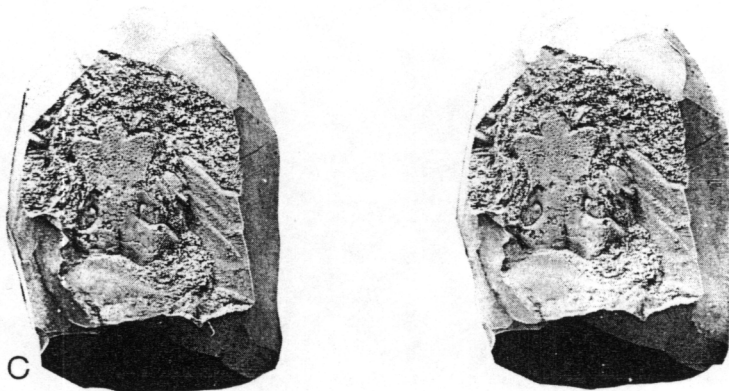
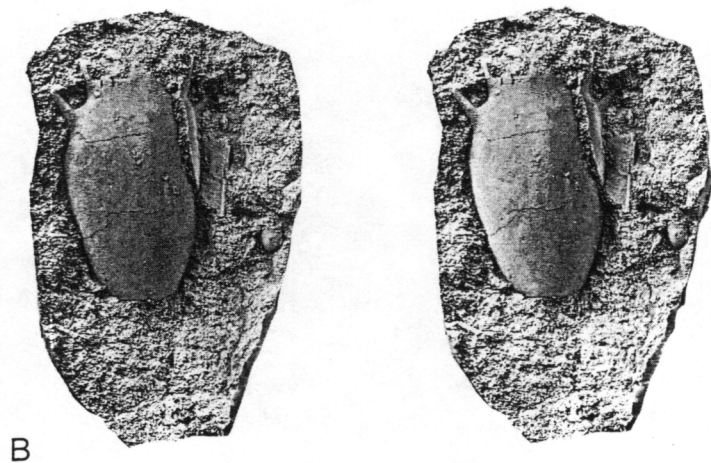


Fig. 18. *Laeviranina borealis* sp. nov. from the Middle Paleocene at Qaersutjægerdal. A: holotype, MGUH 21.606, dorsal view of carapace,  $\times 1.5$ ; B: paratype, MGUH 21.607, dorsal view of silicone rubber cast of the carapace; C: paratype, MGUH 21.608, silicone rubber cast of the anterior part of sternites,  $\times 2$ .



the longitudinal curvature is gently convex. The anterior margin is reduced to a short regular curve between the outer orbital and lateral spines. The orbitofrontal margin is straight and occupies about two thirds the carapace width; the dorsal surface of the triangular rostrum is flat to slightly concave, its sides forming a regular curve with a short interorbital spine, or point, at the edge of the inner orbital fissure. Two deep fissures extend nearly the length of the postorbital depression and the spine between is short, flat and rounded apically. The inner fissure is more distant from the median line than it is from the outer orbital spine and the outer fissure is nearer the inner one than to the outer orbital spine. The slender pointed outer orbital spine reaches as far as the rostral tip and is directed straight forward. Occurring about one ninth distant from the front the forward and outwardly directed lateral spine is a little longer than the outer orbital spine and its length is about one fourth the carapace width. The posterolateral margins curve gradually towards the posterior margin and well behind the lateral spine the edge is granulated, the granules persisting as a ridge bounding the posterior margin which is about half the carapace width.

The dorsal surface is covered with numerous rather closely placed minute pores and there are granules within the depressed frontal area and along the anterior half of the lateral margin. The cardiac furrows are smooth and shallow, but distinct. Casts of the inner surface show a pair of curved impressions for the attractor epimeralis muscles, corresponding to the cardiac furrows. Anterior to these are two groups of impressions for the stomach muscles. On the cardiac region three tubercles are set in an inverted triangle and there is a tubercle on each protogastric and a pair on the mesogastric lobes.

