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BEING

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New Series.

Vol. I.

3. — FAUNA OF THE MIOCENE BEDS OF BURMA.

PLATES I TO XXV

By

FRITZ NORTLING, Ph.D., F.G.S.,

*Palaeontologist, Geological Survey of India.*

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Character of Fauna.	Character of Sediments.	Name of Series.	Name of Division.	Name of Sub-division.	Thickness.	European Equivalent.
Terrestrial and Fluviatile.	Yellow Sandstone.	Irrawaddi Series.	Upper Irrawaddi Series.	Not sub-divided.	30,000 feet.	Eocene.
No Nummulites.	Marine facies, bluish-green glauconitic sandstone.	Irrawaddi Series.	Pegu Division.	Yenang-ungian.	2,150 feet.	Miocene.
					Bluish-green, glauconitic sandstone.	
	Limestone and shales.	Limestone and shales.	Bassein Division.	Not sub-divided.		1,200 feet.
					No Nummulites.	

the former itself, between *Yenangyoungian* and *Promeian*, though local overlaps unquestionably occur.

MIOCENE		YENANGYOUNGIAN.			PROMEIAN.		
PLOCENE	THAYETAYO, PROME.	MINBU.	YENANGYOUNG.	SERGU.	YENANGYAT.		
	Irrawaddi Series.	Irrawaddi Series.	Irrawaddi Series.	Irrawaddi Series.			
	Zone of <i>Tarriella cantuariacuta</i> .			Singa shales.	Irrawaddi Series.		
	Thayemyo sandstone.			Zone of <i>Cardita tydamarensis</i> .			
	Zone of <i>Arca theobaldi</i> .	Minbu shales.	Zone of <i>Cyrcna crassifordi</i> .	Zone of <i>Mytilus nicobaricus</i> .			
	Zone of <i>Paralipis protorhosom.</i>			Zone of <i>Miscocardia melanogaris</i> .			
	Zone of <i>Pholas orientalis</i> .		Twingon shales.	Zone of <i>Diose dubiosa</i> .	Zone of <i>Diose dubiosa</i> .		
	Zone of <i>Arca humerosa</i> .	Zone of <i>Cantharis morisiana</i> .			Zone of <i>Paracyclus caeruleus</i> .		
	Zone of <i>Cytherea erycina</i> .						
	Prome sandstone.						
	(Petroiferous sandstone near Padoonkin and Carboniferous beds near Thayemyo.)		Zone of <i>Asiotherium birmanicum</i> .		Petroiferous sandstone.		
	Sitayahn shales.						
					Petroiferous sandstone.		

species differs only by a larger size and a stronger ornamentation, and these features are therefore quite in harmony with similar observations made with other species which are considered the direct descendants of Miocene species.

GENUS: *CONUS*, Linné.

Though the genus *Conus* is one of the most widely distributed genera in the Tertiary rocks, the determination of the fossil species is one of the most difficult tasks, chiefly on account of the indifferent characters the shell affords. As a rule the fossil specimens do not exhibit any colour markings, or if they do, they are certainly of much less systematic value than in the living species. For specific distinction the palaeontologist can only refer to the shape of the shell, but so far it seems that no general plan has been adopted by which the numerous species might be distinguished. Anybody going through the description of a number of similar species will be greatly puzzled if he tries to find out by which characters the species really differ.

I think that an exceedingly good distinctive feature is the height of the spire, which may be conveniently expressed by the cosine of half the apical angle. As in very few cases the profile line of the spire is straight, being mostly represented by a curved line, I assume the apical angle to be that angle which is formed by two lines from the apex to the keel of the body whorl. I call this angle  $\alpha$  and the height of the apex above a plane laid horizontally through the keel of the body whorl would be represented by cosine  $\alpha/2$ . It is quite true that owing to the spiral volution a plumb line from the apex to this plane would not quite bisect the apical angle  $\alpha$ , but inasmuch as this angle will never be quite constant, this error may be overlooked.

Accepting this view we could distinguish three groups, viz. :—

- (A) cosine  $\alpha/2$   $\angle$  0.25, flat spired shells.  
 (B) cosine  $\alpha/2$  from 0.25 to 0.60, low spired shells.  
 (C) cosine  $\alpha/2$  from 0.61 to 1, high spired shells.

The above definitions are certainly more precise than the old distinctions between flat and elevated or high spires, which leave too large a field for individual views.

