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THE QUARTERLY JOURNAL OF MICROSCOPICAL SCIENCE.

EDITED BY

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Fellow of Exeter College, Oxford, and Professor of Zoology and Comparative Anatomy in University College, London;

WITH THE CO-OPERATION OF

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Fellow and Lecturer of Trinity College, Cambridge.

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Assistant Director of the Royal Gardens, Kew.

AND

E. KLEIN, M.D., F.R.S.,
Lecturer on Histology in St. Bartholomew's Hospital Medical School, London.

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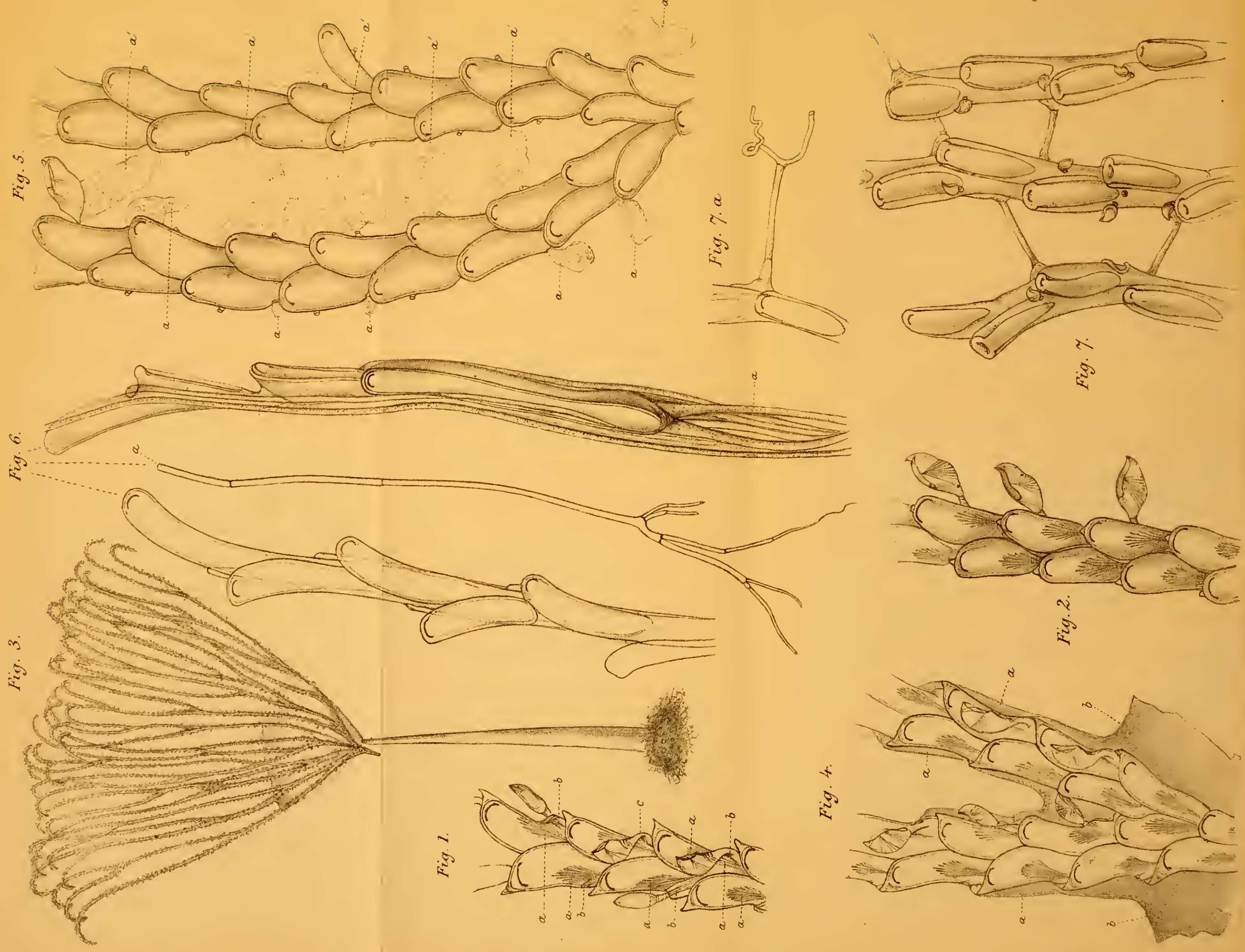
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Fig. 7. a

Fig. 8.

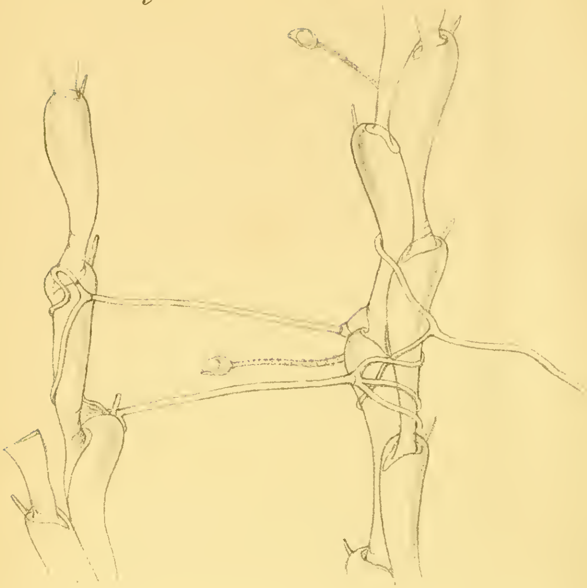


Fig. 9.

DESCRIPTION OF PLATES I AND II,

Illustrating "Notes on a Peculiar Form of Polyzoa closely allied to Bugula (*Kinetoskias,* Kor. and Dan.)."

Fig. 1.—Front view of *Kinetoskias cyathus,* C. W. T.
a. a, a, a, a. The flexor muscle.
b, b, b. The step-like projection for the *avicularium.*
c. The natural position of the avicularium when at rest.

Fig. 2.—Front view of *K. pocillum,* Bk.

Fig. 3.—Zoarium of *K. cyathus,* natural size.

Fig. 4.—Portion of zoarium of *K. cyathus* at the edge of the connecting web.
a, a. Descending radical tubes.
b, b. Upper edge of the web.

Fig. 5.—Bifurcation of a branch of *B. pocillum* viewed in front.
a, a, a, a, a. Commencement of radical or connecting tubes.
a, a, a, a, a, a. Coalesced connecting tubes.
(All the avicularia but one have become detached.)

Fig. 6.—Lower part of zoarium of *Bugula mirabilis,* Bk.
a, a. The corresponding ends of one of the radical tabes springing from the base of the primordial *zoœcium,* and dividing into its terminal twigs.

Fig. 7.—*Bugula reticulata,* Bk.
a. A connecting tube terminating, as it occasionally does, in tendril-like twigs.

Fig. 8.—*Bugula unicornis,* Bk. Showing the usual mode of connection by tendril-like twigs.

Fig. 9.—Portion of a frond of *Carbasea ovoidea,* Bk.
a. One of the abortive marginal cells, with two tubular ones arising from it.
b. The growing extremity of a tubular cell filled with germinal sarcode.
c. A joint representing those of an ordinary radical tube.
d. Two zoœcia arising from one, as at *a.*

EXPLANATION OF PLATES III AND IV,

Illustrating Mr. F. Orpen Bower's Memoir "On the Germination and Histology of the Seedling of *Welwitschia mirabilis*."

The lettering is uniform as follows:—*s.* suspensor; *x.* collar of embryo; *r. c.* root cap; *ap.* apex of root; *r.* root; *f.* feeder; *c.* cotyledon; *e.* endosperm; *n.* nucleus; *p. l.* plumular leaves; *hy. st.* hypo-cotyledonary stem; *fvb.* fibro-vascular bundle; *scl.* sclerenchyma; *ph.* phloem *xy.* xylem; *pr. ph.* proto-phloem; *pr. xy.* proto-xylem; *cb.* cambium; *i. cb.* inter-fascicular cambium; *b. s.* bundle sheath; *s. b.* soft bast; *m. r.* medullary ray; *l.* lignified tracheids; *r. h.* root hairs; *c. t.* cortical tiss; *p.* pericambium; *m.* mucilage.

Fig. 1.—Mature embryo of Welwitschia. $\frac{3}{1}$. A and B. Whole embryo, from points of view at right angles to one another. C. Embryo in longitudinal section.

Fig. 2.—Seedling from a seed sown flat, after twelve days' germination. In A the endosperm is partially removed, the cotyledons and feeder are seen in close connection with it. In B the endosperm removed. $\frac{2}{1}$.

Fig. 3.—Seedling from a seed sown on edge, after eighteen days' germination. A as seen after removing testa. In B the endosperm has also been removed. $\frac{2}{1}$.

Fig. 4.—Seedling six weeks old, showing perforation of testa at different points by stem and root. Seed was sown on edge. Nat. size.

Fig. 5.—Seedling six weeks old. Seed sown flat. Three cotyledons, the two smaller ones evidently taking the place of one normal one. Nat. size.

Fig. 6.—Portion of hypo-cotyledonary stem and root with feeder, taken from a seedling of about six weeks. A. Testa removed, endosperm still surrounding the feeder. B. Endosperm removed, remnants of nucleus still attached by the suspensor. C. The same in longitudinal section. The feeder and endosperm have contracted, owing to treatment with alcohol. $\frac{2}{1}$.

Fig. 7 and 8.—Seedlings ten and a half weeks old, showing plumular leaves. Nat. size.

Fig. 9.—Plumule laid bare by removal of one of the cotyledons.

Fig. 10.—View of apex of the youngest of the specimens in the Kew collections. $\frac{2}{1}$. Sent from Little Fish Bay by J. J. Monteiro, Esq.

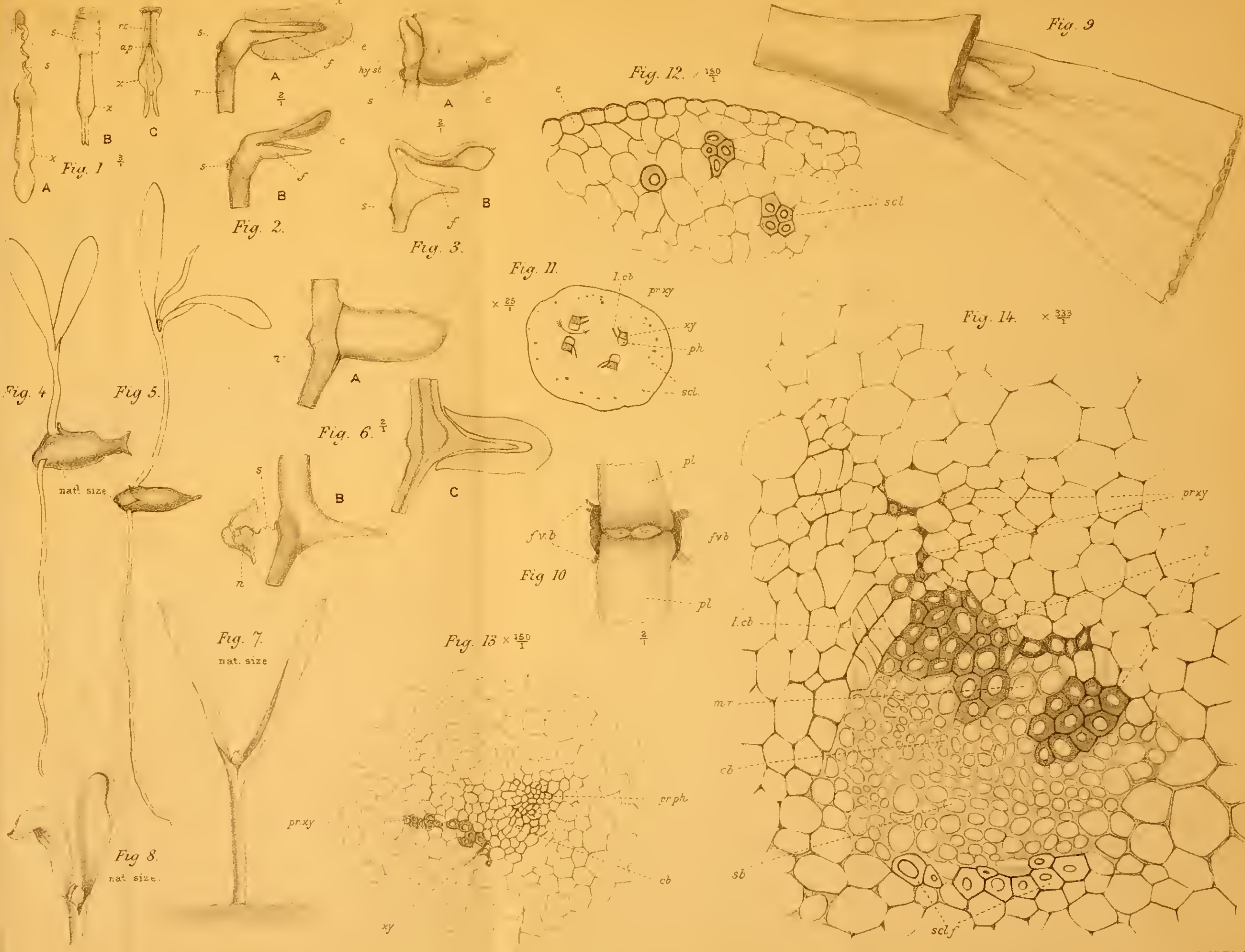


Fig. 1
Fig. 2.
Fig. 3.
Fig. 4
nat^l. size
Fig 5.
Fig. 6.
Fig. 7.
nat. size
Fig 8.
nat. size.
Fig. 9
Fig 10
Fig. 11.
Fig. 12.
Fig. 13
Fig. 14.
pr.xy
pr.ph
cb
xy
ph
scl.
l.cb
fv.b
pl
m.r
sb
scl.f


A
B
C
D
Fig. 15. × 25/1
Fig. 16.
E
F
G
H
Fig. 19. × 150/1
Fig. 17. × 150/1
Fig. 18. × 25/1
Hy. St
Fig. 20.
Fig. 21. × 150/1
Fig. 22. × 150/1
pl
xy
ph
bs
root cap
cort tiss
r.c
r.h
b.s.
pr xy
ct
cb

Fig. 11.—Transverse section of hypo-cotyledonary stem, showing four fibro-vascular bundles. The xylem is shaded. The arrow indicates the direction in which the bundles have rotated on their axes. Cf. text.

Fig. 12.—Margin of section of the hypo-cotyledonary stem. The walls of the outer layers of cells of the cortical tissue are cuticularised.

Fig. 13.—Transverse section of a fibro-vascular bundle, from an unextended hypo-cotyledonary stem.

Fig. 14.—Transverse section of a fibro-vascular bundle, from a fully extended hypo-cotyledonary stem.

Fig. 15.—a—h. Series of transverse sections through plumule, hypo-cotyledonary stem, and root; showing the course and relative position of the fibro-vascular bundles. The xylem is always shaded, the phloem not The arrows indicate the direction of rotation of the bundles on their axes.

Fig. 16.—Diagram showing the course of the fibro-vascular bundles as they might be seen in an ideal preparation of the plumule, &c., laid open by cutting in a plane passing between the two plumular leaves.

Fig. 17.—View of the apical papilla from above.

Fig. 18.—Longitudinal section of the seedling, represented in fig. 2.

Fig. 19.—Section of the apex of the feeder (as in fig. 18) under higher power. The letters indicate the series of elongated cells, corresponding to the series in the cortical tissue of the stem.

Fig. 20.—The most curved part of the fibro-vascular bundle of fig. 18.

Fig. 21.—Transverse section of young root.

Fig. 22.—Transverse section of older root, from seedling of nine weeks.

DESCRIPTION OF PLATES V AND VI,

Illustrating Prof. Milnes Marshall's paper on "The Head Cavities and Associated Nerves of Elasmobranchs."

Each figure has been drawn from a single section by the aid of a Hartnack camera. The numbers attached indicate, in diameters, the magnifying power employed. The majority of the figures are of a semi-diagrammatic nature, the mesoblast being in nearly all cases omitted for the sake of clearness; the outlines are, however, strictly accurate in all cases.

Alphabetical List of References.

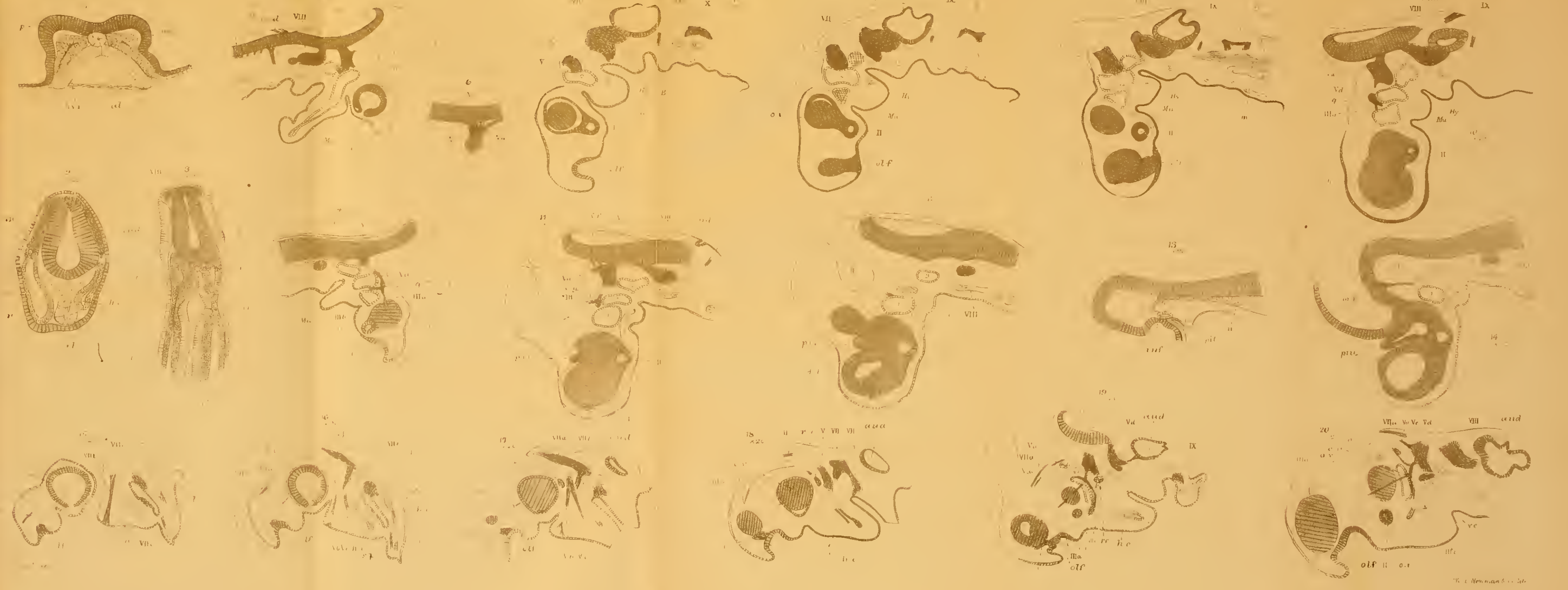
a. Artery; *al.* alimentary canal; *al'.* outgrowth of alimentary canal to form visceral cleft; *aud.* auditory vesicle; *b. c.* body-cavity or cœlom; $Br._1$ first branchial arch; *c. g.* ciliary ganglion; *d. r.* ramus dorsalis; *ep.* epiblast; *f. b.* fore brain; *g.* gills or branchiæ; *h. b.* hind brain; *hy.* hypoblast; *Hy.* hyoid arch; *i. m.* investing mass; *inf.* infundibulum; *m.* muscle; *m. b.* mid brain; *mes.* mesoblast; *Mn.* mandibular arch; *n.* notochord; *o. i.* obliquus inferior; *olf.* olfactory pit; *o. s.* obliquus superior; *o. v.* optic vesicle; *pin.* pineal body; *pit.* pituitary involution from mouth; *r. e.* rectus externus or posterior; *r. i.* rectus internus; *r. inf.* rectus inferior; *r. s.* rectus superior; *sp.* spiracular or hyomandibular cleft; *v.* vein; 1. first head cavity; 2. second head cavity; 3. third head cavity; I. olfactory nerve; II. optic nerve; III. third or oculomotor nerve; III *a.* anterior branch of third nerve, or *ramus ophthalmicus profundus;* III *b.* main branch of third nerve to *rectus inferior* and *obliquus inferior;* V. fifth or trigeminal nerve; V *a.* ophthalmic branch of fifth nerve; V *b.* maxillary branch of fifth; V *c.* mandibular branch of fifth; V *d.* communicating branch between fifth and third nerve; V *e.* branch to obliquus superior; V *f.* anterior non-ganglionic roots of fifth; VI. sixth or abducens nerve; VII. seventh or facial nerve; VII *a.* ophthalmic branch of seventh; VII *b.* palatine branch of seventh; VII *c.* hyoidean or post-spiracular branch of seventh; VII *d.* mandibular or pre-spiracular branch of seventh; VIII. eighth or auditory nerve; IX. ninth or glosso-pharyngeal nerve; X. tenth or pneumogastric nerve.

FIG. 1.—Transverse section through the head of a Scyllium embryo of stage D, showing the mesoblast divided into two layers, which have not yet separated to form the cœlom. × 90.

FIG. 2.—Transverse section through the head of an embryo of stage H, showing the head cavities, hind brain, facial nerves, fore gut, and notochord. × 90.

FIG. 3.—Somewhat oblique section through the hinder part of the head of an embryo of stage I, showing the head cavities and the obliteration thereof caused by the commencing visceral clefts; also the auditory pits and hinder part of the auditory nerve. × 90.