The anterior termination of the 4th sternal element is moderately alate, its anterior margin curving forward and outward, and the junction between the 4th and 5th elements is rather elongate. A deep median sternal cleft extends the length of the 5th element.

Of the chelipeds, parts of the ischium, merus, carpus and propodus are preserved; the surface is granulated, with the granules forming short transverse ridges in some areas, especially on the merus, and there is a distal spine on the outer edge of the carpus.

*Measurements.* Carapace length, including rostrum 21–31 mm. The greatest width excluding lateral spines is about 13–20 mm, or 0.6 of the length; the length of the lateral spines varies between 4–5 mm. The width of the frontal margin ranges between 10.0 and 14 mm and the posterior margin is a little smaller.

*Discussion.* Although the generic characters of *L. borealis*, the earliest member of the genus now known, conform in all respects with those laid down by Glaessner (1969), the decision to place *borealis* in *Laeviranina* was strongly influenced by Feldmann's (1991) discussion of *Laeviranina perarmata* Glaessner, 1960: here, Feldmann drew attention to two characters – the relative breadth of the anterior to basal part of the 4th sternal element and the extent of the median sternal cleft – being of possible value in distinguishing *Laeviranina* from the closely allied genus *Raninoides* H. Milne Edwards, 1837. The anterior part of sternal element 4 of *L. borealis* is relatively less broad than that of *L. perarmata*, from the Middle Eocene of New Zealand, which has transverse not rounded anterior margins and the sternal median cleft extends to the base of the chelipeds in both *L. borealis* and *L. perarmata*.

In dorsal aspect *L. borealis* has much in common with that of *L. perarmata*, differing little more than in having a stronger postfrontal ridge.

Of European species attributed to *Laeviranina*, *L. borealis* has much in common with the dorsal aspects of *Raninoides glabra* (Woodward, 1871), however, the anterior part of the 4th sternal element preserved with recently found specimens of the latter (Collins & Smith, in press) is noticeably narrower – approaching the posterior breadth of that element – than in *L. borealis*, and more readily conforms with Feldmann's (1991) requirement for *Raninoides*.

Section Heterotremata Guinot, 1977  
Superfamily Calappoidea de Haan, 1833  
Family Calappidae de Haan, 1833  
Subfamily Calappinae de Haan, 1833

## Genus *Camarocarcinus* Holland & Cvancara, 1958

*Type species.* *Camarocarcinus arnesoni* Holland & Cvancara, 1958 by original designation.

*Range.* Paleocene.

### *Camarocarcinus quinquetuberculatus* sp. nov.

Figs 19A–E

1970 ?*Necrocarcinus* (*Camarocarcinus*) aff. *arnesoni* (Holland & Cvancara, 1958); Rasmussen in Rosenkrantz, p. 443.

