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XXXV.—On *Marine Vivaria*. By WILLIAM THOMPSON, Esq.

To the Editors of the Annals of Natural History.

GENTLEMEN,

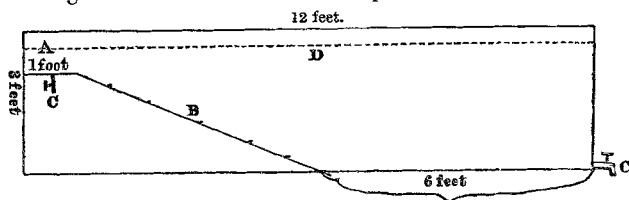
Weymouth, April 8, 1853.

BELIEVING as I do that the suggestions of Mr. Warington, the experiments of Mr. Gosse, and the successful adaptation by Mr. Mitchell at the Gardens of the Zoological Society, of the principle of maintaining a balance between animal and vegetable life in confined sea-water, will cause Marine Vivaria to be generally introduced throughout the country; it has appeared to me that my contribution of notes thereon might possibly prove useful. Since the spring of 1850 I have unintentionally paid attention to the subject, as will appear. It has during the whole of that time been a custom of mine in my almost daily rambles along the sea-shore and very numerous dredging excursions to bring home any marine animals I may have met with, and place them in vessels filled with salt water in order to study their habits. I began by changing the salt water of the littoral species twice a day, leaving them without water for an hour or so each time; thus intending to represent the tides: this I could do as the sea is not fifty yards from my house, consequently sea-water is easily procured. It however struck me that the constant changing of the water was attended with what might turn out to be unnecessary trouble; I then tried changing it only once a week, many died in consequence, and those that survived (amongst which were *Carcinus mænas* and *Actinia mesembryanthemum*) were undoubtedly in a very sickly state. Some little time after, a storm threw on the beach a quantity of weeds attached to pieces of stone; amongst them *Delesseria sanguinea*, *D. ruscifolia*, *D. hypoglossum*, also *Rhodymenia laciniata*, *R. jubata*, and *R. ciliata* attracted my attention by the beauty of their fronds. I took them home and placed them in a vessel of salt-water which contained Crustacea, Echinodermata, Testacea, Zoophytes and other things the result of a day's dredging; I watched them daily in order to change the water as soon as I detected my prisoners becoming sickly, and (with the exception of one or two that died and which I removed) to my astonishment at the end of a month the whole of the animals were healthy, and the water remained in my opinion pure and limpid. This fact, through my ignorance of the rudiments of "Chemistry of Creation," I did not set down to the right cause. I however knew the effect, and from that time invariably placed a few marine plants in my vivarium, knowing from experience that they prolonged the life of the animals, and at the same time did away with the necessity of a constant change of water. It was my idea that the plants acted as

a filter by withdrawing the impurities from the water and thus keeping it sweet, not knowing the fact to be that they consumed the carbonic acid gas, and gave off oxygen for the supply of the animals. Thus it was left to others to find out and account for what accident had thrown in my way, and to adopt that principle which my ignorance had prevented me from availing myself of. Having said thus much, I will proceed to give the results of my experience on the subject; first, as to prolonging the health and life of the captives; and secondly, as to a few of the species most easily kept in confinement. And first as to prolonging their life, no one will doubt that after supplying them with proper air, one of the main points to ensure success, is as far as artificial means will allow to assimilate their state of captivity to their state of freedom, and this has been my chief object in the experiments I have made. I began at first by changing the water every tide during the day, but only for the littoral species, such as *Trochus umbilicatus* and *cinerarius*, *Littorina*, *Rissoa* and *Purpura* amongst shells, and *Carcinus Porcellana* and *Athanas* amongst the Crustacea; this I found very troublesome, and I then thought the same end might be attained by placing weed-covered pieces of stone in the pans in such a way as that their apices might rise above the water, thus giving the animals power to suit themselves as to the depth of water; this I found succeeded well; I therefore only changed it once a day, and eventually every other day; I then extended it to a week, but unsuccessfully, until accident caused me to place some plants of *Delesseria* and *Rhodymenia* in the vessel as detailed in the former portion of this paper.

