

**THE CAUSATION OF
SLEEP. A
PHYSIOLOGICAL ESSAY**

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The causation of sleep. A physiological Essay by James Cappie

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JAMES CAPPIE

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CAUSATION OF SLEEP.

A Physiological Essay.

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P R E F A C E.

THE following essay is divided into two parts. In the first I submit the views I entertain as to the physiological causes of sleep, without waiting to discuss in detail all those points on which a difference of opinion is likely to be held. This plan enables me to state my argument not only concisely, but more clearly than if I were to digress at every step to controvert the opinions of others when hostile to my own. To the second part are reserved what remarks I have to make on some points which have already been fruitful of controversy. I also take the opportunity here to make one or two objections to current views of the physiology of sleep, and especially to those which have been so ably advocated by Mr Durham.

diately conscious of those organic conditions which favour or impede its activity, and limit the scope of its operations. But sleep illustrates the tyranny of physical conditions. It is a state, therefore, whose existence is almost ignored by the metaphysician. The feeling of drowsiness may be painfully or pleasantly experienced, but so soon as sleep has fairly asserted its supremacy, the higher consciousness which recognises existence and succession is suspended. Its characteristic phenomena are to be studied, not by self-introspection, but by external observation. If its causation be the object of inquiry, that is to be determined, as in the case of the simplest phenomenon, by an analysis of the agents and forces concerned in its production, and by ascertaining, as far as may be, their usual steps of combination and sequence.

I at once assume the correctness of certain general views in regard to the physiology of the brain. As during the state of alert wakefulness the mind can be readily directed into whatever channel circumstances may require, and the consciousness may in succession be engrossed by impressions on sensory nerves,

or by efforts of imagination, or reason, or voluntary motion, so, in the same circumstances, the brain is functionally active; each portion of its mass is ready to respond to its appropriate stimulus, and to take on itself its special duty. Then, as during the continuance of sleep the consciousness of external impressions is obscure or altogether lost, and as the power to perform any intelligent mental act is suspended, so, during the same time, the brain ceases to be able to perform its characteristic functions, and this on account of some physical change in its structure or relations.

What this physical change may be—or at least certain of its elements—is the object of our present inquiry. I leave the metaphysics of sleep entirely out of view. Whether, as Sir William Hamilton and others insist, thinking goes on in the soundest sleep,—or whether, as physiologists are inclined to believe, dreaming or thinking even of the most nebulous sort indicates imperfect sleep, will not be discussed. The questions I intend to keep before myself are:—In what respect do the condition and action of the brain or its relations, during the continuance of sleep,

differ from those which are present during wakefulness?—what is the physiological sequence of change from the one state to the other, and on what special change do the more characteristic phenomena of sleep depend?

In entering on such an inquiry we are at once confronted with an extensive series of conditions or factors,—organs, structures, processes, forces,—each taking a part, direct or more remote, in producing the final result. Some of these conditions belong to questions of general physiology, others are strictly special or local. Before the causative sequence of changes can be comprehended or intelligibly expressed, the more important of these must previously have received individual recognition. Of course, I cannot here enter into the whole cyclopædia of subjects involved in the anatomy and physiology of the brain. A selection must be made. I shall have a special position to take up, and in arranging my arguments, or in giving prominence to particular points, I am at liberty to assume the privilege of the special pleader, and to choose such as may appear best fitted to exhibit and support that position. Any other plan would

be unsuitable for an essay like the present. The results or conclusions are to be judged, on the one hand, by their harmony with the greatest amount of recognised fact; and, on the other, by the extent to which they afford a satisfactory explanation of special phenomena.

If our knowledge of physiology were perfect, it might be possible to undertake at once a systematic exposition of the various conditions involved, to specify the laws affecting their successive changes, and, by a series of inferences, to arrive inevitably at the last result we are aiming at—the production of sleep. Our knowledge, however, is on many points too general or too uncertain to allow this natural method of procedure to be carried out. We must content ourselves with a less direct mode of reasoning, and certain steps of the process may, in the first instance, appear rather hypothetical. The following is an outline of the argument I intend presently to pursue.

In the first place, proof can be afforded that if the surface of the brain be subjected to pressure the consciousness is so suspended that some of the more characteristic phenomena of sleep are produced. In the second place, we

may find a (hypothetical) source of pressure in the venous vessels which, large and tortuous, are spread over the whole surface of the brain. These simply require to become more distended with blood in order to act as compressing agents. Then, to show how this possible source of pressure can be brought into play, I shall have to consider some special circumstances in the physiology of the brain. Unless the latter is to afford an exception to a very general rule, it is to be assumed that during functional activity—that is, during the period of wakefulness—its capillary circulation must be most active, and the expansive tendency of the organ as a whole must be at the greatest. The veins, therefore, must have their calibre reduced to a minimum. But in accordance with another general law the nutritive energies must, by-and-bye, begin to flag. As this occurs so must the forces which keep up an active state of the circulation become languid. In other organs this state is accompanied by collapse or contraction. As the skull is rigid, and as its cavity must be constantly full, any collapse of the brain must be accompanied either by an accumulation of