CHAPTER XVIII.

BILATERAL SERIES.

OF the organs repeated in Linear Series whose variations have been illustrated, many are bilaterally repeated also; but thus far we have considered them only in their relations as members of Linear Series. It now remains to examine the variations which they exhibit in virtue of their relation to each other as members of a Bilateral Series.

Meristic Variation in this respect is manifested in two ways. A normally unpaired organ standing in the middle line of a bilateral symmetry may divide into two so as to form a pair of organs; and conversely, a pair of organs normally placed apart from each other on either side of a middle line may be compounded together so as to form a single organ in the middle line.

In animals and plants nothing is more common than for different forms to be distinguished from each other by the fact that an organ standing in the middle line of one is in another represented by two organs, one on either side. The facility therefore with which each of these two conditions may arise from the other by discontinuous Variation is of considerable importance.

Admirable instances of the bearing of this class of evidence upon the question of the origin of Species are to be seen in zygomorphic flowers. *Veronica* for example differs from the other Scrophulariaceæ especially in the fact that it has only one posterior petal, instead of two posterior petals one on each side of a middle line. But there is evidence not only that forms having normally two posterior petals may as a discontinuous variation have only one such petal, placed in the middle line, but also that the single posterior petal of *Veronica* may as a variation be completely divided into two. Similarly the single *anterior* petal of *Veronica* may also as a variation be divided into two, thus giving three posterior and two anterior petals as in for example *Salpiglossis*[1]. In these cases, which might be indefinitely multiplied,

[1] An account of several discontinuous variations in the structure of zygomorphic corollas was given by Miss A. BATESON and myself. *Jour. Linn. Soc.*, 1892, XXVIII., *Botany*, p. 386.

there is thus a clear proof that so far as the variations in number and symmetry are concerned, the transition from the one form to the other *may* be discontinuous.

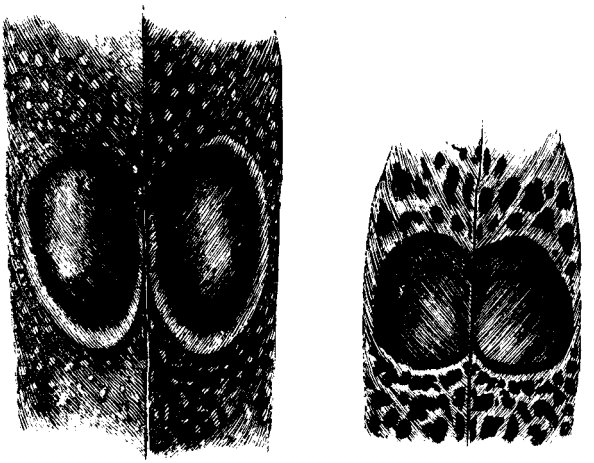
Analogous phenomena in animals are so familiar that general description of them is for the most part not needed, and an account will only be given of a few less known examples both of union and of division of such parts. Besides these strictly Meristic Variations in the amount of separation between the two halves a few examples are introduced in further illustration of the relationship that subsists between the two halves of a bilateral animal.

In considering the evidence both of median union and of division it must be remembered that the germs of most of the organs in question are at some time of their developmental history visibly double, and that when organs that should normally unite to form single median structures are found double in older stages, this duplicity is strictly speaking only a persistence of the earlier condition. But to appreciate this comment it should be extended. For, in every animal in which at some period of the segmentation of the ovum, the plane of one of the cleavages corresponds with the future middle line, all median organs must in a sense be paired in origin, and the distinction between paired and median organs is thus seen to be only one of the degree or amount of separation between the symmetrical halves. Nevertheless the evidence of Variation bears out the expectation that would be formed on examination of normal diversities between species or larger groups both in animals and plants, namely that whenever structures are geometrically related to each other as optical images, instability may shew itself as Variation in the degree to which such parts unite with or separate from each other. It is remarkable that this instability appears as much in the case of organs bilaterally symmetrical about an axis of Minor Symmetry as it does in the parts paired about the chief axis of Symmetry of the whole body.

Examples of such Variation in bilaterally symmetrical parts of a Minor Symmetry have been already given in the case of the feet of the Horse and of the converse phenomenon in the feet of Artiodactyles (*q.v.*).

A good illustration of the way in which duplicity about an axis of Minor Symmetry may pass into the unpaired condition is seen in the case of ocellar markings on bilaterally symmetrical feathers. By comparing different feathers on several species of *Polyplectron*, DARWIN found that it was possible to find most of the gradations between the complete duplicity shewn in Fig. 140, I, where each half of the feather bears an almost symmetrical ocellus, and the partially confluent condition shewn in Fig. 140, II, which is not far removed from the state of the ocellus in the Peacock's tail-coverts, where the whole ocellus has no peripheral

indentation and is very nearly symmetrical about the rachis of the feather, though each of its *halves* has no axis of symmetry.