From my experiments, I suggest the following plan, in respect to the manufacture of Vivariums. Never having seen one it is possible some of my suggestions may already be in use. I should propose that the bottom be made of well-seasoned varnished wood, for the facility it affords of attaching battens to it, and that supposing the tank to be 12 feet long, the bottom should incline upwards, say at half the length, with a ledge of a foot wide at the top (I send a sketch, to elucidate my meaning,

A. The ledge. B. The incline. C. C. Taps. D. General level of water.



on a scale of 3 feet to an inch). When the tank is full there

should be only about 6 inches water over the ledge; the inclined plane I would have represent the zones of the sea, the ledge should represent high and low-water mark; I should fasten battens across the incline, in order to attach stones and weeds at different levels, and also sand; as plants as well as animals, it is well known, affect different levels. I may mention amongst plants, *Chylocladia articulata*, which is a beautiful species, but must be left dry occasionally. I propose also that a tap be fixed at one end of the tank, so as to draw off gradually as much water as will leave uncovered the ledge at the top of the incline, the ledge to remain uncovered a short time every day; this I intend to represent the tides, and the advantage I expect to derive from this plan is:—First, we should give those species, such as *Chylocladia*, *Corallina*, amongst plants, and Littoral Crustacea and Testacea, as also the Nudibranchs, which are left dry by the tide twice a day, a near approximation to their state of freedom; and secondly, the water when poured back, which I propose it should be, would freshen up the water in the tank on the same principle that at sea, they stir up the water casks to freshen the water. I propose a Vivarium of this construction, only in the case of but one being used. I am, however, convinced, the far better plan would be to have separate tanks, but all fitted with taps. I should suggest that for the strictly littoral species the tank should be only a foot in depth, and the bottom on such an incline that about 2 inches of water should lie left for about half its length, and in this tank the chief plant should be *Fucus serratus*. I think the larger and more voracious carnivorous Mollusca, such as *Buccinum undatum*, should be kept in a tank by themselves, as they can be easily fed on *Mytilus edulis*, *Patella virgata*, or indeed on offal; and with them you might place the Starfish, Decapoda, that is the larger Macroura, the Anomoura and Brachyura. These might easily be fed; and with respect to food generally, the carnivorous mollusca we see can be provided for: the vegetable feeders will be amply supplied by the plants and Confervæ. But this is not the case with the Bivalves, some of the Zoophytes and Nudibranchs, but more especially the bivalves; they will exist some time without food, but it would be more satisfactory to know that this cruelty was not inflicted upon them; the greater number of the bivalves bury themselves, and most of them swallow mud and sand and decayed vegetable matter, probably on account of the animalculæ and other minute animals they may obtain. What is then to be done in their case? I admit the difficulty and cannot solve it: you must either procure their food, or exclude them from the vivarium; and as they generally burrow, I fancy they will be no great loss to the sight-seeing public. As to the Starfish and Sea-Urchins they are essentially

