

CHAPTER XIX.

BILATERAL SERIES—*continued.*

FURTHER ILLUSTRATIONS OF THE RELATIONSHIP BETWEEN RIGHT AND LEFT SIDES.

I. *Variations in Segmentation of the Ovum of Loligo.*

The following facts, taken from WATASE¹, are introduced in further illustration of the mode of occurrence of bilaterally symmetrical Meristic Variation.

*720. **Loligo pealei.** In the blastoderm the nucleus is placed eccentrically, being rather nearer to the posterior pole, as shewn in Fig.

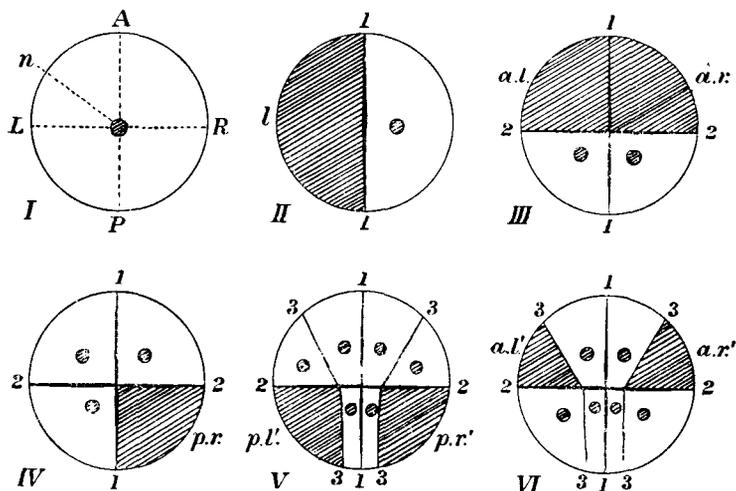


FIG. 149. Diagrams illustrating variations in segmentation of a Squid. (*Loligo pealei*).

I. Normal unsegmented ovum. *n*, the nucleus eccentrically placed. *A*, anterior. *P*, posterior. *L*, left. *R*, right. II, III, and IV. The shaded portions shew areas in which in some specimens nuclear division was precocious. V. In the two shaded areas triasters occurred in one specimen. VI. The blastomeres of the shaded areas in one specimen were not divided from each other. 1, 2, 3, successive planes of division. *ar*, anterior right quadrant. *pr*, posterior right quadrant. *ar'*, *pr'*, &c. areas separated off by the third segmentation-furrow. (After WATASE.)

¹ WATASE, S., *Jour. of Morph.*, iv. 1891, p. 247, Plates.

149, I. The first furrow, 1, 1, divides the blastoderm into two halves and corresponds with the future longitudinal middle line. The second furrow, 2, 2, is at right angles to this, dividing the blastoderm into anterior and posterior halves, and the third furrow, 3, 3, passes as shewn in Fig. 149, V.

In the subsequent segmentations various irregularities were seen in single eggs, some of the variations being bilaterally symmetrical while others were confined to a particular half or to a particular quadrant. For example, in some ova the nuclei of the cells formed from the left half of the blastoderm, excepting those next the median axis posteriorly (Figs. 149, II and 150, I), began to divide before those of the right side and reached an advanced stage of karyokinesis while the nuclei of the right half were still resting. The nuclei of each half kept time very nearly (for details see original figures). This curious variation was seen in three (perhaps four) ova all taken from one mother.

In another the nuclei of the two anterior quadrants *al*, *ar*, in their divisions kept ahead of those of the posterior quadrants. Fig. 149, IV, represents an ovum in which the nuclei of the right posterior quadrant on the contrary divided before those of the 3 other quadrants.

Another variation is shewn in Figs. 149, VI and 150, II. There the four blastomeres shaded had either been never fully divided from each other or had subsequently fused together symmetrically on each side.

