of blood in the brain, and at the same time an increased amount in the extremities. He showed further that there are frequent adjustments in the distribution of the blood, even during sleep. Thus a strong stimulus to the skin or to a sense organ—but not strong enough to awaken the sleeper—caused a contraction of the vessels of the fore­arm, an increase of blood pressure, and a determination of blood towards the brain ; and, on the other hand, on suddenly awakening the sleeper, there was a contraction of the vessels of the brain, a general rise of pressure, and an accelerated flow of blood through the hemispheres of the brain. So sensitive is the whole organism in this respect, even during sleep, that a loudly spoken word, a sound, a touch, the action of light, or any moderate sensory impression modified the rhythm of respiration, determined a contraction of the vessels of the forearm, increased the general pressure of the blood, caused an in­creased flow to the brain, and quickened the frequency of the beats of the heart. These observations show how a physiological explanation can be suggested of the influ­ence of external impressions in modifying the dreams of a sleeper. Further, Mosso found that during very pro­found sleep these oscillations disappear : the pulsatory movements are uniform and are not affected by sensory impressions, and probably this condition exists when there is the absolute unconsciousness of a “ dead ” sleep. By such methods as have been employed by Mosso, three movements of the brain have been observed,—(1) *pulsa­tions*, corresponding to the beats of the heart ; (2) *oscilla­tions,* or longer waves, sometimes coinciding with the heart beats, or more generally consisting of longer festoons, carrying each a number of smaller waves, and believed to correspond generally to the respiratory movements ; and (3) *undulations,* still longer and less marked elevations and depressions, first clearly observed by Mosso, and believed by him to indicate rhythmic contractions of the vessels of the pia mater and of the brain. This view is in keeping with the observations of Donders, Kussmaul, Tenner, and others on changes of calibre observed in the cerebral vessels, and with the experiments of many physio­logists, showing that the vessels of the pia mater, like other vessels, are controlled by the vaso-motor system of nerves (see Physiology, “Nervous System”). It may therefore be considered certain that during sleep there is an anæmia, or partially bloodless condition, of the brain, and that the blood is drawn off to other organs, whilst at the same time this anæmic condition may be modified by changes in the circulation or in the respiratory mechanism caused by posi­tion, by sensory impressions, or by sudden changes in the state of repose of the muscles. The examination of the retina (which may be regarded as a cerebral outwork) by the ophthalmoscope during sleep also shows a compara­tively bloodless condition. Such are the facts; the de­ficiency in the way of a theoretical explanation is that physiologists cannot satisfactorily account for the anæmic condition causing unconsciousness. Sudden haemorrhage from the brain and nerve-centres, or a sudden cessation of the supply of blood to the brain, as occurs in syncope (failure of the heart’s action,—a faint), no doubt causes unconsciousness, but in these circumstances there is a tendency to convulsive spasm. Such spasm is usually absent in sleep, but sudden jerks of the limbs may some­times be observed during the time when there is the con­fusion of ideas preceding the passage into sleep.

During sleep the amount of carbonic acid eliminated is very much reduced, indicating that molecular changes in the tissues do not occur to the same extent as in the wak­ing state. This is also shown by the fact that less heat is produced. Helmholtz states that the amount of heat pro­duced by a man weighing 67 kilogrammes (147∙4 lb) is

about 40 calories per hour during sleep, as against 112 calories per hour while awake. This diminished production of heat may be largely accounted for by the quiet condition of the muscles of locomotion, but it also indicates dimi­nished tissue changes throughout the body. In profound sleep the bodily temperature may fall from ∙6° to 2° Fahr. In consequence of diminished oxidation changes during sleep, it is not improbable that excess of nutrient matter may then be stored up in the form of fat, and that thus the proverb “ He who sleeps dines ” is based on a correct appreciation of the fact that sleep tends to produce plethora or obesity.

Whilst it is easy to state that sleep is caused by fatigue of the nervous system, it is a more difficult matter to ex­plain what the precise changes are that produce the state of unconsciousness. Various hypotheses have been ad­vanced, but it cannot be said that any one is wholly satis­factory. Aware that the fatigue of muscle is associated with the accumulation of sarcolactic acid, Preyer surmised that the activity of nervous matter might be interfered with by the accumulation in the nerve-centres of some such acid, or of its soda salt (lactate of soda), but this view has not been supported by the results of experiment, as the injection into the blood of a dose of lactate of soda has not produced sleep. Pflüger has observed that frogs de­prived for a considerable time of oxygen passed gradually into a state resembling profound sleep, and he has advanced the theory that there is no organ of the body so quickly affected by deprivation of oxygen as the brain. According to Pflüger, the phenomena of life depend on a dissociation of living matter, and in particular the activity of the cere­bral substance connected with psychical states depends on dissociation changes in the grey matter. To excite the dissociation, however, oxygen is necessary. The oxygen unites with certain of the compounds set free by the dis­sociation, forming, amongst other substances, carbonic acid. If such matters as these that unite with oxygen are in sufficient amount to use up all the oxygen, the grey matter of the brain suffers from a deficiency of oxygen (or from its absence), and also from the accumulation of carbonic acid. According to such a theory, cerebral activity depends on cerebral respiration, and sleep is a kind of cerebral asphyxia. Some such condition is not improbable, but it must be stated that the evidence at present in support of it is meagre. Possibly, in attempt­ing to account for the phenomenon of sleep, too much im­portance has been attributed to the changes occurring in the brain, forgetting that not merely brain matter but every tissue of the body becomes exhausted by work, and that sleep may be partly due to phenomena occurring through­out the body and not in the brain alone. Some more comprehensive hypothesis than any yet advanced may be possible when the condition of all the functions during sleep has been more thoroughly investigated.

All the phenomena of sleep point to a diminished ex­citability of the cerebral nerve-centres and of the spinal cord. Contrary to what is often stated, there can be no doubt that reflex action is in partial abeyance and that the spinal cord is in a state of partial inactivity as well as the brain. The only nerve-centres that do not sleep are those absolutely essential to life, such as those connected with the heart, with respiratory movements, and with the dis­tribution of blood by the vaso-motor arrangements ; and Mosso’s experiments indicate that even these have a certain amount of repose in profound sleep.

There is little doubt that all living beings require periods of repose alternating with periods of activity. Many plants close their flowers and bend their petioles at certain times of the day. These phenomena, called “ the sleep of plants,” depend apparently on changes in solar radiation,