

*The Malacology of Lower Bengal and the adjoining provinces ; by  
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Under the above title I propose to record a series of papers, the special object of which is the exposition of the Molluscous fauna of Lower Bengal and of the adjoining provinces. It is not my intention to follow in these papers any systematic arrangement, but simply to bring the materials, as they are collected, to the notice of Conchologists.

At first sight it may seem that there is hardly a necessity for a series of such papers, as the Molluscous fauna of Bengal is pretty well known through the valuable researches of H. Benson, W. T. Blanford, and others. With regard to our knowledge of the shells, or the solid parts of Molluscs, this statement would deserve a fair consideration, but it is marvellous how very ignorant we are of the soft parts of the respective animals. The course of study pursued in Conchology during the last twenty years, has shewn that no systematic arrangement can be attempted without the due knowledge of the animals, even generic and specific determinations are sometimes impossible to be carried out without them. Comparative anatomy and morphology of our Molluscs are equally deficient as the principal elements.

Strictly speaking it is by no means surprising that the anatomy of our Indian Molluscs is as yet so little known. The shells are easily preserved and more or less commonly found at all times of the year. The animals on the contrary are met with only at certain seasons characterized by a large proportion of moisture in the atmosphere, which combined with the tropical heat often rapidly decomposes the animal substance, while under the knife and the needle. Besides few of our able conchologists had had the opportunity of observing many live animals, and the examination of specimens, preserved in spirit, glycerine, &c., are very easily misleading, so as to give various organs a different interpretation from that to which they are actually destined.

During the course of my papers I shall, therefore, endeavour to pay special attention to the soft parts of the animals, to the anatomical

and morphological details. Only the shells of newly discovered species will be separately figured, but of all species, as far as they can be procured, representations of the animals, of the dentition, &c., will be given. I shall feel amply rewarded, if I can see that any of my conchological friends appreciate this course of inquiry; and I will feel greatly obliged if they would favour me with live specimens of Molluscs. During the rains and in the cold weather most of the land shells will survive for 9 and 10 days in a box with a little moistened moss, a few holes being made in the box for the purpose of ventilation. If not procurable alive, specimens in spirit or glycerine\* will be also thankfully received.

I do not wish to give my papers a more extensive title, than the one quoted above, because I as yet have only the hopes to procure those specimens which are within my own reach and that of my collectors, but I trust that the area of my research and examination will gradually obtain a wider range. The first paper will be devoted to the examination of some remarkable Molluscs, for a species of which Dr. F. Buchannan 70 years ago proposed the name *Onchidium*.† These animals may be in a certain point regarded as the tropical representatives of the slugs, or *Limaces*, which are generally found only in temperate climates. Although I have numerous materials on other groups of Molluscs collected, I have given preference to this one, because the characteristics given of the genus are very deficiently known, and partially incorrectly recorded in the present leading works on Conchology. Dr. Buchannan's description of the type species, *Onchidium typhæ*, is not very clear, neither is it sufficient, and the general belief was, that the species has been lost sight altogether. Nevertheless I find that it was very well known for many years to several of our Indian Conchologists, and it is actually during the rainy season a very common species about Calcutta.

\* Glycerine does admirably for these purposes. It is occasionally advantageous to put the animal first in hot water for a few minutes, and after its death in glycerine or spirit, the animal does not shrink afterwards so much as it would when put in glycerine alive.

† An account of the *Onchidium*, a new genus of the class of Vermes, found in Bengal, by F. Buchannan, M. D., A. L. S.;—read June 5th, 1798; Transactions Linn. Society, Vol. V., 1800, p. 132.

No. I. On the genus ONCHIDIUM, with descriptions of several new species; (with plates XIV and XV.)

Order.—PULMONATA.

Family.—ONCHIDIIDÆ.

Genus.—*Onchidium*, Buchannan, 1800.

*Char.* Body oblong, entirely covered by a coriaceous, more or less tuberculated mantle, projecting at the sides and internally fleshy; foot long, narrower and little shorter than the mantle; head large, distinct; the mouth situated below, forming a longitudinal slit surrounded by thickened lips, and two, more or less, prolonged and thickened buccal appendages, to the upper edge of which are, so to say, the tentacles soldered on, being represented merely by thickened rims; superior to these are the long, retractile pedicles bearing on their tips the eyes. Two cartilaginous plates in the œsophagus are covered with a broad radula furnished with very numerous, small equally formed teeth, the central tooth being pointed and equilateral, the laterals usually somewhat smaller, almost all of equal size, slightly hooked, claw-shaped; no special upper jaw is present. Anus situated at the upper basal end of the foot; pulmonary orifice posterior to it in the mantle. The sexes are united, the common sexual opening being placed more or less close to the right of the anus, in the fold between the inner side of the mantle and the foot; a special male organ is besides situated under the right eyepedicle; it is thick, long, provided with a short flagellum; the propagation is effected by mutual reciprocal impregnation. Shell none. Habit similar to that of the *Limaces*, or rather more to that of sea slugs, as I shall endeavour to prove hereafter.

Before entering upon a description of the various species, it will be necessary to give a detailed statement of the most important and characteristic anatomical and morphological points. I select for this purpose the type species of the genus; any differences in the other species from this type can be afterwards much easier recorded, without giving a repetition of those details. In conclusion I shall allude to the genera *Onchidella* and *Peronia*, which have been considered as distinct from *Onchidium*.

The upper part of the body of all the *Onchidia* is, as stated above, always entirely covered by a more or less coriaceous mantle, the epidermis of which chiefly consists of a chitinous or horny substance, and

can be removed from it without producing a change in the colour of the animal. The surface of the mantle is generally finely granulated, but in all our species some larger tubercles are besides found, more or less numerous, and irregularly distributed on it. These larger tubercles can be protruded or retracted at will. When the animal is in a healthy state, they are generally very distinct, each of them bearing one to four jet black dots, the functions of which in the economy of the animal it is difficult to understand, but most likely the pigment which they contain, when added to the mucus secreted by the entire body, acts as a kind of defensive fluid against other animals. The mantle is amply supplied with nerves issuing from the central ganglion, but to the touch, the tubercles do not appear to be much more or less sensitive than the rest of the body; they are always retracted when they come in contact with a solid object, but soon protruded again. Sickly animals not only change colour, but the body often shrinks to less than half the original size, and all the tubercles of the surface are smoothed down, and assimilated to the mass of the mantle. The mesial portions of the mantle are usually thin, but the sides are very consistent and fleshy, the muscular tissue being solid, very tough in some of the species (*O. tigrinum*), soft, almost pulpy, in others, (*O. tenerum*). The internal fleshy part of the mantle is pure white, but the external parts, to a smaller or greater thickness, blackened, and filled with pigment cells, producing the various colours of the animal. Near the edge of the mantle, there are usually some larger cavities in the tissue, as shewn in the section of the portion of the mantle (fig. 3, plate xiv), evidently allowing for an easier motion of these extreme edges.