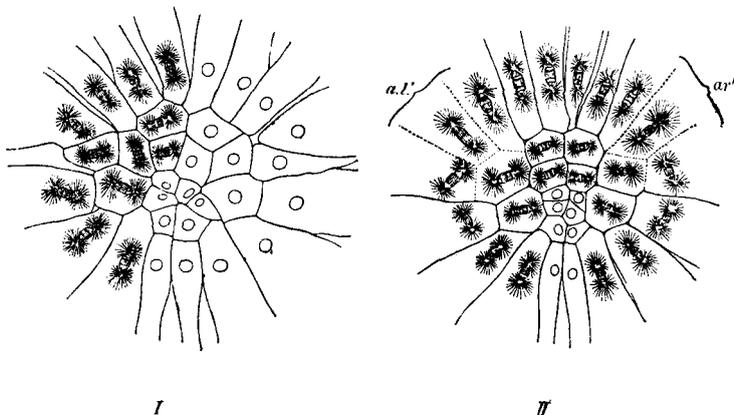


FIG. 150. Variations in segmentation of ovum of *Loligo pealei*. I. Case in which the nuclei of cells of the left half of the blastoderm began to divide precociously. II. Case in which the blastomeres of the areas *ar'* and *al'* were not distinct from each other. (After WATASE.)

Fig. 149, V, illustrates another remarkable Meristic variation which symmetrically affected the portions shaded. In both of these shaded segments the nuclei divided into *three* by triple karyokinesis, forming "tristers."

II. *Homœosis in cases of normal Bilateral Asymmetry.*

In proportion as an animal is bilaterally symmetrical the right side is an image of the left. Nevertheless in many substantially symmetrical forms there is asymmetry in the condition of some one or more organs present on both sides. (This asymmetry, in the cases to be considered, is of course distinct from that due to asymmetrical disposition of unpaired viscera, such as the heart and liver of vertebrates, &c.) In several of these cases there is evidence that both sides may on occasion assume the form normally proper to one only.

Some one will no doubt be prepared with the suggestion that these variations are reversions: with this suggestion I shall deal after the facts have been recited.

Spiracle of Tadpole.

721. **Pelobates fuscus**: a tadpole, 7 cm. long, having two spiracles symmetrically placed (Fig. 151), one on the right side and the other on the left¹. [No details given.] HÉRON-ROYER, *Bull. soc. zool. Fr.*, ix.



FIG. 151. A tadpole of *Pelobates fuscus*, having, as a variation, two spiracular openings, No. 721. (After HÉRON-ROYER.)

1884, p. 162, *fig.* [In the normal there is only one spiracle, that of the left side. In *Pipa* and *Dactylethra* two spiracles are normally present. See WYMAN, *Proc. Bost. N. H. S.*, ix. p. 155; WILDER, *Am. Nat.*, 1877, xi. p. 491; BOULENGER, *Bull. soc. zool. Fr.*, 1881, vi. p. 27.

Tusk of Narwhal.

722. **Monodon monoceros** (Narwhal). In normal males the left tusk alone is developed while the right remains abortive in its alveolus. In the female both tusks are in this rudimentary condition. No reliable record (1871) of a specimen having the *right tusk only* developed, but in eleven cases from various sources the two tusks were *both* developed, and in several of these the two were of about equal length. The normal asymmetry of the skull is not affected by the presence or absence of the teeth. CLARK, J. W., *P. Z. S.*, 1871, p. 42, *figs.* (full literature); see also TURNER, W., *Jour. Anat. Phys.*, 1871, p. 133 and 1874, p. 516.

Ovary and oviduct of Fowl.

It might be anticipated that development of the right ovary and oviduct in birds would be a frequent form of Variation, but as a matter of fact very few such cases are recorded. In consideration of

¹ In the same place is recorded a case of a tadpole of this species having the spiracle on the right side instead of the left, perhaps a case of *situs inversus*.

the large numbers of birds, wild and domesticated, annually dissected in laboratories it may perhaps be concluded that these variations are exceedingly rare¹.

