

FIG. 188. **Nepea narinosa* WHITEHOUSE (Nepeidae), M.Cam., Queensl.; exoskel. lacking librigenae (reconstr.), $\times 2$ (493).

rows present, with prominent median boss on preglabellar field; with anterior border and marginal furrow; occipital spine may be present; eye ridges present, may be double, eyes small, opposite anterior third of glabella; fixigenae upsloping, with palpebral areas as wide or wider than glabella, posterior area narrow, much wider (*tr.*) than occipital ring, posterior marginal furrow curving forward, genal spines present; librigenae forming small convex triangles. Thorax of 22 or fewer narrow segments, axis much narrower than pleurae, pleural furrows narrow, distinct, on anterior third of pleurae. Pygidium transverse; axis broad, tapered to rounded end, about same in width as pleural regions, border narrow. Surface unknown. *M.Cam.*

Family NEPEIDAE Whitehouse, 1939

Characters of superfamily. *M.Cam.*

Nepea WHITEHOUSE, 1939 [**N. narinosa*]. Glabella tapering forward, truncate at front, with 3 pairs of lateral furrows; swollen median boss occurs on preglabellar field, bounded laterally by furrows continuous from axial furrows, boss may impinge forward onto marginal furrow; anterior border very narrow; occipital spine present; fixigenae steeply upsloping, with palpebral areas 1.5 times width of glabella, posterior area elongate, about 3 times width (*tr.*) of occipital ring, with long or short slender genal spines. Thorax of no fewer than 22 segments. Pygidium very small, axis convex, with 2 or 3 axial rings; pleural regions low, with 2 or 3 pleurae (340). *Up.M.Cam.*

(Amphoton Stage), NW.Queensl.—FIG. 188. **N. narinosa*; exoskel. lacking librigenae (reconstr.), $\times 2$ (493, modified).

Superfamily DIKELOCEPHALACEA Miller, 1889

[*nom. transl.* HENNINGSMOEN, 1951, but attributed by him to RICHTER, 1933 (*ex* Dikelocephalidae MILLER, 1889)] [=Dikelocephalidea RICHTER, 1933 (*partim*); Dikelocephaloidae HUPÉ, 1953 (attributed to RICHTER, 1933)]

Exoskeleton opisthoparian, medium-sized to large, ellipsoidal in outline, heteropygous to subsipygous. Cephalon mostly semi-circular, with more or less broadly tapering glabella that bears 2 or 3 pairs of lateral glabellar furrows, posterior pairs commonly complete; frontal area broad (*sag.* and *tr.*), anterior border furrow shallow to obsolete; palpebral lobes prominent, eyes usually medium-sized; librigenae bearing medium to long genal spine. Thorax with 13 or fewer segments. Pygidium broadly ovate to transverse, with interpleural and pleural furrows tending to curve conspicuously backward across broad border, some forms with pair of short posterolateral spines. Surface smooth to finely granulose. *L.Cam.-U.Cam.*

Family IDAHOIIDAE Lochman, 1956

Exoskeleton opisthoparian, heteropygous. Glabella tapering, truncate-tapering or sub-rectangular, with 3 pairs of arcuate lateral furrows distinct to very faint; eye ridges narrow; with broad palpebral furrows and wide palpebral rims; eyes medium-size to large, opposite or somewhat behind mid-length of glabella; ratio of preglabellar field to anterior border highly variable; anterior border furrow narrow; fixigenae variable in position and width, with palpebral area arcuate, 0.3 to 0.5 of glabellar width, posterior area narrow (*exsag.*), straplike, of medium length (*tr.*); librigenae quadrate, with obsolete marginal furrows at genal angles, genal spines rounded. Pygidium with convex axis, tapered to broadly rounded end with usual median indentation and short postaxial ridge, with 3 or 4 axial rings and terminal ring; pleural field low, pleurae 3, with broad shallow furrows and narrower interpleural grooves that are distinct to very faint, without border furrow; border of variable width. Surface granulose. Derived from Ptychopariidae. *U.Cam.*

- Idahoia** WALCOTT, 1924 [**I. serapio*]. Glabella truncate-tapering, with lateral furrows faint to obsolete, occipital spine commonly present; eyes somewhat behind mid-length of glabella; frontal area between 0.3 and 0.5 of length of cranidium, bearing row of small granules along anterior border furrow; fixigenae horizontal to slightly upsloping, with palpebral areas about 0.3 of glabellar width; librigenae with long anteriorly or posteriorly recurved genal spine. Pygidium semicircular; axis about equal in width to pleural field, somewhat more than 0.5 of length of pygidium, pleural furrows distinct, interpleural grooves faint; border wide, flat to concave. Surface smooth or very finely granulose (8, 321). *U.Cam.(Francon.)*, N. Am.—FIG. 189,2. **I. serapio*, Idaho; 2a, ceph.; 2b, hypostoma; 2c, pyg., all $\times 1$ (321).
- Bellaspidella** RASETTI, 1945 [**B. resseri*]. Glabella convex, subrectangular, with 2 pairs of lateral deep furrows; eyes of medium size, slightly behind center of glabella; frontal area 0.12 of length of cranidium; fixigenae horizontal to slightly upsloping, narrow, with palpebral areas about 0.3 of glabellar width, posterior area very narrow (*exsag.*). Surface finely granulose (189). *U.Cam.(Trempeal.)*, E.N.Am.
- Comanchia** FREDERICKSON, 1950 [**Ptychopleurites amplexoculata* FREDERICKSON, 1948]. Glabella subrectangular, with distinct lateral furrows; eyes relatively large, slightly behind mid-length of glabella, frontal area between 0.2 and 0.25 of length of cranidium; preglabellar field narrow, fixigenae slightly upsloping, very narrow, with palpebral area 0.3 of glabellar width. Surface finely granulose. *U.Cam.(Francon.)*, C.N.Am.—FIG. 189,1. **C. amplexoculata* (FREDERICKSON), Okla.; 1a,b, cran., dorsal, side, $\times 10$ (47).
- Pseudosaratogia** WILSON, 1951 [**P. magna*]. Glabella elongate-tapering to truncate-tapering, with distinct lateral furrows, posterior pair in some complete; eyes relatively large, opposite mid-length of glabella; frontal area a little more than 0.25 of length of cranidium; anterior border narrow; fixigenae horizontal to upsloping, with palpebral areas slightly less than 0.5 of glabellar width, posterior area very narrow (*exsag.*); librigenae with short genal spine. Pygidium narrow-transverse; axis equal in width to pleural field, 0.7 of length of pygidium; pleural furrows and interpleural grooves distinct, running nearly to margin, with narrow flat to concave border (363). *U.Cam.(Francon.)*, C.N.Am.-E.N.Am.—FIG. 189,4. **P. magna*, Pa.; 4a, ceph., $\times 10$; 4b, profile of cran., $\times 4.5$; 4c, pyg., $\times 6$ (363).
- Saratogia** WALCOTT, 1916 [**Conocephalites calciferous* WALCOTT, 1879 (*sic*)]. Glabella truncate-tapering, with faint lateral furrows; eyes of medium size, near center of glabella; occipital spine present, frontal area about 0.3 of length of cranidium, very narrow (*tr.*); anterior border furrow shallow, border narrow; fixigenae upsloping, very narrow, with palpebral area 0.3 of glabellar width, posterior area very narrow (*exsag.*). Pygidium narrow-transverse; axis somewhat wider than pleural field, 0.75 of length of pygidium; pleural furrows and parallel interpleural grooves both distinct, border very narrow, poorly defined. Surface finely granulose. *U.Cam.(Trempeal.)*, E.N.Am.—FIG. 189,3. **S. calciferus* (WALCOTT), N.Y.; 3a, cran., $\times 1.5$; 3b, pyg., $\times 3$ (316).
- Wilbernia** WALCOTT, 1924 [**Ptychoparia pero* WALCOTT, 1890]. Glabella elongate, tapering to subrectangular, lateral furrows faint to obsolete; eyes of medium size, somewhat behind center of glabella; frontal area broad (*tr.*), about 0.25 of length of cranidium; ratio of preglabellar field to border variable, anterior border furrow narrow, straight or curved; fixigenae slightly upsloping, with palpebral areas somewhat more than 0.3 of glabellar width, posterior area very narrow (*exsag.*); librigenae with long slender genal spine. Pygidium transverse; axis narrower than pleural field, 0.83 of length of pygidium; pleural furrows and interpleural grooves distinct, slightly curved, abutting against a narrow ridge in position of border furrow, border narrow, flat. Surface may be smooth (8). *U.Cam.(Francon.)*, N. Am.—FIG. 189,5a,b. *W. explanata* (WHITFIELD), Wis.; 5a, ceph.; 5b, pyg., both $\times 1.5$ (8). —FIG. 189,5c,d. **W. pero* (WALCOTT), Tex.; cran., $\times 1.5$ (321).
- Meeria** FREDERICKSON, 1949 [**M. lirae*]. Glabella moderately convex, elongate truncate-tapering, with 3 pairs of faint lateral furrows, posterior pair arcuate, usually complete, shallow axial furrows may have a pair of anterior pits; frontal area 0.25 to 0.3 of length of cranidium, shallow curved anterior border furrow; eyes below medium size, slightly anterior to center of glabella; fixigenae upsloping, with arcuate palpebral areas about 0.25 of glabellar width, posterior areas straplike, about 0.7 length (*tr.*) of occipital ring, posterior sections of facial sutures sigmoidally curved. *U.Cam.(Francon.)*, C.U.S.A.—FIG. 202,2. **M. lirae*, Okla.; ceph., $\times 1.7$ (399). [Transferred to Idahoiidae at request of LOCHMAN-BALK after earlier assignment of genus by her to Parabolinoiidae.]

Family DIKELOCEPHALIDAE Miller, 1889

Exoskeleton opisthoparian, isopygous. Glabella rectangular to broad quadrate, with 2 or 3 pairs of lateral furrows, posterior pair usually complete, arcuate; frontal area with anterior border furrow usually faint to obsolete; eyes above medium size, opposite posterior 0.3 of glabella; palpebral rims prominent, palpebral furrows deep, arcuate, about 0.3 of glabellar width, posterior area narrow (*exsag.*), straplike; librigenae rec-

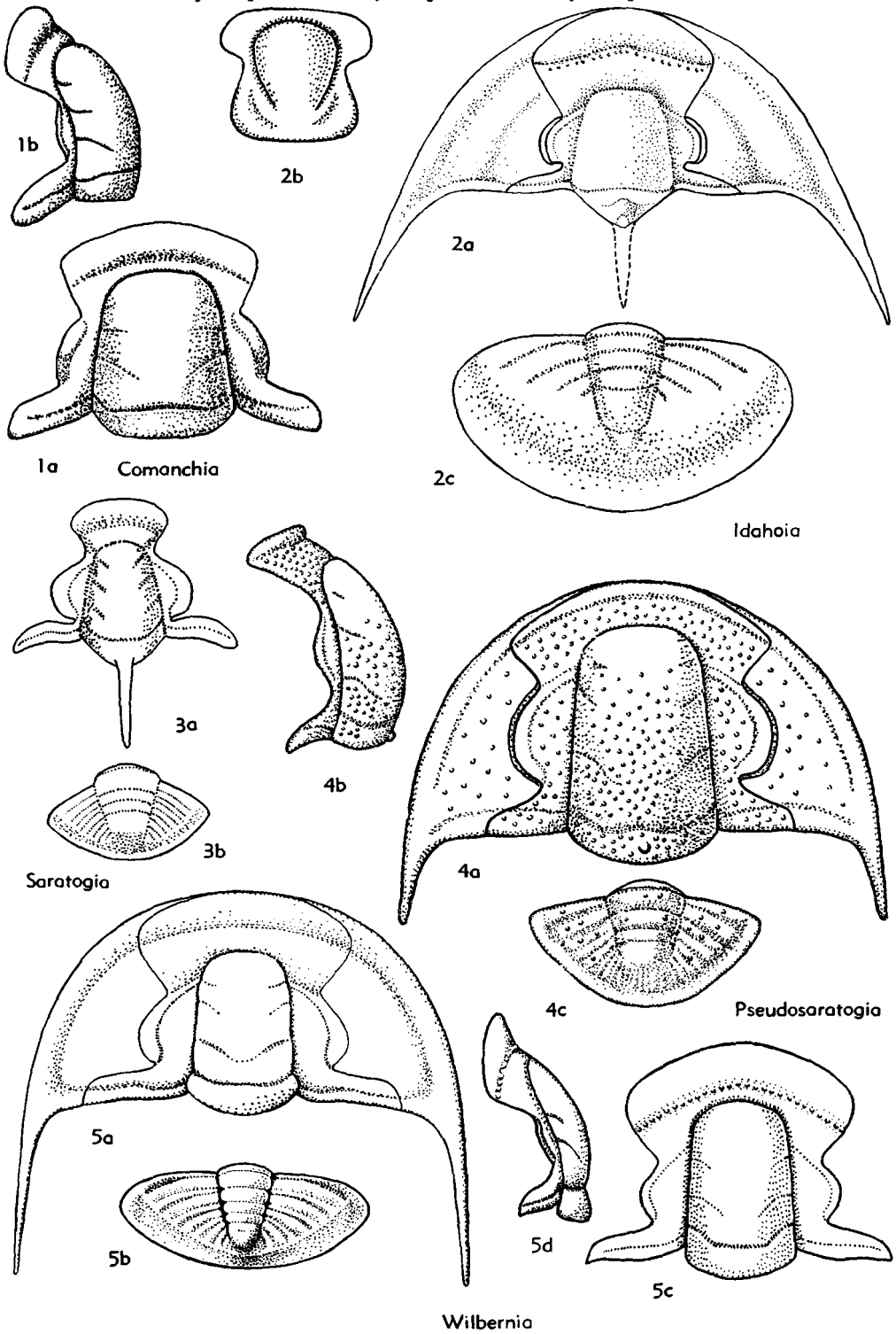


FIG. 189. Idahoiidae (p. 0252).

tangular, with genal spine; hypostoma subquadrate to rectangular, with small anterior wings, globose central lobe, convex curved posterior lobe, and pair of deep oval maculae at posterior corners of central lobe. Thoracic segments with wide low axis, length of pleurae (*tr.*) twice axial width, slightly curved, ends bluntly pointed, pleural furrow diagonal. Pygidium elliptical; axis tapered to narrow rounded end, posterior axial furrow obsolete, postaxial ridge extending onto border; interpleural grooves and pleural furrows curving back onto inner edge of border, last pair running nearly straight back, without border furrow, border of variable width. Surface smooth or granular, with Bertillon pattern on borders and doublure. Derived from *Wilbernia*. *U.Cam.*

Dikelocephalus OWEN, 1852 [**D. minnesotensis*]. Glabella low, broadly quadrate, front nearly straight, with 2 pairs of lateral furrows; eye ridges faint; frontal area about 0.3 of length (*sag.*) of cranium, anterior and lateral border furrow obsolete, posterior border furrow distinct to base of genal spine; fixigenae with palpebral areas about 0.3 of glabella width, posterior area nearly as long (*tr.*) as occipital ring; librigenae with slender genal spine of medium length. Pygidium broadly elliptical; axis and pleural field of same width, axis tapering through 0.6 of its length, with 4 distinct axial rings and long terminal with 1 or 2 faint additional rings; pleural field low, merging into broad flat semicircular border, 4 pairs of interpleural grooves, each segment may be crossed by a nearly parallel pleural furrow, a pair of short flat spines at posterolateral corners of margin. *U.Cam.*(*U.Francon.-Trempeal.*), N.Am.—FIG. 191.3. **D. minnesotensis*, Trempeal., Wis.; *pyg.*, $\times 0.4$ (461, 487).—FIG. 190.1. *D. regalis* ULRICH & RESSER, Trempeal., Wis.; *1a*, ceph.; *1b*, thoracic segment, both $\times 0.3$; *1c*, hypostoma, $\times 0.4$ (461, 487).

Briscoia WALCOTT, 1924 [**B. sinclairensis*]. Glabella convex, rectangular, with sides converging slightly to rounded front, 3 pairs of lateral furrows, anterior pair very faint; low eye ridges; frontal area about 0.25 of length of cranium, divided by broad shallow anterior furrow into preglabellar field and narrow convex anterior border; fixigenae with palpebral areas about 0.3 of glabella width, posterior areas 0.75 of length of occipital ring; librigenae with heavy medium-length spine. Pygidium broadly elliptical; axis and pleural field of same width, axis tapering 0.5 to more than 0.7 of its length, with 4 distinct axial rings and terminal showing one faint ring; pleural field low, merging into flat or concave border of variable width, with 5 pairs of interpleural grooves,

pleural furrows parallel, on anterior part of segment, posterior border smooth, with slight median inward bend. Surface granulose (321). *U.Cam.* (*Francon.-Trempeal.*), NE. Asia-N. Am.-NW. Eu.—FIG. 190.2. **B. sinclairensis*, Francon., W.Can. (B.C.); *2a*, ceph.; *2b*, thoracic segment; *2c*, *pyg.*; all $\times 0.67$ (461, 487).

Elkia WALCOTT, 1924 [**Dicelloccephalus nasutus* WALCOTT, 1884] [= *Parabriscoia* KOBAYASHI, 1935]. Glabella moderately convex, rectangular, with sides converging slightly to rounded front, posterior glabella furrow very shallow across center, frontal area 0.3 of length of cranium, divided by straight shallow anterior border furrow into narrow preglabellar field and wide, convex, triangular anterior border; fixigenae very narrow anteriorly, with palpebral area about 0.3 of glabella width, posterior area about 0.7 of length (*tr.*) of occipital ring; librigenae with long slender genal spine. Pygidium broadly elliptical; axis and pleural fields of same width, convex, axis tapering 0.5 to 0.75 of pygidial length, with 4 axial rings and terminal with one faint additional ring; 4 interpleural grooves between 5 pleural segments, narrow pleural furrows placed anteriorly on segments, becoming shallower posteriorly; border narrow, flat, with 4 or 5 pairs of short flat marginal spines, posterior margin inwardly bent. Surface smooth, with Bertillon pattern on borders, doublures, and posterior part of glabella (321). *U.Cam.* (*U.Francon.-Trempeal.*), W.N.Am.—FIG. 191, *4a,b.* **E. nasuta*, Trempeal., Nev.; *4a,b*, ceph., *pyg.*, $\times 1$ (321).—FIG. 191.4c. *E. elegans* (KOBAYASHI) (type species of *Parabriscoia*), U. Francon., W.Can.(B.C.), *pyg.*, $\times 1.5$ (419).

Osceolia WALCOTT, 1914 [**Dikelocephalus osceola* HALL, 1863]. Glabella moderately convex, rectangular, sides converging slightly to rounded front, with 2 pairs of lateral furrows; frontal area slightly more than 0.25 of length (*sag.*) of cranium, usually divided by narrow anterior border furrow into a medium-width preglabellar field and narrow convex anterior border; fixigenae extremely narrow anteriorly, with palpebral area a little more than 0.3 of glabella width, posterior area very narrow (*exsag.*), about 0.7 of length of occipital ring; librigenae with slender, medium-length genal spines. Pygidium narrow elliptical; axis convex, narrower than pleural fields, tapering through 0.7 of its length, postaxial ridge running onto border, with 3 or 4 axial rings and terminal with one faint ring; with 3 to 5 pairs of distinct interpleural grooves, pleural furrows obsolete, a pair of stout medium-length lateral spines, arising from 1st and 2nd segments, narrow flat border, posterior margin curved. Surface may be smooth. *U.Cam.*(*Trempeal.*), W. N.Am.-C.N.Am.—FIG. 191.2. **O. osceola* (HALL), Wis.; *2a,b*, ceph., *pyg.*, $\times 2$ (461, 487). *Walcottaspis* ULRICH & RESSER, 1930 [**Dikelocephalus vanhornei* WALCOTT, 1914]. Glabella low,

broadly quadrate, front slightly rounded, with 1 or 2 pairs of very shallow lateral furrows; eye ridges very faint; frontal area slightly more than 0.3 of length (*sag.*) of cranidium, anterior border furrow obsolete; fixigenae with posterior area about 0.75 of length (*tr.*) of occipital ring. Pygidium

narrow elliptical; axis and pleural fields of same width, axis tapering through 0.75 of its length, with 4 axial rings and long terminal with 3 faint rings, pleural fields with 4 interpleural grooves and 3 pleural furrows, border flat, medium in width, posterior margin smoothly curved. Outer

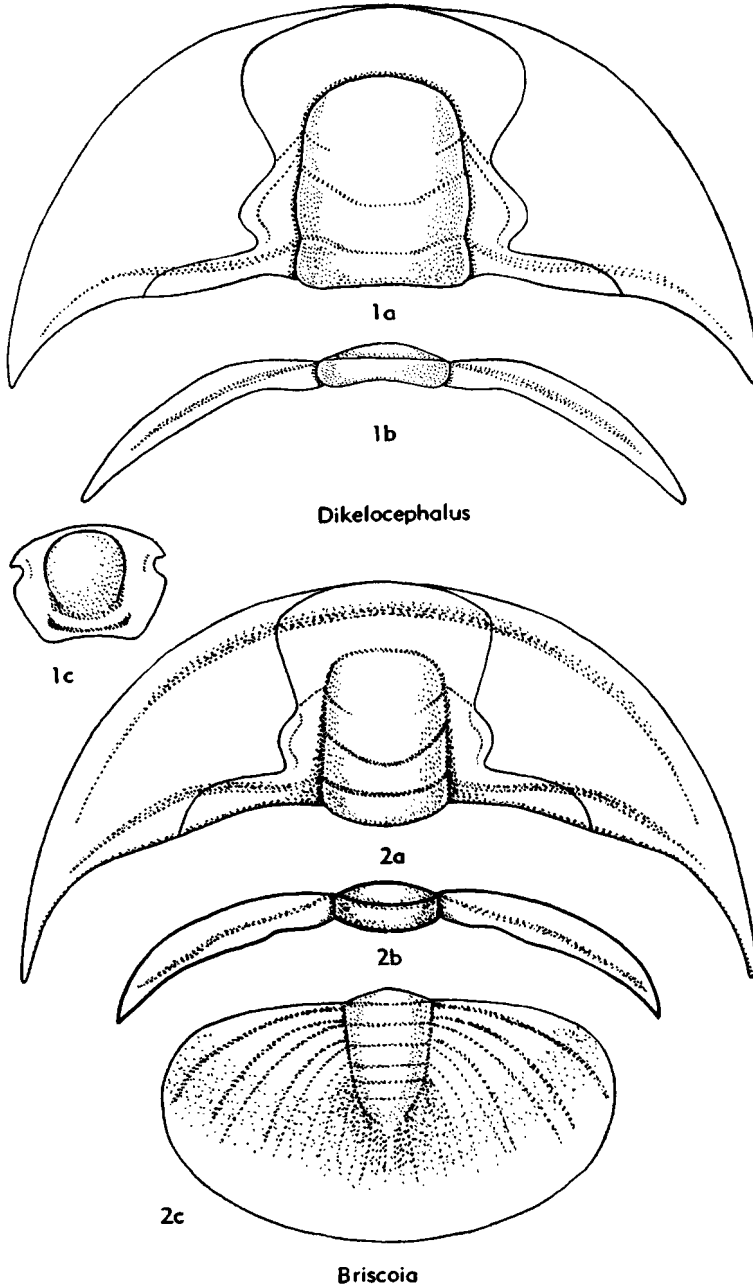


FIG. 190. *Dikelocephalidae* (p. 0254).

surface granulate (321). *U.Cam.(Trempeal.)*, C. N.Am.—FIG. 191, I. **W. vanhornei* (WALCOTT), Minn.; *1a,b*, cran., pyg., $\times 0.5$ (321).

Family PTEROCEPHALIIDAE

Kobayashi, 1935

[*nom. transl. et correct.* LOCHMAN, 1956 (ex Pterocephalinae KOBAYASHI, 1935)] [=Camaraspidae LOCHMAN, 1953]

Opisthoparian, heteropygous. Glabella low to moderately convex, tapering to truncate-tapering, with 3 pairs of lateral glabellar furrows; eye ridges, palpebral lobes and palpebral furrows present, of variable strength; occipital spine may occur; frontal area 0.25 to more than 0.5 length (*sag.*) of cranidium; anterior border furrow shallow to obsolete; eyes of medium size or smaller, position variable; fixigenae variable in position, with palpebral area width and posterior area shape variable; librigenae elongate rectangular, with broad-based flat genal spine. Thorax with at least 13 segments; axis convex; pleurae wider (*tr.*) than axis, with broad shallow central pleural furrow extending to sharply pointed tips. Pygidium ovate to transverse; axis convex, tapered to rounded end, with short postaxial ridge, 2 to 10 axial rings and terminal; pleural field variable in width, interpleural grooves obsolete or faint, pleural furrows broad and shallow, border furrow obsolete, border of variable width. Surface smooth, finely punctate or granulate. Derived from Ptychopariidae. *U.Cam.*

Pterocephalia F. ROEMER, 1852 [**P. sanctisabae*] [= *Pterocephalus* HALL & WHITFIELD, 1877]. Glabella tapering to truncate-tapering; eye ridges distinct; frontal area 0.5 or more of length (*sag.*) of cranidium, with concave preglabellar field and border, anterior border furrow obsolete; eyes of medium size, somewhat posterior to center of glabella; fixigenae upsloping, with palpebral areas about 0.5 of glabellar width, posterior areas narrow, straplike, long (*tr.*); librigenae with very broad concave border but no marginal furrow, bearing broad-based medium-length genal spine. Pygidium broadly semicircular; axis narrower than pleural fields, tapered 0.5 to 0.7 of its length, with 7 to 10 axial rings and terminal; pleurae 4 to 7, pleural furrows broad, shallow, curving backward onto broad concave border; short narrow interpleural groove may appear just behind the posterior edge of several pleurae. Surface finely granulate (15, 162). *U.Cam.(Francon.)*, N.Am. — FIG. 192, I. **P. sanctisabae*, Tex.; *1a,b*, ceph., pyg., $\times 1.3$ (15).

