A MANUAL

OF THE

ANATOMY OF INVERTEBRATED ANIMALS.

BY

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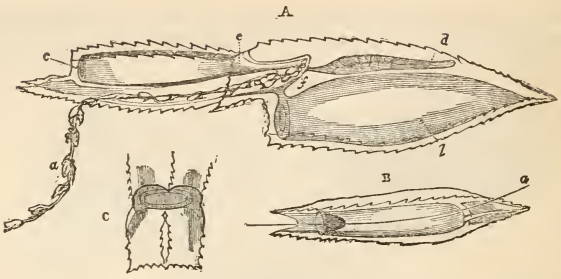

FIG. 22.—*A, Diphyes appendiculata.*—*a*, hydranths and hydrophyllia on the hydrosoma; *b*, proximal nectocalyx; *c*, aperture of distal nectocalyx; *d*, somatocyst; *e*, prolongation of the distal nectocalyx, by which it is attached to the hydrosoma; *f*, point of attachment of the hydrosoma in the cavity, or hydrœcium, of the proximal nectocalyx. *B*, the distal nectocalyx with the canal (through which the bristle *a* is passed), which is traversed by the hydrosoma in *A*. *C*, extremity of the distal nectocalyx, with its muscular velum.

which are traversed by canals which unite, pass through the pillars, and open into the central cavity of the umbrella.[1]

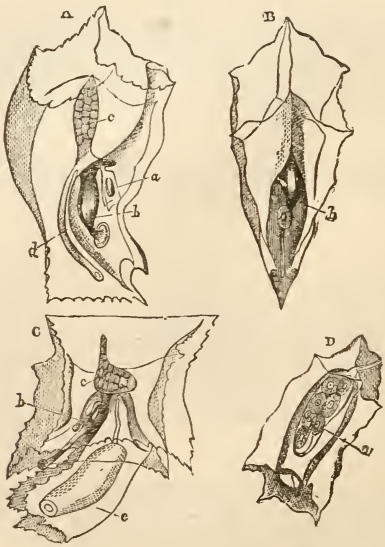

FIG 23.—*A, B*, Diphyzoöid (*Sphenoides*), lateral and front views. *C*, Diphyzoöid of *Abyla* (*Cuboides*). *a, e*, gonophore or reproductive organ; *b*, hydranth; *c*, phyllocyst or cavity of hydrophyllium, with its process (*d*). *D*, free gonophore, its manubrium (*a*) containing ova.

[1] The species of *Cephea*, the anatomy of which is here given, was obtained in the South Pacific, near the Louisiade Archipelago, on the 11th of July, 1849.

3. The Siphonophora.—In this group the hydrosoma is always free and flexible, the ectoderm developing no hard chitinous exoskeleton, save in the case of the pneumatophores of some species. In most, the hydranths are of equal size; but in *Velella* and *Porpita*, the hydranth situated in the centre of the discoidal body is very much larger than the rest, which occupy a circumferential zone around it; and the

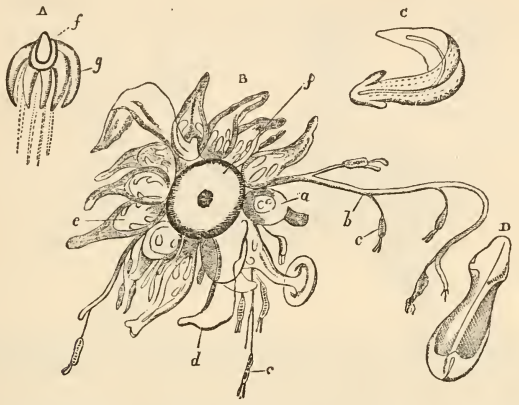

Fig. 24.—*Athorybia rosacea*.—*A*, lateral view; *B*, from above; *C*, *D*, detached hydrophyllia; *a*, polypites; *b*, tentacles; *c*, sacculi of the tentacles; *d*, hydrophyllia; *f*, pneumatophore.

principal function of which is to develop the gonophores from their pedicles. In these two genera the tentacula are separate from the hydranths, and form the outermost circle of appendages.

