R. littorea, Delle Chiaje, is an apocryphal British species; and the so-called *R. eximia* is an undoubted *Chemnitzia* allied to *C. excavata*; I have described the shell, the animal being undiscovered, under the title of *C. Barleei*. The *R. ulvæ* and its varieties have appeared in the 'Annals,' N. S. vol. v. p. 358. I cannot speak of the *R. anatina* and *R. ventrosa*, not having met with them alive. The account of the animal of *R. fulgida* is published in the 'British Mollusca' from my notes; it differs much in the proportionate dimensions of its organs, but there is no sufficient generic variation to remove it from this genus. At Exmouth it is abundant on the algæ of the half-tide littoral levels. The *Turbo subumbilicatus* of Montagu is still in obscurity; it is perhaps a variety of one of the species of the estuaries, and if it could be identified, its position would probably be in this genus. I mention the *Jeffreysia diaphana* and *J. opalina*, because they have recently been styled *Rissoæ*; they appear from several characters to form the passage to the *Chemnitziæ*. I think I have now named every *Rissoa*.

I conclude this still imperfect monograph by calling on the naturalists of this branch of science to make it more complete, by searching in their respective localities after the animals which continue to elude our view; as without the inhabitants of shells, the essential part of this portion of nature is hidden from us. Conchology as a science is little better than the toy of the shell-fancier; we can only admit that these persistent forms, independent of the animal, are useful as objects of comparison with some of the antediluvian relics of our globe, as they prove that nature, at least a part of it, existed in the palæontozoic epochs as at the present time.

I am, Gentlemen, your most obedient servant,

WILLIAM CLARK.

XXIV.—*On keeping Marine Animals and Plants alive in unchanged Sea-water.* By P. H. GOSSE, A.L.S.

To the Editors of the Annals of Natural History.

GENTLEMEN,

IN a recent Number of 'Chambers' Edinburgh Journal' (July 1852) a paper has just been pointed out to me, on maintaining the balance between animal and vegetable life in an aquarium. Mr. Warington, whose experiments are there alluded to, has

succeeded in keeping living plants and animals together in fresh water, and announces that he is "attempting a similar arrangement with a confined portion of sea-water, employing some of the green sea-weeds as the vegetable members of the circle, and the common winkle or whelk to represent the *Limneæ*," which in the former case he had found useful in consuming the slime produced by the decay of the vegetable matter.

Priority of publication is universally acknowledged to give a title to whatever honour attaches to a new discovery, and this I shall not dispute with Mr. Warington. I may be permitted to state, however, that I have for some considerable time been pursuing experiments on the same subject.

For several years past I have been paying attention to our native Rotifera, and in the course of this study had kept fresh water in glass vases unchanged from year to year, yet perfectly pure and sweet and fit for the support of animal life, by means of the aquatic plants, such as *Vallisneria*, *Myriophyllum*, *Nitella* and *Chara* (but particularly the former two), which were growing in it. Not only did the Infusoria and Rotifera breed and multiply in successive generations in these unchanged vessels, but *Entomostraca*, *Planariæ*, *Naïdes* and other Annelides, and *Hydræ*, continued their respective races; and the young of our river fishes were able to maintain life for some weeks in an apparently healthy state, though (perhaps from causes unconnected with the purity of the water) I was not able to preserve these long.

The possibility of similar results being obtained with sea-water had suggested itself to my own mind, as it has to that of Mr. Warington; and the subject of growing the marine Algæ had become a favourite musing, though my residence in London precluded any opportunity of carrying out my project. But in the course of last winter, ill-health drove me to the sea-side, and gave me the opportunity I had been long desiring. My notion was exactly that of Mr. Warington, that as plants in a healthy state are known to give out oxygen under the stimulus of light, and to assimilate carbon, and animals on the other hand consume oxygen and throw off carbonic acid, the balance between the two might be ascertained by experiment, and thus the great circular course of nature, the mutual dependence of organic life, be imitated on a small scale.

My ulterior object in this speculation was twofold. First, I thought that the presence of the more delicate sea-weeds (the Rhodosperms or red families especially, many of which are among the most elegant of plants in colour and form), growing in water of crystalline clearness in a large glass vase, would be a desirable ornament in the parlour or drawing-room; and that the attractions of such an object would be enhanced by the

curious and often brilliant-hued animals, such as the rarer shelled Mollusca, the graceful Nudibranchs, and the numerous species of Sea-anemones, that are so seldom seen by any one but the professed naturalist.

