

sion in his environment (the identity of a wall paper), and it might be urged that the failure to be impressed by such a condition would correspond to a diminished keenness of sense impression; this might certainly account for the diminution of frequency of its occurrence as life advances; the reverse should rather be the case were it an utter abnormality.

Sir James next proceeds to discuss the dreamy mental states associated with epilepsy, with nitrous oxide inhalation, states of drowning, &c., and in relation to treatment urges the necessity that exists for extended observations on diets of various kinds in epilepsy and allied conditions.

The lecture is full of suggestive thought, and should be read by every alienist physician.

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*The Physiology and Pathology of the Cerebral Circulation, an Experimental Research.* By LEONARD HILL, M.B.  
London: J. and A. Churchill, 1896.

This work contains the substance of the Hunterian Lectures delivered to the Royal College of Surgeons in 1895, and is the embodiment of the work done by Dr. Hill as Research Scholar of the Worshipful Company of Grocers, a work carried on during five years. It is the most complete and thorough investigation of the subject with which it deals that has yet been made, alike in its careful examination of the methods and results of previous workers at the same subject, and in the experimental methods employed by Dr. Hill himself; and it deserves careful consideration on the part of all neurologists and physiologists. Dr. Hill has followed the plan that was employed with such fruitful results, in a different department of neurology, by Duchenne of Boulogne. He has first made his own experimental investigations independently, and only after their completion appealed to the literature of the subject—a method which has the merit of yielding the unbiased results of the individual worker.

The great difficulty, in studying the physics of the cerebral circulation, is due to the necessity of making an opening in the skull, and introducing a disturbing factor in the shape of the pressure of the atmosphere. This difficulty has been apparently successfully overcome by means of an ingenious apparatus introduced into the trephine opening, which, while

completely closing the aperture, enables the intra-cranial pressure to be accurately estimated.

By means of this apparatus Dr. Hill has shown that the brain pulsates (1) through the ebb and flow of the cerebro-spinal fluid (during its diastole the occipito-atlantal and other vertebral ligaments yield, during its systole they recoil and force the fluid back into the cranial cavity); (2) by the compression of the cerebral veins by the entrance of the arterial blood into the arteries.

In Chapter II. the physiology of the cerebro-spinal fluid is discussed. Dr. Hill rightly draws attention to the fact, that the large sub-arachnoid cisterns which are demonstrated by Key and Retzius are only potential cavities, that as a matter of fact they are not distended by fluid as the coloured injections of these observers would lead us to believe, but that the brain fits the dura much as a finger fits a glove. Dr. Hill also points out that the veins and venous sinuses and not the lymphatics are the principal channels of absorption of the cerebro-spinal fluid, and that this absorption commences as soon as the pressure of this fluid begins to exceed that in the veins.

As regards the cerebral circulation (Chapter III.) Dr. Hill's observations lead him to support the so-called Monro-Kelly doctrine, that the quantity of blood in the brain varies little. A valuable criticism is given of the various methods of inferring the quantity of this blood either by post-mortem examination or by experiments made during life. Dr. Hill's method involves the estimation of the arterial and venous pressure, the tension of the cerebro-spinal fluid at the occipito-atlantal ligament, of the blood in the Torcular Herophili, as well as the brain pressure at the vertex—in fact an observation of all the possible variable conditions. Dr. Hill confirms the statement of Gulland and others that there are no vaso-motor nerves in the cerebral arteries—a result which, if it will bear further examination, must greatly influence our views as to the cerebral circulation; but which, when one considers the rich supply of fibres that enter the cranial cavity with the carotid arteries, one finds difficulty in accepting offhand. The vascular cerebral pressure is more dependent on the state of the veins than on that of the arteries. If the venous pressure is raised the tension within them will rise, while that within the arteries will fall. Conversely a fall in venous pressure will be compensated for by a rise in arterial pressure; but Dr. Hill considers that

this result is brought about independently of vaso-motor nerves.

