TUNICATA

THIS group of animals was formerly regarded as con­stituting along with the *Polyzoa* and the *Brachio- poda* the invertebrate class *Molluscoidea.* It is now known to be a degenerate branch of the *Chordata,* and to be more nearly related to the *Vertebrata* than to any group of the *Invertebrata*

History.@@1

More than two thousand years ago Aristotle gave a short account of a Simple Ascidian under the name of *Tethyum.* He described the appearance and some of the more important points in the anatomy of the animal. From that time onwards to little more than a century ago, although various forms of Ascidians had been briefly de­scribed by writers on marine zoology, comparatively little advance was made upon the knowledge of Aristotle. Schlosser and Ellis, in a paper containing a description of *Botryllus,* published in the *Philosophical Transactions* of the Royal Society for 1756, first brought the Compound Ascidians into notice ; but it was not until the commence­ment of the 19th century, as a result of the careful ana­tomical investigations of Cuvier (*I*) upon the Simple Ascidians and of Savigny (*2*) upon the Compound, that the close relationship between these two groups of the *Tunicata* was conclusively demonstrated. Up to 1816, the date of publication of Savigny’s great work (*2*), the few Compound Ascidians then known had been generally regarded as *Alcyonaria* or as Sponges ; and, although many new Simple Ascidians had been described by O. F. Müller (*4*) and others, their internal structure had not been investigated. Lamarck (*3*) in 1816, chiefly as the result of the anatomical discoveries of Savigny and Cuvier, instituted the class *Tunicata,* which he placed between the *Radiata* and the *Vermes* in his system of classification. The *Tunicata* included at that time, besides the Simple and the Compound Ascidians, the pelagic forms *Pyrosoma,* which had been first made known by Péron in 1804, and *Salpa,* described by Forskal in 1775.

Chamisso in 1820 made the important discovery that *Salpa* in its life-history passes through the series of changes which were afterwards more fully described by Steenstrup in 1842 as “alternation of generations”; and a few years later Kuhl and Van Hasselt’s investigations upon the same animal resulted in the discovery of the alternation in the directions in which the wave of contraction passes along the heart and in which the blood circulates through the body. It has since been found that this observation holds good for all groups of the *Tunicata.* In 1826 H. Milne- Edwards and Audouin made a series of observations on living Compound Ascidians, and amongst other discoveries they found the free-swimming tailed larva, and traced its development into the young Ascidian. Milne-Edwards (*5*) also founded the group of “Social” Ascidians, now known as the *Clavelinidæ,* and gave a classification of the Compound Ascidians which was universally accepted for many years. From the year 1826 onwards a number of new and remarkable forms were discovered, as, for instance, some of the *Bolteninæ* (Macleay), *Chelyosoma* (Broderip and Sowerby, and afterwards Eschricht), *Oikopleura* (Mertens), *Perophora* (Lister), *Pelonaia* (Forbes and Goodsir), *Chondro- stachys* and *Diplosoma* (Denis Macdonald), *Diazona* (Forbes and Goodsir), and *Rhodosoma* (Ehrenberg, and afterwards Lacaze-Duthiers).

In 1845 Carl Schmidt (*6*) first announced the presence

in the test of some Ascidians of “ tunicine,” a substance very similar to cellulose, and in the following year Löwig and Kölliker (7) confirmed the discovery and made some additional observations upon this substance and upon the structure of the test in general. Huxley (*8*), in an im­portant series of papers published in the *Transactions* of the Royal and Linnean Societies of London from 1851 on­wards, discussed the structure, embryology, and affinities of the pelagic Tunicates *Pyrosoma, Salpa, Doliolum,* and *Appendicularia.* These important forms were also investi­gated about the same time by Gegenbaur, Vogt, H. Müller, Krohn, and Leuckart. The most important epoch in the history of the *Tunicata* is the date of the publication of Kowalevsky’s celebrated memoir upon the development of a Simple Ascidian (p). The tailed larva had been previously discovered and investigated by several naturalists—notably H. Milne-Edwards (*5*), J. P. van Beneden (zo), and Krohn (*II*) ; but its minute structure had not been sufficiently examined, and the meaning of what was known of it had not been understood. It was reserved for Kowalevsky in 1866 to demonstrate the striking similarity in structure and in development between the larval Ascidian and the vertebrate embryo. He showed that the relations between the nervous system, the notochord, and the alimentary canal are much the same in the two forms, and have been brought about by a very similar course of embryonic de­velopment. This discovery clearly indicated that the *Tunicata* are closely allied to *Amphioxus* and the *Verte­brata,* and that the tailed larva represents the primitive or ancestral form from which the adult Ascidian has been evolved by degeneration, and this led naturally to the view usually accepted at the present day, that the group is a degenerate side-branch from the lower end of the phylum *Chordata,* which includes the *Tunicata (Urochorda), Amphi­oxus (Cephalochorda),* and the *Vertebrata.* Kowalevsky’s great discovery has since been confirmed and extended to all other groups of the *Tunicata* by Kupffer (*12*), Giard (*13* and *15*), and others. Important observations upon the process of gemmation and the formation of colonies in various forms of Compound Ascidians have been made by Krohn, Metschnikoff, Kowalevsky, Ganin, Giard, Della Valle, and others, and have gradually led to the establish­ment of the general principle, that all the more important layers of the bud are derived more or less directly from the corresponding regions in the body of the parent.

In 1872 Fol (*14*) added largely to the knowledge of the *Appendiculariidæ,* and Giard (*15)* to that of the Compound Ascidians. The latter author described a number of new forms and remodelled the classification of the group. The most important additions which have been made to the Compound Ascidians since Giard’s work have been those described by Von Drasche (*16*) from the Adriatic and those discovered by the “Challenger” expedition (*17*). The structure and the systematic arrangement of the Simple Ascidians have been mainly discussed of recent years by Alder and Hancock (*18*), Heller (zp), Lacaze-Duthiers (*20*), Traustedt (*21*), and Herdman (*17*, *22).* In 1874 Ussoff (*23*) investigated the minute structure of the nervous system and of the underlying gland, which was first dis­covered by Hancock, and showed that the gland has a duct which communicates with the front of the branchial sac or pharynx by an aperture in the dorsal (or “olfactory”) tubercle. In an important paper published in 1880 Julin *(24)* drew attention to the similarity in structure and rela­tions between this gland and the *hypophysis cerebri* of the vertebrate brain, and insisted upon their homology. He suggests that they perform a renal function. The *Thaliacea*

@@@1 Only the more important works can be mentioned here. For a more detailed account of the history of the group and a full biblio­graphy, see *(17*) in the list of works at the end of this article.