Aphelaspis RESSER, 1935 [**A. walcotti* RESSER, 1938, ICZN pend.] [= *Clevelandella* RESSER, 1938]. Glabella tapering to truncate-tapering; eye ridges and glabellar furrows faint; occipital spine may be present; frontal area about 0.3 of length (*sag.*) of cranidium; anterior border furrow very shallow to obsolete; eyes of medium size, opposite center of glabella; fixigenae horizontal, with palpebral areas 0.5 of glabellar width, posterior areas straplike, long (*tr.*); librigenae with very shallow to obsolete marginal furrow and flat slender genal spine; hypostoma elongate ovoid, with very small alae, large tumid anterior lobe, and narrow semicircular posterior lobe separated by shallow curved furrow, shallow semicircular marginal furrow, and marginal rim. Thorax of 13 segments. Pygidium transverse; axis tapered nearly full length, slightly wider than pleural field, with 2 or 3 axial rings and terminal; pleurae 2 or 3, interpleural grooves and pleural furrows faint to obsolete, border of medium width. Surface smooth or finely punctate (162). *U.Cam.(U.Dresbach.)*, N.Am.-SW.Sib.— FIG. 193, 5. **A. walcotti*, Tex.; *5a,b*, ceph., pyg., $\times 2$ (162).

Blandicephalus PALMER, 1954 [**B. texanus*]. Glabella low, truncate-tapering, with all furrows nearly obsolete on exterior, faint on interior; eye ridges faint; frontal area nearly 0.5 of length (*tr.*) of cranidium, anterior border furrow obsolete; eyes of medium size, opposite center of glabella; fixigenae slightly downsloping, with palpebral areas more than 0.5 of glabellar width, posterior areas 0.7 of length (*tr.*) of occipital ring; librigenae with obsolete marginal furrows and short flat genal spine. Pygidium broad-transverse; axis tapering nearly full length, slightly wider than pleural field; all furrows obsolete except shallow axial furrow, border of medium width. Surface smooth (162). *U.Cam.(U.Dresbach.)*, C.USA.— FIG. 193, 8. **B. texanus*, Tex.; *8a,b*, ceph., pyg., $\times 2$ (162).

Camaraspis ULRICH & RESSER, 1924 [**Arionellus (Agraulos) convexus* WHITFIELD, 1878] [= *Berkeia* RESSER, 1937 (obj.)]. Glabella low, tapering to truncate-tapering, with 2 pairs of shallow lateral furrows on interior only; faint eye ridges may be present; frontal area 0.25 of length (*sag.*) of cranidium; all furrows faint to obsolete on exterior, faint on interior; eyes slightly below medium size, behind mid-length of glabella; fixigenae downsloping, with palpebral areas 0.3 to 0.5 of glabellar width, posterior areas short, triangular; librigenae with shallow lateral border furrow and short slender genal spine. Pygidium transverse; axis wider than pleural field, extending nearly full length, with 2 or 3 axial rings and terminal; with 2 or 3 broad pleurae, all furrows obsolete on exterior, faint on interior, border narrow. Surface smooth (8, 47). *U.Cam.(Francon.)*, N.Am.—

FIG. 193,7. **C. convexa* (WHITFIELD), Wis.; 7a,b, ceph.; 7c, pyg., all $\times 1$ (8, 47).

Camaraspoides FREDERICKSON, 1949 [**Modocia berkeyi* RESSER, 1935]. Glabella moderately convex, tapering to truncate-tapering, with lateral furrows on interior; eye ridges and all other fur-

rows distinct on exterior; frontal area between 0.3 and 0.25 of length (*sag.*) of cranidium; eyes about medium in size, somewhat posterior to center of glabella; fixigenae downslipping, with palpebral areas about 0.5 of glabellar width, posterior area straplike, of medium length (*tr.*). Pygidium trans-

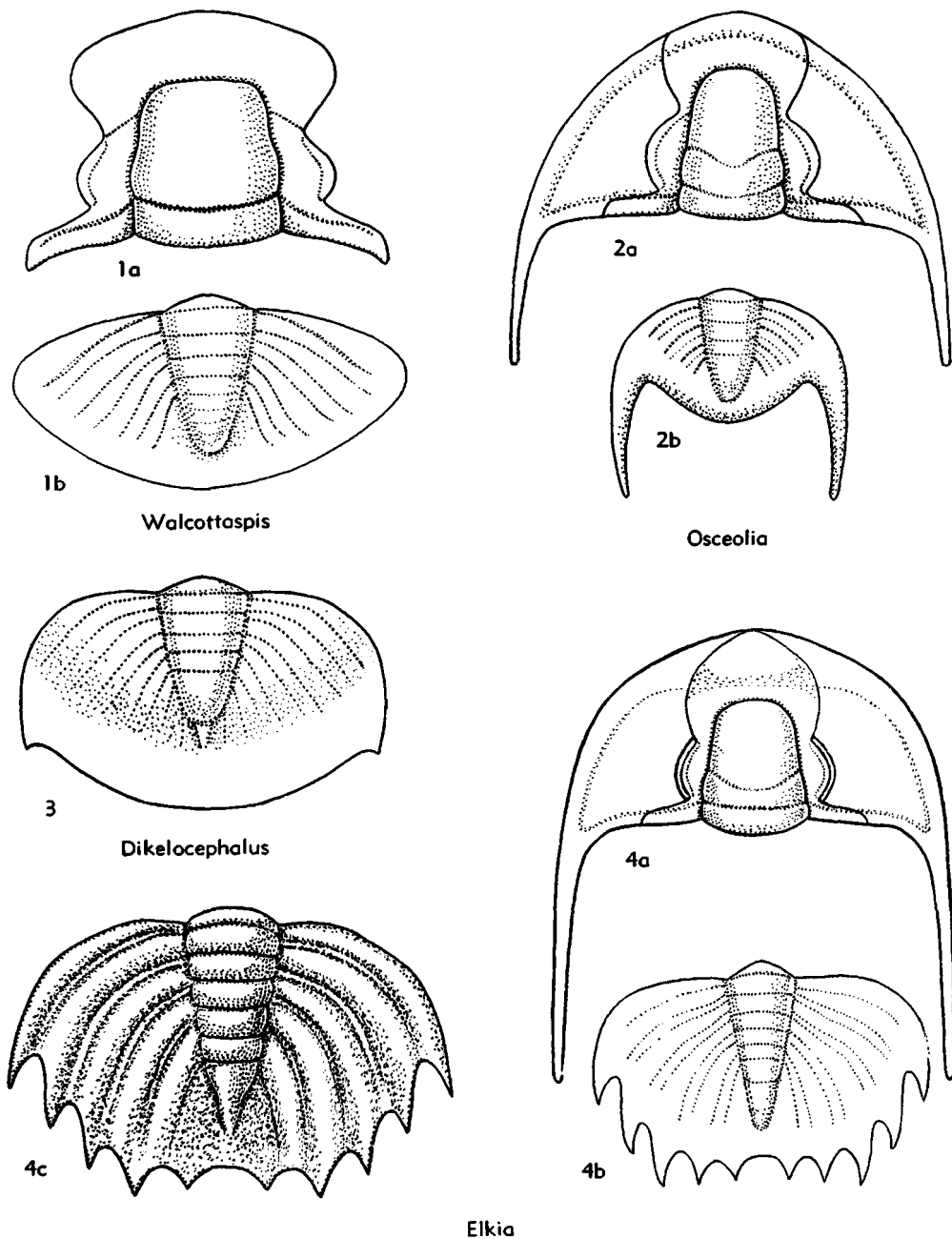


FIG. 191. Dikelocephalidae (p. 0254-0256).

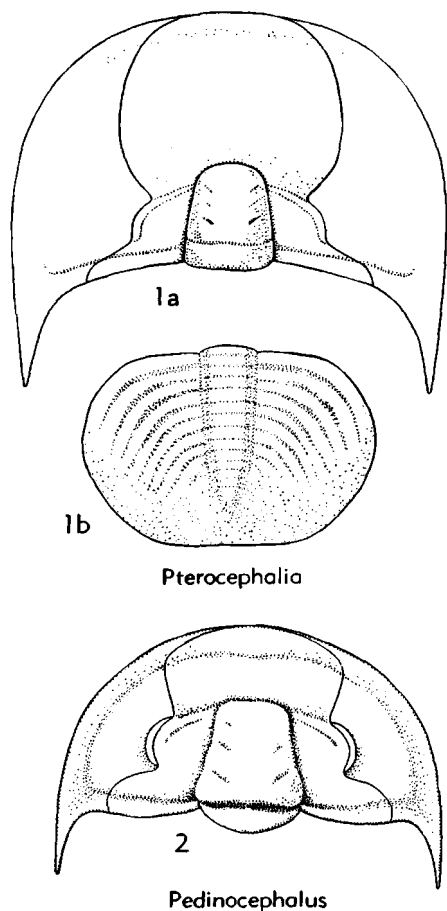


FIG. 192. Pterocephaliidae (p. O256, O260).

verse; axis wider than pleural field, moderately long, with 3 axial rings and terminal; with 3 broad pleurae, interpleural grooves and pleural furrows distinct on exterior, border narrow (48). *U.Cam.(Francon.)*, N.Am.—FIG. 193,9. **C. berkeleyi* (RESSER), Wis.; 9a,b, cran., $\times 1.5$, $\times 5$; 9c,d, pyg., $\times 4$ (48).

Dikelocephalites SUN, 1935 [**D. flabelliformis*]. Glabella tapering, frontal area 0.3 of length (*sag.*) of cranium, flat to slightly concave; anterior border furrow obsolete; eye ridges faint; eyes of medium size, opposite center of glabella; fixigenae horizontal, narrow, with palpebral areas little over 0.3 of glabellar width, posterior areas straplike, long (*tr.*); librigenae broadly triangular, with short genal spine. Pygidium semicircular; axis convex, narrower than pleural fields, tapered about 0.5 of its length, with 3 or 4 axial rings and terminal; pleurae 3 or 4, interpleural grooves faint to obsolete, with short, faint pleural furrows and broad flat border. Surface ?granulose (289). *U. Cam.(Daizanian)*, NE.Asia.—FIG. 193,1. **D.*

flabelliformis, China; 1a,b, ceph., pyg., $\times 0.7$ (289).

Dytremacephalus PALMER, 1954 [**D. granulosis*]. Glabella moderately convex, truncate-tapering, with pair of anterior pits; eye ridges narrow; frontal area about 0.3 of length (*sag.*) of cranium; anterior border furrow shallow to obsolete, border narrow; eyes of medium size, somewhat anterior to center of glabella; fixigenae horizontal or slightly upsloping, with palpebral areas between 0.25 and 0.3 of glabellar width, posterior areas narrowly triangular, long (*tr.*); librigenae, thorax and pygidium unknown. Surface smooth or finely granulose (162). *U.Cam.(U.Dresbach.)*, C.USA.—FIG. 193,6. **D. granulosis*, Tex.; cran., $\times 4$ (162).

Eugonocare WHITEHOUSE, 1939 [**E. tessellatum*]. Glabella truncate-tapering; eye ridges distinct; frontal area 0.3 of length (*sag.*) of cranium with distinct anterior border furrow and narrow convex border; eyes of medium size, opposite center of glabella; fixigenae upsloping, with palpebral areas somewhat more than 0.5 of glabellar width, posterior areas unknown. Pygidium broad-transverse; axis narrower than pleural field, tapered nearly full length, with 5 axial rings and terminal; pleurae 5 or 6, interpleural grooves and pleural furrows shallow, border of medium width with slight posterior median inward bend. Surface finely granulose. *U.Cam.*, Austral.

?**Iranella** HUPÉ, 1953 [**Saratogia latifrons* KING, 1937]. *U.Cam.*, Iran.

Kazelia WALCOTT & RESSER, 1924 [**K. speciosa*]. Glabella low, truncate-tapering, with 2 pairs of shallow lateral furrows on interior; eye ridges obsolete, all other furrows faint to obsolete on exterior, faint on interior; frontal area 0.25 of length of cranium, eyes about medium in size, posterior to center of glabella; fixigenae downsloping, with palpebral areas about 0.3 of glabellar width, posterior areas short, triangular; librigenae with rounded genal angle. Pygidium unknown (322). *U.Cam.(Francon.)*, N.Am.-N.Zem.—FIG. 193,2. **K. speciosa*, N.Zem.; 2a,b, cran.; 2c, librigena, all $\times 2$ (322).

Labiostria PALMER, 1954 [**L. conveximarginata*]. Glabella moderately convex, tapering to truncate-tapering; eye ridges faint; occipital spine may be present; frontal area 0.3 of length (*tr.*) of cranium, with narrow anterior border furrow; eyes of medium size, opposite center of glabella; fixigenae horizontal, with palpebral areas somewhat more than 0.5 of glabellar width, posterior areas straplike, long (*tr.*); librigenae with distinct marginal furrows and flat slender genal spine. Pygidium broad-transverse; axis tapered nearly full length, slightly wider than pleural field, with 4 or 5 axial rings and terminal; pleurae 4, pleural furrows broad, shallow, curving posteriorly, interpleural grooves obsolete, border of medium width

with slight posterior median inward bend. Surface smooth or punctate (162). *U.Cam.* (*U.Dresbach.*), N.Am.—FIG. 193,3. **L. conveximarginata*, Tex.; 3a,b, ceph., pyg., ×2 (162). *Litocephalus* RESSER, 1937 [**Dicellocephalus richmondensis* WALCOTT, 1884, based on cranium]

(=*Dikellocephalus (Pterocephalus) bilobatus* HALL & WHITFIELD, 1877, based on pygidium) [= *Pterocephalina* RESSER, 1938]. Glabella moderately convex, tapering; eye ridges faint; frontal area between 0.25 and 0.3 in length (*sag.*) of cranium, with distinct anterior border furrow;

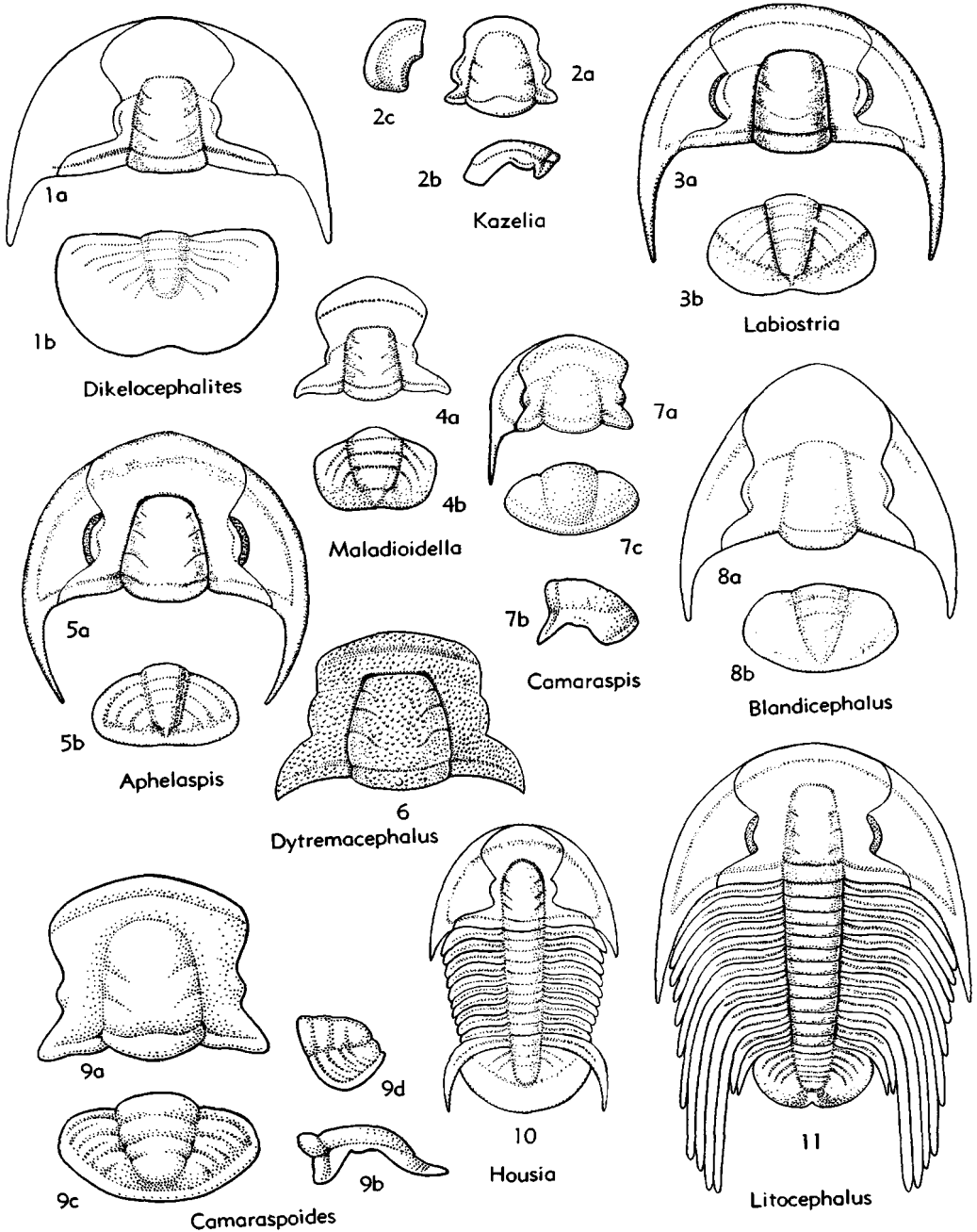


FIG. 193. Pterocephaliidae, Housiidae (p. 0256-0260).

eyes of medium size, opposite center of glabella; fixigenae upsloping, with palpebral areas about 0.7 of glabellar width, posterior area straplike, long (*tr.*); librigenae rectangular, with well-defined lateral border furrow, convex border, and medium-length genal spine. Thorax of 13 segments; axis convex, one-half width (*tr.*) of pleurae; pleurae geniculate, faintly furrowed, ending in very long, posteriorly-drooping spines. Pygidium ovate; axis tapered nearly full length, as wide as pleural fields; with 4 or 5 axial rings and terminal; pleurae 4 or 5, interpleural grooves obsolete, pleural furrows broad and shallow, curving back across medium-width concave border almost to margin with prominent posterior medium inward bend. Surface finely granulose. *U.Cam.* (Francon.), N.Am.—FIG. 193,11. **L. bilobatus* (HALL & WHITFIELD), Nev.; exoskel., $\times 2.7$ (162).

Maladioidella ENDO, 1937 [**M. splendens*]. Glabella moderately convex, tapering; eye ridges distinct; frontal area almost 0.3 of length of cranium, with distinct anterior border furrow; eyes less than medium size, opposite center of glabella; fixigenae horizontal, with palpebral area 0.3 of glabellar width, posterior area narrow triangular, long (*tr.*). Pygidium ovate; axis tapered 0.75 of its length, wider than pleural field, with 2 or 3 axial rings and terminal; pleurae 3, pleural furrows and interpleural grooves faintly impressed, border poorly defined. Surface finely punctate (37). *U.Cam.* (Daizanian), NE.Asia.—FIG. 193,4. **M. splendens*, Manch.; 4a, cran., $\times 0.7$; 4b, pyg., $\times 1$ (37). [Authorship of genus should be cited as ENDO, in ENDO & RESSER, 1937.—Ed.]

Olentella IVSHIN, 1956 [**O. olentensis*]. Glabella low, elongate-tapering, lateral furrows obsolete; eye ridges faint, frontal area 0.3 of glabellar length (*sag.*), anterior border furrow narrow, distinct; eyes medium in size, nearly opposite center of glabella; fixigenae horizontal, with palpebral areas 0.5 of glabellar width, posterior areas triangular, medium in width (*exsag.*). Pygidium broad, transverse, with convex axis and pleural fields subequal in width; 3 axial rings and long terminal; 3 or 4 pleurae, pleural furrows broad, border medium width. Surface unknown. *U.Cam.*, SW.Sib.

Pedinocephalus IVSHIN, 1956 [**P. bublichenkoi*]. Glabella truncate-tapering with median keel, lateral furrows weak; eye ridges distinct, frontal area slightly more than 0.3 of length (*sag.*) of cranium, anterior border furrow curved, very shallow; eyes medium in size, opposite center of glabella; fixigenae slightly upsloping, with palpebral areas 0.7 of width of glabella, posterior areas triangular, medium in width (*exsag.*); librigenae with broad, shallow marginal furrow, flat short genal spines. *U.Cam.*, E.Sib.—FIG. 192,2. **P. bublichenkoi*, Kazakhstan; ceph., $\times 2$ (413).

Pterocephalops RASSETTI, 1944 [**P. acrophthalma*].

Glabella moderately convex, subrectangular, lateral furrows nearly obsolete; eye ridges faint; frontal area not quite 0.3 of length (*sag.*) of cranium; preglabellar field steeply downsloping, with anterior border furrow very shallow to obsolete and horizontal border narrow; eyes below medium size, somewhat behind center of glabella; fixigenae upsloping, with palpebral areas about 0.7 of glabellar width, posterior areas straplike, narrow, long (*tr.*). Librigenae, thorax, and pygidium unknown. Surface smooth (188). *U.Cam.* (?Francon.), Que.

Family HOUSIIDAE Hupé, 1953

Exoskeleton opisthoparian, subisopygous. Cranium narrow, elongate; glabella low, tapering, all furrows very shallow to obsolete, with 3 pairs of lateral furrows on interior; frontal area about 0.3 of length of cranium, crossed by change in slope or very shallow anterior border furrow; no eye ridges, eyes below medium size, in front of center of glabella; fixigenae very narrow, upsloping, with arcuate palpebral areas less than 0.25 of glabellar width, posterior areas straplike, long (*tr.*); librigenae quadrate, with short genal spines or rounded genal angles. Thorax with 10 segments; axis convex; pleurae low, somewhat wider than axis (*tr.*), with deep pleural furrows extending about 0.7 of length and bluntly pointed ends. Pygidium narrowly transverse; anterior segment with or without long spines, poorly ankylosed; axis convex, tapered 0.7 of length to narrow end, with 3 or 4 axial rings and terminal; pleural regions about same in width as axis, interpleural grooves obsolete, 3 or 4 pleurae with shallow pleural furrows; broad shallow marginal furrow, flat border. Outer surface smooth. *U.Cam.* [The family Housiidae is placed close to the family Pterocephaliidae, from which it may have developed, according to information given by A. R. PALMER.]

Housia WALCOTT, 1916 [**Dolichometopus (Housia) varro* WALCOTT, 1916] [= *Housiella* KOBAYASHI, 1955]. *U.Cam.* (Francon.), N.Am. (321).—FIG. 193,10. *H. canadensis* (WALCOTT), Can. (B.C.); exoskel., $\times 1$ (488, modified).

Family ANDRARINIDAE Raymond, 1937

[= *Liostracidae* ANGELIN, 1854 (invalid because based on junior homonym)]

Preglabellar area of medium width, nearly straight at front; facial sutures slightly concave in front and behind palpebral lobes,

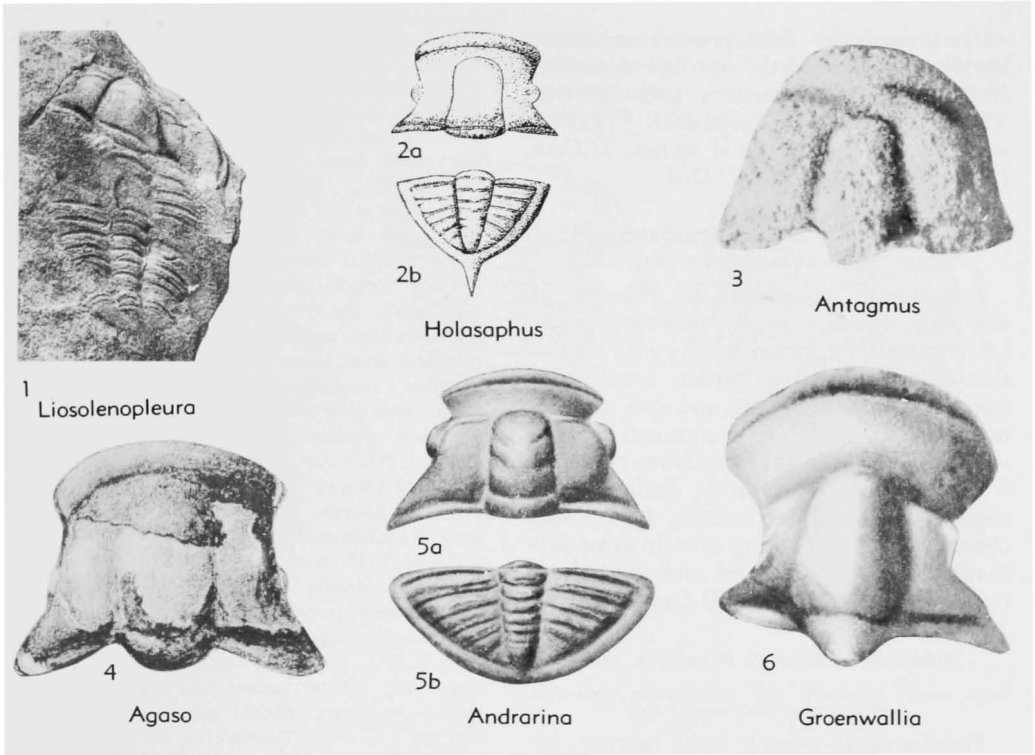


FIG. 194. Andrarinidae (p. O261).

which are short but prominent; glabella parallel-sided, its front end bluntly rounded. Pygidium short, wide, and well segmented. *L.Cam.-M.Cam.*

Agaso COBBOLD & POCKOCK, 1934 [**Liostracus (Agaso) rushtonensis*]. Cranium trapezoidal, with rounded front and flat anterior border, from which convex surface rises abruptly and curves evenly back to weak occipital furrow. Surface pitted. *M.Cam.*, NW.Eu.—FIG. 194,4. **A. rushtonensis* (COBBOLD & POCKOCK), *Paradoxides forchhammeri* Grit, Eng.; cran., $\times 3.5$ (388*).