FIG. 4.—Longitudinal and vertical sections through the head of an embryo of stage K, showing the dorsal ends of the first three head cavities, the



VIII
IX
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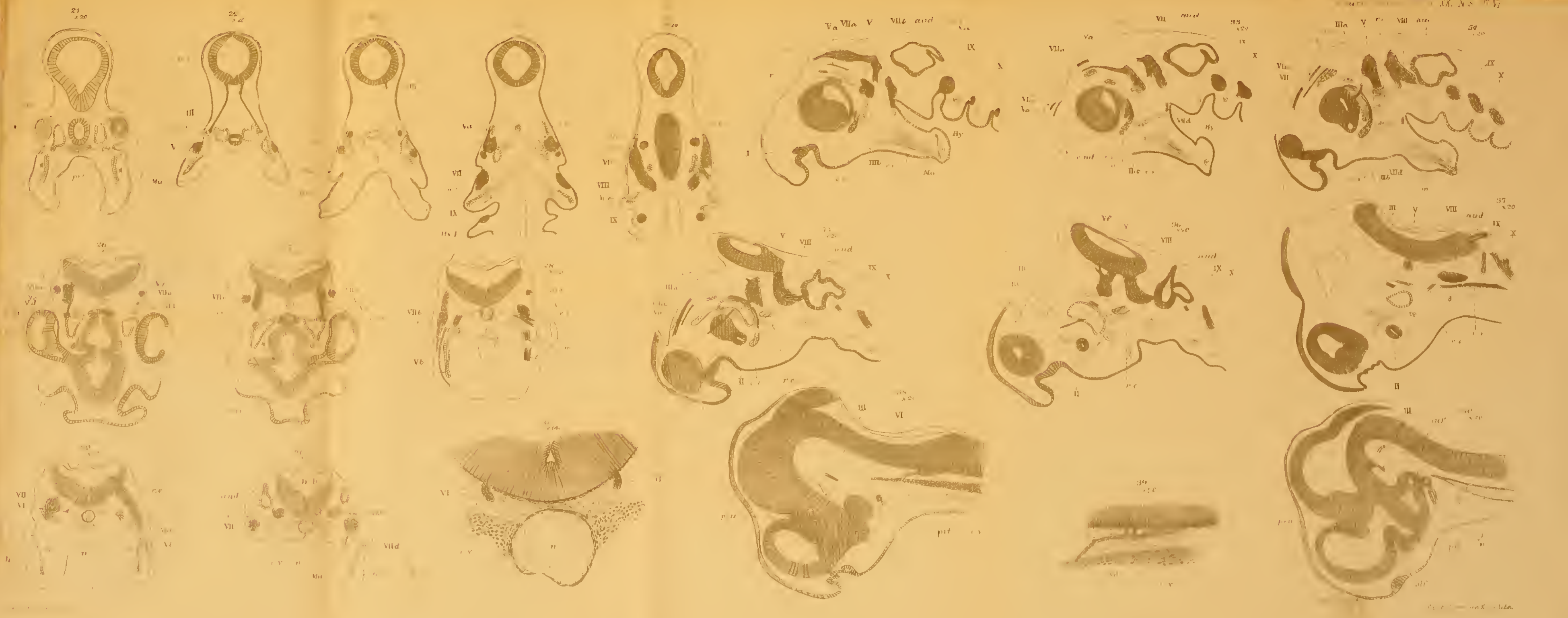
VIIa



ciliary ganglion with the two branches of the third nerve arising from it, and the communicating branch between the third and fifth nerves. × 25.

Figs. 5 and 6.—Longitudinal and vertical sections through the head of an embryo of stage L.

Fig. 5 shows the whole length of the second head cavity; also the third head cavity, and the fifth nerve, with the roots of its ophthalmic and communicating branches. × 20.

Fig. 6 shows the fifth nerve with its anterior non-ganglionic roots, and its posterior ganglionic root; also the root of the ophthalmic branch of the fifth. × 25.

Figs. 7 to 14.—Longitudinal and vertical sections through the head of an embryo of stage L. × 25.

Fig. 7, the most superficial of the series, shows the second head-cavity, and parts of the trigeminal, facial, and auditory nerves.

Fig. 8 shows the second head cavity, and the wall of the first and third; also the fifth, seventh, and auditory nerves.

Fig. 9 shows the three head cavities, the fifth nerve with the root of its ophthalmic branch, the facial, and auditory nerves.

Fig. 10 shows the three head cavities, the ciliary ganglion with the roots of the two branches of the third nerve, the trigeminal with the posterior part of the communicating branch.

Fig. 11 shows the three head cavities, the ciliary ganglion with the anterior end of the communicating branch, the trigeminal nerve with its anterior and posterior roots and the root of the ophthalmic branch, the auditory nerve, and the olfactory nerve.

Fig. 12. shows the first and third cavities, and a part of the inner wall of the second; also the third and olfactory nerves, and the pineal body.

Fig. 13, the median section of the series, shows the notochord ending against the median portion of the first head cavity, also the infundibulum and pituitary involution.

Fig. 14, taken from the opposite side of the body to the preceding sections; shows the first head cavity, and the root and greater part of the length of the third nerve.

Figs. 15 to 20.—Longitudinal and vertical sections through the head of a Scyllium embryo of stage M. × 20.

Fig. 15, the most superficial of the series, shows the olfactory nerve and pit, the anterior branch of the third, and the palatine and hyoidean branches of the seventh nerve; also the spiracular cleft with its branchiæ.

Fig. 16 shows, in addition to the parts seen in the preceding figure, the ophthalmic branch of the seventh, the maxillary and mandibular branches of the fifth, and the lower part of the mandibular head cavity.

Fig. 17 shows the same parts as Fig. 16, but at a somewhat deeper level.

Fig. 18 shows the olfactory nerve and pit, the anterior branch of the third nerve, the mandibular branch and main stem of the fifth, and the ophthalmic branch and main stem of the seventh; also the *rectus externus* muscle.

Fig. 19 shows the first cavity flattened out and embracing the eyeball, anterior and posterior branches of third nerve, ciliary ganglion, ophthalmic and communicating branches of fifth, ophthalmic branch of seventh, *rectus inferior* and *obliquus inferior ;* also terminal portion of mandibular head cavity, with its walls converted into muscles.

Fig. 20, taken from the opposite side of the body, shows ciliary ganglion, and the two branches of the third nerve arising from it; communicating branch of the fifth, with its branch to the *obliquus superior ;*

ophthalmic branches of fifth and seventh, first head cavity, and *rectus externus* and *obliquus inferior* muscles.

Figs. 21 to 25.—Horizontal sections through the head of an embryo at a stage intermediate between L and M. × 20.

Fig. 21. The most ventral of the series; shows first head cavities, infundibulum, and pituitary involution.

Fig. 22 shows first and second head cavities, with prolongation of latter into mandibular arch; also whole length of third nerves on both sides, and ciliary ganglion.

Fig. 23 shows the median portion of first head cavity, second head cavities, ciliary ganglia, and fifth nerves.

Fig. 24 shows third head cavities, fifth nerve with ophthalmic and communicating branches, seventh nerve, and ventral portions of third head cavities in hyoidean arches.

Fig. 25 shows third head cavities, fifth, seventh, and auditory nerves, with ophthalmic branches of seventh.

Figs. 26 to 31.—Transverse sections through the head of an embryo at a stage intermediate between M and N. × 25.

Fig. 26, the most anterior of the series, shows first head cavities, ciliary ganglia, fifth nerve with its anterior roots, ophthalmic and communicating branches, and the ophthalmic branches of the seventh nerve.

Fig. 27 shows first head cavities, fifth nerve with ganglionic root on left side, non-ganglionic root on right side, ciliary ganglia, and ophthalmic branches of seventh.

Fig. 28 shows palatine and ophthalmic branches of seventh, maxillary branch of fifth, investing mass, *rectus externus*, and other eye muscles.

Fig. 29 shows sixth nerve on left side, *rectus externus*, and palatine branch of seventh on right side.

Fig. 30 shows anterior portion of auditory vesicles, seventh and auditory nerves, investing mass, and roots of sixth nerve arising from the hind brain.

Fig. 31 shows roots of sixth nerve on larger scale. × 140. The round shape of some of the cells of these roots is due to their being cut transversely; there are no ganglion cells.

Figs. 32 to 40.—Longitudinal and vertical sections through an embryo of stage O. × 20

Fig. 32 shows olfactory nerve and pit, ophthalmic branch of fifth, ophthalmic, palatine, and mandibular branches of seventh, *rectus externus, rectus superior*, and *obliquus inferior*.

Fig. 33 shows ophthalmic branches of fifth and seventh nerves, remains of first head cavity, and portions of *rectus superior, rectus internus, rectus inferior, rectus externus, obliquus superior*, and *obliquus inferior* muscles.

Fig. 34 shows same parts as preceding figure, at slightly deeper level; together with anterior branch of third.

Fig. 35 shows same parts at still deeper level.

Fig. 36 shows first head cavity, anterior branch of third, anterior and posterior roots of fifth, root of seventh, auditory nerves, and *rectus externus* muscle.

Fig. 37 shows first head cavity, third nerve, and junction of sixth nerve, with *rectus externus* muscle.

Fig. 38 shows third and sixth nerves, investing mass, and lateral dilatation of pituitary involution.

Fig. 39 shows sixth nerve from preceding section on a larger scale, × 56.

Fig. 40 shows anterior and posterior roots of third nerve, pineal body, infundibulum, and pituitary involution.

Fig. 1.

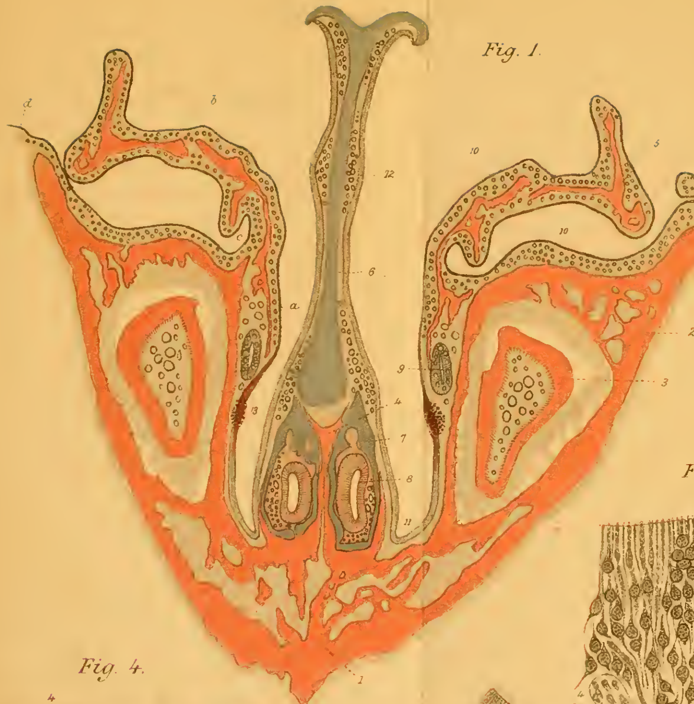


Fig. 2.

Fig. 3.

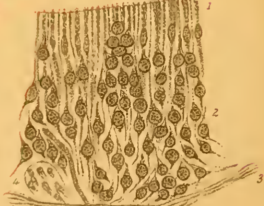


Fig. 4.

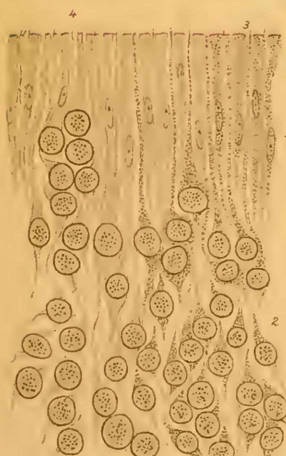


Fig. 5.

E. Klein, del.

Huth Lith.

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DESCRIPTION OF PLATE VII,

Illustrating Dr. Klein's paper on the 'Minute Anatomy of the Nasal Mucous Membrane.'

Fig. 1.—Transverse section through the nasal septum and adjoining part of the upper jaw of the guinea-pig. Magnifying power about 12 diameters.

1. Spongy bone of the upper jaw, in the middle line.
2. The same at the side.
3. A tooth cut transversely, showing its dentin and vascular pulp.
4. Osseous substance projecting from the lower jaw in the middle line into the nasal cavity as the nasal crest.
5. The osseous substance of the lower concha or turbinal bone.
6. The cartilaginous septum narium.
7. The cartilaginous capsule of the organ of Jacobson.
8. The organ of Jacobson.
9. The accessory organ of Jacobson.
10. The epithelium covering the mucous membrane of the concha and nasal surface of the upper jaw. In the mucous membrane are seen numerous glands.
11. The furrow between the alveolar process of the upper jaw and the nasal septum.
12. The epithelium of the mucous membrane of the nasal septum, the latter containing numerous glands.
13. A lymph-follicle.

The epithelium covering the nasal surface of the upper jaw, from *a* downwards past the lower sulcus at 11, and over the surface of the nasal septum is stratified columnar epithelium, the superficial cells being ciliated. From *a* to *b*, the epithelium consists of a superficial layer of short columnar and a deep layer of short conical epithelial cells; no cilia on the superficial cells. From *b*, over *c*, to *d*, the epithelium is stratified pavement epithelium, with a superficial stratum of horny scales, like the stratum corneum of the epidermis. Owing to the very small scale on which the drawing is made, these details could not be shown.

Fig. 2.—From a transverse section through the nasal septum of the guinea-pig. Magnifying power about 45.

1. The organ of Jacobson.
2. The hyaline cartilage. The cartilage-cells are not indicated.
3. The bone. The bone-cells are not drawn here, but the spaces for the blood-vessels are indicated.

4. Large spaces in the bone, filled with marrow, not indicated here.

5. The connective tissue, or internal periosteum, between the two lateral halves of the osseous nasal crest.

6. Cavernous tissue, with large veins in transverse section, of the outer or lateral wall of the organ of Jacobson.

7. Alveoli of the serous glands, cut in various directions.

8. The ciliated epithelium lining the lateral wall.

9. The sensory epithelium lining the median wall of the organ of Jacobson.

10. A large channel in the cartilage, containing nerve-bundles and blood-vessels, in transverse section; the latter are the empty circles, the former are filled with the nerve-fibres transversely cut.

Fig. 3.—From a preparation similar to that drawn in Fig. 1, showing part of the sensory epithelium of the median wall. Magnifying power about 230.

1. The epithelial cells.
2. The sensory cells.
3. The fibrous tissue forming the most superficial layer of the mucosa.
4. A minute bundle of nerve-fibres.

Fig. 4.—Part of the sensory epithelium, as seen with a high power, about 660.

1. The epithelial cells.
2. The sensory cells.
3. The minute projections of both the epithelial and sensory cells.
4. A point where the sensory cells reach very near to the surface.

Fig. 5.—From a preparation similar to that drawn in Fig. 1, showing the junction of the median and lateral wall of the organ of Jacobson.

1. Part of the median wall.
2. Part of the lateral wall.
3. The duct of a serous gland.
4. Venous blood-vessels in transverse section.
5. The mucosa of the median wall.
6. The alveoli of the serous glands.
7. The boundary of the outer cartilage, not included in the drawing.

Fig. 1.

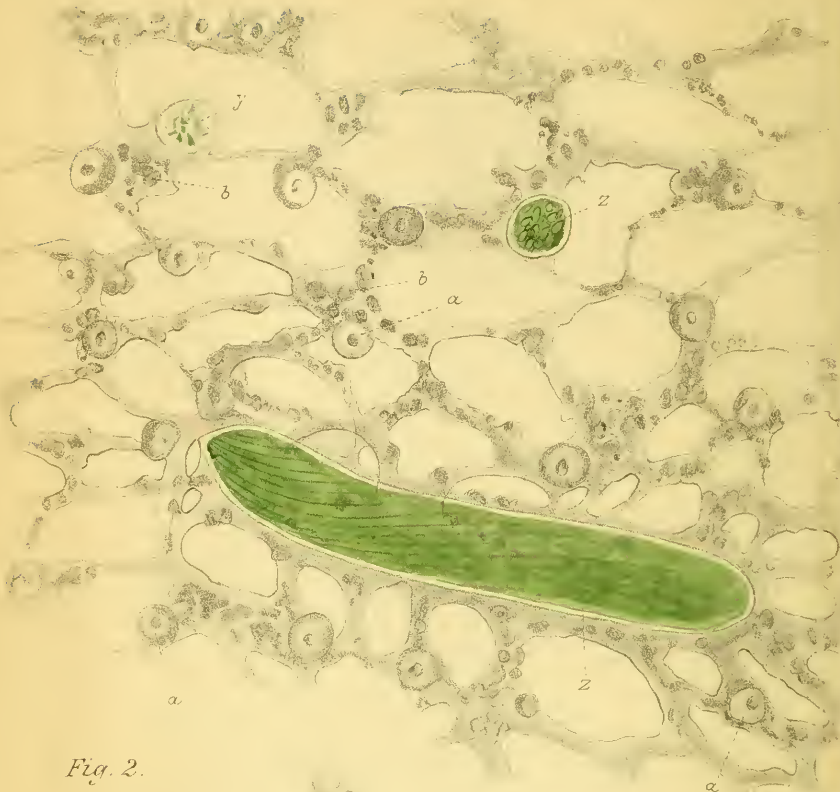
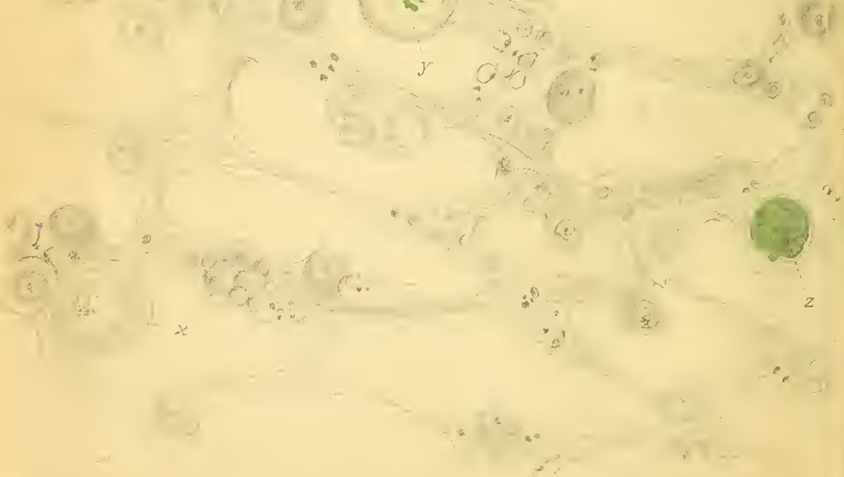
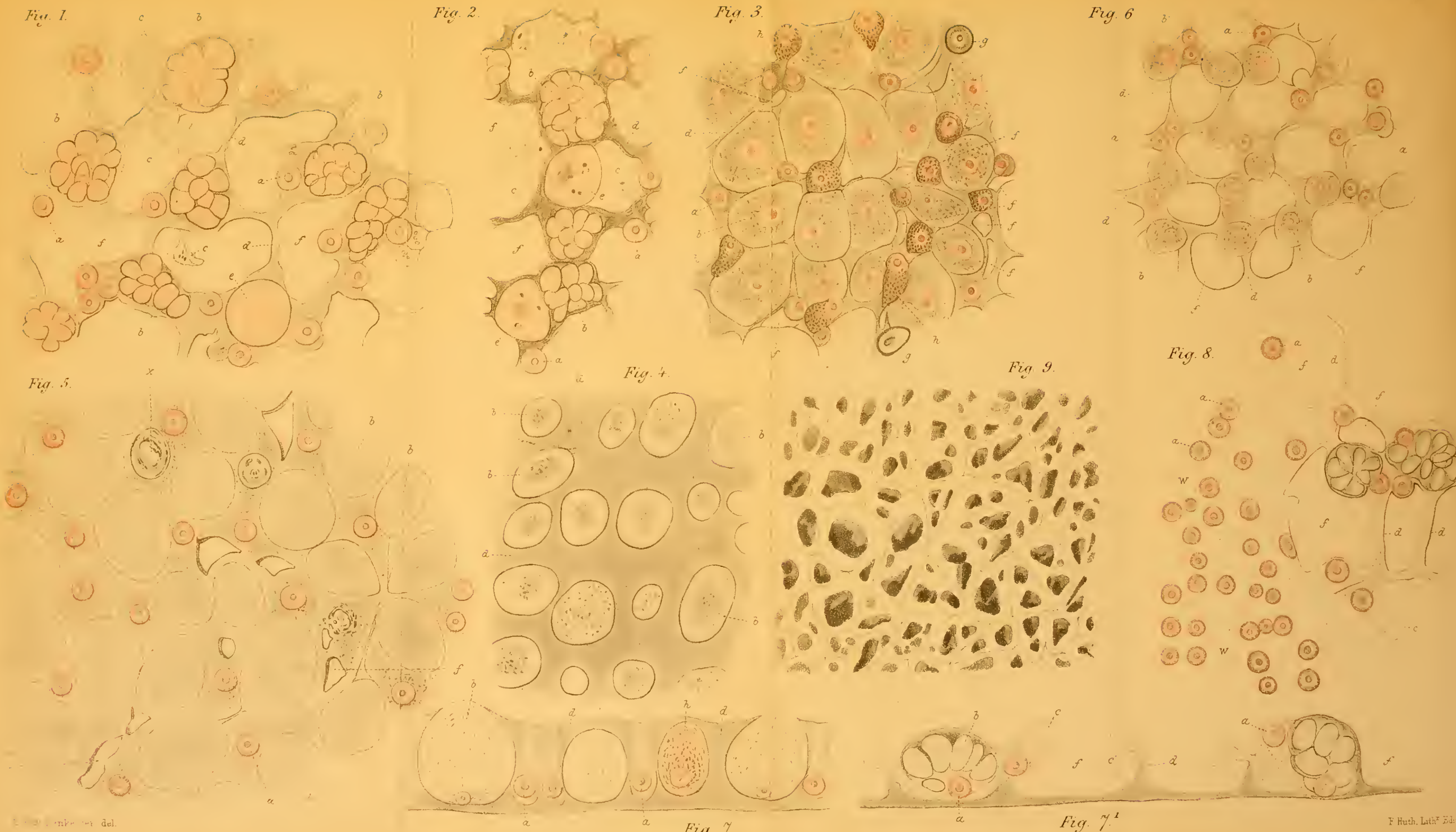


Fig. 2.





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EXPLANATION OF PLATES VIII, IX, & X,

Illustrating Professor Lankester's Memoir on "Intracellular Digestion and Endoderm of Limnocodium."

PLATE VIII.

Figs. 1 and 2.—Portions of the ingestive endoderm from the proximal end of the gastric tube, showing green unicellular organisms embedded in the protoplasmic network. Drawn from a living specimen as seen with Hartnack's 10 immersion and ocular 4.

a, nuclei; *b*, granules (secretion-products?); *x*, vacuole filled with products of digestion and broken-down remains of a Protococcus; *y*, partially digested Protococci; *z*, Protococcus and Euglena recently ingested.

PLATE IX.

Fig. 1.—Portion of the ingestive endoderm from the proximal end of the gastric tube, after treatment with osmic acid and picrocarmine. Hartnack's 10 immersion and ocular 4.

a, nuclei; *b*, groups of refringent substance; *c*, pseudopodia-like processes of the protoplasm; *d*, trabeculæ connecting neighbouring cell-masses; *e*, vacuole filled with coagulable material, which stains with carmine; *f*, intercellular space. The endoderm is in the form of an open meshwork.

Fig. 2.—A similar piece, showing dark pigmented granules in the walls of the large vacuoles (*e*).