723. **Hen** having a small right ovary in addition to the left ovary. The left oviduct was normal, but the left ovary was partially transformed into sacculated tissue. [Full histological details of the structure of both ovaries given.] The hen had partly assumed the plumage of the cock, having four sickle-feathers and other characters proper to the male. BRANDT, *Z. f. w. Z.*, XLVIII. 1889, p. 134, *Pls.*
724. **Hen** having a normal left oviduct and in addition a partially developed right oviduct which formed a large thin-walled cyst distended with gas. C. S. M., *Ter. Cat.*, 1872, 455.

*Proboscis-pore of Balanoglossus
and water-pores of larvæ of Asterias.*

- *725. **Balanoglossus kowalevskii.** The anterior or proboscis-body-cavity is continued backwards into the proboscis-stalk as two hollow horns. In this and most other species the left of these alone acquires an opening to the exterior at the proboscis-pore. In *B. kupfferi* alone there are two such pores, one opening into each of the two horns². A specimen of *B. kowalevskii* in which both horns thus opened to the exterior was seen by MORGAN, T. H., *Jour. of Morph.*, 1891, v. p. 442.
726. **Asterias vulgaris.** The *Bipinnaria* larva as commonly seen resembles the usual *Tornaria* in having a left water-pore only. In several larvæ $3\frac{1}{2}$ to 4 days old the presence of two such water-pores, a right and a left, symmetrically placed, has been observed by FIELD and BROOKS. The right pore subsequently closes. This condition is believed by Field to represent not a variation but a normal phase of development [though further confirmation is needed]. FIELD, G. W., *Q. J. M. S.*, 1893, xxxiv. p. 110, Pl. xiv. figs. 22 and 23.

Variations in Flat-fishes.

A curious series of variations bearing on the relations of the right side to the left occur in Pleuronectidæ. The evidence on this subject was collected by STEENSTRUP³ in 1863.

Flat-fishes are normally coloured on the upper side and are without chromatophores in the skin of the lower side⁴. Variations in colour occur in two ways; the upper side may be white like the lower, or on the contrary the lower side may be coloured like the upper. The former change cannot well be distinguished from other cases of albinism⁵ and does not call for special notice here.

¹ In view of the cases of the Crayfish and the Cockroach mentioned in the Preface, much stress cannot be laid on this consideration.

² SPENGLER, J. W., *Mitth. zool. Stat. Neap.*, 1884, v. p. 494, Pl. xxx. fig. 2.

³ STEENSTRUP, *Overs. k. Dansk. vid. Selsk.*, 1863, p. 145, abstr. by WYVILLE THOMSON, *Ann. and Mag. N. H.*, 1865 (1), p. 361.

⁴ In some species the coloured side is normally the right, in others the left, reversed specimens being common in some species (*P. flesus*), rare in others. The reversed condition concerns only the head, skin, muscles, &c., and there is no transposition of the internal viscera.

⁵ Evidence collected by STEENSTRUP. GOTTSCHKE (*Arch. f. Naturg.*, 1835, II. p. 139) states that *P. platessa* is not rarely wholly white on both sides. I have never

The converse variation, by which the lower side assumes the colour of the upper side is important in several aspects.

Interest has of late been drawn to this subject especially through an experiment recently made by CUNNINGHAM¹, who found that of a number of young flat-fishes reared in a vessel illuminated by mirrors from below, some became partially marked with pigmented patches on the lower side. The suggestion was made that this pigmentation was induced by the direct action of light. It is of course impossible here to enter into the theoretical questions raised in connexion with this subject and this account will be confined to description of the colour-variation as seen in nature and of the singular variation in structure commonly associated with it. Mr Cunningham has obligingly advised me in connexion with this subject.

