NOTES ON PROSOBRANCHIATA.

No. i.—*LOTORIUM.*

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Part i.—Synonymy.

Family LOTORIIDÆ, Harris.

(Harris, Cat. Tert. Moll. Brit. Mus. Pt. i., p. 185, 1897.)

Genus Lotorium, Montfort.

Buccinum, Tournefort, 1742. *Lotorium nodiferum*, Lamarck (*fide* Bayle, Journ. de Conch., 1880, p. 241).

Buccinum-tritonis, Klein, Tent. Meth. Ostrac. 1753, p. 43, pl. 7, f. 117. *B. penatum*, &c. = *Lotorium tritonis*, Linn.

Argobuccinum, Klein, op. cit. p. 44, pl. 7, f. 128. *A. fasciatum* = *Gyrineum vexillum*, Sowb.

Lagena, Klein, op. cit. p. 49, pl. 3, f. 61. *L. toroides* = *Lotorium clandestinum*, Chemnitz.

Simpulum, Klein, op. cit. p. 50, pl. 3, f. 62, 63. *S. torosum* = *Lotorium costatum*, Born.

Gutturnium, Klein, op. cit. p. 51, pl. 3, f. 64. *G. ranula* = *Lotorium tuberosum*, Lamarck.

**Epidromus*, Klein, op. cit. p. 52. *E. buccinum-sulcatum*, &c. = *Colubraria maculosa*, Chemnitz.

**Murex*, Linnæus, Syst. Nat. 1767, Tom. i., Pars 2, p. 1213.

Tritonium, Bolten, Mus. Bolt. 1798, p. 125; ed. ii. p. 88, 1819. Not *Tritonium*, O. F. Müller, Prodr. Zool. Dan., p. 243, 1776.

Cymatium, Bolten, op. cit.

Cabestana, Bolten, op. cit.

Tritonium, Link, Beschr. Rostock. Samml. p. 121, 1807. *Lotorium tritonis*, Linn.

**Persona*, Montfort, Conch. Syst. ii. 1808, p. 633. Type *P. anus*, Linn. = *Distortrix anus*, Linn.

Aquillus, Montfort, op. cit. p. 579. Type *A. cutaceus*, Linn. = *Lotorium cutaceum*, Linn. Not *Aquilus*, Brisson, Ornithol. i., p. 419 (AVES).

**Apollon*, Montfort, op. cit. p. 571. Type *A. gyrinus*, Linn. = *Gyrineum gyrinum*, Linn.

Lotorium, Montfort, op. cit. p. 583. Type *L. lotor* = *Lotorium lotorium*, Linn.

Triton, Montfort, op. cit. p. 587. Type *T. tritonis*, Linn. = *Lotorium tritonis*, Linn. Not *Triton*, Linn., 1768 (Crustacea), nor of Laurenti, 1768 (Batrachia).

Monoplex, Perry, Conchology, 1811, pl. iii. *M. cornutus* = *Lotorium exaratum*, Reeve.

**Biplex*, Perry, op. cit. pl. iv. *B. rosa* = *Gyrineum bufonia*, Gmelin.

Septa, Perry, op. cit. pl. xiv. *S. parkinsoniana* = *Lotorium fusiforme*, Kiener.

Lampusia, Schumacher, Essai Nouv. Syst. Habit. Testacés, 1817, pp. 72, 250. *L. pileare*, Linn. = *Lotorium pileare*, Linn.

**Colubraria*, Schum., op. cit. pp. 76, 251. *C. granulata* = *Colubraria maculosa*, Gmelin.

**Gyrina*, Schum., op. cit. pp. 77, 253. *G. maculata* = *Gyrineum giganteum*, Lamk.

Ranularia, Schum., op. cit. p. 253. (*Ranula*, p. 77) *R. labiata* = *Lotorium pyrum*, Linn.

Luterium, Herrmannsen, Indicis Gen. Malac. i. 1846, pp. 625, 632. Emend. for *Lotorium*.

Cumia, Bivon, Caratt. Nuov. Gen. Conchiglie, 1838.

Charonia, Gistel, Naturg. des Tierreichs, 1848, p. 107.

Linatella, Gray, Guide Moll. Brit. Mus. 1857, p. 39. Type *L. cingulata* = *Lotorium cingulatum*, Lamk.

Neptunella (Gray), H. & A. Adams, "Genera" ii., p. 654, 1858.

**Priene*, H. & A. Adams, op. cit. p. 654. *P. rudis*, Broderip.

? *Trachytriton*, Meek, Smithsonian Miscell. Coll. vii. 1864; Smith, Check List Tert. Foss., pp. 22, 37. *T. vinculum*, Hall & Meek.

**Tritonopsis*, Conrad, Am. Journ. Conch. i. 1865, p. 20. *T. subalveatum* = *Cymia woodii*, Dall (*fide* Dall).

? *Personella*, Conrad, op. cit. p. 21. *P. septemdentata*, Gabb.

? *Ranellina*, Conrad, op. cit. p. 21. *R. maclurii*, Conrad.

**Buccitriton*, Conrad, op. cit. p. 21. *B. altus* = *Nassa* (*fide* Dall).

? *Sassia*, Bellardi, "T. Moll. Terreni Terz. del Piedmont e della Ligura," Mem. Reale Accad. Sci. Torino xxvii. (ser. ii.) 1873, p. 219. First sp. *Triton apenninicum*, Sassi.

**Aspella*, Mörch, Malak. Blatt. xxiv. 1877, p. 24. *Aspella anceps*, Lamk.

? *Plesiotriton*, Fischer, Man. de Conch. 1884, p. 654.

? *Hilda*, Hoernes et Auinger, 1884. Die Gasterop. der Meeres-Ablagerungen, p. 182, pl. xxii. f. 17-20. Abhand. der k. k. Geologischen Reich. Band xii. Type *Triton* (*Hilda*) *transsylvanicum*, H. & A.

The Generic Name.

The names in the above synonymy marked with an asterisk are included, because they have been associated with "*Triton*," more or less erroneously, by Tryon, Fischer and others. Some are good genera, others synonyms of other groups. Klein's pre-Linnæan names acquired a right to quotation when endorsed by later writers.

Murex, Linn., being retained for another distinct genus, the first names we need consider are those of Bolten. I have been unable to consult his work, but they seem to be *nomina nuda*, and, therefore unquotable. Fischer (11, 206) reviewed the 'Museum Boltenianum,' and came to this conclusion; and Dall's sentence, "There is no good reason why we should not adopt the name *proposed* by Bolten, *given a scientific standing* by Link, and adopted by Cuvier" (7, 225); and his repeated rejection of Bolten's *nomina nuda* points to his being of the same opinion. (The italics are mine.) The name to which the above sentence refers is *Tritonium*. He has since regarded the name as preoccupied at the time of its proposal, and inadmissible on that account (8, 416).

With reference to *Aquillus*, I cannot do better than quote Harris (15, 186):—"Commencing with *Aquillus*, the etymology of the word is uncertain, and in any case is hybrid. When it is emended in the manner suggested by Agassiz (2, p. 31, Moll. p. 7) and others, we have *Aquilus* or *Aquila*, which is anticipated by the well known *Aquila*, Brisson, in ornithology, and by several other authors prior to the appearance of Montfort's work. To prevent difficulty, therefore, it is not advisable to select *Aquillus*, the more so that Montfort suggested another name at the same time, in the same work which will do very well."

The next name on my list, which is arranged chronologically, is *Lotorium*, which is not preoccupied, is proposed in a thoroughly scientific manner, and for which a type (*Murex lotorium*, Linn.) is named, described and figured. *Triton* is preoccupied; *Septa* and *Lampusia* were proposed subsequent to *Lotorium*.

I am of the opinion that Harris is right in maintaining that *Lotorium* should be accepted. With this conclusion both Messrs. E. A. Smith (*fide* Harris, l.c.) and C. Hedley agree.

Until a generic *nomen nudum* is absolutely defined there will be an element of uncertainty in this synonymy. Verrill (38, 54) says Bolten worked in a rational manner, and that "he gave no diagnoses, but he cited well known and figured species as types, so that his meaning is clear." If this is so, and it constitutes a generic description, Montfort's name must give place to that of Bolten. It is a point which can, it seems, be only settled finally by a consultation of a few malacologists of experience, and a careful consideration of the consequences, rather than a rigid application of the rules of nomenclature. The following extract from Dall's Report to the American Association for the Advancement of Science (1877 Meeting) "On Nomenclature in Zoology and Botany" (p. 45, § lxii.) makes a fitting conclusion to a discussion on this synonymy:—

"The following kinds of works are entitled to citation in bibliography, but not in synonymy:—1.........2.........3. Works not published.

"It may seem superfluous to object to works of the third category. But besides several MSS. preserved in museum libraries and sometimes quoted, though never printed, there are a few works that have been printed but never published. This is the case with a Museum Catalogue prepared by Link about 1806.

"It was printed and contained a host of new names. But whether the author was ashamed of his work, or the authorities of the University declined to be sponsors for the innovations, the work was never offered for sale, distributed, or advertised by the author.