Another feature which seems to me of systematic value is the angle  $\beta$  formed by the two parts of the body whorl, as divided by the revolving keel; in almost all cases this angle will have an extremely short posterior and an unproportionately long anterior side. I certainly found that all the species here described could be easily distinguished by this character, as will be seen from the following table :—

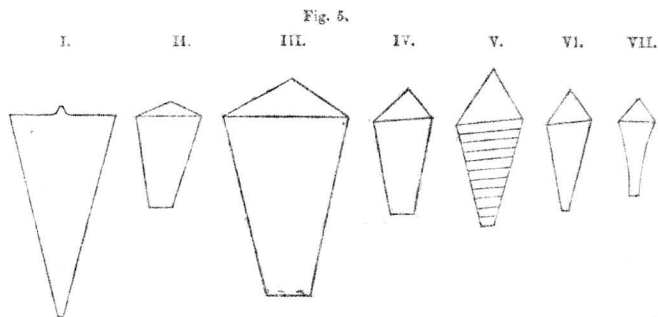
	Angle.	Posterior side.	Anterior side.
<i>Conus literatus</i>	less than 90°	straight	straight.
" <i>malaccanus</i>	obtuse	straight	straight.
" <i>arvensis</i>	obtuse	flatly concave	straight.
" <i>hansa</i>	obtuse	straight	straight.
" <i>yulei</i>	obtuse	straight	straight.
" <i>galensis</i>	obtuse	very concave	slightly concave.
" <i>protofurvus</i>	obtuse	straight	straight.

If in each instance the accurate value of angle  $\beta$  could be given, the differences would be more obvious than if only expressed by the rather vague terms "obtuse" and "acute."

It is, however, difficult to obtain the value of this angle with accuracy, except from a longitudinal section.

Another equally valuable feature is the angle  $\gamma$  formed by the anterior sides of the body whorl; as far as I can see this angle is very constant in the species, though further researches would be necessary to prove this view.

If we construct a longitudinal diagrammatic section of each species based on the above three features, we see at once and much better than by the ordinary illustration the difference of a certain number of species, as will be illustrated by the following woodcut:—



I. <i>Conus literatus</i> . II. " <i>malaccanus</i> . III. " <i>avanicus</i> . IV. " <i>hanza</i> .		V. <i>Conus yulei</i> . VI. " <i>galensis</i> . VII. " <i>protofurvus</i> .
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Of course I do not pretend to say that these characters would exhaustively describe and fix a species; this is by no means the case, as will be illustrated by the diagrams of *Conus hanza* and *Conus protofurvus*, but if, in addition to the above characters, any ornamentation will be mentioned, the description of *Conus* could be given in an exceedingly accurate way, perhaps more precise than of any other genus of Gastropoda.

By carefully examining the above principles in a large number of species, it may, perhaps, be possible to arrive at a sub-division of the genus *Conus*, which would be of value to paleontologists, and not valueless like the present one adopted by the conchologists. The Miocene of Burma has yielded seven species which can be distinguished in the following way:—

A.  $\text{Cos. } a/2 < 0.25$  (spire flat).

1. *Conus literatus*, Linné.

B.  $\text{Cos. } a/2$  from 0.26 to 0.60 (spire low).

- (a) Spire turreted, step-like.  
 2. *Conus malaccanus*, Hwass.
- (b) Spire conical.  
 3. *Conus awaënsis*, spec. nov.
- C. Cos.  $a/2 > 0.60$ . (Spire moderately high).
- (a) Both sides of  $\beta$  straight.  
 (aa) Surface of body whorl smooth.  
 4. *Conus yulei*, spec. nov.  
 (bb) Surface of body whorl covered with engraved lines.  
 5. *Conus hanza*, spec. nov.  
 (cc) Surface of body whorl only anteriorly covered with engraved lines.  
 6. *Conus protofurvus*, spec. nov.
- (b) Sides of  $\beta$  concave.  
 7. *Conus galensis*, spec. nov.

The relationship of these species is rather varied, two of them, *Conus literatus*, Linné, and *Conus malaccanus*, are unquestionably identical with species inhabiting at present the Indian Ocean, while of the other five it is almost certain that they have no relatives among that fauna. One of them, *Conus awaënsis*, may, perhaps, be related to a species from the Eocene of Paris, while the relatives of *Conus hanza* and *Conus protofurvus* inhabit at present the Eastern Seas. *Conus galensis* most probably represents an entirely extinct type, while *Conus yuleianus* is too ill-preserved to allow of a comparison.

CONUS (LITHOCONUS) LITERATUS, Linné, Pl. XXIII, figs. 12, 12a, 13, 13a, 14.

