Some New Zealand Tertiary Cephalopods.

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INTRODUCTION.

Identification of an Aturia from the Eocene beds at Pahi, North Auckland, led to an examination of the somewhat scanty nautiloid material from other localities and horizons in the Geological Survey collections. Early Tertiary nautiloids have been the subject of intensive study in the past few decades in America, and it was hoped that New Zealand members of the group might show affinities which would help in the correlation of local Tertiary stages with extra-lateral stratigraphic units.

Two species of Aturia and a species each of Hercycossa, Nautilus and Argonauta are herein described.

TETRABRANCHIATA.

ATURIDAE.

In a recent paper, Teichert (1944), in differentiating two Australian species of Aturia and defining the characters and distribution of A. australis McCoy, expressed doubt as to the occurrence of that species in New Zealand. Aturia has been recorded from Eocene, Oligocene and Miocene rocks in New Zealand, but no critical examination of the material has hitherto been made, and the names A. ziezac (Sowerby) and A. australis McCoy have been used without question.

The Geological Survey collection includes about 16 specimens of Aturia, mainly fragmentary or crushed, which fall into two groups, both morphologically and stratigraphically. The genus ranges from Bortonian (mid-Eocene) to Tongaporutuan (Upper Miocene) in New Zealand, and the two groups represented come from either end of this range. No Oligocene examples have been studied, though the Wharekuri specimen figured by Hamilton (1903, plates 37, 38) is of that age.

The Eocene specimens examined are all Aturia and not Aturoidea, judging from the position of the siphuncle upon the dorsum and from the disposition of the lateral lobes of the sutures.

Genus Aturia Brong.  
Subgenus Aturia (s.str.).

Aturia (Aturia) grangei n.sp. (Plate 60, Figs. 1, 2, 3; Text Fig. 1, b, c, d.)

Holotype: A complete shell, somewhat crushed, very large, discoidal, involute. Venter narrowly rounded, flanks slightly compressed in region of lateral lobes, expanding at lateral saddles and widest at umbilical shoulder, giving a narrowly trigonal whorl section, with the lateral zones converging at about 24°. Sutures (Text Fig. 1, c, d) convex towards mouth across venter, a broad shallow
ventrolateral lobe and a well-defined deep obliquely directed saddle at the ventral corner of the base of the lateral lobe. Lateral lobe rapidly tapering, narrow, dorsal limb sweeping forward into an evenly arched lateral saddle. Sutures crowded orally so that tip of a lateral lobe enters preceding lobe, but less so on preceding whorl where tip fails to reach ventral corner of base of preceding lobe.

**Text Fig. 1.**

*External suture lines of *Aturia.*

(a.) *A. (Aturia) cf. australis* McCoy (G.S. 3312).
(b.) *A. (Aturia) grangei* n.sp. (Paratype A, G.S. 1917).
(c.–d.) *A. (Aturia) grangei* n.sp. (Holotype, G.S. 3328).
(e.) *A. (Brazutaria) mackayi* n.sp. (Holotype, G.S. 480).
(f.–g.) *A. (Brazutaria) mackayi* n.sp. (Paratypes, G.S. 544).
(h.) *A. (Brazutaria) mackayi* n.sp. (Paratype, Hampden).

All figures half natural size.

Paratype A: (G.S. 1917) An incomplete but undistorted phragmocone showing narrowly trigonal whorl section, and suture line with similar ventral complexity and narrow lateral lobes (Text Fig. 1, b). The last septum is closely similar to that of *A. australis* McCoy, and has the deep wide-mouthed septal invagination of *Aturia* s. str.

Paratype B: (G.S. 3329) A badly crushed internal cast with suture lines showing the same ventral crenulation as the above.

Localities: G.S. 3328, Rangi S.D., Mokau Series (holotype, collected by Dr. L. I. Grange); G.S. 1917, Whareorino S.D., Mohakatino Series; G.S. 3329, Aria S.D., Mohakatino Series.