I II

FIG. 140. I. Part of tail-covert of *Polyplectron chinquis*, with the two ocelli of nat. size. II. Part of tail-covert of *Polyplectron malaccense*, with the two ocelli partially confluent, of nat. size.
(From C. DARWIN, *Descent of Man*, 1871, II. p. 139, *figs.* 54 and 55.)

Attention should be called to the fact that abnormal division along a middle line may in many cases represent one of two different phenomena which are not readily distinguishable. For when a normally single organ is represented by two, standing on either side of a middle line it is often possible that there may be not only a division of the organ but a partial duplicity of the axis. These two conditions are of course morphologically distinct; for in the case of division of the organ only, the two parts are still in symmetry about the original axis of Major Symmetry of the body, but in the case of duplicity of the axis there are two equivalent axes of symmetry, about which each half is separately symmetrical. But though this distinction is in a sense a real one it cannot be applied to cases of duplicity occurring in any organ whose halves assume a bilaterally symmetrical form when separate. For example in the case of the foot of the Horse, or of the hæmal spines &c. of Gold-fishes (*v. infra*), when division occurs, each of the two halves is only hemi-symmetrical, and this duplicity is no more evidence that the axis is double than is the ordinary double condition of the vertebrate kidney; but in the case of duplicity of the central neural canal in Man for instance, or in the case of the tail-spine of *Limulus* described below, it is not clear that there is not a partial duplicity of the axis.

DIVISION OR ABSENCE OF UNION IN MIDDLE LINE.

Most of the organs which in a vertebrate stand in a median position have been seen more or less often in a divided condition.

Examples of such division in the middle line were, I believe, first put together by GEOFFROY ST HILAIRE, and a very full collection of the evidence seen in Man is given by AHLFELD[1]. The organs most often divided are the sternum, neural arches, uterus, penis, &c., and of these, specimens may be seen in any pathological collection. Organs more rarely divided are the tongue[2], epiglottis[3], uvula[4], and central neural canal[5]. The following are special cases of variation consisting in a median division.

Division of caudal and anal fins in Gold-fishes.

*691. **Cyprinus auratus** (Gold-fish). The following account of the multiple fins of Gold-fishes in China and Japan is taken chiefly from Pouchet[6] and Watase[7]. There is evidence to shew that these animals were first imported to Japan from China.

Three distinct breeds of Gold-fishes are kept in Japan. The first, called "*Wakin*" has a slender body closely resembling that of the common carp. The second "*Maruko* or *Ranchiu*" has a very short body, being in some cases almost globular in shape and in it the dorsal fin is generally entirely absent. The head is usually disfigured by rough-looking protuberances of the skin which often attain a considerable size.

The third or "*Riukin*" has a short body with a rounded abdomen. Of all the breeds, this has the most beautiful tail which is very large and often longer than the rest of the body.

Gold-fish breeders of the present day can freely produce the "*Riukin*" or "*Maruko*" from the "*Wakin*." Various intermediate forms between the above-mentioned breeds exist.

In all gold-fishes, irrespective of the breed to which they belong, the tail-fin is, above all other parts, subject to the greatest variation. It is to be found in one of the following three states;

(1) It is vertical and normal.

(2) It may consist of two separate halves; each of these halves is to all appearance a complete tail and the two tails pass backwards side by side, *but are united dorsally at the point where they join the body.*

(3) The two tails thus formed are united by their dorsal edges to a variable degree and their lower edges may be bent outwards, so that the two combined tails come to be spread out into a three-lobed, nearly horizontal fin.

[1] AHLFELD, F., *Missb. d. Menschen*, 1880.

[2] PARTSCH, *Bresl. Ärztl. Ztsch.*, 1885, No. 17; POOLEY, *Amer. Jour.*, 1872, N.S., CXXVI. p. 385 [from AHLFELD, p. 119].

[3] MANIFOLD, W. H., *Lancet*, 1851 (1), p. 10; FRENCH, *Ann. Anat. Surg. Soc. Brooklyn, N. Y.*, 1880, ii. p. 271 [not seen], from *Cat. Libr. Surg.-gen. U. S. Army.*

[4] TRÉLAT, *Gaz. des Hôp.*, 1869, No. 125 [for others v. AHLFELD, *Abschn.* II. p. 175].

[5] WAGNER, J., *Müll. Arch. Anat. Phys.*, 1861, p. 735, Pl. XVII. A.

[6] POUCHET, G., *Jour. de l'anat. et phys.*, VII. p. 561, Pl. XVII.

