

siderations, that this involves rapid change. The statement that the rate of this blood-flow may amount to 7.7 liters (8.1 quarts) per minute for a person with a total blood volume of 4.7 liters (4.9 quarts) offers a concrete instance of the marvelous performances of the human circulation.

SOURCES OF CEREBROSPINAL FLUID

It has been thought that the cerebrospinal fluid is derived from the choroid plexuses and possibly also from the nervous tissues by way of the perivascular spaces, but conclusive evidence as to its source has been lacking until recently. Thus Dandy and Blackfan,¹ and also Frazier and Peet,² have produced internal hydrocephalus in animals by blocking the aqueduct of Sylvius. Then Weed,³ under the direction of Cushing, took a step nearer to the final solution of the problem by introducing a cannula directly into the third ventricle from the fourth. When the cannula is introduced there is at first a rapid flow of several drops, whereupon a gradual diminution ensues, and after three or four hours, all flow ceases. The fluid obtained in this way appears identical with that in the subarachnoid spaces. By Weed's method it will be possible to study the action of drugs and other factors on the production of fluid, that is, on the functions of the choroid plexuses.

Around the cerebral vessels are spaces which extend to the capillaries and communicate into the subarachnoid spaces. If the direction of the flow of the fluid in these perivascular spaces could be determined, light would be thrown on another possible source of the cerebrospinal fluid. By subarachnoid injection according to the method already discussed in these columns,⁴ Weed found no granules of Prussian blue in the perivascular spaces after injection at low pressure. After injection under medium pressure granules were found in the perivascular and pericapillary spaces, not, however, in the vessels, but sometimes adhering to the periphery of the nerve cells and their prolongations. On injection under high pressure, granules sometimes were found in the lumen of capillaries. These results point unmistakably, it would seem, to a flow from the capillaries into perineuronal and perivascular spaces and thence into the subarachnoid spaces, where the fluid mixes with that from the ventricles.

These results point clearly to a dual source of the cerebrospinal fluid, namely, the choroid plexus and the cerebral capillaries. It will be recalled that by the same method of subarachnoid injection, Weed⁴ could

demonstrate that the cerebrospinal fluid escapes largely by way of the longitudinal sinuses, and also along the nerves. These results certainly go far to give us a clear idea of the circulation of the fluid.

THE CORPUS LUTEUM AND OVULATION

Aside from the immediate scientific value of the experiment, there is a peculiar sort of satisfaction in being able to duplicate new facts found in one species of animals by observations on another species. Whenever a process or a structure is seen to be common to many types, the frequency of its occurrence gives a justification for belief in its universality. It is often asked whether physiologic or pathologic phenomena noted in the dog, cat, rabbit or other laboratory animals are safely referable, under similar conditions, to man. The more wide-spread such phenomena are in the animal kingdom, the more justifiable is the reliance which we feel in upholding the belief in their broad applicability. Comparative physiology and pathology deserve the earnest consideration of the student of human biologic manifestations.

In view of what has just been said, there is a special satisfaction derived from the report that the desiccated fat-free substance of the corpus luteum of the cow, when injected in suspension, in proper dosage, into an actively laying fowl immediately inhibits ovulation. The duration of this effect varies with different birds from a few days up to two or three weeks. After the bird begins ovulating again the laying goes on unimpaired. The same effect is produced by the injection of extracts of the luteal substance, either intravenously or intra-abdominally. The active substance producing the inhibition is inactivated by boiling.¹ As Pearl and Surface,¹ who ascertained these facts, point out, the ovulation-inhibiting function of the corpus luteum is specific in a physiologic or chemical sense. The fact that the same chemical substance inhibits ovulation in mammals and birds, the latter of which do not possess any organ corresponding to the one which produces the substance in mammals (the corpus luteum), suggests that natural selection probably had nothing to do with the evolution of either the organ or the function in the mammals. If it had, one would expect that the function would have been perfected as a specifically and exclusively mammalian one.

The chief interest, to the student of medicine, in the effect of corpus luteum substance on ovulation in the fowl lies in its corroboration of the well-known work of Leo Loeb² on mammals. He has shown that one function of the well-developed corpus luteum in the

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2. Frazier and Peet: *Am. Jour. Physiol.*, 1914, xxxv, 268.

3. Weed: *Jour. Med. Research*, 1914, xxxi, 93.

4. Absorption of the Cerebrospinal Fluid, editorial, *THE JOURNAL A. M. A.*, Nov. 21, 1914, p. 1857.

1. Pearl, R., and Surface, F. M.: Studies on the Physiology of Reproduction in the Domestic Fowl, IX, On the Effect of Corpus Luteum Substance upon Ovulation in the Fowl, *Jour. Biol. Chem.*, 1914, xix, 263.

2. Loeb, Leo: *Jour. Morphol.*, 1911, xxii, 37; *Zentralbl. f. Physiol.*, xxv, No. 9; *Virchows Arch. f. path. Anat.*, 1911, ccvi, 278; *Deutsch. med. Wchnschr.*, 1911, No. 1, and other papers.