bus; canali recurvata; lacuna umbilicali magna; labro intus crebrilirato; labio conspicuo, spiraliter rugose lirato.

Hab. Sta Barbara, Pleistocene formation (*Jewett*).

Col. Jewett's single specimen is in very fine condition, and is confirmed by a fragment obtained by Mr. Gabb, the palæontologist to the California State Survey. Although resembling *Purpura aperta* and congeners in the irregular rugose folds of the labium, and *Siphonalia* in the strongly bent canal, Mr. H. Adams considers that its affinities are closest with the *Cantharus* group of *Pisania*. That genus is extremely abundant in the tropical fauna, but does not now live in California. It is the only distinctly tropical shell in the whole collection; and its presence, along with so many boreal species and types, appears somewhat anomalous, like the appearance of *Voluta* and *Cassidaria* in the Crag fauna. It is distinguished from the extreme forms of *P. insignis* by having the spiral liræ pretty equally distributed over the early whorls, by the close internal ribbing of the labrum, by the absence of the stout posterior parietal tooth, and by the great development of the columellar folds.

Note.—Unfortunately, during the long interval which has elapsed between the transmission of the MS. and receipt of the proof, the types have been returned to the owner, and (with the remainder of Col. Jewett's invaluable collection of fossils) have become the property of a college in New York State. As they are packed in boxes, and at present inaccessible, I am unable to give the measurements; but the unique specimens were drawn on wood by Mr. Sowerby for the Smithsonian Institution.—P. P. C., Montreal, Feb. 22, 1866.

XXX.—*On the Float of the* Ianthinæ.

By Dr. H. Lacaze-Duthiers*.

Fabius Colonna was the first to indicate the existence of the peculiar float of the *Ianthinæ*, under the name of *spuma cartilaginea*. Cuvier proved that this organ had no organic connexion with the body. "It is attached," he says, "to the posterior part of the foot, almost immediately beneath the spot where the operculum of other genera occurs. I should be very willing to think that it is a vestige of the operculum which has undergone, in its form and tissue, changes similar to those with which nature presents us in so many of her other productions." We shall recur to this last notion, which does not appear to be quite correct. Cuvier evidently had not observed the living animal,

* Translated by W. S. Dallas, F.L.S., from the 'Annales des Sciences Naturelles,' série v. tome iv. pp. 328–341.

but his investigation had been made upon individuals preserved in spirits. He adds, "The organ has no direct communication with the interior of the body; it is a mere appendage of the integuments. And it does not appear that the animal can at pleasure empty or fill it with air; it can only compress it by drawing it into the shell, or leave it to its natural elasticity by allowing it to escape"*.

I have been able to examine animals in the expanded and contracted states—even strongly contracted, such as those which the sea had rolled upon the beach; and it is impossible to admit that the float enters entirely within the shell; it follows the *Ianthina* as it withdraws, but it is not introduced into the shell as a part of the organism.

All differences of opinion will be easily explained when we have shown what is the real origin of this curious object. It will be seen how erroneous was the opinion of Bosc† (already justly criticised by Cuvier) when he said that *the animal absorbs the air from its vesicles and inflates them at pleasure*. Cuvier adds, "This assertion of Bosc is only a supposition, and not a fact ascertained by direct experiments." Even the very presence of the organ did not appear to the celebrated naturalist to be absolutely necessary; for he says distinctly, "All individuals do not possess this organ: I have three which do not show the least trace of it."

Bory Saint-Vincent had no doubt observed the living *Ianthina* in his voyages; and he says, "I have not observed that the animal had the faculty of emptying or filling it at pleasure and with promptitude"‡. The same observer adds that he has seen *Ianthinæ* "in which the organ had been crushed, or reduced one-fourth, without their appearing to have suffered." And Cuvier, who cites this opinion, remarks that "its nature is in fact such that *Ianthinæ* deprived of it by violence would probably experience no other inconvenience than that resulting from the difficulty of rising to the surface of the water."

All this is in accordance with its anatomical nature—that is to say, the independence of the tissue and of the float, but not with its origin and nature. Thus, when Cuvier adds, "But I have reason to believe that there are some which are naturally deprived of it," he makes a supposition, and his opinion expresses doubt when he seeks to give its explanation. Thus he invokes age and the season of the year to explain its absence, his reason being that he was unable to "perceive any cicatrix

* Cuvier, "Mémoires pour servir à l'Histoire et à l'Anatomie des Mollusques" (Mém. sur la *Ianthine* et la *Phasianelle*, p. 4).