1840. *Conus brevis*, J. de Carle Sowerby, Transact. Geol. Soc. of London, 2nd ser., Vol. V, pl. XXVI, fig. 33.

1843. *Conus literatus*, Reeve, Monograph of the Genus *Conus*, pl. XXXIII, fig. 188.

MEASUREMENTS.

Length . . . . .	52 mm.
Width . . . . .	23 "
Angle of body whorl . . . . .	27°

The shell is of moderate size, acuminate, conical in shape, and composed of about nine whorls forming a very low spire, having apparently an average apical angle of almost 180° and long and high strongly acuminate body whorl.

Embryonic whorls not observed.

Earlier spire whorls unfortunately broken off, but it appears that their surface was steeply sloping towards the suture; the whorls form during the brepheic stage, a rather elevated spire, but the angle of slope rapidly decreases and must have become almost zero at the beginning of the neanic stage; thus the posterior part of the spire whorls as well as that of the body whorl are almost in one plane. The whorls imperceptibly increase in height and are separated by a deep suture. On the earlier whorls there are a few engraved revolving lines, but they appear to become effaced on the body whorl, where there are only numerous curved fine concentric striae of growth.

The body whorl is rather large and high, very regularly conical in shape, divided by a sharp keel into small flat posterior, and a gently sloping anterior portion; a longitudinal section through the body whorl would show a sharp angle of  $75^{\circ}$  having two straight sides, a very short posterior and a very long anterior one. The surface is smooth except for numerous fine striæ of growth bending sharply backwards near the posterior keel.

*Geological occurrence.*—

Zone of *Aricia humerosa*, Thayetmyo.

*Remarks.*—*Conus literatus* is easily distinguished from all the others here described by a spire so strongly depressed, that it appears almost flat, that is to say,  $\cos. a/2$  is smaller than 0.25; there appear to be, however, some variations, inasmuch as in one specimen the spire is perfectly flat, while in the other ones it is slightly raised; the living specimens seem to exhibit the same variations, inasmuch as the specimen examined by me shows a perfectly flat spire, while that figured by Reeve has a distinctly raised one. Another distinctive feature is the absence of spiral striæ at the anterior end of the body whorl.

Sowerby has described and figured three species, *Conus brevis*, *Conus militaris* and *Conus catenulatus*, which represent most probably one and the same species; at least better distinctive characters must be given before the specific independence of these three species can be accepted. There is no doubt that *Conus brevis* is identical with the species here described, and I identify the specimens from Burma with that species, should *Conus militaris* and *Conus catenulatus* turn out to be really different.

A specimen of *Conus literatus* from Ceylon which I have been able to compare, shows no difference whatsoever, angles  $\beta$  and  $\gamma$  being almost the same.

CONUS (RHIZOCONUS) MALACCANUS, Hwass, Pl. XXIII, figs. 17, 17a, 18, a-b, 19, 19a, 20, 20a.

1842. *Conus malaccanus*, Reeve, Monograph of the Genus *Conus*, pl. X, fig. 49.

1895. " " Nostling, Miocene Foss. Upper Burma, Mem. Geol. Survey of India, 1895, Vol. XXVII, p. 42, pl. X, figs. 4, 5, 6, 6a, 7, 7a.

MEASUREMENTS.

Height . . . . .	25 mm.
Width . . . . .	12.5 "
Apical angle . . . . .	$127^{\circ}$
Angle of body whorl . . . . .	$25^{\circ}$

The shell is of small size, conical in shape and composed of a short spire and a high, acuminate body whorl. Embryonic whorls not observed.

The spire is composed of not less than 10 whorls, separated by a sharp suture and increase very slowly in height. During the brepheic stage the surface of the whorls formed an angle of about  $60^{\circ}$  with the suture; this angle gradually flattens down, and the profile line of the spire is therefore concave; as each succeeding whorl does not quite reach up to the keel of the preceding one, the spire becomes somewhat step-like, a feature which is very characteristic of this species. The earliest spire whorls appear slightly granulated, because the ends of the short longitudinal ribs which line

the anterior part of the whorls near the keel, rise just above the suture. This feature is, however, only noticed in well-preserved specimens and soon disappears when only a revolving ornamentation, consisting of a few engraved lines which are crossed by numerous striae of growth, remains visible.