Andrarina RAYMOND, 1937 [*pro Liostracus* ANGELIN, 1854 (*non* MÖRCH, 1852)] [**Liostracus costatus* ANGELIN, 1854; SD LINNARSSON, 1873]. Glabella with 3 pairs of furrows, sides of glabella and facial sutures nearly parallel with axial line; genae convex, bent downward. Surface more minutely pitted than in *Agaso*. *M.Cam.*, Eu. (Swed.-Norway).—FIG. 194,5. **A. costata* (ANGELIN), *Lejopyge laevigata* Z., Swed.; 5a, cran., $\times 3.7$; 5b, pyg., $\times 3$ (491a*).

Groenwallia KOBAYASHI, 1935 [**Liostracus platyrhinus* GRÖNWALL, 1902]. Preglabellar area large, facial sutures flaring anteriorly; no lateral glabellar furrows; large occipital spine. *M.Cam.*, NW.Eu.—FIG. 194,3. **G. platyrhinus* (GRÖNWALL),

Paradoxides forchhammeri Z., Denm.; cran., $\times 5.25$ (402*).

Holasaphus MATTHEW, 1895 [**H. centropyge*]. Preglabellar area short; glabella like that of *Andrarina* but lacking furrows; facial sutures only slightly curved. Pygidium with spine at rear. *M.Cam.*, NE.Can.—FIG. 194,2. **H. centropyge*, MacMullin F., N.Scot.; 2a,b, cran., pyg., $\times 1.3$ (429).

Liosolenopleura THORAL, 1948 [**L. serventi*]. Small; surface smooth. Pygidium smaller than in *Solenopleura*. *M.Cam.*, W.Eu.—FIG. 194,1. **L. serventi* Bailiella levyi Z., Fr.; exoskel., $\times 2$ (483*).

Superfamily OLENACEA Burmeister, 1843

[*nom. transl.* HENNINGSMOEN, 1957 (*ex Olenidae* BURMEISTER, 1843)] [=Olenidea RICHTER & RICHTER, 1941 (*partim*); Olenoidae HUPÉ, 1953 (*partim*)]

Exoskeleton subovate to elongate, opisthoparian (exceptionally proparian), micropygous to subisopygous (rare), and with rounded or spinose genal angles. Cephalon with narrow border, small to medium-sized eyes and in most forms distinct eye ridges; glabella tapering forward, with simple, sigmoidal, or bifurcate lateral furrows (if pres-

ent); preglabellar field present or absent; librigenae separated by median suture or fused together. Hypostoma probably free. Thorax with 9 to 24 segments. Pygidium with or without marginal spines. *M.Cam.* (some Papyriaspidae)—*U.Ord.*

Family OLENIDAE Burmeister, 1843

[=Leptoplastidae ANGELIN, 1854]

Exoskeleton opisthoparian, subovate to elongate, usually small, micropygous to heteropygous. Cephalon usually with narrow threadlike, prominent border, usually distinctly defined eye ridges, and eyes of small to medium size. Thoracic segments 9 to 19, with furrowed pleurae. Pygidium with 3 to 7 axial rings, pleural fields distinctly segmented. Hypostoma probably free. Other characters greatly varying even in same subfamily; cephalic doublure and ventral sutures imperfectly known. *U.Cam.-U.Ord.*

Subfamily OLENINAE Burmeister, 1843

[*nom. transl.* KOBAYASHI, 1935 (ex Olenidae BURMEISTER, 1843)] [=Continuae PERSSON, 1904]

Heteropygous olenids with almost flat exoskeleton, narrow to moderately wide glabella, more or less well-developed preglabellar field, palpebral lobes opposite or anterior to cranial center, genal spines in direct continuation of lateral margin of librigenae; more or less oblique pleural furrows, fairly well-developed pleural spines. Hypostoma subovate, with large strongly convex ovate anterior lobe, small depressed crescentic posterior lobe, small acute anterior wings, and narrow raised posterolateral border. *U.Cam.-L.Ord.*(*Tremadoc.*).

Olenus DALMAN, 1827 [(illegally proposed by 1822, but now long recognized as applicable to a DALMAN, 1827, *pro Paradoxides* BRONGNIART, distinct group of species, ICZN Opinion 496)] [**Entomotrachites gibbosus* WAHLENBERG, 1821; SD ICZN Op. 496]. Exoskeleton more or less elongated ovate. Cephalon 0.25 to 0.4 of total length; cranium subtrapezoidal; glabella subcylindrical or slightly tapering, somewhat truncate in front, with 2 or 3 pairs of oblique lateral furrows; preglabellar field long; fixigenae fairly wide, with acute posterior extremities; eye ridges at right angles to axis or running obliquely forward from anterior corners of glabella; anterior sections of facial sutures slightly convergent between eyes and anterior border. Thorax of 13 to 15 segments. Pygidium small, triangular to semicircular, with narrow raised border, and commonly with a few

minute marginal spines (114, 331). *U.Cam.*, N. Eu.-N.Am.-Asia.—FIG. 195,1a. **O. gibbosus* (WAHLENBERG), Swed.; pyg., $\times 3$ (331).—FIG. 195,1b,c. *O. truncatus* (BRÜNNICH), Swed.; 1b,c, exoskel., hypostoma, $\times 4$ (331).

?*Highgatella* SHAW, 1955 [**Terranovella gelasinata* SHAW, 1951]. Convex tapering glabella with rounded front, 3 pairs of lateral furrows, anterior pair faint, posterior pairs deep, arcuate; small occipital node; preglabellar field 0.3 of cranial length; anterior border furrow narrow; eyes small, anterior to center of glabella, eye ridges distinct, straight; fixigenae horizontal, with palpebral areas more than 0.3 of glabellar width, posterior areas long (*tr.*), triangular; librigenae with long slender genal spines. Pygidium unknown. Surface finely granulate. *L.Ord.*(*Tremadoc.*), NE.N.Am.-W.N.Am.—FIG. 195,6. **H. gelasinata* (SHAW), Vt.; ceph., $\times 6$ (245).

Parabolina SALTER, 1849 [**Entomotrachites spinulosus* WAHLENBERG, 1821] [=*Odontopyge* HAWLE & CORDA, 1847 (*non* BRANDT, 1841)]. Differs from *Olenus* in having larger glabella, shorter preglabellar field, palpebral lobes placed nearer to anterior border; larger, usually semicircular pygidium with 2 to 6 fairly well-developed, more or less converging pleural spines; and hypostoma with almost completely reduced anterior wings (331). *U. Cam. - L. Ord.* (*Tremadoc.*), Eu. - E. Can. (Atl. prov.)-Arg. — FIG. 195,3. **P. spinulosa* (WAHLENBERG), Swed.; exoskel., $\times 3$ (331).

Parabolinites HENNINGSMOEN, 1957 [**Parabolinitella laticauda* WESTERGÅRD, 1922]. Cranium as in *Parabolina* but with larger preglabellar field; facial sutures subparallel or diverging in front of palpebral lobes; glabella tapered forward, rounded in front; librigenae with spines (where known). Pygidium entire (61). *U.Cam.*, Swed.-?Wales.—FIG. 195,4. **P. laticaudus* (WESTERGÅRD), Swed.; 4a, cran. and librigena, $\times 1.2$; 4b, pyg., $\times 1.2$ (61).

?*Paraolenus* LERMONTOVA, 1951 [**P. papilionaceus*]. *U.Cam.*, Kazakhstan.

?*Plesioparabolina* HARRINGTON & LEANZA, 1942 [**P. proparia*]. *L.Ord.*(*Tremadoc.*), Arg.

Subfamily LEPTOPLASTINAE Angelin, 1854

[*nom. transl.* KOBAYASHI, 1935 (ex Leptoplastidae ANGELIN, 1854)] [=Abruptae PERSSON, 1904]

Micropygous to nearly isopygous olenids with almost flat to strongly convex dorsal exoskeleton. Cephalon with narrow to moderately wide glabella, short or completely reduced preglabellar field, genal spines abruptly projecting from lateral portion of cephalic margin well in front of posterior margin. Thorax with moderately oblique pleural furrows. Hypostoma usually subrectangular but may have very small anterior wings. *U.Cam.-L.Ord.*(*Tremadoc.*).

Leptoplastus ANGELIN, 1854 [**L. stenotus*; SD VOGDES, 1890]. Exoskeleton ovate, depressed. Glabella wide, parallel-sided to slightly tapering, rounded in front, with 2 or 3 pairs of oblique

lateral furrows; preglabellar field very short or lacking; anterior and palpebral areas of fixigenae relatively narrow, and posterior areas moderately wide, with acute extremities; eye ridges more or

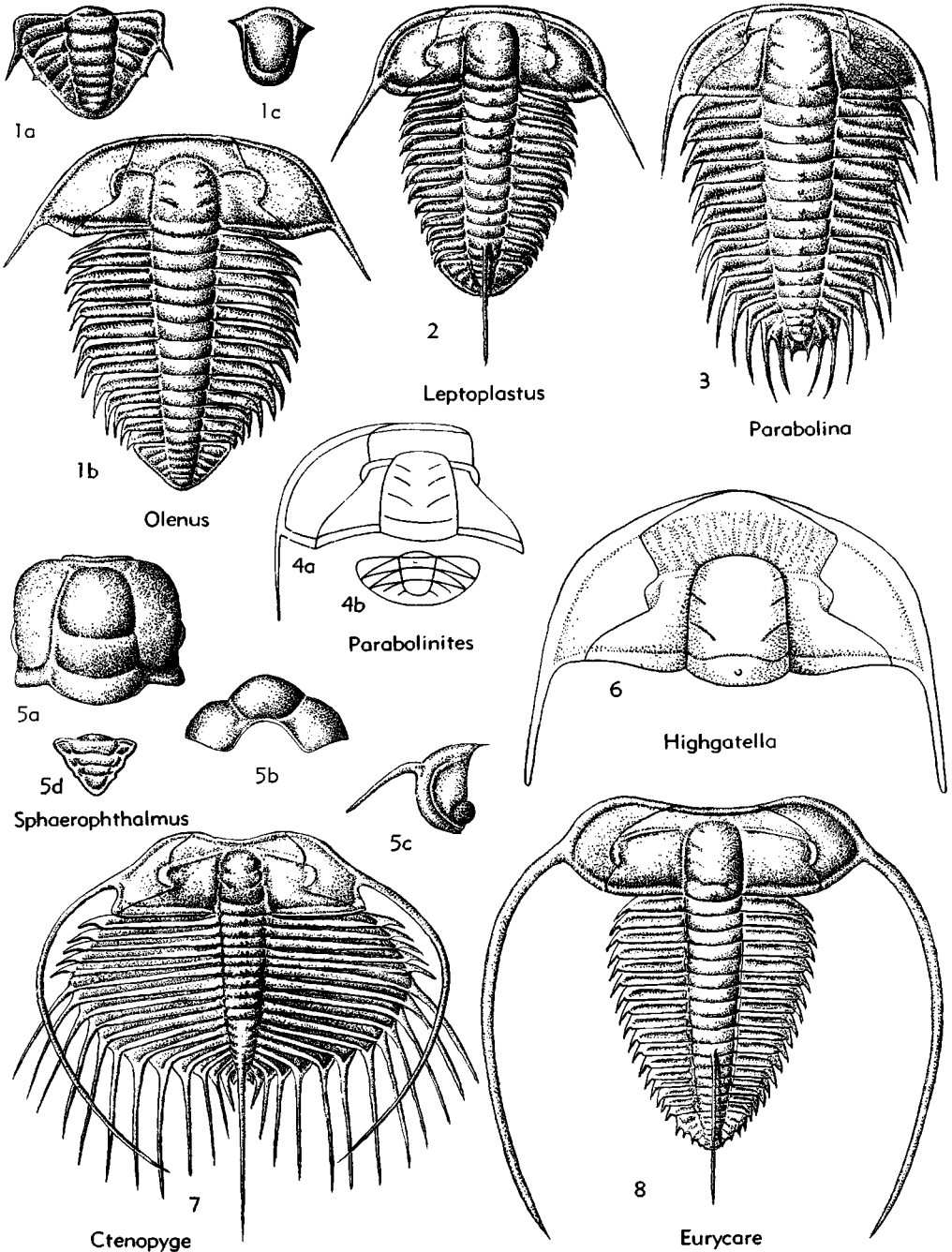


FIG. 195. Olenidae (Oleninae, Leptoplastinae) (p. 0262-0264).

less oblique; palpebral lobes usually opposite or a little in front of glabellar center; librigenae with almost evenly curved outer margin and slender, almost straight genal spines. Thorax of 9 to 12 segments, with short (to long) pleural spines and axial nodes or spines, 11th segment of some forms with very long, backward-directed axial spine. Pygidium small, rounded triangular to semi-circular, with rapidly tapering axis, 3 or 4 axial rings and generally 2 or 3 pairs of minute pleural spines (114, 331, 333). *U.Cam.-L.Ord.(Tremadoc.)*, Eu.-E.Can.(Atl.prov.).—FIG. 195.2. **L.stenotus*, *U.Cam.*, Swed.; exoskel., $\times 3$ (331).

Ctenopyge LINNARSSON, 1880 [**Olenus (Sphaerophthalmus) pecten* SALTER, 1864; SD VOGDES, 1890]. Exoskeleton depressed, ovate to subcircular. Cephalon wide, with straight or emarginate front, long, narrow, slightly tapering glabella more or less truncate in front, 1 to 3 pairs of lateral furrows, posterior pair represented in some by a transglabellar furrow; preglabellar field short or lacking; fixigenae moderately to very wide, with posterior areas of greatly varying length and width, and with acute or rounded extremities; palpebral lobes usually opposite or a little anterior to glabellar center; librigenae moderately wide, with long, curved genal spines springing from anterior or middle part of lateral margins. Thorax of 8 to 10 segments with long pleural spines, especially in posterior part. Pygidium (of type species) very large, consisting of several fused axial rings, small terminal plate, free pleurae similar to those of thorax, and axial ridge continued backward as long, straight spine (114, 331, 335). *U.Cam.*

C. (Ctenopyge). Hypostoma without expanded posterior brim; pleural spines flattened (61). *U.Cam.*, Eu.-E.Can.(Atl.prov.).—FIG. 195.7. **C.(C.) pecten* (SALTER); exoskel. (reconstr. from figures by LAKE and WESTERGÅRD), $\times 3$ (445n).

C. (Eoectenopyge) HENNINGSMOEN, 1957 [**Sphaerophthalmus flagellifer* ANGELIN, 1854]. Differs from *C. (Ctenopyge)* in having rounded pleural spines (61). *U.Cam.*, Eu.

C. (Mesoctenopyge) HENNINGSMOEN, 1957 [**Ctenopyge spectabilis* BRÖGGER, 1882]. Differs from *C. (Ctenopyge)* in having hypostoma with expanded posterior brim, and rounded pleural spines (61). *U.Cam.*, Eu.

Eurycare ANGELIN, 1854 [**E. brevicauda*; SD VOGDES, 1925]. Differs from *Leptoplastus* in having wider fixigenae, much longer, more curved genal spines, and 12 to 17 thoracic segments; and from *Ctenopyge* in number of thoracic segments with short pleural spines throughout and small pygidium with fused pleurae terminating in minute spines (114, 331, 333). *U.Cam.*, Denm.-Norway-Swed.-?Wales.—FIG. 195.8. *E. latum* (BOECK), Swed.; exoskel. (reconstr.), $\times 2$ (445n). ?*Leptoplastides* RAW, 1907 [**Conocoryphe salteri* CALLAWAY, 1877]. *L.Ord.(Tremadoc.)*, Eng.

?*Mekynophrys* HARRINGTON, 1938 [**M. nanna*]. *L.Ord.(Tremadoc.)*, Arg.

Sphaerophthalmus ANGELIN, 1854 [**Trilobites alatus* BOECK, 1838; SD LINNARSSON, 1880]. Differs from *Ctenopyge* in having narrower, strongly convex cephalon, much narrower posterior areas of fixigenae, spherical eyes usually placed far back, and very small, almost perfectly triangular pygidium with very narrow, threadlike, raised border and entire or slightly undulating margin (114, 331). *U.Cam.*, Eu.-E.Can.(Atl.prov.).—FIG. 195.5. *S. humilis* (PHILLIPS), Swed.; 5a,b, cran., dorsal, anterior, $\times 6$; 5c, librigena, $\times 6$; 5d, pyg., $\times 8$ (331).

Subfamily PELTURINAE Hawle & Corda, 1847

[*nom. transl. et correct.* HENNINGSMOEN, 1957 (ex Pelturides HAWLE & CORDA, 1847)] [=Jujuyaspidinae HUFÉ, 1953; Pelturinae HARRINGTON & LEANZA, 1952]

Micropygous to heteropygous olenids having subovate to elongate, moderately to considerably convex exoskeleton. Cephalon semicircular, transversely elliptical or subreniform, with moderately to very wide, anteriorly more or less rounded glabella; very short or completely reduced preglabellar field; palpebral lobes usually close to anterior border; librigenae with rounded (rarely angular) genal angles without spines or (rarely) with short genal spines. Thoracic segments usually with strongly oblique pleural furrows. Pygidium greatly varying in shape and number of segments. Hypostoma wide, subrectangular to octagonal or subovate, with fairly small, strongly convex middle body and very wide, flat lateral and posterior border, and raised margin. *U.Cam.-L.Ord.(Tremadoc.)*.

Peltura MILNE EDWARDS, 1840 [BURMEISTER, 1843 (pro *Peltoura* MILNE EDWARDS, 1840); emendation to *Peltura* of *Peltoura* MILNE EDWARDS validated by ICZN, 1958, Opinion 499] [**Entomostracites scarabaeoides* WAHLENBERG, 1821; SD HAWLE & CORDA, 1847] [=*Anthes* GOLDFUSS, 1843 (obj.); *Anopocare* ANGELIN, 1854]. Exoskeleton elongated subovate, strongly convex. Cephalon subreniform, with rounded genal angles lacking genal spines or (rarely) with poorly developed spines; cranium subtrapezoidal to semi-circular; glabella much wider than posterior areas of fixigenae, reaching wholly or nearly to anterior border, with 2 or 3 pairs of shallow, oblique lateral furrows; fixigenae very narrow; eye ridges usually obscure; palpebral lobes very small, close to glabella and anterior border. Thorax of about 12 segments, slightly contracted in front; axis rapidly tapering, usually wider than pleural regions; pleurae obliquely truncated, with short, obliquely backward-directed pleural spines. Pygidium small, wide,

with 2 axial rings, short terminal axial portion, 2 or 3 pairs of pleurae, and narrow border with pleural spines or entire margin (331). *U.Cam.*, Eu.-E.Can.(Atl.prov.).—FIG. 196,3. **P. scarabaeoides* (WAHLENBERG), *U.Cam.*, Swed.; exoskel., $\times 1$ (331).

Acerocare ANGELIN, 1854 [*A. ecorne*]. Differs from *Peltura* in having moderately convex exoskeleton. Cephalon transversely elliptical; glabella equal in width to posterior areas of fixigenae or narrower; small palpebral lobes prominent, not close to anterior border yet well in front of

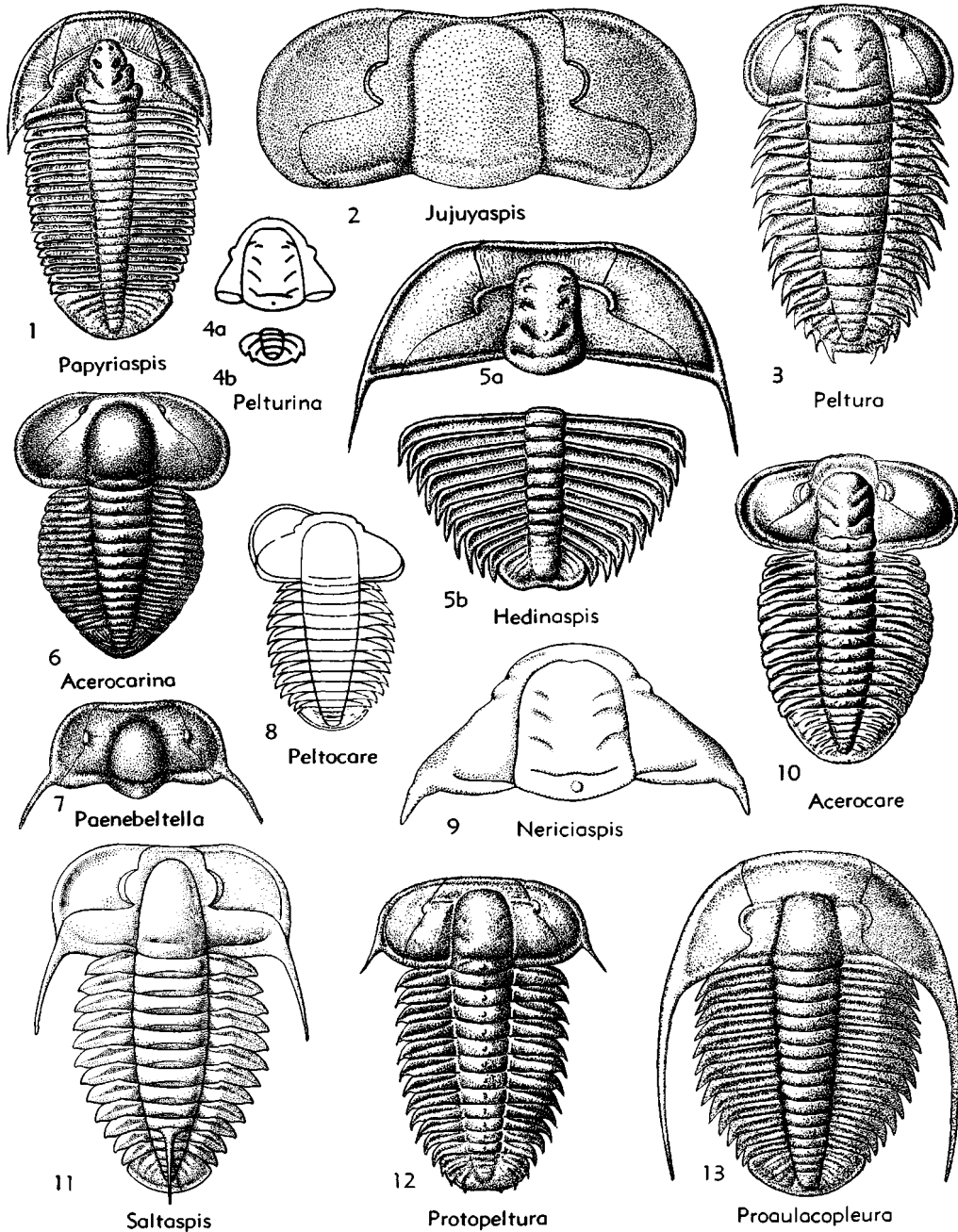


FIG. 196. Olenidae (Pelturinae), Papyriaspidae (p. 0265, 0266, 0269).

