

SEA SQUIRTS.

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No one who has spent a few hours on the sea shore, turning over weed-covered stones, can have failed to notice clusters of leathery objects, styled by the fishermen sea peaches, sea apples, sea potatoes, etc. They are of various shapes, as these names indicate, and differ in colour, some bright pink, others scarlet, or orange, or pure white, or stone colour, and other tints. Some strongly resemble leathery grapes, or coarse plums, or even small leather bottles, while many are semi-transparent, and not unlike green-glass flasks, one or two inches long. They cling by the base to stones and other objects, and frequently hang from the underside of shelving rocks, others are upright and stalked, resembling a brown potato on a long stem (like *Boltenia*), others are jelly-like colonies (such as *Amarousium*), and some occur as long strings of clear glassy creatures, floating as *Salpa* does, near the surface of the sea. On touching them they squirt out two thin jets of water, from an aperture at the top, and another at the side. They have the appearance of motionless vegetables, and are scientifically called Tunicates, or less accurately, Ascidians, but by more philosophical naturalists they have been dignified with the name Urochordates. They merit some notice in these pages for two reasons, viz:—their very special scientific interest, and for a second important reason, that they have formed the subject of some most remarkable original investigations by Dr. A. G. Huntsman, of the University of Toronto, a distinguished worker among our younger Canadian biologists. The high scientific interest possessed by the Tunicates, or Sea Squirts, arises from the fact that they have been looked upon as the ancestral progenitors of the human race (or rather of all vertebrates), and about them Andrew Lang wittily wrote:

“The ancestor remote of Man,
Says Darwin was the Ascidian.”

The additions to our knowledge of Canadian Ascidians, due to Dr. Huntsman's labours, are a source of just pride to our scientists. Dr. Huntsman was trained under Professor Ramsay Wright, whose retirement from his Toronto chair zoologists on this continent will never cease to deplore. Laborious and successful work at the three Dominion Government biological stations, during many years, led to Dr. Huntsman's appointment by the Biological Board recently to the responsible position of curator in charge of the marine and fishery investi-

gations at the Biological Station, St. Andrews, New Brunswick. His work now covers a varied field, but it is his Tunicate researches that claim notice here.

In 1908 and 1909 Dr. Huntsman investigated the Ascidians of British Columbia, making a fine collection himself, and having placed in his hands collections made by Professor John Macoun, and by myself and the late Rev. G. W. Taylor, and others. As a result of his studies he was able to publish several papers on these curious creatures, but his most notable memoir: "The Holosomatous Ascidians from the coast of Western Canada," covering over 80 pages of the volume; "Contributions to Canadian Biology, 1908-1911," with 12 splendid photographic plates, and issued by the King's Printer, Ottawa, in 1912, is an extensive and thorough record of his discoveries. It has attracted wide attention, and specialists in various countries, from the United States in the west, to Russia in the east, have welcomed this memoir as an unusually important one. Indeed, Professor W. Redikowzew, a distinguished Russian zoologist, has been so impressed by Dr. Huntsman's results as to adopt these Canadian discoveries and conclusions set forth in the memoir alluded to, and has embodied them in a fine paper, in Russian, recently issued at Petrograd.

Dr. Huntsman's beautiful plates, with precisely 100 figures, are heliotypes of his own exquisite photographs of Ascidians. They are so skilfully done that the most minute structural features are shown with marvellous delicacy and faithfulness. The descriptions in the text are clear, accurate, and models of scientific exposition. Important classificatory features are given in graphic tabular forms, inserted under each species, and summarizing measurements, and other details.

It is impossible here to do more than indicate some of Dr. Huntsman's results. They embrace the following families:—The Perophoridæ; the Family Agnesiidæ, with one species new to science; the Chelysomatidæ, three new species; the Caesiridæ, four new species; the Styelidæ, five new species, including, indeed, a new genus, *Chemidocarpa*, and one new species *Metandrocarpa Taylora*, appropriately named after the late Rev. Mr. Taylor, who did herculean work as a pioneer in Pacific zoology; and, finally, the Family Tethyidæ. In view of our extended knowledge, due to Dr. Huntsman's researches, the last-named Family has acquired a new significance, and one of the genera, *Boltenia*, has changed its application. Very interesting facts are to be noted regarding the geographical distribution of these sedentary forms. The two species *B. ovifera*, of the eastern shores, and *B. villosa*, of the Pacific shores, meet

