

MATERIALS TOWARD A MONOGRAPH OF THE GADINIIDÆ.

BY W. H. DALL, SMITHSONIAN INSTITUTION.

The genus *Gadinia* was instituted by Gray in 1824, for the *Patella afra* of Gmelin. In 1840 he instituted for it a special family. In his early publications on the subject, he rightly placed it near *Siphonaria* in his classification. Afterwards, misled by the erroneous description of Philippi, he referred it to the *Cervicobranchiata*, with *Tectura* and *Scurria* which have the gills over the neck, and *Lepeta* which has no gills. Most other authors have followed Gray.

The Messrs. Adams combine in the sub-order *Edriopthalma* the *Chitonidæ*, the *Dentaliidæ*, *Fissurellidæ*, *Tecturidæ*, *Lepetidæ* and *Gadiniidæ*, thus reaching a climax of confusion rarely equalled. Chenu, as usual, follows the Messrs. Adams, but unites a fossil genus (whose affinities are clearly with *Emarginula*, etc.) with *Gadinia* in the *Gadiniidæ*.

Keferstein, with a singular misapprehension of its affinities, places *Gadinia* in the *Acmaeidæ* and refers it to the *Tænioglossa*.

A more thorough examination of the soft parts than that afforded by the single specimen of Dr. Philippi, shows that the first conclusion of Dr. Gray was much nearer the truth than any subsequent references.

It is a true pulmonate, breathing air by means of a lung and unprovided with gills of any kind. The anatomy shows affinities with the *Auriculidæ*, and the dentition has relations with that family, but more strongly with that of the *Siphonariidæ*.

Order PULMONATA.

Sub-order BASSOMATOPHORA.

Family GADINIIDÆ, Gray.

Genus GADINIA.

Syn. *Gadinia*, Gray, Tilloch's (London) Philos. Mag. lxiii, 1824, pp. 274--277. Isis, von Oken, Heft v, col. 460, 1834.
Mouretia, Sby. (nec Gray), Proc. Zool. Soc. 1835, p. 6.

Muretia, D'Orb., Voy. Amer. Meridionale, v, pp. 470, 682 (pars).

Siphonaria, D'Orbigny (non Sby.), Ibid. pp. 470, 682, 741.

Clypeus, Scacchi (non Brod.), Osserv. Zool. 1833.

Gardinia, Pictet, Traite de Paleon. vol. iii, p. 293, 1855. (err. typog.)

Rowellia, Cooper, Proc. Cal. Acad. Nat. Sci. 1865, p. 188. (= *Gadinia* jun.)

Gadinia, H. & A. Adams, Gen. Rec. Moll. i, p. 463. Chenu, Man. de Conchyl. i, p. 375, et auctores omnes nov. q. v.

Pileopsis (sp.), Payr, (non Lam.), Catal. 1836.

Lepas (sp), Adanson, Hist. Nat. du Senegal, 1757, p. 33.

Patella (sp), of the older authors.

Testa univalvis, non symmetrica, oblique conica; vertice obtuso, subpostico apertura suborbiculata, irregularis; cavitas simplex, sulco in latere dextro, prope limbum anticum impressionis muscularis; impressionis muscularis elongata arcuata submarginalis. (Gray.)

Animal pulmone distincto præditum, branchiis nullis; rostro bifido, infundibulato.

Type.

GADINIA AFRA, Gray.

Patella afra, Gmelin, 3715. Dillwyn, Rec. Shells ii. 1046. Hanley's Wood's Index Testac. pl. xxxvii. fig. 65a.

Gadinia afra, Gray, Tilloch's (London) Phil. Mag. lxiii, 1824, pp. 274, 277. Isis, von Oken, Heft. v, col. 460, 1834. H. and A. Adams, Gen. Rec. Moll. i, p. 463, vol. iii, pl. lii, fig. 8, a. Chenu, Man. de Conchyl, vol. i, p. 375, fig. 2818.

Lepas gadin, Adanson, Hist. Nat. du Senegal, (Genus *Lepas*, species "*Le Gadin*"), p. 33, pl. ii, fig. 4.