Remarks: The Mokau beds are at present considered Awamoan (Mid-Miocene, Finlay and Marwick, 1940, p. 120) and the overlying Mohakatino Series is somewhat younger. Specimens of *Aturia* from higher horizons (G.S. 1115, 1119, Mimi S.D., Tongaporutuan Stage, Early Upper Miocene) are the last appearance of the genus
in the Tertiary of New Zealand and are very small shells (altitude, 50 mm.) badly crushed and lacking diagnostic features. The only specimen seen from a lower horizon in the Miocene is from G.S. 3312, Coral Point, Hukaterē S.D., the same horizon as Pakaurangi Point beds, high in the Waimatā Series, which are correlated on microfaunal evidence with zones high in the Lower Miocene in the Australian Janjukian (Finlay and Marwick, 1940, p. 95), and with the Upper Aquitanian-Lower Helvetian. The specimen from G.S. 3312 has a simpler ventral suture than grangei (Text Fig. 1, a) and thus approaches australis, but is more compressed than a Muddy Creek specimen of the latter species available for comparison. Unfortunately the shell is too incomplete for description.

Subgenus Brazatūria Stenzel.

Type (original designation, Stenzel, 1935); Aturia (Brazatūria) brazoensis Stenzel (Middle Eocene, Texas).

Aturia (Brazatūria) mackayi n.sp. Plate 60, Figs. 4, 5, 6, 7, Text Fig. 1, e–h).


An incomplete phragmocone with early whorls crushed. Shell involute, lenticular, cross section of whorl broadly rounded at venter, with flat or very slightly convex sides, widening dorsally toward well-defined umbilical shoulder. Lateral zones converging at about 32° in latest stage on specimen. Sutures (Text Fig. 1, e) almost straight across venter, small shallow saddles at ventral base of lateral lobes. Lateral lobes broad, gradually tapering at first, but somewhat pinched in toward the point, with slight ventrally directed kink where they join the somewhat unevenly arched lateral saddles. Tip of lateral lobe touching ventral oral corner of preceding lobe.

Paratypes A, B: G.S. 544, Pahi, Hukaterē S.D. Incomplete phragmocoones; cross sections more ovate (less trigonal) than holotype, with convex sides. Sutures (Text Fig. 1, f, g), similar to holotype but lateral lobe barely touching corner of preceding lobe. One Pahi specimen is broken along a septum to show a cross section and septal details (Plate 60, Fig. 6) markedly different from those of A. australis McCoy and A. grangei n.sp. which are assumed to represent Aturia s.str. The septum is broadly concave anteriorly and sharply retracted into the lateral funnels. The septal funnel is narrow and shallow, and the siphuncle is subdorsal, adjoining the dorsum, so that, in cross section, the tube rides upon the venter of the preceding whorl.

Paratypes C: Hampden. Several crushed specimens and fragments, one with estimated altitude of 250 mm. and suture as illustrated (Text Fig. 1, h), another with altitude of 220 mm., too badly crushed to show the suture, but with the wide siphuncular tube preserved. The latter consists of a series of connected funnels not greatly constricted at each septum (Plate 60, Fig. 7).

Dimensions: See table below.

Localities: G.S. 480, Waihao Valley (holotype, collected by A. Mackay, 1880); Hampden; G.S. 544, Pahi. All localities are of Bortonian age.
Remarks: The Pahi specimens have a different cross section from the holotype and may represent a different species, but further division is undesirable without better material. It should be noted that the allocation to *Brazaturia* is based on paratypes alone, but the holotype has a similar suture, and comes from a horizon certainly not higher than Bortonian, so that it is likely to belong to the same subgenus, which, as Stenzel (1935, p. 556; 1940, p. 765) has shown, includes most Eocene Aturias. It is also to be noted that the oral sutures of the holotype are crowded, suggesting maturity, whereas the larger Pahi shells may still be immature, judging from their uneroded chambers.

*Brazaturia* has been recognised in America (Stenzel, 1935, 1940) from the Jackson group (Bortonian*), Claiborne group (Lutetian–Auversian), and in addition the Californian species *myrlae* Hanna and *kerniana* Anderson and Hanna from the La Jolla (Lutetian) and Tejon formations (Bortonian) are apparently to be included in the subgenus. The recognition of the subgenus in New Zealand is, therefore, in accord with other evidence of the mid–Eocene (Ypresian–Lutetian) age of the Bortonian stage.