"Only one copy is definitely known to have escaped from the University cellars, and it has been stated that the remainder, or most of them, were destroyed by fire. Yet in 1851, the solitary copy having been discovered, one or two authors called attention to it, and demanded that these names should take precedence of those of Lamarck and others, which had been in use for nearly half a century. A few writers have adopted this suggestion, and in one branch of science at least, deplorable confusion has resulted.

"The auctioneer's catalogue of Bolten's collection printed in 1798, but fortunately containing no diagnoses, and of which only one or two copies are known, falls nearly in the same category. A reprint was made in 1819, but is also one of the rarest books."

The Family Name.

The consideration of what name should be applied to the family has been complicated by the action of Dall and Simpson. They have, without giving any reason, divided the group known of old as *Triton* into four genera, and, while admitting *Lotorium*, they make *Septa* the type genus of the family (Septidæ) [8, 416, et seq.].

Perry enumerated six species of the genus *Septa*; they are, in the order he gave them :—

Septa parkinsoniana	=	*Triton fusiformis*, Kiener.
,, *scarlatina*	=	,, *rubecula*, Linn.
,, *spengleri*	=	,, *spengleri*, Chemn.
,, *rubicunda*	=	,, *nodiferus*, Lamk.
,, *rubecula*	=	,, *pilearis*, Linn.
,, *triangularis*	=	,, *costatus*, Born.

Lotorium parkinsonianum is not related to the *tritonis*-group (vide post, p. 475), but makes with some of the Australian Tertiary species a rather distinct section, which is, however, connected with *L. waterhousei.* Thus the first three species are all referable to the so-called genus *Lampusia,* which is, therefore, a synonym of *Septa.* These again are generically inseparable from *Lotorium.* Therefore it is only by admitting *Lotorium* as the type of the family, and removing Perry's first three species thereto, that the name *Septa* can be applied to the *tritonis*-group. It is obvious that they cannot be referable to *Lampusia* or *Ranularia,* both of these being later names. If, therefore, Septæ are typical forms (and *parkinsonianum* is the type thereof), *Lotorium* must be regarded as a synonym, which has been shown to be impossible. Should my "lines of generic similarity" not be considered sufficiently complete, nor the other evidence conclusive, then the name *Septa* must be applied to the group formed by *parkinsonianum* and the Australian fossils, this section being more distinct than any of the others.

The *tritonis*-group cannot be retained as the typical section of the genus; it has not yet received a name which can be used. Unless we are to regard *L. parkinsonianum* as the type of the genus, the name *Septidæ* cannot be adopted; under these circumstances it seems far more reasonable to accept Harris's term *Lotoriidæ.*

This is not only correct in point of nomenclature, but it will be found more in accordance with a natural arrangement of the groups if it is advantageous to split the genus up into systematic divisions.

Lotorium (*sensu stricto*) will embrace all those typical forms which have been placed by Tryon under *Simpulum*, *Cymatium*, and *Gutturnium*. The sections will then include a few forms which cannot be regarded as in any way typical.

The conclusions of this Part are that the following should be adopted :—

Family LOTORIIDÆ, Harris.

Genus LOTORIUM, Montfort.

Part ii.—ARRANGEMENT OF THE SPECIES.

"The original group has been considerably divided; in fact, Bolten, Montfort, and others began the work of division. The whole matter is worth an exhaustive discussion. . . . " (Dall, 'Blake Mollusca,' p. 225, 1889).

In the following pages I discuss this subject at some length, and have come to the conclusion that the whole of the species included by Tryon in *Triton* (*sensu stricto*), *Simpulum*, *Cymatium* and *Gutturnium* form one natural genus. From a study of figures and descriptions, and of one species (*P. scaber*, King), I feel inclined to regard *Priene*, H. & A. Adams, as a good genus. I am unable to express any opinion as to the value of the various fossil groups proposed by Fischer, Conrad, Gabb and others. *Epidromus* (= *Colubraria*) has rightly been treated as a distinct genus by most late writers. I agree with Dr. Dall that Fischer (12, 655) incorrectly referred the *Apollon* group of *Gyrineum* and *Aspella* to "*Triton*" as subgenera.

In this essay I have used conchological and embryonic characters only. I have, however, also studied the matter from an anatomical standpoint, and, although my investigations here have been by no means extensive, I think it may safely be said that investigations in this line will have no important modifying effect on the conclusions arrived at. So far as our knowledge at present goes the species of the "*tritonis*"-group (post, p. 474) have a dentition somewhat different from that of other groups, and the so-called subgenus *Gutturnium* has been stated by Fischer (12, 655) to have an operculum distinct from that of the rest. I would, however, draw attention to the fact that only about half-a-dozen radulæ have been figured, and of these few that of *L. femorale*, Linn., is intermediate between those of *L. tritonis*, Linn., as the one extreme, and *L. cutaceum*, Linn., as the other. Hitherto there have been known three apparently distinct types of protoconchs—those typified by *L. rutilum*, Menke (Pl. xvii., fig. 21), *L. cornutum*, Perry (Pl. xvii., fig. 10), and *L. woodsi*, Tate (Pl. xvii., fig. 1). These are later shown to be extreme forms of one generic type. It is more than probable that when the subject is systematically investigated the two types of dentition will suffer the same fate, and all the intermediate forms will be forthcoming.

The fact that *Gutturnium* has an operculum differing from that of other groups is not necessarily of much importance; since there is much variation in the form of the protoconch and dentition (and these variations of little note), a certain amount of variety in the operculum is also to be expected.

As already stated, my anatomical investigations have not been extensive; the cause of this has been the difficulty of obtaining material. Having in view the proposal to use four generic names for this group, I have thought it as well to publish this essay in its present incomplete form, and to follow it with an anatomical supplement as soon as sufficient material can be obtained.

Conchological Evidence (Recent Species).

The genus has hitherto been divided on the form of the shell only; with what diversity of opinion is shown in the next part of my paper. In the present part I propose to use that evidence with, I submit, rather conclusive results, to point out the uselessness of such divisions as nomenclatural entities. For want of better I have had to use such phrases as "nearest ally" and "nearly related" in this discussion; but it is not argued that any one species is more nearly related to any one other than to the rest. Such a line of argument, were it substantiated, would prove disastrous to my contention, for community of relationship presupposes community of descent. Were it possible to prove a common progenitor for any group, distinct from that of another, it would certainly be advisable to separate such, at least subgenerically. I would suggest that the groups are to be accounted for by variation along similar lines from the original parent.

The four genera of Dall and Simpson are *Septa*, *Ranularia*, *Lampusia* and *Lotorium*. Being full genera it is important that they should be discussed. The descriptions given with the rehabilitation of each of these are not sufficient to define them; there is, however, another way of determining their value. On comparison with sections previously proposed they appear to equal those of Tryon.

Septa can be no other than *Triton* (*sens. str.*). Two out of the three species enumerated under *Lampusia* occur in *Simpulum*. *Lotorium* evidently equals *Cymatium*. The species named under *Ranularia* is placed by Tryon in his subgenus *Gutturnium*. That this is an unsatisfactory way of deciding the matter must be admitted, but it receives support from the fact that there are only four divisions in each work (though Tryon divides his subgenera into groups), and that *Septa* could not have been applied to the *tritonis*-group had not these authors accepted Tryon's classification of *L. parkinsonianum*, Perry (= *L. fusiforme*, Kiener). If, however, this deduction is incorrect, and Dall and Simpson's genera do not equal Tryon's subgenera, the following statements will not be invalidated. It is submitted that they serve to prove that the group known of old as *Triton* is a natural genus and cannot be divided. The specific nomenclature here employed is that of Tryon's "explanation of plates" as a ready means of intimating to my readers the particular forms referred to; not that I entirely disagree with his synonymy. The values of a few specific names are dealt with in the concluding part of the paper.

The species which are referred to *Lotorium*, Dall and Simpson (= *Cymatium*, Tryon) are—*femorale*, Linn. ; *tigrinus*, Brod. ; *lotorium*, Linn., *pyrum*, Linn.; *dunkeri*, Lischke; and *münsteri*, Anton. The difference between *L. pyrum* and *L. cynocephalum* is if anything, less than that between the former and *L. lotorium*. It would, therefore, be unreasonable to separate generically *pyrum* and *cynocephalum*. By the same argument we may include first *L. sarcostoma*, then *L. trilineatum*, Reeve; thence all the rest of the species included in Tryon's *Gutturnium*.

A series of species generically similar in every way, but with gradually shortening canals, is formed by—*sarcostoma*, *tripus*, *aegrotus*, *vespaceus*, *thersites*, *crispus* and *quoyi*. It would be impossible to place any one in this series in one genus and either of those next to it in another. They are all included in Tryon's *Gutturnium*. The same remarks may be made of the series, with gradually elongating canals, formed by *doliarium*, *spengleri*, *waterhousei*, *tranquebaricus*, *pilearis*, *mundum*, *gemmatus* and *orientalis*. This series is placed by Tryon in *Simpulum*. The resemblance between *gemmatus* and *quoyi* is very much greater than between *quoyi* and *sarcostoma*. Again, *crispus* is more nearly related to *orientalis* than *orientalis* is to *spengleri*. Another line of generic similarity is—*waterhousei*, *chemnitzi*, *succinctus*, *cingulatus*, connecting completely the tun-shaped species of Tryon's group *Linatella* with *Simpulum*. Yet another perfect series is presented by—*verracosum*, *quoyi*, *intermedius*, *mundum*, *vespaceus*, *exaratus*, *chlorostoma*, *thersites*, *orientalis* and *crispus*. This is not merely a series but a complete ring, for *crispus* is nearly related to *verrucosum*. Of this series Nos. 1, 2, 5, 6 and 8 are, according to Tryon's classification, referable to *Ranularia*. Nos. 3, 4, 7, 9 and 10 to *Lampusia*. *Lotorium tritonis* is connected, though not so perfectly, to the typical group by—*nodiferus*, *bassi*, *subdistortus*, *tumulosus*, *philomelæ*,* *oligostirus*, *eburneum*, *quoyi*, etc.