The foot is composed of numerous transverse muscles and is always shorter and narrower than the mantle; this varies, however, in the different species. In some the foot is only one-third, or one-fourth, of the width of the mantle, in others almost four-fifths of the same, setting aside, however, those variations which merely depend upon the position of the body. When the animal is at rest,—in a sort of contracted position,—the width of the foot is in proportion smaller, than when the animal moves about, in which case the mantle stretches out longitudinally, while the narrowness of the foot appears to be more limited by the transverse muscles.

No generic importance can, strictly speaking, be attached either to

the number and size of the pustules on the mantle, nor to the relative narrowness, or width, of the foot. This is a very important statement as regards the classification of the animals, and I shall endeavour to prove its correctness by some observations which I shall subsequently put upon record.

The head is posteriorly on either side connected with the foot by a thin membrane.

#### Anatomy of *Onchidium typhæ*.

The respective places which the digestive and generative organs occupy divide, so to say, the entire cavity of the body into two parts. Figure 2 on plate xiv represents a specimen, opened along the entire length of the centre of the mantle, the portions of which are removed a little on the sides. The albuminous string of the penis is also a little lifted up, and placed from the right to the left side, so as to allow the ganglion and the penis to become visible. All the other internal organs are in their original position; the head with the œsophagus (oe), salivary glands, (sg); alimentary canal (ac), &c. The signification of the principal other letters is as follows; pe. = pedicle; p = penis with the *vas deferens* twisted round it; and (ps) the supplementary albuminous string; ng = principal nervous ganglion; the digestive organs with the liver (l) and the anterior portion of the stomach (st), rectum (r), &c., are visible; the generative organs with the ovarium (o), testis (t), large albuminous gland (ag), receptaculum seminis (rs), &c.; ht = heart; l = lungs; g and v = the hermaphrodite genital opening, a = anus; ol = pulmonary orifice. The digestive organs, thus roughly estimated, occupy the greater portion of the front part, and the generative organs that of the hinder part of the body.

In order to understand more clearly the anatomical details, I must direct the attention to figure 5 of plate xiv. This figure represents a very large specimen of *Onchidium typhæ*; the foot has been along its anterior and posterior, and the entire left basal margin detached from the body and folded over to the left side, then the mantle has been cut in two halves and the left half (d) also removed laterally, so as to join the other half only at the pulmonary orifice. The digestive organs have been exposed in the figure on the right and the generative organs on the left side.

*Digestive organs and their appendages.*

The food first enters through the mouth which, as already stated, is surrounded by thickened, soft and grooved lips, with the œsophagus (œ), a large muscular sack of an oval shape, closed posteriorly. This sack encloses two cartilaginous plates, which are situated in a strongly muscular mass, attached to the posterior and inferior sides of the œsophagus. Sometimes, as in this particular species, these plates resemble a bivalve shell, being convex externally and concave internally; they are white, connected by a membrane below and open above. Their microscopical structure distinctly shews the formation of a cartilaginous tissue, many of the cells being of irregular shape, others granular and hardened. Externally they are covered by the tongue membrane, or radula, which is provided in its entire extent with very numerous teeth.

This radula is thus very differently formed from the narrow and long lingual ribbon of the *Prosobranchia*. Fig. 4 on plate xiv, represents the relative position of these organs. The cartilaginous plates (cp) actually only give support to the radula (ra), which is by the muscular action of the former pushed out of the mouth, scraping the organic substance in the usual way from below upwards; the food then passes in the cavity behind the plates where the salivary glands (sg) enter. At the beginning of the alimentary canal, immediately behind the cartilaginous plates, there is a small fleshy tubercle (to) which appears to act as a tongue, pressing the food down the canal every time that the œsophagus contracts. Each of the salivary glands (sg) is represented by a small, whitish, dendritic organ, connected with each other by a thin string, and by numerous threads with the hepatic mass, enveloping the anterior part of the intestines. The alimentary canal issues at the upper part of the œsophagus, lying in a special muscular cavity of the tissue of the body, it bends downwards, then passes through the hole of the principal central ganglion ring (ng) to the stomach. This consists of two, almost quite separate divisions. The first portion (pst) has the form of a double cone, pointed on either end and widened in the middle; it is soft and composed of numerous folds or partitions. On this anterior portion follows a second one, which is more elongated, consisting of three sub-divisions, being in the middle surrounded and partially divided by a very strong muscular tissue (mst). The extreme end (m) is capped by a separate

portion of the liver (l). The intestines (i) issue somewhere at the muscular bridge which connects the two portions of the stomach, being from here in their entire length enveloped in the liver which is readily recognised by the greenish colour of the hepatic cells. The length of the intestines is from 4—5 inches, the rectum (r) being much wider, and passing almost in a straight direction to the anus. Near its termination it is accompanied by two whitish, dendritic organs, (gp and pa), each of which at their posterior ends is connected with a small yellowish brown gland. The latter may represent the kidneys, and the former are probably only albuminous glands, or they may be an equivalent organ of some of the pyloric appendages or the cœca. The anus is situated at the end of the upper base of the foot, it is surrounded by ring muscles, but externally very slightly thickened.

*Onchidium typhæ*, and probably most of the other species live, on decaying wood and earth, impregnated with organic matter. I have never seen them feeding on fresh grasses. With the solid excrements always a large portion of watery liquid is given out.

#### *Generative organs.*

All the species of *Onchidia* which I have examined are hermaphrodites, not as Buchanan stated in the case of *O. typhæ*, supposing the sexes to be distinct. The generative organ occupies the posterior half of the internal cavity of the body (see fig. 2, pl. xiv), sometimes even a little more. The hermaphrodite genital pore (g and v in fig. 5) lies very close to the right of the anus; in this pore a very strong, almost cartilaginous tube, the oviduct, (or here the uterus, ov) terminates, and a short distance upwards gives off a short branch, ending in a flattened large vesicle, which usually is interpreted as the *receptaculum seminis* (rs). The contents of this organ in numerous specimens which I examined was a dark yellowish brown, rather watery substance, containing some solid bodies, resembling the spiculæ of *Spongiæ*, or those peculiar arrows connected with the copulation of *Helices*. The uterus which is only a continuation of the oviduct is, as stated above a thick, white, doubly twisted string, near the middle it is partially enveloped in a mucus secreting, foliated, pale orange gland (as in fig. 2, pl. xiv.)\* The contents of this gland is a simple granular

\* In figure 5 this gland lies to the right of the testis (t) and to the left of the receptaculum seminis (rs).

substance. It is not clear to what purpose it exists, but probably it is in some way connected with the ovarium or the testis.