Pigmentation of the lower side has been seen in *Rhombus macimus*, *R. laevis*, *Pleuronectes flesus*, *P. platessa*, *P. oblongus*, *Solea vulgaris* [?] and probably other forms. Attention is drawn to one feature in these changes which from our standpoint has an important bearing. When the underside of a flat-fish is pigmented, it is often not merely pigmented in an indefinite way but it is coloured and marked just as the upper side is. There are, I know, many specimens upon whose undersides a brownish yellow tint is either generally diffused or restricted to patches, but when there is pigmentation of a deeper shade, as in all the well marked cases of the variation, the colour and markings are closely like those of the upper side. For example, a Plaice (*P. platessa*) sent to me by Mr Dunn of Mevagissey is fully coloured over the posterior half of the lower side; but there is not merely a general pigmentation, for the coloured part of the lower side is *marked with orange markings* exactly like those of the upper side.

More than this: it was found by passing pins vertically through the body that there was in the case of most of the spots a close *correspondence in position between those of the upper and those of the lower side*. There were 13 spots on the coloured part of the lower side, which extended slightly beyond the line of greatest width. Of these, 13 spots on body and fins coincided exactly with those of the upper side; 2 coincided nearly; 2 were not represented on the upper side; and 2 spots of the upper side were not represented on the lower. From these facts it is clear that in "double" flat-fishes we have an instance of *symmetrical* variation of one half of the body into more or less complete likeness of the other half, resembling other cases of Homœosis in Bilateral Series already noticed.

This is made the more evident by the fact that in the two best described specimens of "double" Turbot (No. 727) not merely did the lower side resemble the upper side in point of colour, but upon it were also present the bony tubercles normally proper to the dark side, being only slightly less well developed on the lower side than on the upper

succeeded in seeing an entirely white specimen, though individuals partially white on the upper side are not rare. See also *Zool.*, pp. 4596, 4914. *Zeugopterus punctatus* white on both sides, DAX, *Brit. Fishes*, II. p. 19.

¹ CUNNINGHAM, J. T., *Proc. Roy. Soc.*, 1893.

(Such a development of tubercles¹ on the lower side may however occur without any correlated change of colour.) It is also stated that in the "double" turbot^s the muscles of the lower side are thicker than they normally are, thus approximating to the upper side, a feature that may be taken as an indication that the manner of swimming is different from that of normals.

A flat-fish having pigmentation on the lower side does not necessarily present any other abnormality². The Plaice, for instance, just mentioned, was, colour apart, quite normal. But some specimens of flat-fishes darkly coloured below present in addition a very singular structural variation. This consists essentially in the presence of a notch of greater or less depth occurring below the anterior end of the dorsal fin above the eye (Fig. 152). By this cleft the anterior end of the dorsal fin is separated from the back of the head and is borne on a process or horn projecting anteriorly so as to continue the contour of the body above the

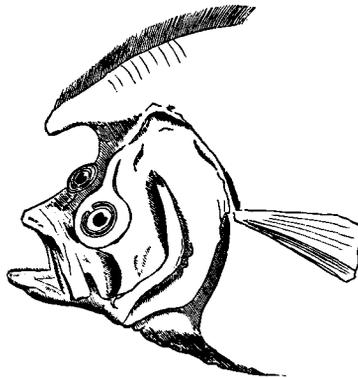


FIG. 152. Head of a Brill (*Rhombus levis*) having the dorsal fin separated from the head as described in the text. (From YARRELL.)

¹ The literature relating to discontinuous variations consisting in the presence of bony tubercles upon the blind side of *Rhombi* is extensive. See especially DÉMIDOFF, *Voy. dans la Russie Mérid.*, 1840, III. p. 534, Pls. 28, 29 and 30. STEINDACHNER, *Sitzb. Ak. Wiss. Wien*, 1868, LVII. (1), p. 714. RATHKE, *Mém. Ac. Sci. Pét.*, 1837, III. p. 349. GÜNTHER, *Cat. Brit. Mus. Fishes*, IV. p. 409. These cases will not be confounded with those of supposed hybrids between *R. maximus* and *R. levis*, which bear upon both sides scales of various sizes.