[7] WATASE, S., *Jour. Imp. Coll. Sci. Tokio*, I. p. 247, *Plates.*

Besides the caudal fin, the anal fin undergoes remarkable

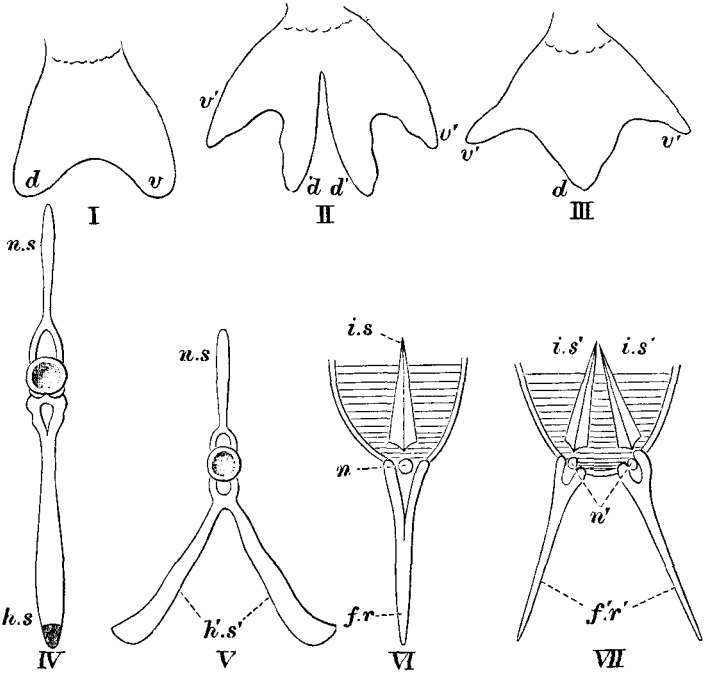


FIG. 141. Caudal and anal fins of Gold-fish (*Cyprinus auratus*).
I. Normal tail, seen from side. *v*, dorsal lobe. *d*, ventral lobe. II. Abnormal form divided as far as the notochord. *v' v'*, two ventral lobes. *d' d'*, two dorsal lobes. III. Abnormal form, the two ventral lobes, *v' v'*, separate. IV. Penultimate vertebra of normal Carp (*C. carpio*). *n.s*, neural spine. *h.s*, hæmal spine. V. Penultimate vertebra of a Gold-fish with trilobed caudal fin. *h'.s'*, double hæmal spine. VI. Diagram of transverse section through region of anal fin of normal Gold-fish. VII. Similar section through a specimen having the anal fin doubled. *i.s*, interhæmal spine. *f. r*, fin ray. *n*, bony nodule. *i.s'*, *f'.r'*, *n'*, corresponding parts doubled. (After WATASE.)

variation. It is either median and normal; or it may be distinctly paired (Fig. 141, VII).

There are all stages of caudal and anal fins, intermediate between the normal and the completely paired states. Thus the tail-fin with its lower portion alone in a double state, or the anal fin with either its anterior or posterior portion double and the remainder single, is of quite common occurrence. These different conditions of the two fins combine in various ways in different individuals thus giving rise to manifold varieties of form.

This doubling of the tail-fin consists essentially in a longitudinal splitting of the morphologically lower lobe of the tail. The first step in the process of doubling is seen in the case of gold-fishes in which there is a slight longitudinal groove in the

ventral margin of the tail-fin. This groove may be extended up through all the rays of the lower lobe of the tail, which then consists of two tails side by side. *The small dorsal lobe, which lies above the notochord, is never involved in the process, but always remains single.* There is therefore in this case no doubling of the axis of the body. Examination of the skeleton shews that in those fishes which have two tails the hæmal spines of the last three vertebræ are longitudinally split[1] and diverge to carry the two tail-fins (Fig. 141, V).

POUCHET lays stress on the fact that the size of each of the paired tails is greater than that of the normal tail of a Gold-fish; but as Watase states that in the variety "*Riukin*" the tail may be as long as the body, it is clear that this hypertrophy may exist without any repetition.

In cases where the anal fin is doubled the process is exactly the same, resulting from a longitudinal splitting of the rays of which it is composed. This may only affect the outermost parts of the fin or may be carried up further so as to divide the inter-hæmal spines, in which case the two anal fins arise from the body wall at separate points and diverge from each other.

POUCHET, who has extensively studied the history of Gold-fishes in Europe, believes that it is almost certain that those which were brought to Europe in the eighteenth century were all more or less of the double-tailed order. He refers especially to the figure given by LINNÆUS[2] representing the double-tailed form as a normal.