The body whorl is rather large, broad at its posterior, acuminate towards its anterior end. A rounded, though distinctly marked keel, sets off a small posterior portion sloping towards the suture and a larger anterior one sloping in opposite direction. As the posterior part is flat, the profile line is represented by an obtuse angle, the apex of which is rounded, having a short straight posterior and a long straight anterior side. The revolving ornamentation noticed on the spire whorls becomes more marked and stronger. The striae of growth are numerous and well marked towards the anterior end; a number of weak, revolving keels separated by rather broad interstices are visible.

The aperture is long and narrow, expanded at the anterior, deeply cut out at the posterior end; the outer lip is thick but sharp and cutting.

*Geological occurrence.*—

Zone of *Cancellaria martiniano*, Minbu.

Zone of *Paracyathus caeruleus*, Yenangyat.

*Remarks.*—In my previous memoir I identified *Conus javanus*, K. Martin, with this species, but I think it preferable to adopt now a nother view. *Conus javanus*, Martin, is unquestionably a close relative of *Conus malaccanus*, the characters of the step-like spire being the same in both species, but on the other hand *Conus javanus* does not show the spiral lines on the anterior part of the body whorl, a feature which is well marked in all the specimens I examined. The absence of this character in *Conus javanus* may be due to the state of preservation, though it appears as if this species is well preserved. My view of the absence of these spiral lines seems to be supported by the description in which they are not mentioned, and if I be correct, this feature would form a good specific distinction from *Conus javanus*, though this species may otherwise be closely related to *Conus malaccanus*.

Professor Martin has recently described another species, *Conus odengensis*, which even seems to have a closer relationship to the species here examined, than *Conus javanus*. Professor Martin himself draws attention to the close relationship of *Conus odengensis* and *Conus malaccanus*, but he is inclined to consider them specifically different, because he did not observe either the twisted columella, or the close spiral striae on the anterior part of the body whorl of *Conus malaccanus*. The latter character seems to me of no great importance, because as long as the spiral striae are present, it does not matter whether they are a little closer or wider apart. In the specimen I examined they are certainly not much wider than in the fossil species, but even if the examination of a larger number of fossil and living species would prove that the spiral striae or lines are habitually closer in the fossil than in the living species, would such a difference which unquestionably has to be considered in an evolutionary light constitute a specific character? I think decidedly not.

A similar argumentation may apply to the twisting of the columella which shows certainly a varying degree in Professor Martin's own figures.



To summarize, I think that the species which I here described under the name of *Conus malaccanus* is identical with the living species, and most probably also with *Conus odengensis* from Java, but in intricate cases like the above, when minute differences may perhaps decide, it must be left to the author to settle for himself which view he will take.

*Conus malaccanus* is easily distinguished from all the others here described by the peculiar step-like appearance of the low spire, and the granulated earlier spire whorls.

I have carefully compared the specimens under examination with *Conus malaccanus* from the Indian Ocean, and I can find no other difference, but that they do not seem to attain the size of the living specimen; in all other details they are exactly alike it; the living *Conus malaccanus* has an apical angle of  $130^\circ$ , in the fossil one it is  $126^\circ$ , while the angle of the body whorl is  $29^\circ$ , and in the fossil specimen  $28^\circ$ . Still more convincing are the characters of the spire: the granulated keel of the earlier spire whorls is well visible, and the step-like profile of the spire is well marked.

CONUS AVAENSIS, spec. nov., Pl. XXIII, figs. 15, a-b, 16, a-b.

MEASUREMENTS.

Height . . . . .	44	mm.
Width . . . . .	27	"
Apical angle . . . . .	126	"
Angle of body whorl . . . . .	28	"

The shell is of moderate size, conical in shape and composed of a fairly elevated spire and a high acuminate body whorl.

Embryonic whorls not observed.

The spire is composed of not less than ten whorls separated by a sharp suture, and increases very slowly in height; during the bryophic stage the surface of the whorls formed an angle of about  $45^\circ$  with the suture; this angle gradually flattens down up to the penultimate whorl when it becomes a little larger again; the profile line of the spire is therefore S-shaped. The surface is covered with about eight, rounded revolving lines, which are crossed by coarse striae of growth.

The body whorl is rather large, broad at its posterior, acuminate towards its anterior end. A rounded, though distinctly marked keel sets off a small posterior portion sloping gently towards the suture, and a large anterior one, sloping in opposite direction. As the posterior portion is slightly canaliculate, a feature which already begins on the penultimate whorl, the profile line is represented by an obtuse angle having a short, concave posterior, and a long straight posterior side. The revolving lines noticed on the spire whorls have almost disappeared, only one or two lines remaining, though they are rather indistinct; on the other hand the striae of growth become stronger; near the aperture the surface is still covered with a brown shiny epidermis and the striae of growth become very numerous and closely set. Towards the anterior end a number of weak, revolving keels, separated by rather broad interstices, are visible.

