formulations stem from many observations on higher plant embryos where, for the most part, cleavage patterns are quite regular. Notable exceptions have been recorded, however, for embryos of *Gossypium* and *Capsella* and one cannot say with certainty that orderly cell displacement is a requirement for normal growth in these organisms[8]. Furthermore, notwithstanding the dramatic 2-cell differentiation in *Fucus*, its histogenesis is quite simple and 'indefinite' as compared with more advanced systems. The second apparent differentiation in *Fucus* comes about when the embryo is comprised of approximately 100 cells; i.e., the formation of a peripheral cell layer which is likened to a dermatogen. Therefore, up to this point in growth the function of cleavage would be merely to 'cut up' the existing, generally polarized mass, and the pattern of doing so need not to be uniform. In this respect the young *Fucus* embryo is like an early phase of echinoderm embryos. It is of interest to consider, however, that the overall form of the treated embryos of *Fucus* is maintained in spite of rotated spindles and unequal cleaving. This fact leads one to emphasize the regional nature of polarization in the embryo, and to assign a less critical role to orderly cleavage patterns, cell displacement and early differentiation. If this holds true it should be possible to reverse the initial events in early embryogeny (up to a point) and still obtain normal embryos e.g., multicellular, apolar embryos which later polarize. Further, in view of these considerations, one might ask, 'how different really are the first-formed 2-cells of the embryo?'

Finally, these observations on the relationship of polarity, cell cleavage and histogenesis suggest a profound flexibility in the early embryogeny of *Fucus*. This is noteworthy in view of the fact that mature forms of this species are characterized by a similar degree of morphological variation even within a short range of the intertidal zone[9-11].

Zusammenfassung. 17β-Östradiol verändert die Lage der Spindelachse und verursacht eine abnormale Mitose in jungen Embryonen von *Fucus distichus*. In der Folge zeigen die wachsenden Embryonen Furchungsmuster, welche keine geordnete Abfolge der Teilungen mehr zeigen. Trotzdem können die Embryonen eine örtliche Polarisierung aufrecht erhalten und überleben.

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[10] This work was supported in part by a National Science Foundation Summer Research Fellowship administered by Friday Harbor Biological Laboratories, University of Washington and by the Research Foundation of SFVSC.
[11] Sincere appreciation is extended to Professor RALPH HATHAWAY of the University of Utah for help and encouragement in initiating this work.

Catecholamines in the Avian Carotid Body

The presence of catecholamines in cells, which was formerly detected only by their chromaffin reaction, has recently come to be studied by fluorescence histochemical methods of ERÄNKO, FALCK and HILLARP[1]. This modern method has made it increasingly evident that the mammalian carotid body, long believed to be a chemoreceptor, represents a kind of endocrine gland consisting of cells which secrete catecholamines[2]. However, the avian carotid body does not seem to have been observed by either fluorescence or electron microscopy. The carotid body in some birds is known to be characteristically enclosed by the parathyroid, like the relation of the medulla to the cortex in the mammalian adrenal, to form the so-called parathyroid-carotid body complex[3] and, if studied by modern methodologies, seems to provide a key to the elucidation of the function of this organ.

Material and methods. Adult love-birds, *Uroloncha domestica,* were used in this investigation. The carotid body was found bilaterally in the thoracic inlet, beside the common carotid artery just beyond the origin of the subclavian artery.

For the examination of catecholamines in the carotid body, the histochemical method described by DAHLSTRÖM and FUXE[1] was applied. Freeze-dried tissues were treated with gaseous formaldehyde and embedded in paraffin. Sections were examined under an Olympus microscope 'Photomax' with a HB 100A high pressure mercury lamp (Ushio), an activation filter U (maximum transmission, 365 nm), a dark field condenser for immersion oil and a barrier filter FY3 (transmission, 410 nm).

For electron microscopy, the brachiocephalic artery and its branches were perfused, via a polyethylene tube, with 2.5% glutaraldehyde in phosphate buffer at pH 7.1. The carotid body, together with surrounding tissues, was further fixed in glutaraldehyde followed by 1.3% osmium tetroxide. After dehydration with ethanol, the tissues were embedded in Luft's Epon. Thin sections were cut with a Porter-Blum microtome and stained with uranylacetate and lead hydroxide. A Hitachi HS 7s electron microscope was used for observation.

Thicker (2μ) serial sections of Epon embedded materials were stained with toluidine blue and were studied light microscopically and partially reconstructed using photomicrographic methods (x c. 400). Light microscopic chromaffin reaction was examined with bichromate fixed specimens.

Results and discussion. In the fluorescence microscopy, the cytoplasm of the glomus cell of the carotid body showed green fluorescence which was interpreted as indicating the presence of catecholamines rather than indolalkylamines[1]. This interpretation was supported by the electron microscopic observation that cored vesicles, resembling the catecholamine-containing granules of the adrenal medullary cells, occurred in the cytoplasm of the glomus cells. A series of electron micrographs were obtained which seemed to indicate different stages of the

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emiocytotic release of the catecholamine granules of the glomus cell (Figures 1 and 2).

Although the glomus cells of the mammalian carotid body have been described as partly chromaffin, not a single chromaffin cell has been demonstrated in the avian carotid body as yet[3]. The present light microscopic observation confirmed previous evidence of the negative chromaffin reaction in the avian carotid body. However, this was interpreted to indicate not necessarily the absence of catecholamines but a low value; and it was concluded that the avian carotid body is essentially a 'chromaffin' paraganglion, as is the mammalian carotid body[2].

