The viviparous winged female. While a pupa it much resembles the wingless female in colour, but is comparatively flat; when the wings are unfolded it is dark brownish green, and very often slightly covered with white powder: the abdomen is pale green with a very slight pearly tint on its disc; it has also a black line across each segment, and a row of black spots on each side: the feelers are black, and a little shorter than the body; the third joint is long and thick; the fourth is less than half the length of the third; the fifth is a little shorter than the fourth; the sixth is shorter than the fifth; the seventh is about twice the length of the fifth: the eyes are dark brown: the mouth is dull yellow with a brown tip: the nectaries are black, and as long as one-twelfth of the body: the legs are black; the thighs are pale green towards the base: the wings are colourless, and very much longer than the body; the wing-ribs are pale yellow; the wing-brands are very pale brown, and their tips are very slightly clouded; the second vein diverges more from the first than it does from the third vein; the forks of the latter usually begin respectively before one-third and before two-thirds of the length of the vein; the fourth vein is curved moderately and equally throughout its length; the angle of the brand whence it springs is distinct.

1st var. Greenish yellow varied with brown.

2nd var. The feelers are as long as the body.

3rd var. The mouth is green with a black tip: the thighs are wholly black.

4th var. The thighs and the middle shanks excepting the tips are pale yellow.

Length of the body 1 line; of the wings 3 lines.

Most of the winged race die during the growth of their progeny, and adhere to the leaf at a short distance from the groups of the wingless insects. This species feeds also on *Brassica Rapa, B. campestris, B. Napus, Sinapis arvensis, S. alba, S. nigra, Crambe maritima* (on this plant, especially in a wild state, it occurs in great profusion), *Raphanus sativus, R. Raphanistrum, Capsella Bursa, Diplotaxis tenuifolia, Lepidium sativum, Thalictrum minus, Spinacia oleracea.*

[To be continued.]

VIII.—*On the Animal of* Kellia rubra.

By Joshua Alder, Esq.

To Richard Taylor, Esq.

Dear Sir, Newcastle-upon-Tyne, 18th June 1849.

My remarks on the animal of *Kellia rubra* have unfortunately brought me into a controversy with Mr. Clark, a gentleman with whom it would have given me much greater pleasure to have

found myself in agreement. Our opinions, however, appear to differ more widely that I at first expected.

In my last letter I ventured to lay down, perhaps more broadly than usual, the theory of the branchial currents in the Conchifera as generally received*; and confirmed, as far as my experience goes, by my own observations. This theory of ciliary currents, received and expelled by separate apertures, Mr. Clark entirely denies, and thinks, if I understand him rightly, that no apertures are specially set apart for this purpose, but that the water for branchial purposes flows in and out of all the openings of the mantle indiscriminately;—whether by ciliary action or not, is not stated.

To enter into a review of this process as applied to the whole of the bivalves would greatly extend a discussion already, I am afraid, encroaching too much upon your pages; and as I do not feel that I shall be able to throw any new light upon it from my own observations, I shall waive the general subject for the present and confine myself to the consideration of Mr. Clark's objections to my views on *Kellia rubra*, which he thinks it not difficult to show are wrong. Let us, then, carefully examine the arguments by which this position is to be established.

The first is thus stated:—"It must be borne in mind that the mantle of *Kellia rubra* is *open* from the posterior branchial slit to its anterior termination. The open fold in question is merely a prolongation of that membrane; and when the animal *opens its valves*†, it must receive, like the *Mactræ* and *Veneres*, or any other bivalve with an open mantle, the currents of sea-water; and *in closing them*, a great part thereof, after bathing the branchiæ, is ejected from the aperture of *ingress*, and only a portion of it passes out of the posterior orifices." This I admit to be the natural effect of the *opening and closing* of the valves, but surely Mr. Clark does not mean to say that the branchial currents are produced by this means? According to my views this is an occasional action entirely independent of the regular branchial currents, and should not be confounded with them, as these latter go on when the valves are entirely at rest, and when consequently no such effect as here described could possibly be produced by them. As to the siphonal fold being merely a prolongation of the mantle, this is the case with the siphons of all the Conchifera; the only difference being, that in the present instance the tube is formed by a fold of the mantle, while in other genera, and in

* See Lamarck, Anim. s. Vert. 2nd ed. vol. vi. p. 7; Grant, Comp. Anat. p. 539; Owen, Lectures on Comp. Anat. vol. i. p. 282.