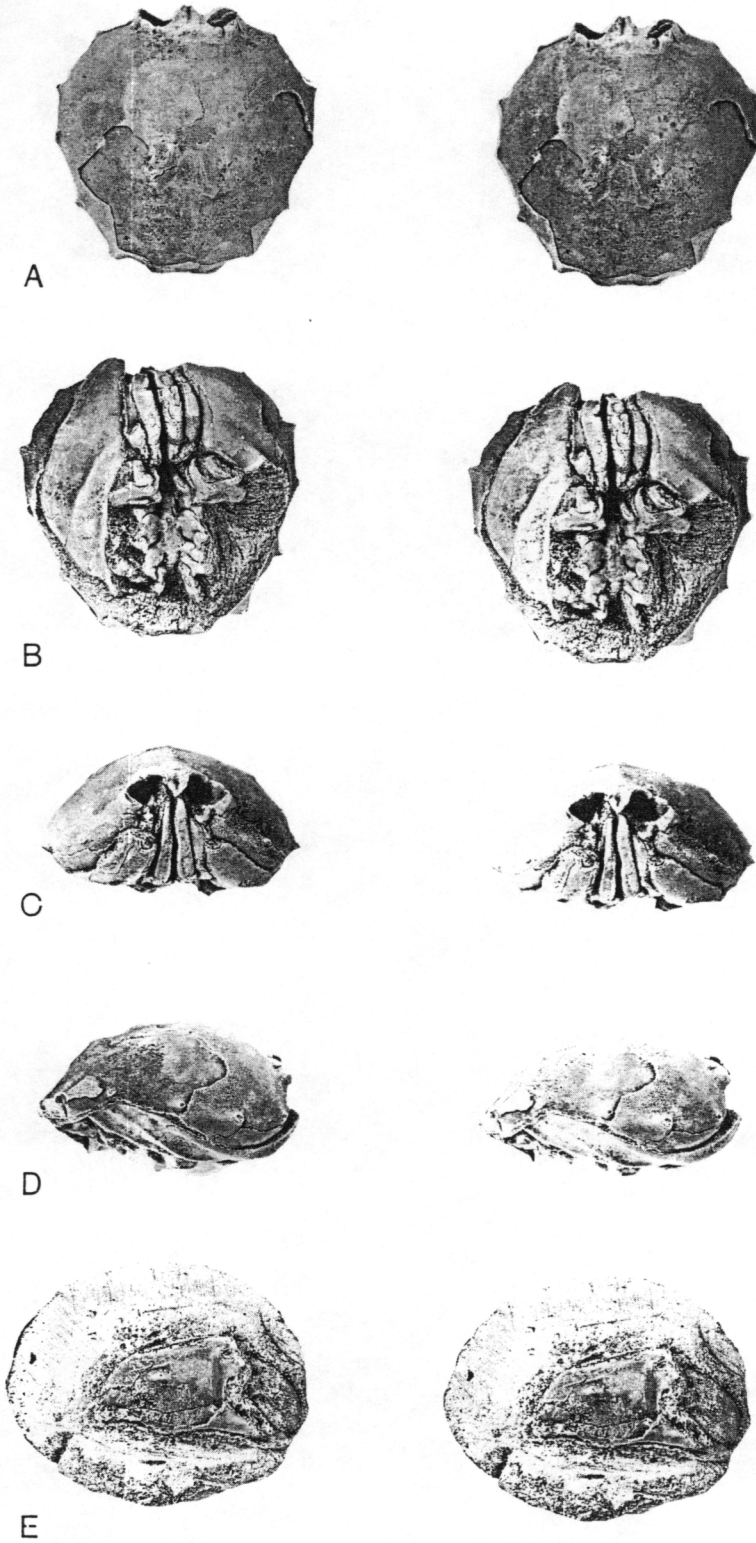


Fig. 19. *Camarocarcinus quinquetuberculatus* sp. nov. from the Middle Paleocene,  $\times 1$ . A-D: holotype, MGUH 21.609, from Turrnellakløft, A: dorsal view; B: ventral view; C: frontal view, D: lateral view; E: paratype, MGUH 21.610, from Qaersutjægerdal, outer surface of a right-hand chela.

*Derivation of name.* In reference to the five dorsal tubercles.

*Diagnosis.* A *Camarocarcinus* with three median tubercles corresponding to mesogastric, urogastric and cardiac regions, and a less prominent tubercle on each epibranchial lobe. Rostrum depressed, obtusely triangular, deeply sulcate with the high arched edges of the hinder part forming lobes rather than spines. Dorsal surface densely granulated. Cheliped with a long fixed finger sloping obliquely downwards from the propodus.

*Material.* Thirty-two carapaces and an isolated chela. Holotype, a carapace (MGUH 21.609) from a sandstone concretion found in 1946 in the gorge of Turritellakløft, no doubt originating from the Turritellakløft Member of the Agatdal Formation, central Nûgssuaq. Additional specimens, 3 carapaces from the Agatdal Formation, 553 m above sea level in the profile of Scaphitesnæsen, in Turritellakløft; 5 carapaces either displaced or from unspecified localities in Turritellakløft; 22 carapaces and 1 chela are from the upper bed of concretions in the sandy Turritellakløft Member of the Agatdal Formation in the great profile of Qaersutjægerdal; 1 juvenile carapace from the Sonja lens of the Agatdal Formation.