**Dimensions of New Zealand Aturia in Millimeters.**

<table>
<thead>
<tr>
<th>Locality</th>
<th>Type</th>
<th>A. mackayi n.sp.</th>
<th>Type</th>
<th>A. grangei n.sp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum diameter</td>
<td></td>
<td>480</td>
<td></td>
<td>544</td>
</tr>
<tr>
<td>Height of outer whorl</td>
<td></td>
<td>84</td>
<td></td>
<td>92</td>
</tr>
<tr>
<td>Median height</td>
<td></td>
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<td></td>
<td>75</td>
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<tr>
<td>Height of preceding whorl</td>
<td></td>
<td>32</td>
<td></td>
<td>48</td>
</tr>
<tr>
<td>Width of preceding whorl</td>
<td></td>
<td>23</td>
<td></td>
<td>25</td>
</tr>
<tr>
<td>Width of outer whorl</td>
<td></td>
<td>46.5</td>
<td></td>
<td>54</td>
</tr>
<tr>
<td>Width of lateral lobe at base</td>
<td></td>
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<td></td>
<td>13</td>
</tr>
<tr>
<td>Height of whorl at lobe measured</td>
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<td></td>
<td>77</td>
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<tr>
<td>Width of lobe as percentage of height of whorl</td>
<td></td>
<td>20.4</td>
<td></td>
<td>22.1</td>
</tr>
</tbody>
</table>

**Hercoglossidae.**

Genus *Hercoglossa* Conrad, 1866.

Type: (by subsequent designation, Hyatt, 1883) *Nautilus orbiculatus* Tuomey, Alabama (Basal Midway Group, Paleocene).

*Hercoglossa innominanda* n.sp. (Plate 60, Figs. 8–10; Plate 61, Figs. 12–15.)

Holotype: An incomplete cast from a calcareous concretion with fragmentary shell material adhering, somewhat dorsoventrally crushed; shell large, subglobular; adoral whorl expanded, alate; ventral margin broadly rounded; whorls apparently dorsoventrally depressed. One suture line is exposed and shows the broad ventral saddle and deep lateral lobe characteristic of the genus.

Paratype A: Adoral portion of a crushed phragmocone with external shell and external sutures preserved. Outer surface lacking ornamentation, with well-marked growth lines disposed in a shallow hyponomic sinus. Suture with broadly rounded ventral saddle and deep rounded lateral lobe, but lacking the dorsal limb of the lateral

* The European equivalents of Californian Eocene formations quoted in this paper are taken from Clark and Vokes (1936), and those of Eastern United States formations from Roy and Glockzin (1941).
saddle. Whorl shape apparently dorsoventrally depressed, but shell crushed.

Paratype B: A portion of the walls and septa of three chambers of a shell with lensoid cross section certainly due to crushing in incompetent glauconitic mudstone sediments. Only the internal surface of the chambers and an incomplete mould therefrom are exposed. The external suture (Plate 60, Fig. 10), clearly indicated by the intersection of septa with chamber walls, is sinuous and nautiliform, with a broad somewhat flattened ventral saddle, a deep rounded lateral saddle, a deep rounded lateral lobe, and a high narrow lateral saddle, representing an acutely angled, forwardly directed funnel in the septum towards the umbilical region. The ventral saddle is probably not as broad as drawn, as the mid-ventral line is difficult to locate owing to crushing and damage.

Dimensions: (holotype), altitude, 96; height of outer whorl, 51; width of outer whorl, 66; of preceding whorl, 37 mm.

Paratype A: Length of fragment, 62; maximum width, 37 mm.

Paratype B: Height of outer whorl, 35 mm.

Locality: Hampden Beach (Bortonian stage).

Remarks: The sutures of all specimens forbid comparison with any nautiloid genus other than Hercoglossa, and are so close to sutures of species of that genus illustrated by Miller and Thompson (1933), Miller (1935), Vokes (1937), and Stenzel (1940) that the generic placing is made with some confidence. More than one species may be represented by the three specimens—there is some variation in sutural detail, as figured—but for the present the recognition of the genus in New Zealand is more important than the number of species.