*Geological occurrence.*—Zone of *Mytilus nicobaricus*, Singu.Zone of *Meiocardia metarugaris*, Singu.Zone of *Arca theobaldi*, Kama.Zone of *Parallelipipedum prototortuosum*, Kama.Zone of *Pholas orientalis*, Thayetmyo.Zone of *Aricia humerosa*, Thayetmyo.Zone of *Cytherea erycina*, Prome.

*Remarks.*—*Conus avaënsis* is so similar to *Conus malaccanus* that at the first glance both species might be considered the same; on closer examination it will, however, be seen that they are decidedly different: *Conus avaënsis* has a higher spire and cos.  $\frac{1}{2}$  = 51 is considerably larger than that of *Conus malaccanus* which is 44 to 42; the step-like spire as well as its concave profile line form another distinctive feature of *Conus malaccanus*; in *Conus avaënsis* the profile line is S-shaped, and each whorl comes close up to the keel of its predecessor.

I have not been able to find any living relative of this species, though I cannot state with certainty that there exists none, but it seems that there is a certain similarity with *Conus diversiformis*, Desh., from the Eocene of Paris.

## CONUS YULRIANUS, spec. nov., Pl. XXIII, figs. 21, 22.

## MEASUREMENTS.

Height . . . . .	25 mm. (approx.).
Width . . . . .	12.5 "
Apical angle . . . . .	90°
Angle of body whorl . . . . .	23°

The shell is of small size, double conical in shape consisting of an elevated turreted spire and a large acuminate body whorl.

Embryonic whorls not observed.

The spire consists of about seven flat whorls, separated by a sharp suture; the surface of the whorls forms a steep angle with the suture which becomes only slightly flatter on the later ones; the profile line is slightly curved but sharply step-like because each succeeding whorl does not reach up to the keel of the preceding one. The surface is covered with numerous exceedingly fine revolving lines.

The body whorl is high, broad at the posterior, acuminate at the anterior end, divided by a sharp keel into a small posterior part, gently sloping towards the suture and a long anterior one, sloping in opposite direction. The profile line of the body whorl forms, therefore, an obtuse angle having two straight sides, a shorter posterior and a larger anterior one. Surface perfectly smooth except for numerous striae of growth; there appear, however, a few indistinct spiral lines on the anterior end.

Aperture narrow, anteriorly apparently not expanded.

*Geological occurrence.*—Zone of *Aricia humerosa*, Thayetmyo.Zone of *Parallelipipedum prototortuosum*, Kama.

*Remarks.*—I hesitated for a long time before I distinguished this species under a separate name, but on examining and comparing its features with those of the other species here described, I found that it would be impossible to unite it with any one of them. In shape *Conus yuleianus* is almost the same as *Conus hanza* except that the spire is certainly a little lower, the difference in the apical angle being about  $10^{\circ}$ ; a more distinctive feature is, however, the ornamentation of the body whorl which is covered with engraved lines in *Conus hanza*, while it is perfectly smooth except for a few spiral lines on the anterior end in *Conus yuleianus*. On the other hand, it bears by the latter character a great similarity to *Conus malaccanus*, but the spire of this species is much lower and the apical angle larger than in *Conus yuleianus*; the spire of this species is also much less step-like than in *Conus malaccanus*.

From *Conus ovaënsis* it differs by a higher spire, composed of step-like whorls, covered with much finer revolving striae.

The specimen is too ill-preserved to allow of a comparison with either living or fossil species.

CONUS HANZA, spec. nov., Pl. XXIII, figs. 23, 24, 24a.

MEASUREMENTS.

Height . . . . .	I	27 mm. (approx.)	II	9 mm.
Width . . . . .	14	"	4.5	"
Apical angle . . . . .	80°	"	78°	"
Angle of body whorl . . . . .	25° (?)		40°	

The shell is of small size only, double conical in shape consisting of a high elevated spire and a large attenuated body whorl.

There are three to four rounded and smooth embryonic whorls, which formed a high spire during the brepheic stage.

The spire is composed of about six whorls, separated by a sharp suture; the surface of the whorls is steeply inclined towards the suture in the earlier whorls, but becomes flatter with advancing age; as each succeeding whorl does not reach up to the preceding one, the profile line of the spire is, though curved, distinctly step-like. The ornamentation consists of a few revolving lines.