But more prominent still was the anticipation that by this plan great facilities would be afforded for the study of marine animals under circumstances not widely diverse from those of nature. If the curious forms that stand on the threshold, so to speak, of animal life, can be kept in a healthy state, under our eye, in vessels where they can be watched from day to day without being disturbed, and that for a sufficiently prolonged period to allow of the development of the various conditions of their existence, it seemed to me that much insight into the functions and habits of these creatures, into their embryology, metamorphoses and other peculiarities, might be gained, which otherwise would either remain in obscurity or be revealed only by the wayward "fortune of the hour."

Nor were these expectations wholly unrealized. My experiments, though not yet entirely successful, and needing much more attention and time to complete them, have yet established the fact, that the balance can be maintained between the plant and the animal for a considerable period at least, without disturbance of the water; while my vivaria have afforded me the means of many interesting researches, the details of which I am preparing for the press.

The first thing to be done was to obtain the Algæ in a growing state. As they have no proper roots, but are in general very closely attached to the solid rock, from which they cannot be torn without injury by laceration, I have always used a hammer and chisel to cut away a small portion of the rock itself, having ready a jar of sea-water into which I dropped the fragment with its living burden, exposing it as little as possible to the air. The red sea-weeds I have found most successful: the *Fuci* and *Laminariæ*, besides being unwieldy and unattractive, discharge so copious a quantity of mucus as to thicken and vitiate the water. The *Ulvæ* and *Enteromorphæ* on the other hand are apt to lose their colour, take the appearance of wet silver-paper, or colourless membrane, and presently decay and slough from their attachments. The species that I have found most capable of being preserved in a living state are *Chondrus crispus*, the *Delesseriæ*, and *Iridea edulis*. The last-named is the very best of all, and next to it is *Delesseria sanguinea*, for maintaining the purity of the water, while the colours and forms of these render them very beautiful objects in a vase of clear water, particularly when the light (as from a window) is transmitted through their expanded fronds. Many of my friends, both sci-

entific and unscientific, who have seen my vases of growing Algæ at various times during the present year, both at Torquay and at this place, have expressed strong admiration of the beautiful and novel exhibition.

I have not as yet been able to preserve the water to an indefinite period. Sometimes the experiment has quite failed, the plants decaying and the animals dying almost immediately; but more commonly, the whole have been preserved in health for several weeks. The following notes from my journal give the particulars of the most successful of my efforts.

On the 3rd of May I put into a deep cylindrical glass jar (a confectioner's show-glass) 10 inches deep by $5\frac{1}{2}$ inches wide, about three pints of sea-water, and some marine plants and animals.

On the 28th of June following, I examined the contents of the jar as carefully as was practicable without emptying it, or needlessly disturbing them. It had remained uncovered on the tables in my study, or sometimes in the window, ever since, a little water only having once been added merely to supply the loss by evaporation. The water was perfectly clear and pure. A slight floccose yellow deposition had accumulated on the sides of the jar, but there was very little sediment on the bottom. I had taken no note of the plants or animals when I had put them in; but as none of them had died, and none had been either abstracted or added, the following enumeration gives the original as well as then present contents.

There were at this time in the jar the following Algæ all in a growing state, and attached to the original fragments of rock :—

Two tufts of *Delesseria sanguinea*, each with numerous leaves.

Two of *Rhodymenia jubata*, one small, the other a large tuft.

A small *Ptilota plumosa*, growing with one of the last-named.

A *Chondrus crispus*, with

An *Ulva latissima*, growing parasitically on one of its fronds.

These seven plants had supplied for eight weeks the requisite oxygen for the following animals, which were at this time all alive and healthy :—

Anthea cereus.

Actinia bellis, a large specimen.

—— *bellis*, a half-grown one.

—— *anguicoma*, large.

—— *anguicoma*, small.

—— *nivea* (MS.).

—— *rosea* (MS.).

—— *rosea*, a small specimen.

—— *mesembryanthemum*, young.

—— *mesembryanthemum*, young, another variety.