Fig. 3.—Oral gastric endoderm, from the same specimen as that from which the proximal gastric endoderm of figs. 1 and 2 is taken.

a, nuclei; *b*, full-sized secretion-cells (goblet-cells); *d*, intercellular trabeculæ (framework); *f*, intercellular spaces; *g*, adventitiously embedded nematocysts; *h*, young secretion-cells.

Fig. 4.—The same piece focussed so as to show the surface.

b, the naked ends of the large secretion-cells; *d*, the intercellular substance covering in the younger cells and perforated by the larger ones.

Fig. 5.—A piece of the proximal or ingestive gastric endoderm from another specimen, in which the oral gastric endoderm presented the appearance drawn in fig. 6.

x, digested Protococcus. Other letters as in fig. 1. The endoderm-cells are gorged with fine granules and the intercellular spaces nearly obliterated.

FIG. 6.—Oral gastric endoderm from the same specimen as that from which fig. 5 is taken. The larger secretion-cells appear to have been shed and to have left the intercellular spaces (*f*) unoccupied. New secretion-cells (*b*) are projecting from the intercellular trabeculæ (*d*), and will probably fill up the vacant spaces as they increase in size.

FIG. 7.—Diagrammatic vertical section of the oral gastric endoderm of fig. 3. Letters as in fig. 3.

FIG. 7′.—Diagrammatic vertical section of the proximal or ingestive endoderm of fig. 1. Letters as in fig. 1.

FIG. 8.—Junction of the ingestive endoderm with the endoderm of a radial canal.

w, endoderm of the radial canal. Other letters as in fig. 1.

FIG. 9.—Endoderm of the gonads, showing the polygonal outline of the cells and the block-like deposits within their substance.

PLATE X.

FIG. 1.—Endoderm of the middle region of the gastric tube.
a, nuclei; *b*, secretion-cells; *f*, intercellular spaces.

FIG. 2.—Endoderm of the middle region of the gastric tube, consisting of uniform hexagonal-cells.

g, embedded nematocysts.

FIG. 3.—Surface view of a tentacle of the smallest size, to show the grouping of nematocysts.

FIG. 4.—Optical section of a small tentacle in a plane including the long axis.

b, endoderm-cell; *c*, structureless lamella closely adhering to the endoderm-cells; *d*, layer of muscular processes of the ectoderm-cells; *e*, endoderm-cells with nematocysts.

FIG. 5.—Actual transverse section of a tentacle.

a, rudimentary lumen (probably due to the shrinking caused by reagents). Other letters as in fig. 4.

FIG. 6.—Nematocysts with extruded thread.
a, completely, *b*, incompletely everted.

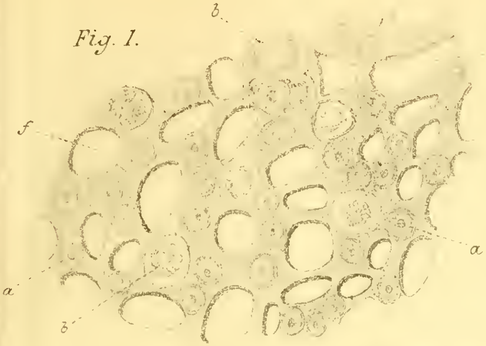


Fig. 1.

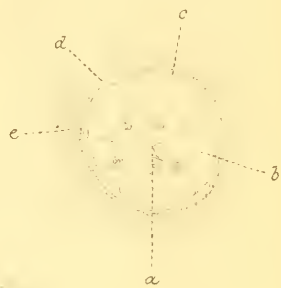


Fig. 5.

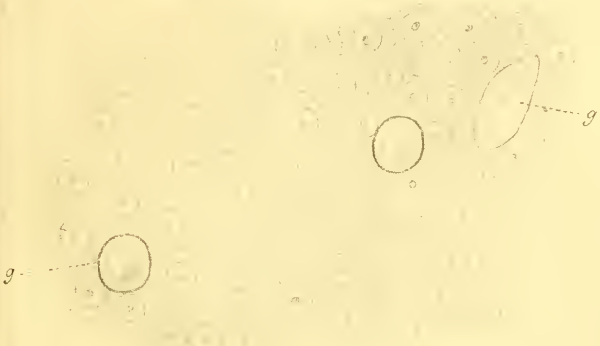


Fig. 2.

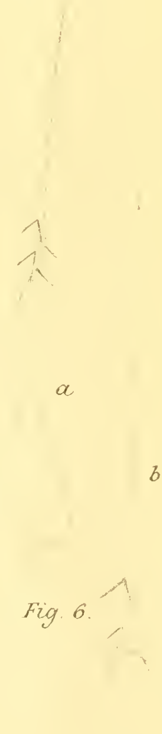


Fig. 6.

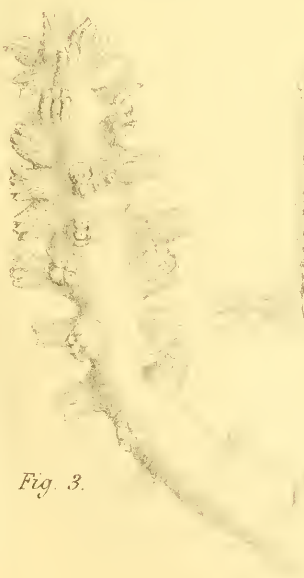
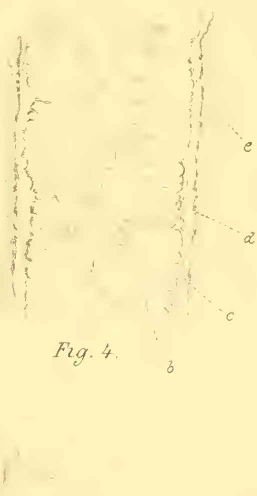


Fig. 3.



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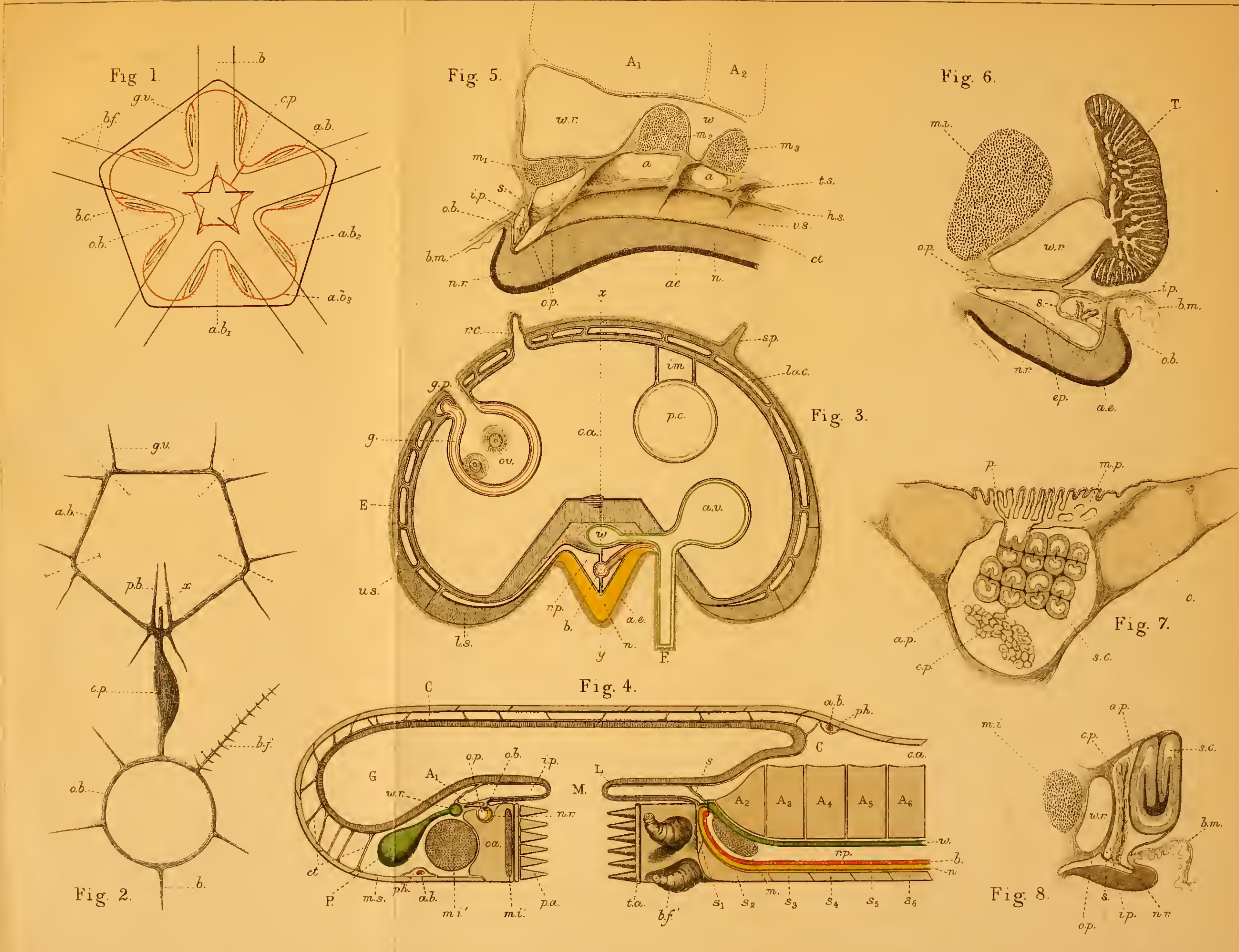


After Ludwig.

McFarlane & Erskine, Lithrs Edinr

EXPLANATION OF PLATES XI AND XII,

Illustrating Mr. P. Herbert Carpenter's paper on "The Minute Anatomy of the Brachiate Echinoderms."

The following letters denote the same parts in all the figures of both Plates:

a. b. Aboral blood-vascular ring; *a. e.* ambulacral epithelium; *a. p.* axial perihæmal canal; *b.* radial blood-vessel; *b. f.* its branches to the sucking feet; *b. m.* buccal membrane; *C.* cœlom; *c. a.* cœlom of the arms; *c. p.* central plexus; *E.* epithelium of body; *G.* gut; *g.* blood space around genital gland; *g. v.* genital vessel; *i. p.* inner oral perihæmal ring-canal; *L.* lip; *M.* mouth; *m. i.* interradial muscle; *n.* radial trunk of the ambulacral nervous system; *n. r.* its oral ring; *o. b.* oral blood-vascular ring; *o. p.* outer oral perihæmal ring-canal; *ov.* ovary; *ph.* perihæmal space; *r. p.* radial perihæmal canal; *s.* annular septum in oral perihæmal canal; *s. c.* stone canal; *w.* radial water-vessel; *w. r.* water-vascular ring.

The following colours are used for the same parts in both Plates:

Red, blood-vascular system; yellow, ambulacral nervous system; green, water-vascular system.

PLATE XI.

Anatomy of the Starfishes and Ophiurids.

All the figures in this Plate are copied from Ludwig, with slight alterations in the colouring.

Fig. 1.—Diagram of the blood-vascular system of an Ophiurid, as seen from the dorsal side. The contours of the disc and arms are indicated by dark lines, and the radial vessels by dotted lines.

> *a.* b_1 Interradial portions of the aboral blood-vascular ring, which rest on the mouth shields; *a.* b_2 descending limbs of this ring at the sides of the rays; *a.* b_3 radial portions of the ring beneath the radial shields; *b. c.* bursal cleft.

Fig. 2.—Diagram of the blood-vascular system of a Starfish, based upon preparations of *Astropecten aurantiacus.* The positions of the falciform folds are indicated by |.........|.

> *p. b.* Plexiform vascular bundles, proceeding to the walls of the stomach; *x.* dorsal terminal portion of the central plexus.

Fig. 3.—Diagram of the structure of a Starfish arm. The outer wall of the arm is too thin in proportion to the structures in the ambulacral groove, the relative size of which is somewhat exaggerated. On the left of the dotted line *x y*, the section passes through the middle of a vertebra; while on the right, the section passes between two vertebræ. The pyloric cæcum is omitted from the left side, and the genital gland from the right. The upper and lower transverse muscles of the vertebræ are represented on the left side. The inner layer of the integument is simply shaded, and the outer

layer cross-shaded. The marginal plates are calcifications of the latter, and the vertebræ of the former.

a. v. Ambulacral vesicle or ampulla; *F.* ambulacral tube foot; *g. p.* genital pore; *im.* intermesenteric space; *lac.* lacunar spaces in the integument connected with the perihæmal system; *p. c.* pyloric cæcum; *r. c.* respiratory cæcum of perisome; *sp.* spine; *u. s.*, *l. s.* upper and lower side plates of arm.

Fig. 4.—Diagrammatic vertical section through an Ophiurid, based upon preparations of *Ophioglypha*. The right half of the section passes along a ray, and the left half is interradial.

A_1 First ambulacral ossicle (vertebra), or peristomial plate; $A_2 ... A_6$ second to sixth ossicles; *b. f'.* buccal feet; *ct.* connective-tissue bands, fastening the stomach to the body wall; *m.* lower transverse muscle of the second vertebra; *mi'.* and *mi''.* external and internal interradial muscles of the oral angle; *m. s.* mouth-shield; *o. a.* oroangular (interambulacral) piece; *P.* polian vesicle; *p. a.* palæ angulares; S_1—S_6 first to sixth under arm plates (superambulacral, Müller); *t. a.* torus angularis.

Fig. 5.—Vertical section through the peristome of *Asteracanthion rubens*, close to the middle line of a radius. × 50.

A_1, A_2. First and second ambulacral ossicles; *a, a.* Apertures in the vertical septum (*v. s.*); *ct.* connective-tissue membrane above the nerve; *h. s.* horizontal septum in the perihæmal canal; $m._1$ and $m._2$ lower transverse muscles of the first ossicle; $m._3$ transverse muscle of the second ossicle; *t. s.* and *v. s.* transverse and vertical septa in the radial perihæmal canal.

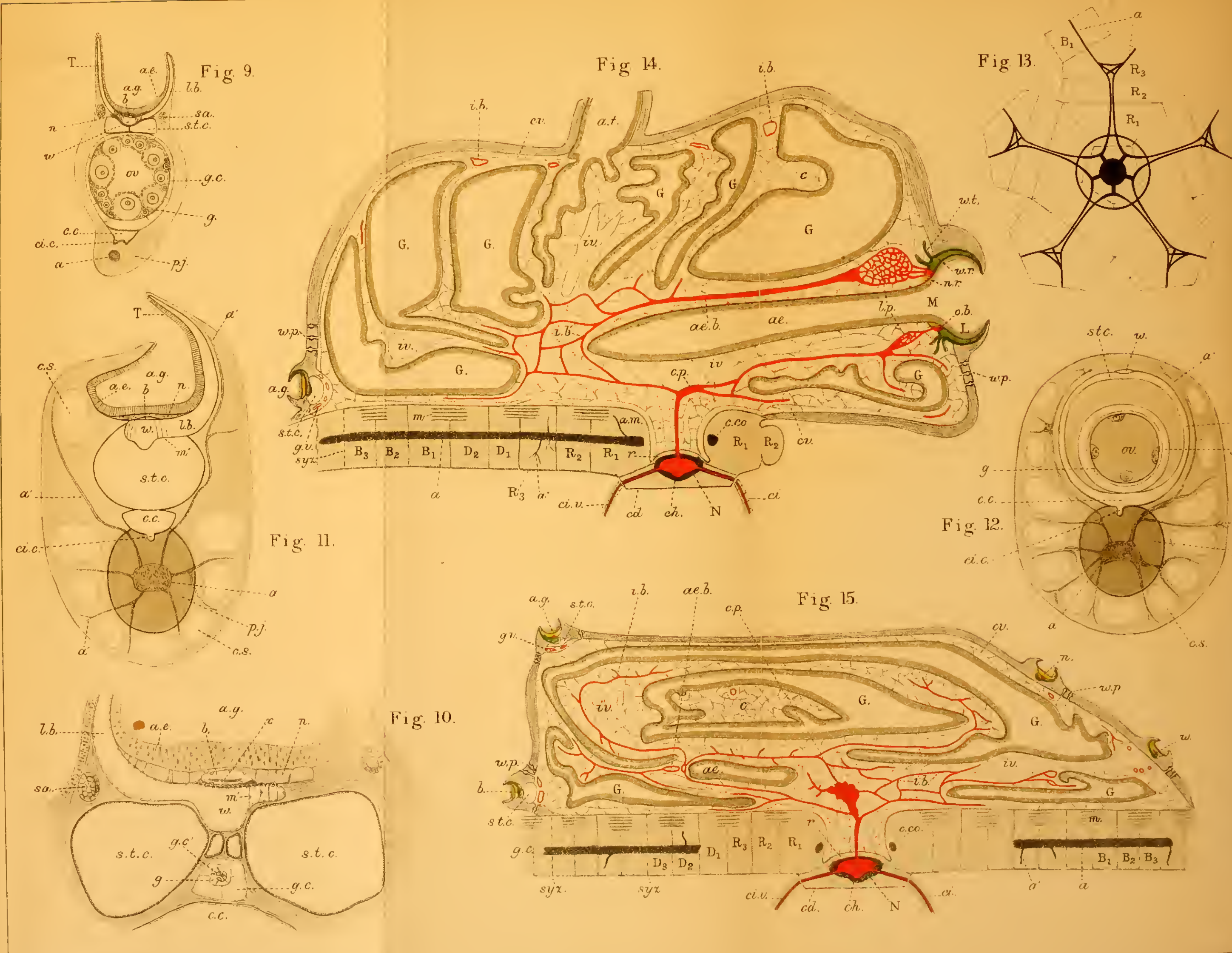
Fig. 6.—Vertical section through the peristome of *Asteracanthion rubens*, to show the connection of the canalicular spaces of Tiedemann's body (*T.*) with the water-vascular ring. × 60.

ep. Thickened epithelium lining the perihæmal ring-canal.

Fig. 7.—Section through the madreporic plate of *Asterina pentagona*, near its distal margin. × 45.

c. Calcareous pieces in integument; *m. p.* madreporic plate; *p.* its pores.

Fig. 8.—Vertical section through the peristome of *Asteracanthion rubens*, to show the relation of the central plexus and axial perihæmal canal with the oral ring. × 18.



9. 10. 13. after Ludwig. 11. 12. 14. 15. P. H. C. fec.

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DESCRIPTION OF PLATE XII.

Illustrating the anatomy of the *Comatulæ*. Figs. 9, 10, and 13 are copied from Ludwig. The following letters denote the same parts in all the figures:

a. Axial cords of the skeleton; *a'.* the branches proceeding from them; *œ.* œsophagus; *œ. b.* œsophageal bundle of vessels; *a. g.* ambulacral groove; *a. m.* muscle branches from the axial cords; *a. t.* anal tube; B_1, B_2, B_3, &c., first, second, and third brachials, &c.; *c.* connective-tissue network in the cœlom; *c. c.* cœliac canal; *c. co.* circular commissure in the first radials; *cd.* centrodorsal piece; *ch.* chambers of the chambered organ; *ci.* cirrhi; *ci. c.* ciliated cups; *ci. v.* cirrhus vessels; *c. s.* connective-tissue spaces in the perisome; *cv.* circumvisceral cœlom; D_1, D_2, D_3. first, second, and third distichals; *g. c.* genital canal; *i. b.* intervisceral blood-vessels; *iv.* intervisceral cœlom; *l. b.* lateral branches of the water-vessels; *l. p.* labial plexus; *m.* muscles; *m'.* transverse muscle threads in the water-vessels; *N.* fibrillar sheath of the chambered organ; *p. j.* pinnule joint; R_1, R_2, R_3. first, second, and third radials; *r.* rosette; *sa.* sacculi; *s. t. c.* subtentacular canal; *syz.* syzygy; *T.* tentacles; *w. p.* water-pore; *w. t.* water-tube.

FIG. 9.—Transverse section of a pinnule of a sexually mature *Antedon Eschrichtii.* ♀ × 50.

FIG. 10.—Transverse section through the ventral perisome of an arm of *Antedon Eschrichtii.* × 75.

g. c'. Genital cord; *x.* coagulum in radial blood-vessel.

FIG. 11.—Transverse section through the end portion of a grooved pinnule of *Actinometra polymorpha.* × 70.

FIG. 12.—Transverse section through an ungrooved pinnule of the same animal. ♀ × 50.

l. t. Lateral trunks connecting the subtentacular and cœliac canals.

FIG. 13.—Diagram of the distribution of the axial cords within the calyx of *Comatula,* showing their origin in the fibrillar envelope of the chambered organ.

FIG. 14.—Longitudinal vertical section through the body of *Actinometra polymorpha.* × 10. Diagrammatic. Since the position of the mouth is interradial, the section traverses the joints of a ray behind the mouth, but does not pass along the corresponding ambulacral groove, which only reaches its destination after a circuitous course round the margin of the disc, and is cut somewhat obliquely.

FIG. 15.—Vertical transverse section through the centre of the body of a somewhat larger specimen. × 7. Diagrammatic. Two of the rays and four ambulacral grooves are cut rather obliquely. The section is represented as seen from its anterior side.

DESCRIPTION OF PLATE XIII,

Illustrating Professor Lankester's memoir "On Young Stages of Limnocodium and Geryonia."

All the figures were drawn from the same embryo, in the living condition.

Fig. 1 shows the velum (*a*) retracted, so as to expose the surface of the præumbral lid (*c*), with its central perforation (*b*). Eight tentacles are present, four per-radial (t^4) and four adradial (t^8); also two marginal bodies, one of which only (*ot*) is seen.

Fig. 2.—Deep optical horizontal section of the same specimen, showing:
a. ectoderm of the abumbral surface; *b.* the four radial canals. *c.* ectoderm of the manubrium; *d.* endoderm of the manubrium; *e.* striated muscular fibres.

Fig. 3.—Similar view to that of Fig. 1, with the velum now expanded, so that the free margins of its folds meet at the central region (*a*), and completely cover in the præumbral lid.

ot. marginal body (tentaculocyst).

Figs. 4—5.—Two views of the velum in different conditions of contraction.

a. free margin of the velum; *b.* præumbral lid; *ot.* tentaculocyst.

Fig. 6.—Enlarged drawing of one of the two tentaculocysts.

Fig. 1.