² I know no detailed description of a flat-fish wholly pigmented on the underside, having the dorsal fin normal, but numerous authors (Gottsche, Duhamel, &c.) make mention of such cases. Since this chapter was written I have seen two recent papers on the subject by GIARD (*Comptes rend. Soc. Biol.*, 1892, S. 9, IV. p. 31 and *Nat. Sci.*, 1893, p. 356) contributing further evidence on the subject and giving new cases in the Turbot. According to Giard, of flounders (*P. fesus*) at Wimereux 3% are fully coloured on the blind side, in addition to many that are piebald. This must be a very much higher proportion of abnormal specimens than is found in English fisheries.

head. STEENSTRUP states that the variation has, he believes, been observed in all flat-fishes¹ except the Halibut (*Hippoglossus*).

In several but *not all* cases of this abnormality the eye belonging to the lower side was not placed in its normal position on the upper surface, but stood in an intermediate position on the top of the head, so that it could be partially seen in profile looked at from the "blind" side. It seems possible that the pigmentation of the "blind" side is in some way correlated with some abnormal delay in the shifting of the eye and a consequent continuation of the power of receiving visual sensations from this side.

The abnormality of the dorsal fin is in accordance with this supposition. To understand the nature of this condition it must be remembered that the form of the flat-fish is derived from the usual "round" form by two principal changes. (1) By a twisting of the head the eye is brought over from the blind side to the upper side. (2) The dorsal fin is extended forwards *above* the eye thus shifted; for as STEENSTRUP and TRAQUAIR² have shewn, this anterior extension of the dorsal fin is not in the morphological middle line. It is in fact an anterior repetition of the series of dorsal fin-rays along the new contour-line of the body, and occurs irrespective of the fact that the tissues with which it is there associated are not median at all.

STEENSTRUP and TRAQUAIR shewed plainly that it is insufficient to suppose that there is a twisting of the head, for this does not explain the presence of the dorsal fin in the position in which it is found, *curving along that which was once the side of the head*. Traquair suggested that these relations could be attained by two processes; (1) a twisting of the head so as to bring over the eye from the future "blind" side, and (2) a forward growth of the dorsal fin along that which is then the upper contour-line of the head. These processes have now been actually seen by AGASSIZ³ in several Pleuronectidæ. The first observation of a specimen at the stage when the eye is on the top of the head and the dorsal fin is not yet extended, seems to be that of MALM⁴ and there can be little doubt that the normal development proceeds in this way⁵. It has been pointed out by many writers that if the upper eye were to remain in an intermediate position on the top of the head, and the dorsal fin were then to grow forwards, arching over it, the condition of these abnormal forms would be reached. That this is what has actually occurred in them seems likely.

A number of difficult questions are thus raised as to the histological

¹ The evidence as to the Sole seems to be doubtful (v. infra).

² TRAQUAIR, *Trans. Linn. Soc.*, 1865, xxv. p. 263.

³ AGASSIZ, *Proc. Amer. Ac. Sci.* 1878, xiv. p. 1, Pls.

⁴ MALM, *Ejvers. k. Sven. Vet. Ac.*, 1854, p. 173, see *Ann. and Mag. N. H.* 1865 (1), p. 366.

⁵ Allusion should be made to the fact that in the genus "*Plagusia*" the dorsal fin acquires its forward extension at a time before the shifting of the eye occurs. When the time for this change comes the eye of the future blind side passes under the dorsal fin and above the skull, *through the tissues from one side of the head to the other*. This was first observed by STEENSTRUP, and afterwards by AGASSIZ in great detail and the fact can hardly now be questioned. This mode of development is peculiar to "*Plagusia*," though when Steenstrup wrote he expected that the same would be found to occur in other Pleuronectidæ.

processes by which the dorsal fin comes to stand where it does. We are accustomed to think of the repetition of the fin-rays as being an expression of the fundamental segmentation of the trunk, accessory to it no doubt, but still of the same nature and histologically dependent upon it. The extension of this repetition along the morphological side of the face is thus an anomaly.