- glabellar center; posterior areas of fixigenae broadly rounded. Thoracic axis moderately tapering, equal in width to pleural regions or narrower; truncate pleurae spineless, or with rudimentary pleural spines. Pygidium large, approximately semicircular, multisegmentate (152, 331). *U.Cam.*, Norway-Swed.—FIG. 196,10. **A. ecorne*, *U.Cam.*, Swed.; exoskel. (reconstr.), $\times 2$ (152).
- Acerocarina** POULSEN, 1951 [*pro Cyclognathus* LINNARSSON, 1875 (non St. HILLAIRE, 1833)] [**Cyclognathus micropygus* LINNARSSON, 1875]. Differs from *Acerocare* in having glabella wider than posterior areas of fixigenae, effaced lateral furrows, extremely small palpebral lobes opposite front of glabella; shorter, anteriorly strongly contracted thorax with rapidly tapering axis; and much smaller, paucisegmented pygidium without border (152, 331). *U.Cam.-L.Ord.(Tremadoc.)*, Norway-Swed.-E.Can.(Atl.prov.)-?Arg.—FIG. 196,6. **A. micropyga* (LINNARSSON), *U.Cam.*, Swed.; exoskel., $\times 4$ (331).
- beltella** LAKE, 1919 [**Ellipsocephalus depressus* SALTER, 1859; SD VOGDES, 1925]. Differs from *Peltura* in having semicircular cephalon, anterior sections of facial sutures diverging from eyes to anterior border and then converging so as to meet at axial line; more prominent, distinctly defined eye ridges, angular genal angles, and well-developed genal spines; thoracic segments with truncate extremities (55, 114, 331). *U.Cam.-L.Ord.(Tremadoc.)*, Eu.-S.Am.-N.Am.
- boeckaspis** HENNINGSMOEN, 1955 [*pro Boeckia* BRØGGER, 1882 (non MALM, 1870; nec BRADY, 1871; nec THOMSON, 1883; nec GRIMM in SARS, 1894)] [**Boeckia hirsuta* BRØGGER, 1882]. Differs from *Acerocare* in having very wide anterior and palpebral areas of fixigenae, distinctly marked eye ridges, palpebral lobes placed opposite to glabellar center or farther back; thoracic segments terminating in long pleural spines, and almost perfectly trapezoidal pygidium with pair of short spines projecting from posterior part of border (18, 330). *L.Ord.(Tremadoc.)*, Norway-Swed.
- Cyclognathina** LERMONTOVA, 1951 [**C. microps*]. *U.Cam.*, Kazakhstan (HE).
- Jujuyaspis** KOBAYASHI, 1936 [**J. keideli*]. Differs from *Acerocare* in having effaced glabellar furrows, palpebral lobes situated opposite to glabellar center; wider, rapidly tapering thoracic axis, thoracic segments terminating in long pleural spines (55, 58, 98). *L.Ord.(Tremadoc.)*, Arg.-Norway-N.Am.—FIG. 196,2. **J. keideli*, Arg. (Jujuy); ceph. (restored), $\times 3$ (58).
- Nericiaspis** TJERNVIK, 1955 [**Jujuyaspis? robusta* TJERNVIK, 1953]. Differs from *Saltaspis* in having 3 pairs of strong lateral glabellar furrows, smaller, more anteriorly situated eyes, and obliquely backward-directed, almost straight course of posterior sections of facial sutures (298). *U.Cam.*, Swed.—FIG. 196,9. **N. robusta* (TJERNVIK), cran., $\times 4.5$ (298).
- ?**Paenebeltella** ROSS, 1951 [**P. vultulata*]. Differs from *Beltella* in having ovate glabella, wider palpebral area of fixigenae and converging course of anterior sections of facial sutures from eyes to anterior border (258). *L.Ord.*, W.N.Am.—FIG. 196,7. **P. vultulata*, Utah; ceph. (reconstr.), $\times 4$ (258).
- Parabolinoopsis** HOEK, 1912 [**P. mariana*] [= *Andesaspis* KOBAYASHI, 1935 (obj.)]. Like *Paenebeltella* but having much narrower fixigenae and genal angles remote from facial sutures (279). *L.Ord.(Tremadoc.)*, S.Am.
- Peltocare** HENNINGSMOEN, 1957 [**Acerocare norvegicum* MOBERG & MÖLLER, 1898]. Like *Acerocarina* but having wider fixigenae and posterior sections of facial sutures cutting lateral cephalic borders (61). *L.Ord.(Tremadoc.)*, Eu.-E.Can.(Atl.prov.)-Arg.—FIG. 196,8. **P. norvegicum* (MOBERG & MÖLLER); exoskel. (reconstr.), $\times 1.5$ (61).
- Pelturina** HENNINGSMOEN, 1957 [**P. punctifera*]. Differs from *Peltura* in having palpebral lobes farther back (opposite 2nd lateral furrows) (61). *U.Cam.*, Norway-Swed.—FIG. 196,4. **P. punctifera*, Norway; 4a,b, cran., pyg., $\times 3$ (61).
- Protopeltura** BRØGGER, 1882 [**Peltura praecursor* WESTERGÅRD, 1909; SD by ICZN, 1958, Opinion 499]. Differs from *Peltura* in having transversely elliptical cephalon, narrower glabella, wider fixigenae, distinctly marked eye ridges, genal spines almost in continuation of lateral cephalic border, narrower thoracic axis, and wider pleural regions (18, 331). *U.Cam.-L.Ord.(Tremadoc.)*, Norway-Swed.-USSR-?Arg.—FIG. 196,12. **P. praecursor* (WESTERGÅRD), *U.Cam.*, Swed.; exoskel., $\times 4$ (331).
- Saltaspis** HARRINGTON & LEANZA, 1952 [**Jujuyaspis steinmanni* KOBAYASHI, 1936]. Differs from *Jujuyaspis* in having posterior areas of fixigenae produced into a pair of well-developed intergenal spines and in having facial sutures of proparian type (58). *L.Ord.(Tremadoc.)*, S.Am.-Swed.-Norway.—FIG. 196,11. **S. steinmanni* (KOBAYASHI), Arg. (Salta); exoskel. (reconstr.), $\times 3.3$ (445n).
- ?**Sphaerophthalmella** KOBAYASHI, 1955 [**S. inexpectans*]. *L.Ord.*, W.Can.
- Westergaardia** RAYMOND, 1924 [**Boeckia scanica* WESTERGÅRD, 1909] [= *Sphaerophthalmoides* HUTCHINSON, 1952 (subj.)]. Differs from *Acerocare* in having wider, more tapering glabella extended to anterior border and somewhat depressed between fixigenae, much wider anterior and palpebral areas of fixigenae, palpebral lobes situated farther back and remote from glabella; shorter

thorax with rapidly tapering axis much wider than pleural regions; and much smaller, paucisegmented pygidium (333). *U.Cam.*, Norway-Swed.-E.Can.(Atl.prov.).

Subfamily TRIARTHRIINAE Ulrich, 1930

[*nom. transl.* KOBAYASHI, 1935 (ex Triarthridae ULRICH in BRIDGE, 1930)]

Micropygous to heteropygous, with subovate to elongate, moderately convex exoskeleton. Cephalon semicircular to semielliptical; glabella wide, usually quadrate, with strongly impressed occipital and lateral furrows, usually a preglabellar field, narrow to moderately wide fixigenae, small palpebral lobes anterior to glabellar center, and librigenae generally with genal spines continuing lateral cephalic borders or (rarely) without genal spines. Cephalic doublure and ventral sutures imperfectly known. *U.Cam.-U.Ord.*

Triarthrus GREEN, 1832 [**T. beckii*]. Exoskeleton elongate. Cephalon semicircular; glabella considerably wider than posterior areas of fixigenae, separated from front border by anterior border furrow or by short preglabellar field, with 2 to 4 pairs of lateral furrows, usually 1 or 2 anterior pairs separated from axial furrows; fixigenae very narrow, especially anterior and palpebral areas; anterior sections of facial sutures converging from eyes to front border; librigenae extremely narrow, spineless or (rarely) with slender, curved genal spines. Thorax of 13 to 16 segments, with axis wider than pleural regions, obliquely truncated or rounded pleural extremities, and fulcrum placed very close to axis. Pygidium small, with 3 to 5 axial rings and entire, evenly rounded posterolateral margin. *Ord.*, N.Am.-S.Am.-Eu.—FIG. 197, 8. *T. eatoni* (HALL), *U.Ord.*, N.Y.; exoskel. and distal ends of ventral appendages (reconstr.), $\times 1.3$ (374).

?**Angelina** SALTER, 1859 [**A. sedgwickii*; SD VOGDES, 1890] [= *Keidelaspis* HARRINGTON, 1937]. Differs from typical Triarthrinae in having much larger exoskeleton, narrower glabella, shallow occipital furrow, effaced or obscure lateral furrows, more posteriorly located palpebral lobes, anterior sections of facial sutures convergent on front border so as to meet at median line, and with very long, broad genal spines (114). *L.Ord.* (*Tremadoc.*), Wales-?Swed.-S.Am.-?Can.—FIG. 197, 5. **A. sedgwickii*, Wales; ceph., $\times 1$ (114).

Bienvillia CLARK, 1924 [**Dikelocephalus? corax* BILLINGS, 1865] [= *Diatemnus* RAYMOND, 1937]. Cranium uniformly convex; glabella broadly conical to subquadrate, about 0.8 of length of cranium, lateral furrows distinct to obsolete; small occipital node; convex preglabellar field; eye ridges faint, small eyes opposite anterior 0.3

of glabella; fixigenae downsloping, with palpebral areas not more than 0.25 of glabellar width, posterior areas triangular, broad, short (*tr.*); librigenae elongate triangular with bluntly pointed genal angles. Pygidium unknown. Surface smooth. *U.Cam.-L.Ord.*, N.Am.

B. (Bienvillia). Axial, occipital, and posterior lateral furrows deeply impressed; 3 pairs of lateral furrows, posterior 2 pairs deep, arcuate, complete, anterior pair shallower, incomplete; frontal area differentiated by narrow border furrow into very narrow anterior border and wider convex preglabellar field; librigenae with narrow lateral border furrows. *U.Cam.*, NE.N.Am.—FIG. 197, 1. **B. corax* (BILLINGS), Que.; ceph., $\times 5$ (445n).

B. (Desmetia) WALCOTT, 1925 [**D. annectans*]. Axial, occipital, and posterior lateral furrows moderately impressed; 2 pairs of shallow, arcuate incomplete glabellar furrows; frontal area undifferentiated, anterior border furrows obsolete; lateral border furrows obsolete on librigenae. *L.Ord.* (*Tremadoc.*), NE.N.Am.-W.N.Am.—FIG. 197, 3. **B. (Desmetia) terranova** RASETTI, Newf.; 3a,b, ceph., dorsal, lateral, $\times 5$ (445n).

Leiobienvillia RASETTI, 1954 [**L. laevigata*]. Cranium uniformly convex, all furrows obsolete abaxially but adaxially with very shallow axial, occipital, and posterior border furrows; glabella low, broad, subquadrate, length about 0.8 of cranium, with 3 pairs of shallow arcuate lateral furrows; short, convex undifferentiated frontal area, eyes small, opposite anterior third of glabella; fixigenae downsloping, with palpebral areas about 0.5 of glabellar width, posterior areas triangular, broad, medium in length (*tr.*); librigenae and pygidium unknown. Surface smooth. *L.Ord.* (*Tremadoc.*), NE.N.Am.—FIG. 197, 7. **L. laevigata*, Newf.; cran., $\times 6$ (445n).

Moxomia WALCOTT, 1924 [**M. hecuba*]. Differs from *Parabolinella* in having subrectangular cranium with corner furrows and very narrow posterior areas of fixigenae (320). *L.Ord.* (*Tremadoc.*), W.Can.(B.C.)—FIG. 197, 2. **M. hecuba*, Mt. Robson; cran., $\times 3$ (320).

Parabolinella BRØGGER, 1882 [**P. limitis*; SD BASSLER, 1915]. Differs from *Triarthrus* in having regularly ovate exoskeleton, much wider, semielliptical cephalon, longer preglabellar field, wider fixigenae, prominent eye ridges, diverging course of anterior sections of facial sutures from eyes to front border, wide librigenae with straight genal spines. Thorax of 16 to 21 segments with axis narrower than pleural regions and short pleural spines. Pygidium smaller, with 1 to 3 axial rings (18, 55, 114). *U.Cam.?*, *L.Ord.* (*Tremadoc.*), Eu.-N.Am.-S.Am.—FIG. 197, 9. **P. limitis*, *L.Ord.* (*Tremadoc.*), Norway; ceph., $\times 1$ (18)—FIG. 197, 6. *P. triarthra* (CALLAWAY), *L.Ord.* (*Tremadoc.*), Eng.; nearly whole dorsal exoskeleton, lacking librigenae, $\times 1.7$ (114).

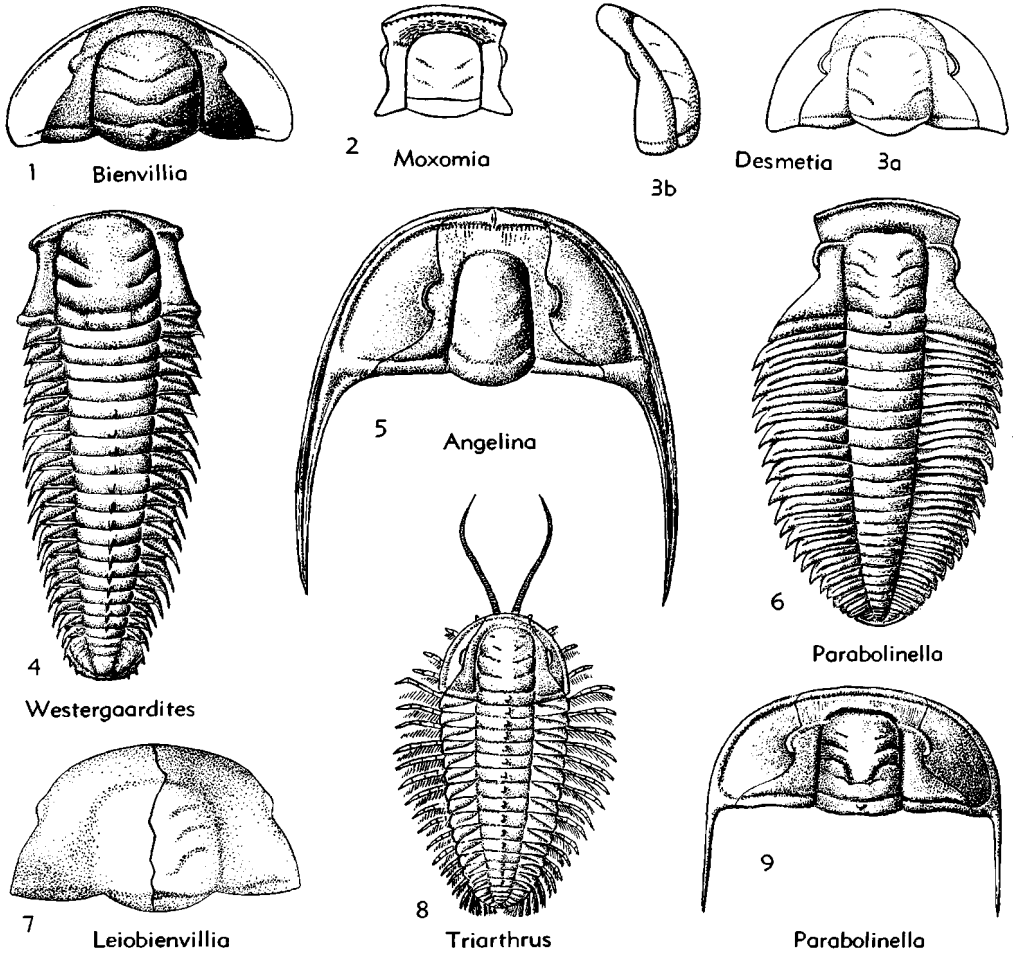


FIG. 197. Olenidae (Triarthrinae) (p. 0267, 0268).

Plicatolina SHAW, 1951 [**P. kindlei*]. Differs from *Triarthrus* in having median notch in front margin of glabella, 1 or 2 transglabellar furrows formed by posterior lateral furrows, prominent eye ridges, diverging course of anterior sections of facial sutures from eyes to front border, and thorax of more than 16 segments with pleural spines (273). *L.Ord.*(*Tremadoc.*), N.Am.-S.Am.

Porterfieldia B. N. COOPER, 1953 [**Triarthrus caecigenus* RAYMOND, 1920]. Differs mainly from *Triarthrus* in lacking eyes and facial sutures, and in having genae crossed by furrows extending obliquely backward from axial furrows at anterior corners of glabella and merging with lateral border furrows, evenly rounded genal angles. Thorax of 11 segments. Pygidium larger than in *Triarthrus*, with 7 axial rings (26). *M.Ord.*, E.N.Am.-Arg.

Westergaardites TROEDSSON, 1937 [**W. pelturaeformis*]. Differs from *Triarthrus* in having extremely long exoskeleton, wider anterior areas of fixi-

genae, smaller, more anteriorly placed eyes, thorax of 19 segments with extremely wide axis, extremely narrow pleural regions, pleural spines, and pygidium with marginal spines (301). *U.Cam.*, C.Asia.—FIG. 197,4. **W. pelturaeformis*, E.T'ien-shan; exoskel. without librigenae, $\times 1.3$ (301).

Family POPYRIASPIDIDAE
Whitehouse, 1939

[*nom. transl. et correct.* POULSEN, herein (ex Papyriaspidae WHITEHOUSE, 1939)]

Micropygous to heteropygous olenaceans with ovate, remarkably flat and thin dorsal exoskeleton. Cephalon with well-developed preglabellar field, genal spines in direct continuation of lateral cephalic border. Thoracic axis very narrow, pleural furrows parallel or subparallel to edges of segments. Hypo-

stoma, cephalic doublure, and ventral sutures unknown. *M.Cam.-U.Cam.*

Papyriaspis WHITEHOUSE, 1939 [**P. lanceola*]. Cephalon approximately semicircular, 0.3 of total length; cranium subtrapezoidal; glabella short, strongly tapering; occipital ring markedly wider than 1st thoracic axial ring; occipital furrow continuous; 4 pairs of lateral furrows (2 pit-shaped anterior pairs separated from axial furrows, 2 posterior pairs of furrows extending obliquely backward from axial furrows); preglabellar field very long; fixigenae wide, with acute posterior areas; eye ridges almost rectilinear, oblique; palpebral lobes fairly small; situated a little behind glabellar center; anterior sections of facial sutures converging between eyes and anterior border. Thorax of 18 segments, with gradually tapering axis and bluntly terminating pleurae. Pygidium about 0.125 of total length, almost semicircular, with 4 axial rings in addition to terminal axial portion, and with entire margin (340). *M.Cam.*, NE.Austral. —FIG. 196,1. **P. lanceola*, Queensl.; exoskel. (reconstr.), $\times 1$ (340).

Hedinaspis TROEDSSON, 1952 [*pro Hedinia* TROEDSSON, 1937 (*non* NAVÁS, 1936)] [**Hedinia regalis* TROEDSSON, 1937]. Differs from *Papyriaspis* in having wider cephalon, less tapering glabella, occipital and all glabellar furrows separated from axial furrows, shorter preglabellar field, wider posterior areas of fixigenae, palpebral lobes situated slightly anterior to glabellar center. Thorax of about 24 segments, with narrower, less tapering axis and short, backward-directed pleural spines. Pygidium very small, with faintly indicated axial rings, wide, shallow indentation behind axis, and subreniform outline (301). *U.Cam.*, Asia. —FIG. 196,5. **H. regalis* (TROEDSSON), E. T'ien-shan; 5a, ceph., $\times 1.4$; 5b, pyg. and part of thorax, $\times 2$ (301).

Pianaspis SAITO & SAKAKURA, 1936 [**P. kodairai*]. Differs from *Papyriaspis* in having wider thoracic axis and more deeply furrowed thoracic pleurae with short pleural spines. *M.Cam.*, E.Asia.

?**Proaulacopleura** KOBAYASHI, 1936 [**P. buttsi*]. Differs from *Hedinaspis* in having shorter, wider glabella, longer preglabellar field, longer palpebral lobes; thorax of 13 segments, wider thoracic axis, 1st thoracic axial ring almost as wide as occipital ring, narrowly furrowed thoracic pleurae with obliquely backward-directed pleural spines; and larger, rounded triangular pygidium without posterior marginal indentation (98). *U.Cam.*, E.N. Am. —FIG. 196,13. **P. buttsi*, Ala.; exoskel., $\times 1.5$ (419).

?**Prohedinia** LERMONTOVA, 1955(?) [**P. attenuata*]. *M.Cam.*, Sib. (HE).

?**Rhodonaspis** WHITEHOUSE, 1939 [**R. longula*]. Differs from *Papyriaspis* in having parallel-sided glabella, 3 pairs of lateral furrows, rapidly tapering posterior areas of fixigenae, eye ridges at right angles to axis, longer palpebral lobes, 1st thoracic

axial ring as wide as occipital ring; thoracic segments terminating in fairly long, slender, obliquely backward-directed pleural spines; and pygidium with 3 pairs of pleural spines (340). *U.Cam.*, NE. Austral.

Family HYPERMECASPIDIDAE Harrington & Leanza, 1957

Subisopygous to micropygous, with elliptical dorsal exoskeleton. Cephalon semi-elliptical in outline, transversely elongate, with rounded or spinose genal angles and opisthoparian sutures; glabella wide, tapering forward, truncate anteriorly, with 5 pairs of lateral furrows, 3p furrows sigmoidal, 2p, sigmoidal and bifurcated distally; occipital ring strongly trisegmented longitudinally; preglabellar field narrow; anterior border narrow, depressed, not differentiated by border furrow; eyes large, submedian, close to glabella; anterior sections of facial sutures convergent forward.

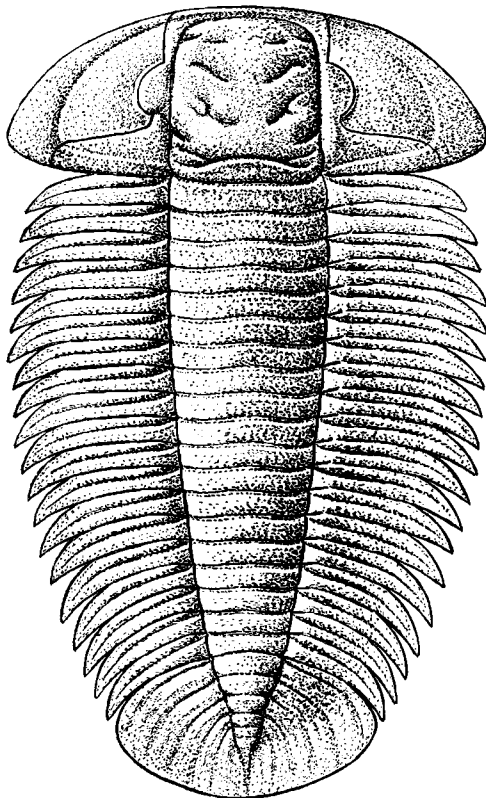


FIG. 198. **Hypermecaspis inermis* HARRINGTON & LEANZA (Hypermecaspidae), L.Ord. (Arenig.), NW.Arg.; exoskel. (holotype), restored, $\times 1.6$ (59*).

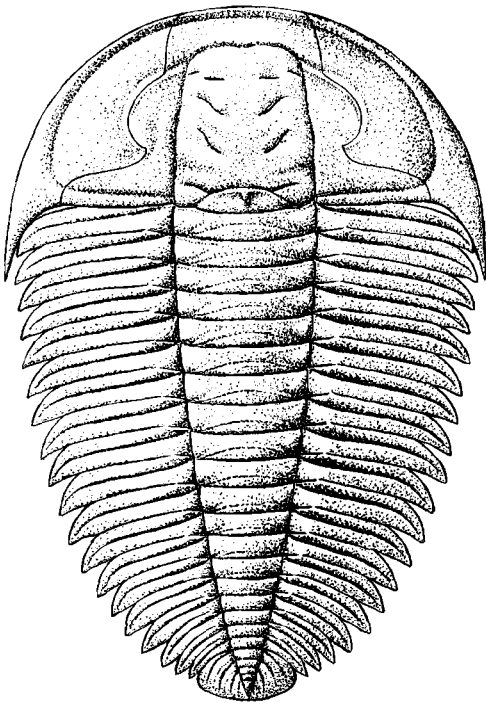


FIG. 199. *Hypermecaspis armata* HARRINGTON & LEANZA (Hypermecaspididae), L.Ord.(Arenig.), NW.Arg.; exoskel. (holotype), $\times 5.2$ (59*).

Thorax with 19 segments; pleurae spinose, with proximal fulcra and oblique furrows. Pygidium large to moderately small, elliptical in outline, with tapering axis prolonged in postaxial ridge; segmentation strong to obsolete; axis with 5 to 8 rings or nearly smooth; pleural furrows curved; border ill- or nondifferentiated; margin entire. L.Ord.-M.Ord.

Hypermecaspis HARRINGTON & LEANZA, 1957 [*H. inermis*]. Exoskeleton large. Cephalic border flat, wide near genal angles, progressively narrowing anteriorly; genal angles rounded or produced into spines; anterior sections of facial sutures short, convergent in front of eyes, marginal to mid-line. Pygidium elliptical in outline, transversely elongate, with 5 to 7 rings; pleural fields with 5 to 7 well-marked, curved pleural furrows and much fainter interpleural grooves; border wide, depressed, not differentiated from pleural fields; margin evenly rounded. L.Ord.-M.Ord., Arg.-Bol. —FIG. 198. *H. inermis*, L.Ord.(Arenig.), NW. Arg.; exoskel. (holotype), restored, $\times 1.6$ (59*). —FIG. 199. *H. armata* HARRINGTON & LEANZA, L.Ord.(Arenig.), NW.Arg.; exoskel. (holotype), $\times 5.2$ (59*).

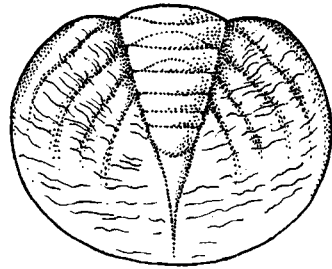


FIG. 200. *Tropidopyge broeggeri* (MOBERG & SEGERBERG) (Hypermecaspididae), L.Ord., Swed.; pyg. (holotype), $\times 2$ (432, * 1906).

Tropidopyge HARRINGTON & KAY, 1951 [*Dikelocephalus bröggeri* MOBERG & SEGERBERG, 1906]. Differs from *Hypermecaspis* in having pygidium gently convex, subelliptical in outline, slightly wider than long, with postaxial ridge reaching posterior margin, pleural fields with few short pleurae without pleural furrows and ill-defined wide depressed border. Cephalon and thorax unknown. [*Parabolinella rugosa* BRÖGGER, 1882, known only from cranidia from Norway and Great Britain, may correspond to this genus.] L.Ord., Swed.-S.Am.(Colom.). —FIG. 200. *T. broeggeri* (MOBERG & SEGERBERG), Swed.; pyg. (holotype), $\times 2$ (153).

Superfamily ILLAENURACEA Vogdes, 1890

[*nom. transl.* LOCHMAN-BALK, herein (ex Illacnuridae VOGDES, 1890)]

[Families grouped in this assemblage are so placed by MOORE on recommendations of HARRINGTON and HENNINGS-MOEN primarily. LOCHMAN-BALK considers the Parabolinoidea and Shirakiellidae as most closely related to the Olenidae, signifying their assignment to the Olenacea]

Exoskeleton opisthoparian, micropygous to subisopygous. Glabella quadrate or tapering forward, lateral glabellar furrows generally obsolete but with 3 distinct pairs in some Parabolinoidea; anterior border furrow distinct to absent; eyes medium in size or small; fixigenae typically horizontal or upsloping, with rather narrow palpebral areas; librigenae generally bearing short to moderately long, slender genal spines but with rounded genal angles in some genera. Thorax mostly unknown, that of *Illacnurus* with 11 segments showing broad, low axis and faintly furrowed, blunt-ending pleurae. Pygidium transverse to subtriangular, with axis reaching almost to posterior extremity, axial furrows shallow or obsolete; pleural fields with distinct to obsolete pleural furrows and interpleural grooves; border fur-

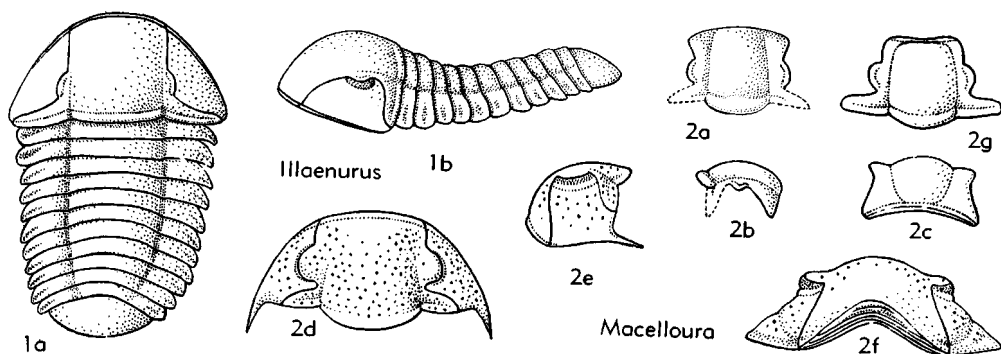


FIG. 201. Illaenuridae (p. 0271).

row usually absent; 1 to 4 pairs of marginal spines may be present. *U. Cam.*

Family ILLAENURIDAE Vogdes, 1890

Exoskeleton opisthoparian, ovate, micro-pygous. Glabella low, quadrate to rectangular, without lateral furrows, other furrows faint or obsolete on exterior and faint on interior; preglabellar field narrow or absent, border rimlike; eyes of medium size, slightly behind mid-level of glabella; fixigenae horizontal, with very narrow palpebral areas, posterior areas short, straplike, length (*tr.*) variable; librigenae unfurrowed, with short genal spines or rounded genal angles. Thorax with 11 segments; axis low, broad; pleurae narrower than axis, faintly furrowed. Pygidium narrowly transverse; axis low, wider than pleural fields, with smooth or punctate, transverse ridges on anterior border. Polyphyletic derivation. *U. Cam.*

Illaenus HALL, 1863 [**I. quadratus*] [= *Illaenus* KOBAYASHI, 1943]. Cranidium rectangular, with low apparently quadrate glabella; anterior border furrow obsolete; anterior border narrow, rimlike; faint axial furrows only developed posteriorly; occipital and posterior border furrows shallow; fixigenae with posterior areas 0.7 of length (*tr.*) of occipital ring; librigenae with rounded genal angles. Pygidium unfurrowed (317). *U. Cam.* (*Trempeal.*), N. Am.—FIG. 201, 1. **I. quadratus*, Wis.; 1a, b, exoskel., $\times 1.5$ (317).