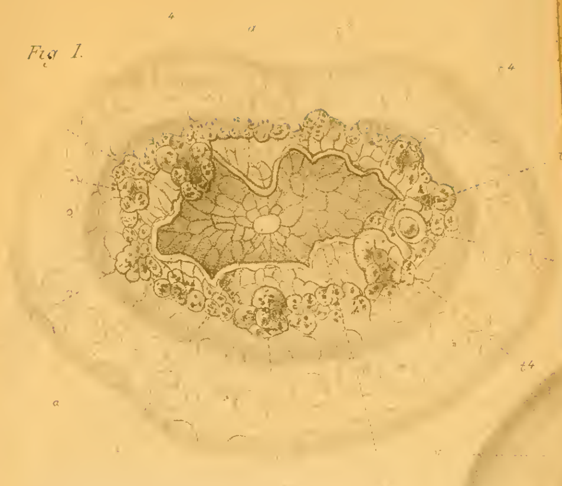
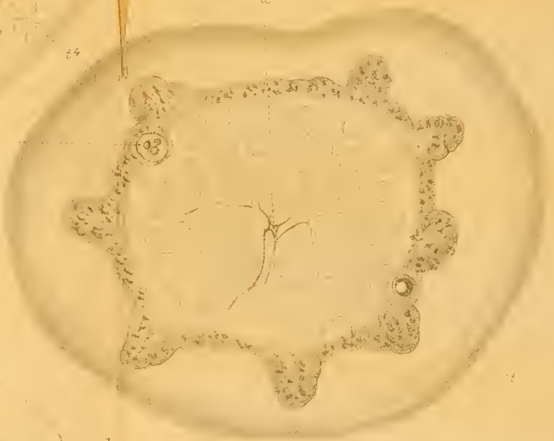


Fig. 4.

Fig. 6.

Fig. 3.



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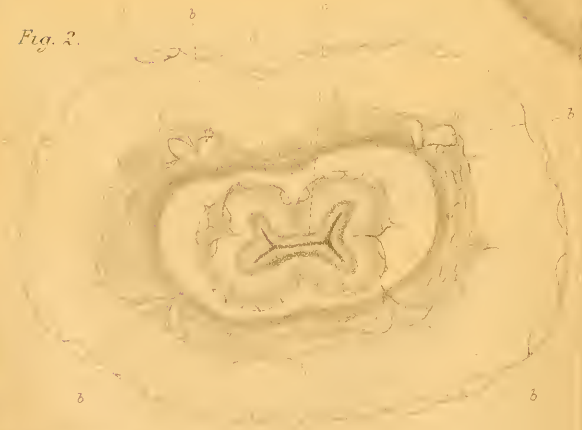

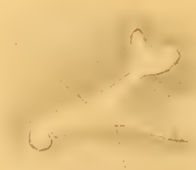

Fig. 5.

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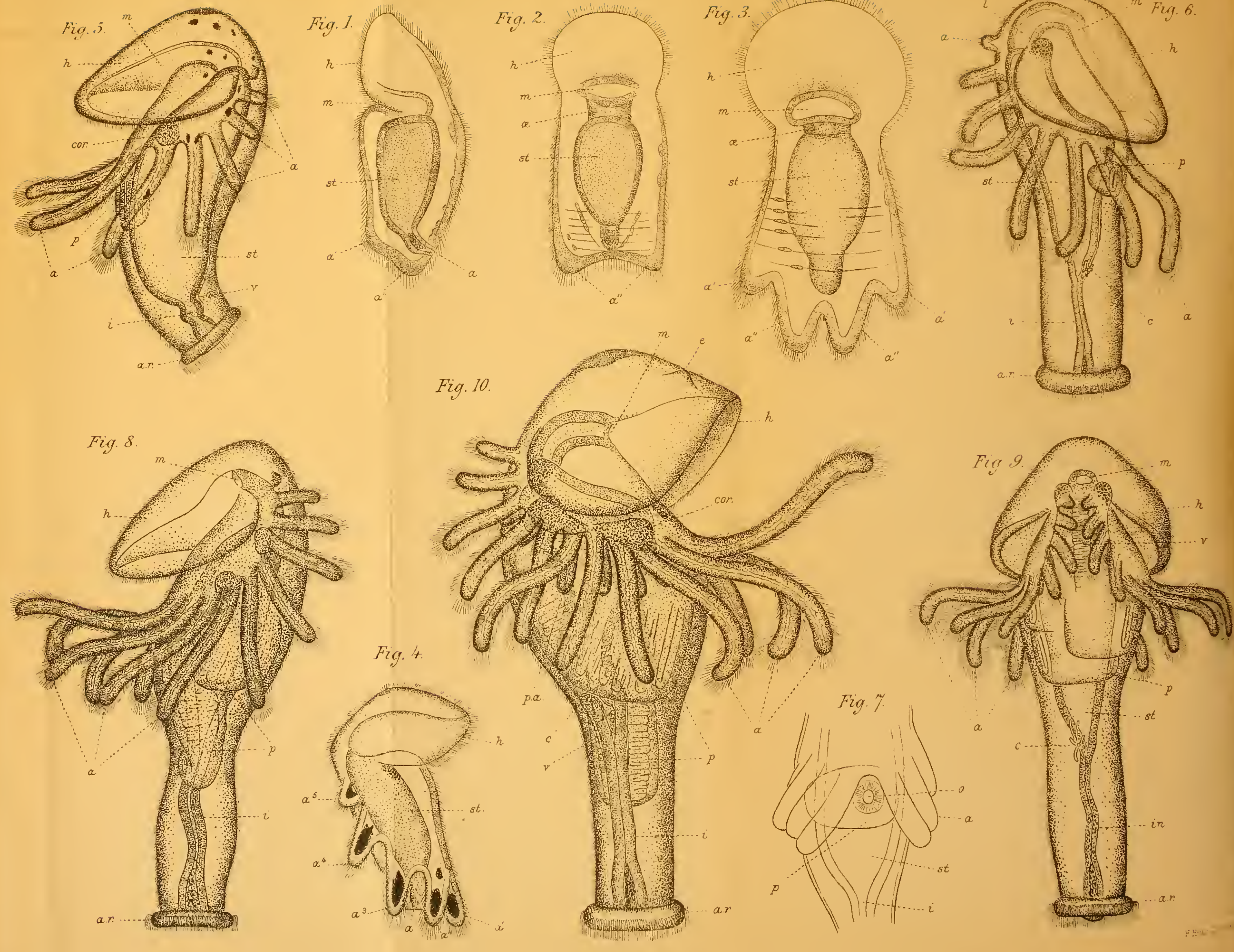
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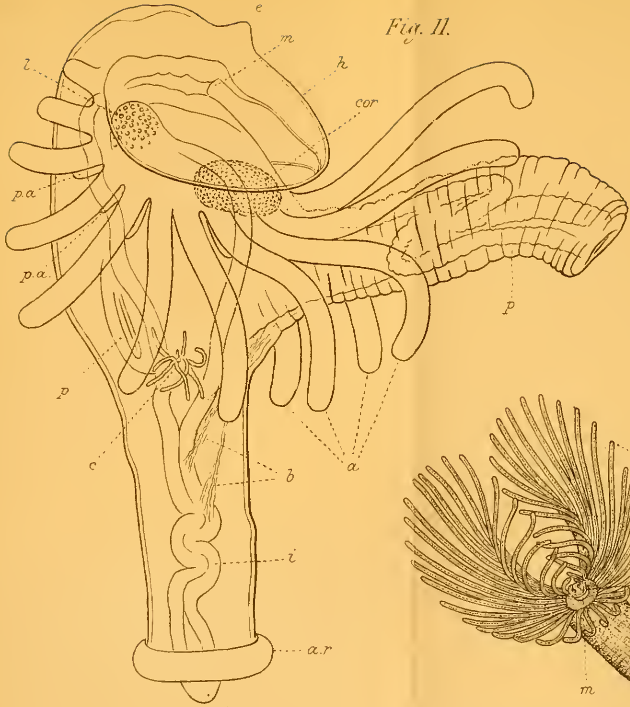

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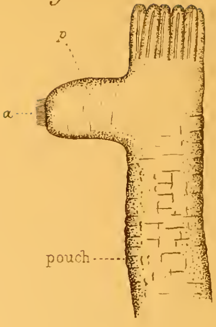

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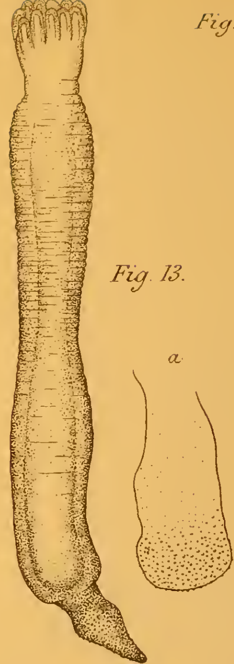

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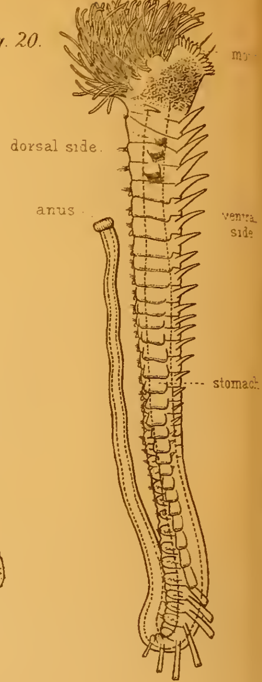

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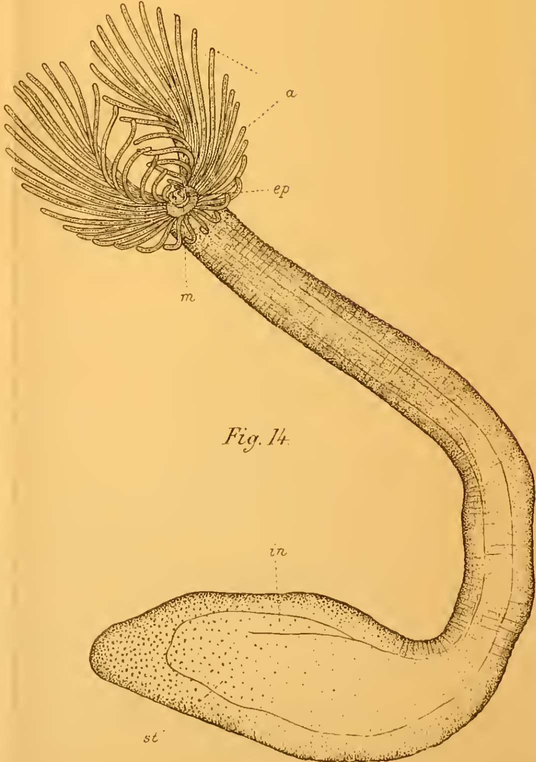
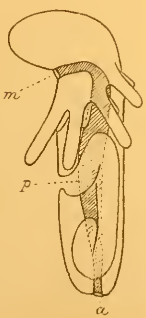


Fig. 15.

Fig. 16.



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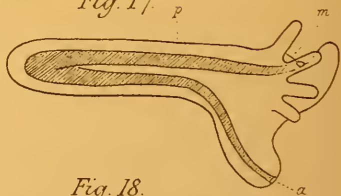

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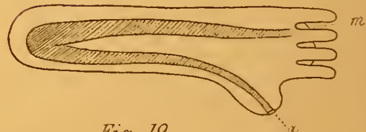

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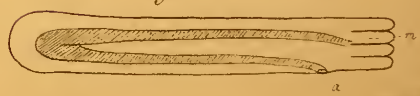


EXPLANATION OF PLATES XIV & XV,

Illustrating Mr. Edmund B. Wilson's paper on 'The Origin and Significance of the Metamorphosis of Actinotrocha.'

FIG. 1.—Very young Actinotrocha, lateral view.
h, hood; *m*, mouth; *st*, stomach; *a*, anus; *a'*, *a''*, rudiments of arms.

FIG. 2.—Ventral view.
Letters as before; *œ*, œsophagus.

FIG. 3.—Older larva.
Letters as before.

FIG. 4.—Older larva.
Letters as before; *a'*, *a''*, a^3, a^4, a^5, arms. These four figures copied from Metschnikoff.

FIG. 5.—Still older larva of species "*A*," from Chesapeake Bay.
p, ventral pouch; *i*, intestine; *a*, *r*, præanal ciliated belt; *v*, dorsal vessel; *cor.* mass of pseud-hæmal corpuscles.

FIG. 6.—Opposite view, species "*B*."
l, glandular lobe of stomach; *c*, cœcal appendages of pseud-hæmal system.

FIG. 7.—Ventral view.
o, opening of pouch.

FIG. 8.—Much later stage; lateral view.

FIG. 9.—Same stage; dorsal view.
v, dorsal vessel.

FIG. 10.—Full-grown larva of B.
e, conical elevation of hood; *p*, *a*, rudiments of permanent tentacles.

FIG. 11.—"Critical stage," species *B*.
b, *b*, fibrous connections between pouch and intestine.

FIG. 12.—Immediately after metamorphosis, species A.

FIG. 13.—Twenty-four hours later.

FIG. 14.—Twenty-two days later.
a, tentacles; *ep*, epistome; *m*, mouth; *in*, intestine; *st.* stomach.

FIGS. 15 to 19.—Diagrams to illustrate the metamorphosis.
m, mouth; *a*, anus; *p*. pouch.

FIG. 20.—*Sabellaria*, from North Carolina.

EXPLANATION OF PLATES XVI & XVII,

Illustrating Dr. Klein's paper on the "Organ of Jacobson."

All figures are drawn with the camera lucida.

Figs. 1, 2, 3, 4, and 7 are drawn under a magnifying power of a little over 16; figs. 5 and 6 under one of about 50; fig. 8 drawn under one of about 320; figs. 9 and 10 under one of about 30.

In figs. 1, 2, 3, 4, 5, 6, and 7 the numbers have the following meaning:

1. The cartilage of the nasal septum. 2. The cartilage of the lower turbinated bone. 2*a*. The osseous substance of the lower turbinated bone. 3. The cartilage of Jacobson. 4. The lower nasal furrow. 5. The naso-lachrymal duct. 6. An alveolar cavity in the superior maxilla. 7. The bone of the superior maxilla. 8. The epithelium covering the mucous membrane of the nasal septum. 9. The epithelium covering the mucous membrane of the lower turbinated bone. 10. Fat tissue in the middle line of the superior maxilla. 11. Osseous substance around the Jacobson's cartilage. 12. The mouth of the organ of Jacobson in open communication with the lower nasal furrow. 13. The organ of Jacobson already a closed tube. 14. The blood-vessels of the cavernous tissue in the lateral wall of Jacobson's organ. 15. The gland alveoli in the wall of Jacobson's organ. 16. The osseous substance of the crista nasalis of the superior maxilla. 17. Spaces containing the bundles of the olfactory nerve supplying the organ of Jacobson. 18. Venous plexus near the epithelium lining the naso-lachrymal duct. 19. Arterial vessels. 20. The tissue of the wall of the duct. 21. A lymph-follicle.

Fig. 8.—From a longitudinal section through the wall of the naso-lachrymal duct.

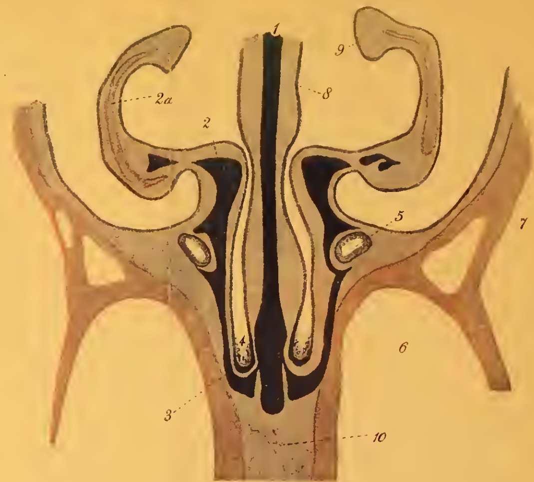
1. The stratified columnar epithelium lining the inner cavity. *a*. The superficial cylindrical cells. *b*. The deep small cells. *c*. The intra-epithelial cavities containing cells and capillary blood-vessels. 2. The sub-epithelial layer of connective tissue. 3. Large veins in section, forming the "sub-epithelial venous plexus." 4. The tissue of the outer part of the wall. 5. An artery. 6. A lymph-follicle. 7. A vein in transverse section.

Figs. 9 and 10 are transverse sections through the Stenonian ducts. The meaning of the letters is—

A. Anterior wall. P. Posterior wall. B. Blood-vessels. C. The Stenonian cartilage. E. The stratified pavement epithelium. T. The fibrous tissue of the wall of the duct. S. The lumen of the duct.

Fig. 1.

Fig. 2.



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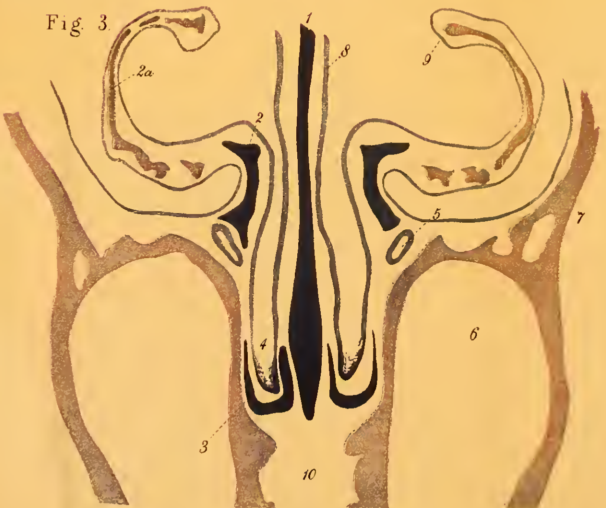
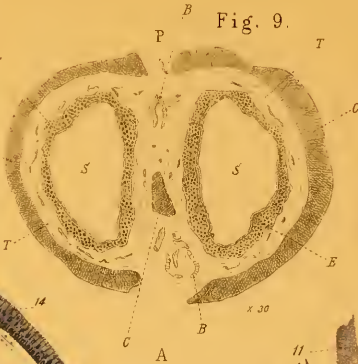


Fig. 4.

McFarlane & Erskine, Lith^rs Edin^r

Fig 5.

Fig. 9.



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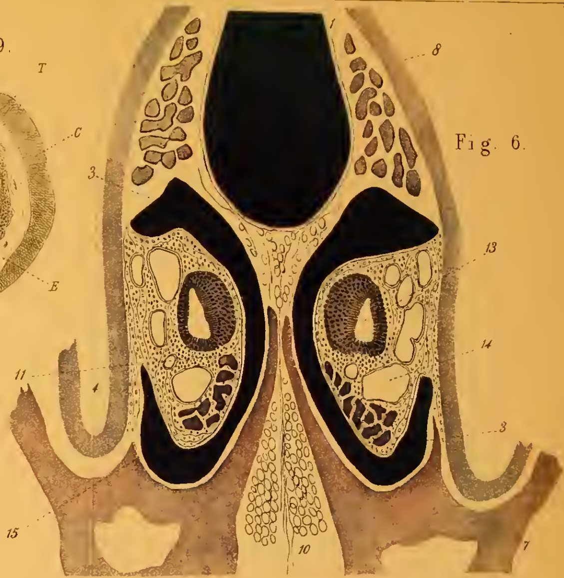
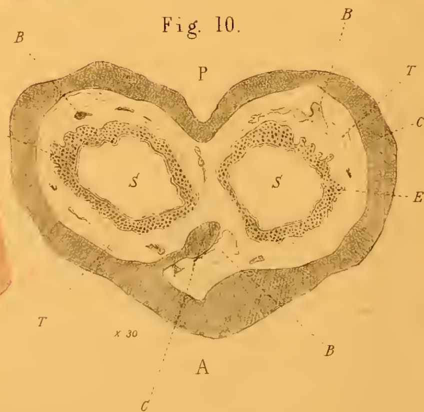


Fig. 7.

Fig. 10.



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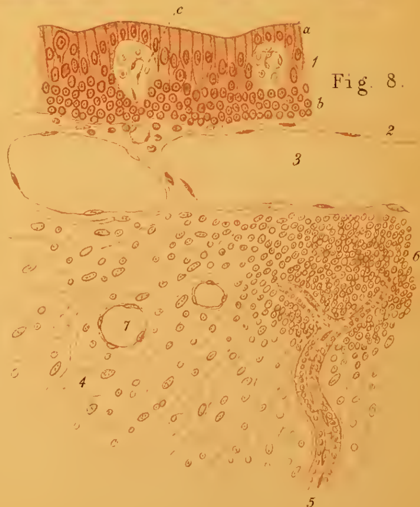

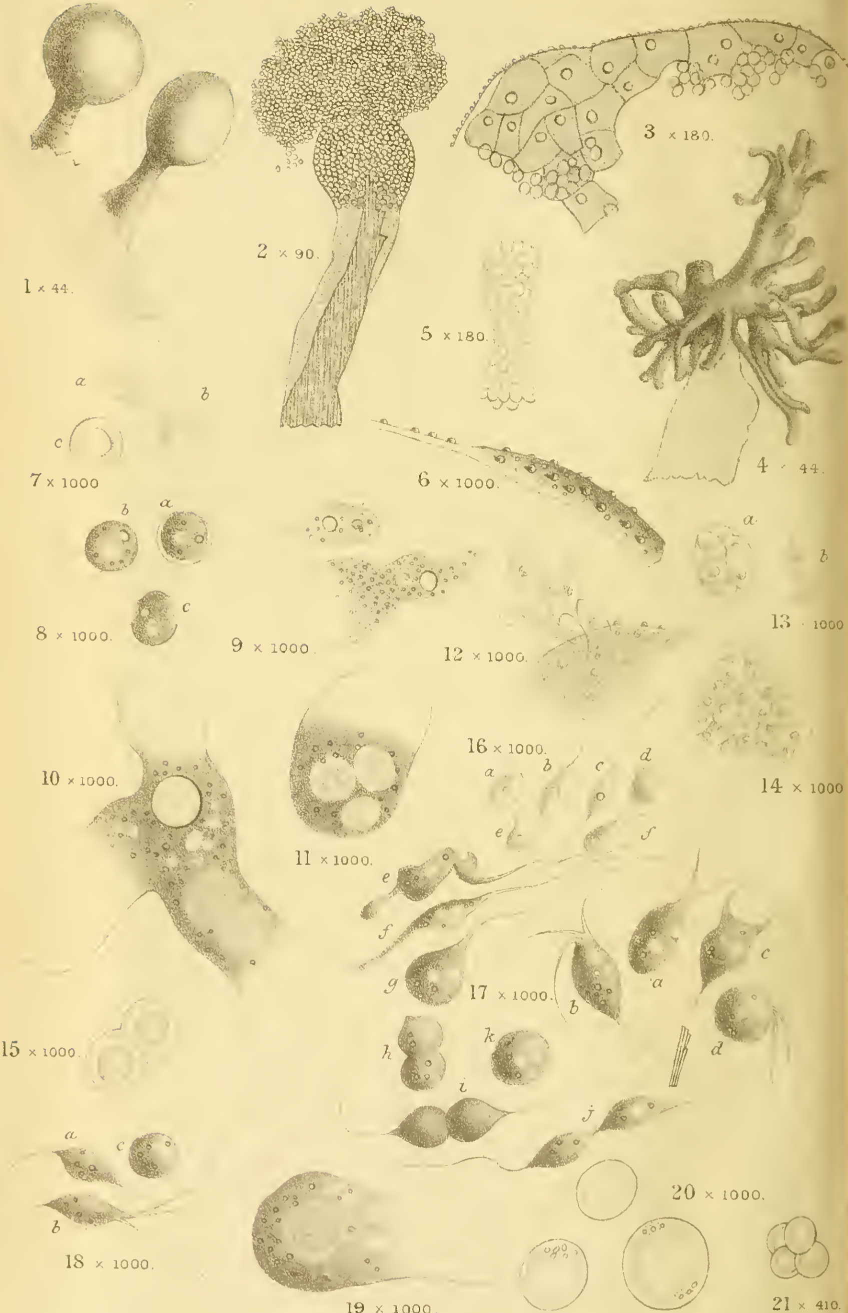

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DEVELOPMENTAL FORMS OF CERTAIN ORGANISMS OCCURRING IN THE INTESTINAL CANAL OF VARIOUS ANIMALS.