in the northern waters of Alaska, and as Dr. Huntsman observes, "perhaps overlap" in Behring Sea. Some species seem to be very local, while others are world-wide in their range. The familiar *Pelonaia corrugata* occurs in both oceans, and in the Arctic as well, and presents in all localities the same features; "they do not seem to differ in any respect," as Dr. Huntsman notes. Alas, they are the homeliest in looks of all the Tunicates! The same ubiquity applies to the greenish transparent *Ciona intestinalis*. *Phallusia ceratodes* appears, on the contrary, to be very local, and is a species first found and named by Dr. Huntsman, and "quite distinct from any yet described." In contrast are forms like *Ascidioopsis paratropa*, a new species described by the author, and very distinct, yet closely related to species from Korean seas, from Northern Europe, and from Puget Sound, which latter is, however, less than a hundred miles south of Departure Bay, where it was first discovered.

But if the colours, the forms, and the distribution of these strange animals present such striking features, their life-history, physiology and anatomy are, to the popular mind, even more extraordinary. Thus, they possess a heart, without valves, and ventral in position, below the base of the endostyle. The heart, in all true invertebrates possessed of that pulsating organ, is dorsal in position, but in man and the Vertebrata it is on the ventral or under side, as in Tunicates. It is enclosed in a pericardium, and pulsates with a progressive vermiform movement, and every few minutes it reverses its action, and drives the blood in the opposite direction. Thus the heart's contractions drive the blood now this way, now that way, a curious characteristic feature of the Sea Squirts, and not probably found in any other group of animals. Can it be that human fickle-heartedness has come down to us from our Ascidian ancestors, with their uncertain cardiac phenomena! The endostyle is interesting, and is a long open canal, glandular and ciliated, with thickened sides, and extending along the ventral face of the cage-like gullet or perforated branchial pharynx. It is active in the digestive functions. The sac-like body has two important openings, one at the top, inhalent, and the other lower down at the side, which is exhalent. A thick coat or tunic loosely encloses the whole animal, whence the name Tunicate. This peculiar leathery tunic shows fibrillæ, and even cells (mesoderm cells which have wandered from the body of the enclosed animal), but it contains, most wonderful of all, a substance, like the cellulose which is peculiar to plants. Bertholet regarded it as a special substance, Tunicin, but recent researches appear to confirm the old and long accepted view that it is really cellulose. Now, cellulose has been regarded as

affording one of the distinctions between plants and animals, but this outer coat of the Ascidians is an animal product, though not more essentially a part of the Tunicate's body than the shell of an oyster or clam. A thin epidermis covers the tunic, in which pigmented cells occur, and these migrate into the tunic itself and impart to the animal its colour, which is very brilliant and striking in some Ascidians.

A few words only can be added about the life-history and development of Tunicates. Eggs and sperms are produced by the same individuals, though some are protandric, and do not produce eggs until after the sperms are ripened; but budding also occurs, and reproduction by stolons, a peculiar phenomenon. From the egg issues a larva, very like a tadpole, the enlarged head of which possesses several sticky papillæ for the purpose of adhering to external objects. A strong muscular tail permits it to progress actively through the water. A rod passes down the centre of the tail composed of a row of cells at first, but later by the coalescence of these cells, it appears as a clear hyaline resistant rod, or axis, representing the notochord or primitive backbone of all higher animals. This first indication of a vertebral column is a profoundly interesting feature in Tunicates. Hardly less interesting are the larval organs of vision and hearing, though, like mythical Cyclops, there is only one eye, and the ear or otocyst is unpaired. Some Tunicate larvæ secrete a clear gummy blanket or floating house, and live in it for a time, at the sea's surface. *Oikopleura* does that.

It is unnecessary to describe subsequent changes further than to say that, at a certain stage, the wriggling tadpole becomes rooted by its mouth-end to rocks or other objects, loses its tail, its eye, its ear, and other organs, and becomes changed into a leathery sac-like creature, sightless and motionless, the typical rooted Ascidian, such as those Dr. Huntsman describes. There are three main types among the Tunicates, viz.: the Ascidiaceæ, the Thaliaceæ, and the Larvaceæ, and over one hundred genera. A promising field waits investigation, and Dr. Huntsman's additions to our knowledge proves what a great opportunity for scientific discovery young Canadian workers have who resort to our three Government biological stations each summer. The Tunicates offer a fruitful field for research. Science has revealed unexpected marvels in the study of these lowly-looking Tunicates, but while they are degenerate, as a class, they appear undoubtedly to have formed the starting point whence higher animals have evolved, and have progressed in an ascending scale until Man, the highest Chordate or Vertebrate, developed.



Prince, Edward Ernest. 1916. "Sea Squirts." *The Ottawa naturalist* 30(7), 80–83.

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