H. innominanda is apparently one of the less advanced species of the genus lacking the laterally compressed form of more typical Hercoglossa and retaining to some extent the subglobular shell of Cimonia, which Stenzel (1940) considers ancestral. In detail of suture innominanda is close to H. clarki Miller from the "Paleocene" of Landana, Portuguese West Africa, but in view of the condition of the New Zealand material, and as there are other named species of which descriptions have not been available for comparison, the similarity has little significance.

The presence of Hercoglossa in the New Zealand Bortonian would appear to place an upper limit on the age of the Bortonian. According to Miller and Thompson (1933, p. 313) the genus is "widespread in the Upper Cretaceous and Eocene of Europe, Asia and Africa." Species are present in the Danian, the "Paleocene" Midway of the Atlantic and Gulf Coasts, the Martinez of California and equivalent beds in West Africa. There are fewer records from higher horizons: H. tuomeyi C. and M., Nanjemoy formation, Maryland, Lower Eocene; Hercoglossa sp. Stenzel, 1940, Texas (Claiborne group, Lutetian); Hercoglossa cassiniana Foord and Crick, London Clay (Ypresian); H. aegeytiace Foord, Egypt (Mogattam beds, Ypresian-Lutetian). No upper Eocene examples have been noted in literature and the genus apparently made its last appearance in the Lutetian. Finlay and Marwick (1937, p. 14) have presented reasons for considering the New Zealand Bortonian to be not later than Bartonian in the European time scale, and the occurrence of
Hercoglossa makes it improbable that it is higher than Lutetian. Aturia—as A. (Brazaturia) mackayi, n.sp.—is well established in the Bortonian, and this also suggests a Lutetian age, since "it appears well established that the genus Aturia appeared first in the Reklow formation" (Stenzel, 1940, p. 736) of Eastern America (lowest Lutetian, fide Roy and Glockzin, 1941). In Western America the earliest Aturia is also Lutetian (A. myrlae Hanna, from the Domengine), earlier species listed by Schenck (1931) having been removed to Aturoidea (Vokes, 1937). In Europe the genus is present in the Ypresian (A. ziczac (Sow.), A. charlesworthi Foord, London Clay), but no definite records of the genus in earlier stages have been seen.*

The evidence of the Nautiloids confirms other evidence for the mid Eocene age of the Bortonian (Finlay and Marwick, 1940, pp. 87, 93) and suggests, more exactly, equivalence with the Ypresian or Lutetian.

**Nautilidae.**

**Genus: Nautilus Linne, 1758.**

**Type:** N. pompilius Linne. Recent.

Nautilus (s.l.) allani n.sp. (Plate 62, Figs, 16, 17, 18. Text Fig. 2.)

One incomplete specimen.

Shell large, subglobose, involute, imperforate. External surface with strong growth lines disposed in a hyponomic sinus. Septa extremely convex, with centrodorsally placed siphuncle. Cross section of whorl (Text Fig. 2b) broadly rounded ventrally and laterally, moderately impressed dorsally, umbilical shoulders ill defined. Suture simple (Text Fig. 2), a broad gently arched shallow ventral saddle, a broad shallow assymmetrical lateral lobe and a shallow umbilical saddle. Internal suture simple, with extremely shallow, ill-defined dorsal (annular) lobe. A slight callus, similar to that of Recent Nautilus, is developed in the umbilical hollow.

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*Cossmann and Pissino (1906), Pl. 61, Figs. 5–1’ figure a nautiloid as "A. ziczac mut, non denominée," from the Thanetian.
Fig. 1.—Aturia (Aturia) grangei n.sp. (Holotype).
Figs. 2, 3.—Aturia (Aturia) grangei n.sp. (Paratype, G.S. 1917).
Figs. 4, 5.—Aturia (Brazaturia) mackayi n.sp. (Holotype).
Fig. 6.—Aturia (Brazaturia) mackayi n.sp. (Paratype, G.S. 544).
Fig. 7.—Aturia (Brazaturia) mackayi n.sp. Siphuncular tube of Hampden specimen.
Figs. 8, 9, 10.—Hercoglossa innominanda n.sp., suture lines. (Holotype Fig. 8.)

(Approximately half natural size.)
Fig. 11.—Argonauta oveiri n.sp. (Holotype).
Figs. 12, 13.—Hercoglossa innominanda n.sp. (Holotype).
Figs. 14, 15.—Hercoglossa innominanda n.sp. (Paratypes). Sutures inked.
(Approximately $\frac{1}{2}$ natural size.)
Figs. 16, 17, 18.—*Nautilus* (s.l.) *allani* n.sp. (Holotype).