DESCRIPTION OF PLATE XVIII,

Illustrating Surgeon-Major Cunningham's Memoir on the "Development of Certain Microscopic Organisms occurring in the Intestinal Canal."

FIG. 1.—Pedicillate sporangia of Protomyxomyces. × 44.

FIG. 2.—Ruptured sporangium with mass of escaped spores. × 90.

FIG. 3.—Portion of an immature sporangium, showing its formation by aggregation of amœboid bodies, and some formed spores. × 180.

FIG. 4.—Abnormal dendritic form of sporangium. × 44.

FIG. 5.—Portion of one of the branches of a dendritic sporangium showing contained spores. × 180.

FIG. 6.—Sporangial membrane studded with organic granules. × 1000.

FIG. 7.—Biconcave spores from a mature dry sporangium. × 1000.

FIG. 8.—(*a*) Mature spore in nutritive fluid ; (*b*, *c*) emergence of Amœbulæ from similar bodies. × 1000.

FIG. 9.—Protomyxomycete Amœbæ in different stages of development. × 1000.

FIG. 10.—Fully developed Amœba. × 1000.

FIG. 11.—A similar body showing subdivision of nucleolus. × 1000.

FIG. 12.—Portion of sporangium containing fusiform, nucleated spores. × 1000.

FIG. 13.—(*a*) Mass of fusiform spores as first expelled from a ruptured sporangium : (*b*) Individual spores after solution of the gelatinous investing substance of the mass. × 1000.

FIG. 14.—Larger aggregate of fusiform spores. × 1000.

FIG. 15.—Structure of the nucleus in a fully developed Protomyxomycete Amœba. × 1000.

FIG. 16.—Various stages in the development of fusiform spores in nutritive fluid, showing the transition through the monad to the amœbal condition. × 1000.

FIG. 17.—Various forms presented by Protomyxomycete zoospores and process of multiplication by transverse division. × 1000.

FIG. 18.—Zoospores from human excreta. × 1000.

FIG. 19.—Large amœbal form in human excreta. × 1000.

FIG. 20.—Sporoid cells developed from an Amœba, with remains of the parent body as a gelatinous investment. × 1000.

FIG. 21.—Aggregate of sporoid cells in a cultivation of human excreta. × 410.

EXPLANATION OF PLATE XIX,

Illustrating Dr. Schimper's Paper on the "Development of Starch-grains."

In all cases the magnifying power is 850 diameters. The chlorophyll-corpuscles are more darkly shaded than the leucophyll-corpuscles or the starch-forming-corpuscles.

Figs. 1—3.—From the stem (pith) of *Vanilla planifolia.*

Fig. 1.—Young flattened chlorophyll-corpuscles, containing but little starch, collected round the nucleus.

Fig. 2.—A more advanced stage: the chlorophyll-corpuscles are now spherical, and contain numerous starch-grains.

Fig. 3.—Mature starch-grains: the chlorophyll-corpuscles have nearly or entirely disappeared.

Figs. 4, 5.—From the cortical parenchyma of the stem of *Philodendron grandifolium.*

Fig. 4.—Young flattened chlorophyll-corpuscles with small starch-grains attached to their surfaces; seen on the surface and in profile.

Fig. 5.—From an older cell. The originally free starch-grains have become adherent, forming compound grains: the chlorophyll-corpuscles are represented by a small gelatinous residue.

Figs. 6—8.—From the pith of the stem of *Peperomia stenocarpa.*

Fig. 6.—Young chlorophyll-corpuscles of a flattened form, with small starch-grains projecting from the surface; seen on the surface and in profile.

Fig. 7.—A more advanced stage. Most of the starch-grains have now a distinct hilum.

Fig. 8.—Large starch-grains from an older cell; *a*, with a gelatinous chlorophyll-corpuscle attached to the posterior end; *b*, a starch-grain, with two chlorophyll-corpuscles, in consequence of which it has grown especially in two directions.

Figs. 9, 10.—From the pith of the stem of *Oxalis Ortgiesii.*

Fig. 9.—From a young cell. A simple flattened chlorophyll-corpuscle, and others in process of division, with small starch-grains projecting from the surface. Seen from above.

Fig. 10.—A large starch-grain, with a chlorophyll-corpuscle attached to it posteriorly.

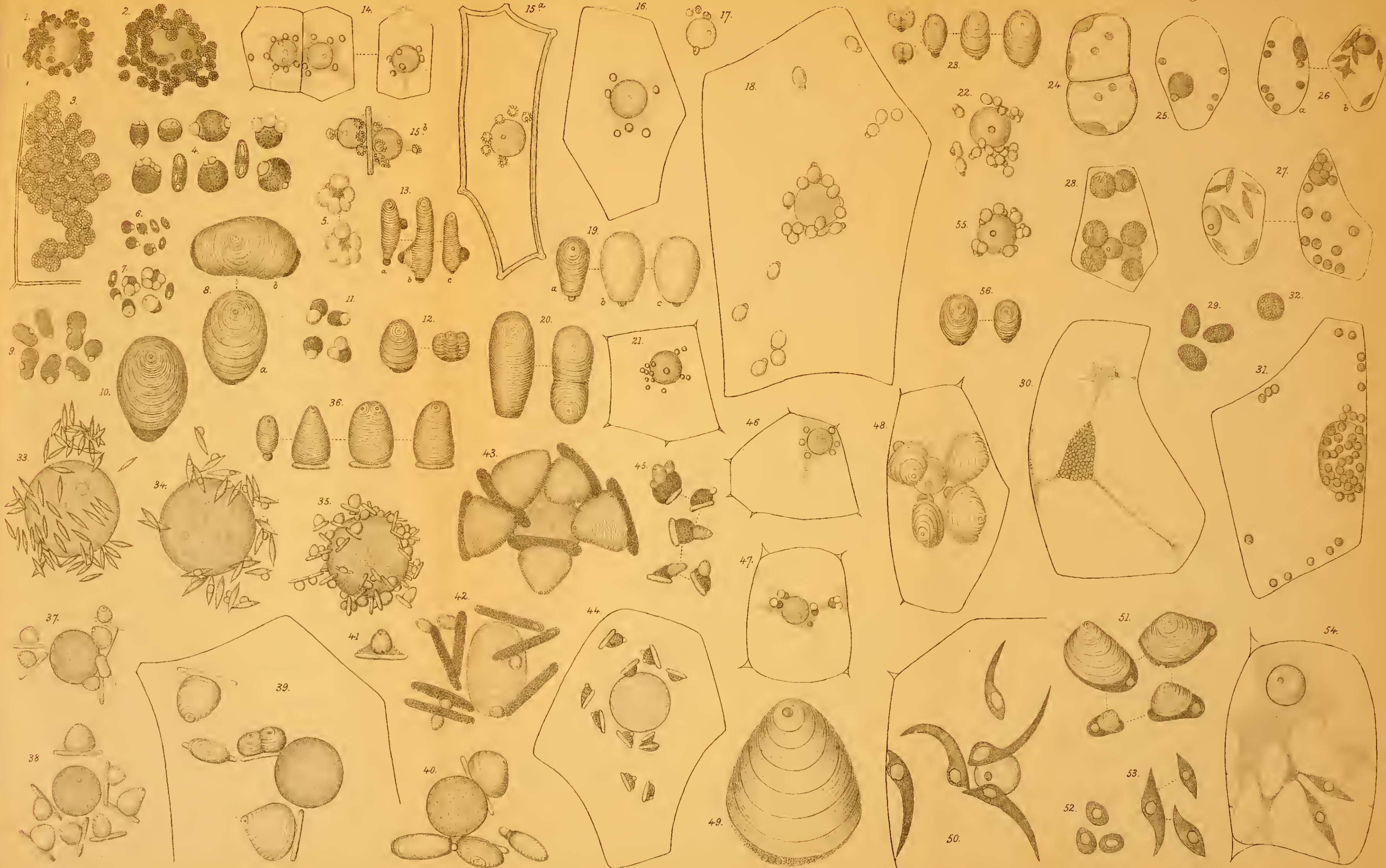
Figs. 11, 12.—From the pith of *Begonia cucullata.*

Fig. 11.—Surface view of young lenticular chlorophyll-corpuscles, with starch-grains.

Fig. 12.—Older starch-grains, with chlorophyll-corpuscles attached to their posterior ends.

Fig. 13.—From the cortical parenchyma of the stem of *Dieffenbachia Seguina.*

Fig. 13.—Each of the three starch-grains has been formed by two chlorophyll-corpuscles, and its growth has therefore proceeded in two directions. In *a* and *b* there is only a small portion of the chlorophyll-corpuscle remaining, in *c* it has entirely disappeared. The other



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chlorophyll-corpuscles are still large and consistent, and appear to have come into contact with the starch-grains only after these had attained a considerable size. Chlorophyll-corpuscles destitute of starch are seen lying near those which contain it, and they may possibly have been formed by the division of the latter; this view is supported by the frequent occurrence of elongated forms (see also Trécal, *loc. cit.*, plate vi, fig. 62).

FIGS. 14, 15.—From the epidermis of the stem of *Philodendron grandifolium.*

Fig. 14.—Young cells, with newly-formed starch-forming-corpuscles.

Fig. 15.—*a*, an older stage: the corpuscles are covered with small starch-grains; *b*, two parietal nuclei surrounded by corpuscles as in *a*.

FIGS. 16—20.—From the pith of the rhizome of *Amomum cardamomum.*

Fig. 16.—Very young cells, with six starch-forming-corpuscles.

Fig. 17.—Starch-forming-corpuscles with very small starch-grains near the nucleus.

Fig. 18. Young cell with nucleus and starch-grains; to the posterior ends of the latter starch-forming-corpuscles are attached.

Fig. 19.—Older starch-grains, with starch-forming-corpuscles attached to their posterior ends; *a*, fresh, *b* and *c* treated with tincture of iodine. In this stage the corpuscles are very delicate, and can only be seen with difficulty in the fresh state.

Fig. 20.—Mature starch-grains. The compound grain has been formed by the coalescence of two grains, which were developed at opposite points by the starch-forming-corpuscles.

FIGS. 21—23.—From the cortical parenchyma of a young potato.

Fig. 21.—Young cell of the external cortex, with very small starch-forming-corpuscles collected about the nucleus.

Fig. 22.—Starch-forming-corpuscles, with young starch-grains round the nucleus.

Fig. 23.—Starch-forming-corpuscles, with large and distinctly stratified starch-grains.

FIGS. 24—29.—From the endosperm of *Melandryum macrocarpum.*

Fig. 24.—Two young cells with parietal nuclei, and a thin lining layer of protoplasm. The starch-forming-corpuscles are in process of development, and form hemispherical protuberances.

Fig. 25.—Young cells from the peripheral portion of the endosperm: the starch-forming-corpuscles are fully developed, but contain no starch as yet.

Fig. 26.—The corpuscles, spherical at *a*, spindle-shaped at *b*, contain minute granules.

Fig. 27.—A later stage: the starch-grains have become larger and more numerous.

Fig. 28.—Elongated starch-grains, which have been formed by spindle-shaped-corpuscles.

FIGS. 30—32.—From the endosperm of *Beta trigyna.*

Fig. 30.—Young cell: the corpuscles are numerous in the protoplasm around the nucleus, and less so in other parts.

Fig. 31.—A somewhat older cell with corpuscles, shortly before the commencement of the formation of starch.

Fig. 32.—Mature compound starch-grain from a nearly ripe seed.

FIGS. 33—45.—From the tuber and the root of *Phajus grandifolius* (*Bletia Tankervilliæ.*

Fig. 33.—From the pith of the root: young corpuscles collected round the nucleus.

Fig. 34.—From the same at a somewhat later stage: most of the corpuscles contain minute starch-grains.

Fig. 35.—From the same: the corpuscles, which have become rod-shaped, bear triangular starch-grains.

Fig. 36.—From the same: large starch-grains with corpuscles; at this stage the corpuscles are delicate, and can only be well seen after treatment with iodine.

Figs. 37, 38.—From the young colourless tuber: starch-forming-corpuscles bearing starch-grains collected round the nucleus.

Figs. 39, 40.—From the same, at a later stage.

Fig. 41.—From the same: the preparation has been treated with iodine. The posterior end of the starch-grain is invested by a gelatinous substance which only becomes visible after treatment with iodine.

Fig. 42.—From the apical portion of the tuber after it has become green: the rod-shaped chlorophyll-corpuscles bearing small starch-grains are collected about the nucleus.

Fig. 43.—From the same: chlorophyll-corpuscles bearing starch-grains.

Fig. 44.—From the same: cortical cell containing chlorophyll-corpuscles and minute starch-grains.

Fig. 45.—From the root which has become green: chlorophyll-corpuscles bearing starch-grains.

Figs. 46—53.—From the pith and the cortical parenchyma of the rhizome of *Canna gigantea.*

Fig. 46.—Very young cell of the pith, with starch-forming-corpuscles.

Fig. 47.—An older cell: the corpuscles now bear starch-grains.

Fig. 48.—At a later stage: the corpuscles, which have become swollen and somewhat elongated, are attached to the posterior ends of the starch-grains. In the swollen portion is a crystalloid, which only becomes visible on treatment with water.

Fig. 49.—An older starch-grain: the corpuscle forms a delicate margin along its posterior border.

Fig. 50.—From the rhizome after it has become green: nucleus, and chlorophyll-corpuscles each containing a crystalloid, from a cell of the inner cortex.

Fig. 51.—From the same: chlorophyll-corpuscles and starch-grains from the young pith.

Figs. 52, 53.—From the same; chlorophyll-corpuscles from the outer cortex.

Fig. 54.—From the rhizome of *Canna discolor.*

Fig. 54.—Cortical cell, with spindle-shaped corpuscles containing crystalloids (probably starch-forming corpuscles).

Figs. 55, 56.—From the etiolated stem of *Begonia cucullata.*

Fig. 55.—Leucophyll-corpuscles, bearing small starch-grains, collected round the nucleus; from the apical portion.

Fig. 56.—Leucophyll-corpuscles with large starch-grains.

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EXPLANATION OF PLATE XX,

Illustrating Professor Ray Lankester's memoir on the "Appendages and Nervous System of *Apus cancriformis.*"

In all the figures the following letters have the significance here attached to them:

Ax. Axis or corm (Protopodite) of the appendage.

Ax^1 to Ax^4. First, second, third, and fourth segments of the corm.

Ax^1 and Ax^2, in Fig. 7, are the equivalents of Ax^1 in Fig. 8; and Ax^3 and Ax^4 in Fig. 7 of Ax^2 in Fig. 8.

Ax^1, in Fig. 7, is the equivalent of the Coxopodite of higher Crustacea.

Ax^2, in Fig 7, is the equivalent of the Basipodite of higher Crustacea.

En^1. Proximal endite (proximal ventral apophysis) or gnathobase.

En^2. Second endite, or second ventral apophysis.

En^3. Third endite, or third ventral apophysis.

En^4. Fourth ditto.

En^5. Fifth ditto, the Endopodite.

En^6. Sixth ditto, the Exopodite.

P. Sub-apical lobe of the corm.

Fl. Distal exite (dorsal apophysis), or flabellum (Epipodite).

Br. Proximal exite, or bract (branchia).

N.B.—All the figures are drawn to the same scale, excepting Figs. 1 *a*. 7 *a*, and 14, and all the appendages are those of the right side seen from the posterior face, except Figs. 3 *a* and 4 *a*. The plumose character of the finer setæ is not rendered, except in Figs. 6 and 13.

Fig. 1.—First præoral appendage, or first antenna.

Fig. 1 *a*.—Enlarged view of the termination of another specimen with four terminal setæ.

Fig. 2.—Second præoral appendage, or second antenna.

Fig. 3.—Mandible.

Fig. 3 *a*.—Mandible revolved on its long axis (anterior face).

Fig. 4.—Maxilla anterior piece.

Fig. 4 *a*.—The same piece reversed (anterior face).

Fig. 5.—Maxilla posterior piece (gnathobase).

Fig. 6.—Maxillipede.

Fig. 7.—First thoracic foot.

Fig. 7*a*.—Enlarged view of the sixth endite of the first thoracic foot.

Fig. 8.—Second thoracic foot.

Fig. 9.—Seventh thoracic foot.

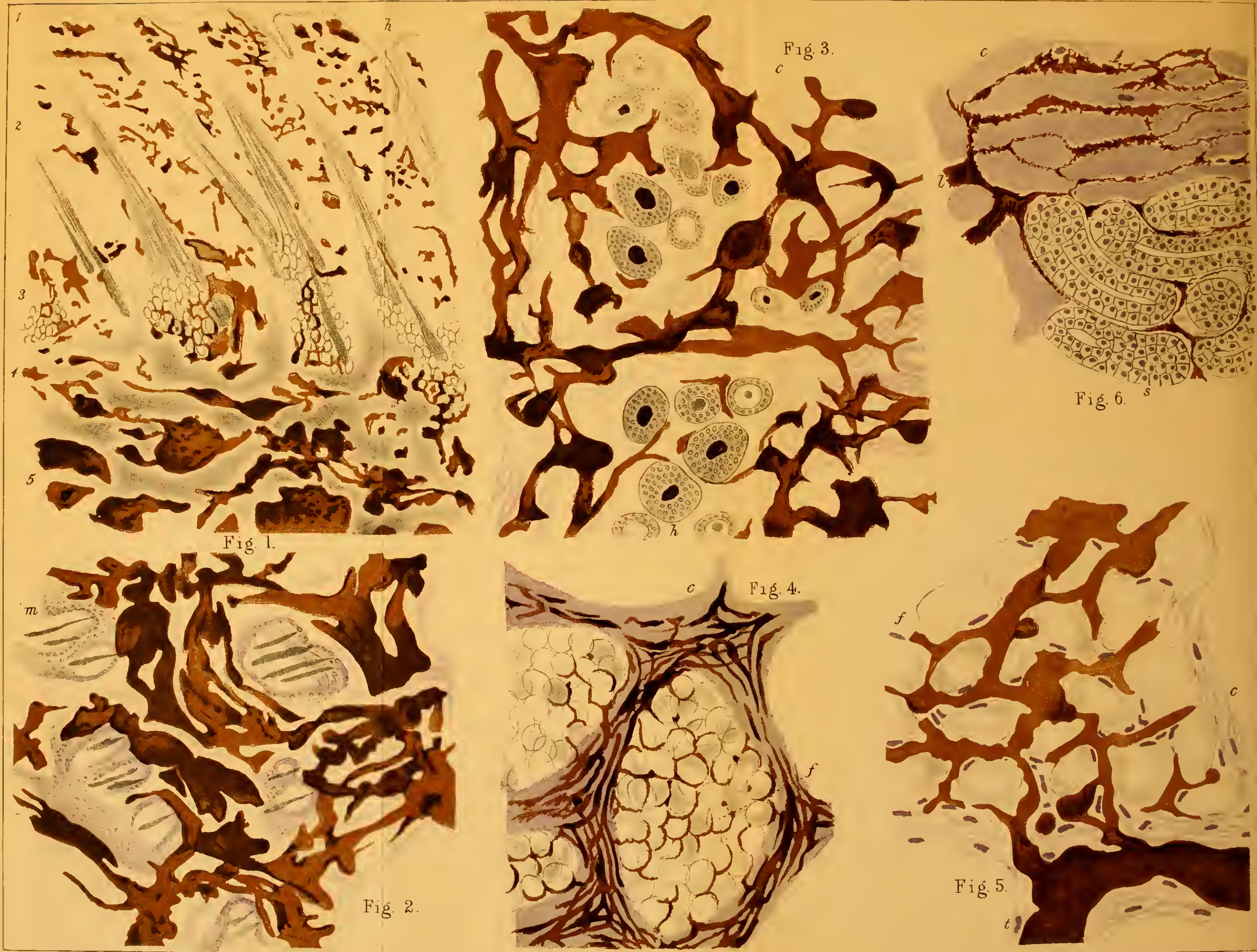
Fig. 10.—Eleventh thoracic foot (oostegopod).

Fig. 11.—First abdominal (post-genital) foot.

Fig. 12.—Abnormal thirtieth abdominal foot, with two flabella and rudimentary bract. Fl^2. Second or additional flabellum.

Fig. 13.—Fifty-second abdominal, or sixty-third truncal foot (sixty-sixth post-oral appendage, sixty-eighth or last appendage of the entire series).

Fig. 14.—Setæ from the apophyses: *a* and *b*, lateral and full views of the short setæ on the endites 2 to 5 of the appendages, drawn in Figs. 9, 10, and 11; *c*, longer setæ from the gnathobase of the maxillipedes and the margin of the sub-apical lobe and flabellum.