*Description.* The carapace is broadly ovate in outline; the width almost equals the length and widest about one third distant from the front. It is rather strongly rounded both longitudinally and transversely; in side view the highest point occurs about one third distant from the front and the descent from the cardiac region to the posterior margin is steeply inclined. The anterolateral margin is short and more or less evenly rounded with a short triangular spine on a level with the upper orbital margin, followed in some instances by a row of four or five irregular-sized granules. The posterolateral margin is gently rounded with four prominent radiating spines of which the hindermost is the longest – reaching up to one tenth of the carapace width – and most boldly curved. The distance between the second and third spines is slightly greater than between the first and second and third and fourth. Acutely rounded posterior angles lead into the gently concave posterior margin which is a little narrower than the orbitofrontal margin and bounded by a narrow rim.

Deep, broadly ovate orbits are directed a little upwards and in front view are inclined downward and outward at an angle of *c.* 52°; they take up the outer halves of the orbitofrontal margin which occupies about four fifths of the carapace width. The rostrum is deeply

sulcate, obtusely triangular and abruptly downturned in front where it extends a little beyond the orbital margin; behind, the prominently arched sides form a projection, but not a spine as in *C. arnesoni*. Two notches pierce the raised upper orbital margin which becomes somewhat thickened at the rounded lower orbital angle. On the dorsal surface three large tubercles or elevations occupy the mesogastric, urogastric and cardiac regions; that on the mesogastric is low and broadly rounded, the urogastric one is higher and more or less pointed, while that on the cardiac region is much the same height but more elongate and often has a small elevation posteriorly. On each epibranchial lobe a low tubercle forms a transverse line with the mesogastric tubercle, but on some of the larger specimens these tubercles are less distinct. From a small pit on either side of the midline the cervical furrow extends forwards and outwards as an indefinite line of pits set at an angle of about 40° to the midline; at the outer end of each line is a large, deep indentation ringed with fine pits followed by a curve of two or three rows of irregularly sized pits which, tapering to a single row, reaches the margin just forward of the second lateral spine. A little forwards and median to the above-mentioned indentation is a small pit containing a single granule. On either side of the urogastric lobe is a large circular indentation which on subsurface shell-layers is seen as a group of individual pits. Behind this indentation a shallow depression with traces of epimeral attractor muscle scars separates the urocardiac from the branchial regions. A hatched mass of pits, tapering to a single row curves outwards from the anterior part of the cardiac region to the margin between the second and third spines.

The dorsal surface of the remarkably thick shell is densely covered with granules of two, relatively speaking, quite distinct diameters, the smaller maintaining a constant ratio irrespective of the actual size of the larger. In general those on and behind the rostrum, covering the tubercles and towards the posterior margin are the smallest and more densely packed. On larger specimens a few crateriform pits are interspersed among the open pits marking the cervical furrow and there is a scattering on the anterolateral part of the protogastric lobes which almost ousts the granular ornament. These pits, which do not appear to penetrate the shell surface, are fairly constant in size and about equal in diameter to the largest granules. On inner shell-layers cratered pits take the place of the granules. Internal moulds show a weak tubercle on each protogastric lobe and a scattering of fine granules behind the orbits. Hatched pits behind the mesogastric lobe mark the possible site of either the posterior gastric or internal mandible adductor muscles.



The pterygostomial processes are trapezoidal in outline: a bluntly rounded sigmoidal ridge curves along the lateral margin and a second, narrower, sharper almost median ridge runs back almost parallel to the lateral one to the posterior angle of the buccal margin. The area between the ridges is broadly concave, as is the somewhat narrower area between the median ridge and buccal margin. The third maxillipeds completely cover the buccal cavity. The long endognath has a slender ischium and a strongly curved very long and narrow merus reaching the underside of the rostrum. The somewhat narrower exognath is a little longer than the ischium of the endognath.

The sternites are partly fused to a rather narrow sternum forming a median furrow, on each side of which is a lateral flange divided by furrows or fissures into four or five sternites.