† Coquilles, tome iv. p. 74.

‡ Voyages, tome i. p. 241.

or residue of this part in the individuals in his possession which wanted it."

Dr. Coates confirmed Cuvier's opinions, and showed that there was no anatomical relation between the body and the float*. He also found that the latter was entirely secreted by the foot, and that when a portion is removed the damage is quickly repaired.

The last author who has paid attention to the float of *Ianthina* is Mr. Adams†; his work is recent, dating only three years ago. It contains numerous facts which are perfectly correct and prove that the author observed the living animal. He says, "The float is attached to the under surface of the caudal end of the foot, where what appear to be the muciparous follicles give it a striated appearance. . . When the animal is weakly or dead, the the float readily becomes detached, for there is no organic connexion between it and the foot." This perfectly correct notion always recurs, and all the observers who have closely examined the matter come to the same conclusion as Cuvier.

As to the origin of the float, Mr. Adams is less positive. He says, "The vesicles are probably formed in the same manner as the frothy spume of the little green Homopterous larva which is seen on bushes in the spring, and which, in Hampshire, usually goes by the name of 'Cuckoo-spit.' When a portion is cut off, the float is enlarged at the end next the foot of the animal, and is not regenerated at the excised part." We shall see, however, that it may be repaired at the point which has been destroyed, but that this depends entirely on the position occupied by this point. Mr. Adams adds, "With a pair of sharp-pointed scissors I made incisions into the floats, and allowed the air to escape, when the animals gradually descended and remained helpless at the bottom of the vessel; the floats were not regenerated or renewed during the period the animals remained alive." I call particular attention to this passage, which very correctly indicates a fact, and which I shall cite in favour of the opinion that I shall maintain. Lastly, Mr. Adams remarks that crepitating portions continue floating until the air which they contain gradually escapes and they collapse, and, finally, that the floats, when pounded in a mortar, are readily reduced to a mucus. Such are the observations that have been made upon the float of *Ianthina*.

The following are the facts that I have ascertained, and from which I deduce the consequences that will be found in this article. In the first place, I was struck with the fact that all the *Ianthinæ* absolutely destitute of aëriferous vesicles remained

* Journ. Acad. Nat. Sci. Philad. vol. iv.

† Annals & Mag. Nat. Hist. ser. 3. vol. x. p. 417 (1862).

at the bottom of the water, although they were quite alive—that some of the more lively ones crept, although with difficulty, with their foot applied to the walls of the vessels, arrived at the surface, then turned themselves up, but most frequently without succeeding in reconstructing their float, and finally fell heavily to the bottom of the water.

I never saw them swim, as so many Mollusca are seen to do, by alternately dilating and contracting the foot. Perhaps in the open sea things may proceed differently, but of this I can say nothing; everything seems to indicate that the shell and the animal are of a weight which does not allow them to swim without a float; and it must be added that the *Ianthinæ* which remained at the bottom of the water quickly died there.

The unsuccessful efforts made by the animals either to return to the surface, or probably to reconstruct their float, gave me the idea of placing them in different conditions, and which, as it appeared to me, must be those sought by them.

I first of all endeavoured to ascertain exactly the constitution of the frothy mass, and, like preceding writers, I soon found that there was no organic relation between it and the body, but that it was merely adherent to the foot, and consequently that the air which it contained, as it could not be the product of a secretion, must have been imprisoned or mechanically enclosed within the vesicles. The thing to be sought, therefore, was the means or mechanism by which the animal was able to introduce a bubble into each vesicle.

The float is very regularly formed; the cells composing it are polyhedral in consequence of the mutual pressure which they exert upon each other, but they are always perfectly spherical in the part that remains free. This may be very well seen, for example, in all the vesicles of the circumference of the organ, upon the upper surface, and especially in the newly-formed cells. Moreover in the arrangement of these vesicles there is a well-marked order: they form nearly straight lines running from one end of the mass to the other, and the greatest length of which is in a direction from before backward.

By carefully observing the anterior extremity (that is to say, that nearest the head), one may exactly count the number and positively ascertain the volume, form, and relations of these terminal cells or vesicles. We may then trace and judge of what takes place when the animal is at work in restoring or increasing its float.