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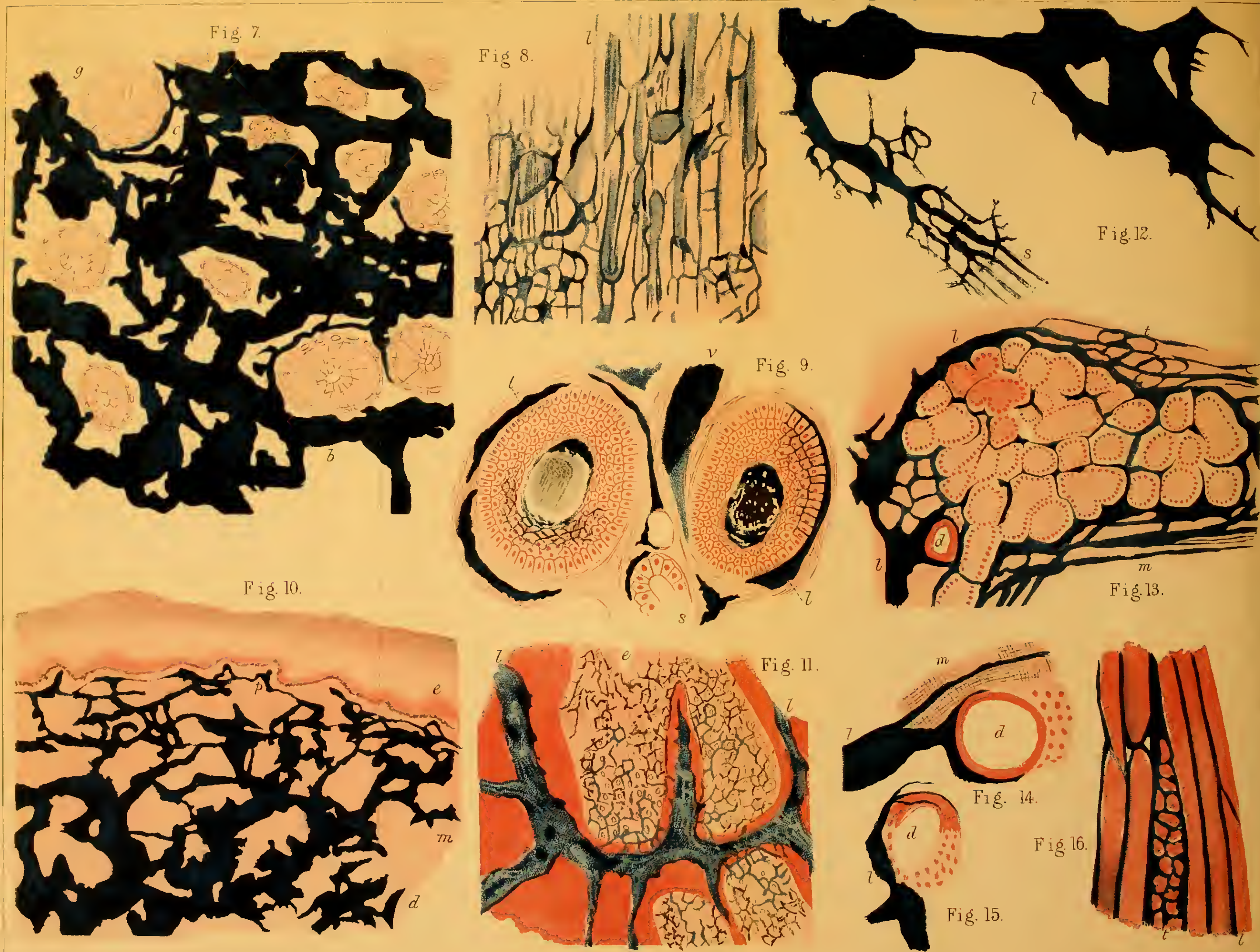
M^c Farlane & Erskine, Lith^rs Edin^r



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EXPLANATION OF PLATES XXI and XXII.

Illustrating Dr. Klein's memoir 'On the Lymphatics of the Skin and Mucous Membranes.'

Fig. 1.—Vertical section through the scalp of the dog; the lymphatics have been injected with a solution of asphalt in benzole. Magnifying power about 25.

1, the most superficial lymphatics; 2, the lymphatics of the middle strata of the corium; 3, the lymphatics of the hair-bulbs and fat-cells; 4, the subcutaneous lymphatics; 5, the large efferent vessels.

Fig. 2.—From a horizontal section through the scalp of the dog, showing the lymphatics of the layer 1 of Fig. 1, as seen from the surface. Magnifying power about 60.

m, mouths of hair-follicles.

Fig. 3.—A horizontal view of layer 2 of Fig. 1. Magnifying power about 60.

c, trabeculæ of connective tissue; *h*, hair-follicles and sweat-gland tubes in transverse section.

Fig. 4.—From a horizontal section through the skin of the cheek of a child; the lymphatics had been injected with asphalt-benzole.

c, connective tissue separating the fat-lobules, and containing a dense plexus of minute lymphatics; *f*, fat-cells, and between them the intercellular lymph-channels. Magnifying power about 100.

Fig. 5.—A horizontal view of the lymphatics of layer 3 of Fig. 1. Magnifying power about 350.

f, fat-cells; *c*, fibrous connective tissue separating the fat-lobules; *t*, large interlobular lymphatic vessel taking up the intercellular lymphatics.

Fig. 6.—From a section through the scalp of a new-born child. Magnifying power about 350.

c, trabeculæ of the connective-tissue, cut in various directions; *s*, sweat-gland tubes cut in different directions; *l*, lymphatics taking up the lymph-spaces between the gland-tubes, and between the connective-tissue trabeculæ.

Fig 7.—The superficial plexus of the lymphatics of the skin of the frog injected with Berlin blue, seen under a higher power, about 300.

b, large vessels; *c*, minute lymphatic channels around the glands; *a*, the cutaneous glands.

Fig. 8.—From a horizontal section through the corium of the scalp of the dog, whose lymphatics had been injected with Berlin blue; showing the interfascicular lymph-spaces of the connective tissue of the corium.

l, in longitudinal; *t*, in transverse and oblique view. Magnifying power about 350.

Fig. 9.—From a horizontal section through the scalp of the dog; the lymphatics had been injected with Berlin blue. Showing two hair-follicles in transverse section. Magnifying power about 180.

l, lymph-spaces of the hair-sac; *v*, lymphatic vessels of the surrounding connective tissue; *s*, sweat-gland tube, also surrounded by lymph-spaces. (See the text.)

Fig. 10.—From a slightly oblique section through the mucous membrane of the mouth of the rabbit. The lymphatics are injected with Berlin blue. Magnifying power about 60.

e, epithelium, the individual cells are not indicated; *p*, papillary layer and the superficial lymphatics; *m*, the middle layers of the lymphatics; *d*, the deep plexuses of the lymphatics.

Fig. 11.—From a horizontal section of a similar preparation as in Fig. 10. Magnifying power about 260.

e, the epithelium horizontally or obliquely cut, the interstitial cement substance between its cells contains pigment, and the injection has found its way into it from the lymphatics of the mucosa; *l*, the lymphatic vessels of the superficial plexuses, *i. e.* those situated in the papillary layer of the mucosa.

Fig. 12.—Lymphatics of the mucous membrane of the mouth of the rabbit. Magnifying power about 350. The lymphatics are everywhere connected with the interfascicular lymph-spaces, hence the numerous fine processes.

Fig. 13.—A lobule of a serous gland from the tongue of the rabbit. Magnifying power about 100.

l, lymphatic vessels in connection with the lymph-clefts between the gland-alveoli; *m*, lymph-clefts between the muscular fibres, in a longitudinal view; *t*, the same in transverse section, the structure of the muscular fibres is not indicated; *d*, a duct in transverse section.

Fig. 14.—From a similar preparation as the preceding figure. Magnifying power 200.

d, the duct of a mucous gland, in transverse section; *m*, striped muscular fibres; *l*, lymphatic vessel in connection with the lymph-spaces around the duct and between the muscular fibres.

Fig. 15.—From the same preparation. Magnifying power about 200.

d, duct; *l*, lymphatic vessel.

Fig. 16.—From the same preparation. Magnifying power about 150. The lymph-spaces between the muscular fibres are injected with Berlin blue.

t, the bundle of the muscular fibres in transverse section; *l*, the same in longitudinal section.


Fig. 1
Fig. 2.
Fig. 3.
Fig. 5.
Fig. 6.
Fig. 7.
Fig. 8
Fig. 9
Fig. 10.

EXPLANATION OF PLATE XXIII.

Illustrating Mr. Walter Gardiner's Paper on the "Development of the Water-glands in the Leaf of the *Saxifraga crustata*."

(All the figures refer to *Saxifraga crustata*.)

Fig. 1.—Transparent preparation of a mature leaf.
g. Water-gland.

Fig. 2.—Longitudinal section of a bud.
m. Mother-cell of water-pore. *b.* Young hairs. *p.* Punctum vegetationis. *f.* Rudimentary leaf.

Fig. 3.—Surface view of young leaf.
b. Hairs. *w.* Water-pore. *y.* Secondary lobe. *v.* Main fibro-vascular bundle.

Fig. 4.—Surface view of young lobe.
m. Mother-cell of water-pore. *w.* Mother-cell which has undergone division.

Fig. 5.—Longitudinal section of fully developed, though not fully grow gland.
b. Hairs. *w.* Water-pore. *e.* Endodermis.

Fig. 6.—Transverse section of gland.
e. Endodermis.

Fig. 7.—Cells of mature gland (longitudinal).

Fig. 8.—Mature water-pores.

Fig. 9.—Mature stoma.
n. Displaced cell.

Fig. 10.—Surface view of a portion of the epidermis, showing development of stomata.
i, ii, iii, and iv. Various stages of development. *n.* Displaced cell. *m.* Mother-cell of stoma. iv. Stoma.

EXPLANATION OF PLATES XXIV & XXV,

Illustrating Mr. Blomfield's Paper on "Spermatozoa."

Figs. 1—23.—*Helix*. Figs. 24—31.—Various animals.

Figs. 1—4.—Original cells which are destined to form the spermatozoa, called on this account spermatospores, the spermatocytes of Meyer and v. la Valette St. George. An intranuclear network is conspicuous in the majority.

Figs. 5—8.—Commencement of the process of spermatogenesis by multiplication and division of the nucleus with a corresponding constriction of surrounding plasma.

Figs. 9—12.—Various stages in the formation of the sperm-polyplasts. These are multinuclear masses of a mulberry-like appearance, each nucleus of which is surrounded by its own plasma and thus constitutes a spermatoblast. The whole mass of the spermatoblasts are supported on a darkly-granular plasma, which possesses a large darkly-stained nucleus. This is the blastophoral cell, or, more shortly, blastophor (*b. c.*).

Fig. 13.—Longitudinal optical section of a polyblast.

Figs. 14—16.—Polyplasts, whose spermatoblasts are commencing their transformations into spermatozoa. This consists in the nucleus becoming placed at one pole, while the plasma elongates and draws away from it, previously throwing out a filament forming the tail.

Figs. 16*a*—18.—Isolated spermatoblasts with filaments.

Figs. 19—22.—Elongation of the protoplasm to form the tail. The plasma, being viscid, appears to elongate like a drop of viscid liquid, presenting as it does so many thickenings and bead-like swellings, which often gives the young tail a monilliform appearance.

Fig. 23.—A bundle of nearly mature spermatozoa, united by their heads to a blastophoral cell (*b. c.*).

Fig. 24.—A series of drawings from the spermatoblast to the mature spermatozoon of the frog.

Fig. 25.—A bundle of spermatozoa from the testis of Dytiscus. Superficial to the bundle are seen several nuclei (*s. n.*), with surrounding plasma. These seem, at first sight, similar to the superficial nuclei of the polyplast of the frog.

Figs. 26 and 27.—Bundles of spermatozoa from Pieris in different stages, with the superficial nuclei (*s. n.*).

Fig. 28.—Copied from Meyer's drawings. *Sg.* is his Spermatogone, and *Sge.* is the Spermatogemme. It is obvious from the drawing that the two correspond with the polyplast of the snail and its blastophoral cell, though according to his view the upper portion of the Spermatogemme is the result of the nuclear multiplication of a separate cell, the spermatocyte, which is derived from the Spermatogone at an early stage and shown in connection with it in Fig. 31.

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Fig. 29.—Copied from v. la Valette St. George, shows a later stage of the above.

Fig. 30 is a stage from the same source, which corresponds to Fig. 28 of Meyer's.

Fig. 31.—Copied from Meyer, shows the spermatocyte, which is to be known by its granular appearance in connection with the Spermatogone, to which it owes its origin.

PLATE XXV.

All the figures relate to the Common Frog.

Fig. 1.—Transverse section across a testicular crypt of the frog, about the end of the summer. Next the wall (*w.*) of the crypt is the testicular epithelium (*t. e.*), composed of two kinds of cells, one the spermatospores (*s*)., destined for future crops of spermatozoa, the other interstitial supporting cells (*i. c.*) ; *n.*, nuclei of fibres forming the wall of the crypt. Next the epithelium are bundles of spermatoza (*b. s.*), arranged radially with their tails towards the lumen and their heads towards the periphery supported on the blastophors.

Figs. 2—8.—Bundles of spermatozoa from a testis in the same stage as Fig. 1, shows the spermatozoa united by their elongated heads to a blastophoral cell (*b. c.*).

Figs. 9—21.—Stages in degeneration of blastophoral cells, the nuclei appear to have been broken up into small pieces, and the protoplasm to have become vacuolated.

Fig. 22.—Transverse section of a crypt about the end of July, showing the large swollen polyplasts (*s. p.*) in various stages of growth; other letters same as Fig. 1.

Fig. 23.—A polyplast stained with picrocarmine, it shows the superficial nuclei (*s. n.*) each surrounded with a portion of granular plasma.

Fig. 24.—Ditto, after longer staining.

Figs. 25 and 26.—Polyplasts stained in a solution of magenta. The staining fluid reaches and stains the superficial nuclei (*s. n.*) before it can act on the spermatoblasts.

Figs. 27—29.—Polyplasts from sections showing a difference in the appearance of the nuclei, due to a difference in the arrangement of the nuclear network.

Fig. 30.—A polyplast viewed in the fresh state, it shows the superficial nuclei (*s. n.*).

Fig. 31.—Transverse section of a crypt about the middle of August. It shows the vesicular polyplasts (*s. p.*) breaking up, and the spermatoblasts coming into connection with one of the superficial nuclei, as at A; then falling back with it, as at B, on to the wall of the crypt, and finally assuming a radial position with regard to the wall of the testicular crypt.

Fig. 32.—Surface view of a vesicular polyplast.

Fig. 33.—Optical section of a polyplast.

Figs. 34—37.—Polyplasts from sections which show the centripetal elongation of the plasma of the spermatoblasts to form the tail of the mature spermatozoa. *s. n.*, superficial nuclei, in 37 the spermatoblasts may be seen coming into connection with these bodies.

Fig. 38.—Spermatoblasts arranged round one of these superficial nuclei, which has now become the blastophoral cell.

Fig. 39.—Interstitial cells from young testis.

DESCRIPTION OF PLATE XXVI,

Illustrating Mr. Adam Sedgwick's Paper "On the Early Development of the Anterior Part of the Wolffian Duct and Body in the Chick, together with some Remarks on the Excretory System of the Vertebrata."

List of Reference Letters.

al., alimentary canal; *ao.*, aorta; *c. v.*, cardinal vein; *e. gl.*, external glomerulus; *ep.*, epiblast; *hy.*, hypoblast; *i. c. m.*, intermediate cell mass; *i. gl.*, internal glomerulus; *k. b.*, blastema of Wolffian tubules; *me.*, mesentery; *m. p.*, muscle plate; *nc.*, notochord; *p. c.*, body cavity; *p. f.*, peritoneal funnel; *pv.*, proto-vertebra; *pv.*[1], cell-mass, which later becomes a protovertebra; *W. d.*, Wolffian duct; *W. t.*, Wolffian tubule.

Fig. 1.—Section through 10th segment of a chick with ten segments, showing origin of Wolffian duct.

Fig. 2.—Section through 10th segment of a chick with twelve segments. Shows second stage in development of Wolffian duct.

Figs. 3 and 4.—Successive sections through the 10th segment of a chick with thirteen segments. Shows further development of Wolffian duct.

Fig. 5.—Section through 10th segment of a chick with fourteen segments, showing further development of Wolffian duct and anterior Wolffian tubules.

The above series are all taken through the points where rudimentary segmental tubes connect the Wolffian duct and peritoneal epithelium, except Fig. 4, which is through a point between two tubules. The object of the series is to trace the continuity in the development of the Wolffian duct and anterior tubules, which exists between the 7th and 11th segments inclusive.

Fig. 6.—Section through a chick with twelve segments just behind the 12th segment. Shows independence of Wolffian duct from peritoneal epithelium and intermediate cell mass.

Fig. 7.—Section through the 13th segment of a chick with thirteen segments. Shows how almost at once the Wolffian duct becomes connected with the intermediate cell mass. The continuity between the two structures is not well represented in this figure.

Fig. 8.—Section through 16th segment of a chick with twenty-one segments. Shows separation of Wolffian duct and intermediate cell mass, which persists for some time in this region.

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F. Huth, [illegible]

FIGS. 9 and 10.—Successive sections through the 15th segment of a chick with about twenty-two protovertebræ, showing the connection between the Wolffian duct and intermediate cell mass. In Fig. 9 the intermediate cell mass is continuous with the peritoneal epithelium; in Fig. 10 it is separate.

FIG. 12.—Section through a chick late in the third day behind the 16th segment, showing the independence of the developing Wolffian tubule and the Wolffian duct in this region.

FIGS. 13, 14, and 15.—A series of successive sections through the 13th segment of a chick with thirty-one or thirty-two segments, Fig. 13 being anterior. Show a further stage in the development of a Wolffian tubule in this region. In Figs. 13 and 14 the tubule is connected to the peritoneal epithelium, and a lumen has appeared in it, which is continued behind into the part of the tubule separated from the peritoneal epithelium, seen in Fig. 15.

FIGS. 16, 17, and 18.—Sections through the 13th or 14th segment of a chick with thirty-four or more segments. Show the further development of a Wolffian tubule in this region, and the first appearance of the external and internal glomeruli. Figs. 16 and 17 are contiguous sections. Between Figs. 17 and 18 there is a section not figured. The three figures respectively correspond to and are further developments of Figs. 13—15.

FIGS. 19, 20, and 21.—Successive sections through the 13th or 14th segment of a chick with thirty-six or more segments. Show further development of external glomerulus.

FIG. 22.—Diagrammatic longitudinal, vertical section, showing the relations of the external and internal glomerulus.

FIG. 23.—Section through the 13th or 14th segment of a chick with thirty-three segments, showing the opening of the Wolffian duct near the external glomerulus.

FIG. 24.—Section through the anterior part of the Wolffian body of a 4th day chick, showing the glomerulus projecting into the Wolffian duct.

FIG. 25.—Section through the hinder region of a tadpole of *Rana temporania*, showing the first appearance of the cells from which the Wolffian tubules will arise.

DESCRIPTION OF PLATE XXVII,

Illustrating Prof. Marshall's and Mr. Spencer's Paper on "The Cranial Nerves of Scyllium."

All the figures are taken from sections of *Scyllium* embryos. Figures 1, 2, 3, 4, 5, 6, 8, and 13, were drawn from single sections. Figures 7 and 9 each represent two sections, the right hand half of the figure being in both cases taken from a section a short distance posterior to that represented in the left hand half. The remaining figures, viz. 10, 11, 12, 14, 15, and 16, are of a diagrammatic nature, each being constructed by combining a number of sections from the same embryo; in these, as in the other figures, the outlines were in all cases drawn by means of a Hartnack camera.

The numbers attached indicate, in diameters, the magnifying power employed.

Alphabetical List of References.

aud., auditory vesicle; *Br.* 1, first branchial arch; *c. g.*, ciliary ganglion; *cr.*, cerebellum; *h. b.*, hind-brain; *Hy.*, hyoid arch; *inf.*, infundibulum; *l.*, lens; *m.*, muscle; *m. b.*, mid-brain; *m. c.*, mucous canal; *Mn.*, mandibular arch; *n.*, notochord; *N.*, nerve from ciliary ganglion to fore part of head, forms the distal portion of the *ramus ophthalmicus profundus; N. c.*, communicating branch between third and fifth nerves, forms the proximal part of the *ramus ophthalmicus profundus; N. c'.*, communicating branch between fifth and seventh nerves; *o. c.*, optic cup; *o. i.*, *obliquus inferior; olf.*, olfactory pit; *o. s.*, *obliquus superior; pit.*, pituitary involution from mouth; *r. e.*, *rectus externus; r. i.*, *rectus inferior; r. int.*, *rectus internus; r. s.*, *rectus superior; spr.*, spiracle, = hyomandibular cleft; 1, first head cavity; 2, second head cavity; 3, third head cavity; I, olfactory nerve; II, optic nerve; III, third, or oculomotor nerve; III *b*, branch of third nerve to *rectus superior;* III *c*, branch of third nerve to *obliquus inferior;* III β, ? secondary root of III; III γ, anterior roots of III; IV, fourth nerve, or *patheticus;* V, fifth, or trigeminal nerve; V *a*, ophthalmic branch of fifth nerve; V *b*, maxillary branch of fifth; V *c*, mandibular branch of fifth; V α, primary dorsal root of fifth; V β, secondary root of fifth; V γ, anterior, or tertiary roots of fifth; VI, sixth, or *abducens* nerve; VII, seventh, or facial nerve; VII *a*, ophthalmic branch of seventh nerve; VII *b*, mandibular branch of seventh; VII *pa*, palatine division of mandibular branch; VII *sp*, spiracular division of mandibular branch; VII *c*, hyoidean branch of seventh; VII *c* 1, *ramus mandibularis externus*, or branch of hyoidean into mandibular arch; VII *c* 2, *ramus mandibularis internus*, or terminal branch of hyoidean to walls of third head cavity; VII *d*, buccal branch of seventh; VII α, original dorsal root of seventh; VII β, secondary root; VIII, eighth, or auditory nerve; IX, ninth, or glossopharyngeal nerve; IX *a*, *ramus dorsalis* of ninth nerve; IX *b*, hyoidean branch of ninth; IX *c*, branch of ninth to first branchial arch; X, tenth, or pneumogastric nerve; X *b*, anterior branch of tenth nerve in first branchial arch.

Marshall del.

F. Huth, Lith^r Edin^r

FIGS. 1 and 2.—Transverse sections through the hind brain of a *Scyllium* embryo, intermediate between stages I and K. × 90.

Fig. 1, showing dorsal (primary) and ventral (secondary) roots of fifth nerve; also the second or mandibular head cavity.

Fig. 2, showing origin of dorsal (primary) roots of seventh nerve from neural crest; also the third or hyoidean head cavity.

FIGS. 3 and 4.—Transverse sections through the hind brain of an embryo of stage K. × 90.

Fig. 4, showing the fifth nerve, arising by its ventral or secondary root alone.

Fig. 3, showing the dorsal and ventral roots of the seventh nerve.

FIGS. 5 to 7.—Transverse sections through the hind brain of an embryo of stage N. × 20.

Fig. 5, showing the ventral roots of the fifth nerves, the ophthalmic branches of the seventh nerves, and the terminations of the maxillary branch of the fifth aud the buccal branch of the seventh nerve; also the first head cavity.

