quickly perish. A better knowledge of these nervous reactions will go far toward clarifying our understanding of certain puzzling

phenomena of immunity and may throw some light on the obscure problem as to how mental suggestion can influence a morbid physical condition in a favorable manner.

The classic work of Head¹ on the "Mental Changes Accompanying Visceral Disease" has not, I believe, received sufficient attention on the part of general practitioners and students of medicine.

Some time since, as a result of reading Head's article, and following certain suggestions of Dr. Stewart Paton, which were most valuable, I began a study of the nervous and mental symptoms of cardiac disease, and, while this work was not carried as far as I wished, I desire to present, in a preliminary way, some of my tentative conclusions. Head found that there were two symptoms referable to the nervous system which occurred quite constantly in cases of disturbed or broken cardiac compensation. First, a reflected pain along the distribution of the fifth nerve, and second, a mental and emotional abnormality, aside from any worry about the disease, characterized by depression, anxiety and fear, often with a sense of impending ill, and, further, that these emotional states occurred either with or without distinct delusions and hallucinations. It was my purpose to determine, if possible, whether these nervous symptoms could be made of practical diagnostic value, and whether the development of these emotional states in cases of cardiac irregularity could be made to throw any further light on certain disputed questions in connection with our knowledge of the emotion-producing mechanism.

We know that the mental state following a perception which is to cause an emotion, is followed by marked changes in the whole circulatory system, especially in the rhythm of the heart, the heart frequently being checked in its action, or momentarily paralyzed, this being followed by a rapidity and irregularity of action of varying degrees. The Lange-James theory of emotion, which has had many opponents, holds, as stated briefly by Ribot, that, in any emotional state, there is, "first, an intellectual state, then organic and motor disturbances, and then the consciousness of these disturbances, which is the emotion," or, as James says, "The bodily changes follow directly the perception of the exciting fact and our feeling of the same changes, as they occur, is the emotion." In view of this much discussed psychologic theory, it becomes most important to determine whether cardiac motor disturbances, caused in a purely mechanical way, as by a leaking heart valve, may act as a stimulus from below, as a certain intellectual state may act from above in producing an emotional state, and whether this emotional state, so caused, may bring about an intellectual state to explain it. If this is possible, then we have a complete reversal of the emotion-producing mechanism and very strong corroborative evidence in favor of the Lange-James theory. The observations of Head, which, as far as I went, I have been able to confirm, are of great value, for the reason that they give us new evidence on this point. As briefly as possible I desire to state some of the tentative conclusions which I have drawn from a study of Head's cases, as reported, and from observations on cases of my own.

AUTHOR'S CONCLUSIONS.

1. A defective heart valve, producing cardiac muscle strain and irregularity, is sufficient to create a dis-

1. Head: *Brain*, 1901, xxiv.

tinct emotional state of depression, anxiety and fear, independent, as Head says, of any worry about the disease. This emotional state, arising from a mechanical difficulty, resembles closely that arising from a psychic state, and the emotional state so caused may either remain vague and unexplained, or there may be induced delusions and hallucinations to explain it. One of my patients (Case 3) with mitral regurgitation suffered during the first stages of broken compensation from extreme depression, fear and irritability, but later became suspicious and obstinate and finally developed delusions of persecution and hallucinations. His delusions first appeared in the hypnagogic state, fading as he became fully aroused and attentive. Later, he came to hold them more tenaciously, and they finally became fixed. Further observations will prove, I believe, that persistent irregularity of the heart's action does, in almost every case, produce a mental and emotional state deviating in some important respects from the normal, which abnormality may be occasional, slight and transitory or so marked and permanent as to constitute a distinct psychosis.

2. The first mental symptoms of cardiac disease occur when the inhibitions of the higher centers are relaxing in the hypnagogic or in the sleeping state, and there is much to substantiate the old view that night terrors and nightmares are often caused by an irregularity of the heart's action. As the physical disturbance becomes more massive, either by increased intensity or chronicity, the mental abnormality is carried over into the partially or fully awakened state. One patient with aortic regurgitation and arteriosclerosis when trying to sleep would become greatly troubled with mild delusions of self-persecution and with self-accusation. This distress was frequently keen and would persist after he was fully awake. Often, to free himself from the annoying delusion, he would get up and move about, when the idea would become weaker, only to grow stronger again when he returned to bed. All heart patients should be questioned closely about their sleeping and dreaming, for it is quite possible that periods of failing compensation might be forestalled, in certain instances, if rest were instituted at the first approach of these marked nervous phenomena. There can be no doubt of the fact that any alteration of any of the normal physiologic rhythms, especially of the heart rhythm, exerts a profound influence on the mental state, especially during sleep. This being the case, it is evident that any system of psychic or dream analysis, as advocated by the Freudians, should take into consideration the condition of the circulatory apparatus and its functions.