Further comment on the nature of the variation will be made after the chief cases have been given.

- *727. **Rhombus maximus** (Turbot). Two specimens respectively 9 in. 9 lines and 7 in. 6 lines in length, 7 in. 6 lines, and 5 in. 6 lines broad. Both sides of a similar coffee-brown colour. The smaller had a yellowish white spot, about 1 in. square, on the operculum of the lower side. The colour was more uniform than usual and the dark spots normally found on the fins of the Turbot were absent. Both sides irregularly beset with horny tubercles, only slightly more developed on the upper than on the lower sides. Fine *scales* were also found deep in the skin of both sides. All fins except the dorsal were normal in form and position. The dorsal fin was anteriorly detached from the head, being borne on a horn-like projection. The separation between the head and dorsal fin was continued backwards as a semi-circular notch to a level behind the eyes. Upon many of the fin-rays of the dorsal, anal and caudal fins there were 1—7 small knotty elevations of the size of poppy-seed. In the smaller specimen these elevations were smaller, and on the caudal fin absent. The left eye had its normal position, but the right eye [of "blind" side] was placed on the top of the head, but in such a position that it could scarcely have seen any thing not directly over it. [See further details given.] SCHLEEP, *Isis*, 1829, p. 1049, Pl. III.

Similar specimen COUCH, *Fishes Brit. Isl.*, III. p. 157. Dried specimens in Brit. Mus., Newcastle Mus., &c.

- *728. Very good figures of such a Turbot are given by DUHAMEL DU MONCEAU (*Traité général des Pesches*, 1777, III. Sect. IX. p. 262, Pl. III. figs. 3 and 4). The under side was of nearly the same colour as the upper and the tubercles generally found on the upper side only were present on the lower side also, though of smaller size. A slight notch separated the dorsal fin from the head; *but the upper eye is figured as in its normal place*, not being on the top of the head, and it would of course be invisible from the "blind" side. [This important case is referred to by STEENSTRUP, but seems to be unknown to others, who attribute the separation of the dorsal fin to the persistence of the eye on the top of the head.]

729. A young turbot, similarly coloured on both sides, having the eyes still symmetrical, swimming on edge, is figured by McINTOSH, *Fishes of St. Andrews*, 1875, Pl. VI. figs. 5 and 6. Prof. McIntosh kindly informed me that these "double" individuals swim on edge much longer than usual.

730. **Rhombus lævis** (Brill). Specimen presenting similar characters. The lower (rt.) side of a uniform dark colour with exception of a white patch on operculum. The right pectoral fin was whitish. The under side was rather darker than the upper and the mottling present on the upper side was entirely absent from the under side, which was without marking or spot. This is very probably a post-

mortem change. Right pelvic fin dark, but the left was whitish, speckled with black. Nostrils normal. The eye of the right (blind) side was placed almost entirely on the left side, but not completely so, for it could be seen to some extent in profile from the right side. The notch separating the dorsal fin from the head was rounded, and extended to about the level of the posterior margin of the left eye. There were about 6 chief fin-rays borne by the prominence above the eye. The fish seemed to be in all respects healthy and well grown. *Paris Mus.*, numbered *90*310. [This specimen was kindly shewn to me by Prof. Vaillant.]

Similar specimen, also having white patch on operculum DUHAMEL DU MONCEAU, *l. c.* See also Fig. 152, from YARRELL, *Brit. Fishes*, 3rd ed., i. p. 643.

The specimen described by DONOVAN (*Brit. Fish.*, 1806, iv. Pl. xc.) under the name "*Pleuronectes cyclops*" was in Steenstrup's opinion a young Brill having this variation. In this specimen the right eye is seated on the top of the head and is seen in profile from the right side. The right side was coloured like the left, but was not so dark. The dorsal fin began behind the right eye. This specimen was found in a rock-pool "enveloped in a froth" said to have resembled cuckoo-spit.