carnivorous, as I can testify having seen a *Pecten opercularis* in the stomach of *Solaster papposa*, the edges of the oral disc being so tightly drawn over it, that I could not get the *Pecten* out without tearing the *Solaster*, this, by the by, shaking my faith in the opinion of some naturalists, that the Starfish seizes its prey by everting the stomach. I have also seen *Cyprea europæa* in the stomach of *Palmipes membranaceus*. Many others of our most showy Testacea are carnivorous, and they must be cared for; others, no doubt, live on minute Entomostraca and other bodies constantly floating in the ocean. Many, if not all of the Annelides, are carnivorous (in the extended use of the word as contradistinguished to vegetable feeders), as also are the *Holothuriæ*; it is clear then that their food will sooner or later require, in a confined place, to be replenished, especially if you wish them to breed. It is my opinion this might be managed by introducing the different species of *Talitra*, which are very prolific, and I believe, feed on decaying weed and decaying animal matter; I know they very soon clear all the muscles from a dead fish; they might thus be turned to account as scavengers. If the balance between the carnivora and their prey is not kept up by this means, it is clear the tank would soon be depopulated. With respect to *Actinia* they are easily satisfied, a Muscle or *Pecten* now and then is all that *A. crassicornis* or *A. coriacea* require; as to *A. dianthus* I have kept one for two months in a pan quite alone; it has not fed the whole time, for three weeks of that time the water was not changed, neither were any plants placed with it. For six weeks I have kept *Actinia clavata* (mihi) in a pomatum pot in the same state, and it is now as lively as when taken. With respect to the safe carriage of specimens, I am of opinion the better method of packing them is in damp *Fucus serratus*: this will apply to the greater number; many we know must be moved in water, and I am confident I shall succeed in a plan I am about to try, for sending fish by rail alive; and I do not despair of seeing the lovely *Wrasse* family, located under the paternal care of Mr. Mitchell, with other fish equally interesting, but less beautiful, adorning the Vivaria, by which the ingenuity of man and his knowledge of chemistry have enabled many a scientific person to observe, and many a casual observer to see some few of the treasures of the ocean, and to point out to the inhabitant of inland towns, that the ocean has her gems and her flowers equal to the earth, and even stars in her depths. And now I would suggest a word or two to those who manage places of public resort where Marine Vivaria are, or are about to be established. Many of the animals and some of the plants will be but partially seen in the tanks, and there is one all but insurmountable difficulty in naming them, so as that the unscientific observer may be enabled to identify them, as the

animals will be in constant motion; to remedy this I suggest that around each tank should be placed glass cases or tables containing specimens of all living in the tank and properly named; this, I think, would enable the public to identify the species, it would also instruct and amuse; by this plan you might also point out the burrowing bivalves, which, although in the tank, would be seldom visible. I believe the public exhibition of Marine Vivaria will bring them into almost universal use as ornaments to the drawing-room or for purposes of instruction in Museums, Literary Institutions, and perhaps even in the school-room. Should this be the case, the labours of sea-side naturalists will be called into requisition, and a better class will enter into the supplying specimens.

I will now give a list of some of the more easily obtainable species to place in a vivarium. I am very fortunate in obtaining species here, and it is but seldom that I have not also some rarity in my possession.

Of shells I recommend species of *Pholas*, *Scrobicularia*, *Donax*, *Tapes*, *Cardium*, *Mytilus*, *Crenella*, *Tellina*, *Nucula*, *Pectunculus*, *Pecten*, *Chiton*, *Patella*, *Acmea*, *Pileopsis*, *Fissurella*, *Puncturella*, *Emarginula*, *Haliotis*, *Trochus*, *Phasianella*, *Littorina*, *Lacuna*, *Rissoa*, *Truncatella*, *Apporhais*, *Cerithium*, *Scalaris*, *Natica*, *Velutina*, *Laminaria*, *Murex*, *Purpura*, *Nassa*, *Buccinum*, *Fusus*, *Trophon*, *Mangelia*, *Cypræa*, *Ovula*, *Cylichna*, *Amphisphyra*, *Tornatella*, *Akera*, *Bulla*, *Scaphander*, *Philine*, *Aplysia*, *Pleurobranchus*.

Of Echinodermata the most showy are—*Solaster*, *Uraster*, *Palmites*, *Comatula*, *Asterina*, *Asterias*, *Cribella*, *Ophiocoma*, *Echinus* and *Spatangus*.

Of Crustacea, all the species; as also the *Cirrhipeda* and *Annelides*.

Of sea plants I strongly recommend *Fucus serratus* as a useful, and the whole of the Rhodospirms as lovely additions, and some few of the Melanosperms; but the colours of the Chlorospirms or green sea-weeds are so fugitive, that it is with regret I cannot recommend a family of which the beautiful *Bryopsis* is a member.

I am, Gentlemen, yours very obediently,

WILLIAM THOMPSON.

XXXVI.—*Rambles in Ceylon*. By EDGAR LEOPOLD LAYARD, Esq.

To Richard Taylor, Esq.

[Continued from p. 314.]

Anarajahpoora, Wednesday, 30th April, 1852.

MY DEAR SIR,—Here I am, in the City of the Kings, now the abode of ruin and desolation: torrents of rain are falling day and night: a rushing mountain stream, called the Malwatteoya, bounds our walks,