(Approximately half natural size.)
Dimensions: (Estimated where specimen incomplete); altitude, 193; height of last whorl (living chamber), 120; height of preceding whorl, 77; width of last whorl, 115; width of preceding whorl, 70mm.

Locality: Upper part of coarse tuffaceous limestone, ½ mile south of Wireless Station, Waitangi, Chatham Islands. Collected by Dr. R. S. Allan, Canterbury University College.

Horizon: Marwick (1928, pp. 435–436) noted that the Waitangi and Tioriori beds lack Wanganuan elements present in other members of the Wharekauri–Waitangi Series and are possibly older than upper calcareous tuffs of the same series, which he classified approximately as Early or Middle Tertiary. Some of the upper beds are now regarded as Older Pliocene. In the Waitangi (Waikaripi) bed, the species of Chlamys, Notostrea, Venericardia, Nemocardium, and Perofrochus have affinities which suggest that the bed is no younger than Upper Oligocene. The affinities of Nautilus allani tend to indicate an early rather than mid-Tertiary age for the bed.

Remarks: Generic placing is made without prejudice. The centrodorsal siphuncle, globose, compressed form, and simple suture with ill developed annular lobe, are features foreign to living species of Nautilus. Entrophoceras Hyatt includes a number of Jurassic to lower Oligocene species similar in form to allani; some species also lack the annular lobe of Nautilus and the siphuncle varies in position. The suture of Entrophoceras is described as slightly sinuous or essentially straight externally and ‘entirely in front of the guide line,’ but some species at present included in the genus depart from such definitions. Teichert (1943, p. 263) has discussed the position in describing the Australian Eocene N. victorianus Teichert, which is similar in several features, including sutureal pattern, to N. allani, though a much smaller shell. It seems probable that both species would be included in Entrophoceras by some American workers. Their affinities may be closer to aberrant members of that genus, such as E. bryani Gabb, Vicentown, New Jersey (Lower Eocene) than Nautilus. Both Teichert (op. cit.) and Stenzel (1940) suggest that bryani is a Nautilus (s.l.) rather than a Entrophoceras (s.str.).

DIBRANCHIATA.

ARGONAUTIDAE.

GENUS ARGONAUTA Linne, 1758.

According to Spath (1927), ‘after the Miocene, Nautili almost disappeared, and Aturids became extinct, but Argonauts arose. Of these we now recognise some 20 forms.’ Davies (1935, p. 356) notes Pliocene occurrences in the Mediterranean and Japan, but the relevant literature is not available and the following New Zealand Pliocene species has been compared only with Recent forms.

Argonauta oweni n.sp. (Plate 61, Fig. 11).

Shell large; whorl section and aperture laterally compressed; though crushed, original shape more like A. tuberculata Shaw than other Recent forms, and superficially agreeing with that species in lacking the curvedalar processes of argo L., nodosa Sol., americana Dall, etc., but clearly showing affinity to those specialised species rather than to tuberculata in the form of the growth lines which are
disposed in a distinct outwardly directed kink, at the point where lip joins body of shell, foreshadowing the alar processes of Recent forms. Sculpture of the argo type, i.e., of smooth sinuous radial rugae not divided into tubercles; ridges fairly coarse as in typical argo (figured by Reeve, 1842, plate CCC), secondary ridges arising somewhat irregularly but chiefly at outer third of shell. Peripheral nodulation alternating, coarse, tubular, probably euspate distally.

Dimensions: Altitude, 118; height of aperture, 95; maximum width of aperture (slightly crushed), 40 mm.

Locality: G.S., 2607; limy concretionary boulder in Hautapu River due west of Flat Spur Trig., 1.4 miles south of east from Utiku. Collected by Mr. John R. Ower, Superior Oil Company, and secured for the Geological Survey Collection through the kind offices of Mr. R. E. Turner.

Horizon: Although the specimen was not collected in situ, the Hautapu River flows only through Lower Pliocene rocks and the horizon is almost certainly Waitotaran.

LITERATURE.


