neutral sulphur, wherein deficient oxidation would be most apt to be manifested, with the amounts of a normal child, shows very slightly higher figures but the difference is not sufficient to justify the conclusion of deficient oxidation.

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On parenteral protein assimilation.

By **P. A. LEVENE** and **G. M. MEYER.**

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The results of recent work on the fate of protein introduced parenterally led to the conviction that such protein is assimilated and utilized by the organism in the same manner and in accordance with the same laws as protein ingested *per os.* However, there exists a considerable divergence in the views on the mechanism by which this assimilation is accomplished.

Very recently Freund advanced a theory that protein introduced into the organism subcutaneously or through the circulation is eliminated into the intestinal tract where it undergoes the usual digestion and absorption.

The present investigation aimed to test the correctness of the last theory. An animal deprived of its jejunum and ileum was placed on a standard diet and brought into a condition of nitrogenous equilibrium. On the days of experiments the animal received a subcutaneous injection of horse serum, heated for one half hour at 60° C. The volume of injected serum was equivalent to 1.5 grams of nitrogen. The elimination of additional nitrogen was followed for several days following the days of the serum injection. In all experiments was noted a complete retention of the protein introduced parenterally in the same manner as this occurs in normal animals. Thus the theory of Freund is contradicted by the results of our experiments.

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A method of isolating the cerebro-medullary circulation.

By **ARTHUR BRADLEY EISENBREY.**

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In a recent study by Dr. R. M. Pearce and myself of the mechanism of certain experimental conditions of low blood pressure, the following difficulties were encountered:

1. When substances that have been shown by special experiments to exert a selective peripheral action are injected into the circulation of an intact animal, the results frequently point to some additional central action that tends to mask or to neutralize to some extent the usual peripheral action.

2. Substances that have an essentially central action may sometimes produce results to be explained only on the basis of an added peripheral influence.

3. In experiments accompanied by a condition of extreme low blood pressure it is often difficult to know whether to ascribe these final results directly to the primary assault on the central or peripheral mechanism respectively, or to the additional secondary effects produced by the cerebral anemia that is the concomitant of the lowered systemic blood pressure. It is evident, therefore, that a knowledge of the extent and importance of the part played primarily by the central and peripheral mechanisms respectively, and by the central mechanism secondarily, in the production of any given result, is necessary for the interpretation of the mode of action of the substance used.

The chief difficulty is the impossibility in an intact animal of limiting a substance to the cerebro-medullary, as contrasted with the spinal and peripheral portion of the vasomotor system, or *vice versa*. It was apparent that this difficulty could be overcome only by isolating the circulation of the head and neck from that of the trunk and then transfusing the blood from another dog. If this could be accomplished it would be possible to obtain relatively pure central and peripheral results by the injection of solutions into either of the two independent circulations. The following procedure has been worked out on the dog.

Under full ether anesthesia, the right common carotid artery of the animal to be experimented upon, called hereafter the recipient, is freed for its entire length and a ligature is placed loosely about it. When it is desired to have none of the injected solution reach the donor's circulation, and in short experiments, the external jugular vein on the left side is similarly freed and is later used for the outlet of the venous blood. The femoral artery is prepared for taking manometric records and likewise the saphenous vein of the opposite side for the injection of solutions into the circulation of the trunk.

When the experimenter is ready to institute artificial respiration, the thorax is opened by sawing through the entire length of the sternum. This gives rise to very little hemorrhage and, if the sterno-cleido-mastoid muscles are detached from their origin, allows free access to the vessels at the base of the heart. The two pairs of sternal vessels are now double ligated and cut between the ligatures. A full exposure of the superior vena cava is thus provided. By carefully separating the loose tissue over it the nerves which run alongside may be avoided and a ligature passed around the vessel just above the entrance of the azygos vein. The large brachio-cephalic artery which lies just behind and to the left of the vena cava is exposed by blunt dissection at its point of origin from the arch of the aorta, and a ligature passed about it. The second large arterial branch, the left subclavian, best approached through the left side of the mediastinum, is similarly treated. Ligation of the subclavian arteries requires the greatest care, for it is essential to have the ligatures so placed as to occlude the thyroid axis, superior intercostal and suprascapular arteries, which might, through their anastomosing branches, form a communication with the circulation of the trunk. The same care in the ligation of the corresponding *veins* insures against the passage of venous blood from the trunk into the cerebral circuit.

The right common carotid artery which has already been freed is ligated and severed at its upper end, and, by the method of vessel anastomosis described by Crile, its central end is attached to the central end of a carotid artery of the donor, preferably a larger dog, and the isolation of the cerebral circulation of the recipient is next performed.

By means of the ligatures that have been placed about them the large vessels are raised and clamped. First the left subclavian and then the branchio-cephalic arteries are clamped close to the aorta. Simultaneously the blood is allowed to pass through the transfusion anastomosis. The exposed left external jugular vein is then opened close to the subclavian branch to allow venous outflow from both directions and the superior vena cava is raised and clamped. When it is desired to have a complete circulation between the donor and the cerebral circulation of the recipient, a second anastomosis is made between the central end of the right

external jugular veins of the recipient and the central end of a similar vein in the donor, omitting the opening of the vein in the left side of the recipient's neck. This prevents the early termination of the experiment by the exsanguination of the donor.[1]

By this procedure, the arterial supply of the recipient's head and neck is maintained through the right vertebral and left common carotid arteries, both of which are branches of the brachiocephalic artery. The venous outflow is maintained by the unobstructed passage of the blood into the superior vena cava from which it escapes through the external jugular vein on the right or left side as the case may be.

Injections may be made into the cerebral circulation of the recipient through a hypodermic needle inserted in the carotid artery in the region of anastomososis, or through a canula placed in the central end (clamped) of the superior thyroid artery. It is also evident that the solution may be given intravenously in the donor, but under such circumstances the influence of changes in the arterial blood pressure of the donor must be considered.

By this method of isolation, physiological experimentation upon altered cerebral blood pressure is rendered feasible by (1) diminishing the venous outflow through the jugular anastomosis, (2) by constriction of the arterial anastomosis, or (3) by raising the donor's general blood pressure.

The success of this method of isolation is evidenced by the fact that an injection of horse serum into the cerebral circulation of a sensitized animal does not cause the typical fall of blood pressure which is characteristic of anaphylactic shock, while a subsequent injection into the trunk does cause such a fall.

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A reversion of the starch-dextrin reaction.

By **EDWARD TYSON REICHERT.**

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In the reversions of enzymic and catalytic processes heretofore recorded, the synthesis has been brought about by a high concen-

[1] Before making the venous anastomosis it is essential to ascertain whether there is an efficient back flow from the superior vena cava through the central end of the recipient's right external jugular vein. To provide this it is frequently necessary to rupture the valves that are present just above the subclavian branch.