G. afra testa oblique conica, alba, radiatim striato-costata, subsquamosa, vertice sublævi, marginibus crenulatis.

Hab. West coast of Africa.

This is the typical species. The name of the genus is derived from Adanson's trivial name. He found it on the rocks of the island of Goree and at Cape Manuel on the adjacent coast of Africa. He says they were particularly abundant from January until May. At that time they may change their station for the purpose of depositing their ova. He does not describe the animal.

GADINIA GARNOTII, Payr.

Pileopsis Garnotii, Payr, Coq. Corse, pl. v, figs. 3, 4. Phil. Enum. Moll. Siciliæ. Philippi, Wieg. Archiv. fur Nat., i, 1839, p. 115, pl. iii, fig. 3, a, b.

Clypeus Garnotii, Scacchi, Catalogus, p. 17.

Gadinia Garnotii, Gray, Figs. Moll. Anim., p. 93, vol. iv. Pl. 110, fig. 4. Gray, Guide to Moll. p. 172. H. and A. Adams, Gen. Rec. Moll. i, 463, pl. 52, fig. 8.

G. Testa alba, ovata, conica; radiatim striato-costata. Vertice subpostico; intus lævissimi, margine denticulato.

Hab. Living in the Mediterranean, and fossil, in the Tertiary quaternaries of Sicily.

The single specimen of Dr. Philippi afforded him material for some anatomical notes upon the animal. Either there is a very great difference between this and the Pacific species, or the paucity of material led him into error. He has apparently taken the renal organ for a gill, and, in this manner, led later authors into the error of placing *Gadinia* among the *Cervicobranchiata*.

GADINIA STELLATA, Sby.

Mouretia stellata, Sby., Proc. Zool. Soc., 1835, p. 6.

Gadinia pentagoniostoma, Sby., teste Cpr., 16th Rep. Brit. Assoc. 1856, pl. vii, fig. 3, a to g. (Not of Angas, P. Z. S. 1856, p. 220.)

G. testa depressa, squamiformi, alba, radiatim-costata; margine dentato.

Hab. Real Llejos C. Am. and the Gulf of California.

Seven varieties of this very variable shell are figured by Carpenter, in his first Report on the West Coast Mollusca.

GADINIA PERUVIANA, Sby.

Mouretia peruviana, Sby., Proc. Zool. Soc. 1835, p. 6. Ib. Zool. Beechey's Voy. p. 147, pl. 39, fig. 1.

Gadinia peruviana, Woodw., Man. Rec. and Fos. Shells, p. 155, pl. xi, fig. 26.

Siphonaria peruviana, D'Orb., Voy. Am. Mer. v, p. 470.

G. testa subdepressoconica, alba, radiatim striata; vertice centrale; epidermide cornea tenui.

Hab. Cobija, Peru.

This is not the type of the genus, nor was it described by Gray, as Woodward states. It is the first of three species of *Gadinia* described under the name of *Mouretia* by Sowerby, P. Z. S. 1835.

GADINIA COSTATA, Krauss.

Mouretia costata, Krauss. Sud afrischen Mollusken, Stuttgart, 1848.

Gadinia costata, (Krauss,) H. and A. Adams, Gen. Rec. Moll, vol. i, p. 463.

I have not been able to examine specimens or have access to description or figure of this species, which is from South Africa.

GADINIA CONICA, Angas.

Gadinia conica, Angas, Descr. of new sp. of Moll. from N. S. Wales, in Proc. Zool. Soc. 1867, p. 115, No. 127, pl. xiii, fig. 27. List of Port Jackson Moll. P. Z. S., 1867, p. 220.

G. testa alba, conica; costis fortioribus, irregularibus, radiantibus xxxviii; extus rugis concentricis fortibus, intus alba.

Convexly conical, white; strongly irregularly radiately ribbed; ribs about thirty-eight in number, concentrically ridged. Apex sub-central, white within. Alt. $2\frac{3}{4}$ lines, lon. $3\frac{1}{2}$ l., lat. 3 l.

