and there was little or no difference in size of internodes near the tips. Elongation continued in controls after aerated plants had started to flower. This response tended to reduce size differences when mature plants of both groups were compared. The physiological effect of aeration on tops appeared to be acceleration in development with earlier maturation rather than prolonged development and increase in bulk. Percentage dry weight of top was the same in tops of aerated and unaerated plants.

B. E. Dean, working in this laboratory under the author's direction, has found that root systems of submerged aquatics, such as Typha, Sagittaria, and Hibiscus increase greatly in size in aerated sand, clay and muck. Roots in aerated soils were longer, more highly differentiated as shown by marked lignification of the new primary roots in many cases. In the main, unaerated roots were fibrous but less numerous than the corresponding fibrous elements of aerated root systems. Submerged (but not subterranean) water roots in Typha and Sagittaria were more numerous and profusely branched in unaerated soils. In every case larger tops were associated with more extensive root systems.

5575

Exchange of Hypophysis Hormones in Parabiotic Amphibians.*

EMIL WITSCHI.

From the Zoological Laboratory, State University of Iowa.

Experiments of Burns[1] and the author[2] on gonad development in parabiotic amphibians gave evidence of interesting variations in the mode of hormonic response in heterosexual combinations, which partly, are due to different hormone concentrations. Unfortunately the development of these reactions can not be followed satisfactorily in live pairs. In this respect conditions are much more favorable in the study of the exchange of hormones of the hypophysis, because of the marked external effects which they produce as controllers of metamorphosis and chromatophore reaction.

* Aided by a grant from the Committee for Research in Problems of Sex of the National Research Council.

[1] Burns, R. K., *J. Exp. Zool.*, 1930, **55**, 123.

[2] Witschi, E., PROC. SOC. EXP. BIOL. AND MED., 1930, **27**, 763; *J. Exp. Zool.*, 1931, **58**, 113; Witschi and McCurdy, PROC. SOC. EXP. BIOL. AND MED., 1929, **26**, 655.

The Californian newt, *Triturus torosus,* ordinarily metamorphoses at about 5 months old. After hypophysectomy it becomes a perennibranchiate. As in other amphibians complete hypophysectomy causes also the contraction of the epidermal melanophores. The incomplete operation, however, leaves either the color unchanged or the larva becomes very dark. In the latter case the persisting intermediate lobe which, according to Allen,[3] controls the melanophore reaction, seems to hypertrophy.

Parabiotic twins of this newt likewise metamorphose when 5 months old. If hypophysectomized even as late as at the end of the fourth or beginning of the fifth month, they become perennibranchiate and eventually also albinistic. If, again on the verge of metamorphosis, one only of the pair is hypophysectomized, metamorphosis is delayed for from 2 to 6 months. From the fact that the unoperated twin-mate needs so much time to restore the hormone concentration to the level required for the inauguration of metamorphosis, we conclude that it can accomplish this not simply by an increased physiological activity but only through some hypertrophy of its hypophysis. It becomes evident also that the anterior lobe normally does not release an overdose but just the adequate amount of the metamorphosis hormone. Thirdly, we note that this hormone is practically evenly distributed in the twin pair, for when metamorphosis after this delay comes on, it begins simultaneously in both animals.

Slightly different is the melanophore reaction. If the hypophysis is removed from one member of a Triturus pair, it turns distinctly lighter than its co-twin and this effect is lasting even through metamorphosis.

This difference between the metamorphosis and the melanophore reaction becomes even more pronounced in parabiotic chains. In this mode of grafting the hypophysis as a rule is completely removed from the posterior animal. Consequently its melanophores are contracted from their very first appearance and stay so permanently. If the head is cut off the first member, its melanophores contract also, within a few hours.

One may, however, by cutting off the dorsal front only of the second animal, preserve part at least of its hypophysis. In such chains both animals have expanded melanophores. Hypophysectomy of the first animal of such a chain made it turn much lighter because of melanophore contraction, within a few hours. This pair has never metamorphosed but died at the age of 18 months. Serial

[3] Allen, B. M., *Anat. Rec.,* 1925, **31**, 302.

sections show a minute fragment of hypophysis, probably intermediate lobe, in the first one, not over 1/20 of the total gland. In the second one the Diencephalon has been pushed away by the spinal cord of the first animal, connecting with the Rhombencephalon of the second one. The infundibular region is covered with an extensive crust of hypophyseal lobules which, structurally, resemble rather the intermediate lobe type.

Again the color differences in these chains are lasting, even through metamorphosis. And again do we observe that the metamorphic changes of both animals run synchronously.

It appears that the zone of fusion acts like a filter, allowing the metamorphosis hormone to pass but retaining the melanophore hormone. Microscopic study shows that the circulatory systems of the 2 individuals are connected by a net of capillaries only. This seems to indicate that the melanophore hormone is quickly used up, disappearing in the capillaries.

If frogs or toads are grafted in chains the hypophysis deprived animal stays lighter for about the first 2 weeks. In chains of 3 the third animal is very light for an even longer period. As in twins, however, the second animal later turns to its normal color. Metamorphosis occurs simultaneously. When the resorption of the tail stump of the first animal begins, the second animal presently turns light again.

Frogs and newts therefore give identical results for the metamorphosis hormone and are but quantitatively different with respect to the melanophore hormone.

5576

The Barrier Between the Blood and Cerebrospinal Fluid; a Microchemical Modification of the Walter Method.

WM. MALAMUD AND B. M. MULLINS. (Introduced by L. E. Travis.)

From the Iowa Psychopathic Hospital, State University of Iowa.

In investigations of this barrier by the Walter bromide method,[1, 2, 3, 4, 5] the value of the procedure as an aid in the diagnosis and

[1] Malamud, Wm., Fuchs, D. M., and Malamud, N., *Arch. Neurol. and Psychiat.*, 1928, **20**, 780.

[2] Malamud, Wm., Wilson, R. B., *Arch. Neurol. and Psychiat.*, 1929, **22**, 1135.

[3] Malamud, Wm., PROC. SOC. EXP. BIOL. AND MED., 1930, **27**, 477.

[4] Malamud, Wm., Rothschild, D., *Arch. Neurol. and Psychiat.*, 1930, **24**, 348.

[5] Malamud, Wm., Hayward, E. P., *Zeitsch. ges. Neurol. und Psychiat.*, 1930, **128**, 295.