The hydranths of the *Siphonophora* (Fig. 25, *A*) never possess a circlet of tentacula round the mouth, which, when expanded, is trumpet-shaped. The endoderm of the hydranth is ciliated, and villus-like prominences project into its cavity.

The aboral surface of the umbrella was of a brownish-gray color, variegated with oval white spots; the oral surface, light brown with eight bluish-green lines radiating toward the lithocysts; the brachia, gray with brown dots. The brachia divide into two at their origin, and then subdivide into an infinity of small branches. The general color of the smaller branches is light brown, the small interspersed clavate tentacles being white. The long tentacles which terminate each brachium are blue and cylindrical at their origin, but become trigonal farther on, where they are shaded with brown and green. Is it identical with the *Cephea ocellata* of Peron and Lesueur? The individual figured was a young male.

The interior of these frequently contains vacuolar spaces (Fig. 24, *B*, *C*). A valvular "pylorus" separates the gastric from the somatic cavity in the *Calycophoridæ*. Long tentacles, frequently provided with unilateral series of branches, are developed, either one from the base of each hydranth, or, independently of the hydranths, from the cœnosarc.

In the *Calycophoridæ* and many *Physophoridæ*, complex

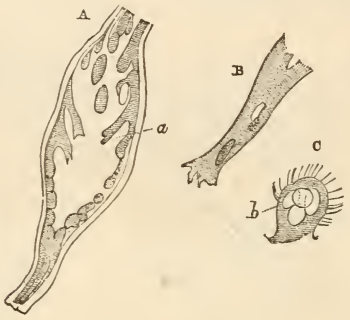

FIG. 25.—*Athorybia rosacea*.—*A*, a hydranth with villi (*a*). *B*, one of the villi in its elongated state, enlarged. *C*, a small retracted villus, still more magnified, with its vacuolar spaces and ciliated surface.

organs, containing a sort of battery of thread-cells, terminate each lateral branch of a tentacle (Figs. 24 and 26). Each consists of an elongated *sacculus*, terminated by two filamentous appendages, and capable of being spirally coiled up. In this state it is invested by an *involucrum*, which surrounds its base. The somatic cavity is continued through the branch, which constitutes the peduncle of this organ, into the sacculus and its terminal filaments. In the latter it is narrow, and their thick walls contain numerous small spherical nematocysts. In the sacculus the cavity is wider. One wall is very thick, and multitudes of elongated nematocysts, the lateral series of which are sometimes larger than the rest, are disposed parallel with one another, and perpendicular to the surface of the sac. Like the other organs, each of these tentacular appendages commences as a simple diverticulum of the ectoderm and endoderm, and passes through the stages represented in Fig. 26.

In *Physalia* the tentacula may be several feet long. They have no lateral branches, but the large nematocysts are situ-

ated in transverse reniform thickenings of the wall of the tentacle, which occur at regular intervals.

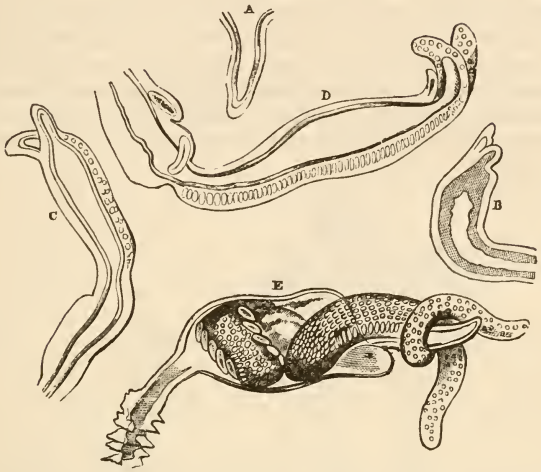

FIG. 26.—*Athorybia rosacea*.—The ends of the tentacular branches in various stages of development. *A*, lateral branch, commencing as a bud from the tentacle. In *B*, terminal papillæ, the rudiments of the filaments, are developed at the extremity of the branch; and, in *C*, the sacculus is beginning to be marked off, and thread-cells have appeared in its walls; in *D*, the division into involucrum and sacculus is apparent; in *E*, the involucrum has invested the sacculus, the extremity of which is straight, while the lateral processes have curled round it.