Hab. Coodgee Bay, outside Port Jackson heads; (Angas).

The figure which accompanies the above description appears to represent a young shell. The concentric ridges are prominent, almost frills.

GADINIA ANGASII, Dall.

Gadinia pentagoniostoma, Angas, (non Sby.), List of Port Jackson Moll., Proc. Zool. Soc., 1867, p. 220.

G. testa depressa, conica, alba; costis creberrimis radiantibus; intus lævissime.

A depressedly conical, white shell; strongly radiately ribbed and polished inside. Length nine lines. Coodgee Bay, outside Port Jackson heads; (Angas).

The specific characters of all the species of *Gadinia* are so faintly marked, that in the absence of information in regard to the local habitation, many, if not all the species, might readily be confounded. It may safely be assumed, however, that *Gadinia pentagoniostoma* + *stellata* Sby., from Middle America and the Gulf of California, is not identical with a species, however similar, from a totally distinct zoölogical province. If not the adult of the preceding species, nor an importation, it may take the name of *G. Angasii*.

GADINIA RETICULATA, Sby. Pl. 2, figs. 1 to 9. Pl. 4, figs. 1, 2, 3.

Mouretia reticulata, Sby., Proc. Zool. Soc., 1835, p. 6. (Hab. Valparaiso, in err.)

Gadinia reticulata, H. & A. Adams. Gen. Rec. Moll. i, p. 463.

Rowellia, sp. Cpr., Suppl. Rep. Br. As., 1863, p. 651.

Rowellia radiata, Cooper, Proc. Cal. Ac. Nat. Sciences, 1865, p. 188, (test. jun.) Geogr. Cat. Moll. p. 24, No. 460, 1867.

Siphonaria reticulata, D'Orb., Voy. Am. Mer. v, p. 682.

Testa subcircularis; apice centrali; colore albo vel ex albo virens; superficies xxx costis radiantibus dichotomis induta, per lineas concentricas cruciatis; intus alba vel livida. Margine simplice; in jun. crenulato; fovea siphonali bene impressa, margine prope extremam foveam, parum inciso.

Shell normally almost circular; depressed conical; white or livid, sometimes tinged by the growth of a green or pink nullipore. The upper surface marked with from thirty to fifty radiating striæ or riblets, which are reticulated by the coarse, somewhat elevated lines of growth. The margin in young shells is denticulated, but with age this character is lost. The edge is usually irregular and owes its form to the locality where the animal was stationed; the notches corresponding to the irregularities of the surface where the animal lived. The interior is usually polished, except on the muscular impressions, which are granulous and strongly impressed. The scar is horseshoe-shaped, the right anterior limb broad near its extremity. Close to the anterior extremity of the left limb is a small oval scar indicating an attachment of the mantle to the shell.

The apex is posteriorly curved, sub-central, smooth, and in the youngest specimens I have seen exhibits no tendency to spiral growth. In older specimens it is usually somewhat eroded. The texture of the shell is exceedingly solid, porcellanous and strong. Old individuals fill up the cavity of the apex while adding to the margin. From the irregularities of their stations most fantastic forms occur. The most elevated specimen had an altitude of 0.45 in. to a longitudinal diameter of 0.56 in. One of the most depressed measured 0.36 in. high and 0.98 in. long by 0.96 in. wide. In one old specimen the thickness of the shell at the apex was 0.32 in. The young shells are usually quite thin, averaging about 0.04 in.

My specimens were identified by Dr. Cooper as his *Rowellia radiata*. The living specimens obtained by him were very young. The adults were examined by Dr. Carpenter, who is disposed to consider them identical with Sowerby's species, which came from Lower California.