POUCHET states that the evidence goes to shew that this anomalous race is not maintained in China by any rigid selection. He quotes a Chinese encyclopædia to the effect that the double-tailed Gold-fish is found in running streams, and gives the evidence of KLEYN[3], a missionary in China during the eighteenth century, who states that "*In fluvio Sleyn Cyprini sunt qui caudam habent trifurcam et a piscatoribus* Leid-brassen *vocantur, quasi diceres aliorum Cyprinorum conductores.*"

Though the duplicity of the hæmal spines may be unaccompanied by other variations it should be noticed that the extraordinary "Telescope" Gold-fish not unfrequently has also the double tail-fin. In the Telescope Gold-fish the eyes project from the orbit to a greater or less extent, in the extreme form being entirely outside the head and attached by a small peduncle only. The various forms of abnormal Gold-fishes are generally to be seen in large quantities in the shops of the dealers in aquariums &c. which abound near the Pont Neuf in Paris. One of these dealers told me that he bred considerable numbers of them every year, and that in fish from the same parents there was little uniformity, many normals being produced for one that shewed any of the extreme variations. It is recorded that of the Gold-fish hatched in Sir Robert Heron's menagerie about two in five were deficient in the dorsal fin and two in a hundred or rather more had a "triple" [sc. three-lobed as described above] tail-fin, and as many have the anal

[1] It should be observed that there is no want of original union between the hæmal spines, for these close in the hæmal canal as usual. The phenomenon is thus altogether different from that of spina bifida in the neural spines.

[2] *Fauna suecica*, 1745, p. 331, Pl. II.

[3] KLEYN, *Miss.*, v. p. 62, Tab. XIII. fig. 1 [not seen], quoted by BASTER, *Opusc. subsec.*, Harl., 1762, p. 91, *note*.

fin doubled. The deformed fishes were separated from the others but did not produce a greater proportion of varying offspring than the normals (*Ann. Mag. N. H.*, 1842, p. 533).

For a magnificent series of plates illustrating the various forms of Gold-fishes see BILLARDON DU SAUVIGNY, *Hist. nat. des Dorades de la Chine*, Paris, 1780. [In Brit. Mus. copy text wanting ; I do not know if it ever appeared.]

Division of median structures in Coleoptera.

The following list includes every case known to me.

I. EPISTOME.

692. **Anisoplia floricola** (Lam.): Algerian specimen having the epistome (*chaperon*) completely divided into two parts in the middle line. Attention is called to the fact that this is a *normal* character in certain genera of Lamellicorns, for example, *Diphucephala* and *Inca*. FAIRMAIRE, L., *Ann. Soc. ent. France*, 1849, *Ser.* 2, VII. *Bull.*, p. LX.

II. PRONOTUM[1].

In Coleoptera the pro-thoracic shield or pronotum is normally a single plate continuous from side to side. The following is a list of cases in which this structure was composed of two lateral parts. In Nos. 695 and 706 the division was not completed through the whole length of the shield. The two halves were in most cases symmetrical, but in Nos. 700 and 703 they were unequal.

As is shewn by No. 704 &c., there is in these variations more than a mere fault of union between two chitinous plates, for in this case the adjacent or inner edges of the plates were beset with yellow hairs such as occur on the anterior and posterior margins of the normal pronotum. In No. 703 again the adjacent edges of the two plates are everted and form definite margins.

693. **Melolontha vulgaris** (Lam.), prothoracic shield consists of two symmetrical pieces which do not meet in the dorsal middle line. The prothorax is greatly reduced in length and the head consequently is almost in contact with the scutellum (Fig. 142, I). KRAATZ, G., *Deut. ent. Ztschr.*, 1880, p. 341, Pl. II. *fig.* 8.

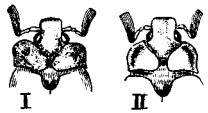


FIG. 142. *Melolontha vulgaris*, the Cockchafer, two cases of division of pronotum. (After KRAATZ.)

[1] With these cases compare the following: **Hydrobius fuscipes**, specimen having pronotum formed into *three lobes*, one being central, and two lateral. The lateral lobes projected from each side as considerable expansions. KRAATZ, G., *Deut. ent. Ztschr.*, 1889, p. 222, fig. 21.

694. A male, closely similar case (Fig. 140, II., *ibid.*, 1877, XXI. p. 57, *Taf.* I. *fig.* 2.

695. A male in which the pronotum was similarly divided, but the division was not quite complete. DE LA CHAVIGNERIE, *Ann. Soc. ent. France*, 1846, *Ser.* 2, IV., *Bull.*, p. XVIII., Pl. II., fig. II.

696. An almost identical specimen (male). MOCQUERYS, *Coléop. anorm.*, 1880, p. 140, fig. [Now in the Rouen Museum, where I have examined it.]

697. Another case; extent of division not specified. STANNIUS, *Müll. Arch. Anat. Phys.*, 1835, p. 304.

698. **Oryctes nasicornis** ♂ (Lam.): anterior part of pronotum divided into two parts by a longitudinal suture: posterior part of pronotum undivided. Head normal. *ibid.*, Pl. V. fig. 7.