The ovarium (as, in fig. 5, or in fig. 2) is of a deep yellowish colour and contains eggs only; these being of an oval form and of various sizes, according to their stages of development; the whole is attached to the uterus by a short string.—It is generally stated that in the PULMONATA, the hermaphrodite gland secretes ova and spermatozoa, but in this case I am certain that they are secreted in two different glands, the ovarium containing, as I stated, merely eggs. The testis (t) is a distinct foliated, or more or less dendritic, purely white gland, which is readily distinguished by its viscous, jelly-like substance. Under the microscope, the contents of the gland had a granular appearance, mingled with a few fat cells, and numerous long thread-like bodies,—spermatozoa. From the testis a very thin hollow string issues, accompanying the oviduct in its entire length and terminating by a special minute pore (g) in the same cavity as the oviduct. This string is evidently the beginning of the *vas deferens*, which continues externally in a groove between the foot and the mantle.

The largest portion of the generative organs are occupied by the albuminous gland (ag) which is of a soft purplish colour, consisting of very numerous follicles attached to short prolongations of the uterus. The albuminous substance has a finely granular appearance under the microscope and is very viscous, adhering to everything that comes in contact with it. It absorbs water to a large proportion swelling up readily in it.

The male copulative organ is at the front end of the body, situated more or less closely to and under the right eye-pedicle. The semen issues, as stated above, first from the genital pore (g), is then conducted in an open canal along the right side between the foot and the mantle, enters the body through a very fine pore (vdo in fig. 5), below, or on the side of, the right buccal appendage, close to the penis opening; then passes through a thin long tube (vd) which is variously twisted round the penis (p) lying on the right side of the body. This tube, the continuation of the *vas deferens* is about 5 inches long, the last inch, or so, forming the penis, which is considerably hardened and straight, situated in a somewhat wider tube and provided at its termination with a short flagellum. In many



specimens the *vas deferens* was in the terminal half of its length filled with a similar colouring fluid which I have noticed in the *receptaculum seminis*; thus it is not likely that this substance is secreted in the latter organ, but more likely is formed in the internal portion of the *vas deferens*. Close to the opening of the male genital pore, terminates the supplementary albuminous string (ps), varying from 9 to 10 inches in length. It is much thicker than the *vas deferens* and the contents is a purely white granular, moderately viscous substance. In some other species, this albuminous string is still longer and more developed.

I have only once (on the 22nd September,) observed two specimens of *Onchidium typhæ* in copulation, they were seated one behind the other, the penis enclosed in the vagina for about the length of one inch. Reciprocal impregnation at the same time, as known in *Limaces*, does apparently not take place. Buchanan's statement on this point is not clear; the error as to his believing the sexes to be divided in two animals is thus readily explained, and would have then been easily corrected, had he examined the internal organisation. But although he states that "during copulation the distinction of sexes is very evident, the penis protruding to a great length," it would appear from his previous statement to the effect that "in both, the anus and sexual organs are placed in a perforation in the under part of the tail" as if he had observed that the copulative organ were also situated posteriorly. This is undoubtedly an error, and can only be explained by the fact that the anterior and posterior end were mistaken one for the other, they being actually undistinguishable in a dorsal view when the animal is resting quietly, and has the pedicles and the head retracted, which position it actually assumes during copulation. I mention this point in particular, because it appears to have been accepted by several authors in its integrity, as recorded by Buchanan, though its correctness was rightly questioned by others. Undue importance has been attached to it, so as to support the presumed generic distinctions of *Onchidium*, *Onchidella* and *Peronia*.

The *Onchidia* in general are to all appearance oviparous, laying their eggs in damp places, either under stones or in holes near the surface of the ground, where I found in large numbers very young specimens, resembling in all external characters the full grown

animals. Direct observations as to the development of the embryos, etc. remain, however, as yet a desideratum.

*Organs of respiration and circulation.* (See fig. 5, pl. xiv).

All the *Onchidia* are pulmoniferous, the respiratory cavity occupying about one-fourth of the posterior length of the body. This cavity is situated dorsally immediately under the mantle, its internal walls being folded and fitted out with a soft whitish largely cellular and cavernous epithelium, the lungs; it is anteriorly closed on the left and open on the right side, and the former half is somewhat smaller than the latter. The respiratory opening is a round hole, situated on the lower side at, or near, the end of the mantle; it is surrounded by strong concentric muscles and has occasionally a swollen margin, which can be expanded or contracted at will, sometimes also forming a retractile tube.

The cardiac cavity lies on the right side about two-fifths distant from the posterior end, and in front of the respective larger half of the lungs. It is very muscular and encloses the heart, which is represented by a small, reddish, oval capsule, thicker posteriorly than anteriorly. The arterial blood enters the heart from behind in which point,—save that they have lungs,—the ONCHIDIDÆ perfectly agree with the NUDIBRANCHIATA of the OPISTHBRANCHIA, with which they have so much common in the general form of the body. From the heart issues in front only one thick artery, being at the beginning attached to the wall of the mantle by numerous very thin muscles. A short distance from its issue, it divides in two branches, one supplying the reproductive organs and the other the digestive system. The latter branch again divides before entering that system, one portion being reserved for the digestive organs, and the other supplying the head; this portion of the artery, accompanying the alimentary canal, passes through the large ganglion. From all the internal organs, numerous very thin threads issue, connecting them with the mantle and the foot; some of these threads are no doubt blood-vessels, and others of a muscular and nervous character. The venous blood appears to be conducted to the lungs by an open capillary system, at least I did not observe special vessels for that purpose. A very large number of capillary tubes, connects the upper frontal portion of the pulmonary cavity

with the intestinal and the generative organs. The arterial blood is white, and the corpuscles very minute and of an oval shape.

*Nervous system and organs of sensation.* (See fig. 5, pl. xiv.)

The principal ganglion which is a thick white ring, lies immediately behind the head; a portion of the aorta and the alimentary canal passing through it. This ganglion gives up numerous branches laterally to the base of the eye-pedicles, the tentacular rims and buccal appendages. One thick branch, subsequently dividing, issues below and supplies the head, some of its small nervous threads uniting into a small ganglion between the oral appendages. Another very thick branch also issues from the central ganglion below, and is directed backwards, accompanying the alimentary canal. It divides at the digestive organs in two branches, one supplying these and the other the generative organs. Besides these, there issue from the central ganglion five long threads on each side, two giving the requisite number of nerves to the foot and four (or 8 altogether) to the mantle. They appear, however, to be connected with the other nervous branches of the intestines by numerous very fine threads.