Macelloura RESSER, 1935 [**Illaenus? dia* WALCOTT, 1890] [= *Tatonaspis* KOBAYASHI, 1935; *Yukonaspis* KOBAYASHI, 1936]. Cranidium quadrate, with low subrectangular glabella; no preglabellar field or anterior border furrow; anterior border vertical, with median upward bend; axial

furrows only visible posteriorly on exterior but complete though shallow on interior; occipital and posterior border furrows faint or obsolete on exterior, shallow on interior; small occipital node may be present; fixigenae with posterior areas about 0.3 of length (*tr.*) of occipital ring; librigenae with short slender genal spines. Pygidium unknown. Surface may be punctate (172, 189). *U. Cam.* (*Trempeal.*), N. Am.—FIG. 201, 2a-c. **M. dia* (WALCOTT), Tex.; 2a-c, cran. (interior), $\times 1.5$ (488, modified).—FIG. 201, 2d-g. *M. levisensis* (RASETTI), Que.; 2d-f, ceph. (exterior), $\times 3$; 2g, cran. (interior), $\times 2$ (189).

Family SHIRAKIELLIDAE Hupé, 1953

Exoskeleton opisthoparian. Glabella tapering or truncate-tapering, lateral furrows obsolete; no eye ridges, shallow palpebral furrows; frontal area convex, about 0.25 of length of cranidium; anterior border furrow obsolete or very faint; eyes below medium size, opposite anterior 0.3 of glabella; fixigenae horizontal or upsloping, with arcuate palpebral areas, 0.3 of glabellar width, posterior areas triangular, of medium width (*exsag.*), same in length as occipital ring; librigenae elongate, rectangular, marginal furrows nearly obsolete, with short genal spines. Thorax and pygidium unknown. *U. Cam.*

Shirakiella KOBAYASHI, 1935 [**S. elongata*]. Characters of family (97). *U. Cam.* (*Kaolishanian*), N.E. Asia (Korea).—FIG. 202, 9. **S. elongata*; ceph., $\times 2$ (419).

Family PARABOLINOIDIDAE Lochman, 1956

Exoskeleton opisthoparian, subsopygous. Glabella tapering to truncate-tapering, with 3 pairs of distinct to obsolete lateral fur-

rows; frontal area 0.25 to 0.3 of length of cranium, with distinct to obsolete anterior border furrow; eye ridges distinct or faint, eyes small to medium in size; fixigenae variable in width and position, with posterior areas triangular to straplike; librigenae rectangular, with genal spines or rounded angles. Pygidium transverse to subtriangular, with convex axis tapered nearly full length to broadly rounded end; border furrow usually obsolete; border narrow, poorly defined; pleurae may end in 1 to 4 pairs of marginal spines or margin smooth. Surface finely granulose or smooth. *U.Cam.*

Parabolinoidea FREDERICKSON, 1949 [**P. contractus*]. Glabella moderately convex, tapering, with 2 anterior pairs of lateral furrows short, diagonal, arcuate posterior pair may be complete; frontal area 0.25 to 0.3 of length of cranium, crossed by distinct curved anterior border furrow; eyes small, opposite anterior 0.3 of glabella; fixigenae nearly horizontal, with arcuate palpebral areas equalling about 0.3 of glabellar width, posterior areas broadly (*exsag.*) triangular, not quite same length (*tr.*) as occipital ring; librigenae with long genal spines. Pygidium narrowly transverse; axis wider than pleural fields, with 3 or 4 axial rings and terminal; 4 pleurae with distinct interpleural grooves and faint to obsolete pleural furrows; border furrow faint or obsolete; 1 to 4 pairs of marginal spines. *U.Cam.(Francon.)*, N.Am.—FIG. 202,6. **P. contractus*, Okla.; 6*a,b*, ceph., pyg., $\times 2$ (399).

Bernia FREDERICKSON, 1949 [**B. obtusa*]. Glabella moderately convex, broadly truncate-tapering, with 2 pairs of complete arcuate lateral furrows; frontal area 0.25 to 0.3 of length of cranium, with straight anterior border furrow; eyes small, opposite anterior 0.3 of glabella; fixigenae slightly downsloping, with palpebral areas almost 0.3 of glabellar width, posterior areas broad (*exsag.*), triangular, almost same in length (*tr.*) as occipital ring. *U.Cam.(Francon.)*, C.U.S.A.—FIG. 202,8. **B. obtusa*, Okla.; cran., $\times 3$ (399).

Croixana NELSON, 1951 [**Arionellus bipunctatus* SHUMARD, 1862]. Glabella moderately convex, truncate-tapering, lateral furrows obsolete, axial furrows shallow, with pair of anterior pits; frontal area 0.25 of length of cranium, anterior border furrow obsolete, anterior margin may be pointed; eyes small, opposite anterior 0.3 of glabella; fixigenae slightly upsloping, with palpebral areas 0.3 to 0.5 of glabellar width, posterior areas medium in width (*exsag.*), almost same in length (*tr.*) as occipital ring; librigenae with medium-length genal spines (316). *U.Cam.(Francon.)*, C.U.S.A.—FIG. 202,3. **C. bipunctata* (SHUMARD), Wis.; ceph., $\times 3$ (435).

Kendallina BERG, *nom. subst.* herein [*pro Kendallia* BERG, 1953 (*non* EVERMANN & SHAW, 1927)] [**Conocephalites eryon* HALL, 1863]. Glabella moderately convex, truncate-tapering, axial furrows shallow, may have pair of anterior pits, 1 or 2 pairs of very faint lateral furrows; frontal area 0.25 of length of cranium, narrow (*tr.*), anterior border furrow straight, very faint, anterior border narrow (*sag.*), anterior margin bluntly pointed; eyes small, opposite anterior third of glabella; fixigenae horizontal or slightly upsloping, with palpebral areas 0.25 of glabellar width, posterior areas triangular, of medium width (*exsag.*), almost same in length (*tr.*) as occipital ring; librigenae with medium-length genal spines. Pygidium narrowly transverse; axis same in width as pleural fields, with 3 axial rings and terminal; 4 pleurae with obsolete interpleural grooves and shallow pleural furrows; posterior margin smooth. *U.Cam.(Francon.)*, C.U.S.A.—FIG. 202,1. **K. eryon* (HALL), Wis.; 1*a,b*, ceph., pyg., $\times 3$ (376).

Maustonia RAASCH in LOCHMAN, 1950 [**Conocephalites nasutus* HALL, 1863]. Glabella convex, truncate-tapering, with 3 pairs of short, faint to obsolete lateral furrows; frontal area 0.25 of glabellar length or slightly less, anterior border furrow straight or concave, anterior border short (*tr.*), triangular, anterior margin pointed; eyes small, opposite anterior third of glabella; fixigenae slightly upsloping with palpebral areas about 0.3 of glabellar width, posterior areas straplike, almost same in length (*tr.*) as occipital ring, posterior sections of facial sutures sigmoidally curved; librigenae with medium-length genal spines. Pygidium narrowly transverse; axis same in width as pleural fields, with 3 axial rings and terminal; probably 4 pleurae, with obsolete interpleural grooves and very faint pleural furrows; posterior margin smooth or with single pair very small marginal spines. *U.Cam.(Francon.)*, C.U.S.A.—FIG. 202,4. **M. nasuta* (HALL), Wis.; ceph., $\times 2$ (376).

Orygmaspis RESSER, 1936 [**Ptychoparia llanoensis* WALCOTT, 1890]. Glabella moderately convex, elongate tapering, faintly keeled, with 3 pairs of faint lateral furrows; frontal area 0.25 to 0.3 of length of cranium, anterior border furrow shallow, straight, may have row of granules; eyes slightly below medium size, barely anterior to center of glabella; fixigenae horizontal, with palpebral areas 0.3 of glabellar width, posterior areas straplike, almost same in length (*tr.*) as occipital ring, posterior sections of facial sutures sigmoidally curved. Pygidium subtrigonal; axis wider than pleural fields, with 4 axial rings and terminal; 4 pleurae, with obsolete interpleural grooves and 3 broad shallow pleural furrows, anterior 3 pleurae ending in medium-length posteriorly directed marginal spines, 4th pleura in a very small spine. *U.Cam.(Francon.)*, C.U.S.A.—FIG. 202,12. **O.*

llanoensis (WALCOTT), Tex.; 12a,b, cran., pyg., $\times 1.3$ (457).

Psalaspis RESSER, 1937 [**Conocephalites patersoni* HALL, 1863]. Glabella low, truncate-tapering with 2 pairs of faint, arcuate lateral furrows, axial and occipital furrows faint; frontal area 0.3 of length of cranium, anterior border furrow very faint to obsolete, anterior border short (*tr.*), triangular, anterior margin pointed or curved; slender occipital spine may be present; eyes small,

slightly anterior to center of glabella; fixigenae horizontal to slightly downsloping, with palpebral areas a little less than 0.3 of glabellar width, posterior areas straplike, almost same in length (*tr.*) as occipital ring, posterior sections of facial sutures sigmoidally curved; librigenae broad, bearing prominent inwardly curved genal spines. Pygidium narrowly transverse, diamond-shaped; axis wider than low pleural fields, with 2 or 3 axial rings and terminal; 3 pleurae with distinct

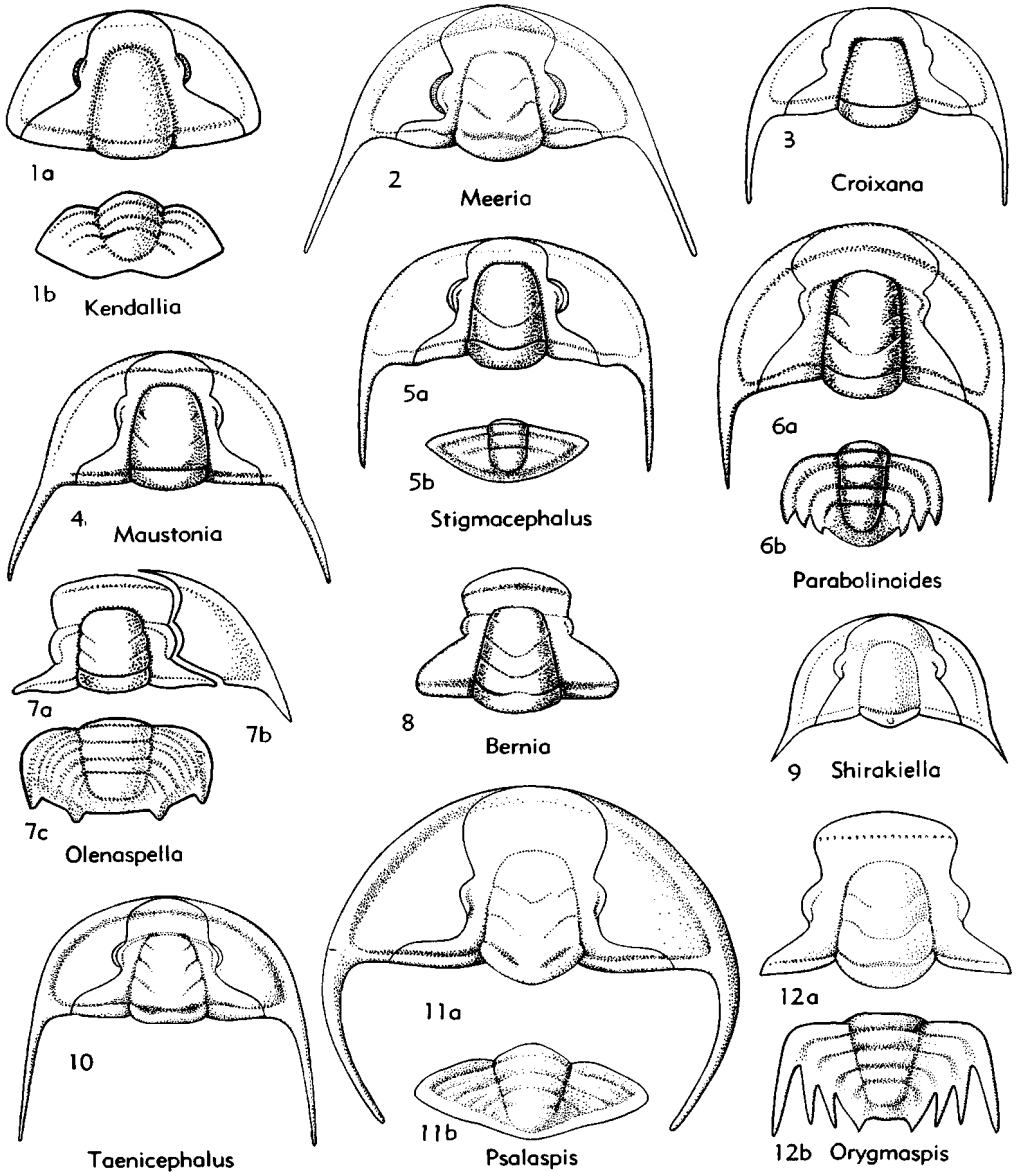


FIG. 202. Idahoïidae, Shirakiellidae, Parabolinoïdidae (p. 0252, 0271-0274).

pleural furrows, and faint to obsolete interpleural grooves; border furrow narrow, posterior margin smooth (8). *U.Cam.(Francon.)*, C.USA.—FIG. 202,11. **P. patersoni* (HALL), Wis.; 11a,b, ceph., pyg., $\times 1$ (457).

Stigmacephalus RESSER, 1936 [**Conocephalites oweni* HALL, 1863]. Glabella low, elongate tapering with 2 pairs of faint lateral furrows, axial and occipital furrows shallow; convex frontal area about 0.25 of length of cranium, anterior border furrow faint to obsolete; eyes slightly below medium size, nearly opposite center of glabella; fixigenae horizontal or slightly upsloping, with palpebral areas slightly less than 0.25 of glabellar width, posterior areas straplike, about 0.7 of length (*tr.*) of occipital ring, posterior sections of facial sutures sigmoidally curved; librigenae with short genal spines. Pygidium narrowly transverse; axis wider than pleural fields, with 3 axial rings and terminal; 3 pleurae with obsolete interpleural grooves, and broad shallow pleural furrows; border furrow shallow, border narrow (156). *U.Cam.(Francon.)*, C.USA.—FIG. 202,5. **S. oweni* (HALL), Wis.; 5a,b, ceph., pyg., $\times 1$ (435).

Taenicephalus ULRICH & RESSER in WALCOTT, 1924 [**Conocephalites shumardi* HALL, 1863]. Glabella low, truncate-tapering, axial furrows deep, in some with pair of anterior pits, 3 pairs of short diagonal lateral furrows; frontal area 0.25 to 0.3 of length of cranium, anterior border furrow straight or slightly curved, anterior border pointed or curved; eyes small, opposite anterior third of glabella; fixigenae upsloping, with arcuate palpebral areas, about 0.3 of glabellar width, posterior areas subtriangular, about same in length (*tr.*) as occipital ring, posterior sections of facial sutures slightly curved inward; librigenae with medium-length genal spines. Pygidium narrowly transverse axis about same in width as pleural fields, with 3 or 4 axial rings and small terminal; 4 pleurae with faint interpleural grooves and distinct pleural furrows; posterior margin smooth. *U.Cam.(Francon.)*, N.Am.—FIG. 202,10. **T. shumardi* (HALL), Wis.; ceph., $\times 2$ (487).

Olenaspella WILSON, 1956 [**Parabolinella? evansi* KOBAYASHI, 1936]. Glabella slightly convex, subrectangular, front rounded, posterior 2 pairs of lateral furrows distinct; wide (*tr.*) frontal area 0.25 to 0.3 of length of cranium, crossed by slightly curved anterior border furrow; eye ridges distinct, eyes of medium size, opposite center of glabella; fixigenae nearly horizontal, with palpebral areas about 0.5 of glabellar width, posterior areas narrowly (*exsag.*) triangular, posterior sections of facial sutures sigmoidally curved; librigenae with tapered genal spines. Pygidium transverse; axis same in width as pleural fields, with 4 axial rings and terminal; 4 pleurae with distinct interpleural grooves and faint pleural furrows; border furrow faint; 2 pairs of short, widely spaced marginal

spines. *U.Cam.(U.Dresbach.-Francon.)*, N.Am.—FIG. 202,7. **O. evansi* (KOBAYASHI), W.Can.(B.C.); 7a-c, cran., librigena, pyg., $\times 2$ (497).

Superfamily SOLENOPLEURACEA Angelin, 1854

[*nom. transl.* HENNINGSMOEN, herein (*ex* Solenopleuridae ANGELIN, 1854)] [=Solcnopleuroidae HUPÉ, 1953 + Parasolenopleuroidae HUPÉ, 1953 + Agrauloidea HUPÉ, 1953]

Exoskeleton mostly of rather generalized ptychopariid appearance, with small to medium-sized pygidium (Solenopleuridae, Agraulidae, Lonchocephalidae, Dokimoccephalidae). Characteristically, the glabella is ovate, but in many forms it tapers forward or is parallel-sided; also the rather prominent glabella may be pyriform (e.g., Catillicephalidae, which apparently developed from the Lonchocephalidae). Axial and occipital furrows characteristically deep and wide, but may be less distinct or obsolete (Agraulidae, Kingstoniidae). The preoccipital lateral glabellar furrows commonly curve inward-backward, in some forms almost isolating the basal (preoccipital) lobes. Dorsal surface generally granulose or tuberculate, but may be smooth. *M.Cam.-L.Ord.*

Family SOLENOPLEURIDAE Angelin, 1854

Opisthoparian, ovate to elongate fairly convex exoskeleton, micropygous to heteropygous. Cephalon generally semicircular, with tapering to ovate glabella defined by very wide and deep axial and occipital furrows, generally deep border furrow, and prominent, commonly narrow border. Thorax (as far as known) of 11 to 17 segments with prominent axis and deeply furrowed pleurae. Pygidium with 1 to 9 axial rings, more or less distinctly segmented pleural fields, entire margin, and usually well-defined narrow border. Surface granulose or tuberculate. Character of cephalic doublure, ventral sutures, and hypostoma imperfectly known. *M.Cam.-L.Ord.*

Subfamily SOLENOPLEURINAE Angelin, 1854

[*nom. transl.* POULSEN, 1954 (*ex* Solenopleuridae KOBAYASHI, 1935)]

Strongly convex, anteriorly rounded glabella with 2 or 3 pairs of oblique lateral furrows; eye ridges usually distinct; palpebral lobes short, librigenae spineless or with poorly developed genal spines. Thorax (as

far as known) of 13 to 17 segments with rounded extremities or (rarely) short pleural spines. Pygidium with 2 to 9 axial rings. Surface granulose or finely tuberculate. *M. Cam.-U. Cam.*

Solenopleura ANGELIN, 1854 [**Aulacopleura* (*Calymene*) *canaliculata* ANGELIN, 1851; SD MILLER, 1889]. Cephalon with approximately trapezoidal cranidium and evenly curved anterior margin; glabella tapering to subovate; preglabellar field usually short (*sag.*); fixigenae with considerably elevated palpebral areas and posterior areas extending almost to genal angles, short palpebral lobes situated opposite or slightly in front of glabellar center, more or less converging course of anterior sections of facial sutures from eyes to anterior border, and usually more or less rudimentary acute genal spines. Thorax of about 14 segments with rounded extremities and pleural furrows almost parallel to edges of segments. Pygidium fairly wide, with 7 or 8 axial rings and strongly marked segmentation of pleural fields (51, 114, 338). *M. Cam., Eu.-Asia-E.N. Am. (Atl. prov.)-P.N. Zem.* — FIG. 203. **S. canaliculata* (ANGELIN), Swed.; exoskel. (reconstr.), $\times 0.5$ (1, somewhat modified).

?**Albansia** HOWELL, 1937 [**A. pusilla*]. Very small, differing from *Solenopleura* in having ovate glabella, more oblique posterior pair of lateral furrows, and effaced or very indistinctly defined eye ridges (74). *Up.M. Cam., E.N. Am.*

Asthenopsis WHITEHOUSE, 1939 [**A. levior*]. Differs from *Solenopleura* in having palpebral lobes situated close to posterior border furrow, and thoracic segments terminating in obtuse pleural spines (340). *M. Cam., NE. Austral.* — FIG. 204, 2. **A. levior*; exoskel. (reconstr.), $\times 1$ (340).

?**Crusioia** WALCOTT, 1924 [**C. cebes*]. Differs from *Solenopleura* in having upturned cephalic front with broad indentation of anterior margin between anterior sections of facial sutures, smaller palpebral lobes situated very far forward, obliquely truncated pleurae, and minute pygidium (321). *M. Cam., N. Am.* — FIG. 204, 3. **C. cebes*, Mont.; exoskel., $\times 3$ (321).

Jincella ŠNAJDR, 1957 [**Solenopleura pranli* RŮŽIČKA, 1935]. *M. Cam., Eu. (USSR).*

Maiaspis CHERNYŠEVA, 1956 [**M. mirabilis*]. *Up. M. Cam., USSR.*

?**Menocephalites** KOBAYASHI, 1935 [**Solenopleura acantha* WALCOTT, 1905]. *M. Cam., E. Asia.*

Parasolenopleura WESTERGÅRD, 1953 [**Calymene aculeata* ANGELIN, 1851] [*non* POLETAEVA, 1955 (**P. subconsocialis*)]. Differs from *Solenopleura* in having less convex dorsal exoskeleton; less sloping anterior portion of cephalon; shallower axial and border furrows; less inflated genae, less convex anterior border, nearly flat lateral border; pygidium with more pronounced interpleural

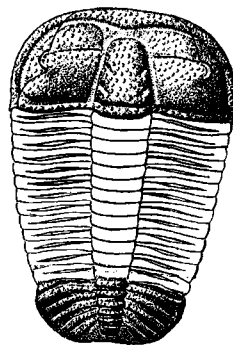


FIG. 203. **Solenopleura canaliculata* (ANGELIN) (Solenopleuridae); *M. Cam., Swed.*; exoskel. (reconstr.), $\times 0.5$ (1, mod.).

grooves; and outer surface of exoskeleton smooth to the naked eye (338). *M. Cam., Eu.-E.N. Am. (Atl. prov.)-Asia.* — FIG. 204, 12. **P. aculeata* (ANGELIN), Swed.; exoskel. (reconstr.), $\times 2$ (based on WESTERGÅRD).

Perneraspis PRANTL, 1947 [*pro Perneria* RŮŽIČKA, 1940 (*non* FRITSCH, 1904)] [**Perneria lata* RŮŽIČKA, 1940]. Differs from *Solenopleura* in having wider, more rapidly tapering glabella; narrower fixigenae; same width of anterior border for greater part of its extension between facial sutures, diverging course of anterior sections of facial sutures from eyes to anterior border; and pygidium with 3 or 4 axial rings and faintly marked segmentation of pleural fields (264). *M. Cam., Czech.* — FIG. 204, 5. **P. lata* (RŮŽIČKA); cran., $\times 2$ (264).

Pseudosolenopleura SUN, 1935 [**Solenopleura kotoi* KOBAYASHI, 1933]. *U. Cam., E. Asia.*

Solenopleurella POULSEN, 1927 [**S. ulrichi*]. Differs from *Solenopleura* in having smaller, much narrower exoskeleton, almost quadrate glabella extended to anterior border furrow, and less oblique lateral furrows (172, 197). *M. Cam., Greenl.-N. Am.* — FIG. 204, 6. **S. ulrichi*, Greenl.; cran., $\times 8$ (172).

Solenopleurina RŮŽIČKA, 1938 [**S. týřovicensis*]. Differs from *Solenopleura* in having considerable distance between genal angle and posterior end of facial sutures (263). *M. Cam., Czech.*

Spencia RESSER, 1939 [**S. typicalis*] [= *Staurololcus* RESSER, 1939]. *M. Cam., N. Am.*

Subfamily ACROCEPHALITINAE Hupé, 1953

[*nom. transl.* POULSEN, 1954 (*ex* Acrocephalitidae HUPÉ, 1953)]

Strongly convex, anteriorly truncate glabella, usually with 3 pairs of oblique lateral furrows; swelling or boss occupying more or less well-developed preglabellar field; eye

ridges faintly marked; genal spines fairly well developed. Pygidium with 1 to 8 axial rings. Surface granulate to finely tuberculate. *M.Cam.-U.Cam.*

Acrocephalites WALLERIUS, 1895 [**Calymene stenometopa* ANGELIN, 1851]. Cranidium approximately pentagonal, with tapering glabella, more or less angular anterior margin that usually bears a forward-directed median cusp or spine; converging course of anterior sections of facial sutures from eyes to anterior border. Thoracic segments with short pleural spines. Pygidium very short, wide, with few segments (331, 336). *M.Cam.-U.Cam.*, Eu.-Asia-?N.Zem.—FIG. 204,11. **A. stenometopus* (ANGELIN), *M.Cam.*, Swed.; cran., $\times 4$ (331).