The foot is very distinctly divided into two different parts: the posterior and larger one is flat, and it is this which furnishes the insertion for the float; the other, or anterior one, is rounded in front and hollowed beneath by a canal which changes its form

every moment, in consequence of the folding of its margins downwards*. It is the moveable anterior portion that constructs the float; and this is effected as follows:—

It is seen at first to become elongated in front, then to curve and become elevated, pass to the right and left, and embrace in its concavity the anterior extremity of the float, upon which it moulds itself. In its movements of elongation, this part of the foot often acquires the form of a small club, especially when it rises above the surface of the water. The position of the foot upon the anterior extremity of the float has been indicated by Mr. Adams.

But it is especially necessary to follow the succession of the movements or manœuvres of the anterior part of the foot when it issues from the water and approaches the float. The foot is first of all seen to elongate itself, so as to issue from the water in a direction nearly opposite to that of the float, then the animal lifts it up and causes it to project above the liquid. At this moment the organ presents the appearance of a cup at its extremity; it becomes hollowed into a canal by the approximation of its margins beneath, and slightly wrinkles its anterior portion. All these movements of course take place without interruption, but their succession may be observed without difficulty.

When the foot has issued from the water, the animal moves it backward, causing it to describe an arc, which removes it from the head and approximates it to the float; but at the same time the animal bends it in such a manner that the channel and the cup, which were turned upwards, become inferior. Then this extremity of the foot encloses beneath it a certain quantity of air, like an inverted glass or bell immersed under water....In this position the foot gradually approaches the top of the float, and it is then that we see it spread out and slide gently in all directions, as if it was gluing the surface of the float by creeping upon it.

When this manœuvre, which Mr. Adams observed, without, I think, appreciating its purpose, has continued for a certain time,

* We must apply a clear and precise meaning to the words "above" and "below," in order to render the descriptions intelligible. The *Ianthina*, when swimming suspended from its float, is reversed, like a *Limnæa*, which swims by gliding with its foot at the surface of the water. Hence, when we speak of the inferior surface of the foot, we mean of the foot in its natural position; and when, in the preceding paragraph, it was said that "the foot is hollowed into a canal *beneath*," this relates to the position of the animal supposed to be erected and creeping upon the foot. For if we take the position of the animal beneath the float absolutely, this ought to be described as the superior surface. It will be remembered, therefore, that the words "above" and "below" relate not to the reversed animal, but to the animal supposed to be in the normal position of a Gasteropod.

the foot withdraws, quite gently, under water, to remain there if its operations cease, or to move forward again and recommence if its work is to be continued.

When we have counted the number of vesicles at the extremity of the float, and thoroughly observed their arrangement before the manœuvres just indicated, we see, when they have ceased, that another cell has been glued on in front of those which we had ascertained to be the furthest towards the mouth. This first fact proves incontestably that the growth of the float takes place longitudinally and at its anterior extremity. It proves also that it is the foot which manœuvres in such a manner as to add the new vesicles towards this extremity; and the process of growth is, no doubt, as follows:—The foot, first of all curled up into a cup, had, when applied to the float, a certain thickness of air between it and the latter; by secreting a layer of mucus and then spreading out, it must necessarily join this viscous layer to the rest of the float, and thus keep the air-bubble imprisoned.

We may form an idea of what takes place when we observe a garden-snail or slug creeping upon a body covered with dust: we often find, beneath the train of mucus left behind it by the animal, a bubble of air which is imprisoned between the unmoistened surface of the body and the lamella secreted by the foot. Here we have something produced, mechanically speaking, perfectly similar; but in the former case it is accomplished by design and for a particular purpose.

The mucosity is evidently insoluble in water; and as it dries in the emergent portion, it acquires a certain consistence, which has led to the supposition that it was cartilaginous.

If we admit the process of the formation of the float to be as just described (and it seems difficult to me not to regard it as true, since at each new movement of the foot we count a fresh bubble added), we may easily explain the dissidences of authors, their opinions, and most of the facts which they relate. Thus we understand why the animal, when once at the bottom of the water, is incapable of forming a new float. Most probably the *Ianthinæ* which have lost their float are fated to die, unless they be carried to the surface by some cause which I shall not attempt to imagine.

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To verify the notion which has just been put forward, it was necessary that experiments, varied in several ways, should furnish its confirmation.