699. **Onitis bison** (Lam.): pronotum divided in the middle by a longitudinal suture, the lateral pieces being raised up. *ibid.*

700. **Heterorhina nigritarsis** (Lam.): specimen in the Hope Collection at Oxford having the pronotum completely divided into two somewhat unequal halves, of which the left is the largest. The posterior angle of each of the pieces does not occupy its normal position, but lies internal to the outer border of the elytron. Owing to this disposition the mesothorax is exposed for a short distance on each side and for a considerable extent in the centre.

701. **Attelabus curculionides** (Rhyn.): specimen of moderate size; head, elytra and legs normal. Structure of prothorax peculiar in that the two lateral halves do not meet in the middle line, leaving betwixt them a membranous space. The prothorax is shortened and the head is pushed back into the thorax as far as the level of the eyes. The edges of the plates of the prothorax are well formed and properly finished. Scutellum present, but is not at all concealed by the prothorax. DRECHSEL, C., *Stettiner ent. Ztg.*, 1871, XXXII. p. 205.

702. **Chrysomela fucata** (Phyt.): Pronotum divided centrally into two parts, each of which is triangular. The parts of the head and scutellum which should be covered by the thoracic shield are thus exposed. KRAUSE, *Stettiner ent. Ztg.*, 1871, XXXII. p. 137.

703. **Telephorus nigricans** (Mal.): the pronotum is divided into two unequal halves. The left half is nearly twice as large as the right, and projects beyond the middle line, covering a part of the right side of the prothorax. The right portion is small and very concave. Both of these two parts of the pronotum are everted at their edges to form a definite margin. The margins are continued all round each piece, and thus two margins are adjacent in the contiguous parts of the plates. This specimen was kindly lent to me by M. H. GADEAU DE KERVILLE.

704. **Carabus scheidleri:** thorax dorsally covered by two completely separate and symmetrical plates, whose inner edges are beset with yellow hairs [as the anterior and posterior margins

normally are]. The rest of the animal was normal. KRAATZ, G., *Berl. ent. Ztschr., 1873,* XVII. *p. 430, fig.*

705. **Carabus lotharingus**; thoracic shield divided in centre to form two triangular pieces which only unite at a single point. The head is drawn back into the thorax. DUPONCHEL, *Ann. Soc. ent. France,* 1841, S. 1, X., *Bull.*, p. XX., *Pl.*

706. **Lixus angustatus** (Rhyn.): thoracic shield partially divided, present a deep emargination both before and behind [description not quite clear]. DOUÉ, *Ann. Soc. ent. France,* 1851, IX. *Bull.*, p. LXXXII.

III. METASTERNAL PLATES.

707. **Rhizotrogus marginipes** ♀ (Lam.) having the abdomen deformed in a symmetrical manner. Looked at from the ventral surface the metasternal plates are seen to be divided in the middle line by a deep depression so that the abdomen consists superficially of two lobes; these two lobes are united together in the last segment in which the metasternal plate is undivided. The two lobes are of equal size and the longitudinal depression which divides them is shewn in the figure to be regularly and symmetrically formed. The animal is otherwise normal. [No dissection was made.] BAUDI, L. V., *Bull. Soc. Ent. Ital.*, 1877, IX., p. 220, fig.

IV. PYGIDIUM.

708. **Melolontha vulgaris** (Lam.): pygidium bifid, two cases. KRAATZ, G., *Deut. ent. Ztschr.*, 1880, p. 342, Pl. II., figs. 4 and 4*a*; and *ibid.*, 1889, p. 222, Pl. I., fig. 19.

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709. A case of "double proboscis" is recorded in **Sphinx ligustri.** The specimen was a pupa, and through the pupal skin it could be seen that the two mandibles had not united to form the single proboscis, but were divaricated. KRAATZ, *Deut. ent. Ztschr.*, 1880, XXIV., p. 345, fig.

Miscellaneous cases of doubtful nature.

710. **Ascidians.** Prof. W. A. Herdman tells me that he has several times met with Ascidians having a supplementary lateral atriopore. He regards this as a retention of a larval character, since in the young there are two atriopores which in normal individuals afterwards unite dorsally.

711. **Limulus polyphemus:** large specimen found at Fort Macon, N. Carolina, having a forked caudal spine (Fig. 143). This variation is

FIG. 143. *Limulus polyphemus* No. 711, having forked caudal spine. (After PACKARD.)

probably very rare. PACKARD, A. S., *Mem. Bost. N. H. S.*, 1872, II. p. 201, *fig.*

712. **Palamnæus borneensis** (Scorpion): specimen in which the terminal poison-spine was double, as shewn in Fig. 144. The two halves were not quite equal and there was no opening of a poison-gland on the shorter spine. This specimen, which is in the Brit. Mus. was kindly shewn to me by Mr R. I. POCOCK.