The body whorl is large, broad at its posterior, acuminate at its anterior end; a sharp keel sets off a small posterior part which is slightly concave, sloping towards the suture, from a large anterior one sloping in opposite direction. The revolving lines have disappeared on the posterior part, and there are only striae of growth a few of which are raised and sharper than the others, following at regular intervals, thus imitating longitudinal ribs. The whole length of the anterior part is covered with about 20, deeply engraved revolving lines, separated by broad and flat interstices.

Aperture not observed.

*Geological occurrence.*—

Zone of *Parallelipedium prototortuosum*, Kama.

*Remarks.*—Though the general shape of this species with its high turreted spire, raised on a broad basis is almost the same as that of *Conus yuleianus*, it differs from it, as well as from all the other species here described, by the ornamentation of the body whorl. In all the other species it is only provided, towards the anterior end, with a certain number of rounded spiral keels, separated by linear interstices; in *Conus hanza* the whole surface is covered with sharply engraved lines separated by flat broad interstices.

*Conus tjaringinensis*, K. Martin, exhibits a certain similarity with this species, though it seems certain that it is different.

Among the living species *Conus lacteus* and *Conus subulatus*, Kiener, exhibit a similar ornamentation of the body whorl, but both species show a much less elevated spire.

It is under these circumstances rather difficult to settle the relationship of *Conus hanza*; it seems certain that it has no relative in the Eocene of Paris, neither could I find a similar species among the fauna of the Indian Ocean, but it seems that *Conus sinensis*, Sow., is a near relative, a question which I could not decide having no specimens of that species for comparison. It is, therefore, probable that *Conus hanza* represents a type extinct among the present fauna of the Indian Ocean.

*CONUS (LEPTOCONUS) PROTOFURVUS*, spec. nov., Pl. XXIII, figs. 25, *a-b*, 26, *a-b*.

1895. *Conus (Leptoconus) marginatus*. Noetling, Miocene Foss. Upper Burma, Mem. Geol. Survey of India, 1895, Vol. XXVII, p. X, pl. X, figs. 8, 8a, 8b.

MEASUREMENTS.

Height . . . . .	25 mm. (approx.).
Width . . . . .	19.3 "
Apical angle . . . . .	65°
Angle of body whorl . . . . .	25°

The shell is of small size, double conical in shape, being composed of a high elevated spire and a long acuminate body whorl.

Embryonic whorls not observed.

The high elevated spire consists of at least six whorls, separated by a deep suture; the surface of the whorls forms a steep angle with the suture, which does not seem to change much with advancing age; the profile line is therefore almost straight, but slightly step-like, because each succeeding whorl does not fully reach up to the preceding one.

The body whorl is high, rather narrow at its posterior end, acuminate in front. A sharp keel sets off a small posterior part which gently slopes towards the suture from a larger anterior one, sloping in opposite direction. About one-half to two-thirds of the surface is smooth; the anterior half or third is covered with deeply engraved revolving lines, separated by broad interstices which are almost raised into ribs near the anterior end. Striae of growth numerous, but somewhat irregular.

Aperture long, very narrow, outer lip thin and sharp.

*Geological occurrence.*—

Zone of *Paracynthus caeruleus*, Yenangyat.

Zone of *Parallelipipedum prototortuosum*, Kama.

*Remarks.*—The general shape of *Conus protofurvus* resembles greatly that of *Conus galensis*, from which it is easily distinguished by the characters of the spire; in *Conus galensis* the upper part of the whorls, *i.e.*, that which is visible of the spire, is deeply canaliculate; in *Conus protofurvus* it is perfectly flat so that all the whorls are almost flush with each other; though the spire is somewhat step-like it never attains that degree as observed in *Conus galensis*.

In my previous memoir I identified this species with *Conus margitatus*, Sowerby, but I think it better to distinguish it under a special name. *Conus margitatus* has apparently a lower spire, and its whorls are canaliculate and not plain as in *Conus protofurvus*.

There is no similar species described from either Java or Sumatra, nor could I find among the fauna of the Indian Ocean a species which could be compared to it. On the other hand, *Conus furvus*, Reeve, from the Philippine Islands exhibits the greatest similarity, the chief distinguishing feature being a larger size; but as I could not compare a specimen of that species I refrain from expressing any further opinion except that it is very probable that *Conus protofurvus* represents a type extinct among the fauna of the Indian Ocean.