From the generic characteristic which I have previously given, it will be seen that I have made the distinction between eye-pedicles and tentacles. This verbal distinction is, I believe, in most of the Gastropods, an essential one and it is, for instance, not correct to speak in the HELICIDÆ of four tentacles, for they do not all serve the same purposes. Strictly speaking, there is only one pair of each, two tentacles and two pedicles. The presence of only one pair of tentacles,—actually the eye-pedicles,—has been pronounced as a peculiarity of the *Onchidia* and was used as an important distinction from the genus *Vaginulus*. The *Onchidia* possess, however, beside the pair of prolonged pedicles, a pair of true tentacles, which appear as thickened rims on the upper surface of the buccal appendages. Thus the distinction from *Vaginulus*, which has the tentacles free and bilobed, is in this point only a gradual one of development.

When the mantle of an *Onchidium* is dorsally cut open, and the internal organs exposed, the dark pedicles are seen to be attached laterally to the mantle, reaching with their bases beyond the head

(see *pe* in fig. 5, pl. xiv ; and the figure between 1 and 1 a). The base of each is flattened, white, cartilaginous, intimately connected with the muscular tissue of the mantle in this place ; above the base numerous nerves enter to it, and the trunk of the pedicle becomes hollow, more cylindrical and soft. The small, black eye is situated eccentrically near the tip, which is pointed, angularly bent and attached by a strong muscle to the internal side of the outer skin (*tp*, in fig. 5) of each pedicle. The muscle then bends backward, and joins the trunk of the pedicle about one-third or one-fourth of the length distant from the tip. The external cover of the pedicle, is formed by the soft skin, in the fold between the head and the mantle.

This organisation of the pedicles fully agrees with that of the HELICIDÆ in general, and makes it perfectly clear that the idea as to the non-retractibility of the pedicles in *Onchidium* cannot be retained. In all the species of *Onchidium*, of which I have observed live animals, I found the pedicles to be almost *entirely* retractile, but it is not usual that an animal, unless strongly irritated, does retract them fully, because the mantle which covers the head gives, as a rule, sufficient protection to them. Whenever specimens are, however, put in spirit, it is a common case that the strongly muscular mantle and the disc of the foot shrink more rapidly than the soft skin between them, and the head with its pedicles, and tentacles and buccal appendages is consequently easily pressed out. Thus the examination of specimens in spirit, evidently seems to have given ground to the idea, that the pedicles in *Onchidium* are not retractile. This observation appears to have been supported by the existence of two indentations, which are formed in the edge of the mantle above the pedicles, when the animal moves about. Occasionally these indentations, or grooves, are traceable for some time even after the death of the animal, but they are by no means permanent, and constantly change in live specimens. Whenever the animal retracts its head, and covers it from above with the mantle, and from below with the front edge of the foot, the indentations perfectly disappear in each such case.

The true tentacles are, as already noticed, in their entire length grown to the upper surface of the buccal appendages, and generally are with their external terminations connected with the extreme

outer edges of these. Both the tentacles and the front edges of the appendages are, as a rule, of a yellowish green colour and somewhat thickened; the former more so, being provided with numerous nerves, which issue directly from the anterior edge of the central ganglion, lying at the base of the head, and are a portion of those nerves which supply the lips. During the motion of the animal the tentacles are always moved in front of the edges of the buccal appendages, and when each of them are successively touched with a solid object, it will be observed, that the animal much easier responds to the former than to the latter; the first being the more sensitive organ.

#### *Habits.*

Dr. Buchannan says that he found *Onchidium typhæ* always on *Typha elephantina*. This plant is at present not nearly so common as the allied species, *Typha angustifolia*. However, that is no proof that both the species were formerly not more common than they are at present. No doubt, seventy years ago, swampy grounds, overgrown with vegetation, were more extensive about Calcutta, than they are now when our worthy municipality takes such good care to clear everything away! In places, however, (along the Eastern Bengal and the South Eastern and Calcutta railway lines, and in Alipore) where both species of *Typha* grow abundantly I have not been successful in procuring any *Onchidia* on the plants themselves. As a rule, these animals live, like *Limaces*, in damp places, generally close to tanks or ditches, especially those which are supplied during high tide with brackish water. They also seem to be common on the sea-shore, preferring the damp insular climate to that of large continents. Sometimes they are found in places which come under the influence of high tides. They either crawl about on the high ground between the vegetation, or on old wood and stones, etc. During the rainy season, they are naturally most numerous. When kept in a vessel with water, they often go voluntarily into it and remain for some time there, (as I have observed in *Onchidium tigrinum* and *pallidum*) until they are obliged to appear on the surface for the sake of breathing. In this point they fully agree with the species of *Scarabus*, and other estuary shells. *Onchidium tigrinum* sometimes voluntarily remained for 24 hours in brackish water, a small air-bubble being visible near its pulmonary orifice; *Onchidium typhæ*

does, however, not stand a long immersion in tank water, and in brackish water it dies much sooner. *Onchidium tenerum* burrows in soft mud, and appears on the surface only in warm weather after the rain. Lesson says of *Ochidium ferrugineum*, that it is a truly marine species, living as a rule, several feet below the surface of the water.

*Relations and probable identity of Onchidium with Onchidella and Peronia.*

I have given the anatomy of the type species, *Onchidium typhae*, in detail, because it must form the basis of further comparison with other species, which have been believed to belong to distinct generic types. Cuvier, in his admirable "Memoires, p. serv. l'histoire et l'anatomie des Mollusques," 1817, gave a very good account\* of the anatomy of *Onchidium Peronii* from Mauritius, and drew attention to the existence of a small British species, *Onch. celticum*. Lesson, described several species in the "Voyage de la Coquille;" *O. granulosum*, *marmoratum*, *ater et ferrugineum*. A very good general figure and correct drawings of the different external organs are given by Savigny of the so-called *Peronia verruculata*, from the red sea, in the French Scientific Expedition to Egypt, (Moll. Pl. III). Quoy and Gaimard, in the "Voyage de l'Astrolabe" (Moll. Pl. XV) figure five species, but in none of them the position of the genital pores has been noticed. No details of the anatomy are given. Gray refers the largely tuberculated species, like *O. punctatum* and *Tongensis* to *Peronia*, the granular ones, like *O. patelloide* and *incisum* to *Onchidella*. Several other species of the same group of Molluscs were described by other authors from Mauritius, the Phillipines, etc. Keferstein lately (Zeitschrift für wiss. Zoologie, Bd. XV, 1864, p. 76-85) published some notes on *Janella*, *Aneitea*, and allied forms, but unfortunately I have not as yet been able to procure this paper. However, as far as the forms which interest us here specially are concerned there is sufficient for our purpose extracted in Bronn's "Klassen und Ordnungen des Thierreiches," Vol. III. On plate 105 a good side view is given of *Peronia verruculata*, shewing the correct position of the pulmonary,

\* The figures are reversely drawn, for instance in figures 2 and 5 the external *vas deferens* appears on the left side, and equally so the heart in figure 5, which represents an upper view.

anal and genital openings. Figure 2 on the same plate represents the genital organs, but does not seem to be very correct; in any case it is not sufficiently clear.