Acrocephalopsis IVSHIN, 1956 [**A. fidus*]. Glabella short, truncate-tapering with 2 pairs of faint curved lateral furrows; wide (*sag.*) preglabellar field with globose boss filling all area in front of glabella and impinging on preglabellar and anterior border furrows; anterior border narrow, anterior border furrow distinct, narrow, curving forward on sagittal line; eyes of medium size opposite center of glabella, palpebral lobes crescentiform, eye ridges present; fixigenae upsloping, with palpebral areas slightly more than 0.5 of glabellar width, posterior areas narrow (*exsag.*), triangular. Surface finely granulate. *U.Cam.*, SW.Sib.

?**Acrocephalina** TROEDSSON, 1937 [**A. armata*]. Resembles *Acrocephalites*, but with longer anterior spine and with distinct eye ridges. *U.Cam.*, eastern T'ien-shan, Sinkiang, C.Asia (HE).

Aldanaspis LERMONTOVA, 1940 [**A. punctata*]. Differs from *Acrocephalites* in having subrectangular glabella; longer, much stronger median spine on anterior border; and diverging course of anterior sections of facial sutures from eyes to anterior border (117). *M.Cam.*, USSR.

Cliffia J. L. WILSON, 1951 [**Acrocephalites lataegenae* J. L. WILSON, 1949]. Differs from *Acrocephalites* in having evenly curved anterior cephalic margin without median cusp or spine; moderately converging, almost subparallel course of anterior sections of facial sutures from eyes to anterior border; wider posterior area of fixigenae; wider librigenae; and long, fairly large, rounded triangular, borderless (associated) pygidium with about 8 axial rings and strongly marked segmentation of pleural fields (363). *U.Cam.*, N. Am.—FIG. 204,10. **C. lataegenae* (J. L. WILSON), Tex.; ceph., $\times 4$ (363).

?**Paracrocephalites** POULSEN, 1954 [*pro Arctaspis* LERMONTOVA, 1940 (*non* HEINTZ, 1929)] [**Arctaspis robusta* LERMONTOVA, 1940]. Differs from *Acrocephalites* in having less angular cephalic front without median cusp or spine; effaced glabellar furrows; shorter preglabellar field without appreciable swelling; and almost rectilinear an-

terior border furrow (117). *U.Cam.*, Asia.—FIG. 204,15. **P. robustus* (LERMONTOVA), Sib.; cran., $\times 1.5$ (117).

Pesaia WALCOTT & RESSER, 1924 [**P. exsculpta*]. Differs from *Cliffia* in having shorter preglabellar field; anterior border furrow almost effaced along preglabellar swelling; effaced glabellar furrows; narrower (*sag.*) occipital ring; short wide pygidium with few indistinctly defined segments and well-defined border (322). *U.Cam.*, N. Zem.—FIG. 204,7. **P. exsculpta*; cran., $\times 2$ (322).

Subfamily SAOINAE Hupé, 1953

[*nom. transl.* POULSEN, 1954 (*ex* SAOIDAE HUPÉ, 1953)]

Moderately convex glabella with 2 or 3 pairs of transverse or (rarely) oblique lateral furrows; eye ridges usually well defined; palpebral lobes of medium size; genal spines short, poorly developed. Thorax of 16 or 17 segments with rounded or truncated extremities. Pygidium small, with up to 4 axial rings. Surface covered with spine-like tubercles or spines or both. *M.Cam.*

Sao BARRANDE, 1846 [*non* BILLBERG, 1820, ICZN Opinion 512] [**S. hirsuta*] [= *Monadina* BARRANDE, 1846; *Acanthocnemis*, ?*Acanthogramma*, *Crithias*, *Endogramma*, *Enneacnemis*, *Goniacanthus*, ?*Micropyge*, *Selenosema*, *Staurogmus*, *Tetracnemis* HAWLE & CORDA, 1847]. Lateral glabellar furrows wide, impressed, transverse, united with longitudinal furrow on crest of glabella; cephalic border moderately wide, strongly convex; axial and anterior border furrows confluent so as to form considerable concave space without surface markings between glabella and anterior border. Thorax of 17 segments with truncated extremities. Pygidium very short, wide, with 2 segments. All convex parts of outer surface covered with small tubercles forming regular transverse rows on glabella, thorax, and pygidium, also a median spine and smaller lateral spines on occipital and thoracic axial rings (3). *M.Cam.*, Eu.—FIG. 204,13. **S. hirsuta*, Czech.; 13a, exoskel. (reconstr.), $\times 2$; 13b, thoracic segment, $\times 4$ (3).

Pardailhania THORAL, 1947 [**Solenopleura? hispida* THORAL, 1935]. Differs from *Sao* in having glabella without median longitudinal furrow; moderately long, slightly convex preglabellar field with surface markings; fairly flat or slightly concave anterior cephalic border with upturned anterior margin, and coarser surface markings consisting of spines or (rarely) crests (296). *M.Cam.*, S.Eu.-?N.Afr.

Rimouskia RESSER, 1938 [**R. typica*]. Differs from *Sao* in the less tapered, longer glabella, lack of definite longitudinal glabellar furrow; straight posterior sections of facial sutures; and stronger, more distally located geniculation of posterior cephalic

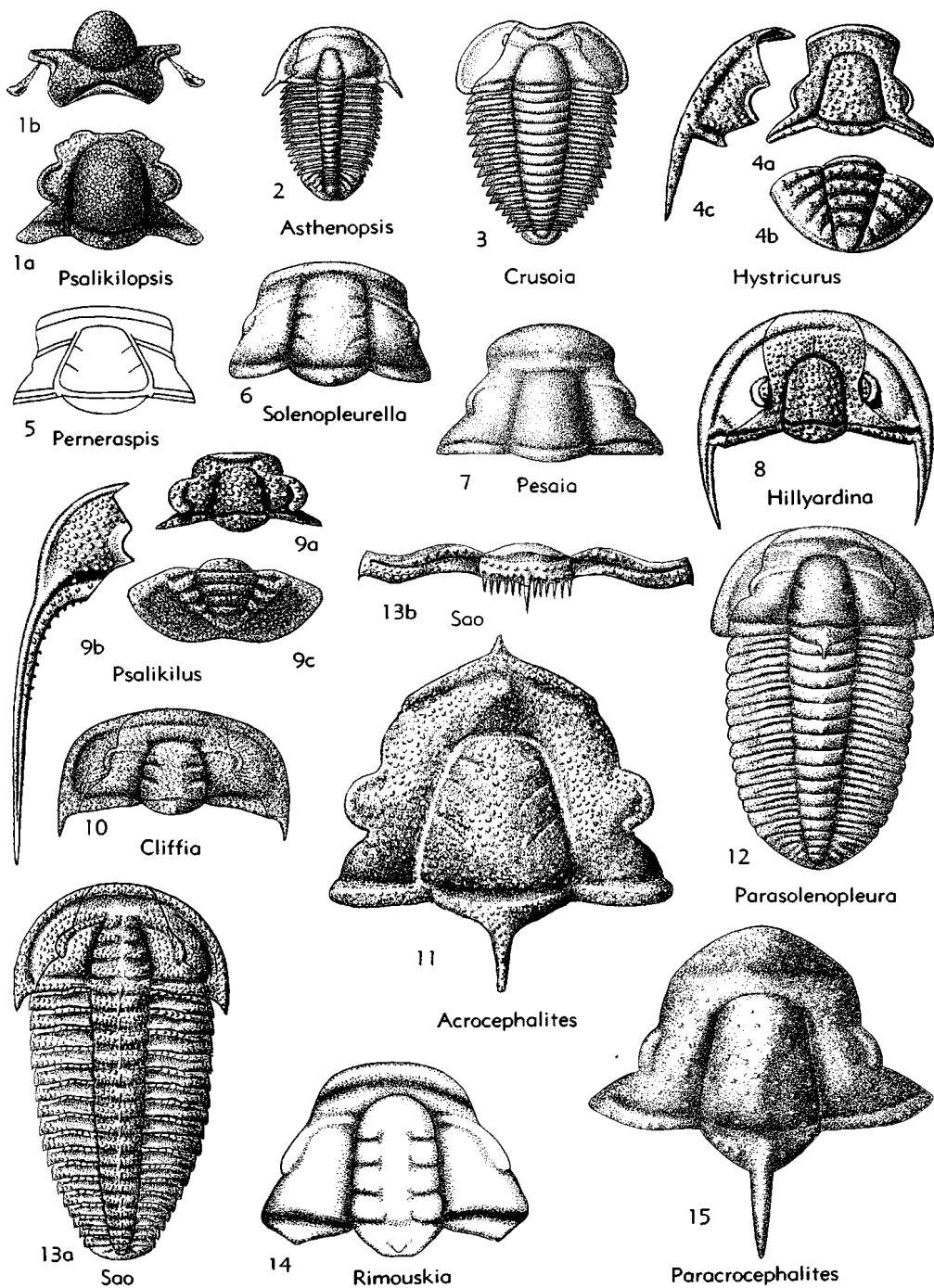


FIG. 204. Solenopleuridae (p. O275-O278).

border (203). *L.Cam.*, E.N.Am.—FIG. 204,14.
**R. typica*, Que.; cran., $\times 4$ (203).

Solenopleuropsis THORAL, 1947 [*Conocoryphe rouayrouxi* MUNIER-CHALMAS & BERGERON, 1889]. Differs from *Sao* in having glabella without median longitudinal furrow, oblique lateral furrows; very long slightly convex tuberculate preglabellar field; very narrow cephalic border; rounded extremities of thoracic segments; and coarser tuberculation forming regular transverse rows on occipital and postoccipital parts only (296). *M.Cam.*, Eu.

Subfamily HYSTRICURINAE Hupé, 1953

[*nom. transl.* POULSEN, 1954 (ex Hystricuridae HUPÉ, 1953)]

Glabella moderately to strongly convex, rounded anteriorly, with effaced lateral furrows or these represented by nonpustulose patches; eye ridges usually effaced; palpebral lobes short to long; genal spines generally well developed. Thorax of about 11 segments (in type genus) with blunt or spined extremities. Pygidium with about 3 to 6 axial rings. Surface usually coarsely tuberculate. *U.Cam.-L.Ord.*

Hystricurus RAYMOND, 1913 [*Bathyurus conicus* BILLINGS, 1859]. Cephalon with tapering to subovate glabella; preglabellar field varying in length; fixigenae with narrow to moderately wide anterior and palpebral areas, slender lateral extremities of posterior areas divided into subequal portions by deeply impressed posterior border furrows, medium to long palpebral lobes behind or (rarely) opposite glabellar center and terminating fairly close to posterior border furrows; strongly diverging course of posterior sections of facial sutures from eyes to posterior border furrow; moderately wide librigenae. Thoracic segments with spined or bluntly rounded pleural tips. Pygidium with long axis, narrow border, and evenly curved posterolateral margin. Ventral sutures delimit a small trapezoidal rostral plate (63, 258). *L.Ord.*, N.Am.-Greenl.-E.Asia. — FIG. 204,4a,b. **H. conicus* (BILLINGS), N.Y.; 4a, cran., $\times 2$; 4b, pyg., $\times 2$ (494).—FIG. 204,4c. *H. genalatus* Ross, Utah; librigena, $\times 4$ (258).

Amblycranium Ross, 1951 [*A. variable*]. Differs from *Hystricurus* in having much wider posterior areas of fixigenae, and palpebral lobes situated anterior to glabellar center (258). *L.Ord.*, N.Am.

?**Apachia** FREDERICKSON, 1949 [*A. trigonis*]. *U.Cam.*, N.Am.

Hillyardina Ross, 1951 [*H. semicylindrica*]. Differs from *Hystricurus* in having flat-topped, acutely edged anterior and lateral cephalic border; preglabellar field divided by median furrow; very acute lateral extremities of posterior areas of fixigenae, short palpebral lobes situated opposite to glabellar center; boss in posterolateral corners of librigenae, and genal spines divided longitudi-

nally by continuation of lateral border furrows (258). *L.Ord.*, N.Am.—FIG. 204,8. **H. semicylindrica*, Utah; ceph., $\times 4$ (258).

Pachycranium Ross, 1951 [**P. faciculus*]. Differs from *Hillyardina* in having convex, narrower cephalic border; more strongly impressed preglabellar median furrow; palpebral lobes situated anterior to glabellar center; librigenae with unfurrowed genal spines and without boss in posterolateral corners, and smooth surface (258). *L.Ord.*, N.Am.

Parahystricurus Ross, 1951 [**P. fraudator*]. Differs from *Hystricurus* in having more strongly curved palpebral lobes; more acute extremities of posterior areas of fixigenae; moderately diverging course of posterior sections of facial sutures from eyes to posterior borders (258). *L.Ord.*, N.Am.

Psalikilopsis Ross, 1953 [**P. cuspidicauda*]. Differs from *Psalikilus* in having more ovate glabella without lateral furrows; extremely slender palpebral lobes situated opposite to glabellar center; and much shorter occipital ring. *L.Ord.*, N.Am.—FIG. 204,1. **P. cuspidicauda*, Utah; 1a,b, cran., dorsal, anterior, $\times 3$ (463).

Psalikilus Ross, 1951 [**P. typicum*]. Differs from *Hystricurus* in having 2 pairs of distinct, very short nonpustulose depressions on steep sides of glabella adjacent to axial furrows; sharply deflected anterior areas of fixigenae; librigenae with ridge extending obliquely backward to genal angles so as to prevent confluence of lateral and posterior border furrows; very long genal spines furrowed to tip by backward extension of posterior border furrow; subtriangular pygidium with shorter axis and wide fairly flat, more or less downward-directed border (63, 258). *L.Ord.*, N.Am.—FIG. 204,9. **P. typicum*, Utah; 9a, cran., $\times 4$; 9b, librigena, $\times 4$; 9c, pyg., $\times 8$ (258).

Rollia CULLISON, 1944 [**R. goodwini*]. Differs from *Hystricurus* in having relatively shorter, less prominent, furrow-bearing glabella, wider and flatter frontal area, and larger pustulose palpebral lobes (392). *L.Ord.*, N.Am.

Family AGRAULIDAE Raymond, 1913

Cephalic axis tapering forward; preglabellar field present; palpebral lobes small, opposite anterior half of glabella, librigenae with genal spine. Thorax with as many as 16 segments, proximal ends of pleurae bent upward toward axial rings. Pygidium small. *M.Cam.*

Agraulos HAWLE & CORDA, 1847 [**Arion ceticephalus* BARRANDE, 1846; SD MILLER, 1889] [*pro Arion* BARRANDE, 1846] [= *Arionides* BARRANDE, 1847 (*pro Arion* BARRANDE, 1846); *Arionellus* BARRANDE, 1850 (*pro Arionides* BARRANDE, 1847); *Proampyx* FRECH, 1897 (subj.); *Agrauloides* HOWELL, 1937 (subj.)]. Relatively long (*tr.*) frontal

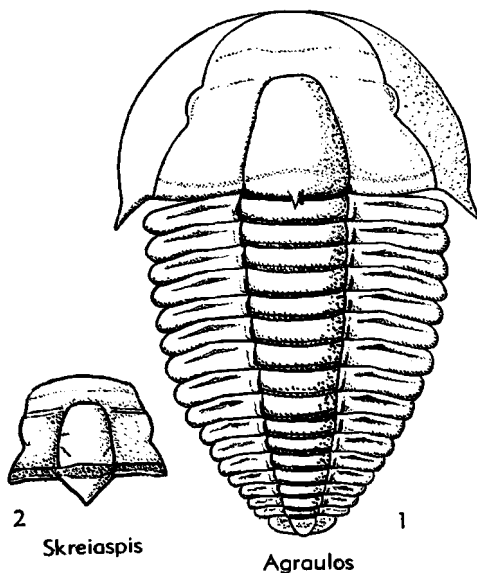


FIG. 205. Agraulidae (p. 0278-0279).

area; eye ridges, lateral glabellar furrows, and border furrows practically effaced. *M.Cam.*, Eu., N.Am.—FIG. 205,1. **A. ceticephalus*, Czech.; restored exoskel., $\times 2$ (406n).

Skreiaspis RŮŽIČKA, 1944 [**Agraulos spinosus* JAHN, 1895] [=Herse HAWLE & CORDA, 1847, *partim* (non OKEN, 1815; nec LESSON, 1837; nec GISTL, 1848)]. Like *Agraulos* but with shorter frontal area and distinct axial furrow. *M.Cam.*, Czech.—FIG. 205,2. **S. spinosus* (JAHN); cran., $\times 4$ (464).

Family LONCHOCEPHALIDAE Hupé, 1953

Small, compact trilobites with presumably 7 to 10 thoracic segments and pygidium of medium size. Glabella well defined, rather large, tapering, rounded or truncate in front, commonly deeply furrowed; furrows of posterior pair invariably curving inward and backward, in many forms almost isolating basal lobes; fixigenae usually convex, with palpebral areas of moderate width, eye ridges generally present, palpebral lobes narrow, short or of medium length, usually near level of glabellar mid-point, border furrow usually not confluent with axial furrows, border elevated; librigenae usually carrying genal spines. Rostral plate presumably present in all genera. Thoracic pleurae rounded distally. Pygidium wide and short,

subtriangular, with several segments; axis long, border commonly turned down vertically. *U.Cam.* (201).

Lonchocephalus OWEN, 1852 [**L. chippewaensis*; SD MILLER, 1889]. Glabella tapering, rounded; palpebral area convex, less than half as wide as glabella; eye ridges prominent; occipital ring with spine; librigenae with genal spines. Thorax of 7 segments (*L. chippewaensis*). Pygidium subtriangular, with flat, furrowed pleural fields and downturned border. *U.Cam.*(Dresbach.), N.Am.—FIG. 206,1. **L. chippewaensis*, Wis.; 1a,b, cran., pyg., $\times 4$ (448n).

Amiaspis LOCHMAN, in LOCHMAN & DUNCAN, 1944 [**A. erratica*]. Cephalon strongly convex; glabella ovate, rising above fixigenae; long occipital spine; anterior area downsloping; border indistinct; palpebral lobes small, anterior in position. *U.Cam.* (Dresbach.), N.Am.—FIG. 206,4. **A. erratica*, Mont.; 4a,b, cran., dorsal and lateral, $\times 15$ (132).

Calymenidius RASETTI, 1944 [**C. tuberculatus*]. Cranidium proportionately wide and short; glabella truncate; axial and glabellar furrows exceptionally deep; preglabellar field short (*sag.*), border elevated, arched transversely; posterior area very wide (*tr.*). *U.Cam.*(Trempeal.), N.Am.—FIG. 206,2. **C. tuberculatus*, Que.; cran., $\times 5$ (448n).

Glyptometopus RASETTI, 1944 [**Solenopleura laflammei* CLARK, 1924]. Glabella as in *Calymenidius*; no occipital spine; border not greatly elevated; posterior area much narrower (*tr.*). *U.Cam.* (Trempeal.), N.Am.—FIG. 206,5. **G. laflammei* (CLARK), Que.; cran., $\times 5$ (448n).

Quebecaspis RASETTI, 1944 [**Q. breviceps*]. Glabella subtrapezoidal, of moderate convexity; occipital spine present; border and axial furrows almost confluent in front of glabella; eye ridges faint; palpebral lobes relatively long; posterior area short (*exsag.*). *U.Cam.*(?Francon.), N.Am.—FIG. 206,9. **Q. breviceps*, Que.; cran., $\times 4$ (448n).

Glaphyraspis RESSER, 1937 [**Liostracus parvus* WALCOTT, 1899] [=*Raaschella* LOCHMAN, 1938]. Glabella truncate; fixigenae downsloping; palpebral lobes anterior to glabellar mid-point; posterior areas of fixigenae long (*exsag.*); no occipital or genal spines. Pygidium with sharply downturned border. Size very small. *U.Cam.*(Dresbach.), N. Am.—FIG. 206,6. *G. ornata* (LOCHMAN), Tex.; 6a,b, cran., pyg.; 6c, librigena, $\times 10$ (162).

Talbotina LOCHMAN, 1938 [**T. degrasensis*]. Glabella rounded in front; fixigenae downsloping, palpebral lobes at level of glabellar mid-point. May be synonymous with *Weeksina*. *U.Cam.*(Dresbach.), N.Am.—FIG. 206,7. **T. degrasensis*, Newf.; 7a, cran., $\times 6$; 7b, pyg., $\times 8$ (125).—FIG. 228,4. *T. jewelli* LOCHMAN, in LOCHMAN & DUNCAN, Pilgrim F., Mont.; 4a,b, cran.; $\times 2$; 4c, librigena, $\times 4$, 4d,e, pyg., $\times 3$ (425).

Terranovella LOCHMAN, 1938 [**T. obscura*]. Glabella tapered, subtruncate in front; occipital spine present; axial furrows deep; anterior areas of fixigenae convex, lacking border, palpebral lobes small, near level of glabella mid-point. Pygidium subtriangular; axis long, prominent; pleural fields furrowed; border downturned. *U. Cam. (Dresbach.)*, N.Am.—FIG. 206,8a. **T. obscura*, Newf.; cran.,

×8 (448n).—FIG. 206,8b. *T. dorsalis* (HALL), Va.; pyg., ×10 (448n).

Weeksina RESSER, 1935 [**Asaphiscus? unispinus* WALCOTT, 1916]. Anterior angles of cranidium rounded; anterior sections of facial sutures reaching margin only near mid-line; fixigenae with relatively long palpebral lobes, posterior areas short (*exsag.*), genal spines present. Thorax of 10

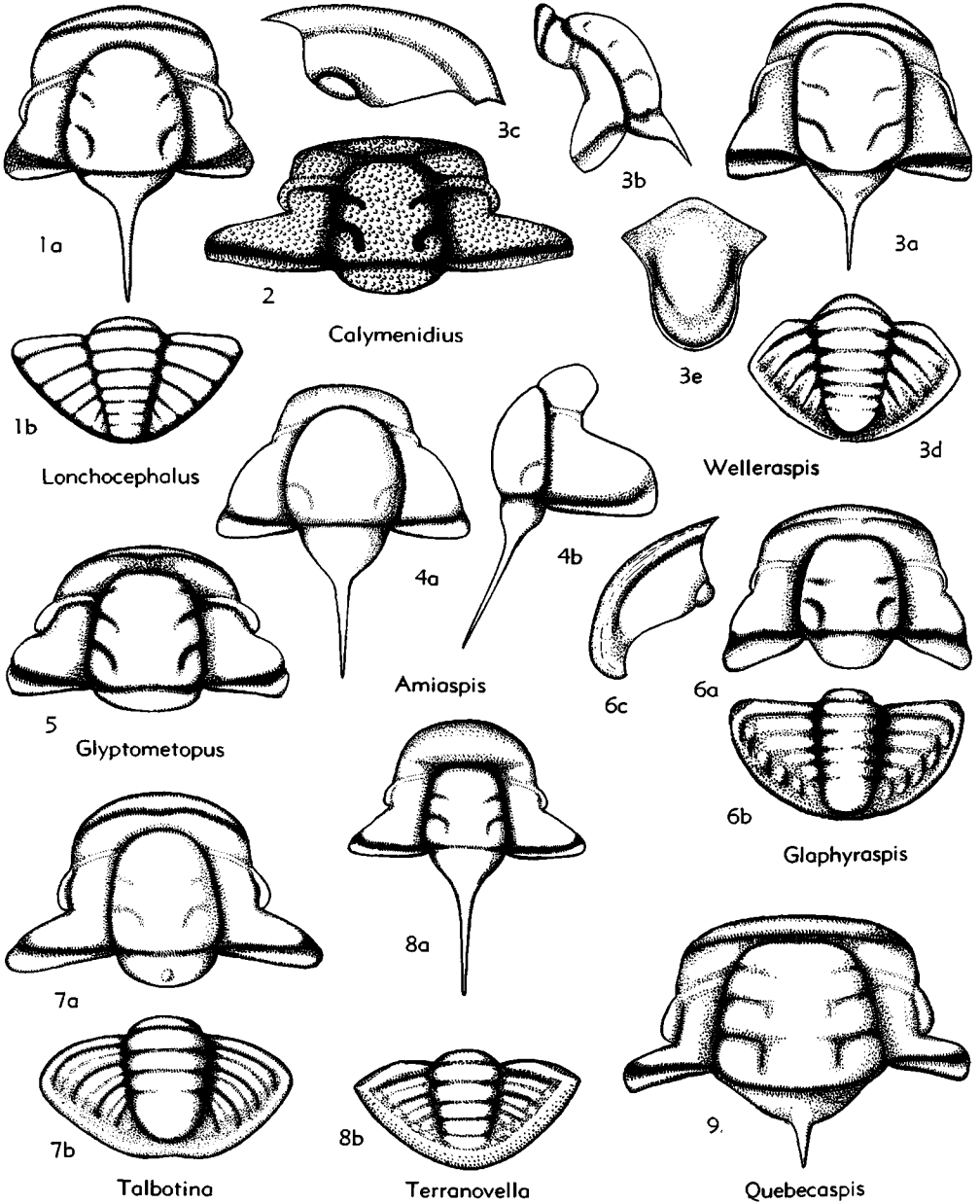


FIG. 206. Lonchocephalidae (p. 0279-0281).

segments, 8th with axial spine. *U.Cam.* (*Dresbach.*), N.Am.—FIG. 207. **W. unispina* (WALCOTT), Utah; exoskel. flattened in shale, $\times 4.5$ (448n).