Associated, though more or less damaged chelipeds are preserved with several carapaces. The shell is very thick and there is considerable difference between the stout chela seen on impressions of the outer surface and the apparently slender ones preserved only as casts of the inner surface. The left and right chelipeds are similar in size and form: the merus is short and has a tumid outer and flattened inner surface apparently with neither ridge nor spine. In side view the almost triangular carpus is very short and tumid, it has a lateral spine and another, distal, on the upper margin. The rather long, slender propodus increases in height distally, the upper margin is sharp with, perhaps, four tubercles and three or four line the lower margin. There is a longitudinal ridge on the outer surface with three or four spines and another, transverse, ridge behind the upper part of the distal margin. The inner surface is almost flat. The fixed finger is curved a little outwards and strongly downwards and a row of rounded teeth lines the opposing margin. The outer surface is closely and finely granulated.

A specimen from Qaersutjægerdal with associated chelipeds has a carapace length of 36 mm, the length of the merus is 14.0 mm; carpus, *c.* 9.0 mm; propodus *c.* 22.0 mm; dactylus, *c.* 13.0 mm, and the height of the segments from merus to propodus increases from about 7.0 mm to 9.0 mm.

*Discussion.* Dorsal tubercles or nodes are to some degree present on young forms of both the other members of the genus. *C. arnesoni* Holland & Cvancara, Paleocene Cannonball Formation of North Dakota and *C. obtusus* Jakobsen & Collins, 1979 from the Selandian of Sjælland, Denmark, but apart from that on the cardiac region which remains fairly obvious, the others are for the most part absorbed as growth advances. Thus, the

prominent median gastric and epibranchial tubercles persisting through all stages of growth readily distinguish the new species. The orbits are as open as are those of *C. arnesoni*, but rather more upwardly directed; and their inclination to the midline is 52° compared to 45° obtained in *C. arnesoni*. The orbits of *C. obtusus*, on the other hand, are considerably less open and inclined at an angle of 68°. *C. quinquetuberculatus* lacks the spine at the base of the rostrum present on the other species, but unlike either of them has a stronger spine preceding the row of granules lining the anterolateral margin. The numerous crateriform pits crowding the surface of *C. arnesoni*, interpreted by Holland & Cvancara (1958, 1959) to have been setiferous, and seen also on *C. obtusus* are much less in evidence on *C. quinquetuberculatus*.

### Genus *Cristella* gen. nov.

*Derivation of name.* A little keel – in reference to the median crest.

*Type species.* *Cristella hastata* sp. nov.

*Diagnosis.* Carapace subhexagonal with a narrow pointed rostrum: three spines on the upper orbital margin, the outermost stout and in line with the first of four anterolateral spines of which the fourth, at the lateral angle, is much attenuated. The dorsal surface is transversely arched with a median row of compressed spines forming a crest and, on either side, a longitudinal ridge bearing three spines.

### *Cristella hastata* sp. nov.

Fig. 20A, B

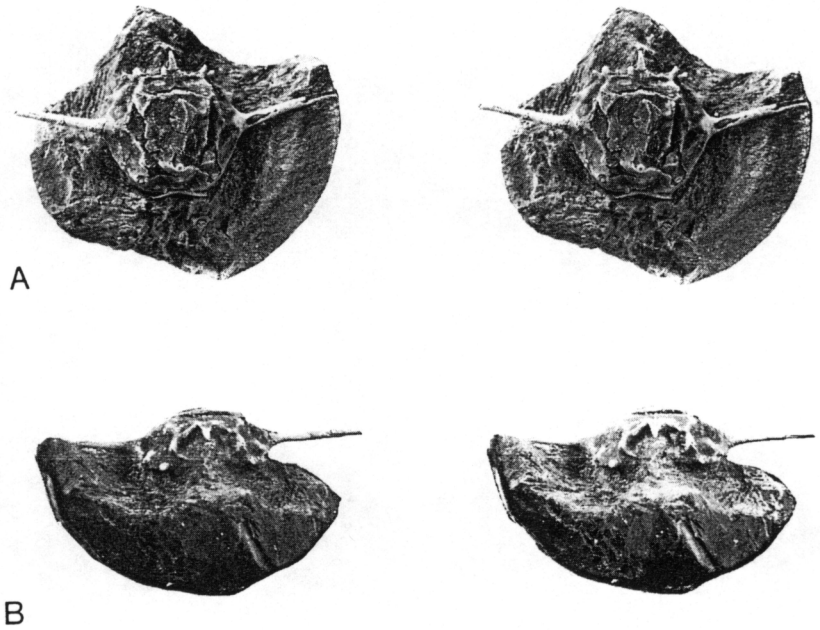
*Derivation of name.* Hasta (Latin) a lance, with reference to the lateral spines.