Hydrophyllia are generally present, and, like the tentacula, are developed either from the pedicle of a hydranth, in which case they inclose the hydranth with its tentacle and a group of gonophores (*Calycophoridæ*), or, independently of the hydranths, from the cœnosarc (many *Physophoridæ*).

The hydrophyllia are transparent, and often present very beautifully defined forms, so that they resemble pieces of cut glass. They are composed chiefly of the ectoderm (and mesoderm), but contain a prolongation of the endoderm, with a corresponding diverticulum of the somatic cavity. They are, in fact, developed as cæcal processes of the endoderm and ectoderm; but the latter, with the mesodermal layer, rapidly predominates.

The gonophores of the *Siphonophora* present every variety, from a simple form, in which the medusoid remains in a state of incomplete development, to free medusoids of the Gymnophthalmatous type. As an example of the former

condition the gonophores of *Athorybia* may be cited (Fig. 27); of the latter, the gonophores of *Physalia*, *Porpita*, and *Velella*.

In *Athorybia*, groups of gonophores, together with pyriform sacs, which resemble incompletely developed hydranths (*hydrocysts*—Fig. 27, *A*, *a*), are borne upon a common stem, and constitute a *gonoblastidium* (Fig. 27, *A*). The groups of male and female gonophores (Fig. 27, *A*, *b*, *c*) are borne upon separate branches of the gonoblastidium (*androphores*

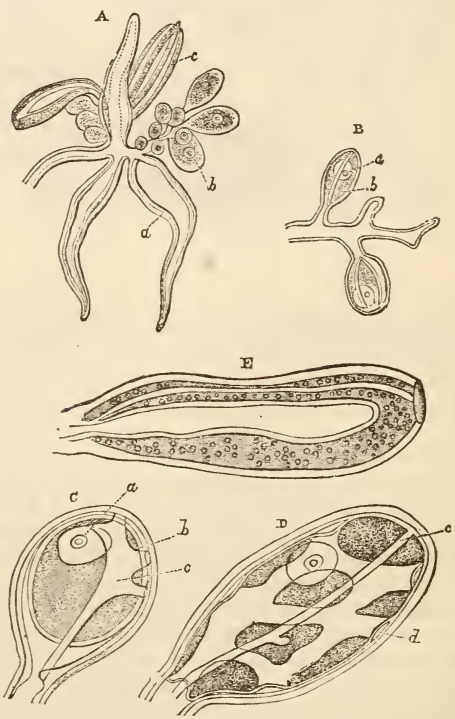

Fig. 27.—*Athorybia rosacea.*—*A*, gonoblastidium bearing three hydrocysts, *a*; gynophore, *b*; and two androphores, *c*. *B*, female gonophores on their common stem or gynophore, showing the included ovum, *a*, and the radical canals, *b*. *C*, *D*, female gonophores enlarged; *a*, germinal vesicle; *b*, vitellus; *c*, radial canals of the imperfect nectocalyx; *d*, canals of the manubrial cavity. *E*, male gonophore.

and *gynophores*). Each female gonophore contains only a single ovum, which projects into the cavity of the imperfectly

differentiated manubrium, and narrowing its cavity at different points gives rise to the irregular canals (Fig. 27, *D*, *d*). In the male gonophore the nectocalyx is more distinct from the manubrium, and its extremity has a rounded aperture (Fig. 27, *E*).