The reason,—that forms which appeared to such exact observers, as Cuvier, Lesson, Quoy and Gaimard, in all external characters to be generically identical with Buchanan's *Onchidium*, but which were by others separated as distinct genera,—evidently lies in the insufficient, and partially incorrect account which the last named author gave of his newly proposed genus, though very probably the desire of man, to discover *new* forms, had also something to do with it. The consequence, in short, was that the name *Onchidium* was reserved for the type species *Onchidium typhæ*, and other forms which were better known, than this, were separated into distinct genera. Now, when all the anatomical details of the type species are before us, we shall be able to draw a more accurate comparison between the same and other species.

Cuvier, as I have already stated, gave an excellent account of the anatomy of a Mauritian species which he called *O. Peronii*. Blainville in the 32nd vol. of the Dict. de scienc. nat. p. 280, proposed for this species the name *Peronia Mauritiana*,\* as the type of a new genus. When we compare externally the position of the anus, the hermaphrodite and male genital pores, and the pulmonary orifice, then the form of the head and the eye-pedicles &c., of Cuvier's original drawings, with those given of *Onchidium typhæ*, it will be readily seen that no essential distinction between them can be recorded. Even the granulation of the mantle is not much stronger, but it is said that the tubercles form (probably during life) short tufts. Referring to the other anatomical drawings, it must be admitted that they shew a perfect identity with those of *Onchidium typhæ*, if we set aside some minute details which are not perfectly clear in Cuvier's figure, and which are easily explained, when we consider that Cuvier had only specimens preserved in spirit for examination, and that many of those minute organs may consequently not have been preserved. Keferstein's and Savigny's figures of *O. Peronii* or *verruculatum* also fully agree with the typical *Onchidium*, as far as internal characters are concerned; the only difference being again the presence of tufts in place of simple

\* The rule, that specific names, unless pre-occupied, must not be changed, ought always to be observed.

granules. I had myself no opportunity of examining any of the forms called *Peronia*, but from the numerous variations in the external appearance of the tubercles, which I have observed in our species (as for instance in *O. tenerum*) I cannot perceive how this character could be considered as of any generic value. Besides that, the authors who acknowledge, upon this ground, the generic distinction of *Peronia*, are far from consistent in dealing with the question, for they refer to *Onchidella* species which are either smooth or granular, some of them being very coarsely granular, and even spinous above. Surely, the distinction between a smooth and granular or tubercular surface is greater than that between the latter and one in which the tubercles bear two or three points in place of only one. The presence of two or three black dots on some of the large tubercles of *Onchidium typhæ* appears to me to be fully equivalent to some of the tufts observed in *Onchidium Peronii*, and very likely in very old specimens these black dots may become pediculated, for I have myself observed them each raised independently from the other. I must here specially call attention to some of the variations in the mantle surface of *Onch. tenerum*, described towards the end of this paper.

Gray proposed for Lesson's species, *Onch. granulosum*, the name *Onchidella*, and referred to this presumed genus all the granular or smooth species, except *Onchidium typhæ*. In what the distinction of *Onchidium* and *Onchidella* ought to consist, I entirely fail to perceive. H. and A. Adams in their "Genera of Shells," II. p. 232, state that the latter differs from the former in having the buccal appendages *lobate*, but then they say exactly the same of *Onchidium*. I am not quite certain about the meaning of the word *lobate* with regard to the buccal appendages, but I think it can only refer to the thickened rims, which I explained as the tentacles and which, with reference to the front edges of the appendages, may be called *lobes*. Wherefrom H. and A. Adams derived the statement regarding the position of the pulmonary orifice "at the right side under the mantle," does not appear evident.

Lesson's figures of the ventral views of *Onch. granulosum* and *marmoratum* do not in the least support any generic distinction among the species described as *Onchidium*. In the former the anal and the respiratory orifices are marked in their proper



places, and the correct position of the sexual opening is indicated by the first portion of the external vas deferens. In the view of *O. marmoratum*, the vas deferens begins at the place where the pulmonary orifice is situated, which is no doubt a small error. None of the other figured species which have been referred to *Onchidella*, appear to me to add anything in support of a generic distinction, and thus I think that a very strong reason exists to withdraw both the generic names, *Peronia* and *Onchidella*, and refer the respective species to *Onchidium*.

The only other closely allied genus which belongs to the family ONCHIDIIDÆ is *Vaginulus* (*Veronicella* apud H. and A. Adams). Mr. W. Theobald, Junr., described one species from Burma, *V. Birmanicus*, and my friend, Mr. G. Nevill, lately obtained near Calcutta two specimens which appear to belong to the same species. I hope to return to this subject as soon as I am able to procure better live specimens of our own and the Burmese forms.

*Description of Bengal species.*

**1. *Onchidium typhæ*, Buch., 1800. Pl. xiv, Figs. 1—5.**

Body during the motion of the animal much elongated and narrow, rather convex, anteriorly and posteriorly obtusely rounded; mantle above greenish, of various shades, covered with very numerous smaller and larger tubercles, which are nearly equally distributed over the whole upper surface. The smaller tubercles vary a little in their size, but the larger ones have pretty nearly the same dimensions, those about the centre of the back being slightly higher than others. These tubercles are at their bases and at the sides somewhat darker than the body, the top being, however, usually paler and provided with from 1—4 jet-black dots. None of the tubercles are permanent, they can be, in the live animal, always retracted in the skin which is rather tough.

The head is of considerable size, dark greyish, in front covered with numerous, rather large whitish warts; the buccal appendages are blackish, with their front edges and the tentacles yellowish green; the pedicles are thick, concentrically roughly wrinkled, slightly bluish, transparent at their base, greenish for the greater part of their length, pale near the tips, where the small black eyes are situated. The

mantle is below blackish, with a grey or brown tint, pale at the margins; the foot is greenish yellow, the dark colour of the digestive and the pale reddish colour of the generative organs shining through the skin. The width of the foot, which is little shorter than the mantle, amounts to about  $\frac{3}{5}$ ths of the width of the latter, but when the animal creeps about, it may be estimated at  $\frac{4}{5}$ th of that width; it is truncate in front and rounded posteriorly. The anus lies at the upper basal end of the foot, the opening being small and not distinct, covered by the terminal free edge of the foot. The pulmonary orifice is situated immediately beyond the anus, its internal margin is smooth. The hermaphrodite genital pore is a longitudinal slit, surrounded by swollen lips, situated about  $\frac{1}{10}$ th of an inch distant to the right of the anus. The external vas deferens, in the fold between the foot and the mantle, is marked as a white groove, and terminates in a minute pore below the right buccal appendage. The male genital pore lies in front, below the right pedicle. The dentition has been described previously (see p. 91, pl. xiv, fig. 6a).