Soft Parts. The external parts are of a livid white. The

foot is almost circular, tough and muscular, without any sinus, tubercles or other appendages. The animal appeared to have the power of inflating the cellular tissue between the epidermis and the sides of the foot, in such a manner as to have the appearance of blisters. These protuberances are persistent in alcohol, though they do not exist in the normal condition. In alcoholic specimens such might readily be taken for lobes or expansions of the foot. The mantle edge is simple, broad and continuous. It is thickened on the right side above the head, and in this thickened portion is the opening of the pulmonary chamber. It is angular, very minute and closed by a small triangular valve or lobe. The head is broad and flattened. There are no tentacles, or rather the tentacles are consolidated and lost in the expanded lobes of the muzzle. The latter is bifid, and the outer extremities are produced into two funnel-shaped expansions, which I will call "ears." The ears are not continuous, but their inner ventral edges overlap one another, while their dorsal edges are separated at their points of insertion by a space as wide as the mouth, which is situated just below in the centre of the double funnel. The edges of the ears in the adult are simple, but, according to Dr. Cooper, in their young state they are flattened and pectinated. In the adult their inner surface is marked with moderately conspicuous folds radiating from the mouth. Their exterior surface is smooth.

The eyes are very minute and black; they are situated on the sides of the head just behind the ears. In alcoholic specimens, on account of the opacity of the cuticle, they are invisible, but may easily be found by shaving off a thin paring of skin with a sharp knife.

On the right side between the mantle and the foot is a small papilla, indicating the genital orifice. Just behind the right eye is an almost invisible foramen, exceedingly minute, through which the verge is exerted.

The mantle and foot exude a peculiar milky slime, with a strong soap-like odor.

The head is capable of considerable extension and retraction.

Muscular System. The foot is composed of solid muscular fibre, radiating from a median line. The superior surface, when the viscera are removed, is opalescent. The adductor muscles are horseshoe-shaped and continuous. The anterior right hand limb is broader at its extremity, which is rounded. The edges of the muscular impression are somewhat irregular. The faintly marked sinus passes close to the anterior extremity of the muscle on the right. On the left the mantle is attached to the shell, forming a small oval impression, which is not continuous with the scar of the adductor.

The buccal mass is controlled by well marked muscles. A broad muscular ribbon is attached to the posterior concavity of the adductor, a little on the right. About midway in the cavity of the viscera it divides into two parts, one of which is fixed on each side of the superior surface of the buccal mass. A similar but more slender muscle is similarly attached below. Three stout bundles of muscular fibre are attached anteriorly on each side to the front of the foot, and posteriorly to the sides of the buccal mass, which they serve to extend outwards, while the long muscles serve for retracting it.

A short stout muscle binds the buccal body to the foot, behind and somewhat below the protractors, on each side.

A long and very slender fibre connects the posterior end of the penis with the spermatic canal behind the prostate.

The protractor muscles of the penis are short and thin, blended somewhat with the fascia of the preputium. The muscles of the female organs will be hereafter described.

Nervous System. This, in the alcoholic specimens, could not be thoroughly traced out. The nervous collar around the œsophagus at the posterior end of the buccal body consisted of two superior ganglia connected with two inferior ganglia and with each other, by nerve fibres. Above, these appeared somewhat reticulated; below they diverged without inosculation. A rather stout nervous cord extended back from the lower ganglion on the right, parallel with the spermatic cord, and provided with an accessory ganglion near the prostatic gland. The nerve fibres, as well as the blood vessels which supply the foot, enter it at or near the buccal mass, on the median line.

Circulatory and Respiratory Systems. Philippi (in his description of the soft parts of *Pileopsis Garnotii*, Payr,) says that a crumpled organ hangs from the lining of the pulmonary chamber, which is "evidently the gill." He admits that he had only a single specimen, in which several of the organs were indeterminate. His figure is extremely indefinite, and is further complicated by the outline of the head, which is represented, on a small scale, as seen from below, while the remainder of the same figure represents the back, on a large scale, as seen from above! His representation of the "gill" is unlike anything in the species now under consideration, though his "gill" occupies the place of the renal organ of the latter. His account must therefore be regarded as erroneous, the error doubtless being due to the small amount of his material.