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* Watson, Chall. Rep. Zool. xv., p. 391, pl. xiv., f. 10 (1885).

Nos. 4 and 6 of this series are Australian Tertiary species (34, 122, 126).

An attempt has been made in the accompanying tables to show at a glance the intricate relationship existing between the various groups.

lotorium
|
pyrum

cynocephalus
|
sarcostoma
|
exaratus

vespaceus

gemmatus
|
mundum
|
pilearis
|
tranquebaricus
|
waterhousei

spengleri
|
doliarium

chemnitzi
|
succinctus
|
cingulatus
|
etc.

gemmatus
|
intermedius
|
quoyi
|
verrucosum

chlorostoma
|
thersites
|
orientalis
|
crispus
|
quoyi
|
verrucosum
|
eburneum
|
oligostirus
|
philomelæ
|
tumulosus
|
subdistortus
|
bassi
|
nodiferus
|
tritonis

dunkeri
|
tuberosus
|
encausticus
|
caudatus
|
exaratus

lotorium
|
pyrum
|
dunkeri
|
tuberosus
|
encausticus
|
caudatus
|
exaratus
|
vespaceus
|
gemmatus
|
intermedius
|
quoyi
|
crispus
|
orientalis
|
thersites
|
chlorostomus
|
exaratus
|
sarcostoma
|
cynocephalus
|
pyrum
|
lotorium

These tables, judged by the form of the shell, are, I submit, correct, and serve to prove the impossibility of dividing the genus into four.

Australian Fossil Species.

That their relationships are to recent species occurring only in southern waters is one of the facts which strike the student of Australian fossil LOTORIIDÆ. *L. quoyi*, Reeve, exists fossil as well as recent. *L. philomelæ* is so like *L. oligostirum*, Tate, that it might be as aptly termed a "living fossil" as *Trigonia.* Other recent allies of these are *L. verrucosum*, *eburneum*, and *nodocostatum* from Southern Australia. *L. parkinsonianum* is the recent representative of *L. radiale*, *abbotti*, *textile*, *woodsi*, and *tortirostris.* This group is more distinct than any I have studied. *L. tortirostris* bears a resemblance to *L. waterhousei;* but, to institute a comparison, this resemblance is not so great as that existing between *L. subdistortum* and *bassi.* As already stated, if it is advantageous to name the groups, *Septa* must be reserved for this one. The species *tumulosum* is nearly allied to *subdistortum*, whilst *bassi* is represented by *ovoideum*, and an undetermined species intermediate between them. *Lotorium protensum* is possibly an archaic form, and resembles somewhat the FUSIDÆ from which the genus is apparently descended. *Lotorium cyphus* seems to stand alone; it might be considered as shadowing forth *Distortio*, and bears a striking resemblance to *Cassidaria gradrata*, Tate (35, 169); this resemblance is, however, dispelled on comparing young specimens. The existence of such widely different species as *protensum* and *cyphus* in an early Tertiary stratum points to a much earlier horizon for the genus than the text-books admit; the wide distribution of the genus in Tertiary times is also evidence of this.

The *parkinsonianum*-group is of particular interest from a zoogeographic and palæontological point of view. The type is to be regarded as the *only surviving species* of an otherwise *extinct Antarctic group.* There are in Southern Australian beds six or nine species; in Patagonian beds one (*L. bicegoi*); and the New Zealand Tertiary species, *L. minimum*, is probably referable here also. We have here, then, another link in the already strong chain of faunal relationship shown to exist between these three countries.

To the palæontologist this group should be of particular interest as throwing light on the vexed question of the age of the deposits in which they are found.

A. E. Ortmann (25, 303), compares the Patagonian with European fossils, and then compares the former with Australian and New Zealand fossils, and says :—

"*The result of the foregoing consideration is: We regard the Patagonian beds as of Lower Miocene age; contemporaneous deposits are found in the southern hemisphere, not only in Chili (within the Navidad series), but also in New Zealand (Pareora beds of Hutton) and Australia.*" The italics are in the original. The Australian beds referred to, are apparently those from which the fossils under discussion are derived.

As a support to the "Lyellian percentage" method of estimating the age of a deposit, the broader comparison of the genera contained therein, with those from deposits of determined age, and with recent representatives, should give more satisfactory results than would a comparison of the species in detail. For this purpose the genus *Lotorium*, being well represented, is of especial value to the Australian palæontologist. Thus, if we compare this genus as it occurs in the lower Australian strata with European Miocene representatives, we are presented with two entirely different types of the genus. The predominating feature of the Australian section—that of the extinct Antarctic group—finds expression in only one European fossil (*L. tarbellianum*). Again, if the two groups be compared with the recent representatives, it will be seen that the European section has the general facies of the recent species, whilst the Australian fossils can, with one exception, be only compared *inter se*. *L. quoyi* and the Australian fossils possibly referable to its group are from more recent deposits than the *parkinsonianum*-group. These facts, namely, that the *predominating feature of the Australian group is that of an extinct section*, and that the *European group has the general facies of the recent species*, assuredly point to the greater antiquity of the Australian fossils.

A comparison of the species in detail would show a single related species in all four localities, and, therefore, give an erroneous impression that the beds were of similar age.

The Evidence of Literature.

A detailed examination of literature has resulted in the discovery of greater support for the arguments I have advanced than I expected when writing the last part of this paper. I have found that the majority of the species spoken of as being referable to or connecting two of the divisions proposed by Tryon and others have been, by different writers, placed in both sections.

Tryon (37, 9) says :—"The species of *Triton* being numerous several attempts have been made to separate them into generic or subgeneric groups, the most successful being the arrangement of Messrs. H. and A. Adams (1)." Previous arrangements never having attained any degree of acceptance, I will date my comparisons from this one. Subsequent classifications are those of Kobelt (20), Gray (13), Fischer (12), Chenu (5), Tryon (36), Melvill and Standen (24), and Dall and Simpson (8). Kobelt's arrangement being the same as Tryon's, and Chenu's the same as that of H. and A. Adams, they are not included in the following table :—

Gray.	Tryon.	H. & A. Adams.	Fischer.	Melvill and Standen.	Dall and Simpson.
Triton, s.st.	*Triton*, s.st.	*Tritonium*, s.st.	*Triton*, s.st.	?	SEPTA
Lampusia	*Simpulum*	*Simpulum*	*Simpulum*	? *Simpulum*	LAMPUSIA
Aquillus	**Cabestana**	*Cabestana*	**Aquillus**	? *Aquillus*, s.st.	Do.
? *Monoplex*	**Linatella**	Wanting	**Linatella**	? Do.	Do.
Lotorium	*Cymatium*	*Cymatium*	**Lotorium**	? *Lotorium*	LOTORIUM
Ranularia	*Gutturnium*	*Gutturnium*	*Ranularia*	? Do.	RANULARIA
Wanting	**Cumia**	Wanting	Wanting	Wanting	Wanting

Generic names in small capitals, subgeneric in italics, group names in black type.

From this table it will be seen that though there is a general agreement as to the number of sections, in no one point do any five of these writers agree as to the values of the sections.

Cymatium is regarded by the brothers Adams, Kobelt, and Tryon as a subgenus; Fischer deemed it a section of *Simpulum;* Melvill and Standen apparently treat it as a section of *Gutturnium;* whilst Dall and Simpson consider it a full genus. Such a diversity of opinion can only be attributed to the imperfection of this line of classification.

The arrangement of Melvill and Standen is given in such a haphazard way that it is possible I have not rightly interpreted it. They regard *Aquillus* as the name which should be accepted for the genus as a whole, and enumerate five species in the following order:—

Aquillus chemnitzi, Gray (= *A. tranquebaricus*, Lamk.)
,, (*Lotorium*) *lotorium*, Linn.
,, (*Simpulum*) *aquatilis*, Reeve.
,, (*Lotorium*) *retusus*, Lamk.
,, (*Lotorium*) *tripus*, Lamk.

Two facts, however, are plain—(1) *Lotorium*, according to these writers, includes forms referred by Tryon to *Cymatium* and *Gutturnium;* and (2) *Simpulum* of Tryon is divided into two.