The length of large specimens is about  $2\frac{1}{2}$  inches, and the width varies from one-third to one-fourth of it, when the animal moves about in its ordinary way. The usual length of pedicles is about half an inch. Old specimens, when fresh caught, very often secrete from the smooth lower portion of the mantle, a deep carmine red, gelatinous substance, of a distinct alkaline character. The substance coagulates in spirit, but is partially dissolved by, or is at least made thinner in, glycerine.

I have already mentioned, that this species is the commonest, and as yet the only one which was found near Calcutta. It is seen crawling about on old bricks, in ditches on the maidan, about the fort, along the Tollis-nullah (canal), and locally also on the banks of the Hooghly.

## 2.—*Onchidium pallidum*, *Stol.*, Pl. xv, Fig. 1.

Body elongated, moderately elevated, rounded anteriorly and posteriorly, generally covered with copious mucus. The mantle above is pale yellowish white, with a central, blackish, longitudinal stripe, commencing above the head, and extending posteriorly to about  $\frac{3}{4}$ th of the length of the body. It is accompanied on either side by a pale yellowish or greyish stripe, and the interspaces between these and the central stripe, are somewhat darker than the general colour of the

body. The entire surface is almost equally granular, with a small number of more or less regularly distributed larger tubercles, each provided with one, seldom two black dots. The larger tubercles were in one specimen arranged in two longitudinal rows on either side of the dorsal stripe, but in other specimens, they were irregularly placed. The black central stripe is widest in the middle, with a pale spot in the centre in which are situated three black dots; these being only observable in large specimens. The edges of the mantle are slightly thickened; its colour below being of the same, uniform, pale yellowish white hue, as above. The foot is obtusely pointed posteriorly and truncate in front; it is greyish yellow, varying in tints according to its expansion and consequent transparency; the colour of the internal organs is traceable through it.

The head and eye-pedicles are dark, with a distinct greenish tinge; the mantle and the buccal appendages paler; the front edges of the latter and the tentacles pale yellowish green. The length of the pedicles is generally less than half an inch, and they are somewhat thinner than in the previous species; the eyes are black.

The anus lies at the end of the foot; the pulmonary orifice just behind it, being rather small and surrounded by thickened margins. The hermaphrodite genital pore lies to the right, quite close to the anus; the external vas deferens enters the body on the side below the right buccal appendage, and the penis opening is situated in front, below the right pedicle. Young specimens are paler in colour than old ones, and the dorsal stripe becomes occasionally rather indistinct.

The disposition of the internal organs entirely agrees with the type species, *Onchidium typhæ*. The internal vas deferens is fully four inches long; the supplementary albuminous string, near the penis, is about 5 inches long, much shorter than in the previous species, but thicker in front; the liver at the end of the stomach is a large, dendritic gland; the receptaculum seminis is very large and folded; uterus thick and twisted, and like the small albuminous gland and the testis pure white; the large albuminous gland is purple or rose-coloured, the follicles being filled with a granular substance, which has the appearance of undeveloped eggs. The ovarium is deep yellow, containing large oval eggs. The cardiac cavity extends to nearly half the length of the body, but the heart itself

is only about  $\frac{2}{7}$ th of the length, distant from the posterior end. The penis is about  $\frac{8}{10}$ th of an inch long, thick and strongly constricted near the end, the flagellum being very short.

The dentition (fig. 1d) is similar to that of the last species, the lateral teeth are rounded at the base with one large and one small incurved denticle. I counted about 150 cross series and about 500 teeth in each the formula thus being 250-1-250.

The finely granular mantle with few scattered larger tubercles readily distinguish this species from the previous, and the large quantity of mucus which it secretes, has not been observed in any of the other forms. The narrower form and greater convexity of the body are equally characteristic distinctions between the present species and *O. tigrinum*, n sp.

The species was found at Port Canning, and appears to be rare. I first obtained two large specimens through my friend G. Nevill. Both had in front on the right side a small portion of the edge of the foot detached (see fig. 1a), just on the place where the external vas deferens turns towards the buccal appendages. This detached portion had exactly the same structure as the rest of the foot disc, but whether it is an accidental formation, or a normal one, assisting during the act of copulation, I am not in a position to ascertain at the present. In several small specimens which I subsequently obtained myself on the banks of the Mutlah river, that particular detached piece was entirely wanting.

### 3.—*Onchidium tigrinum*, *Stol.*, Pl. xv, Fig. 2.

Body large, ovate, depressed; mantle strongly coriaceous, hardened, provided with sharp edges. The upper surface is entirely covered with small granules, between which more or less numerous large elongated tubercles are interspersed. Specimens of different sizes vary in this point a great deal; when young the tubercles are equally distributed between the granules, being three or four times as large, and each bearing a black dot at the tip, but being pale at the base. Old specimens have either two or three irregular rows of large elongated tubercles on each side of the back, or the larger tubercles are more numerous, more equally distributed and spinulose, so as to give the surface a very rough appearance. The latter stage is met with only in quite

fresh and very large specimens; when they are kept for only a short time, all the fine spines are retracted in the mantle.

The colour is above pale green with numerous blackish, irregular spots, which are generally more numerous about the centre of the back and at the edges of the mantle, than between both. Young specimens are more uniformly coloured. In the old ones, the green colour is sometimes rather dark, so as to make the spots less conspicuous; in others there is a distinct blackish green irregular stripe along the centre of the back, of about the same length as the foot; two similar blackish stripes originate one behind each of the pedicles, running a short distance from it more or less parallel to the dorsal stripe, till all three join near the posterior end. Both the central and the lateral stripes are not continuous, they are moreover formed by the spots becoming more or less confluent. Young specimens have the mantle below uniform, light bluish with very numerous and minute white dots; large ones have occasionally a number of dark green or rusty, more or less confluent spots along the lateral margins, and the general colour is paler. The foot is comparatively narrow, about one-third of the width of the body and when contracted about one-fourth only; it is of a uniform dark bluish grey colour, sub-truncate anteriorly and rounded or obtusely pointed posteriorly, with the edges free and sharpened all round.