The present species is a true Pulmonate. The pulmonary chamber extends over more than half the body, reaching the adductor muscle on the left side behind, and thence forward

with the opening as previously described to the right of the head, in the mantle margin. The buccal organs and viscera are separated from the chamber by a tough membrane, which lines the latter. The lung is leaf-shaped, and included between the lining of the chamber and the inner surface of the mantle; to the left of the lung between the membranes are a series of solid, flattened lobes, which empty by a duct near the pulmonary papilla. These are analogous with the renal organ of *Melampus*. They do not project into the chamber, nor have they any resemblance to a gill. The lung terminates in a bifid papilla just within the opening in the mantle. In the posterior part of the lung is a capsule which contains the heart. The suture between the auricle and ventricle is very strongly impressed. The heart is closely connected with a network of large blood vessels, from which branches penetrate the tissue of the lung, and the smaller capillaries anastomose between the membranes beyond the edge of the lung in the most delicate and beautiful manner. Dr. Leidy, who examined the organ, had no doubt as to its being a true lung.

Several large vessels supply the liver and buccal region, and the smaller vessels enter the foot below the buccal mass.

Alimentary System. The mouth is transversely oval, capable of considerable dilatation, with numerous rugæ, parallel with the axis of the throat, when contracted. There is no jaw. The buccal mass is smaller and less muscular than in most pulmonates.

The radula contains about four hundred rows of teeth; the lateral rows forming a sharp angle with the rhachis. The formula is about $110 \cdot 1 \cdot 110$, so that the odontophore contains about 88,400 teeth. The nearest relations of the dentition appear to be with *Siphonaria*. The rhachidian tooth is minute, inconspicuous, with an ill-defined cusp. The outline of the base is hardly perceptible. The cusp is short, oval and pointed. The edges of the base are slightly thickened. The bases of the inner laterals are obliquely rhombiform. The cusp consists of one long prominent tooth, flanked on each side by a slender, needle-like, minute, transparent denticle. These are very liable to be overlooked from their extreme transparency and small size. They are shorter, proportionally, toward the edge of the radula. Occasionally the main point of the cusp is bifid, or the smaller points are blended more or less with it; these forms, however, are evidently abnormal.

(It is noteworthy in cases, such as this, when the radula contains a large number of similar and minute teeth, that the tendency to variation among them is much greater than when the

radula is much narrower and contains fewer teeth. The same generalization holds good in regard to the individual teeth. The larger the number of denticles on the cusp, the greater the tendency toward variation among them. In working over the dentition of the Pulmonata, especially, it is very desirable that as large a number as possible of ribbons of each species should be compared to correct such errors of variation from the normal type.)

The main point of the cusp in the inner laterals is about twice as long as the base; it becomes proportionally shorter toward the edges of the radula.

All the denticles or teeth of the cusps are sharply pointed. About the seventy-fifth lateral the edges of the cusp on each side of the prominent denticle are slightly notched, and the two small denticles are almost evanescent. These notches disappear about the one hundredth lateral, and the long tooth gradually decreases in proportional length, until in the extreme outer laterals it is not more than half as long as the base.

The œsophagus leaves the buccal body above and before the posterior extremity of the latter, and is slightly dilated there.

It enters the ventral side of the stomach with a short double flexure. The stomach is oval in shape, and in all the specimens dissected was filled with a dark green vegetable matter. Leaving the stomach at the posterior end, the intestine turns upon itself and passes over the superior surface of the liver, diagonally across the body, terminating just inside the opening in the mantle. The sinus in the shell is due to the anterior extremity of the lung, and does not quite correspond with the course of the rectum. The latter half of the intestinal canal is divided interiorly by incomplete septa, which serve the purpose of expelling the fæces in oval pellets.

Reproductive System. The ovary is situated to the right of, and below the stomach. It consists of a number of convoluted tubes, more or less spirally twisted upon each other. The oviduct is short, and provided with an accessory mucous gland. Near the anterior extremity of this a small muscle is attached, and is fixed at the other end to one corner of the nearly triangular vagina. The uterus is a kidney-shaped organ, and the duct passing from it into the vagina is provided with a genital bladder as in other Pulmonates. The vagina terminates in a small papilla externally. In small specimens this is almost invisible.