† These words are here put in italics, though not so in Mr. Clark's letter, to draw particular attention to them. I have taken the liberty of doing the same in other places.

another species of the same genus, the walls are closed; yet their functions are surely analogous. A similar siphonal fold, though less perfect, may be seen in some of the *Modiolæ*: but the case most in point is the siphon of the zoophagous gasteropods, which is a prolongation and fold of the mantle similar to this, yet no one that I am aware of has argued that it cannot be for the supply of water to the branchiæ because it is continuously open with the other parts of the cloak*.

Mr. Clark thinks my views incorrect: "As in those bivalves with open mantles the currents of water enter by the great pedal orifice or *rima magna* of the mantle *to aërate the branchiæ*, and the greater part of the impure fluid is expelled by the aperture of *ingress*, a small portion, as before stated, passes out by the posterior siphonal apparatus." Is this any more than a repetition of the former statement, leaving out the *opening and shutting of the valves*, and defining the purpose more distinctly to be, "to aërate the branchiæ"? That it has reference to the same action is evident from the words "as before stated." Mr. Clark must therefore either think that the branchial currents are produced by the opening and shutting of the valves, or he is confounding two things that are distinct. If the pedal orifice is the principal one by which the true branchial currents are received and expelled, of course my observations, and the views of almost every author who has written on the subject must be wrong, but the proof requires to be brought forward in some more definite form than this.

Again, Mr. Clark says, "In the mollusca with nearly closed mantles, only a small portion of the fluid can enter by the restricted pedal orifices; the far greater portion must be inhaled by the posterior siphons" (not necessarily by both), "and is often expelled simultaneously at both orifices, as I have observed in *Pholadidea papyracea*, the most closed of all the bivalves." This fact of the occasional simultaneous expulsion of water at both orifices seems to be the only one that Mr. Clark has satisfactorily ascertained from observation in this species; he might perhaps have added that it was accompanied by *a closing of the valves*;—at least such is the case with the allied *Pholades* as I have myself witnessed. But this sudden ejection of water is only occasional, and caused by other means than the regular ciliary currents. It is probable that in the *Pholades* and some other bivalves with

* I am sorry to have misunderstood Mr. Clark with respect to the sense in which he took the words branchial and anal. I did not say, however, that he *used* the words, but that he appeared to *take* them (as used by others) in too restricted a sense. My reason for thinking so was, that he said the posterior opening had "passed for the *anus*," and took some trouble to show that the true anus is distinct from it.

long siphons (*Mya, Lutraria,* &c.), the branchiæ, being situated at a great distance from the apertures, may require from time to time the assistance of muscular contraction for a thorough cleansing out of the branchial cavity, and in this case the water will be discharged out of both siphons from the stronger force overcoming the action of the cilia*.

Mr. Clark takes some pains to prove that the water does not make a circuit through the intestines, which position, being undisputed and apparently unconnected with the argument, I should not have noticed but for the conclusion drawn from it; which is, "that the water *therefore*" (on account of not passing through the intestine?) "for the branchiæ and sustentation must pass into the great branchial cavity, and issue therefrom by *both the ducts at which it entered.*" How is this? The conclusion appears to be a *non sequitur*: but possibly I may misunderstand the meaning of the paragraph, though I have read it over carefully more than once.

With respect to my statement of having seen, under the microscope, a *continuous* current of water flowing into the anterior tube of *Kellia rubra*, Mr. Clark observes, "All must admit this fact: as the fold is a part of the open mantle, no microscope is here required, as in every open-mantled bivalve of adequate size this action is instantly made apparent by a common lens, and is the invariable result of *the animal opening its valves.*" In Mr. Clark's former letter he says, "*No currents*, at least branchial ones, enter therein or issue therefrom; it is a fold merely subservient to locomotion." The flow of a continuous current into this tube-like fold is now treated as an admitted fact, requiring no microscope for its demonstration;—but it is attributed to the *opening of the valves*. It may be necessary therefore to state that the operation goes on when the valves are perfectly at rest, and cannot in that case be produced by their means. That I could see a current passing out at the posterior aperture is however to Mr. Clark a matter of the "gravest difficulty," only to be got over by supposing that I was deceived by the "aberration and well-known great deceptions involved in the use of high microscopic powers." It will be a satisfactory answer to this to state that I was able to see it with the lowest power of my microscope, where there could be no aberration. The advantage of a microscope over a pocket-lens in this case is the greater facility it affords in managing the light, which requires to be transmitted