Welleraspis KOBAYASHI, 1935 [**Solenopleura jerseyensis* WELLER, 1900] [= *Avonaspis* LOCHMAN, 1940]. Like *Lonchocephalus*, with which it intergrades; glabella subrectangular, proportionately larger; preglabellar field shorter (*sag.*); pleural fields of pygidium downsloping. *U.Cam.* (*Dresbach.*), N.Am.—FIG. 206,3. **W. jerseyensis* (WELLER), Pa.; 3a,b, cran., dorsal and lateral, $\times 5$; 3c,d, librigena, pyg., $\times 5$; 3e, hypostoma, $\times 8$ (448n).

Bucksella HOWELL, 1957 [**B. brevis*]. Similar to *Welleraspis*, but differs in having the glabella in the more typical species less quadrate in outline and more evenly curved in front, in not having the front of the glabella as close to the border, and in having the fixigenae more widely confluent in front of the glabella and the border more definitely turned up, so that it rises above the confluent portion of the fixigenae. *U.Cam.*, N.Am. (Pa.) (HE).

Family DOKIMOCEPHALIDAE Kobayashi, 1935

[= *Burnetiidae* RESSER, 1942; *Heterocaryoninae* HUPÉ, 1953]

Exoskeleton opisthoparian, subisopygous. Glabella broadly tapering, convex to tumid, front rounded, with 2 or 3 pairs of usually deep lateral furrows; preglabellar field wide to very narrow (*sag.*) or absent, all furrows well defined, anterior border commonly modified in shape; eye ridges and occipital node or spine common, eyes medium in size, behind center of glabella; fixigenae horizontal to elevated; librigenae large, with medium to long genal spines, commonly directed laterally. Thorax unknown. Pygidium transverse to ovate; axis and pleural regions variable in width, pleural furrows and interpleural grooves may cross flat or concave border, border furrow faint or obsolete. Surface granulate, coarse pustules common. Derived from *Ptychopariidae*. *U.Cam.*

Dokimocephalus WALCOTT, 1924 [**Ptychoparia? pernasutus* WALCOTT, 1884]. Preglabellar field variable in width (*sag.*), anterior border commonly extended into concave tongue, spine, or spatulate process; occipital spine may be present; eyes opposite posterior third of glabella; fixigenae upsloping, with palpebral areas about 0.5 of glabellar width; librigenae with short laterally directed genal spines. Pygidium with wide axis extending 0.6 of length to broad end, 3 axial rings; 3 pleurae curving back on to concave border, no

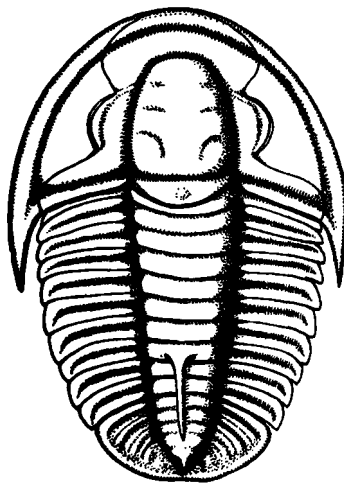


FIG. 207. **Weekesina unispina* (WALCOTT) (*Lonchocephalidae*), *U.Cam.* (*Dresbach.*), Utah; exoskel., $\times 4.5$ (448n).

border furrow (47, 362). *U.Cam.* (*Francon.*), N. Am.—?N.E. Asia.—FIG. 208,1. **D. pernasutus* (WALCOTT), Nev.; 1a,b, cran., $\times 0.75$; 1c, librigena, $\times 0.75$; 1d, pyg., $\times 1.5$ (47, 362).

Sulcocephalus J. L. WILSON, 1948 [**Talbotina candida* RESSER, 1942]. Glabella short, broadly tapering, posterior 2 pairs of lateral furrows deep, diagonal; preglabellar field of medium width to narrow, anterior border furrow well defined, may bend posteriorly at mid-length (*sag.*); eyes slightly behind mid-length of glabella; fixigenae horizontal, with palpebral areas slightly less to slightly more than 0.5 of glabellar width. Librigenae, thorax, and pygidium unknown (363). *U.Cam.* (*Francon.*), N.Am.—FIG. 208,8a,b. **S. candidus* (RESSER), Tex.; 8a,b, cran., $\times 2$ (363).—FIG. 208,8c,d. *S. typicus* (RESSER), Wis.; 8c,d, cran., $\times 2$ (239).

Burnetiella LOCHMAN, 1958 [*nom. subst. pro Burnetia* WALCOTT, 1924 (*non* BROOM, 1923)] [**Ptychoparia? urania* WALCOTT, 1890]. Two pairs of glabellar furrows; preglabellar field narrow or absent, anterior border wide; eyes opposite posterior third of glabella; fixigenae slightly upsloping, with palpebral areas about 0.5 of glabellar width; librigenae quadrate, with slender genal spines. Pygidium narrowly transverse; axis 0.7 of length, with rounded end and postaxial ridge extending to margin, 4 axial rings; pleural fields wider than axis, 4 broad pleurae curving sharply backward on to flat border (48, 363). *U.Cam.* (*Francon.*), N.Am.—FIG. 208,2. **B. urania* (WALCOTT), Tex.; 2a,b, cran., $\times 1$; 2c, librigena, $\times 1$; 2d, pyg., $\times 2$ (363).

Deckera FREDERICKSON, 1949 [**D. aldenensis*]. Glabella short broad, with 2 pairs of lateral fur-

rows; eyes below medium size, opposite posterior third of glabella; fixigenae upsloping, with palpebral areas almost equal in width to glabella; librigenae quadrate, with medium-length genal spines. Pygidium narrowly transverse; axis parallel-sided, extending full length of pygidium, with 6 axial rings; pleural fields wider than axis, with 4 broad pleurae bearing furrows that curve backward on to border; border widest at sides, very narrow on mid-length (*sag.*), posterior margin sinuous (363). *U.Cam.*(*Francon.*), N.Am.-N.Zem.—FIG. 208, 4.

D. completa WILSON, Pa.; 4*a,b*, cran., $\times 2$, $\times 1.5$; 4*c*, librigena, $\times 2$; 4*d,e*, pyg., $\times 4$ (363). **Heterocaryon** RAYMOND, 1937 [*H. platystigma*]. (213). *U.Cam.*(*Trempeal.*), E.N.Am. **Iddingsia** WALCOTT, 1924 [*Ptychoparia? similis* WALCOTT, 1884] [= *Plataspella* WILSON, 1949]. Glabella with 2 or 3 pairs of strong lateral furrows, posterior pair complete or faint; anterior border furrow deep to broad and shallow; occipital node or spine may be present; eye ridges diagonal, eyes opposite posterior third of glabella;

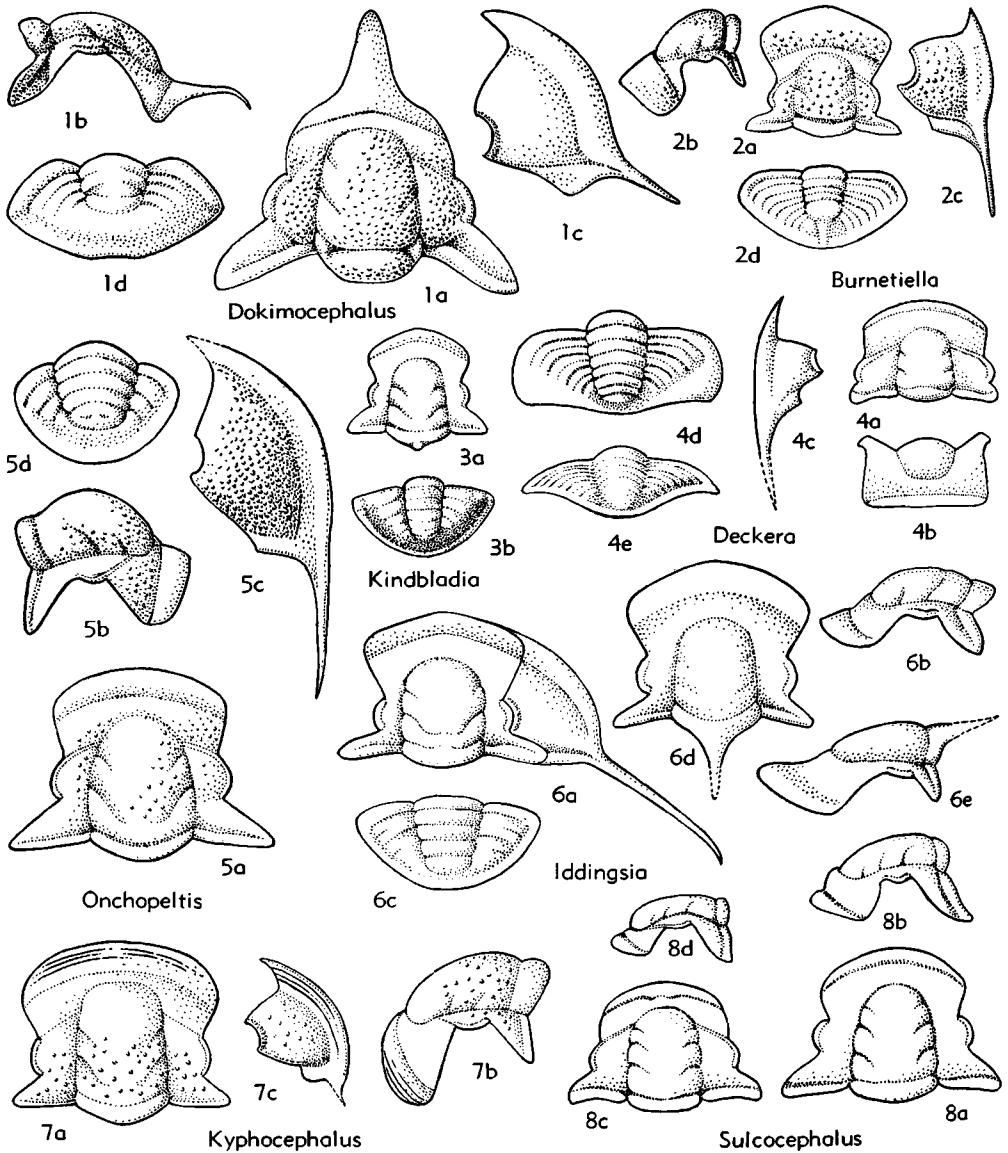


FIG. 208. Dokimocephalidae (p. O281-O283).

fixigenae horizontal, with palpebral areas 0.3 to 0.5 of glabellar width, posterior areas narrow (*sag.*), straplike; librigenae quadrate, with long laterally directed genal spines. Pygidium subovate; axis slightly tapered to rounded end, extending nearly full length of pygidium, 3 axial rings; pleural fields wider than axis, 2 broad pleurae; border slightly concave (362). *U.Cam.(Francon.)*, N.Am.—FIG. 208,6a-c. **I. similis* (WALCOTT), Nev.; 6a,b, cran. (with librigena), 6c, pyg., $\times 1$ (8, 362).—FIG. 208,6d,e. *I. anatina* (RESSER), Okla.; 6d,e, cran., $\times 2$, $\times 1$ (362).

Kindbladia FREDERICKSON, 1948 [**Berkeia wichitaensis* RESSER, 1942]. Glabella tapered, with 3 pairs of lateral furrows, posterior 2 pairs deep; axial and anterior border furrows deep; occipital spine or node present; eyes slightly behind mid-length of glabella; fixigenae upsloping, with palpebral areas about 0.3 of glabellar width; librigenae unknown. Pygidium subovate; axis tapered nearly full length, with 5 or 6 axial rings; pleural fields wider than axis, 5 broad pleurae with faint furrows continuing on to concave border (47, 363). *U.Cam.(Francon.)*, N.Am.—FIG. 208,3. **K. wichitaensis* (RESSER), Okla.; 3a,b, cran., pyg., $\times 2$ (363).

Kyphocephalus B. M. MILLER, 1936 [**K. bridgerensis*]. Glabella elongate, broadly tapering; anterior border heavy; eye ridges present, eyes near posterior third of glabella; fixigenae horizontal, with palpebral areas more than 0.5 of glabellar width; librigenae quadrate, with very short genal spines. Pygidium unknown (363). *U.Cam.(Francon.)*, N. Am.—FIG. 208,7. *K. ponderosus* WILSON, Pa.; 7a,b, cran., $\times 3$; 7c, librigena, $\times 1.3$ (363).

Onchopeltis RASETTI, 1944 [**O. spectabilis*]. Glabella with 2 pairs of lateral furrows, posterior pair deep and arcuate; eye ridges faint, eyes only slightly behind mid-length of glabella; fixigenae horizontal, with palpebral areas about 0.3 of glabellar width; librigenae with medium-length genal spines. Pygidium ovate; axis wide, slightly tapered to rounded end, with 3 axial rings; pleural fields narrower than axis, 2 broad pleurae with furrows sloping backward onto concave border (188). *U. Cam.(Francon.)*, E.N.Am.—FIG. 208,5. **O. spectabilis*, Que.; 5a,b, cran., $\times 1.5$; 5c, librigena, $\times 1$; 5d, pyg., $\times 1.5$ (188).

Tatulaspis IVSHIN, 1956 [**T. princeps*]. Convex, broadly tapering glabella, 2 pairs of arcuate lateral furrows; preglabellar field narrow; faint diagonal eye ridges, eyes posterior to center of glabella; fixigenae slightly upsloping with palpebral areas almost 0.7 of width of glabella, posterior areas long (*tr.*), narrow (*exsag.*). Librigenae and pygidium unknown. Outer surface granulose (82). *U.Cam.*, SW.Sib.

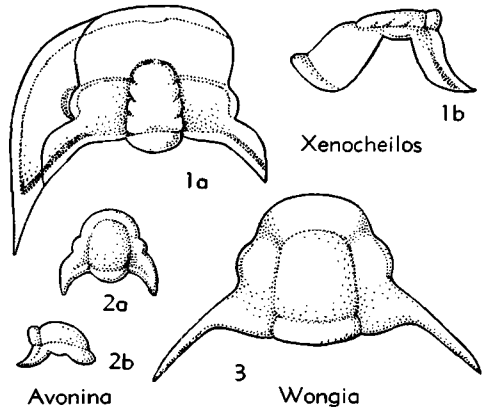


FIG. 209. Avoninidae (p. 0283).

Family AVONINIDAE Lochman, 1936

Exoskeleton opisthoparian. Glabella tapering to parallel-sided, lateral furrows present; preglabellar field and anterior border furrow present or absent; eyes just below medium size, opposite or slightly in front of center of glabella, eye ridges present or absent; fixigenae of variable width, with posterior areas showing variable development of metafixigenal spines, librigenae narrow, elongate, with short genal spines. Thorax and pygidium unknown. Surface finely granulose or smooth. Polyphyletic derivation. *Up.M.Cam.-U.Cam.*

Avonina LOCHMAN, 1936 [**A. bizarria*]. Glabella, strongly convex, gently tapering, front rounded, without lateral furrows, preglabellar field, or anterior border furrow; with narrow convex anterior border; eyes opposite center of glabella, fixigenae downsloping, with palpebral areas 0.3 of glabellar width, posterior areas long (*tr.*), ending in short flat metafixigenal spines; librigenae and pygidium unknown (123). *U.Cam.(Dresbach.)*, Mo.—FIG. 209,2. **A. bizarria*, Mo.; 2a,b, cran., $\times 6$ (123).

Wongia SUN, 1924 [**W. triangulata*]. Glabella convex, truncate-tapering, without lateral furrows or preglabellar field, faint anterior border furrow running diagonally in to front corners of glabella, medium wide anterior border; eyes in front of glabella mid-length; fixigenae slightly upsloping, with palpebral areas more than 0.5 of glabellar width, posterior areas short (*tr.*), with stout diverging metafixigenal spines; librigenae and pygidium unknown (288). *Up.M.Cam.*, E. Asia.—FIG. 209,3. **W. triangulata*, China (Lincheng); cran., $\times 7$ (288).

Xenocheilos J. L. WILSON, 1949 [**X. minutum*]. Glabella low, tapering, with 3 pairs of short

lateral furrows; preglabellar field, anterior border furrow, and eye ridges present, anterior border narrow, eyes opposite center of glabella; fixigenae horizontal to upsloping, with palpebral areas wider than glabella, posterior areas long (*tr.*), ending in flat metafixigenal spines of variable length and prominence; librigenae elongate, with short genal spines. Pygidium unknown (235, 363). *U.Cam.*(*Francon.*), N.Am.—FIG. 209, *I. X. spineum* WILSON, Pa.; *1a,b*, cran. (with librigenae), $\times 6$ (363).

Family CATILLICEPHALIDAE
Raymond, 1938

[=Cephalocoeliidae RAYMOND, 1937; invalid as based on junior homonym]

Small ptychopariids with convex, compact exoskeleton and few thoracic segments. Glabella large, prominent, ovate, subrectangular, or pyriform, reaching anterior margin of cephalon or at least anterior border; posterior lateral furrows invariably curving inward and backward; fixigenae relatively narrow, with palpebral lobes small to medium-sized, usually at level of glabellar mid-point, in some genera located more anteriorly. Doublures of librigenae either separated by a rostral plate (*Catillicephala*) or

joined along a median suture (*Theodenisia*). Genal spines present or absent; in latter case, posterior sections of facial sutures may reach margins at genal angles (*Catillicephala*, *Madarocephalus*). Thorax with prominent axis; pleurae with distinct geniculation, bluntly terminated. Pygidium variable in shape, small to medium-sized, usually with few segments and large axis, exceptionally with bulbous development of pleural regions (*Pemphigaspis*). *U.Cam.* (161, 188, 193, 201, 274, 363).

Catillicephala RAYMOND, 1938 [*pro Cephalocoelia* RAYMOND, 1937 (*non ÉTALLON*, 1859)] [**Cephalocoelia ovoides* RAYMOND, 1937]. Cephalon highly convex; glabella pyriform or shortly ovate, overhanging anterior cephalic margin; glabellar furrows usually obsolete, occipital furrow deep, occipital ring rounded; fixigenae downsloping, eyes small, prominent, at level of glabellar mid-point, posterior sections of facial sutures reaching margins at genal angles, no genal spines. Rostral plate present, hourglass-shaped. Pygidium triangular, with prominent axis, down-rolled margin. *U.Cam.*, (*Dresbach.*), N.Am.—FIG. 210,7. *C. impressa* RASETTI, Que.; *7a-c*, ceph., dorsal, lateral, anterior, $\times 4$; *7d,e*, pyg., dorsal, lateral, $\times 4$ (448n).

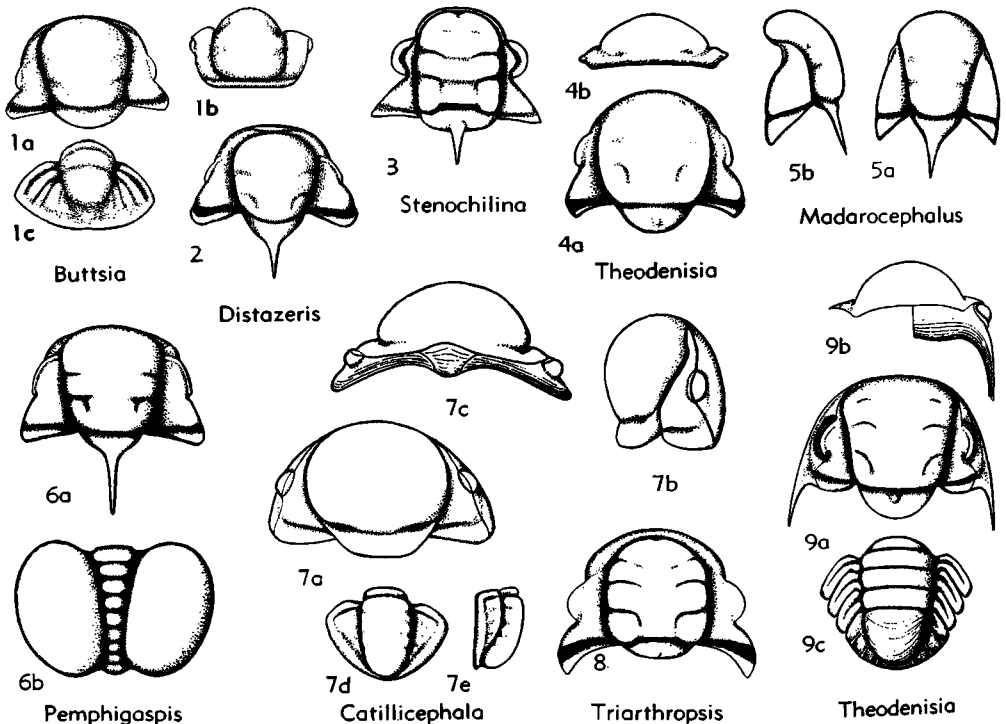


FIG. 210. Catillicephalidae (p. 0284-0285).

Buttsia J. L. WILSON, 1951 [**B. drabensis*]. Differs from *Caillicephalo* in having bandlike border in front of glabella, opisthoparian sutures; pygidium with shorter axis, downslipping pleural lobes, no down-rolled margin. *U.Cam.(Francon.)*, N.Am. —FIG. 210,1. **B. drabensis*, Pa.; 1a,b, cran., dorsal, lateral, $\times 2$; 1c, pyg., $\times 3$ (363).

Distazeris RAYMOND, 1937 [**D. acuta*]. Glabella pyriform, occipital ring spinose; narrow frontal area poorly differentiated into preglabellar field and border or not divided. Closely related to *Welleraspis*, indicating ptychoparian origin of family. *U.Cam.(Dresbach.)*, N.Am. —FIG. 210, 2. **D. acuta*, Vt.; cran., $\times 6$ (448n).

Madarocephalus RESSER, 1938 [**M. laetus*]. Glabella straight-sided, expanded forward, overhanging front margin; occipital ring spinose; position of eyes anterior, close to axial furrows; posterior sections of facial sutures reaching margins at genal angles; no genal spines. *U.Cam.(Dresbach.)*, N. Am. —FIG. 210,5. *M. minor* RASETTI, Que.; 5a,b, cran., dorsal, lateral, $\times 8$ (448n).

Pemphigaspis HALL, 1863 [**P. bullata* (= *Amphion? matutina* HALL, 1863)] [= *Hallaspis* RAASCH & LOCHMAN, 1943]. Glabella expanded forward, occipital ring spinose; frontal area almost or totally obsolete. Pygidium with narrow, multi-segmented axis reaching posterior margin, and swollen, ovate, unfurrowed pleural fields extended into doublet with almost uniform convexity. *U.Cam.(Dresbach.)*, N.Am. —FIG. 210,6. **P. bullata*, Minn.; 6a,b, cran., pyg., $\times 4$ (161).

Stenochilina ULRICH in BRIDGE, 1930 [**S. spinifera*]. Glabella parallel-sided, rounded in front; occipital ring spinose; frontal area reduced to narrow band; fixigenae with relatively large palpebral lobes well defined by palpebral furrows, close to glabella, anterior to glabellar mid-point, posterior sections of facial sutures straight. *U.Cam.(Trempeal.)*, N.Am. —FIG. 210,3. **S. spinifera*, Mo.; cran., $\times 3$ (448n).

Theodenisia CLARK, 1948 [*pro Denisia* CLARK, 1924 (non HÜBNER, 1825)] [**Denisia eminens* CLARK, 1924] [= *Acheilus* RAYMOND, July 1924 (non CLARK, June 1924)]. Glabella pyriform or parallel-sided, reaching anterior cephalic margin; eyes small to medium-sized, rather close to glabella; anterior sections of facial sutures close to axial furrows; posterior areas downslipping, rounded distally; librigenae with genal spines; doublets joining along median suture. Thorax with prominent axis; pleurae strongly geniculated, bluntly terminated. Pygidium small, steeply inclined; axis large, with few segments; pleural fields downslipping. Surface granulose. Size very small. *U. Cam.(Trempeal.)*, N.Am. —FIG. 210,4. **T. eminens*, Que.; 4a,b, cran., dorsal, anterior, $\times 6$ (448n). —FIG. 210,9. *T. lata* (RASETTI), Que. 9a,

ceph.; 9b, cran. and left librigena, anterior view; 9c, pyg. and last 3 thoracic segments; all $\times 6$ (448n).

Triarthropsis ULRICH in BRIDGE, 1930 [**T. nitida*]. Differs from *Theodenisia* in presence of narrow, bandlike frontal area. *U.Cam.(Trempeal.)*, N.Am. —FIG. 210,8. **T. nitida*; cran., $\times 3$ (448n).

Family KINGSTONIIDAE Kobayashi, 1933

[*nom. transl. et correct.* LOCHMAN-BALK, here in (ex Kingstoniac KOBAYASHI, 1933)]

Exoskeleton opisthoparian, subisopygous. Glabella broadly tapering to subquadrate, front rounded, anterior border usually ill defined, all furrows faint or obsolete on exterior, faint on interior, axial, occipital and posterior border furrows most persistent; occipital spine and eye ridges may be present, eyes small, near anterior third of glabella; fixigenae downslipping, with palpebral areas variable, posterior areas triangular; librigenae unfurrowed, with bluntly pointed or rounded genal angles. Thorax unknown. Pygidium subtriangular; axis 0.3 or less of width of pygidium, length variable, exterior furrows obsolete, faint on interior. Surface smooth, with transverse ridges on border. Polyphyletic derivation. *Up.M.Cam.-U.Cam.*

Kingstonia WALCOTT, 1924 [**K. apion*] [= *Ucebia* WALCOTT, 1925]. Glabella low, broadly subquadrate, without lateral furrows, axial furrows obsolete or at posterior only on exterior; occipital and posterior border furrows obsolete on exterior, all present on interior; preglabellar field narrow, continuing slope of glabella, anterior border furrow narrow, anterior border vertical, rim-like; fixigenae with palpebral areas about 0.3 of glabellar width. Pygidium with low axis tapered nearly full length, may continue in spine, axial furrows at sides only, border downcurved to vertical, exterior unfurrowed but interior may show 5 to 7 axial rings; 3 or 4 pleurae; no border furrow (126). *U.Cam.(Dresbach.)*, N.Am.-NE.Asia. —FIG. 211,1. **K. apion*, Tenn.; 1a,b, cran. with librigena, $\times 4$; 1c,d, pyg., $\times 3$, $\times 4$ (126, 321).