In the *Calycophoridæ*, as in the elongated *Physophoridæ*, the development of new hydranths and their appendages, which is constantly occurring, takes place at that end of the hydrosoma which corresponds to the fixed extremity of one of the *Hydrophora;* and, if we consider this to be the proximal end, new buds are developed on the proximal side of those already formed. Moreover, these buds are formed on one side only of the hydrosoma. Hence the appendages are strictly unilateral, though they may change their position so as eventually to appear bilateral or even whorled. In the *Calycophoridæ*, the saccular proximal end of the cœnosarc (Fig. 22, *A*, *d*) is inclosed within the anterior nectocalyx, at the posterior end of which is a chamber, the *hydrœcium* (Fig. 22, *A*, *c*). The second, or posterior, nectocalyx is attached in such a way that its anterior end is inclosed within the hydrœcium of the anterior nectocalyx, while its contractile chamber lies on the opposite side of the axis to that on which the anterior nectocalyx is placed (Fig. 22, *A*). Sets of appendages (Fig. 22, *A*, *a;* Fig. 23), each consisting of a hydrophyllium, a hydranth with its tentacle, and gonophores, which last bud out from the pedicle of the hydranth—are developed at regular intervals on the cœnosarc, and the long chain trails behind as the animal swims with a darting motion, caused by the simultaneous rhythmical contraction of its nectocalyces, through the water (Fig. 22).

From what has been said, it follows that the distal set of appendages is the oldest, and, as they attain their full development, each set becomes detached, as a free-swimming, complex *Diphyzoöid* (Fig. 23). In this condition they grow and alter their form and size so much, that they were formerly regarded as distinct genera of what were termed monogastric *Diphydæ*. The gonophores, with which these are provided, in their turn become detached, increase in size, become modified in form, and are set free as a third series of independent zoöids (Fig. 23, *D*). But their manubrium does not develop a mouth and become a functional hydranth; on the contrary, the generative elements are developed in its wall, and are set free by its dehiscence.

In the *Physophoridæ*, the proximal end of the hydrosoma

is provided with a pneumatophore. This is a dilatation, into which the ectoderm is invaginated, so as to form a receptacle, which becomes filled with air and sometimes has a terminal opening, through which the air can be expelled (Fig. 13, 4). It is sometimes small, relatively to the hydrosoma (*Agalma*, *Physophora*); sometimes so large (*Athorybia*, Fig. 24; *Physalia*, *Porpita*, *Velella*), that the whole hydrosoma becomes the investment of the pyriform or discoidal air-sac; while the latter is sometimes converted into a sort of hard inner shell, its cavity being subdivided by septa into numerous chambers (*Porpita*, *Velella*).

Nectocalyces may be present or absent in the *Physophoridæ*. When present, their number varies, but they are confined to the region of the hydrosoma which lies nearest to the pneumatophore.

In the great majority of the *Hydrozoa*, the ovum undergoes cleavage and conversion into a morula, and subsequently into a planula, possessing a central cavity inclosed in a double cellular wall, the inner layer of which constitutes the hypoblast, and the outer the epiblast.

In most *Hydrophora* the ciliated, locomotive, planula becomes elongated and fixed by its aboral pole. At the opposite end, the mouth appears and the embryo passes into the gastrula stage. Tentacles next bud out round the mouth, and to this larval condition, common to all the *Hydrophora*, Allman has given the name of *Actinula*.

Generally, the embryo fixes itself by its aboral extremity at the end of the planula stage; but, in certain *Tubularidæ*, while the embryo is still free, a circlet of tentacles is developed close to the aboral end; and this form of larva differs but very slightly from that which is observed in the *Discophora*.

In the genus *Pelagia*, for example, the tentacles are developed from the circumference of the embryo, midway between the oral and aboral poles; but it neither fixes itself nor elongates into the ordinary actinula-form. On the contrary, it remains a free-swimming organism, and, by degrees, that moiety of the body which lies on the aboral side of the tentacular circlet widens and is converted into the umbrella, the other moiety becoming the hydranth, or "stomach," of the Medusa.

In *Lucernaria*, it is probable that the larva fixes itself before or during the development of the umbrella, and passes