

CORRESPONDENCE OF SKIN PIGMENTS IN RELATED SPECIES OF NUDIBRANCHS.

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That pigmentary materials occurring in various species of certain genera of marine invertebrates may be chemically very similar, or even identical, has several times been suggested.<sup>1</sup> In some cases the presence of such chemically similar coloring matters, playing an important rôle in determining the appearance of the animals, has a distinct part in the theory of animal coloration, since, if substantiated, identity of composition as regards pigments may be significant for the evolutionary origin of types of pigmentation (e.g. in so called "warning" coloration<sup>2</sup>). The pigmentation of the large nudibranch *Chromodoris zebra* has been studied from the standpoint of its possible adaptive quality,<sup>3</sup> and since it happens that coloring matters superficially corresponding to those in *Chromodoris zebra* are found in a good many species of this widely dispersed genus,<sup>4</sup> it is desirable to examine the degree of chemical similarity of these substances. The blue pigment which plays a conspicuous part in the coloration of these creatures has properties favorable for such study. A yellow pigment, also of frequent occurrence in the genus, belongs to the carotinoid "lipochrome" series, but because of the very general occurrence of such substances as pigmentary components derived from plant food, it is less significant for the present purpose.

<sup>1</sup> Briot, A., *Compt. rend. Soc. Biol.*, 1906, lxxxviii, 1157. Crozier, W. J., *Zool. Jahrb., Abt. Zool.*, 1915, xxxv, 233; *J. Biol. Chem.*, 1918, xxxv, 455; *Am. Naturalist*, lii, 552.

<sup>2</sup> Crozier, W. J., *Anat. Rec.*, 1919-20, vii, 349.

<sup>3</sup> Crozier, W. J., *Anat. Rec.*, 1919-20, vii, 349; *Proc. Nat. Acad. Sci.*, 1916, ii, 672.

<sup>4</sup> Crozier, W. J., *J. Physiol.*, 1913-14, xlvii, 491.

Solutions of the blue material were compared in the case of the three species: *Chromodoris zebra* from Bermuda, *Chromodoris porterae* from La Jolla, California, and *Chromodoris universitatis* from Laguna Beach, California. An extract from specimens of any of these species in aqueous formaldehyde, is bluish purple in color, turned pink by acids at about pH 5.6, and changed to blue (with some precipitation of a greenish flocculent material) by alkali.<sup>5</sup> In some other qualitative respects the substances extracted from the three species also agree, notably in yielding positive tests for the presence of manganese, and in being decolorized, reversibly reduced, by putrefactive bacteria; but the most important data are derived from the absorption spectra. In formaldehyde solution the *Chromodoris zebra* pigment gives a narrow, sharply bounded absorption band centering on 620 to 622 $\mu\mu$ . In alcoholic extract, neutral or faintly acid, the absorption band likewise centers at 622 $\mu\mu$ .

The extracts are stable for at least several years (especially if shielded from bright sunlight), hence it is unnecessary to employ freshly prepared solutions of the pigments. *Chromodoris porterae* pigment, in the comparison spectroscopy, gave an absorption which could not be distinguished from that of *Chromodoris zebra*, and, as determined by successive dilutions, the absorption maximum was also at about 620 $\mu\mu$ . This is likewise true of the pigment of *Chromodoris universitatis*.

It is believed, consequently, that the blue pigment which has a special importance for the coloration of the genus *Chromodoris* is a very similar body, chemically, in widely dispersed species of this genus;<sup>6</sup> and since the habits of the various species differ considerably, it must be reckoned as a distinct probability, therefore, that the pigment has primarily no relation to the habits of these animals, but is an expression, merely, of the fundamental chemistry of the Chromodorid stock.

<sup>5</sup> cf. Crozier, W. J., 1916, *J. Biol. Chem.*, xxiv, 255. In alcoholic solution the green material is soluble.

<sup>6</sup> *Chromodoris porterae* were obtained from the Scripps Institution, and *Chromodoris porterae* and *Chromodoris universitatis* from Professor W. A. Hilton of Pomona College; the author is grateful for this assistance.