The exact extent of the testicle was not clearly made out, but it is very slender and situated at the posterior end of the animal, in or upon the surface of the liver.

The vas deferens is long and slender, passing through a pear-

shaped prostatic gland about midway of the body, it is prolonged to the penis.

The latter is long and larger at its posterior extremity, growing more filiform anteriorly. The foramen opens on the side of the neck, just behind the right eye, and is of extreme minuteness. A slender retractor muscle is attached to the posterior end of the penis, and at its other extremity to the vas behind the prostate. The protractors are on the right side of the penis, shorter and stouter than the retractor.

Special Organs. The specimens were so much contracted by the alcohol that no auditory capsule was visible. The eyes are minute, oval and black. The liver occupies nearly half of the visceral cavity. Part of it was a light brown, and part was whitish. No differences of structure or line of separation could be made out under a very high power.

Two small pear-shaped salivary glands are attached to the upper posterior surface of the buccal mass.

In the form of the verge, the renal organ, lung, muscular bands and other particulars, the general structure of this mollusk recalls *Melampus*, as figured by Souleyet.

Habitat. Close to high water mark on the rocky beach between Point Pinos and Point Cypress, near Monterey, Cal., I noticed a colony of forty-eight individuals. They were stationed pretty close together, on the rounded under side of a large, perfectly clean, granitic boulder. In calm weather and during ordinary tides they would have been dry at high water.

While refreshing myself after my morning tramp, I sat down on the beach, as the tide was falling, and watched the colony.

As long as the rock on which they were remained damp, they continued with the margin of the shell firmly applied to it. The shells were notched and emarginated to correspond with the rugosities of the stone, and adhered to it so firmly as to be immovable, unless great force was applied.

There was absolutely nothing on the rock which could have supplied them with food.

As soon as the boulder became dry, under the hot sun, I perceived a simultaneous motion in the colony. Each shell was raised above the surface of the stone, the head and foot were protruded, and the orifice of the pulmonary cavity was expanded. They were evidently enjoying the warm air. Some of them began to move, and I thought that they were about to descend to the pebbles below, where an abundance of soft green algæ offered an inviting repast. Their motions were so slow and my time so limited, however, that I made a prize of the whole colony with-

out further delay. They evidently moved about to obtain food, and by some mysterious instinct returned to their stations before high tide. The margins of the shells showed that they must have been formed by the peculiar inequalities of the station where I found them. Some of them had lost their way at times, as the lines of growth showed, where sudden changes had taken place in the curves of the margin where it touched the rock. Some of them had assumed the most fantastic forms from this cause; one exactly resembled a planter's straw hat, and others showed curious constrictions or expansions of the margin.

In some cases one or more small ones were mounted on the back of a larger individual, and there were erosions more or less deep, of a circular form, of the diameter of the rider's foot. This erosion was most extensive around the margin, which was often deeply excavated, while the central portion of the circle was hardly eroded at all. It was probably due to the action of the radula, as faint striæ might be distinguished by means of a glass. In one case the indefatigable mollusk had gnawed through a stratum of shell a quarter of an inch thick on the apex of an old individual, which must have carried the incumbrance about for a long time. The rocks exhibited no erosion.

The species was originally described from the Gulf of California or Lower California, though by some misplacement of labels the habitat was published as Valparaiso, in deep water.

I found a few dead specimens on the same rocky beach. Dr. Cooper and Mr. Rowell have obtained it from the Farallones, Half-Moon Bay, New Year's Point, Santa Barbara and Santa Catalina Islands. I have some small but exactly similar specimens from Cape St. Lucas. Dr. Newcomb obtained this species from Santa Cruz Island.

The number of specimens examined while investigating the anatomy of this species, is thirteen; the number of shells which have passed through my hands is about seventy-five.

GADINIA CARINATA, n. sp. Pl. 4, figs. 12, 13.

Testa rotundata, depresso-conica, tenui, alba, subpellucida; apice lævi, subpostico et oblique marginem dextrum versus resupinato; superne, striis multis minutis versus marginem radiantibus; intus lævi, sulco conspicuo munito, qui extus carinam validem format. Lon. 0.66, lat. 0.60, alt. 0.16 in. Animal incognitum.