CONUS GALENSIS, spec. nov., Pl. XXIII, fig. 27, a-b.

MEASUREMENTS.

Height . . . . .	20 mm (approx.).
Width . . . . .	8 "
Apical angle . . . . .	78°
Angle of body whorl . . . . .	18°

The shell is of small size, elongate and double conical in shape, composed of an elevated turreted spire and a high, acuminate body whorl.

Embryonic whorls not observed.

Only two and a half spire whorls are preserved, but they prove that the spire was elevated and composed of rather low whorls, which were deeply canaliculate on the upper side and set with fine granulations along the keel; as each succeeding whorl leaves free a considerable part of the preceding one, the step-like profile line of the spire is more pronounced than in any of the other species.

The body whorl is rather high, not very broad at its posterior end, acuminate anteriorly; a sharp keel divides a narrow, deeply canaliculate posterior portion, sloping towards the suture from a large anterior one, sloping in opposite direction. The profile line is therefore represented by a sharp angle having a short deeply concave posterior and a large apparently slightly concave anterior side.

The surface is smooth, but there appear a few indistinctly visible revolving lines on the posterior portion, while the anterior one bears about 6—7 deeply engraved lines separated by broad flat interstices.

Striae of growth indistinct.

Aperture long, narrow, outer lip apparently thin and sharp.

*Geological occurrence.*—

Zone of *Paracyathus caeruleus*, Yenangyat.

*Remarks.*—*Conus gaiensis* bears the greatest similarity to *Conus margaritatus*, Sow., but it is easily distinguished from that species by the deeply canaliculate whorls, and the strongly step-like profile line of the spire.

I remarked above that the anterior side of the profile line of the body whorl is slightly concave; having only one specimen under examination I am not quite sure whether this feature, which is just perceptible, is an original one or due to disfiguration by pressure.

I have not been able to trace any fossil or living relative of this species, which with the greatest probability represents an extinct type.

### III. Order: OPISTHOBRANCHIA, Milne Edwards.

Family: *ACTEONIDÆ*, Gray.

Genus: *RINGICULA*.

*RINGICULA TURRITA*, K. Martin, Pl. XXIII, fig. 28, *a-c*.

1833—67. *Ringicula turrita*, K. Martin, Tiefbohr. auf Java, Beitr. zur. Geol. Ost. Asiens und Australiens, 1st ser., Vol. III, p. 45, pl. IV, fig. 45.

#### MEASUREMENTS.

Length	. 3 mm.
Width	. 2 "

The minute shell is oval in shape, rather globose and consists of a very short spire and a comparatively large and inflated body whorl.

There are three rounded spire whorls separated by a rather deep suture; it is not quite clear whether they are smooth, or covered with the same flat revolving ornamentation as the body whorl.

The body whorl is rather large occupying at least two-thirds of the total height, globose, slightly acuminate in front. The ornamentation consists of very fine rounded revolving keels which cover the whole of the surface and are separated by interstices of their own breadth.

The aperture is rather large, anteriorly broad, acuminate in posterior direction; the outer lip thick, reflected, inner lip callous, but well set off against the other part of the surface. There are two strong oblique collumellar plaits.

*Geological occurrence.*—

Zone of *Parallelipipedum prototortuosum*, Kama.

*Remarks.*—Only a single specimen which is not particularly well preserved has come under examination, but it agrees perfectly well with *Ringicula turrita*, K. Martin, as regards shape, ornamentation, and character of the aperture.

PLATE XXIII.