The head and the pedicles are dark green, the latter far apart, thick at the base, very thin in the middle, with slightly thickened tips which bear the black eyes at their upper surface. The buccal appendages are of moderate size, blackish, with greenish grey front edges, and the tentacular rims yellowish green. The male genital pore is very distinct, situated in front at the base of the right pedicle; the anus and the pulmonary orifice are normal, the hermaphrodite opening about  $\frac{1}{4}$ th of an inch distant to the right of the anus, elongated, and surrounded with swollen lips; the external vas deferens enters the body below the right buccal appendage, but very close to the lips of the mouth, passing obliquely through the tissue towards the male genital pore.

All the internal organs agree with the type species. The ovarium is small, orange yellow; the testis, and its supplementary gland, white, the albuminous gland and the uterus pale

yellowish white. The receptaculum seminis is a comparatively very small globular capsule, the oviduct being, however, very strong, almost horny; the portion of the liver covering the end of the stomach is cup-shaped and small; the intestines and the rest of the liver normal; the penis above an inch long, with a setous flagellum; the internal vas deferens is about 5 inches, and its supplementary albuminous string about 8 inches long, almost equally thin throughout. The pulmonary cavity is large with numerous cross-folds, the lungs yellowish. The heart is small, white, the aorta at the beginning not much narrower, the thicker branch going to the digestive organs.

The radula is particularly narrow in this species, but the teeth are very similar to those of *Onch. typhæ*, the laterals being only a little larger.

This species is rather common along the banks of the Mutlah at Port Canning, it is generally seen creeping about on old wood. It survives a long immersion in brackish water, but shrinks and soon dies in sweet water. I often found it in holes or at the roots of bushes on the bank of the river during low water; when the water rose the specimens must have been fully for 8 hours submerged. The largest specimen, measured, was two inches long, and about the middle  $1\frac{2}{10}$  of an inch broad.

The broad, depressed form of the body, the narrow foot, thin eye-pedicles and the solid coriaceous structure of the mantle, readily distinguish this species from others.

#### 4.—*Onchidium tenerum*, *Stol.*, Pl. xv, Fig. 3.

The general form of the body is oval, more or less elongated, but very high, it is remarkably soft, almost pulpy in fresh caught specimens, always enveloped in a thin layer of secreted mucus. The ground colour of the upper surface of the mantle is greenish grey, irregularly mottled and spotted with dark. Two obtusely elevated, somewhat undulating and pale coloured, ridges run from the edges of the mantle above the eye-pedicles posteriorly near to the end, enclosing a central area of the back, in which a number of very large oval tubercles are situated. These are of a greenish colour, covered with smaller warts, their tips being yellowish, and each of them provided with from 1—3 black dots. Full grown specimens have besides a row of similar large tubercles running externally and parallel to the ridges

which enclose the central dorsal area. The entire mantle is more or less finely granular. All the tubercles are much less developed in young specimens, and even in old ones their form constantly changes, on account of the softness of the body, in which they can be entirely retracted, making the mantle to appear uniformly convex. Young and half grown specimens generally have on the external side of the dorsal ridges, two or three of the blackish spots larger, separated by oval pale orange spots which sometimes are partially confluent, forming longitudinal stripes, the orange colour also partially extending on the ridges themselves.

The mantle below is uniform pale greenish grey, with very minute and numerous white dots, the same being also traceable on the sides of the foot. The latter is blackish green, little shorter than the mantle, obtuse or slightly rounded in front, pointed at the posterior termination when free, but when the animal moves about on a flat surface, it appears rounded. The width of the foot is on an average  $\frac{3}{4}$ th of that of the body, occasionally somewhat less. The head is very large, greenish, covered in front with numerous ashy warts: the buccal appendages laterally widely expanded, with the front edges slightly swollen, the tentacular rims above them being very thin, and of an ashy grey colour. The eye-pedicles are stout at the base, when extended about half an inch long, slightly warty, concentrically wrinkled, with the tips distinctly swollen, globular, pale yellowish or reddish, bearing the black eyes almost centrally situated in a lighter transverse fold. The lips of the mouth are whitish, strongly thickened and folded. The anus is as usually placed at the upper terminal base of the foot; the pulmonary orifice is removed from it and close to the posterior end of the mantle; it is large, surrounded by a strong swollen margin, internally white, with 8—10 small tubercles, which continue interiorly as short ridges. The hermaphrodite pore is also somewhat removed from the anus, about half an inch distant from it to the right, but situated as in all other *Onchidia* in the fold between the mantle and the foot. The external vas deferens is a distinct narrow groove, entering the body at the outer base of the right oral appendage, although it seems to continue below the mouth, issuing internally quite close to the penis opening. The penis pore itself is large, placed laterally below the right eye-pedicle.

The internal organisation does not essentially differ from the type. The oesophagus is comparatively small, the alimentary canal rather long and thick; the liver extensive and deep greenish; stomach very muscular and large. The internal vas deferens is very thin, yellow, about three inches long, and twisted round the penis which is about  $\frac{8}{10}$ th of an inch long, very thick, but otherwise not offering any distinctions. Its supplementary albuminous string is thick, white, and at least 12 inches long, it almost occupies one-third of the body cavity just behind the head. The hermaphrodite organ is not very extensive, the large albuminous gland of a purplish colour; ovarium deep, yellow; testis white, small albuminous gland yellowish white; the vas deferens, issuing from the testis, is very thin, accompanying the strong and thick oviduct; the receptaculum seminis is represented by a small, oval, dark coloured gland, closely attached to the oviduct.

The nervous ganglion behind the oesophagus is particularly large, sending numerous branches in all directions. The dentition is also similar to the other species, the centrals have a very small point, and the laterals form distinct hooks with an upright point at the end.

The softness of the body, its great height, the peculiarly formed tubercles of the mantle, and the situation of the pulmonary, hermaphrodite and male genital openings, are the characteristic distinctions of this species.

It has been found, at the end of the rainy season,—in September and October,—on the banks of the Mutlah river at Port Canning, but appears to be rare. Its habits are peculiar; it burrows in mud, sometimes several inches deep, and appears on the surface merely after, or during, the rain of a warm day. This evidently accounts for the softness of the body. A few specimens which I kept in a glass instantly burrowed in the soft earth, lying in holes in an oblique or perpendicular position with the posterior tip of the mantle, where the pulmonary orifice is situated, exposed so as to permit free access of air. They sometimes did not appear on the surface for many days, except when covered up and then placed in the sun.