*Diagnosis.* As for genus.

*Material.* The holotype and only known specimen is an almost complete carapace in a small, calcareous concretion from black shales of the Kangilia Formation on the south side of Turritellakløft (opposite west end of the great profile) (MGUH 21.611).

*Description.* The carapace is subhexagonal in outline, the length and breadth almost equal if the rostrum and lateral spines are excluded, and transversely steeply

Fig. 20. *Cristella hastata* sp. nov., holotype, MGUH 21.611, from the late Lower Paleocene at Turritellakløft, A: dorsal view; B: frontal view,  $\times 1.5$ .



arched, much like a gambrel-roof in section. The orbito-frontal margin is straight and occupies a little more than half the carapace width measured at the base of the lateral spines. The orbital and antennal cavities are fairly shallow, ovate and divided by a low septum, the rather long, slender rostrum tapers gradually to a point; it is triangular in section with the dorsal surface slightly concave and weakly depressed between bluntly pointed inner orbital spines. There is a smaller spine near the middle of the thinly raised orbital margin and a stout triangular outer orbital spine which has its outer margin sweeping backwards and outwards towards the third lateral spine. Of the four spines on the weakly rounded anterolateral margin the first occurs almost on a level with and a little below the outer orbital spine and gives a false impression of the width of the orbito-frontal margin. The second, much reduced almost granular spine is set equidistant between the first and stout, triangular third spine. The fourth spine at the lateral angle is slender and circular in section; projecting almost at right angles to the anterolateral margin it curves a little forwards and backwards, its length exceeding three fourths of the carapace width. The posterolateral margin is almost straight and a little longer than the anterolateral margin; it leads by fairly acute posterior angles to the slightly concave posterior margin which is about as wide as the front and bounded by a raised rim.

Shortly behind the front a low transverse ridge extends across the carapace to a stout spine on the proto-gastric lobe, then turns sharply forward to terminate between the middle and outer orbital spines. The prom-

inent median ridge is composed of a large spine, triangular in outline, at the base of the anterior mesogastric process followed on the rhomboidal mesogastric lobe by a high, much compressed spine with a rounded summit. The outlines of these two spines are repeated in miniature on the urogastric lobe and all are united at their base to form a continuous carina. The cardiac region is lingulate and has two rounded spines, the first, much the larger, tops a low rounded 'ridge' which connects with the foremost of the metabranchial spines. There is a large forwardly directed spine on the hepatic region and a somewhat curving ridge on either side of the median ridge unites the bases of three spines; the first, on the epibranchial lobe, is small, laterally directed and also united by a similar ridge to the lateral spine. The second forms the first of the metabranchial spines while the third spine, set a little laterally and opposite the basal cardiac spine, is vaguely joined by an oblique 'ridge' to the marginal base of the lateral spine. A smaller protogastric tubercle occurs between the outer angle of the mesogastric lobe and the hepatic spine. The cervical furrow, interrupted at the midline by the median carina, is straight at the base of the mesogastric lobe then runs sharply forwards and outwards to that lobe's lateral angle where, turning out, it loops round the bases of the protogastric and hepatic spines to reach the lateral margin well forward of the lateral spine. Very faint, crescentic epimeral adductor muscle scars parallel the median course of the cervical furrow and unite, behind, with the branchiocardiac furrow which defines a narrow mesobranchial lobe before curving broadly for-

ward and outward to become obsolete at the base of the lateral spine.