* The internal surface of these siphons is usually (perhaps always) covered with vibratile cilia, more minute than those of the branchiæ, but acting in conjunction with them in producing the currents. Mr. Cocks informs me that he can see the cilia inside the anterior tube of *Kellia suborbicularis*, with a lens of $\frac{1}{4}$-inch focus.

through the fluid to show the floating particles; for it is the size of these, and not that of the aperture, which enables an observer to distinguish the direction of a current. Mr. Clark could see the excrements pass out of this small opening. What then should prevent our seeing other bodies, if sufficiently visible under the microscope, float in or out?

For argument, Mr. Clark would assume that the posterior slit, as I state, shows no sign of an ingress-current. Yet no argument is founded upon it, for in the very next sentence the contrary *fact* is stated to be *proved* "by the contraction and dilatation of the slit" (my dissent from this *proof* is already on record); "especially," that gentleman adds, "as I have shown that the analogous tubes" (the anal ones?) "of the close-mantled mollusca . . . *must of necessity* receive and discharge the fluid necessary for the branchial œconomy." Is this shown? and where?

We have next an assumed case which is also called a *proof*, put in these words: "Suppose *Kellia rubra*, instead of being an open-mantled animal, is one of the closed mollusca,—where, in this case, is the entrance to the branchial currents?" All the known closed mollusca have at least two if not three apertures. A closed mollusk with a single aperture, if such did exist, would be an anomaly, and its branchial arrangement might also be expected to be an exception to the general rule. But what argument can be founded upon this? That where there are two or more apertures, they cannot be set apart for different purposes? Certainly not;—any more than we could argue that because some animals exist where the alimentary and excretory functions are performed through the same orifice, that in other animals where two orifices are found they cannot perform different functions.

"It may be asked," says Mr. Clark, "why has nature departed from her usual scheme only in *Kellia rubra* and *K. suborbicularis*?" The only way in which the usual scheme is departed from in this genus, is, not in giving the species a special inhalant siphon, but in placing it before instead of behind: and perhaps for this some reason might be found. Most bivalves live in sand, and they require to have both tubes placed at that end of the shell which usually communicates with the surface. The *Kelliæ*, on the contrary, never burrow in sand, but inhabit the sinuosities of rocks, sea-weeds, and old shells: a simpler arrangement, by which the water can be admitted direct to the mouth and anterior part of the gills, is therefore not incompatible with its habits. But it is added, "We will now inquire into the 'cui bono' of this fold of the mantle, *considered as a branchial appendage*. It is well known that nature never acts by way of surplusage; and having given *Kellia rubra* an open mantle by which the currents *can* enter, as in other analogous open bivalves, we must conclude

that she has not departed from her usual scheme, and that this fold is not a special branchial organ, but is intended to fulfill other functions." Is this a legitimate conclusion to arrive at? Mr. Clark here argues as if the departure from the usual scheme in *Kellia rubra* was in having a special branchial orifice; but this is not the point of difference, as I have before stated, and these objections, if they have any weight, must apply equally to the posterior branchial siphons of all the open-mantled bivalves. They all have a pedal aperture through which the currents *can* enter. What then is the use of the so-called branchial siphon? Or why are there three apertures performing the same function? Surely there is something very like surplusage here. The "*cui bono*" may well be asked of Mr. Clark's views, but not of mine, as I assign a separate function to each orifice: the branchial one being kept apart from the opening for the foot in order that the currents may not be interrupted by the action of that member.