I now proceed to discuss the "shuttle-cock" fate of some of the species. The first species, instanced as connecting *Cymatium* and *Gutturnium* (*L. cynocephalum*) has been referred: by Kobelt, to *Cymatium;* by Tryon, to *Gutturnium;* and by Dall and Simpson, to *Simpulum. L. pyrum* is referred by the brothers Adams to *Gutturnium*, and by Tryon to *Cymatium.* Kobelt has placed *L. dunkeri* in *Gutturnium*, whilst Tryon assigns it a place in *Cymatium.* I have spoken of the "*quoyi*"-group as connecting *Simpulum* and *Gutturnium.* Watson compared his species *L. philomelæ* to *L. quoyi*, and yet placed it in *Simpulum*, from which it may be concluded that he regarded the latter as referable to that section also. Dall (7, 226) has referred *L. olearium*, Linn (Tryon ?) = *L. costatum*, Born, to *Ranularia.*

Believing that it is the best form in which to put matter of this kind, I have tabulated these differences of opinion.

Species.	Sections to which they have been referred by		
	Kobelt.	Tryon.	H. & A. Adams.
L. lignarium, Brod.	*Simpulum*	*Linatella*	*Simpulum*
L. pfeifferianum, Reeve	*Simpulum*	*Gutturnium*	*Simpulum*
L. cynocephalum, Lamk.	*Cymatium*	*Gutturnium*	*Gutturnium*
L. dunkeri, Lischke	*Gutturnium*	*Cymatium*	not mentioned
L. pyrum, Linn.	*Cymatium*	*Cymatium*	*Gutturnium*

The Apices.

Recent species.

It is here shown that the apices do not present a feature on which the species of the genus can be grouped. Twenty-six protoconchs, including nine of fossil species, are figured and described; and descriptions of a few others are culled from various sources. The species are from all the groups except *Lotorium*. I have found, as might have been anticipated, that species conchologically very similar have similar apices. It has not, however, followed that species conchologically dissimilar have dissimilar apices. *L. succinctum*, Lamarck, has an apex exactly the same as that of *L. exaratum*, Reeve; and the apex of *L. pileare*, Linn., differs very slightly from that of *vespaceum*, Reeve. The protoconchs of the recent species are all of one type, differing from one another in the number and convexity of the whorls and in colour. They consist of a thin coating of lime inside a corneous original. The lime is apparently not generally deposited until the mollusc starts the adult structure. Protoconchs of *L. spengleri*, Chemn., and *L. exaratum*, Reeve (?), to which no adult structure was attached, were not acted upon in any way when immersed in pure hydrochloric acid. That the corneous coating is only outside, not inside as stated by Reeve (30), is proved by the fact that the apices of adult specimens from which the external coating had been removed, were entirely demolished by the same treatment. In none of the species studied has it been found possible to define a nepionic stage; in every instance the sculpture of the postembryonic structure, which immediately adjoins the protoconch, is, in miniature, that of the adult; nor is there in any of the species a varix formed of embryonic structure. In one or two instances, however, the adult structure begins with a small varix. It appears that a suggestion made by the writer in a previous paper (19) applies particularly to the species of *Lotorium*, and that none of them have left a conchological record of the nepionic stage. It might have been inferred that the protoconch had been deposited inside an original corneous one. Judging by those species which I have been able to study, the whole shell is cast inside its epidermal coating. After a rest-period the epidermis grows very quickly and extends beyond the shell (the writer has seen as much as half an inch overhanging, with the merest "stiffening" of lime inside it), and inside this the shell is deposited. It may be worthy of note here that in *Lotorium*, at least, a varix is indicative of a "period of growth" of the mollusc rather than of a "period of rest" of the shell. After the formation of a varix [the gutter which Reeve describes (l.c.)], and while the shell anterior to the preceding varix is yet thin, the mollusc does not fill the cavity nearly so much as when this part of the shell is thickened. The shell is enlarged by periods, faster than the mollusc grows, which while growing is employed strengthening its shell, not enlarging it. Harris (15, p. xii.) speaks of variation in the size of apices of the same species. Among fossils the variation is plainly noticeable, but as far as my experience goes, it is practically non-existent among recent species.

The following descriptions, like the figures on the plates, have been arranged to show the perfect graduation from the tall apex of *L. exaratum* to the very flat one of *quoyi*. The letter A indicates that species so marked have been referred by Tryon to *Simpulum*; B indicates *Gutturnium*. It is worthy of note that the *first* and *last* of the series are marked with a B. Contour is not described, the figures being considered sufficient description thereof.

LOTORIUM CORNUTUM, Perry, sp. B.

(Plate xvii., fig. 10.)

Triton exaratus, Reeve; Tryon, Man. Conch. iii. p. 22, pl. 12, fig. 104.

Apex of four and one-half whorls, brown, semitransparent, smooth, shining, covered with a thin brown epidermis. I have in the paper referred to above figured this apex under the name of *Tritonium olearium*, Linn.

LOTORIUM COSTATUM, Born, sp. A.

Triton succinctus, Lamarck; Tryon, op. cit. p. 11, pl. 6, f. 37.

I have not thought it necessary to figure this apex; it is exactly similar to that of the preceding species.

LOTORIUM VESPACEUM, Lamk., sp. B.

(Plate xvii., fig. 11.)

Triton vespaceus, Lamk.; Tryon, op. cit. p. 22, pl. 12, f. 94.

Apex of four and one-half whorls, fairly solid, opaque, dark brown at the sutures with a lighter band medially; covered with a light brown epidermis.

LOTORIUM CHLOROSTOMUM, Lamk., sp. A.

(Plate xvii., fig. 12.)

Triton chlorostomus, Lamk.; Tryon, op. cit. p. 13, pl. 7, f. 47.

Apex of four and one-half whorls, semitransparent, smooth, shining, covered with a thin light brown epidermis.

LOTORIUM AQUATILE, Reeve, sp. A.

(Plate xvii., fig. 13.)

Triton pilearis, Linn.; Tryon, op. cit. p. 12, pl. 6, f. 31.

Apex of four and one-half whorls, rather solid, semitransparent, light brown, smooth, shining, covered with a thick brown epidermis.

LOTORIUM SINENSE, Reeve, sp. B.

(Plate xvii., fig. 14.)

Triton sinensis, Reeve; Tryon, op. cit. p. 20, pl. 11, f. 85.

Apex of about four whorls, very slightly transparent, light brown, smooth, shining, covered with a rather thick epidermis. The tip of the specimen figured is broken off, but there is enough to show its position in the series.

LOTORIUM GEMMATUM, Reeve, sp. A.

(Plate xvii., fig. 15.)

Triton gemmatus, Reeve; Tryon, op. cit. p. 13, pl. 7, f. 41.

Apex of four and one-half whorls, semitransparent, white, smooth, shining, covered with a thin light brown epidermis.

LOTORIUM ELONGATUM, Reeve, sp. B.

(Plate xvii., fig. 16.)

Triton elongatus, Reeve; Tryon, op. cit. p. 22, pl. 12, f. 96.

Apex shorter and narrower than that of *L. vespaceum*, but resembling it in other respects.

LOTORIUM TUBEROSUM, Lamk., sp. B.

(Plate xvii., fig. 17.)

Triton tuberosus, Lamk.; Tryon, op. cit. p. 23, pl. 13, f. 111.

Apex of four whorls, semitransparent, light brown above, dark brown at the anterior suture, smooth, shining, covered with a thin brown epidermis.

LOTORIUM THERSITES, Reeve, sp. B.

(Plate xvii., fig. 18.)

Triton thersites, Reeve; Tryon, op. cit. p. 32, pl. 12, ff. 99, 100.

Apex of three whorls, semitransparent, light brown, smooth, shining, covered with a thin light brown epidermis.

Lotorium spengleri, Chemn., sp. A.

(Plate xvii., fig. 19.)

Triton spengleri, Chemn.; Tryon, op. cit. p. 16, pl. 9, f. 61.

The apex of this species has been described in a previous paper (19, p. 713). A figure is given here to complete the series. The apex of *L. waterhousei*, Angas, is almost exactly similar to this.

Lotorium strangei, Ad. and Ang., sp. A.

(Plate xvii., fig. 20.)

Triton strangei, Ad. and Ang.; Tryon, op. cit. p. 17, pl. 9, f. 67.

Apex of three and one-half whorls, fairly solid, opaque, shining, smooth, dark brown, covered with a thick dark brown epidermis, which under a lens shows four spiral threads, a few transverse ones equally thick, and close set growth-striæ.

Lotorium rutilum, Menke, sp. A.

(Plate xvii., fig. 21.)

Tritonium rutilum, Menke, Moll. Nov. Holl. Spec. 1843, p. 25.

Apex of three and one-half whorls, rather solid, opaque, polished, smooth, light brown; covered with a thick dark brown epidermis, which is, under a lens, ornamented with four spiral threads and close-set growth-striæ.

Lotorium labiosum, Wood, sp. A.

(Plate xvii., fig. 22.)

Triton labiosus, Wood; Tryon, op. cit. p. 17, pl. 9, f. 65.

Apex of three whorls, semitransparent, smooth, shining; the epidermis was cleaned off the specimens studied.

Lotorium verrucosum, Reeve, sp. B.

(Plate xvii., fig. 23.)

Triton verrucosus, Reeve; Tryon, l.c., p. 24, pl. 13, f. 117.

Apex of one and one-half whorls, white, semitransparent, smooth, shining. No epidermis on the specimens studied.

LOTORIUM EBURNEUM, Reeve, sp. B.

(Plate xvii., fig. 24.)