*Explanation of letters in Plates XIV and XV.*

- æ.*—œsophagus.  
*ac.*—alimentary canal.  
*ps.*—supplementary albuminous gland of the penis.  
*l.*—liver.  
*r.*—rectum.  
*t.* (or *ts*) testis.  
*o.* (or *as* in fig. 5) ovarium.  
*p.*—penis.  
*pp.*—penis opening.  
*sg.*—salivary glands.  
*pe.*—eye-pedicle.  
*tt.*—tentacle, except in fig. 1a, of Pl. XIV, being = buccal  
 appendage.  
*i.*—intestine.  
*pst.*—first portion of the stomach.  
*st.*—middle portion of the stomach.  
*mst.*—muscular, middle part of the same.  
*m.*—terminal part of the same.  
*ag.*—albuminous gland of the generative organs.  
*as.*—in fig. 2, albuminous gland of the testis.  
*ht.*—heart.  
*rs.*—receptaculum seminis.  
*gp.* and *pa.*—supplementary glands (kidneys, &c.?) of the rectum.  
*g o.* or *g v.*—hermaphrodite genital opening.  
*a.*—(in figs. 2 and 5) anus.  
*ol.*—pulmonary orifice.  
*l.*—lungs.  
*rm.*—retractile muscle.  
*n.*—nerves.  
*ng.*—chief ganglion.  
*dn.*—nerve of the digestive organs.  
*bs.*—base.  
*cp.*—cartilaginous plates supporting the radula.  
*to.*—tongue.  
*ra.*—radula.

go. (in fig. 1. c) middle genital pore.

f.—foot.

d.—dorsal part of the mantle.

vd.—vas deferens.

vdo.—opening by which the external vas deferens enters the body.

ba, in fig. 5.—buccal appendage.

tp.—external covering of the eye-pedicle.

ov.—oviduct.

#### Pl. XIV.

Fig. 1, 1 a, 1 b, 1 c, dorsal, ventral, side and front views of *Onch. typhæ*; the figure between 1 and 1 a, represents the eye-pedicle, isolated and enlarged.

Fig. 2. A large specimen of *Onch. typhæ*, cut open along the centre of the back, the internal organs being exposed.

Fig. 3. A small portion of the edge of the mantle showing the internal cavities.

Fig. 4. Œsophagus, cut open, with the radula, salivary glands, &c.

Fig. 5. Internal organisation of *Onch. typhæ*.

Fig. 6, radula, 6 a, central and a few lateral teeth, 6 b, side view of the central, and 6 c side view of the lateral tooth; all greatly enlarged.

#### Pl. XV.

Fig. 1, and 1 a, dorsal, and ventral, views of *O. pallidum*; 1 b, radula, 1 d, central and lateral teeth, 1 e, side view of a lateral tooth;.

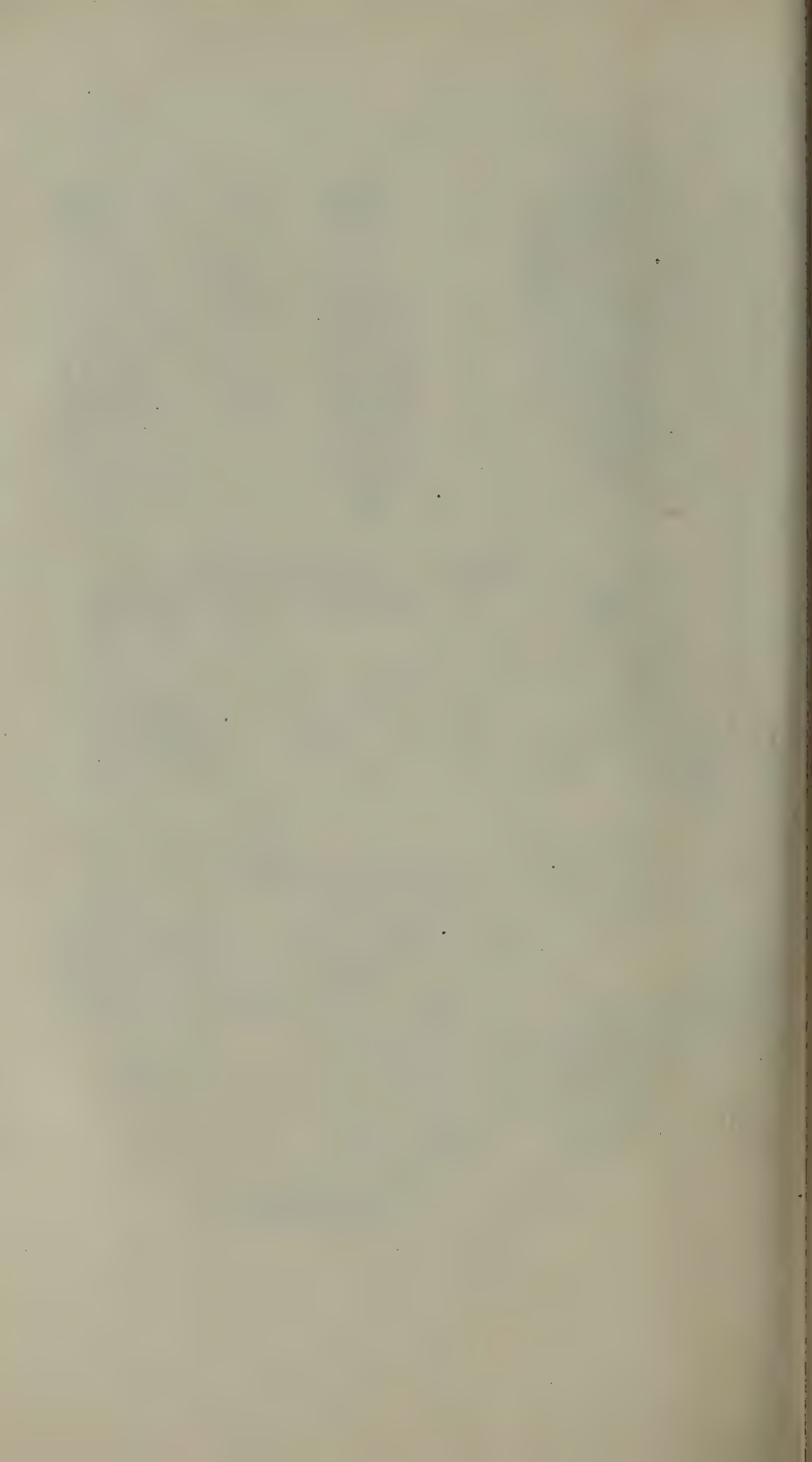
Fig. 2, 2 a, 2 b, dorsal, side, and ventral, views of *O. tigrinum*; 2 c, radula; 2 d, central and lateral teeth; 2 e, side view of a central, 2 f, side view of a lateral tooth.

Fig. 3, 3 a, 3 b, 3 g, dorsal, ventral, side, and front, views of *O. tenerum*; 3 c, radula, 3 d, central and lateral teeth, 3 e, side view of a central, 3 f, side and front views of a lateral tooth.

N. B.—The figures of the teeth are in all cases enlarged.









1. *Onch. pallidam*; 2. *Onch. tigrinum*; 3. *Onch. tenerum*.

Calcutta