But Mr. Clark says, the foot does intrude itself occasionally into the folded siphon of *Kellia rubra*; and this is the last and "conclusive proof" by which I am to be put *hors de combat*. "The animal very often thrusts its foot into the fold, and by the withdrawal of which it is opened and the edges separated. How then can a fold, whose form by this action is continually changing, and is subject to *momentary interruption*, be the conduit of regular, delicate, and uninterrupted currents?" I would ask, does not this objection tell more strongly against the true pedal opening of this and other bivalves, which Mr. Clark wishes to make out is the principal one for the entrance and exit of branchial currents? Let any one look at this little animal with its siphonal fold stretched out in front, and frequently expanded almost into a cup-form, as if courting the entrance of the vivifying stream, and then say whether the basal part through which the foot is constantly protruded when in action, or the siphonal fold into which it not unfrequently makes a *momentary incursion*, is most free to supply the currents necessary for respiration and food. Mr. Clark calls these currents "regular, delicate, and uninterrupted." I have said that they are continuous, and pretty regularly sustained, but never contemplated asserting that they were not liable to occasional or accidental interruption.

I shall now briefly advert to the curious use which Mr. Clark has found for the siphonal fold as a prehensile organ, and the no less curious terrestrial habits which he supposes this little bivalve to possess. For both I think that gentleman is greatly indebted to a lively imagination. Probably he will also find, on a more careful examination, that its *habitat* beyond tidal range has been rather overstated. I have never found it but within tide-marks, and cannot conceive how a bivalve mollusk, whose

structure disables it from procuring any food but what is floated into its shell by the agency of water, can possibly live permanently out of that element. It is true that oysters and several other bivalves can endure a sort of torpid existence out of water for some time when the valves are closed to prevent the evaporation of moisture from the gills; but Mr. Clark supposes this little *Kellia* able to walk abroad beyond tide-marks, notwithstanding the desiccation of the branchiæ which the opening of the valves might cause.

Should I have succeeded in showing that the impossibility or even improbability of my views being correct has not been established, the following interesting letters from Mr. Cocks, detailing a series of observations kindly undertaken at my request, will go far to prove my original statement, that the anterior siphon in *Kellia rubra* is the ingress channel through which water is supplied to the branchiæ and to the mouth. The mode by which it makes its exit has not been so satisfactorily made out, but I have great confidence that my views and observations on this point will also ultimately be confirmed. However that may be, if one fact has been established in the animal œconomy, something has been gained. Mr. Cocks's observations appear to have been more especially directed to the anterior siphon.

I am, dear Sir, very truly yours,

JOSHUA ALDER.

MY DEAR SIR, Falmouth, June 8, 1849.

I have repeated the experiments on *Kellia rubra* and *K. suborbicularis*, and the results confirm my former statements*. I witnessed the ingress of water, atoms, crustacea, &c., very distinctly into the anterior siphon of both species, and also the expulsion of fæces from the posterior siphon, but have failed *in toto* to prove the current of water posteriorly in either, or the expulsion of water from the anterior siphon of *K. rubra*, although in *K. suborbicularis* it takes place: viz. a *K. suborbicularis* that had been confined several months in one of my experimental bottles, was put into a watch-glass of fresh salt water. It sent forth the anterior siphon: the orifice expanded, and the water, atoms, &c. flowed freely into it for a few seconds: it then closed the aperture, contracted in length, and with a slight convulsive jerk of the animal and a partial closing of the valves, sent forth a jet of water, apparently free from any admixture, through the anterior tube. The operation was performed twice or thrice in a minute†.

* Mr. Cocks's first letter is not inserted, as the contents of it are sufficiently illustrated in the sequel.

† This action, according to Mr. Cocks's description, appears to take place more decidedly and frequently when the animal is removed from impure