731. ***Zeugopterus punctatus*** (Müller's Topknot). This fish is very liable to malformations of the anterior end of the dorsal fin, causing it to form an arch over the eyes. YARRELL (quoting COUCH, *Brit. Fish.*, 3rd ed., i. p. 648).
732. "***Platessa oblonga***" De Kay (American Turbot); specimen having both sides darkly coloured; upper eye placed on the top of the head; dorsal fin separated by a notch. STOREY, *Mem. Amer. Ac. Sci.*, viii. p. 396, Pl. xxxi. fig. 2 b.
733. ***Pleuronectes platessa*** (Plaiçe): specimen completely and similarly pigmented on both sides far from rare. In a specimen thus coloured the '*tubercula capitis*' were as strongly marked on the one side as on the other. In several examples the anterior end of the dorsal fin was separated from the head, GOTTSCHÉ, *Arch. f. Naturg.*, 1835, ii. 1, p. 139.
734. ***Pleuronectes fesus*** (Flounder): several specimens found at Birkenhead, having a deep notch of this kind above the eyes. These fishes were 'very dark brown (almost black) on both sides.' In the length of the fins these examples differed somewhat from the Flounder, HIGGINS, *Zoologist*, 1855, p. 4596, fig. Specimen of this kind figured by TRAQUAIR, *Trans. Linn. Soc.*, 1865, xxv. p. 288, Pl. xxxi. figs. 8 and 9. See also NILSSON, *Skandin. Fauna: Fiskarna*, Lund, 1855, p. 621; COUCH, *Brit. Fishes*, 1864, iii. p. 198.
735. ***Solea vulgaris***. Many authors mention Soles coloured on both sides, but I know no good description of one. YARRELL (*l. c.*, p. 669) says "we have not seen the *Solea Trevelyani* of Ireland (Sander's News-letter, 16th April, 1850). It is dark-bellied and is described as bearing a projection on the head like the monstrosity figured on p. 643." DUHAMEL DU MONCEAU (*l. c.*, Pl. i. figs. 3 and 4) represents a sole darkly coloured on both sides. The dorsal fin is shewn in its normal state, not separated from the head. No special description is given, and as the author does not state that he had himself seen such a sole the figure was perhaps not drawn from an actual specimen. A sole with the under side piebald is described in *Zool. x.* p. 3660.

In connexion with this evidence STEENSTRUP refers to a small flat-fish, *Hippoglossus pinguis*, found in a few localities in Scandinavian waters, having a form almost intermediate between a "flat" and a "round" fish. The eye of the "blind" side is exactly on the top of the head and can be seen in profile from the blind side. The blind side is nearly as muscular as the upper side, and its skin is yellowish-brown in colour and is only slightly paler than that of the upper side. The dorsal fin begins behind the eye, not arching over it. Steenstrup looked on this creature as representing in a normal form the "double" condition presented as a variation in the cases we have been speaking of. See description and figures in SMIT's edition of FRIES, EKSTRÖM and SUNDEVAL'S *Hist. of Scand. Fishes*, 1893, pp. 416 and 417. SMIT makes a new genus, *Platysomatichthys*, for this animal.

Comment on the foregoing cases.

In the cases preceding many will no doubt see manifest examples of *Reversion*. *There is a sense in which this view must be true, for it can scarcely be questioned that if we had before us the phylogenetic series through which the Flat-fishes, the Narwhal, &c. are descended, it would be seen that each did at some time have a bilaterally symmetrical ancestor.* But, for all that, in an unqualified description of the change as a reversion the significance of the facts is missed. By the statement that a given variation is a reversion it is meant that in the varying individual a form, once the normal, reappears. The statement moreover is especially intended to imply that the *definiteness and magnitude* of the step from normal to variety is due to the circumstance that this variety was once a normal. It is meant, in fact, that the greatness of the modern change can be explained away by the suggestion that in the past, the form now presented as a variation, was once built up by a gradual evolution, and that though in its modern appearance there is *Discontinuity*, yet it was once evolved gradually.