Crisia denticulata, a large tuft.
Coryne —— ?, young.
Pedicellina Belgica, two numerous colonies.
Membranipora pilosa.
Doris (*bilineata* ?).
Polycera 4-lineata, very small.
Phyllodoce lamelligera, about 11 inches long.
A coil of small *Annelides*.
Several *Serpulæ*.
Acaridæ.
Entomostraca.
Infusoria.
Grantia nivea. And other smaller zoophytes and sponges which I could not identify.

Soon after this examination I went on a journey, and did not return till the 7th of July. The weather had set in very hot: whether this, combined with the closeness of the room, had had any effect I do not know; but on my return I found the water beginning to be offensive, a sort of scum forming on the surface, and the animals evidently dying. Some were already dead, but most of the others recovered on being removed to fresh sea-water. This result, though it put an end to my experiment at that time, I do not regard as conclusive against the hypothesis; for of course animals are liable to death under any circumstances, and the corrupting body of one of these in so limited a volume of water would soon prove fatal to others, even though there might be no lack of oxygen for respiration. It is possible that one of the large *Actiniæ* may have casually died during my absence, the timely removal of which might have averted the consequences to the others; but this is only conjecture. Perhaps there was too large an amount of animal life in proportion to the vegetable; but the maintenance of all these in health and activity for nearly nine weeks seems hardly to agree with such a supposition.

I have always found one of the most unpleasant phænomena in the experiments to be the appearance, in the course of a few weeks, of greenish or yellowish matter about the sides of the jar, hindering their transparency. This I have reason to think is the early state of Confervoid plants, for filaments of green Confervæ soon begin to shoot from this accumulation, and would probably choke up the water in time. Mr. Warington's suggestion of employing the phytophagous Mollusca to get rid of the accumulating vegetable matter, had not occurred to me; it is ingenious, and might perhaps obviate this inconvenience. I had myself observed that the presence of some of the *Trochi*

seemed to be helpful in keeping the water pure, but I did not know how to account for it.

Should these experiments be perfected, what would hinder our keeping collections of marine animals for observation and study, even in London and other inland cities? Such a degree of success as I have attained would admit of so desirable a consummation, for even in London no great difficulty would be experienced in having a jar of sea-water brought up once in a couple of months. I hope to see the lovely marine Algæ too, that hitherto have been almost unknown except pressed between the leaves of a book, growing in their native health and beauty, and waving their delicate translucent fronds, on the tables of our drawing-rooms and on the shelves of our conservatories.

I remain, Gentlemen, your obedient servant,

P. H. Gosse.

Ilfracombe, Sept. 10, 1852.

XXV.—*Notes on the genus* Cyclostoma; *and Characters of some new species from India, Borneo, and Natal.* By W. H. Benson, Esq.

1. *Cyclostoma Nilagiricum*, nobis, n. s.

Testa umbilicata, depresso-turbinata, solida, liris spiralibus 8–9 majoribus, quibusdam parvis obsoletis inæquidistantibus interjectis munita, castanea, ad periphæriam albido-articulata, infra fascia latissima saturatiore, superne strigis radiatis angustis undatis albidis frequentioribus, subtus rarioribus ornata; spira ad apicem exsertiuscula, obtusata; anfractibus 5, convexiusculis, ultimo ad periphæriam subfuniculato-carinato, superne angulato, circa suturam late planato, subtus circa periomphalum excavatum lævigatum compresso, umbilico mediocri profundo, subcylindrico; apertura obliqua, pyriformi-rotundata, aurantiaca, fauce cærulescente, peristomate expanso, incrassato, reflexiusculo, aurantiaco, breviter adnato, prope umbilicum leviter sinuato, superne angulato, producto, intus sulco intrante impresso.

Diam. major 43–45, minor 34–36, axis 22–24 mill.

Hab. ad latus occidentale Montium "Nilgherries" teste Jerdon.

This shell was at first supposed to be *C. Indicum* of Deshayes, but proved to be widely different. It is allied to *C. Jerdoni*, nobis, and to *C. Ceylanicum*, Pfeiffer. *Cyclostoma Indicum* is placed by the last-mentioned author between *C. validum* and *C. linguiferum*, being provided with a linguiform process to the lip, near the umbilicus, of which feature, however, no notice is taken by Deshayes either in his specific character or in his extended description. The remark in vol. viii. of the 'Annals,'