3. There are cases of heart disorder which may long remain undiscovered by the attending physician because of his failure to properly study the nervous symptoms of his patients. Those disorders which are characterized by brief periods, occurring at long and irregular intervals, during which the normal action of the heart is more or less seriously disturbed, are very easily overlooked by the physician who places too much confidence in his stethoscope, which will reveal nothing in the interval between the attacks. A patient giving a history of occasional very distressing dreams, from which he awakes with a sense of oppression, should, if possible, be so placed as to be under observation during the night, when it may be found that the disturbed rest has been due to an attack of extreme bradycardia. I have seen one such instance, and here the occasional nocturnal attack of bradycardia was the only cardiac

symptom for some time, although attacks during the day developed at a later period. Such cases show the importance of observations of the heart action during sleep, especially where there are unusual nervous phenomena. They also raise the very interesting question whether there may not be painful experiences in the somnolent state of a subjective nature induced by cardiac irregularity, caused by coronary and myocarditic changes, which for some time precede and may perhaps give warning of the symptoms of angina pectoris which are to develop later.

From what we know of the extreme sensitivity and quick response of the brain centers in the somnolent state to any alterations in the physiologic rhythms, we should expect to find such premonitory symptoms during sleep at the very beginning of the process of cardiac degeneration, and the question is worth further study.

4. The symptoms referable to the nervous system which we find in certain forms of heart disease are constant enough to be of practical value to the physician. The neuralgia of the fifth nerve and the scalp tenderness over the area of its distribution, as described by Head, is of such frequent occurrence that it is of some diagnostic and prognostic value in heart cases. In any case of heart strain, whether due to valvular lesion or prolonged functional overactivity, as in hyperthyroidism, this symptom may develop, and, in chronic valvular cases, the onset of neuralgia may precede a period of failing compensation so regularly that the patient himself learns that the pain is a signal that he must rest. It is, I believe, quite probable that a neuralgia of the fifth nerve is, far more often than has been generally supposed, a reflex visceral pain. In every case a thorough search should be made for a visceral cause, especially by a careful examination of the heart. In chronic heart cases the onset of neuralgic pains should always be considered an indication of the beginning of a period of disturbed compensation. It is possible that this pain may be the first and only symptom of seriously increasing heart strain in certain exceptional instances.

5. It is important to remember that many cases of fifth nerve neuralgia, and also many cases of neurasthenia with anxiety, fear and depression, especially in patients 40 or 50 years of age, may possibly be due to that condition of nerve strain which may be caused by a nascent cardiac disorder not sufficiently developed to be discoverable by physical signs. The long known favorable results of physical rest in many of such cases of functional nervous disorders might thus be explained if the theory is a sound one. Very much has been written about the far-reaching effect of ciliary muscle strain, and the profound influence of all forms of ocular trouble on the nervous system, and now we are just beginning to realize how necessary is the study of the influence of cardiac center, nerve and muscle strain, and compensation, perfect and imperfect, in the production of nervous symptoms.

Patrick² agrees with Dana,³ that trifacial neuralgia is most apt to occur between the ages of 40 and 60, or in the "degenerative period of life," observations which are of great importance in this connection.

It is worth while to consider whether it is possible that the nervous and psychic symptoms described by

2. Patrick, H. T.: The Symptomatology of Trifacial Neuralgia, *THE JOURNAL A. M. A.*, May 16, 1914, p. 1519.

3. Dana, C. L.: Natural History of Tic Douloureux, with Remarks on Treatment, *THE JOURNAL A. M. A.*, May 5, 1900, p. 1100.

Head, constitute a complex conservative nervous reaction, preserved by natural selection for the protection of the organism, since pain and depression, by tending to limit activity, would in these cases exert a restorative influence. It may be that further careful study of the nervous symptoms of diseased states will furnish other examples of now unknown nerve reflexes which have for their purpose that same limitation of motor activity which is so often of such great therapeutic value.

Every individual is a network of more or less differentiated but intimately associated functions, and a disorder in any part or function, in its incipency, and in its later irradiations, constitutes a natural experiment by which we can increase our knowledge of every part and function. What has already been learned by many able investigators of the interrelation of physical and mental states, has made possible modern psychology and psychiatry, but much more must be accomplished. Every physician should carefully investigate, as far as possible, the nervous and mental symptoms of his patients and make reports on interesting cases, and every general hospital should have a psychologic laboratory for the investigation of suitable cases. This preliminary and, perhaps, premature paper is offered in the hope of securing the interest and cooperation of others in this important line of work.

The following cases illustrate some of the above points:

ILLUSTRATIVE CASES

CASE 1.—H., woman aged 52, married. Mitral regurgitation. March, 1904.