It will follow, therefore, that a rise of arterial pressure will quicken, and a fall will slow, the flow of blood through the brain, and that arterial spasm and arterial hyperæmia will not affect the pressure materially. The great factor in the cerebral circulation is, however, the state of the vessels controlled by the splanchnic nerves.

Special consideration has been given to the influence of anæsthetics, such as chloroform and ether, and to drugs, such as curari, morphia, and amyl nitrite. With reference to the cause of death by chloroform Dr. Hill takes up a position strongly antagonistic to the findings of the Hyderabad commission, maintaining that the primary danger is failure of the cerebral circulation, so that the respiratory centre is not supplied with blood. Hence the danger of administering chloroform in the erect position. Shock is also shown to be due to a fall of the blood pressure in the abdominal vessels, whether the result of chloroform, asphyxia, operations, etc., and to a consequent anæmia of the brain. The dilatation of the abdominal vessels deprives the latter of its proper supply. This will be the greater the more erect the patient is. Hence the value of the treatment by position and by compression of the abdomen.

The influence of the force of gravity and of the compensating effects of the splanchnic vaso-motor mechanism are very clearly and succinctly stated in a series of twenty-four sentences. When the abdominal vessels are dilated then the blood drains away from the brain and heart. The mode of combatting this resulting position and vaso-motor paresis, by raising the feet and compressing the abdomen, and the precautions, necessary, in doing so not to over distend the heart, deserve to be carefully studied in the original work. We have not space to do more than draw attention to them.

Two chapters are devoted to cerebral anæmia and to the metabolism of the brain respectively. In addition to mechanical causes, such as occlusion of arteries or venous sinuses, and hæmorrhage from a large artery, the most important causes of cerebral anæmia are shown to be vaso-motor paralysis, especially of the splanchnic area, and the upright position of the body. The importance of this fact is insisted on in the treatment of syncope and in the production of sleep. Like Mosso, Dr. Hill considers sleep to be due to arterial anæmia and venous hyperæmia of the

brain—hence the value of the absence of all stimuli of the vaso-motor centres, of the dilatation of the splanchnic arteries, and, as producing cerebral venous hyperæmia, of the horizontal position.

Dr. Hill differs from Mosso in regarding the metabolism of tissue in the brain as being inactive compared with that of muscle.

In the concluding chapter, on cerebral compression, Dr. Hill shows, experimentally, that an increase of intra-cranial pressure in any one part is not transmitted equally to all parts of the brain by the cerebro-spinal fluid; that the falx cerebri shuts off the two hemispheres from each other, and the tentorium cerebelli shuts off the cerebellum from the hemispheres. When fluid is injected into the subdural space it presses the hemispheres against the tentorium cerebelli, and prevents fluid from escaping into the posterior fossa, and also wedges the medulla into the foramen magnum so as to block it up. On the other hand a local fluid pressure on the bulb forces the cerebellum upwards, so that the fluid can escape upwards into the posterior fossa, and downwards into the vertebral canal. The symptoms of compression are due to cerebral anæmia, and are most serious when this anæmia affects the bulb. This is more easily produced by a local solid pressure on the bulb itself than by a fluid one, and by a pressure equivalent to the capillary pressure within the bulb. Therefore a smaller solid body in the bulbar or cerebellar region will prove fatal than in the cerebral chambers. Symptoms of compression may be removed by making a sufficiently large opening in the skull to allow the brain to expand, or sometimes (especially in cases of tumour) by depleting the brain by lowering the blood pressure through prepurgation, and dilatation of other vascular areas by hot applications and mustard poultices and so forth.

What has been said will afford some indication of the nature and value of Dr. Hill's laborious research. Its value appears to us to be as great from the point of view of the physician as from that of the physiologist. For both, the results arrived at as regards the distribution, amount, and absorption of the cerebro-spinal fluid; the effects of cerebral anæmia and of vaso-motor paralysis in syncope, chloroform narcosis, and in compression, seem to us to specially warrant careful consideration.