Reconstruction of serial sections of Epon embedded materials showed the detailed vascular architecture of the parathyroid-carotid body complex. The carotid body received a branch from the common carotid artery which entered the carotid body at a site to be called the hylus and repeatedly ramified into capillaries running between the glomus cells. At the periphery of the body, these capillaries emptied into the sinusoid network of the parathyroid. The parathyroidal sinusoids united towards the periphery of this organ to form small veins which finally joined with the internal jugular vein. Thus the particularly close association between the parathyroid and the carotid body seemed to suggest that catecholamines secreted from the carotid body influence the function of the parathyroid. However, further experimental studies must be done to test this hypothesis (Figure 3).

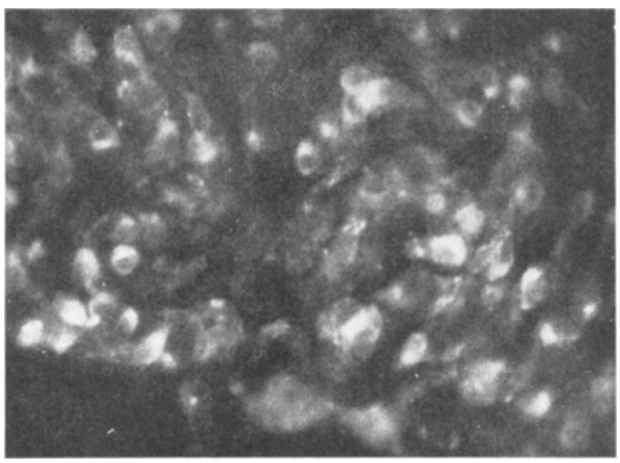

Fig. 1. Fluorescence photomicrograph of the carotid body of a love bird; the fluorescence suggesting the presence of catecholamines is localized in the cytoplasm of the glomus cells. c. × 400.

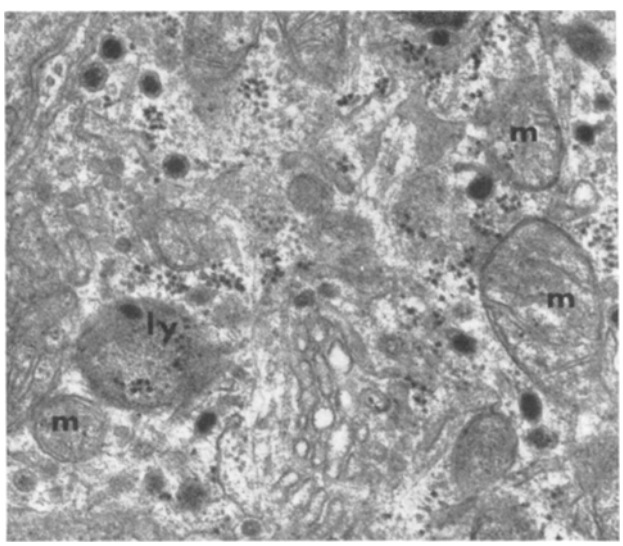

Fig. 2. Electron micrograph of a portion of a glomus cell; note the cored vesicles which are scattered throughout the cytoplasm; ly, lysosome; m, mitochondria. c. × 35,000.

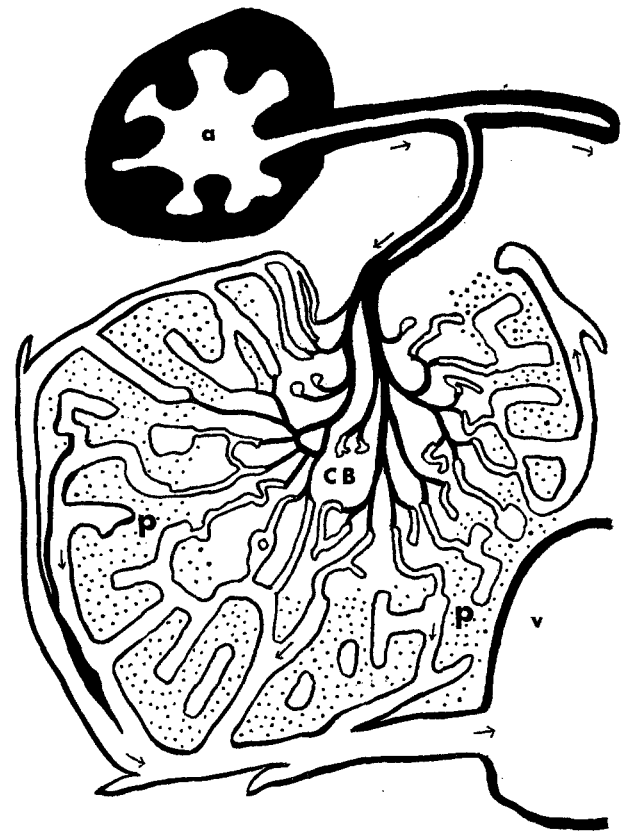

Fig. 3. Schematic representation of the blood supply of the carotid body (CB) and parathyroid gland (P) in the love bird; arteries in black, capillaries, sinusoid and veins in white; arrows indicate the direction of blood stream; a, common carotid artery; v, internal jugular vein.

Zusammenfassung. Fluoreszenz- und elektronenmikroskopische Beobachtungen zeigen, dass die Glomuszellen der Karotisdrüse von *Uroloncha domestica* Katecholamin enthalten. Eine lichtmikroskopische Untersuchung an den Serienschnitten ergibt, dass die Blutgefässe des die Karotisdrüse umhüllenden Epithelkörperchens aus ihrem Kapillarnetzwerk hervorkommen[4].

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