Twenty years before the patient had a severe attack of rheumatic fever, lasting all of one winter. Later, she had two attacks of pneumonia. Ten years ago she had a severe illness marked by fainting spells and dyspnea. In the winter of 1903-04 she went to a sanatorium with her husband, who was an invalid. She complained to the physician in charge that she suffered with severe facial neuralgia, but was told that it was only imaginary, and was advised to take plenty of exercise out of doors. She began walking several miles each day. The neuralgia became very severe after she began her regular walks in December. Early in March compensation was completely broken. Extreme dyspnea, bloody expectoration, edema of feet, soft blowing systolic murmur, with pulse 120, and, at times, very weak. All winter the neuralgia had been severe, worse at times, and when she was walking out of doors. The pain was over left face and forehead, over the back of the head, on the same side, especially behind the ear. It was very severe when treatment began in March. She was put to bed, given digitalis and purged and the neuralgia and heart action improved rapidly until the end of the third week, when the neuralgia disappeared.

I had this patient more or less under my observation for ten years after this attack, and while an invalid, with increasing disability, frequent periods of rest and extreme care prolonged her life. During this period neuralgic pains occurred at intervals and were always considered indications that a long rest in bed was necessary. This patient also had hallucinations, as described by Head, when the neuralgia was at its height. A little man in dark clothes would appear at the foot of her bed and look at her. She thought he was the pain and would say "Go away."

CASE 2.—City Hospital (now Mercy). H., man aged 50, engineer, widower. Aortic insufficiency. Arteriosclerosis. Feb. 14, 1905. Dilated venules on face, lips cyanotic, neck vessels pulsate, emphysema, dilated heart, sounds irregular, with diastolic murmur at the base and systolic at the apex; disseminated arteriosclerosis; extreme dyspnea and orthopnea; Corrigan pulse.

Sleeps very lightly and says he knows the hour at any time in the night. Mental state at night as follows: He finds himself very much worried and reproaches himself for some

piece of work he had left undone or had not done properly years before. He has a strong impulse to go and finish the work in question. The task is always a specific one in his past life, and there is an actual but faint delusion. He says, "I say to myself, that was long ago, that work. I have nothing to do with it now, and I get myself out of it [the delusion]." At these times he is probably partially asleep but is not sure. The idea has recurred over and over again at night. He says, "It is an idea, not a dream," and he is much distressed by it. To rid himself of it he would often get up and light his pipe, but even then sometimes it would persist and get stronger when he would return to bed. Pulse is weak, intermittent and every second or third systole is incomplete and not felt in the radial artery.

CASE 3.—City Hospital (now Mercy). Feb. 28, 1905.

J. G., man aged 42. Mitral regurgitation, failure of compensation, psychosis. Nine years previously the patient had rheumatism; never the same since. Alcoholic; heart dilated; irregular; systolic and presystolic murmur; edema of feet; enlarged liver, 2 inches below costal margin; ascites.

New Year's the patient had been drinking, when he was seized with dyspnea and pain over the heart; feared death. Now is very irritable, excitable and obstinate. Disobeyed directions because he had impulse to disobey. In this state before he came in. He was in a condition of mild resistance. Contradicts statements. March 10, sat up all night. Says, "Dropsy and pain slowly come up to level of lower chest at 10 a. m. and then slowly go back." Was irritable, anxious, emotional. Three days later became very restless and reticent, refusing to talk. Five days later he became suspicious and resentful, taking a dislike to one near him. He stares about in a nervous manner. He asked if he had been home since he had been in the hospital. Thought he had been moving at home, and asked when he would be paid a certain imaginary sum of money. About ten days later the idea that he was moving his furniture the night before seemed firmly fixed, except when he was fully aroused and attentive; but it became more difficult to make him dismiss his ideas and delusions. In the night he left his own bed for another and said he did not know he was doing it. His restlessness was due to a growing state of fear and anxiety and he talked vaguely about men and wagons coming to move him away. His heart symptoms improved but slowly and about a month after admission he became very troublesome, having developed well defined delusions that men were after him to kill him. He saw four men hanging over his bed. Tried to escape by jumping out of window. Begged to be saved, and insists that the delusions are real, pointing to his eyes and ears, saying that he knows what he sees and hears. He became more troublesome and the delusions of persecution more fixed until it became necessary to move him to the annex and put him under restraint. The delusions were very strong, and he seemed to be terrified, talking very confidentially and in pantomime. He was finally removed to Bayview Asylum, where, unfortunately, I lost sight of him.

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An Anastigmatic Spectacle Lens.—Spectacle lenses hitherto employed have had the disadvantage of blurring the image at the edge of the lens, caused by the astigmatism of oblique pencils of light. Much improvement in this respect over the old flat lenses, with an angle of distinct vision of 16 degrees, was secured in the meniscus and Toric lenses, which latter gives an angle of distinct vision up to 52 degrees. A further improvement in the angle of distinct vision up to 60 degrees is said to have been developed by von Rohr in the laboratory of Zeiss of Jena, who succeeded in correcting for all foci the astigmatism noticeable toward the margin of ordinary lenses by computing the power of each lens and its correction separately. Lenses have heretofore been made with the same base curve on one side for all focal distances, the grinding to fit any special error of refraction being done on the other side. In the improved lens both sides are ground after the computation above referred to, with a resulting angle of distinct vision practically equal to that of the normal eye without moving the head.