Triton eburneus, Reeve; Tryon, op. cit. p. 24, pl. 13, f. 115.

Apex of one and one-half whorls, light brown, semitransparent, smooth, shining; covered with a thin light brown epidermis.

LOTORIUM QUOYI, Reeve, sp. B.

(Plate xvii., fig. 25.)

Triton quoyi, Reeve; Tryon, op. cit. p. 24, pl. 13, f. 116.

Apex of one and one-half whorls, dark brown, smooth, shining. No epidermis on the specimens examined.

LOTORIUM NODOCOSTATUM, Tate and May, sp.

(Text fig. 1.)

Lampusia nodocostata, Tate and May, Trans. Roy. Soc. S. Aust., xxiv., 1900, p. 90; Proc. Linn. Soc. N.S. Wales, xxvi., 1901, p. 355, pl. xxiii., f. 2.

Apex of three and one-half whorls, perforate, turbinate, white, semitransparent, polished. The sculpture consists of six faint revolving lines, of which that on the periphery is the most pronounced, and of oblique growth-striæ, some of which are stronger than others. Dimensions: length 5, breadth 3·3 mm.

The large size of this protoconch marks it as unique among recent species. Notwithstanding its entirely normal plan of coiling, it appears to me to be a direct link between the mammillate, excentric apices of some fossils, and the normal apices of the recent species.

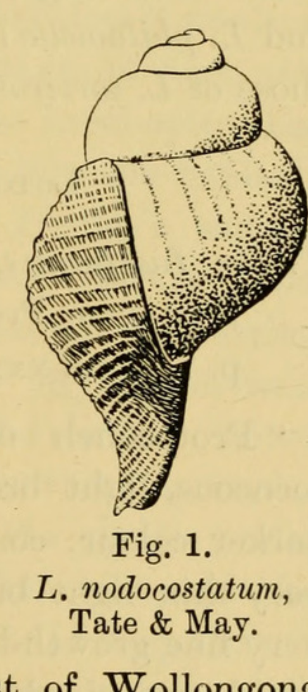

Fig. 1.
L. nodocostatum, Tate & May.

To Mr. C. Hedley I am indebted for the opportunity of figuring and describing this apex, from material dredged by him from a depth of one hundred fathoms 16 miles east of Wollongong, N.S.W. The species has been identified by comparison with a cotype kindly lent me by Mr. W. L. May.

Lotorium rubicundum, Perry, sp.

(Text fig. 2.)

Triton nodiferum, Lamk.; Tryon, op. cit. p. 10, pl. 3, f. 17.

Apex of three and one-half whorls, semitransparent, delicate pink, smooth, shining.

The large size and bright colour of this apex give it a different character from any of the others. Although semitransparent, it has an appearance of strength which others lack. The epidermal original is cast very early in the life of the individual; a specimen of only four adult whorls, obtained alive, shows no sign of it. That it had an original corneous mould may be generally proved by breaking off the tip of the protoconch, when the remains will be seen attached to the base of the piece broken off, or to the top of the part remaining.

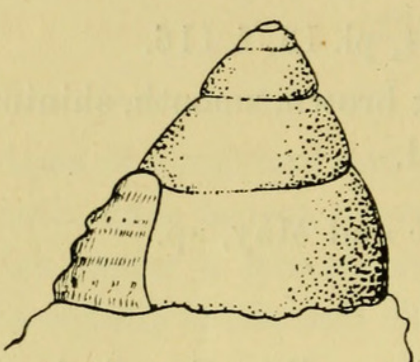

Fig. 2.
L. (Septa) nodiferum, Lamk.

The following descriptions of the apices of *L. parkinsonianum* and *L. philomelæ* are reprinted that they may be compared with those of *L. tortirostris* and *L. oligostirum* on pp. 469, 470.

Lotorium parkinsonianum, Perry, sp.

Triton fusiformis, Kiener; Tryon, op. cit. p. 11, pl. 4, f. 22; Kesteven, Proc. Linn. Soc. N.S. Wales, xxvi., 1901 (1902), p. 712, pl. xxxv., ff. 3, 4, 5.

"Protoconch ovoid, umbilicate, thin, semi-pellicid, shining, corneous, light brown, variously marked with spots or stripes of darker colour; consisting of about three whorls, covered with a very thin light brown epidermis. Transversely sculptured with very fine growth-lines; the epidermis supplies four ciliated ridges which encircle the last whorl, the top one of which is continued on the earlier whorls. . . ."

LOTORIUM PHILOMELÆ, Watson, sp.

Triton (*Simpulum*) *philomelæ*, Watson, Chall. Rep. Zool. xv., 1885, p. 391, pl. xiv., f. 10.

"Apex consists of four polished but spirally threaded, white, turbinated whorls, of which the first is extremely small and somewhat immersed."

LOTORIUM PHARCIDUM, Dall, sp.

Lampusia pharcida, Dall, "Blake Mollusca," pt. ii., p. 227, pl. xxxvi., f. 1.

"A four-whorled subcylindrical nucleus; nucleus smooth with rounded subequal whorls and a rather blunt apex." This protoconch somewhat resembles that of *L. vespaceum*, but is not so tapering.

Fossil Species.

One of the most noticeable features of these fossils was the large number of specimens which had their apices complete (over 70 per cent.). Among recent species I had, like Mr. Baker (3), found that only about five per cent. retained their apices. Talking over this matter with Mr. C. Hedley, he suggested that it was in a great measure due to their having been inhabitants of deep and still waters. Though the greater strength of the fossil apices has doubtless been a contributing cause, an inquiry into the habitats of living allies has provided support for Mr. Hedley's suggestion. He has (17) in dealing with the "Thetis" PELECYPODA instanced several cases of fossil species or their near allies occurring off the coast of New South Wales in deep water. My own investigations have disclosed the fact that many of the shells collected by the "Challenger" in deep waters of high southern latitudes have near allies in the fossil beds from which the species under discussion were obtained. It is thus seen that many of the nearest living allies of these fossils are inhabitants of deep waters, and it might reasonably be inferred that they themselves occupied similiar localities. This inference cannot, however, safely be pressed too far, for Tate (35) has shown that many of the species now inhabiting the tidal zone also occur in these beds. The tabulation of these relationships would be productive of interesting results.

The protoconchs of *Lotorium protensum* and *abbotti* are similar to those of the FUSIDÆ, the elongate, fusiforme shape of the latter also recalling that family. It is from this group that I would suggest the genus *Lotorium* is descended.

A prominent character of all the apices examined is their spiral sculpture. This, it is interesting to find, exists in two recent species (*L. nodocostatum* and *L. philomelæ*),* and is sometimes found on the corneous originals of other species. On a superficial, or first examination, the student is apparently presented with two or three different types of apex. A closer study discloses the fact that they are morphologically only varieties of one form. The difference lies in the size of the nucleus, and the extent of its depression or elevation. A study of the apices in profile gives the first impression, whilst this view studied in conjunction with the view from above, proves the correctness of my conclusion. The following are the apices studied; like those of the recent species they have been arranged in a graduation; that from the very eccentric protoconch of *L. woodsi* to the normal ones of *oligostirum* and *tortirostris*. These two being normal they have not been figured from above :—

LOTORIUM WOODSI, Tate, sp.

(Plate xvii., fig. 1.)

Triton woodsi, Tate, Proc. Roy. Soc. S. Aust., x., 1886-7 (1888), p. 119, pl. v., f. 4.

Apex of two whorls; the first half whorl perpendicular to the plane of coiling of the shell; second half normal, but slightly overlapping the second whorl; first whorl smooth, dull; second whorl normal, polished, faintly biangled, sculptured by two revolv-

* *Vide* also *P.* [= *L.*] *fraterculum*.

ing liræ and close-set transverse striæ. Towards the end of the embryonic structure there are faint indications of three extra spiral liræ, which are suddenly developed on the adult structure.

The sculpture of the anterior whorl of this and all other species studied (with one exception ?) fades away as the nucleus is approached.

LOTORIUM RADIALE, Tate, sp.

(Plate xvii., fig. 2.)

Triton radialis, Tate, op. cit. p. 118, pl. v., f. 8.

Apex of a little more than one and one-half whorls, polished; nucleus mammillate, eccentric, placed rather to one side of the centre, in some instances slightly overlapping the succeeding whorl; the rest of the protoconch normal, gradually acquiring a sculpture consisting of three spiral threads, the uppermost median, and faint transverse growth-striæ. There is also a very faint indication of a fourth spiral thread half-way between the uppermost of the three mentioned and the posterior suture.

Harris (15, p. 187, pl. vi., f. 6) describes this apex as consisting of two and one-half whorls, whilst his figures show the number I have found. The term "lateral" applied by Tate and Harris to the nucleus of this and other protoconchs of this series is somewhat misleading. The whole apex is truly spiral, but the nucleus being somewhat mammillate and large relatively to the rest of the protoconch is placed eccentrically. This apex is defined by a complete change in the sculpture of the shell.

LOTORIUM TUMULOSUM, Tate, sp.

(Plate xvii., fig. 3.)

Triton tumulosus, Tate, op. cit. p. 122, pl. v., f. 2.