713. **Chirocephalus** ♀: specimen having the generative sac with two horns instead of one. [Normally there is only one such horn which forms a median downward prolongation of the ovisac. No further description.] PRÉVOST, B., *Mém. sur les Chirocephales*, p. 232; in Jurine's *Hist. des Monocles*, Geneva, 1820.

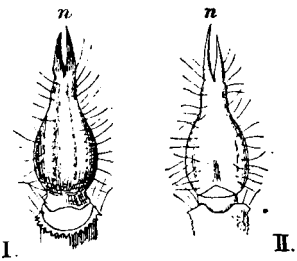

FIG. 144. Double poison-spine of a Scorpion (*Palamnæus borneensis*). I. From dorsal side. II. From ventral side. *n*, the spine which bore the openings of the poison-glands.

714. **Buccinum undatum.** A number of specimens were formerly obtained from Sandgate in Kent[1], having the operculum double. Sometimes the two opercula were separate, sometimes united. Many specimens of this variation are in the collection of Dr A. M. Norman, who kindly shewed them to me. The shells and opercula alone remain and consequently it is not now possible to determine the position of the line of division relatively to the morphological planes of the animal; but, from the fact that in several instances the two opercula were related to each other as images, it seems likely that the division was in the longitudinal median plane, though this must be uncertain. Moreover in one of Dr Norman's specimens, from the fragment of dried flesh adhering, it appeared that the apex of the foot might have been bifid. Four cases are shewn in Fig. 145. In two of them (I and II) there is a fairly close relation of images, while in III this relation is less clear and in IV it is practically destroyed, though it is of course quite possible that this may be the result of unequal growth. Several of these opercula are much contorted and without any very definite shape.

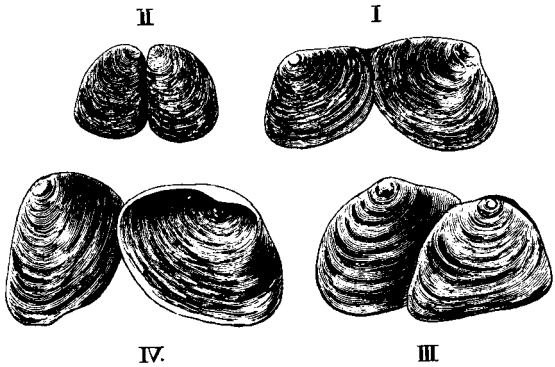

FIG. 145. Cases of duplicity in operculum of *Buccinum undatum*, from specimens in the collection of Dr A. M. Norman. I and II nat. size. III and IV enlarged. III and IV were kindly drawn for me by Mr J. J. Lister.

[1] See JEFFREYS, J. G., *Ann. Mag. N. H.*, 1860 (2), p. 152.

It was intended to have introduced here some account of the curious and very rare cases in which, for a greater or less region of the spine, corresponding half-vertebræ, on either side of the middle line, are not united together in their proper order, but I fear this would be too great a digression. For references on the subject see LEVELING, *Obs. anat. rarior.*, Norimb., 1787, Fsc. 1, cap. III. p. 145, Tab. V.; SANDIFORT, *Mus. anat.*, Leyden, 1835, IV. p. 74. Pl. CLXXVIII.; REID[1], *Jour. of Anat.*, 1887, XXI. p. 76, *fig.*; *Guy's Hosp. Rep.*, 1883, p. 132.

UNION OR ABSENCE OF DIVISION IN THE MIDDLE LINE.

This phenomenon is the converse of that described above. Examples of median union are found in many organs of different kinds. In vertebrates such union is especially well known in the case of the eyes, the ears, and the posterior limbs, producing the cyclopic, synotic and symmelian conditions respectively.

Each of these is of some interest to the student of Variation by reason of the symmetry and perfection with which the union takes place. In the cyclopian the degree to which the two eyes are compounded presents all shades intermediate between the perfect duplicity of the normal and the state in which the eye-balls are united in the middle line of the forehead and have one circular cornea[2]. These variations are closely comparable with those of the eye-spots on feathers referred to on p. 449; for there also all stages are seen between a pair of eye-spots placed one on either side of a middle line and complete union to form one eye-spot bisected by the middle line. There is of course no normal vertebrate having the eyes thus united in the middle line, but as MECKEL has remarked, the case of the cyclopian is not essentially different from that of the Cladocera in which the compound eyes, paired in other Crustacea, are united to form a single median eye. The cases No. 718 and 719 of median union of the compound eyes of Bees may also be considered in this connexion.