Coll. Phil. Acad. Nat. Sciences.

Hab. Aspinwall, Central America, Dr. E. Palmer.

The thin depressed shell, fine striæ, smooth and dextrally bent

apex, and the somewhat prominent carina formed by the internal groove, which causes an emargination of the anterior edge, readily distinguish this from the other species of the genus. The lines of growth are impressed and moderately strong.

It is noticable that the apex is dextral, while in *G. excentrica* it appears from the figure to be sinistral. The latter is reported to inhabit corals in deep water, and it is possible that the animal may prove to differ from the true *Gadinia*, as living in such situations it can hardly be an air-breather.

GADINIA EXCENTRICA, Tiberi.

Gadinia excentrica, Tiberi, Journ. de Conchyl. 1857, p. 37, pl. ii, fig. 6, 6a.

Testa ovalis, oblique conoidea, glaberrima, nitens, striis exilissimis longitudinaliter et transversim decussata; vertex excentricus, posticus, oblique recurvus, infra apicem lateraliter situs, apertura ovalis; margo simplex, acutus. (Tiberi.)

Hab. Mediterranean, on the coasts of Sardinia.

This species presents marked points of difference from all other described species of the genus, in its smooth exterior and twisted apex. It is said to be found in the masses of coral brought up by divers in the Mediterranean. The animal is unknown, and needs examination.

This completes the list of species of this genus as far as I have been able to ascertain. They are widely distributed over the world, but appear to be almost entirely confined to the eastern coasts of the two great oceans.

Woodward speaks of the Red Sea as affording a species, but I have not been able to find any description of a *Gadinia* from that locality.

Genus DESLONGCHAMPSIA, McCoy.

Deslongchampsia, McCoy, MS. in Morris and Lycett, Mon. Gt. Ool. Moll. p. 94, pl. xii, f. 13, 1850.

Hemitoma, Woodw. (non Swains.), Man. Rec. and Foss. Shells (in errata), p. 151, 1851-56.

Deslongchampsia, Chenu, Man. de Conchyl., p. 376, f. 2819-20. (Not = *Metoptoma*, Phil., 1836, as Chenu avers.)

D. testa orbiculata, conica; apice subcentrali, versus marginem anticum inflexo; costulis radiantibus, antico sulco lato longitudinali in laminam appendiculatam producto.

Shell suborbicular, conical; apex acute, subcentral, curving

slightly forwards; with a wide longitudinal anterior sulcus, produced into a rounded lobe beyond the margin.

This genus differs from *Gadinia* in the sulcus being straight and longitudinal, instead of directed to the right; in the termination being produced beyond the margin, instead of producing an emargination; in having a mammillated apex and externally conspicuous sulcus, while in *Gadinia* the apex is inconspicuous and the sulcus is usually invisible externally; and finally in having the apex probably directed forward instead of backward, as seems to be the normal state of *Gadinia*.

Its affinities appear to be rather with *Emarginula* than *Gadinia*, and I have appended this notice of it because the synonymy is confused, and Chenu has placed it in the *Gadiniidæ*.

It is certainly not identical with *Hemitoma*, Swainson, with which Woodward unites it, of which the type is *Subemarginula tricostata*, Sby., sp. It also differs essentially from *Metoptoma*, Phil., which Chenu gives as a synonym. The type of *Metoptoma* is the shell figured as "*P. solaris*," Chenu, p. 376, i, fig. 2821, according to Prof. F. B. Meek.

Type.

DESLONGCHAMPSIA EUGENEI, McCoy.

D. Eugenei, McCoy, MS. Morris and Lycett, Mon. Gt. Ool. Moll. i, p. 94, pl. xii, fig. 13, 13a, 1850. Morris, Cat. Brit. Foss. 1854. Chenu, Man. de Conchyl. i, p. 376, figs. 2819, 2820.