Fig. 6, showing the dorsal and ventral roots of the seventh nerve, the buccal branch of the seventh and maxillary branch of the fifth, and the connection between these two nerves; also the second head cavity.

Fig. 7 shows on the left side the ventral root of the seventh nerve, the termination of the sixth nerve in the *rectus externus*, the mandibular branch of the fifth nerve, the second head cavity, and the termination of the palatine branch of the seventh nerve. On the right side, which represents a more posterior section, are shown the origin of the sixth nerve, the auditory nerve and vesicle, and the palatine branch of the seventh nerve, with the second head cavity.

FIGS. 8 and 9.—Transverse sections through the hind brain of an embryo of stage O. × 17.

Fig. 8, showing the ventral root of the fifth nerve; also the optic nerves aud infundibulum.

Fig. 9, on left side, shows the dorsal and ventral roots of the seventh nerve, aud the terminal branches of the buccal and maxillary nerves; on the right side the auditory vesicle, the seventh nerve with its hyoidean branch, and the termination of the palatine nerve.

FIG. 10.—Longitudinal and vertical section through the head of an embryo of stage L. The outline is from one section, while the details have been filled in from several consecutive sections in order to show the roots of the fifth and seventh nerves, the relations of the third, fifth, and seventh nerves to the head cavities, and the connections of these three nerves with one another. The figure also shows the glossopharyngeal nerve with its *ramus dorsalis*, and its hyoidean branch. × 25.

FIGS. 11 and 12.—Diagrammatic longitudinal and vertical sections through the head of an embryo of stage N; as in the preceding figure, the outline was drawn from one section, and the details from other sections of the same embryo.

The two figures together show the roots and all the branches, with their terminal distribution, of the fifth and seventh nerves, the connections of these nerves with one another and with the third nerve, the principal branches of the third nerve, and the course and distribution of the fourth and ninth nerves, at stage N. No single section could show all or even the greater number of the parts represented in either of these figures, as they lie at very different levels. × 25.

Fig. 11, drawn to show the whole course and relations of the fifth nerve and its connections with the third and seventh nerves. The figure also shows the fourth nerve, and the terminal distribution of the hyoidean branch of the seventh.

Fig. 12 shows the whole course of the seventh nerve and its branches, with the exception of the hyoidean branch (shown in the preceding figure); also the course and distribution of the ninth nerve, and certain branches of the fifth and tenth nerves.

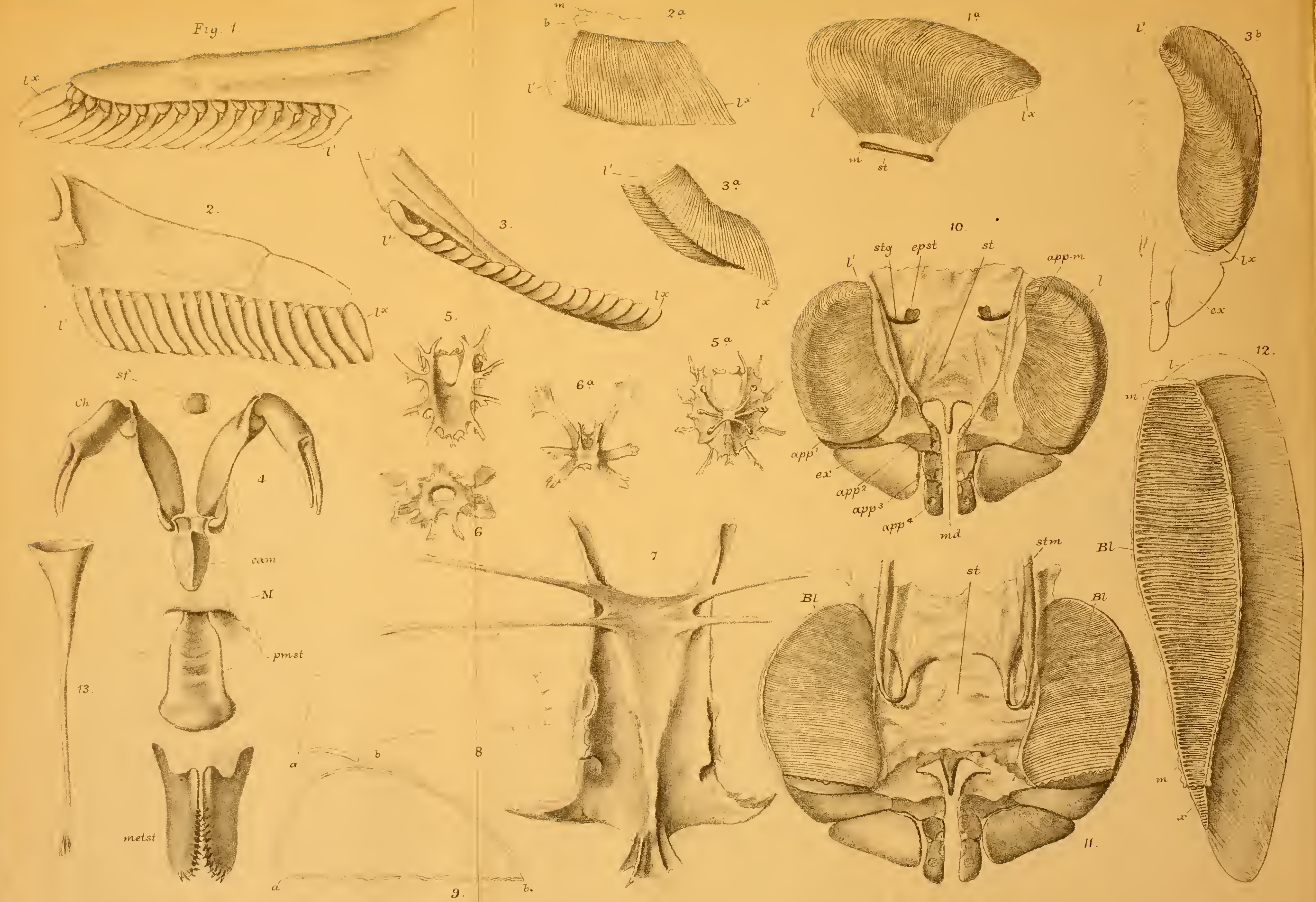
FIG. 13.—Longitudinal and vertical section through the head of an embryo of stage N; the figure, which is taken from two consecutive sections, shows the origin and main trunk of the third nerve, the root of the fourth, and the roots, course, and distribution to the *rectus externus* of the sixth nerve. × 20.

FIGS. 14 and 15.—Diagrammatic longitudinal and vertical sections through the head of an embryo of an age intermediate between stages O and P. × 15.

Fig. 14 shows the roots of origin of the third, fifth, and seventh nerves together with the course and distribution of certain of their branches and the mutual connections between these three nerves.

Fig. 15 shows the dorsal root of the seventh nerve, the ophthalmic branches of the fifth and seventh nerves, the *ramus ophthalmicus profundus*, the fourth nerve, the maxillo-mandibular branch of the fifth, and the buccal and palatine branches of the seventh.

FIG. 16.—Transverse section through the head of an embryo of stage Q, shortly before the period of hatching. Shows the origin, course, and distribution of the fourth nerve, and its close proximity to the ophthalmic branches of the fifth and seventh nerves.



E. Ray Lankester direx. M. P. Parker lith. A. Stone del ad nat.

LIMULUS & SCORPIO.

West Newman & Co imp.

EXPLANATION OF PLATES XXVIII AND XXIX,

Illustrating Professor Lankester's Memoir on "Limulus an Arachnid."

PLATE XXVIII.

Fig. 1.—Right pectinate appendage (eighth segment) of *Buthus Kochii*, anterior face. This figure should be turned so that the pectinate border is uppermost, in order to compare with Fig. 1 *a l'*, proximal lamella; *lx.*, distal lamella (eighteenth).

Fig. 1 *a*.—Similar view of the right lamelligerous appendage of the eleventh segment of the same animal for comparison with Fig. 1. *l.'*, proximal lamella; *lx.*, distal lamella (one hundred and thirtieth; the full number of lamellæ are not indicated by the lines in the drawing); *m.*, membrane attaching the axis of the appendage to the superior margin of *st.*, the stigmatic aperture. The appendage is represented as seen when all other structures are removed from the interior of the Scorpion's body, it is reflected forwards so as to rest with its proper posterior face downwards on the inner surface of the sternite in front of the stigma. The delicate membrane which bounds the pulmonary sac and represents the invaginated integument is removed.

Fig. 2.—Right pectinate appendage of *Buthus Kochii*, posterior face; letters as in Fig. 1.

Fig. 2 *a*.—Similar view of the right lamelligerous appendage of the eleventh segment of *Buthus Kochii*, for comparisom with Fig. 2; letters as in Fig. 1 *a*, except *b*, the canal-like axis which supports the lamellæ.

Fig. 3.—View of the inferior margin of the right pectinate appendage of *Buthus Kochii*, so placed as to show the imbrication of the lamellæ; letters as in Fig. 1.

Fig. 3 *a*.—Similar view of the right lamelligerous appendage of the eleventh segment of *Buthus Kochii*, for comparison with Fig. 3; letters as in Fig. 1 *a*.

Fig. 3 *b*.—Similar view of the right lamelligerous appendage of the eleventh segment of *Limulus polyphemus* for comparison with Fig. 3 and 3 *a*: *l.'*, proximal lamella; *lx.*, one hundred and fiftieth lamella; *ex.*, external lappet (exite) of the bifid distal prolongation of the appendage.

Fig. 4.—View of the sternal surface of the cephalothorax of *Limulus polyphemus*, from which the five hinder pairs of appendages have been detached. *sf.*, subfrontal sclerite; *Ch.*, the first pair of appendages or cheliceræ; *cam.*, the upper lip or camerostome; *M.*, the mouth; *pmst.*, the thoracic promesosternite (representative of pro- and mesosternite as separately developed in the spiders, see woodcut, fig. 9); *metst.*, thoracic metasternite or chilaria, homologous with the pentagonal metasternite of Scorpio, see woodcut, fig. 8, *met.*

Fig. 5.—Entosternite of bird's-nest spider (Mygale, sp.), dorsal face.

Fig. 5 *a.*—The same, neural face.

Fig. 6.—Entosternite of a Scorpion (*Buthus*, sp.), posterior face.

Fig. 6 *a.*—The same, neural face.

Fig. 7.—Entosternite of *Limulus polyphemus*, neural face. Compare with Fig. 5 *a* and Fig. 6 *a*.

Fig. 8.—A single lamella of the right lamelligerous appendage of the eleventh segment of *Buthus Kochii*, formed by two closely adherent plates: *a. b.*, the base or line of attachment. Note the marginal setæ.

Fig. 9.—A single lamella of the right lamelligerous appendage of the eleventh segment of *Limulus polyphemus*, for comparison with Fig. 8: *a. b.*, the base or line of attachment. Marginal setæ are present, but more numerous than in Fig. 8.

Fig. 10.—View of the posterior face of the conjoined pair of lamelligerous appendages of the eleventh segment of *Limulus polyphemus*: *st.*, soft sternal lobe or plate which unites the two appendages; *md.*, median process or soft papilla of the sternal plate; *epst.*, epistigmatic sclerite; *stg.*, parabranchial stigma (invagination to give attachment to the thoraco-branchial muscle); *app. m.*, protractor muscle of the appendage, seen through the the soft integument; *l.*, branchial lamellæ; *l.'*, the proximal lamella; *app.*[1], the proximal division of the appendage carrying the lamellæ and extending beyond them; *app.*[2], *app.*[3], *app.*[4], second, third, and fourth sclerites, forming the jointed axis of the distal prolongation of the appendage; *ex.*, exite or outer ramus of the appendage.

Fig. 11.—View of the pair of lamelligerous appendages of the ninth segment of *Limulus polyphemus*, seen from in front. The chitinised integument has been removed from the surface of the proximal portion of the appendages, so as to expose the bases of the hollow lamellæ, and the soft integument of the median sternal area; and the retractor muscles have also been removed so as to expose the inner face of the corresponding integument of the posterior face, and the insertions of the thoraco-branchial muscles: *st.*, sternal lobe; *stm.*, thoraco-branchial muscle of the left side; *Bl.*, bases of the laminæ, open to the branchial blood-vessels.

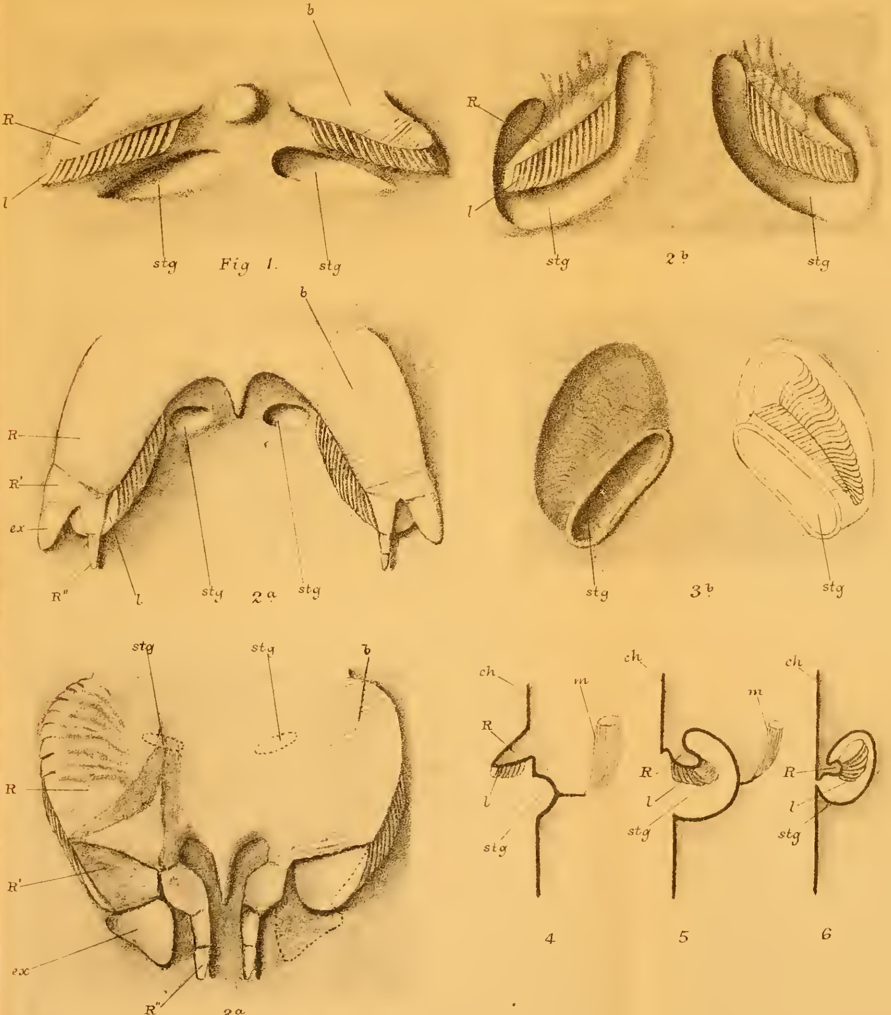
Fig. 12.—A semi-diagrammatic view of one of the respiratory appendages of a Scorpion, to show *Bl.*, the bases of the lamellæ exposed, as in *Bl.*, fig. 11, by the removal of the integument of the axis, the remnants of which are seen at *m.* The drawing further shows the gradual narrowing of the bases of the laminæ in the series as the distal region is approached until the free projecting portion of the axis (*x*) is reached; *l.*, proximal lamella.

Fig. 13.—A tendon-sac of *Limulus polyphemus* detached from the parabranchial stigma, the homologue of the pulmonary sac of Scorpio.

PLATE XXIX.

The drawings on this plate are diagrammatic, and illustrate the hypothesis as to the derivation of the lamelligerous appendages of Limulus and Scorpio from a common ancestral form. All the figures, except 4, 5, 6, present the appendages as seen when the ventral surface of the animal is facing the observer.

Fig. 1.—Hypothetical intermediate form. *R.* axis of appendage; *l.*



E. Ray Lankester del.
M. P. Parker lith.

West, Newman & Co. imp.

LIMULUS & SCORPIO.

lamella; *stg.*, parabranchial stigmata on the sternal surface; *b.*, bases of the lamellæ supposed to be seen through the axis of the appendage by transparency.

Fig. 2 *a.*—Hypothetical form leading on to Limulus. Letters as before, excepting R′ R″ pointing to the distal region of the appendage now prolonged beyond the lamelligerous region, and *ex.* the exite. The parabranchial stigmata are now in proportion to the size of the appendages much smaller than in fig. 1. The median sternal tubercle seen in fig. 1 has now grown up into a fold uniting the bases of the appendages.

Fig. 3 *a.*—The form realised in Limulus. The appendages no longer diverge, but converge, and the median sternal fold or lobe widely unites their proximal segments, and overlaps the parabranchial stigmata, *stg.*, which are indicated by dotted lines, as though showing through the sternal fold by transparency.

Fig. 2 *b.*—Hypothetical intermediate form leading from that represented in fig. 1 to the condition realised in Scorpio. The letters have the same significations as in fig. 1. The parabranchial stigmata are now greatly enlarged, and the appendages reduced in size, so that the latter hang, as it were, from the anterior margins of the former.

Fig. 3 *b.*—The condition found in Scorpio and the pulmonate Arachnids is shown. The margins of the parabranchial stigmata have contracted, enclosing within the sunken sternal surface the reduced lamelligerous appendages. On the right hand side of the figure the appendage is represented as though the integument covering it in were quite transparent. It has rotated on its base line, so as to present what was the concealed or posterior face.

Figs. 4, 5, 6.—Diagrams of sections of the sternal wall of the three stages drawn in figs. 1, 2 *b*, and 3 *b.*; *ch.*, the integument; *R.*, axis of the appendage; *l.*, lamellæ of the appendage; *stg.*, cupped surface of the sternum or parabranchial stigma; *m.*, thoraco-branchial muscle attached to the cupped integument.

Fig 1.

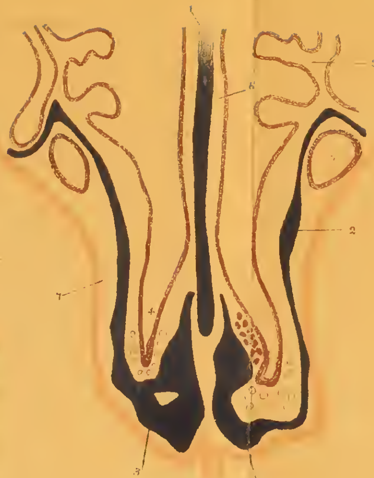


Fig 2

Fig 3

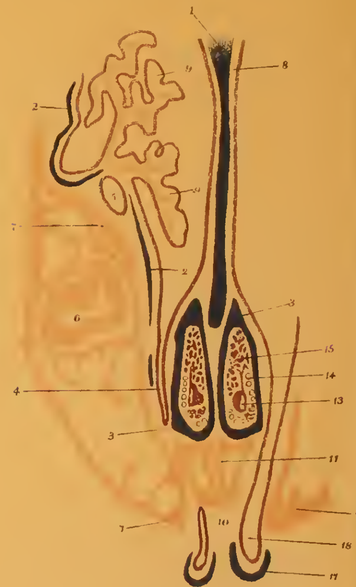


Fig 4

Fig. 5

Fig. 6.

Fig 7

Fig 8

Fig 10

Fig. 11.

Fig 12

Fig 9

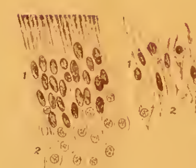


Fig. 13

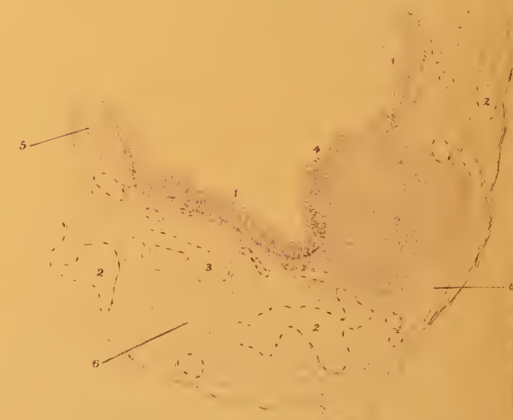


Fig. 14

F. Klein del.

EXPLANATION OF PLATES XXX & XXXI,

Illustrating Dr. Klein's paper "On the Organ of Jacobson in the Rabbit."

Figs. 1 and 2 are transverse sections through the nasal organ anterior to the organ of Jacobson; fig. 3 is a transverse section through the nasal organ in the region of the mouth of the organ of Jacobson; figs. 4, 5, 6, and 7, are transverse sections in the middle region of the organ of Jacobson; figs. 8 and 9 are transverse sections through the posterior extremity of Jacobson's organ. Magnifying power about 30. Fig. 11 is from a similar section as fig. 6, more highly magnified, about 60.

In all these figs., *i.e.* figs. 1, 2, 3, 4, 5, 6, 7, 8, 9, and 11, the meaning of:

1. The cartilage of the nasal septum. 2. The cartilage of the lateral wall of the nasal furrow. 3. Jacobson's cartilage. 3*a*. Inner labium of Jacobson's cartilage. 4. Lower nasal furrow. 5. Naso-lachrymal duct. 6. Tooth. 7. Superior maxilla. 8. Mucosa of nasal septum, indicated. 9. Mucosa (plicated) of lower turbinated bone. 10. Connective tissue above the palate, and containing in the front part of the nasal organ (fig. 1) lobules of mucous secreting glands. 11. Intermaxillary bone. 12. Mouth of Jacobson's organ. 13. Jacobson's organ. 14. Cavernous layer of Jacobson's organ. 15. Glandular layer of Jacobson's organ. 16. Glands of the mucosa above the organ of Jacobson. 17. Stenson's cartilage. 18. Mucosa lining Stenson's cartilage. 19. Lymph-follicles. 20. Fat cells below the septal cartilage.

Fig. 10.—From a transverse section through Jacobson's organ, similar to the one shown in fig. 11, more highly magnified, about 90.

1. Epithelium of the lateral wall. 2. Sensory epithelium. 3. Lymph-follicle. 4. Mouth of duct of the glandfold. 5. Transverse sections through the veins of the cavernous layer. 6. Arteries. 7. Veins in transverse section belonging to the median wall. 8. Glands of the lower sulcus. 9. Glands of the upper sulcus. 10. Transverse sections through bundles of olfactory nerve branches. 11. Plexus of these nerves in the median wall. 12. Inner boundary of Jacobson's cartilage.

Fig. 12.—From an oblique section through part of the median wall of Jacobson's organ. Magnifying power about 500.

