presence of this antigen.

Conclusion. The polysaccharide fraction of the tubercle bacillus may be liberated in the course of infection produced by this organism, but such fractions are not readily demonstrated by the delicate immunologic methods used in these experiments. The positive results herein recorded have been obtained only in material treated by *artificial* agents which may have disintegrated the tubercle bacilli present.

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Pituitary and Nervous Control of Chromatic Responses, Especially of Xanthophores, in Killifish (*Fundulus*).

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Previous work on killifishes has shown the yellow pigmentary effectors (xanthophores) of *Fundulus heteroclitus* and *F. majalis* to be subject to humoral control and to direct, probably double, nervous control permitting independence from melanophore responses.[1] A pituitary hormone dominates the xanthophores of the minnow *Phoxinus*,[2] as it does amphibian melanophores. Pituitary extract causes xanthophore pigment dispersal in this and other teleosts—including *Fundulus*.[3,4] The present paper reports experiments undertaken to verify and evaluate the inferred participation of the hypophysis in pigmentary coördination, with respect chiefly to the xanthophores, in *Fundulus*.

Chromatic responses were determined in 54 *F. majalis* 5 or more days after total hypophysectomy,[5] *i.e.*, when pituitary substances were absent from the circulation. Black-bottomed and white-bottomed vessels evoked darkening and paling, through melanophore change, about as readily as in normal fish (as in *F. heteroclitus*).[6] The hypophysectomized *F. majalis* were clearly incapable of normal adaptive response to yellow, however, irrespective of the duration of their stay over that color (instead of white or pale blue). Yet they became certainly, though only slightly, more yellowish after staying over yellow than otherwise. This fact was verified by reciprocal comparative tests, involving interchange of the yellow and other pale substrates. The xanthophores of the tail fin (as examined microscopically) after hypophysectomy did not effect the usual pigment-dispersing response to yellow, but they did respond to black, thus showing that pituitary intervention is not essential for eliciting their pigment dispersal.

In 20 *F. heteroclitus* the effect of total hypophysectomy on xanthophore response was greater. These fish remained uniformly grayish over a pale ground, whether yellow, white, or blue. Their caudal xanthophores showed none of the normal pigment-dispersing response to yellow (contra Matthews).[3] Nevertheless, these xanthophores could still show the temporary pigment dispersal that may be brought about by handling.

The table summarizes results of keeping normal (N) and pituitaryless (H) fish of both species several hours in bowls of the designated colors.

Pituitary involvement was so manifest in the results of hypophysectomy as to stimulate reconsideration of the question of direct nervous control of the xanthophores. To this end, one or more caudal fin rays were tran-

[1] Fries, E. F. B., *J. Exp. Zool.*, 1931, **60**, 389; *Biol. Bul.*, 1942, **82**, 261.

[2] Giersberg, H., *Z. vergl. Physiol.*, 1932, **18**, 369.

[3] Matthews, S. A., *Biol. Bul.*, 1933, **64**, 315.

[4] Abramowitz, A. A., *Am. Nat.*, 1936, **70**, 372.

[5] For method, see Abramowitz, A. A., *Science*, 1937, **85**, 609.

[6] Reviewed by Parker, G. H., *Proc. Am. Acad. Arts Sci.*, 1940, **73**, 165.

		White	Pale blue	Yellow	Black
Dorsal aspect of fish	N (both species)	Pale; not yellowish	Pale; not yellowish	Pale; markedly yellowish	Dark
	H (*majalis*)	Pale; not yellowish	Pale; not yellowish	Pale; slightly yellowish	Dark
	H (*heteroclitus*)	Pale; not yellowish	Pale; not yellowish	Pale; not yellowish	Dark
Caudal xanthophore pigment	N (both species)	Concentrated	Concentrated	Moderately dispersed	(Often much) dispersed
	H (*majalis*)	Concentrated	Concentrated	Concentrated (?)	Dispersed
	H (*heteroclitus*)	Concentrated	Concentrated	Concentrated	

sected in 45 of the *F. majalis* and 19 of the *F. heteroclitus*, mostly 11 or more days after hypophysectomy. Without exception in *F. majalis* (kept over pale blue or white) the caudal bands thus denervated acted as in normal fish; *viz.*, they turned both darker and yellower through pigment dispersal in their chromatophores. These bands resembled those of unhypophysectomized fish also in subsequent fading and other changes by which they differed characteristically from innervated sectors of the tail. In *F. heteroclitus*, too, the pituitary was found dispensable for xanthophore response characteristic of denervated caudal bands.

Intraperitoneal implantation of fresh *Fundulus* pituitaries (3-6 per recipient) into 7 individuals of each lot, 5-60 days after hypophysectomy, induced pigment dispersal in the xanthophores and melanophores of the faded denervated bands. It did so regardless of the substrate color. In the xanthophores of innervated parts of the fin, the implantation made possible normal dispersal in response to yellow and it opposed, without abolishing, their pigment-concentrating response to white or blue.

Evidently, a pigment-dispersing pituitary secretion, presumably intermedin, is one of several factors controlling xanthophore changes in *Fundulus*. It must be the predominant factor in *F. heteroclitus* while not preponderant in *F. majalis*. Moreover, the results (including further details) confirm the conclusion (1942)[1] that the xanthophores are directly innervated, probably by pigment-dispersing as well as -concentrating fibers. The system of mechanisms regulating the xanthophores resembles that governing the melanophores; in both species, however, the melanophores are more completely under the sway of their direct innervation.