A very similar series of variations occurs in regard to the ears of vertebrates, which in the synotic or cephalotic condition are compounded in the middle line to a varying degree[3]. Such union of the ears is especially common in the Sheep, cyclopia being most frequent in the Pig. DARESTE[4] states that the first beginning of the cyclopian condition appears in the Chick as a precocious union of the medullary folds in the region of the fore-brain, occurring before the optic vesicles are fully formed from it. The degree to which the union of the eyes is complete then depends on the earliness with which the folds begin to meet relatively to the time of budding off of the optic vesicles. DARESTE[5] also declares that the cephalotic state is similarly first indicated by a premature union of the folds in the region of the medulla, taking place

[1] A case in Man, resembling No. 7.

[2] For an extensive collection of cases illustrating the various degrees of cyclopia see especially AHLFELD, *Missb. d. Mensch.*, Abschn. II. 1882.

[3] For figures see *e.g.*, OTTO, *Mus. anat. path. Vratisl.*, Pl. I. fig. 5, Pl. III. fig. 2 (Lambs); GUERDAN, *Monats. f. Geburtsk.*, X. p. 176, Pl. I. (Man) and many more.

[4] *Comptes rendus*, 1877, LXXXIV. p. 1038.

[5] *l. c.*, 1880, XC. p. 191.

before this part of the brain has widened out. In this way the auditory involutions are approximated. This account however cannot apply to all cases of union of ears; for the compounded ears are sometimes on the *ventral* side of the neck, as in Guerdan's case[1].

The body of the symmelian ends posteriorly in an elongated lobe made up of parts of the posterior limbs compounded together by homologous parts. The two femora are usually united to form a single bone, the tibiæ are separate and the two limbs are again compounded in the tarsal region. The axial parts posterior to the hind limbs are always greatly aborted[2].

Union of the kidneys in the middle line (Fig. 146), forming the "horse-shoe kidney" of human anatomists, is a similar phenomenon. As to the mode of development of this variation I know no evidence. Usually the kidneys together form a single horse-shoe shaped mass of glandular tissue, the union being posterior[3]; very

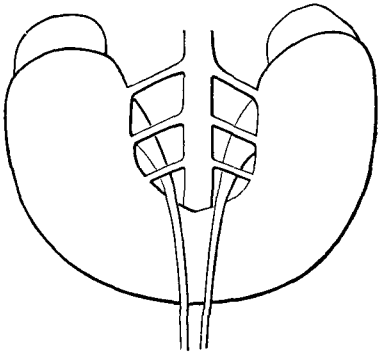

FIG. 146. Kidneys united in the condition known as "horse-shoe" kidney (Man). In this specimen there were three renal arteries on each side.
(From *Guy's Hosp. Rep.*, 1883.)

[1] See note 2, p. 458.

[2] See especially, MECKEL. *Arch. Anat. Phys.*, 1826, p. 273; GEOFFROY ST HILAIRE, *Hist. des Anom.*, ed. 1837, II. p. 23; GEBHARD, *Arch. Anat. Phys.*, 1888, *Anat. Abth.*, p. 164 (good fig.). To the determination of the morphology of the hind limb the structure of the symmelian monster is of unique importance, but I do not know that it has had the notice it deserves from comparative zoologists. From the manner of union of the parts of the two limbs may be obtained a positive proof of the morphological relations of the surfaces of the two limbs to each other. In a symmelian the feet are united by their fibular borders, *the minimi being adjacent*, the halluces exterior, and *the combined plantar surfaces ventral*. The great trochanters are *dorsal*, being often united into one in the dorsal middle line, and the patellæ are also *dorsal*, being also not rarely partly compounded. From these facts, even were other indications wanting, we have a proof that if the hind limbs were laid out in their original morphological relations to each other (as the tail-fins of a Crayfish may be supposed to be) the halluces would be external and anterior, the minimi internal and posterior, the flexor surfaces of the thigh and crus and the plantar surface of the (human) foot would be *ventral* and the extensor surfaces of the thigh and crus and the dorsum of the (human) foot would be *dorsal*. This is of course affirmed without prejudice to any question of phylogeny; but that these must be the ontogenetic relations of the parts is clearly proved by the symmelian.

[3] Sometimes anterior, *e.g.* ODIN, *Lyon méd.*, 1874, No. 12 [from *Canstatt's Jahresb.*, 1874, I. p. 19]; and FREUND, *Beitr. z. Geburtsh. u. Gyn.*, IV. 1875 [from *Canstatt's Jahresb.*, 1875, p. 340].

rarely the posterior ends of the kidneys are joined by a bridge of ligamentous tissue[1].

A remarkable case, in which the union of the two kidneys was very complete and only indications of duplicity remained, is given by PICHANCOURT, *Gaz. hebd.*, 1879, p. 514.