1. Fine branches of olfactory nerve close to the sensory epithelium. 2. Large sensory cells extending from the sensory epithelium into the adjoining subepithelial layer. 3. Sensory cells belonging to the sensory epithelium.

Fig. 13.—Part of the sensory epithelium in transverse section. Magnifying power about 400.

1. Epithelial cells. 2. Sensory cells.

Fig. 14.—From a tranverse section through the naso-lachrymal duct. Magnifying power about 90.

1. Columnar stratified epithelium. 2. Veins of the subepithelial plexus. 3. An artery. 4. Large lymph-follicle. 5. Part of a small lymph-follicle. 6. Outer fibrous coat.

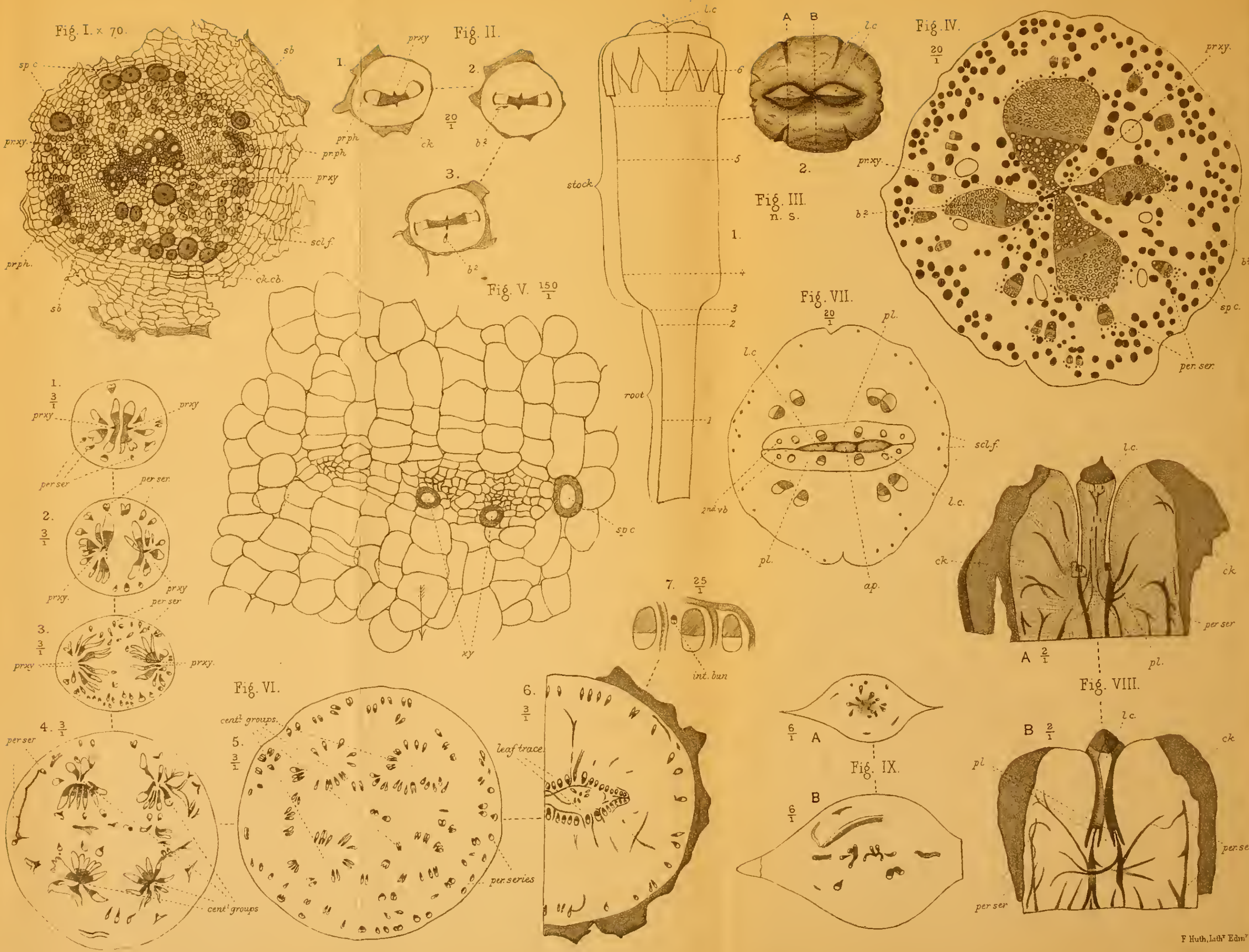
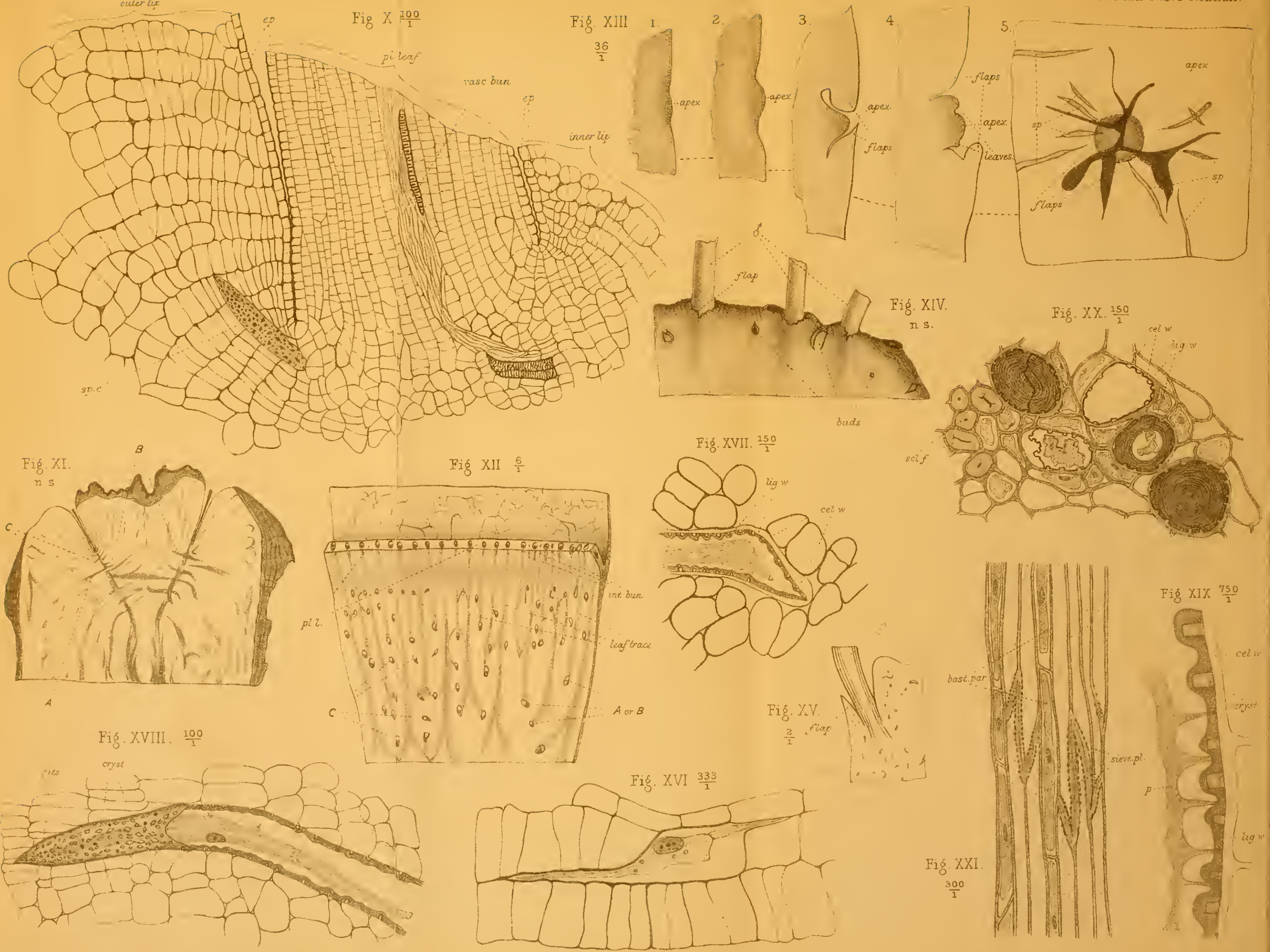


Fig. I. × 70.
sp c
sb
prxy.
pr.ph.
prxy
scl.f.
ck.cb.
pr.ph.
Fig. II.
1.
2.
3.
prxy
20/1
pr.ph
ck
b²
Fig. III.
n. s.
l.c
A
B
stock
root
2.
1.
Fig. IV.
20/1
prxy.
b²
sp c.
per. ser.
Fig. V. 150/1
sp c
xy
Fig. VI.
1. 3/1
2. 3/1
3. 3/1
4. 3/1
5. 3/1
6. 3/1
7. 25/1
per ser
prxy
cent. groups.
leaf trace
per. series
int. bun
Fig. VII.
20/1
pl.
l.c
scl.f.
2nd v.b
ap.
Fig. VIII.
A 2/1
B 2/1
ck
per ser
Fig. IX.
6/1
A
B



F. Huth, Lith^r Edin^r

EXPLANATION OF PLATES XXXII & XXXIII,

Illustrating Mr. F. O. Bower's Memoir "On the Further Development of *Welwitschia mirabilis*."

Key to Lettering.

ap. = apex of stem. *l. c.* = lobe of crown. *pl. l.* = plumular leaf. ♂ = male branch. *pr. xy.* = protoxylem. *pr. ph.* = protophloem. *s. b.* = soft bast. b_2. = secondary bundles. *int. bun.* = intercalated bundle. *per. ser.* = peripheral series. *ep.* = epidermis. *sp. c.* = spicular cell. *scl. f.* = sclerenchyma fibre. *ck.* = cork. *ck. cb.* = cork cambium. *lig. w.* = lignified wall. *cel. w.* = cellulose wall.

Fig. i.—× $\frac{70}{1}$. Transverse sections of the root of the youngest plant in the Kew collections, at a distance of about six inches below the feeder.

Fig. ii.—× $\frac{20}{1}$. i, ii, iii, transverse section of the same root higher up, showing the connection of the secondary bundles (b_2) with the central plate of vascular tissue.

Fig. iii.—i, ii, natural size. External view (i, lateral; ii, apical) of the plant from which the sections figured below (Figs. iv, vi, viii—x) were taken. The dotted lines, 1—6, show the points at which the sections 1—6, Fig. vi, were taken. Those marked A, B, show the position of the planes of section of Fig. viii, A and B. The root continued for a distance of nine inches beyond that represented in this figure, and was there broken off short.

Fig. iv.—× $\frac{20}{1}$. Transverse section of the root of the above plant, at a point about six inches below the swelling. Besides the stellate central group of vascular bundles, a peripheral series is here to be seen. The sign (×) indicates gum passages.

Fig. v.—× $\frac{150}{1}$. Transverse section of the peripheral part of an old root (about one inch in diameter), showing the origin of three vascular bundles; the arrow points towards the centre of the root.

Fig. vi.—(1—6) × $\frac{3}{1}$. Series of transverse sections, taken at points marked 1—6 in Fig. iii, (see text). No 7 (× $\frac{25}{1}$), part of such a section as No. 6, showing the intercalation of a fresh bundle between the older bundles of the leaf trace.

Fig. vii.—× $\frac{20}{1}$. Transverse section at the apex of a seedling four months old, showing externally the base of the cotyledons, within these the two plumular leaves (*pl.*), and between the latter the apical cone (*ap.*). Laterally to this, the two lobes of the crown (*l. c.*).

Fig. viii.—× $\frac{2}{1}$. A, B, longitudinal sections in planes marked in Fig. iii, A, B. In A, the lines of shading are intended to indicate the arrangement of the tissues, (cf. text). The area (×) is represented under a higher power in Fig. x. In B, the dotted line indicates the relative position of Fig. vi, 6.

FIG. IX.—× $\frac{6}{1}$. Transverse sections of one of the lobes of the crown. A at a lower, and B at higher point.

FIG. X.—× $\frac{100}{1}$. The area marked (×) in Fig. VIII, A, showing the manner of division of the tissues at the base of the leaf groove.

FIG. XI.—Natural size. Longitudinal median section of an old plant which died in the Royal Gardens, Kew.

FIG. XII.—× $\frac{6}{1}$. Section from the stem of the above plant in the plane of the leaf continued into the stem. This shows the intercalation of fresh bundles (*int. bun.*) between the older bundles of the leaf trace (cf. text). Figure semi-diagrammatic, but the bundles are drawn true to nature. A, B, C, refer to text, and Fig. XI.

FIG. XIII.—(1—4) × $\frac{36}{1}$. Progressive stages of development of the male branches, as seen in longitudinal sections perpendicular to the surface of the inner lip of the leaf groove. (5) = apical view of the young branch; here the apical cone is covered by irregular flaps, developed from the margin of the depression.

FIG. XIV.—Natural size. View of inner lip of the leaf groove of an old plant with three male branches fully developed, and several still young.

FIG. XV.—Longitudinal section of the base of a male branch, showing its connection with the lip of the leaf groove.

FIG. XVI.—× $\frac{333}{1}$. Part of a longitudinal section at the base of the leaf. The tissue is still undergoing division, but one cell has ceased to divide, and is beginning to develop as a spicular cell. The crystals and lignified wall not yet formed.

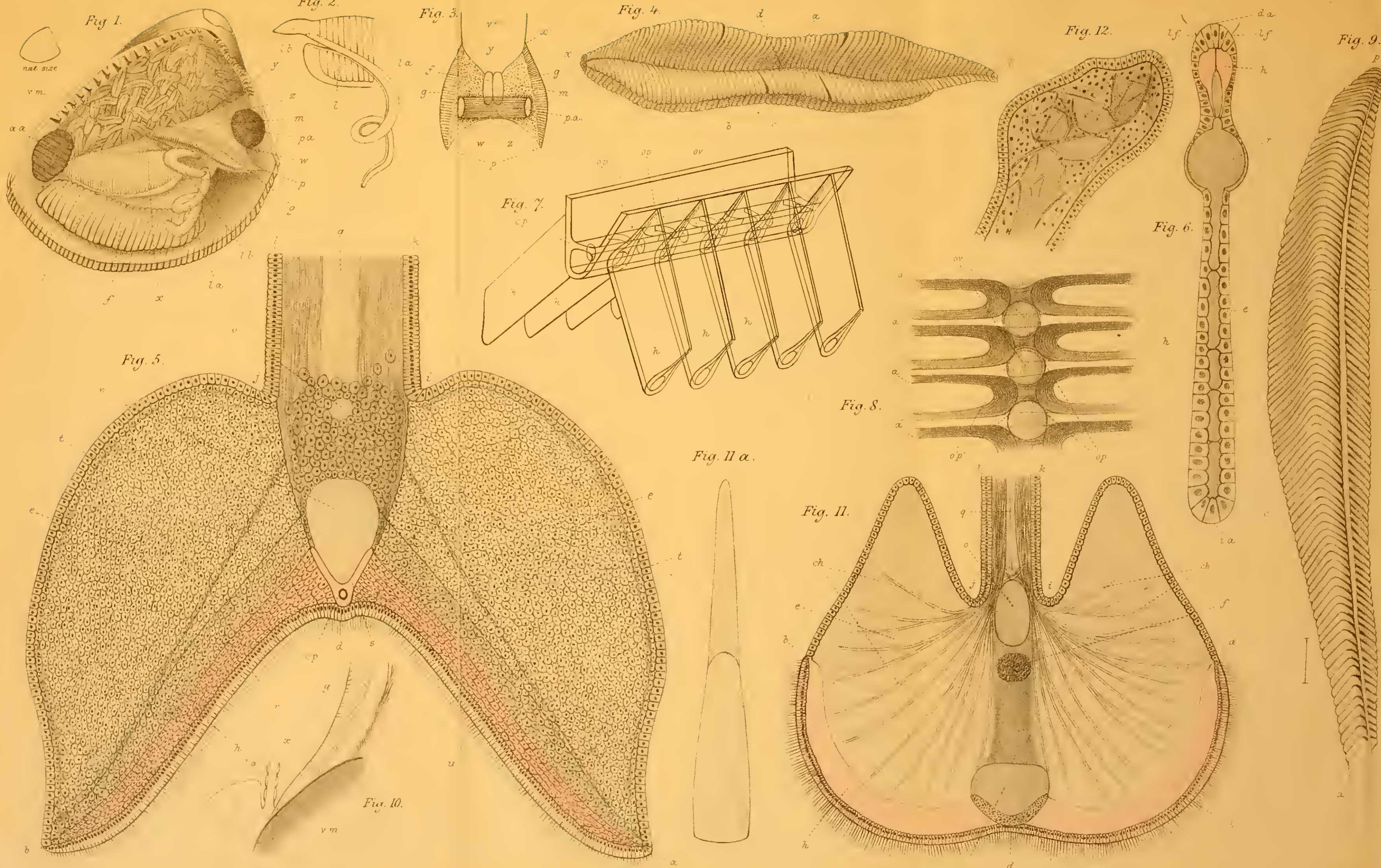
FIG. XVII.—× $\frac{150}{1}$. End of a young spicular cell (crystals and lignified wall already formed) from close below the surface of the lip of the leaf groove. This shows how in growth the cell follows the intercellular spaces.

FIG. XVIII.—× $\frac{100}{1}$. Young spicular cell cut obliquely, showing single nucleus and pitted wall.

FIG. XIX.—× $\frac{750}{1}$. Part of wall of a young spicular cell in longitudinal section, showing how the protoplasm extends as plugs into the pits.

FIG. XX.—× $\frac{150}{1}$. Part of a transverse section of a root, treated with HNO_3 to dissolve the cystals. Side by side are seen spicular cells in various stages of development, cut transversely.

FIG. XXI.—× $\frac{300}{1}$. Longitudinal section of soft bast in the root, showing sieve tubes, with the sieve plates on the oblique walls.



F. Huth, Lith. Edinr.

JOURNAL OF MICROSCOPICAL SCIENCE.

EXPLANATION OF PLATE XXXIV,

Illustrating Mr. Mitsukuri's Memoir on the "Structure and Significance of Some aberrant Forms of Lamellibranchiate Gills."

NUCULA.

Fig. 1.—The view of the soft parts of a male specimen, the left valve having been removed, and the left lobe of the mantle cut away along the lower border of the visceral mass near the line *xy*. Enlarged about seven times.

a. a. Anterior adductor. *p. a.* Posterior adductor. *v. m.* Visceral mass. *f.* Foot. *g.* Gill. *l.* Labial palpi. *l. a.* Tentacular appendage of the labial palpi. *l. b.* Hood-like appendage of the labial palpi. *m.* Membrane suspending the gill, and attached to the body along the broken line *x y z w*. *p.* Posterior end of the gill.

Fig. 2.—Posterior part of the labial palpi of the right side, showing the arrangement of labial appendages. Diagrammatic. Letters same as in Fig. 1.

Fig. 3.—Diagram of the membrane suspending the gill. Seen from above. Letters of the same significance as in Fig. 1.

Fig. 4.—The gill of one side dissected out and drawn by itself. Seen from below and slightly from one side. Enlarged about thirty-five times.

x. Anterior end. *p.* Posterior end. *x c p.* Line of suspension. *x d p.* Ventral median line. *x a p* and *x b p.* Parts projecting downward of the plates composing the gill.

Fig. 5.—An opposed pair of the plates composing the gill. Enlarged 110 diameters. The columnar epithelium cells represented in the figure, along the borders *a d* and *b d*, are the optical section of the characteristic cells found around the edges, and therefore the surface of the irregularly rectangular cells just inside ought to be continuous with the outer edge of the columnar cells, but is not so represented in the figure in order to avoid confusion. The cubical cells along the borders *i a* and *j b* are also shown in optical section in a similar way. The coloured part is the chitinous framework. For the sake of clearness, cells are filled in larger than they should be.

k i j l. Suspending membrane of the gill. *i d j.* Stem which is continuous along the whole length of the gill. Seen here in cross-section. *e.* Plates which project downward from the stem *i d j*, and which are the proper respiratory organ. *n.* Lower blood-channel in the stem. *o.* Upper blood-channel in the stem. *s.* Trough of the chitinous framework. This is continued throughout the length of the gill. Seen here in cross-section. *c. p.* Crosspiece that divides the trough into upper and lower compartments. *h.* Chitinous support along the lower border of the plate. *r.* Branch of the lower blood-channel (*n*) in the plate. *t.* Fibres found along the upper border of the plate. *u.* Fibres that are given off from the stem, slightly above the blood-channel (*r*), and that approach and finally touch the latter near its lower end. *a d* and *b d.* Characteristic columnar epithelium cells found along the lower borders of the plates, having longer cilia than those on the other parts.

FIG. 6.—Cross-section of a plate cut rather below the middle, so that the attachment of the plate to the *stem* is not seen at all. Enlarged about 270 diameters. Letters same as in Fig 5, except *l.f.*, which stands for columnar cells having longer cilia than those on the other parts (Peck's latero-frontal cells).

FIG. 7.—Diagrammatic representation of the chitinous framework. The trough is seen as the middle piece from which a pair of branches (*h*) are sent into each plate. *c.p.* Cross piece that divides the trough into upper and lower compartments. *o v.* Oval openings in the cross piece. *o p.* Openings in one side of the trough that connect the space between the closely-applied pairs of branches (*h*) with the lower compartments of the trough. *o′ p′.* The same of the other side of the trough.

FIG. 8.—A part of the chitinous framework seen from below. Letters same as in Fig. 7. *a a a a* are placed opposite each plate.

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FIG. 9.—The gill of one side dissected out by itself. Seen from below and one side. Corresponds to Fig. 4 of the *Nucula* gill. *x d p.* Median ventral line. *x c p.* Near the line of suspension of the gill.

FIG. 10.—Diagram of the parts around the front part of the gill. *l.* Labial palpi. *l. a.* Tentacular labial appendage. *g.* Gill. *v. m.* Visceral mass. *x.* Membranous ridge-like portion of the gill in front.

FIG. 11.—An opposed pair of the plates composing the gill. Enlarged about 75 diameters. Remarks about Fig. 5 apply to this figure as well. Letters same as in fig. 5, except *s*, which is here a bundle of longitudinal fibres, and not the chitinous trough. In addition, *f.* Longitudinal bundle of a fibrous tissue running the whole length of the gill. *ch.* A second system of chitinous support, spreading out like the frame of a fan.

FIG. 11*a*.—The outline of a plate as seen from one side.

FIG. 12.—Lacunar tissue seen in a cross-section of a plate. The peculiar shape is due to the distortion of the plate. Enlarged 400 diameters.

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