the sugar has helped in the utilization of such proteins for the maintenance of the fœtal growth. The latter is, I think, the better interpretation. It would seem that the sugar has diverted substances which would otherwise have been eliminated as urea or ammonia, and it seems probable that this has been accomplished by synthesis in the embryonic tissues. The very high creatin nitrogen eliminated in the pregnant condition may be taken as an indication that the muscles are the chief source of these proteins but that the creatin itself is not (all) available for the embryonic growth. The fact that the dog was apparently weakened much more by this fasting period than by the period of similar duration when not pregnant would lend support to this view. The conditions would be entirely analogous, therefore, to Miescher's classical case of the fasting Rhine salmon where it has been shown that the muscular tissues are levied upon for the growth of the germ cells just previous to the spawning season. At all events it is clear from the above experiment that the carbohydrate has caused a much greater retention of the proteins in the pregnant condition.

Perfectly concordant results were obtained on a second dog in the sixth week of pregnancy where the reduction in the nitrogen output by a proportional amount of carbohydrate was 38 per cent.

41 (297)

The transplantation of parathyroid glands in dogs.

By **W. S. HALSTED.**

[*From the Hunterian Laboratory, Johns Hopkins University.*]

Our experiments, begun in the winter of 1906–7, have with interruptions been continued to date. In the course of the work many questions have arisen which still require solution and we find ourselves on the threshold of the investigation.

The first attempt of which I know to transplant these organs was made by us in December, 1906. Two parathyroid glands, one from the right and one from the left side of the dog's neck, were successfully implanted into the thyroid lobes from which they were removed.[1]

[1] Halsted: *American Journal of the Medical Sciences*, 1907, cxxxiv, No. 1 (July).

Leischner[1] succeeded in a small percentage of his cases in transplanting præperitoneally parathyroids in rats. These were autotransplantations, the donor being the donee. Pfeiffer, Hermann and Mayer[2] made two successful autotransplantations in puppies.

Beidl, commenting on the unsuccessful attempts of Foges, Kreidl and himself to transplant ovaries, testicles and suprarenal glands contrasts these failures with his success in the transplantation of the parathyroid glands. He states that a year prior to his reports,[3] he transplanted in two dogs, into the spleen, "foreign" parathyroids and "after a time" removed both thyroid lobes as well as the parathyroids. One animal lived seven months without a trace of tetany and finally died of what seemed to be "cachexia thyreopriva." The spleen contained, the report states, two well healed, intact parathyroid glands. The second dog had tetany of short duration. It recovered, however, entirely, still lives and consequently has, the author believes, parathyroids in the spleen which are functionally sufficient.

With the exception of the two cases of Beidl I find no report of the successful isotransplantation of the parathyroid glands, and, besides my own, the only successful autotransplantation of these glandules in dogs are, perhaps, the two reported by Pfeiffer, Herman and Mayer. As to the successful isotransplantations of Professor Beidl I confess to a little surprise in view of the facts that no deficiency was created before the transplantation and that both parathyroid glands survived in both cases. The absolute functional proof is lacking in these cases, inasmuch as the transplanted glands were not excised during life.

FIRST SERIES OF RESULTS (WINTER OF 1906–7). *Autotransplantation.* — Parathyroid deficiency is of necessity created in the autotransplantations. Of five autografts into the thyroid lobes of three dogs, three were successful (macroscopic and microscopic proof). Of eight autografts into the spleens of three dogs one only succeeded (macroscopic proof). In no instance was functional

[1] Leischner: *Archiv für klinische Chirurgie*, 1907, lxxxiv, p. 208.

[2] Pfeiffer, Hermann and Mayer: *Mitteilungen aus den Grenzgebieten der Medizin und Chirurgie*, 1907, xviii, p. 377.

[3] Beidl: *Wiener klinische Wochenschrift*, Feb. 27, p. 304.

proof of the success of these transplantations obtained. Such proof cannot, of course, be so convincingly obtained in the cases of implantation to thyroid because of the lack of certainty that no parathyroid tissue except the transplanted remains at the time of the final operation, at which well nourished thyroid tissue, sufficient to insure the life of the transplanted parathyroid gland, must be left.

Isotransplantation. — In five cases (Dogs K, L, M, N and O), two, seven, five, five and eight parathyroids respectively were transplanted into the spleen. In only one dog (K) was a parathyroid deficiency created. In no instance was the transplantation successful; furthermore tetany supervened and death occurred just as promptly, after removal of the thyroid and parathyroids in the neck, in these dogs with so many intrasplenic isografts as in the ungrafted dog. Hence we may conclude that life is probably little, if at all, prolonged by the absorption of foreign parathyroids transplanted into the spleen.

SECOND SERIES OF RESULTS (WINTER OF 1907–8). — The transplantations were made, usually one gland at a time, at intervals of from seven to ten days, behind the rectus abdominis muscle, within its sheath.

Autotransplantation.—Of eighteen autotransplantations in twelve dogs, seven parathyroids were absorbed or necrotic (Dogs 3, 4, 5 and 10); five to seven lived and performed their function (Dogs 1, 7, 8, 9 and 11). What the fate of the four remaining glands would have been (Dogs 2, 3 and 14) is doubtful, the dogs having died of distemper. Four dogs are living and in good health, each, presumably, with only one autograft.

Isotransplantation. — Of twenty isotransplantations with created deficiency (Dogs 7, 12, 13, 15, 16, 17, 18, 19, 20 and 24) nineteen parathyroids were absorbed or necrotic. The result in one instance remains to be determined. Dog 7, deprived of all parathyroids except the one transplanted (an autograft), lived in good health and spirits twenty-five days or until at a third operation, the sustaining parathyroid was removed. There was in this dog, usually, a suggestion of hypoparathyroidism in a barely perceptible fibrillary tremor of the tongue and of the temporal muscles. On removal of the perfectly normal autograft behind the rectus muscle,

tetany developed within twenty-four hours and death occurred within forty-eight. Isotransplantation or isografting (two grafts) was unsuccessfully resorted to 24 hours after the supervention of tetany.

Summary. — Our experiments have proved that in dogs

1. Parathyroid glands are essential to the life of the animals, and that tetany follows their removal.

2. Transplanted parathyroids (autografts) may for an undetermined time perform at least the most evident function of these bodies.

3. One successfully transplanted parathyroid may suffice to maintain a fair degree of health; traces of hypoparathyroidism may persist.

4. In autotransplantation success is more common than failure.

5. Heterotransplantation rarely succeeds.

6. For the successful transplantation of these organs a deficiency of parathyroid tissue should be created.

7. Transplanted in excess of what is required by the organism parathyroid glands do not survive.

8. Excised or deprived of their blood supply in the course of an operation parathyroids should probably be reimplanted, preferably into the thyroid gland.

9. Complete excision of the thyroid lobes is well borne, for months at least, by these animals. Myxedema begins to manifest itself in a few weeks.

42 (298)

The nervous coördination of the auricles and ventricle of the heart of the lizard.

By **MARIE IMCHANITZKY.**

[*From the Hallerianum, Bern, Switzerland.*]

Communicated by S. J. Meltzer.

The following investigation was carried out on the hearts of lizards (*Ocellata lacerta*) for the purpose of studying the nature of conduction between the auricles and ventricles in these animals. The experimental part was done at the Zoölogical Station of