"Apex of two polished whorls; the anterior one is high, bicarinated, and transversely striated; the posterior one, encircling a shallow concavity, at first suddenly narrowed, then somewhat depressedly dilated, and ending in a blunt appressed point."

The above is Tate's description of this apex, and well describes the specimens I have been enabled to examine, except that in some instances two small spiral threads may be seen below the anterior carination. Though all the specimens examined exhibit the same characters the abrupt termination of the sculpture and "suddenly narrowed" posterior whorl present all the features of a caducous cast and subsequent shedding of the nuclear whorls. At the beginning of the adult structure the lower threads become suddenly strengthened, and all become somewhat nodulose.

Among recent species, *L. subdistortum*, Lamk., drops its protoconch at a very early stage. Dr. Verco, who has sent me specimens of only two and one-half whorls, says he has never taken a specimen with its protoconch attached.

LOTORIUM ABBOTTI, Tenison-Woods, sp.

(Plate xvii., fig. 4.)

Triton abbotti, Ten.-Woods, Proc. Roy. Soc. Tas. 1875 (1876), p. 24, pl. i., f. 8.

Apex of a little more than two whorls; nucleus very small, central, rapidly enlarging; posterior whorl nearly as large as the anterior, first whorl and one-half smooth, polished; thence the sculpture which ornaments the adult shell is gradually developed.

Tate describes (l.c., p. 117) four and one-half whorls to this apex; it is only very faintly defined (at the dotted line on my figure), and it is, therefore, probable that he reckoned from the first varix.

The specimens from which this apex is described are from Schnapper Point, but they have been carefully compared with specimens from the type locality, and there can be no doubt as to their identity.

LOTORIUM PROTENSUM, Tate, sp.

(Plate xvii., fig. 5.)

Triton protensus, Tate, op. cit. p. 124, pl. v., f. 10.

Apex of a little less than two whorls, polished; nucleus small, placed a little to one side of the centre, rapidly enlarging; anterior whorl sculptured with two or three spiral threads, and very fine transverse striæ. This apex is absolutely undefined. I agree with Tate in considering its termination to be a little anterior to the first appearance of sculpture.

LOTORIUM CYPHUS, Tate, sp.

(Plate xvii., fig. 6.)

Triton cyphus, Tate, op. cit. p. 119, pl. v., f. 11.

Apex of one and one-half whorls, polished; nucleus slightly mammillate, but placed centrally; the anterior whorl sculptured by a distinct median and two postero-median spiral threads, and by transverse growth-striæ.

This protoconch is defined by the acquisition of the numerous spiral liræ with which the adult shell is ornamented.

LOTORIUM ANNECTANS, Tate, sp.

Triton annectans, Tate, op. cit. p. 121, pl. v., f. 3.

"The protoconch of this species is similar to that of *L. tortirostris* in being somewhat elevated, roundly turbinate, and spirally striated; it is composed of three and one-half to four whorls, and the striæ, which are four in number, equidistant and very pronounced, decrease in size on being traced backwards; the top of the larval shell is extremely minute and central" (Harris, l.c., p. 192, pl. vi., f. 7).

LOTORIUM OLIGOSTIRUM, Tate, sp.

(Plate xvii., fig. 7.)

Triton oligostirus, Tate, op. cit. p. 126, pl. vi., f. 7.

Apex normal, of three polished whorls, nucleus slightly depressed, first two whorls smooth, thence an ornamentation of four spiral threads and oblique growth-striæ is gradually developed. At the termination of the embryonic shell the structure changes completely.

Compare with this Watson's description of the apex of *Lotorium philomelæ*.

Lotorium tortirostris, Tate, sp.

(Plate xvii., fig. 8.)

Triton tortirostris, Tate, op. cit. p. 123, pl. v., f. 7.

Apex normal, of three whorls, polished, nucleus very slightly depressed, the anterior whorl ornamented by a median spiral ridge, and a very slight thread midway between this and the posterior suture, transversely obliquely striate, defined by the acquisition of the adult sculpture.

Compare with this the description of the protoconch of *L. parkinsonianum*, Perry.

Lotorium textile, Tate, sp.

(Plate xvii., fig. 9.)

Triton textilis, Tate, op. cit. p. 120, pl. v., f. 12.

" Apex acute of three rounded lirate whorls, ending in an acute upward-curved point."

The above is Tate's description; none of the specimens I have examined possess perfect protoconchs. The sculpture on the anterior whorl of the specimen figured consists of six revolving threads and rather distant fine growth-striæ. This apex is not clearly defined; its termination seems to be indicated by a slight transverse swelling (an aberrant varix?), and the ending of the polished surface. Judging from the material to hand it seems probable that Tate counted from the first varix.

The apex has rightly been considered a feature of systematic importance by most recent writers. Unless, as is evident we should do, we regard all the apices here discussed as varieties of one generic type, the division of this group will present some extraordinary anomalies. If the group is to be split up into various genera it will be impossible to disregard the form of the apices, now that we know so much about them ; and we shall have such dissimilar species as *L. costatum*, Born, and *L. cornutum*, Perry, in the same genus, and species so absolutely alike as *L.*

tortirostris and *L. radiale* in different genera. Considered as varieties of one type, they may, for the convenience of the monographer, be disregarded.

"A number of species have a world-wide distribution, which is doubtless due to their free-swimming or pelagic larvæ" (Tryon, op. cit. p. 7). I am inclined to carry this statement further, and to say that the distribution of a species is largely decided by the size of its protoconch. Most of the species with many-whorled protoconchs have a very wide distribution, whilst those with small protoconchs are rather local. There are exceptions to this. *L. cornutum*, Perry, with a many-whorled apex ranges over a small area, whilst if Tryon is correct in regarding *L. loroisii*, Petit, as a synonym of *L. labiosum*, we are presented with a species having a small protoconch and a practically world-wide distribution.

Conclusions of Part ii.

My conclusions are that the subgeneric names heretofore used under "Triton" are redundant and altogether useless. To quote them conveys no more than would the generic name alone. It is impossible to treat them as full genera; to do so would create confusion. References to several species would have to be sought under two or three genera. After eliminating *L. clandestinum*, all the species enumerated by Tryon under *Simpulum*, *Cymatium* and *Guturnium* form one section, which it is impossible to divide into groups, if such groups are to be regarded as nomenclatural entities. If from Tryon's "*Triton* s.st" *L. subdistortum* and *L. parkinsonianum* are withdrawn, and *L. ovoideum* added, we have a second section; a third, as already stated, is formed by *L. parkinsonianum* and some of the Australian Tertiary species. Should it be decided advisable to give the sections quotable names, the above are the three which must be first recognised; any further subdivision is to be deprecated.

I am of the opinion that *none* of the sections are sufficiently distinct to rank as subgenera, and submit the following arrangement of the species of the genus.

In this arrangement I have included only those fossil species of which I have been enabled to examine actual specimens. I note, however, that *Lotorium apenninicum*, Sassi (the type of Bellardi's subgenus *Sassia*), might, judging by Hoernes and Auigner's figures (18), be included in my "*quoyi*"-group. If this is so, I cannot concede that the subgeneric name is a useful one:—

Genus Lotorium.

Typical group.

L. lotorium, Linn.
L. tigrinum, Brod.
L. femorale, Linn.
L. grandimaculatum, Reeve.
(*L. münsteri*, Anton ?)

Group of *L. costatum*.

L. costatum, Born.
L. waterhousei, Angas.
L. barthelemyi, Bern.
L. brasilianum, Gould.
L. chlorostomum, Lamk.
L. spengleri, Chemn.
L. chemnitzi, Gray.
L. cutaceum, Linn.
L. tranquebaricum, Lamk.
L. doliarium, Linn.
(*L. africanum*, A. Ad.; *L. fossatum*, Gould ?)

Group of *L. cingulatum*.

L. cingulatum, Lamk.
L. voigtii, Anton.
L. poulsenii, Mörch.

Group of *L. pileare*.

L. pileare, Linn.
L. aquatile, Reeve.
L. mundum, Reeve.
L. ficoides, Reeve.
L. durbanense, Smith.
L. veliei, Calkins.
L. krebsii, Mörch.
L. intermedium, Reeve.
L. gemmatum, Reeve.
L. rubeculum, Linn.
L. beccarii, Tap.-Can.
L. lineatum, Brod.

Group of *L. labiosum*.

L. labiosum, Wood.
L. rutilum, Menke.
L. orientale, Nevill.
L. strangei, Ad. & Ang.
L. loroisii, Petit.
L. crispum, Reeve.

Group of *L. cynocephalum.*

L. cynocephalum, Lamk.
L. moritinctum, Reeve.
L. pyrum, Linn.
L. sarcostomum, Reeve.

Group of *L. tuberosum.*

L. tuberosum, Lamk.
L. retusum, Lamk.
L. dunkeri, Lischke.
L. encausticum, Reeve.
L. clavator, Lamk.
L. mauritianum, Tap.-Can.

Group of *L. trilineatum.*

L. trilineatum, Reeve.
L. sinense, Reeve.
L. gallinago, Reeve.
L. exile, Reeve.
L. cornutum, Perry.
L. pachycheilos, Tap.-Can.
L. testudinarium, Ad. & Reeve.
L. aegrotum, Reeve.
L. moniliferum, Ad. & Rve.
L. caudatum, Gmel.
L. pyrulum, Ad. & Rve.
L. tripus, Lamk.
L. pfeifferianum, Reeve.