- Fig. 1. CLAVATULA MUNGA, spec. nov., nat. size. Zone of *Parallelipipedum prototortuosum*,  
Kama, page 347.  
" 1a. " " ornamentation of spire whorls enlarged.
- Fig. 2. CLAVATULA FULMINATA, Kiener, nat. size. Zone of *Mytilus nicobaricus*, Singu, page 349.  
" 2a. " " " enlarged.
- Fig. 3. CLAVATULA PROTONODIFERA, spec. nov., nat. size. Zone of *Cancellaria martiniana*,  
Minbu, page 350.  
" 3a. " " " enlarged.
- Fig. 4. CLAVATULA PROTONODIFERA, spec. nov., nat. size. Zone of *Mytilus nicobaricus*, Singu,  
page 350.  
" 4a. " " " " enlarged.
- Fig. 5. DRILLIA YEMANENSIS, spec. nov., nat. size. Zone of *Paracalythus caeruleus*, page 358.  
" 5a. " " " " enlarged.
- Fig. 6. DRILLIA PROTOCINCTA, spec. nov., nat. size. Zone of *Arca theobaldi*, Kama, page 356.  
" 6a. " " " " enlarged.
- Fig. 7. DRILLIA PROTOCINCTA, spec. nov., nat. size. Zone of *Arca theobaldi*, Kama, page 356.  
" 7a. " " " " enlarged.
- Fig. 8. DRILLIA PROTOINTERRUPTA, spec. nov., nat. size. Zone of *Cancellaria martiniana*, Minbu,  
page 354.  
" 8a. " " " " enlarged.
- Fig. 9. DRILLIA PROTOINTERRUPTA, spec. nov., nat. size. Zone of *Arca theobaldi*, Kama, page 354.  
" 9a. " " " " enlarged.
- Fig. 10. DRILLIA PROTOINTERRUPTA, spec. nov., nat. size. Zone of *Arca theobaldi*, Kama, page 354.  
" 10a. " " " " enlarged.
- Fig. 11. DRILLIA PROMENSIS, spec. nov., nat. size. Zone of *Arca theobaldi*, Kama, page 355.  
" 11a. " " " " enlarged.
- Fig. 12. CONUS LITERATUS, Linné, nat. size. Zone of *Aricia humerosa*, Thayetmyo, page 359.  
Fig. 12a. " " " " " "
- Fig. 13. CONUS LITERATUS, Linné, nat. size. Zone of *Aricia humerosa*, Thayetmyo, page 359.  
" 13a. " " " " " "
- Fig. 14. CONUS LITERATUS, Linné, nat. size. Zone of *Aricia humerosa*, Thayetmyo, page 359.  
Fig. 15. CONUS AVAËNSIS, spec. nov., nat. size. Zone of *Mytilus nicobaricus*, Singu, page 362.  
" 15a. " " " " " "  
" 15b. " " " " " "
- Fig. 16. CONUS AVAËNSIS, spec. nov., nat. size. Zone of *Cytherea erycina*, Prome, page 362.  
" 16a. " " " " " "  
" 16b. " " " " " "
- Fig. 17. CONUS MALACCANUS, Hwass, nat. size. Zone of *Cancellaria martiniana*, Minbu, page 360.  
" 17a. " " " " " "
- Fig. 18. CONUS MALACCANUS, Hwass, nat. size. Zone of *Cancellaria martiniana*, Minbu, page 360.  
" 18a. " " " " " " enlarged.  
" 18b. " " " " " " "
- Fig. 19. CONUS MALACCANUS, Hwass, nat. size. Zone of *Cancellaria martiniana*, Minbu, page 360.  
" 19a. " " " " " " enlarged.

PLATE XXIII—*concl.*

- Fig. 20. CONUS MALACCANUS, Hwass, nat. size. Zone of *Cancellaria martiniana*, Minbu, page 360.  
 " 20a. " " " enlarged.
- Fig. 21. CONUS YULEIANUS, spec. nov., nat. size. Zone of *Aricia humerosa*, Thayetmyo, page 363.
- Fig. 22. CONUS YULEIANUS, spec. nov., nat. size. Zone of *Parallelipipedum prototortuosum*, Kama, page 363.
- Fig. 23. CONUS HANZA, spec. nov., nat. size. Zone of *Parallelipipedum prototortuosum*, Kama, page 364.
- Fig. 24. CONUS HANZA, spec. nov., nat. size. Zone of *Parallelipipedum prototortuosum*, Kama, page 364.  
 " 24a. " " " enlarged.
- Fig. 25. CONUS PROTOFURVUS, spec. nov., nat. size. Zone of *Paracathus caeruleus*, Yenangyat, page 365.  
 " 25a. " " " "  
 " 25b. " " " enlarged.
- Fig. 26. CONUS PROTOFURVUS, spec. nov., nat. size. Zone of *Arca theobaldi*, Kama, page 365.  
 " 26a. " " " "  
 " 26b. " " " enlarged.
- Fig. 27. CONUS GALENSIS, spec. nov., nat. size. Zone of *Paracathus caeruleus*, Yenangyat, page 366.  
 " 27a. " " " "  
 " 27b. " " " enlarged.
- Fig. 28. RINGICULA TURRITA, K. Martin, nat. size. Zone of *Parallelipipedum prototortuosum*, Kama, page 367.  
 " 28a. " " " "  
 " 28b. " " " enlarged.  
 " 28c. " " " "



GEOLOGICAL SURVEY OF INDIA

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