May 31st.—I procured from Gwyllyn Vase several fine and healthy specimens of *K. rubra* and *K. suborbicularis*. The *K. rubra* protruded its siphons, and the ingress of water, &c. was very apparent, as also the ejectment of fæces per posterior siphon, within a few minutes after immersion.—*K. suborbicularis*: ingress of water per anterior siphon and egress of fæces per posterior siphon:—at intervals a slight spasmodic twitch of valves, but unable to detect a discharge of water per anterior siphon. [Here follows a register of observations daily made from the 1st to the 8th of June with the same result, excepting that on the 7th, when the water was changed, *K. suborbicularis* showed "a discharge of water per anterior siphon." 8th. *K. suborbicularis*: this action "subdued—flow of water per (into) anterior siphon regular."] From the 4th to the noon of the 7th they were allowed to remain in the glass without changing the water: in the evening of that day I put them into fresh water. The *K. rubra* absorbed the water and its contents freely and ejected fæces; and although I employed powerful glasses, was unable to detect any (egress) current either anteriorly or posteriorly. Not so with *K. suborbicularis*. It imbibed water freely and ejected fæces sparingly; as well as passing a stream from the anterior siphon. I believe that the operation of ejecting water anteriorly by *K. suborbicularis* (with all my tact I have not been able to detect a current from the anterior siphon of *K. rubra*) is performed by the animal in health with little muscular effort; but when in confinement, poorly supplied with food, and that not to its taste, it becomes atrophized and feeble, consequently every effort of the will is demonstrable.

The *Lichina pygmæa* is very common with us on the rocks, and is covered twice a day by the tide to the height of several feet. It forms a good retreat for *K. rubra* and *Turtonia minuta*. The *Lichina confinis* is also plentiful on our rocks, but is generally out of the reach of the waves, although it sips the spray often. I have gathered a great deal of *L. confinis*, but never found a univalve or bivalve shell attached to it or near it. The *Kellia rubra* with us is found in situations within tide-marks, covered twice a day with the sea.

I am, dear Sir, yours very truly,

J. Alder, Esq. W. P. Cocks.

My Dear Sir, Falmouth, June 16, 1849.

The *Kellia rubra* and *K. suborbicularis* imbibe water freely; and *constantly by their anterior siphons*. We have had with us

into fresh sea-water, and is probably a means of cleansing the branchial cavity from the effete water and bathing those organs more completely in the purer element.—J. A.

for the last three weeks Dr. Busch of Berlin, who is making a scientific tour of Great Britain, with a view of pursuing anatomical researches among our marine animals. He left for Dublin last night. His microscope was a magnificent machine. I availed myself of its powers, and placed the bivalves under its magic influence. The sight was delightful. I could see the ingress of water into the anterior siphon of *K. suborbicularis* and *K. rubra*, the ejectment of fæces from both distinctly. The alternate spasmodic action and forcing of water through the anterior tube of *K. suborbicularis* free of any admixture was distinctly seen. The power employed was very great. The animal, one that *had been in confinement for some time.* This creature was removed from the field and a *K. rubra* substituted; the same power being employed. The anterior siphon was in constant motion; and the water, crustacea, and minute atoms floating on its surface were distinctly seen to enter it: no regurgitation took place anteriorly. I kept my eye to the instrument watching the creature's movement until my retina was nearly paralysed, without detecting the "placid stream." I have daily during the last six weeks examined a score of *K. rubra*, both recent specimens and old prisoners, with lenses of different powers,—employed various contrivances with compound mirrors, lenses, &c., *without detecting the current of water passing out of its anterior siphon.*

Believe me, my dear Sir, yours very truly,

J. Alder, Esq. W. P. Cocks.

PROCEEDINGS OF LEARNED SOCIETIES.

ZOOLOGICAL SOCIETY.

June 13, 1848.—Harpur Gamble, Esq., M.D., in the Chair.

3. Description of new species of the genus Cypræa. By J. S. Gaskoin, Esq.

1. Cypræa Thersites (High-backed Cowrie). *Cyp. testâ ovatâ, gibbosâ, dorso elevato, basi latâ planâque, saturatè rufescente-fuscâ; anticè posticèque depressiusculâ, aperturâ angustatâ, posticè recurvâ; dentibus albis, distinctis, labii externi validis, columellari minùs prominentibus; sulco columellari anticè profundo, lato; extremitatibus valdè productis, canali antico pleno.*

Shell ovate, very gibbous and high-backed, of a very dark, reddish-brown colour, not uniformly equal in intensity; a curved whitish mark exists over both the anterior and the posterior extremities, at which places there is a depression, as though the mantle had not deposited any substance there after it had begun to secrete the colouring-matter, particularly that at the last whorl of the spire;