Group of *L. gibbosum.*

L. gibbosum, Brod.
L. pharcidum, Dall.
L. lœbecckei, Lischke.

Group of *L. vespaceum.*

L. vespaceum, Lamk.
L. thersites, Reeve.
L. amictum, Reeve.
L. elongatum, Reeve.
L. gracile, Reeve.
L. tenuiliratum, Lischke.

Group of *L. quoyi.*

L. quoyi, Reeve.
L. verrucosum, Reeve.
L. philomelæ, Watson.
L. eburneum, Reeve.
L. nodocostatum, Tate & May.
L. oligostirum, Tate.

Group of *L. convolutum.*

L. convolutum, Brod.
L. scalariforme, Brod.*

Group of *L. parkinsonianum.*

L. parkinsonianum, Perry.
L. abbotti, T.-Woods.
L. textile, Tate.
L. radiale, Tate.
L. woodsi, Tate.
L. tortirostris, Tate.

* These two species will probably prove to be *Trophon.*

Group of *L. tritonis*.

L. tritonis, Linn.
L. rubicundum, Perry.
L. saulicæ, Reeve.
L. ovoideum, Tate.
L. variegatum, Lamk.
L. australe, Lamk.
L. bassi, Angas.

The following species are not conveniently referable to any of the above groups:—

L. subdistortum, Lamk.
L. cyphus, Tate.
L. clandestinum, Lamk.†
L. tumulosum, Tate.
L. protensum, Tate.
L. fraterculum, Dkr.

Species incertæ sedis.

L. granulatum, Dunker.
L. birostomum, A. Ad.
L. papillosum, A. Ad.
L. contabulatum, Anton.
L. tringa, A. Ad.
L. nodoliratum, A. Ad.
L. dorsuosum, A. Ad.

This arrangement, which is similar to that adopted by Pilsbry for the species of the various genera of *Helices* (28), and Simpson for the *Naiades* (31), has advantages possessed by no previous arrangement of the genus. None of the sectional names are quotable, and are, therefore, not additions to an already over-burdened nomenclature. As they consist of essentially similar species a reference to one of these groups should at once convey to the reader a tangible type; they should, on that account, be of service to the specialist and to the general conchologist when describing new forms. A monograph arranged in this way should greatly facilitate identifications. Since I have worked to some extent from figures and descriptions only, some of my groups may contain species which break their uniformity.

Miscellaneous Notes.

While at work on this paper I have made miscellaneous notes of interest, and arrived at conclusions at variance with Tryon's

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† *Vide post*, p. 479.

specific nomenclature. I have thought it would be useful to collect these together.

Lotorium waterhousei, Ad. & Ang.

This species, rightly treated as distinct by Tryon, has been relegated to the synonymy of *L. spengleri*, Chemnitz, by Pritchard and Gatliff (29, 264). The revolving ribs of *spengleri* are broader than their interstices; those of *waterhousei* are only half as broad, and duplicate. The transverse liræ of the former are very much coarser than those of the latter. The varices of *L. waterhousei* are filled up inside, whereas in *L. spengleri* the porcellanous interior may be seen in every varix. The epidermis of *L. spengleri* is quite smooth; that of *waterhousei* is, as its authors say, "squamato-pilose." In Port Jackson, where *L. spengleri* is to be found on most of the rocks, *L. waterhousei* never occurs.

Lotorium gracile, Reeve.

Both Watson (39, 394) and Dall (7, 227) disagree with Tryon that this is a synonym of *L. vespaceum.*

Lotorium parkinsonianum, Perry.

I have said of this species that it is not related to the "*tritonis*" group. In arriving at this conclusion I have been influenced by the evolution of the species as evidenced by its stages of growth. It is one of the few species in which a neanic stage is plainly definable. I regard it as being a very recent species evolved from *L. tortirostris*, Tate. My reasons for so regarding it are—(1) it has the contour of this species; (2) had it existed in Tertiary times it is reasonable to suppose it would have been found in these beds, especially as (3) it is common on the coasts of South-Eastern Australia; (4) in the neanic stage it is ornamented with the complex sculpture of this form (vide 19, pl. 36, ff. 3, 4); (5) some specimens of *L. tortirostris* show a tendency to lose their complex sculpture on the ultimate whorls. On the other hand, there is undoubtedly an underlying, but indefinable, resemblance to the "*tritonis*"-group. This, it seems, is to be attributed to a "convergence of development" rather than a real affinity; for if the species of this group have been evolved from ancestors ornamented with a complex sculpture, it was at an earlier period than that at which *L. parkinsonianum* was evolved, since none of them show any sign thereof on their early whorls. Further, two species belonging typically to the *tritonis*-group occur in Tertiary strata —*L. ovoideum*, Tate, from Australian beds, and *L. nodiferum*, Lamk., which has been recorded from Mediterranean beds by Hoernes and Auinger (18).

LOTORIUM PILEARE, Linn.

For this species Linnæus quoted figures of two species, and described a third. Hanley (14) says his type, on which his description was founded, was the *Triton corrugatus* of Lamarck, and refers to Reeve's figure in the 'Conchologica Iconica' (pl. v., f. 15). The first of these three species to be recognised as distinct was *Lotorium costatum* by Born in 1780. Lamarck, in dealing with the species, unfortunately bestowed a new name on Linnæus' type, and retained the name *pilearis* for the species, which has since been known under that name.

The principles of nomenclature, however, require that in eliminating from an heterogeneous group, the name originally bestowed thereon shall be retained for the type when that type is available.

The synonymy of these two species will, therefore, stand thus :—

LOTORIUM PILEARE, Linn.

Murex pilearis, Linn., Syst. Nat. 1767, p. 1217, sp. 534.
Triton corrugatus, Lamarck, An. s. Vert. vii., 1822, p. 181; Reeve, Conch. Icon. ii. "*Triton*," pl. v., f. 15, 1844.

LOTORIUM AQUATILE, Reeve.

Triton pilearis, Lamarck, An. s. Vert. vii. 1822, p. 182 (non Linn.).
Triton aquatilis, Reeve, Conch. Icon. ii. "*Triton*," pl. vii., f. 24, April 1844; P.Z.S. 1844 (December), p. 114.
Triton vestitus, Hinds, Zool. Voy. Sulphur, "Mollusca," Oct. 1844; P.Z.S. 1844 (July), p. 21.

T. martinianum, D'Orb., Moll. Cuba, ii., p. 162, 1847.
T. brasilianum, Gould, Proc. Bost. Soc. Nat. Hist. iii., p. 142, 1849.
T. americanum, D'Orb., Moll. Cuba, ii., p. 163, pl. 23, f. 22, 1853 (?) (*fide* Mörch, Malac. Blätt. xxiv., p. 28, 1877).
T. intermedius, Pease, Amer. Jour. Conch. v., 1869, p. 84.
T. veliei, Calkins, Proc. Davenport Acad. Sci. ii., p. 235, pl. viii., ff. 1-2, 1878 (*ex type*, Dall).

In giving the above synonymy of *L. aquatile*, I have accepted the opinions of and quoted from Dall (7, 227) and Tryon (36, 12). Not having specimens of some of them I am unable to judge for myself. The inclusion of *T. americanum*, D'Orb., seems doubtful, since Watson (39, 390) regarded it as a synonym of *L. costatum*, Born. I have recovered the exact date of the publication of the Mollusca of the Sulphur from Pace's admirable work on the *Columbellidæ* (26). In arriving at the above conclusions I have had the advantage of consulting with Mr. C. Hedley, and they may, therefore, be regarded as a joint opinion.

LOTORIUM QUOYI, Reeve.

I cannot agree with Pritchard and Gatliff (*op. cit.*) that this is only a form of *L. verrucosum*, Reeve; and that the name should be relegated to the synonymy thereof. Than that species *L. quoyi* is smaller, has flatter whorls, is more regular in growth, has a slightly smaller and higher protoconch. The body whorl of *quoyi* is sculptured by revolving and transverse riblets of equal strength, seven of the former and nineteen of the latter. *L. verrucosum* has six of the former and eleven of the latter, these being twice as strong as revolving riblets. This sculpture gives *L. quoyi* a beaded appearance which the other species does not possess. They were always treated as distinct species by Prof. R. Tate, whose acquaintance with them was almost life-long.

LOTORIUM RUTILUM, Menke.

This species, considered by Reeve to be synonymous with *L. labiosum*, Wood, has lately been identified by Mr. C. Hedley from the type locality. He finds that it is a valid species, and has in preparation a note on the subject.

Lotorium elongatum, Reeve.

Treated by Tryon as a synonym of *L. vespaceum.* It is more elongate, not so heavily transversely, but more heavily spirally sculptured, and has a smaller protoconch. Watson (*op. cit.*) has already maintained the validity of this species.

Lotorium thersites, Reeve.