D. testa suborbiculata, conica, apice subcentrali, acuto, sulco antico lato striato; costis numerosis, longitudinalibus, transversisque decussantibus, sulcus interstitialibus profundis. Alt. 3 l., lat. 6 l.

Fossil in the Great Oolite beds of Minchinhampton, found rarely in the white stone of Eastcombs and Bussage.

Chenu's figure gives the idea of a much smoother and more regularly radiated shell than that figured by Morris and Lycett. The regular crenulations of the margin, as figured by Chenu, are not found in the original figure, in which the apex is also much less smooth and mammillated.

DESLONGCHAMPSIA LORICATA, Laube.

D. loricata, Laube, Gast. des braunen Jura von Balin; Sitz. Kais. Ak. Wiss. Wien, 1866, p. 82 (name only). Stoliczka, Pal. Indica, Vol. II, p. 324.

This species is catalogued by name without description or

figure, but accompanied by the remark that "it differs from *D. appendiculata* by its greater elevation and reticulated exterior, and from *D. Eugenei* by its more elevated form and alternating stronger and weaker striæ" (Laube, loc. cit.) The discrepancies between the figures of Chenu and Morris have been already alluded to; in default of a figure, the author might at least have afforded an intelligible description; at present the species can hardly be said to have been established. It is merely referred to by name by Stoliczka.

DESLONGCHAMPSIA APPENDICULATA, Desl.

Patella appendiculata, Desl., Mem. Soc. Linn. de Norm. vii, pl. xi, figs. 1, 2.

Deslongchampsia appendiculata, M. and L., Mon. Gt. Oolite Moll. p. 94, vol. i.

D. testa subovata; costis simplicis, grandis, radiantibus.

Shell suboval, with large simple radiating costæ.

According to Prof. McCoy, the genus was first recognized, but not described, by M. Deslongchamps, who had only seen this species.

There are a number of fossils which bear a strong resemblance to this genus and to *Gadinia*, but they are usually described as *Patella*, and the external surface, only, figured, so that it is impossible to decide on their affinities.

I have in each case, when practicable, copied the author's original description.

REFERENCES TO PLATE 2.

Gadinia reticulata, Sby., Monterey, Cal.

Fig. 1. Soft parts from above. *a*, anus. *b*, opening of the pulmonary cavity. *c*, vaginal papilla. *d*, foramen of penis. *m*, buccal mass, showing the two nervous ganglia, the œsophagus, the adductors and retractor muscles, and the position of the radula. *h*, heart. *f*, papilla of the lung. *o*, ovary. *l*, liver, indicated by the darker shade. *a*, *m*, muscles of attachment to the shell. *i*, lung. *r*, renal organ.

Fig. 2. Ganglia. *d*, dorsal. *v*, ventral.

Fig. 3. Foot stripped of all appendages, showing the mode of growth of the muscles.

Fig. 4. *a*, central and six lateral teeth of the radula as in situ. *d*, 6th lateral. *h*, 24th lateral. *f*, abnormal 25th lateral. *b*, 75th lateral. *c*, 80th lateral. *g*, 100th lateral. *e*, extreme outer laterals.

Fig. 5. Muscular impressions on the shell, nat. size. *a*, cicatrix of the mantle. *b*, *b*, horse-shoe-shaped muscle cicatrix. *d*, sinus. (Drawn as if seen from above.)

Fig. 6. Animal, nat. size, as moving.

Fig. 7. *a*, anterior rhachidian teeth. *b*, the same near the middle of the radula. *c*, side figure of 6th lateral. *d*, do. of 75th lateral.

Fig. 8. Section of the rectum.

Fig. 9. Side view of alimentary canal.

REFERENCES TO PLATE 4.

Fig. 1. Side view of normal specimen of *G. reticulata*, Sby.

Fig. 2. Same from below.

Fig. 3. Curious variety of the same.

Fig. 12. *Gadinia carinata*, Dall, from above, nat. size.

Fig. 13. Same from below.



Dall, William Healey. 1870. "Materials toward a monograph of the Gadiniidae." *American journal of conchology* 6, 8-22.

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