Illustrative Cases.

To these familiar instances are added a few less generally known.

*715. **Capreolus caprea** (Roebuck): specimen having the two horns compounded in the middle line, forming a common beam for almost the lower half of the horn (Fig. 147). This specimen was exhibited among a large series of abnormal horns in the German Exhibition held in London 1891. Casts of it are in the Brit. Mus. and Camb. Univ. Mus.[2].

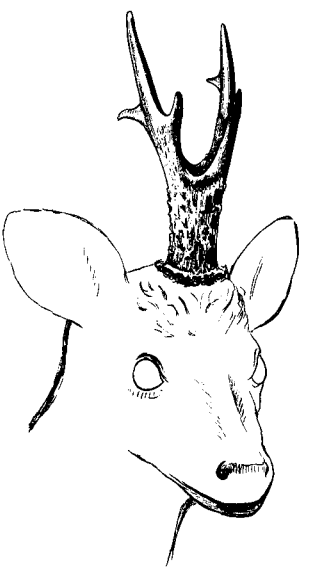

FIG. 147. A Roebuck (*Capreolus caprea*) No. 705, having the horns compounded to form one.

716. **Limax agrestis**: specimen having the upper tentacles united into one in the middle line. The eyes were paired as usual. FORBES and HANLEY, *Hist. Brit. Moll.*, IV. p. 288 and I. Pl. JJJ, fig. 4.

[1] See GRUBER, *Virch. Arch.*, 1865, XXXII. p. 111.
[2] The original is at Darmstadt.

717. **Helix hispida**: specimen in which the tentacles were united together. They were adherent throughout, excepting for a slight cleft at the end, about one line in length. A shallow longitudinal suture was visible between the two. The animal and shell were otherwise normally formed. ROBERTS, G., *Science Gossip*, 1886, XXII. p. 259.

*718. **Apis mellifica** (Honey-bee): a worker having the two compound eyes continued up so as to unite on the top of the head (Fig. 148). The union between the eyes of the two sides was complete. There was no trace of any groove or division between them and the resulting structure was perfectly symmetrical. In a normal the three simple eyes are arranged in a triangle between

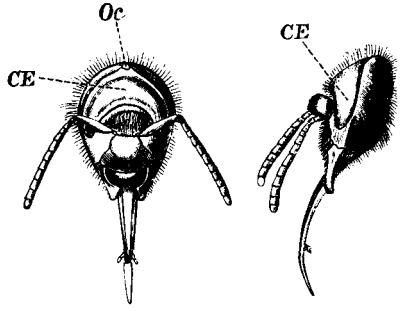

FIG. 148. A worker Bee (*Apis mellifica*) No. 708, having the two compound eyes united across the middle line, seen from in front, and from the side. *CE*, the united compound eyes. *Oc*, a single structure representing the three simple eyes of the normal. (After STANNIUS.)

the upper edges of the compound eyes, but in this specimen they were united into a single structure which was symmetrically placed in the middle line in front of the united compound eyes (Fig. 148, *Oc*). The body thus formed by the union of the simple eyes was a round projection beset with long yellowish hairs.

In a normal male the compound eyes are much larger and are in contact with each other at the top of the head, but the division between them is sharply defined. In a normal worker, however, the compound eyes are widely separated.

The facetting and the hairs on these eyes were normal and the animal was in all other respects properly formed. STANNIUS, *Müller's Arch. Anat. Phys.*, 1835, p. 297, *Pl.*

*719. **Apis mellifica** having the compound eyes completely and symmetrically fused. This individual was either a young and abnormally developed queen, or else a worker. Its structure was in several respects abnormal. The third pair of legs are like those of the workers, as is shewn by the structure of the first joint of the tarsus, the brush of hairs on the outside of the leg is not so

much developed as in the workers, and this feature suggested that perhaps the specimen may be a young and abnormal queen. The abdomen is small and seems to have been arrested in its development, but its shape is that of the abdomen of the workers. The last segment of the abdomen is elongated, triangular, and slightly grooved in the middle of the posterior border, so as to permit the passage of the sting. The wings are more like those of a queen or worker than those of a male; for in the latter they generally greatly exceed the abdomen in length. The thorax is small, narrow, and contracted more than in the normal form, being also less convex. The space between the wings is less than in a fully developed bee. The antennæ are mutilated, but seem to have been normal; but their last joints are slightly reddish brown as they are in females, whether workers or queens, and not black as they are in drones. The two compound eyes were completely fused together in the middle line, across the place in which the simple eyes ought to be found. The simple eyes are not present at all. LUCAS, H., *Ann. Soc. Entom. France*, S. 4, VIII. 1868, p. 737, *Pl.*