Tryon regards this as the mature condition of *L. vespaceum*, a conclusion with which, after studying a fairly large series, I cannot agree. Whilst being slightly shorter, it is decidedly broader, has a shorter canal, is somewhat distorted (*vespaceum* is quite regular), is more prominently angled at the periphery, has more varices, fewer and stronger intervarical ribs, and is more delicately sculptured. The intervarical ribs do not continue on the body whorl so far towards the canal as Reeve's figure shows. The revolving liræ, which are smaller, more finely beaded, and equal, incline to fade away between the transverse ribs, on the crests of which and on the varices they are strongest. The interstitial striæ are also finely beaded. The protoconch of *L. vespaceum* is the larger and set on straight, whilst that of the species under discussion is set obliquely.

Lotorium moritinctum, Reeve.

This was quoted by Dunker (*op. cit.*), and more recently by Stearns and Pilsbry (*op. cit.*). Martens also used the name (*op. cit.*).

Lotorium sauliæ, Reeve.

Quoted by Stearns and Pilsbry (*op. cit.*). With reference to *Lotorium australe*, Lamk., Pritchard and Gatliff (*op. cit.*) write: "In our opinion it is doubtful that *T. nodifer*, Lamk., and *T. sauliæ*, Reeve, are identical, and we cannot concede that *T. australis* is also identical."

Lotorium strangei, Ad. & Ang.

This species, confounded by Tryon with *L. labiosum*, Wood, and by Pritchard and Gatliff (*op. cit.*) treated as the young of *L.*

spengleri, Chemnitz, has rightly been maintained a good species by Smith (32). Its affinities are with *L. labiosum.*

"TRITON SPECIOSUS," Angas.

(Text fig. 3.)

This species is, as Tryon suspected, a *Trophon.* I give figures of its operculum and dentition.

LOTORIUM CLANDESTINUM, Chemn.

This species would be best transferred to *Apollon.*

LOTORIUM COSTATUM, Born.

The complicated synonymy of this species is dealt with at length by Watson (39). Some of the synonyms might advantageously be retained for varieties.

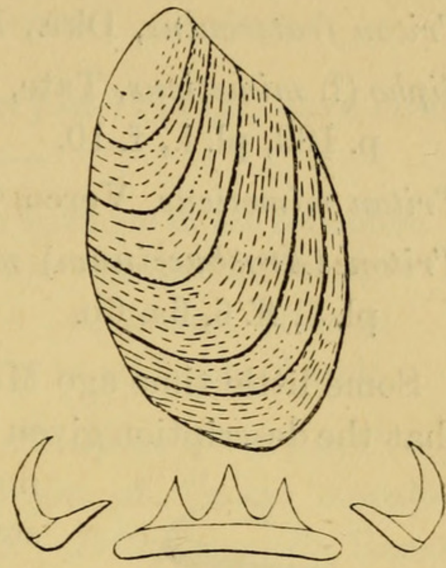

Fig. 3.
Tritonium speciosum, Angas.

LOTORIUM NODOCOSTATUM, Tate & May.

(Text fig. 4.)

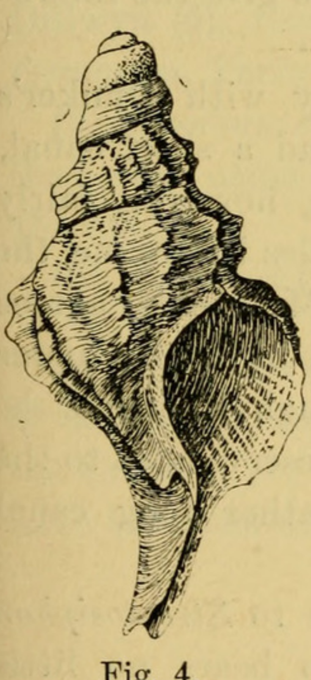

Fig. 4.
L. nodocostatum, Tate & May.

From the material above referred to I have drawn the accompanying sketch. From this it will be seen that New South Wales specimens have a longer canal than the southern form, unless the description and figure of the species were drawn from a mutilated specimen. The co-type lent me by Mr. May has the canal broken short off, and is, therefore, of no assistance on this point.

The length of canal would seem to exclude the species from the group in which I have placed it, but the *tout ensemble* is that of this group.

LOTORIUM FRATERCULUM, Dunker.

(Text fig. 5.)

Triton fraterculus, Dkr., Malac. Blatt. 1871, p. 166.

Sipho (?) *mimeticus*, Tate, Trans. Roy. Soc. S. Aust., 1893, Pt. i., p. 189, pl. i., f. 10.

Triton mimeticus, Verco, loc. cit., 1895, p. 88, pl. 2, ff. 4, 4a.

Triton (*Argobuccinum*) *mimeticus*, Verco, loc. cit., 1896, p. 221, pl. 5, ff. 6, 6a, 6b.

Some little time ago Mr. Hedley drew my attention to the fact that the description given by Dunker under the above name could not apply to *Lotorium bassi*, Angas, as stated by Schmeltz,* Tryon and others. It subsequently occurred to me that the diagnosis described Tate's *Sipho* (?) *mimeticus*. Thanks to the courtesy of Dr. Verco, who has very kindly sent me specimens to study, I am enabled to give the following note on the subject:—

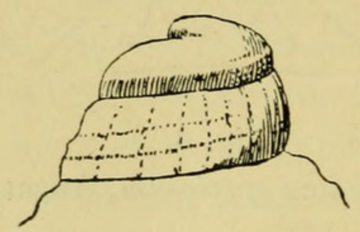

Fig. 5.
L. fraterculum, Dunker.

The specimens do not harmonise perfectly with Dunker's description, his statement that his specimens had a short canal, in particular disagreeing. The description is, however, fairly detailed, and, but for this, applies to the examples before me, the measurements and proportions fitting exactly. Mr. Hedley agrees with me that, on the whole, the species had best be known under Dunker's name. It is a true *Lotorium*, though it cannot be referred to any of my groups, and has a faint resemblance to the *parkinsonianum*-group, but from these its rather long canal separates it.

This species has a most striking resemblance to *Streptosiphon porphyrostoma*, Ad. & Rve.† The apex also bears no little resemblance to that of the family to which *Streptosiphon* belongs. The dentition, however, shows the species to belong to *Lotorium*.

* Mus. God. Cat. v., 1874, p. 139.

† Reeve, Conch. Icon. iv. (*Faciolaria*), pl. v., f. 11, 1847.

LOTORIUM BARTHELEMYI, Bernardi.

This unlocalised species is, as stated by Pritchard and Gatliff (*op. cit.*), a synonym of *L. spengleri*, Chemn.

The following names proposed by Perry in 1811 (27) have lately been reinstated by Mr. C. Hedley (16) :—

Perry's specific name.	Specific synonym in use heretofore.
Lotorium cornutum.	*Lotorium exaratum*, Reeve.
,, *parkinsonianum*	,, *fusiforme*, Kiener.
,, *rubicundum*	,, *nodiferum*, Lamk.

In the same paper Mr. Hedley says "*Monoplex formosus*, Perry, is recognised by Deshayes as a synonym of *Triton clavator*, Lamarck, 1822 (= *Murex clavator*, 1817). *Triton sinensis*, Reeve, seems to me identical." At my request he has gone over this ground again with me, and, as far as our material allows us to judge, we have come to the following conclusions :—

(1) *Triton clavator*, Reeve, is not *clavator*, Chemn., 1795, Dillwyn (9), Lamarck (21), and should be quoted as *Lotorium formosum*, Perry.

(2) *Lotorium clavator*, Chemn., (4) (a binonial name), is probably the correct name for the form hitherto known as *Triton sarcostoma*, Reeve.

(3) *Lotorium sinense*, Reeve (30), is a valid species.

In conclusion I have to thank Mr. C. Hedley for a great deal of assistance rendered me in my search through literature; and the Curator, Mr. R. Etheridge, Junr., through whose kindness I have been enabled to study Australian Museum material.

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EXPLANATION OF PLATE XVII.

Lotorium apices.

Fig. 1.—*Lotorium woodsi*, Tate.
Fig. 2.— ,, *radiale*, Tate.
Fig. 3.— ,, *tumulosum*, Tate.
Fig. 4.— ,, *abbotti*, Tenison-Woods.
Fig. 5.— ,, *protensum*, Tate.
Fig. 6.— ,, *cyphus*, Tate.
Fig. 7.— ,, *oligostirum*, Tate.
Fig. 8.— ,, *tortirostris*, Tate.
Fig. 9.— ,, *textile*, Tate.
Fig. 10.— ,, *cornutum*, Perry.
Fig. 11.— ,, *vespaceum*, Lamarck.
Fig. 12.— ,, *chlorostomum*, Lamarck.
Fig. 13.— ,, *aquatile*, Reeve.
Fig. 14.— ,, *sinense*, Reeve.
Fig. 15.— ,, *gemmatum*, Reeve.
Fig. 16.— ,, *elongatum*, Reeve.
Fig. 17.— ,, *tuberosum*, Lamarck.
Fig. 18.— ,, *thersites*, Reeve.
Fig. 19.— ,, *spengleri*, Chemnitz.
Fig. 20.— ,, *strangei*, Adams & Angas.
Fig. 21.— ,, *rutilum*, Menke.
Fig. 22.— ,, *labiosum*, Wood.
Fig. 23.— ,, *verrucosum*, Reeve.
Fig. 24.— ,, *eburneum*, Reeve.
Fig. 25.— ,, *quoyi*, Reeve.