A few minute granules are scattered over the otherwise smooth dorsal surface.

*Measurements.* The length of the carapace excluding rostrum is 10.2 mm; length of rostrum, 2.2 mm; the carapace width excluding lateral spines is 11.9 mm and each lateral spine is more than 9.0 mm in length.

*Discussion.* *Cristella* appears to have a close affinity to, and could well have been derived from *Necrocarcinus*, particularly the Maastrichtian *N. pierrensis* (Rathbun, 1917). In the latter species the lateral spines are moderately developed, typical of the genus as a whole, the rostrum is short and bifurcate, and the upper orbital margin is pierced by notches and rather more sinuous than in *Cristella*. Both species have in common, however, the transverse row of gastric spines and the outermost one on *N. pierrensis* has a spinule between it and the upper orbital margin foreshadowing the inturned 'ridge' on *Cristella*. In transverse section *N. pierrensis* is more evenly curved, and the hepatic and epibranchial lobes more tumid; the lateral branchial spines are reasonably well developed in *N. pierrensis*, but anteriorly they commence with a spine on the mesobranchial rather than the epibranchial lobe as in *Cristella*; a low ridge connecting cardiac and metabranchial spines is present in some small carapaces.

Rathbun (1917) originally placed '*pierrensis*' in *Campylostoma*, a monotypic Lower Eocene genus. The structure of the frontal region, the vaguely tricarinate dorsal surface and arrangement of the – albeit suppressed – tubercles strongly suggests *Campylostoma* to have been derived from *Necrocarcinus* through *N. pierrensis*. *Campylostoma*, however, differs largely in having much produced lateral spines (Collins, 1961) which are such a prominent feature of *Cristella*, although in the latter they are positioned more anteriorly. There is also a similarity, to some extent, in the dorsal carination and tuberculation, but whereas the front of *Campylostoma* retains the bifurcate, deeply sulcate rostrum of *Necrocarcinus*, *Cristella* has a slender, elongate rostrum. It would seem that where *Campylostoma* and *Cristella* may have a common ancestry in *Necrocarcinus* they have developed independently along separate lines.

Superfamily Xanthoidea Dana, 1851  
Family Xanthidae Dana, 1851

### Genus *Xanthilites* Bell, 1858

*Type species.* *Xanthilites bowerbanki* Bell, 1858 by monotypy.

*Range.* Paleocene to Middle Eocene.

#### *Xanthilites verrucoides* sp. nov.

Fig. 21A-C

*Derivation of name.* With reference to the wart-like ornament.

*Diagnosis.* A *Xanthilites* with four hexagonal spines, the largest at the lateral angle; the regions are tumid with large conical tubercles of which those on the cardiac region are fused into a transverse elevation.

*Material.* Holotype MGUH 21.612 in a limonitic concretion from the upper bed of concretions in the sandy Turritellakløft Member of the Agatdal Formation in the great profile at Qaersutjægerdal in central Nûgssuaq. Additional specimens, 2 specimens in concretions from the type locality.

*Description.* The carapace is hexagonal in outline, about one third wider than long and moderately curved in longitudinal and transverse sections. The front is incompletely preserved, it takes up about half of the orbitofrontal width which occupies rather less than half the carapace width; it projects a little beyond the outer orbital spine and apparently had four spines. The raised upper orbital margin has two shallow notches, possibly separated by a spine and there is a small outer orbital spine. The anterolateral margin is convex with three more or less equal sized slightly upturned triangular teeth and a rather more robust one at the lateral angle. The nearly straight posterolateral margins converge sharply to the posterior margin which is a little less than the orbitofrontal width, almost straight and bounded by a low rim. The anterior mesogastric process tapers narrowly to a point at the base of the front where it is separated by fine grooves from small epigastric lobes which on the shell surface lead back to and are confluent with a robust rounded tubercle on each proto-gastric lobe although they are more or less isolated on internal casts. There is a similar sized median tubercle