Now the attempt to apply this reasoning, especially to the case of the "double" Flat-fishes, leads to difficulty. We may admit that in so far as the varieties are bilaterally symmetrical they represent a normal. Their bilateral symmetry, as a quality apart, may be an ancestral character, if any one is pleased so to call it. But that in the contemporary resumption of a bilateral symmetry we have in any further sense a reappearance of an ancestral form is very unlikely.

First it might be fairly argued that it is improbable that there was ever a typical flat-fish having on *both* sides the peculiar pigmentation of the present upper sides of the Pleuronectidæ of our day. Such a creature would be highly anomalous. But even if in strictness we forego the assumption that since the evolution of Flat-fishes there has never been an ancestor fully pigmented on both sides, there still remains the difficulty that each species may in the "double" state have upon its lower side the *specific* colour proper to its own upper side. A notable instance of this has been mentioned in the Plaice (p. 467); and here not only was the pigmentation of the lower side, as far as it went, like that of the upper, but the spots were even almost bilaterally symmetrical. It is true that the lower side does not in every case copy the upper in colour, but it *may* do so; and, in proportion as it does so in different species, so far at least are the changes not simply reversions; for the several patterns of Turbot, Plaice &c. are mutually exclusive and it can hardly be supposed that each species had separately a "double" ancestor having the present specific pattern on both sides.

The outcome of this reasoning is to shew that the hypothesis of *Reversion* in the strict sense is an insufficient account of the actual variation in these Flat-fishes, and in the production of these varying forms there is thus a *Discontinuity* over and above that which can be ascribed to *Reversion*. The facts stated in connexion with the Plaice (p. 467), especially the symmetry of the spots, probably indicate the real nature of this *Discontinuity*, and raise a presumption that in the new resemblance of the lower side to the upper we have a phenomenon of *Symmetry* resembling that *Homœosis* shewn to occur between parts in

Linear Series. In the Flat-fish the right side and the left have been differentiated on different lines, as the several appendages of an Arthropod have been, but on occasion the one may suddenly take up all or some of the characters, whether colour, tubercles or otherwise, in the state to which they have been separately evolved in the other.

What may be the cause leading to this discontinuous change we do not know. That it is often associated with a delay in the change of position of the eye of the "blind" side seems clear from the frequent detachment of the dorsal fin in these cases. But it should be borne in mind that even in such examples the eye may still eventually get to its normal place, though probably it was delayed in the process and so led to detachment of the fin. Taken with the fact that the young "double" turbot swim on edge longer than the normals it must be concluded that the bilateral symmetry of colour is associated with reluctance or delay in the assumption of the asymmetrical state, but more than this cannot be affirmed.

I do not urge that the same reasoning should be applied in other cases, but the possibility must be remembered. In the Narwhal, for instance, it is perhaps unlikely that there was ever an ancestor which had two tusks developed to the extent now reached by the left tusk of the male; but if there ever were any such form, it is hard indeed to suppose that it could have been connected with the present species by a series of successive normals in which the right tusk gradually diminished while the left was of its present size. On the whole it seems more likely that when the right tusk now develops to be as long as the left, it is taking up at one step the state to which the left has been separately evolved.

However this may be, the fact that such Homœosis is possible should be kept in view in considering the meaning of such cases as that of a *Tornaria* with two water-pores. For while on the one hand we may suppose that *Balanoglossus kuppferi* with its normal pair of water-pores is the primitive state and that the varying *Tornaria* is a reversion, on the other hand *B. kuppferi* may be a form that has arisen by a Homœotic variation from the one-pored form, and of this variation *Balanoglossus* No. 725 may be a contemporary illustration¹.

¹ The following interesting example of a similar Variation has appeared since these pages were set up. *Eledone cirrhosa*: specimen having not only the third left arm developed as a hectocotylus, as usual, but the third right arm also. The right had 57, the left 66 suckers, but otherwise they were alike. APPELÖF, A., *Bergens Museums Aarbog*, 1893, p. 14.