Having taken an *Ianthina* upon a small iron hook and suspended it, not out of the water, but at about that depth below the surface which it occupies when it swims freely suspended

from its float, I remarked that when the first movements preceding its being placed in this position ceased, and the animal believed itself out of danger, it issued by degrees from its shell, extended its foot, and commenced the manœuvres described above. I had the satisfaction of seeing the opinion that I had formed confirmed in every point, by observing the animals in these normal conditions; for I was able to be present, with the help of patience, at the origin and formation of a float. I saw that, in proportion as one bubble was added to another, the animal became specifically lighter, and was less immersed in the water. And I ascertained that, under these circumstances, the *Ianthinæ* which could not reach the surface made vain efforts and movements to form bubbles; and when, under these circumstances, I very gently raised the shell by means of a small hook, as soon as the foot issued from the water, air was imprisoned, a bubble added to the float, and the animal began to reascend. Now, nothing of this could have taken place without the assistance which I gave it.

I have had many individuals of which the floats, being partially destroyed by storms, were insufficient to bring the body of the *Ianthina* near enough to the surface, and allowed the animals to perish floating at mid water, exactly like those which fell to the bottom of the vessels when completely deprived of aëriferous vesicles.

Dr. Coates, cited by Forbes and Hanley, and already mentioned, supposes that the young *Ianthinæ*, on issuing from the capsules suspended beneath the float, in which they passed their first embryonic period, get upon the back of the float, and then attempt the formation of the apparatus which subsequently enables them to do without their mother. This supposition, from what we have just seen, appears to be perfectly legitimate as a supposition. Nevertheless, as this matter is not proved by direct observation, we must not forget that the Gasteropods in an embryonic state have locomotive organs, which enable them to move about, and to come even to the surface of the water; for they are very active. It may be, therefore, that at the moment when the organs of locomotion bring the young *Ianthinæ* to the surface of the water, they begin to form with their foot a few bubbles containing air which serve as their first floats.

As all authors have stated, the floats of the *Ianthinæ* are delicate; they must be affected by the attacks of the numerous and voracious inhabitants of the sea, and consequently they must also be constantly repaired. It is plain, indeed, that constant secretion would either be too late for the necessities of the economy of the animal, or in advance of it, producing a too great and inconvenient flotation. Hence the restoration of

the float must be entirely subject to the will of the animal, to its appreciation, if I may so speak; and this is really the case, as it never makes use of the mucosity of its foot except when it feels its float to be insufficient, just as the spider employs the silk with which its spinnerets furnish it only when injuries have rendered its web unfit to capture the prey which is necessary for its existence.

It is unnecessary to say that a gaseous secretion is inadmissible, and that there is nothing to warrant its existence.

From all that precedes, I may justly be asked whether I have seen in my aquaria *Ianthinæ* entirely deprived of their floats reconstruct new ones. I reply that the animals did not live long enough for this; it is with them as with the spider to which I have just referred: if we destroy its web, it reconstructs this, but at the expense of its body; and if we continue without allowing it to capture a prey, if its organization does not provide itself with what is necessary to repair the losses caused by secreting silk, it is seen to die of inanition. In the same way here: the *Ianthinæ* are animals of the high sea; they find in these regions their proper food, which they did not meet with, in all probability, in my aquaria; hence they only lived a short time, exhausted by their exertions and by the want of nourishment.

In conclusion, I will remark that Cuvier's opinion, so full of reserve and doubt, cannot be maintained. The float of the *Ianthina* cannot in any way represent an operculum, or even its distant analogue.

XXXI.—*Descriptions of some new Species of Diurnal Lepidoptera in the Collection of the British Museum.* By Arthur G. Butler, F.Z.S., Assistant, Zoological Department, British Museum.

Limenitis Calidasa, n. sp.

L. Calidasa, Moore, MS.

Alæ supra fuscæ, fascia media irregulari albo-viridescente, anticarum maculas octo inæquales formante, posticarum integra, in medio latiore; area basali fascia media interrupta rubra nigro circumdata, basi fascia simili obscura; area apicali fascia submarginali rubra, maculis nigris utrinque marginata; margine postico pallido, lunulis nigris marginato.

Corpus fuscum; antennæ nigræ, rubro acuminatæ.

Alæ anticæ subtus area basali viridi, fascia media rubra a vena media partita, lineaque basali obliqua nigra; area apicali cinerea, venis apud costam rubris, linea rubra undata, maculisque nigris submarginata; fascia media velut supra nigroque utrinque marginata;