dissolved separately in CS_2, and the extinction maxima determined with the grid spectroscope, with the following results. The upper yellowish-pink ring of the polyene hydrocarbon portion did not show any characteristic absorption band (autoxydized layer). The yellow ring below this gave an extinction maximum between those which are characteristic for A and B carotenes, *i. e.*, 514 and 479mμ. On the other hand, spectroscopic examination showed the main portion of the other fraction to be xanthophyll, with absorption bands at 509 and 473mμ (in CS_2).

In the experiment just described it appears evident, therefore, that the blood serum contains a considerable quantity of xanthophyll dye, which has to be eliminated from the test material before the carotene determination is made.

It is to be emphasized, however, that the method described may lead to false results in instances where the blood contains lycopene. Lycopene has been, as is well known, identified in human fat tissue[8] to which it is carried by the blood stream. Being a much more intense dye than carotene, a very small amount of lycopene is sufficient to cause an error in the colorimetric determination of carotene. The 5 liters of mixed blood examined by the writers contained no lycopene. It is important to keep patients whose blood is to be tested for carotene on lycopene-free (tomato-free) diet for several days before the blood examination.

Summary. Human blood serum contains other lipochromes besides carotenes, which must be removed from the test material before determinations of provitamine A are made.

8237 P

Homologous Function in Supernumerary Limbs After Elimination of Sensory Control.

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When in a salamander a supernumerary limb is transplanted into the neighborhood of a normal limb so that it receives its innervation from some part of the limb plexus, every movement of the transplanted limb is an exact duplication of the simultaneous movement of the nearby normal limb. This phenomenon of "homo-

8 Zechmeister, L., and Tuzson, P., *Z. f. physiol. Chem.*, 1935, **231**, 259.

logous function," discovered by the author, has led to the conception of a "resonance" principle of nervous control.* Alternative explanations that had proved to be inadequate were (a) a strict selectivity controlling the establishment of nervous connections between the centers and the extra limbs, and (b) secondary central adjustments in the sense of "learning" or "conditioning", effected under the control of sensory messages reaching the centers from the extra limbs.

The former possibility has been ruled out by ample evidence. The latter possibility was contradicted by much circumstantial evidence, but a direct experimental test was wanting. Therefore, experiments were undertaken to decide whether or not homologous function would be found in limbs completely deprived of their sensory innervation so that the centers would fail to receive the necessary peripheral data prerequisite for the supposed conditioning or readjustment.

The experiments, performed on 10 axolotls of about 5 to 7 cm. in length, differed from the original ones in that, prior to the transplantation of the extra limb, the afferent nerve supply of the normal limb area into which it was to be transplanted had been thoroughly destroyed. The left fore limb was deafferented by extirpating the corresponding spinal ganglia 2, 3, 4 and 5, including their dorsal roots. I have reported[1] that, contrary to a widespread belief, the motor functions of limbs in amphibia are not noticeably affected by deafferentation, and that, despite the absence of tactile and proprioceptive control, the limbs continue to move in perfect coordination. The fact that the deafferentation in the operated specimens has been complete, was demonstrated in the living animals by the lack of sensitivity to mechanical stimulation in the deafferented limbs, and was confirmed later by the histological preparations proving the absence of spinal ganglia and dorsal roots throughout the operated area. One or 2 weeks after the deafferentation an additional fore limb was grafted to the deafferented shoulder region. Before inserting the transplant, part of the brachial plexus, now purely motor, was severed and assigned to the transplant for its nerve supply.

The first movements appeared in the grafts between 2 and 3 weeks after their transplantation, which, according to the earlier experiments with mixed nerves, is the time required for the regeneration

* A short account of the "resonance" principle is given in the introduction to a recent paper by the author, *J. Comp. Neur.*, 1934, **61**, 135. A fuller description with a complete list of the literature can be found in DeSilva and Ellis, *J. Gen. Psychol.*, 1934, **11**, 145.

[1] Weiss, P., PROC. SOC. EXP. BIOL. AND MED., 1934, **32**, 436.

of nerves into the transplants. *From their very first appearance, the movements exhibited clearly the phenomenon of homologous function,* each reinnervated muscle of the extra limb contracting synchronously with the corresponding muscle of the normal limb.

The animals were kept under observation for many months, throughout which period the phenomenon of homologous function was observed as constantly and as strikingly as in those earlier experiments where the limbs had been in possession of their full sensory control.

It results from these experiments that sensory messages from the transplants are not instrumental in establishing homologous function. This is in agreement with the conclusions reached in the earlier work and embodied in the "resonance" conception, according to which the phenomenon of homologous function is a direct manifestation of a primary specific rapport between the impulses generated by the centers on one hand and the individual peripheral organs and their "modulated"[2] motoneurons on the other hand.

8238 C

Glycogen and Water Storage.

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MacKay and Bergman[1] stated that in rabbits there is a tendency for water to be stored in direct proportion to glycogen storage in the liver. The same authors[2] found that in young albino rats, on the average 3.8 gm. of water are stored with each gram of glycogen. That there is a relationship between glycogen and water storage is denied by Puckett,[3] Holmquist,[4] and Bridge.[5]

In view of the difference of opinion noted above, the authors decided to study the question. Adult rats (in most cases) of the Long-Evans strain were used. All the animals were kept on the McCollum Stock Diet I (whole wheat ground, 67.5%, casein 15%, whole milk

2 Weiss, P., *Anat. Rec.*, 1934, **60**, Suppl. p. 30.

1 MacKay, E. M., and Bergman, H. C., *J. Biol. Chem.*, 1932, **96**, 373.

2 MacKay, E. M., and Bergman, H. C., *J. Biol. Chem.*, 1934, **105**, 59.

3 Puckett, H. L., and Wiley, F. H., *J. Biol. Chem.*, 1932, **96**, 367.

4 Holmquist, A. G., *Skand. Arch. für Physiol.*, 1932, **65**, 9.

5 Bridge, E. M., and Bridges, E. M., *J. Biol. Chem.*, 1932, **96**, 381.