Ankoura RESSER, 1938 [**A. triangularis*]. Glabella low, broad, tapering or quadrate, without lateral furrows; narrow preglabellar field downslipping, anterior border furrow obsolete, anterior border downslipping or horizontal, all other furrows obsolete on exterior but present on interior; fixigenae with palpebral areas about 0.5 of glabellar width. Pygidium with low axis tapered nearly full length, end commonly upturned, axial furrows at sides only, 6 or 7 axial rings on interior; pleural fields flat, without furrows on exterior; border vertical

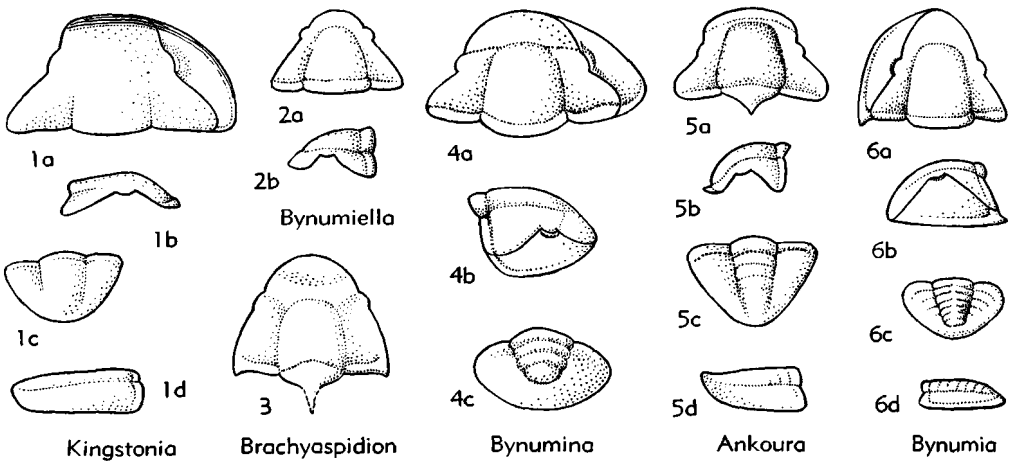


FIG. 211. Kingstoniidae (p. 0285-0286).

(126, 132). *U.Cam.*(*Dresbach.*), N.Am.—FIG. 211,5. **A. triangularis*, Tenn.; 5a,b, cran., $\times 4$; 5c,d, pyg., $\times 4$ (126).

Brachyaspidion B. M. MILLER, 1936 [*pro Brachyaspis* B. M. MILLER, 1936 (*non* SALTER, 1866; *nec* BOULENGER, 1896)] [**Brachyaspis rhynchina* B. M. MILLER, 1936]. Glabella low, short, tapering, front rounded, without lateral furrows; preglabellar field depressed, no anterior border furrow, anterior border broadly convex, axial furrows shallow; occipital spine and narrow arcuate eye ridges present; eyes opposite front of glabella; fixigenae with palpebral areas about 0.5 of glabellar width; librigenae and pygidium unknown (150). *Up.M.Cam.*, N.Am.—FIG. 211,3. **B. rhynchina* (MILLER), Wyo.; cran., $\times 3$ (150).

Bynumia WALCOTT, 1924 [**B. eumus*]. Cranium subtriangular, with low subquadrate glabella, front rounded, lacking lateral furrows; triangular preglabellar field continuing slope of glabella, all furrows obsolete on exterior; axial furrows, occipital furrow, deep posterior border furrows, and very faint anterior border furrow visible on interior; fixigenae with palpebral areas 0.25 of glabellar width. Pygidium flat; axis low, tapered nearly full length, exterior unfurrowed, with 6 to 8 axial rings; 4 to 6 pleurae on interior; no border furrow (132, 239). *U.Cam.*(*Dresbach.*), N.Am.—FIG. 211,6. **B. eumus*, Alba.; 6a,b, cran. with librigena, $\times 2$; 6c,d, pyg., $\times 2$ (132, 239).

Bynumiella RESSER, 1942 [**B. typicalis*]. Cranium subtriangular; glabella tapered to narrow rounded front, no lateral furrows; rounded or pointed preglabellar field, no anterior border furrow, other furrows visible on exterior; eyes near front of glabella; fixigenae with palpebral areas about 0.25 of glabellar width; librigenae and

pygidium unknown (239). *U.Cam.*(*Francon.*), W.N.Am.—FIG. 211,2. **B. typicalis*, Alba.; 2a,b, cran., $\times 4$ (239).

Bynumina RESSER, 1942 [**B. caelata*]. Glabella low, broadly tapering, front nearly straight with 2 pairs of short arcuate lateral furrows on interior; downsloping preglabellar field crossed by faint anterior border furrow on interior, all other furrows visible on exterior; eye ridges narrow; fixigenae with palpebral areas less than 0.5 of glabellar width. Pygidium with convex axis tapered 0.7 of length, axial furrows shallow, with 3 or 4 axial rings on interior; no border furrow (239). *U.Cam.*(*Francon.*), N.Am.—FIG. 211,4. **B. caelata*, Mo.; 4a,b, cran., $\times 4$; 4c, pyg., $\times 6$ (239).

Superfamily ANOMOCARACEA Poulsen, 1927

[*nom. transl.* POULSEN, herein (*ex Anomocaridae* POULSEN, 1927)]

Preglabellar field wide and concave, flat or gently convex; palpebral lobes long and sickle-shaped. Pygidium large, with broad, usually concave border. *M.Cam.-U.Cam.*

Family ANOMOCARIDAE Poulsen, 1927

Characters of superfamily. *M.Cam.-U.Cam.*

Anomocare ANGELIN, 1852 [**A. laeve*]. Preglabellar field concave; fixigenae narrower than in *Anomocaroides* and *Anomocarina*. Pygidium narrower than in *Anomocarina*. *M.Cam.*, NW.Eu.—FIG. 212,1. **A. laeve* ANGELIN, Paradoxides forchhammeri Z., Swed.-Denm.; 1a, cran., $\times 1.2$; 1b, pyg., $\times 2.4$ (51).

[NOTE.—Information furnished by C. J. STUBBLEFIELD indicates that the type species of *Anomocare*, not fixed by ANGELIN (1854), was subsequently designated by VOGDES (1890) as *A. aculeatum* (ANGELIN) (*recte* *Proetus difformis aculeatus* ANGELIN, 1851), which is a species subjectively assigned to *Agraulos* by BRÖGGER, GRÖNWALL, WESTERGÅRD, and other authors. POULSEN (1927), KOBAYASHI (1935), and WESTERGÅRD (1950) have incorrectly construed *A. laeve* as the type species of *Anomocare*, and the genus, chosen as type of the family Anomocaridae, has been interpreted on this basis. Application is being made to ICZN for fixation of *A. laeve* as type species of *Anomocare*.—ED.]

Anomocarina LERMONTOVA, 1940 [**Proetus excavatus* ANGELIN, 1851]. Preglabellar field concave; palpebral lobes extending almost to glabella at front. Pygidium wider than in *Anomocare*. *M. Cam.*, NW.Eu.-Sib.—FIG. 212,4. **A. excavata* (ANGELIN), *Paradoxides forchhammeri* Z., Swed.-Denm.; cran., $\times 1.5$ (51).

Anomocarioides LERMONTOVA, 1940 [**Proetus limbatus* ANGELIN, 1851]. Preglabellar field flat

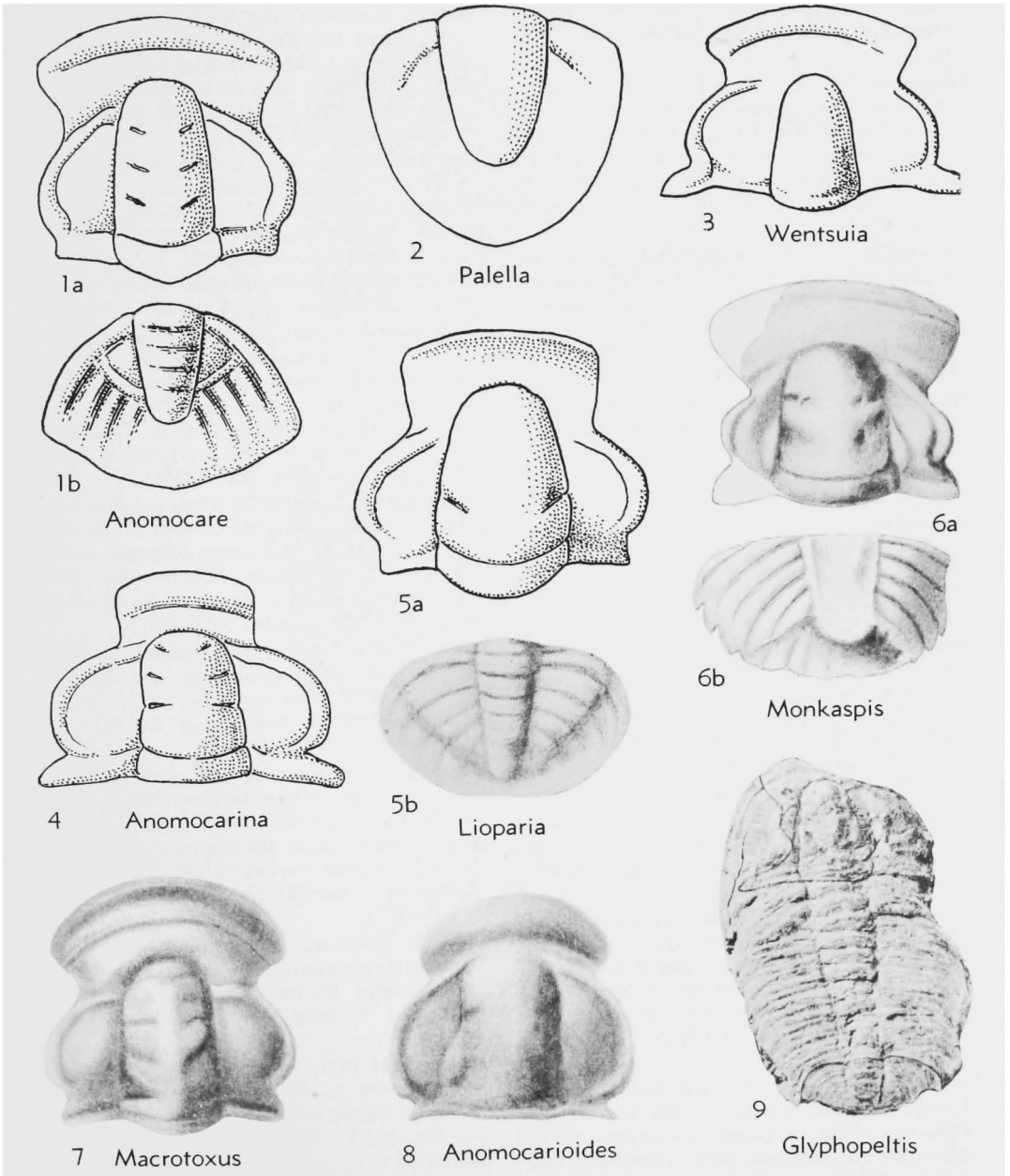


FIG. 212. Anomocaridae (p. 0286-0288).

- or weakly convex; fixigenae bearing small kidney-shaped knobs near glabella. Pygidium semicircular. *M.Cam.*, NW.Eu.—FIG. 212,8. **A. limbatus* (ANGELIN), *Paradoxides forchhammeri* Z., Swed.-Denm.; cran., $\times 1.5$ (51*).
- Eymeokops** KOBAYASHI (*non* RESSER & ENDO), 1935 [**Anomocarella hermius* WALCOTT, 1911]. Preglabellar field relatively short; anterior border strongly developed, convex; glabella quadrate. *M.Cam.*, NE.Asia.—FIG. 213,2. **E. hermius* (WALCOTT), Fu-chóu Ser., Manch.; cran., $\times 5.4$ (313).
- Glyphaspis** POULSEN, 1927 [**Asaphiscus? capella* WALCOTT, 1916]. Preglabellar field concave; palpebral lobes shorter than in *Anomocare*; pleural furrows extending almost to rear edge of broad pygidium. *M.Cam.*, W.N.Am.—FIG. 213,6. **G. capella* (WALCOTT), Wolsey F., Mont.; exoskel., $\times 0.9$ (488*).
- Glyphopeltis** DEISS, 1939 [**G. primus*]. Cranium narrow, with narrow glabella and fixigenae; palpebral lobes shorter than in *Anomocare*. Pygidium smaller than in *Glyphaspis* and bearing spines. *M.Cam.*, W.N.Am.—FIG. 212,9. **G. prima*, Mont.; exoskel., $\times 1.6$ (30*).
- Haniwa** KOBAYASHI, 1933 [**H. sosanensis*]. Like *Eymeokops* but with more quadrate preglabellar field. *U.Cam.*, E.Asia.—FIG. 213,10. **H. sosanensis*, Tsinania Z., Korea; 10a, cran., $\times 4.5$; 10b, pyg., $\times 5.5$ (419).
- Haniwoides** KOBAYASHI, 1935 [**H. longus*]. Cranium narrow; palpebral lobes relatively short and close to glabella. *M.Cam.*, E.Asia.—FIG. 213,8. **H. longus*, Olenoides Z., Korea; cran., $\times 4.2$ (97).
- Inouyella** RESSER & ENDO in ENDO & RESSER, 1937 [**I. peiensis*]. Preglabellar field subtriangular; palpebral lobes rather small. *M.Cam.*, E.Asia.—FIG. 213,4. **I. peiensis*, Taitzu beds, Manch.; 4a,b, cran., pyg., $\times 1.65$ (240). [*Inouyella* KOBAYASHI, 1935, attributed to RESSER & ENDO is *nom nud.*—ED.]
- Kokuria** KOBAYASHI, 1935 [**K. typa*]. Preglabellar field rather narrow, and small. *U.Cam.*, E.Asia.—FIG. 213,3. **K. typa*, Kaolishania Z., Korea; cran., $\times 4.3$ (97).
- Koptura** KOBAYASHI (*non* RESSER & ENDO), 1935 [**Anomocare lisani* WALCOTT, 1911]. Like *Anomocarioides* but with longer (*sag.*) preglabellar field and narrow bifid pygidium. *M.Cam.*, E.Asia.—FIG. 213,5. **K. lisani* (WALCOTT), Fu-chóu Ser., Manch.; 5a, cran., $\times 1.5$; 5b, pyg., $\times 3.3$ (313).
- Lioparia** LORENZ, 1906 [**Anomocare latelimbatum* DAMES, 1883; SD KOBAYASHI, 1935 [= *Lorentzia* COSSMANN, 1908; *Yokusenja* KOBAYASHI, 1935]. Like *Anomocare* but with longer preglabellar field (*sag.*) and shorter palpebral lobes. *M.Cam.*, E.Asia.—FIG. 212,5. **L. latelimbata* (DAMES), Fu-chóu Ser., Manch.; 5a, cran., $\times 1.9$; 5b, pyg., $\times 1.6$ (315).
- Macrotoxus** LORENZ, 1906 [**Anomocare angelini* GRÖNWALL, 1902; SD WESTERGÅRD, 1950]. Like *Anomocare* but with wider preglabellar field and fixigenae, deeper dorsal furrow on cranium, and shagreened surface. *M.Cam.*, NW.Eu.—FIG. 212,7. **M. angelini* (GRÖNWALL), *Paradoxides davidis* Z., Denm.; cran., $\times 3$ (51*).
- Mapania** KOBAYASHI (*non* RESSER & ENDO), 1935 [**M. striata*]. Like *Eymeokops* but preglabellar field narrower (*sag.*), glabella tapering instead of quadrate, and palpebral lobes not so large. *M.Cam.*, E.Asia.—FIG. 213,1. **M. striata*, Mapan beds, Manch.; cran., $\times 1.5$ (240).
- Metanomocare** LERMONTOVA, 1940 [**Metanomocare petaloides*]. Like *Macrotoxus* but with longer preglabellar area, more tapering glabella, and narrower fixigenae; pygidium large and wide, like that of *Anomocarioides*. *M.Cam.*, N.Asia.—FIG. 213,12. **M. petaloides*, *Paradoxides forchhammeri* Z., Sib.; 12a,b, cran., pyg., $\times 1$ (423).
- Monkaspis** KOBAYASHI, 1935 [**Anomocare daulis* WALCOTT, 1913]. Cranium like that of *Macrotoxus* but with shorter palpebral lobes; pygidium with interpleural furrows almost reaching edge and with marginal spines. *M.Cam.*, E.Asia.—FIG. 212,6. **M. daulis* (WALCOTT), Ch'ang-hia F., China; 6a,b, cran., pyg., $\times 2.5$ (315*).
- Monocheilus** RESSER, 1927 [**Conocephalites anatinus* HALL, 1863]. Preglabellar field rather short, narrow; palpebral lobes short; librigenae bearing long curved spine. *U.Cam.*, N.Am.—FIG. 213,7. **M. anatinus* (HALL), Franconia F., Wis.; 7a, cran., $\times 1.4$; 7b, librigena, $\times 1.6$ (403).
- Palella** HOWELL, 1937 [**P. paradoxa*]. Pygidium very narrow, subtriangular; cranium unknown. *M.Cam.*, USA (Vt.-Utah).—FIG. 212,2. **P. paradoxa*, *Centroleura vermontensis* Z., Vt.; pyg., $\times 7$ (72).
- Paracoosia** KOBAYASHI, 1936 [**P. mansuyi* KOBAYASHI, 1936 (*pro asiatica* MANSUY, 1916, preoccupied)]. Preglabellar field long and wide, palpebral lobes relatively short, interpleural furrows short. *M.Cam.*, SE.Asia.—FIG. 213,9. **P. mansuyi* KOBAYASHI, Annamitia Z., Indochina; exoskel., $\times 1.3$ (142*).
- Saimachia** KOBAYASHI, 1937 [**S. damesi*]. Cranium small, with convex border and bluntly truncated glabella. *M.Cam.*, E.Asia.—FIG. 213,11. **S. damesi*, Kiu-lung Group, China; cran., $\times 8.3$ (419).
- Wentsuia** SUN, 1935 [**W. granulosa*]. Like *Anomocare* but with shorter glabella, no glabellar furrows, and thicker palpebral lobes. *U.Cam.*, E.Asia.—FIG. 212,3. **W. granulosa*, Tawenkou beds, China; cran., $\times 3.6$ (289).
- Anomocariopsis** SIVOV, 1955 [**A. salairensis*]. *Low. U.Cam.*, Salair, USSR. [Author's assignment.]

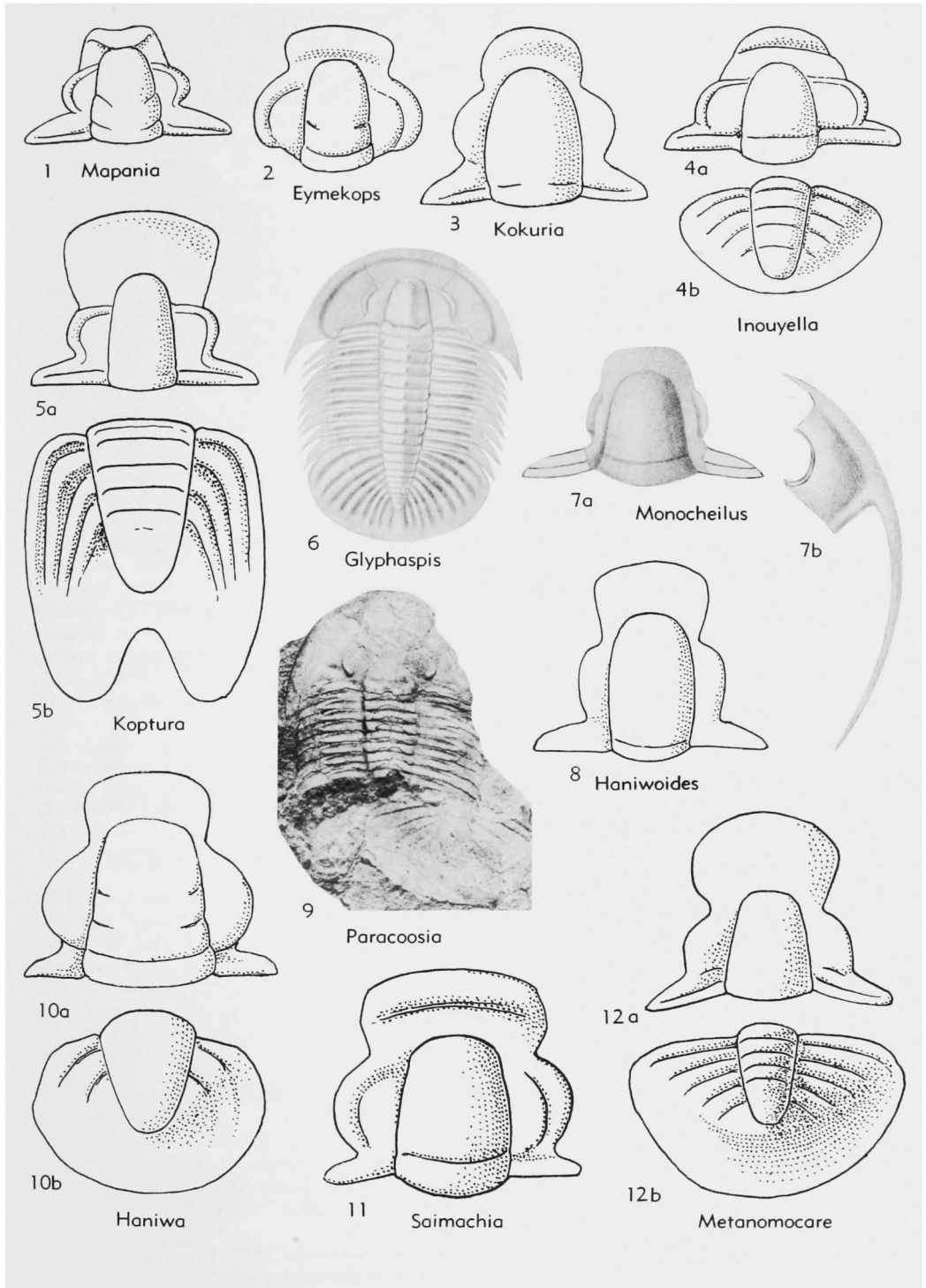


FIG. 213. Anomocaridae (p. 0288).

- Catuniella JEGOROVA, 1956 [**C. digna*]. *Up.M.Cam.*, USSR. [Author's assignment.]
- Chondranomocare POLETAEVA, 1956 [**C. bidjensis*]. *Low.M.Cam.*, USSR. [Author's assignment.]
- †Glyphaspellus IVSHIN, 1953 [**G. primus*]. *M.Cam.*, Kazakhstan. [Author's assignment.]
- G. (Glyphaspellus).
- G. (Glyphanellus) IVSHIN, 1953 [**G. (G.) margaritus*].
- Pseudanomocarina CHERNYSHEVA, 1956 [**P. plana*]. *M.Cam.*, USSR. [Author's assignment.]

Superfamily ASAPHISCACEA Raymond, 1924

[*nom. transl.* HOWELL, herein (*ex* Asaphiscidae RAYMOND, 1924) [=Asaphiscoidae HUPÉ, 1953]

Exoskeleton opisthoparian, elliptical to ovate in outline, isopygous. Cephalon with genal angles rounded or produced into spines; glabella tapering forward, with front rounded; preglabellar field and anterior border present. Thorax with 7 to 11 segments. Pygidium semicircular to subtriangular, with tapered axis; pleural fields equal in width to axis or slightly wider; border variable in width. Surface smooth. *M.Cam.-U.Cam.*

Family ASAPHISCIDAE Raymond, 1924

Characters of superfamily. *M.Cam.-U.Cam.*

Subfamily ASAPHISCINAE Raymond, 1924

[*nom. transl.* HOWELL, herein (*ex* Asaphiscidae RAYMOND, 1924)]

Cephalon with lateral and axial furrows distinct; glabella with 3 pairs of furrows well defined to obsolete; preglabellar field wide to quite narrow (*sag.*); fixigenae bearing narrow but distinct eye ridges, eyes median in size or larger, located opposite or slightly behind center of glabella, palpebral areas 0.3 to 0.5 of glabellar width, posterior areas triangular; librigenae medium in width (*tr.*), with medium-length genal spines or rounded genal angles. Thorax with 7 to 11 segments. Pygidium semicircular, with 5 to 8 segments; border of medium width or narrow. *M.Cam.-U.Cam.*

Asaphiscus MEEK, 1873 [**A. wheeleri*] [=Eteraspis RESSER, 1935]. Preglabellar field wide (*sag.*), palpebral lobes small. Thorax with 7 to 11 segments. Pygidium large, with wide flat border. *M.Cam.*, W.USA.—FIG. 214,1. **A. wheeleri*, Wheeler F., Utah; exoskel., $\times 0.6$ (488*).

Anomocarella WALCOTT, 1905 [**A. chinensis*] [=Psilaspis RESSER & ENDO in KOBAYASHI, 1935]. Glabellar furrows lacking, border flat and narrow.

M.Cam., E.Asia.—FIG. 215,1. **A. chinensis*, Chang Hsia F., China; *1a,b*, cran., pyg., $\times 2.6$ (488*).

Blainia WALCOTT, 1916 [**Asaphiscus (Blainia) gregarius*]. Like *Asaphiscus* but glabella less tapering; thoracic segments 9; pygidium with interpleural furrows extending to margin. *M.Cam.*, SE. USA.—FIG. 214,2. **B. gregaria* (WALCOTT), Conasauga F., Ala.; exoskel., $\times 1.2$ (488*).

Blainiopsis POULSEN, 1947 [**B. holtedahli*]. Like *Blainia* but with shorter preglabellar field (*sag.*) and flat border. *M.Cam.*, Arct.—FIG. 214,3. **B. holtedahli*, Cape Wood F., Ellesmere I.; *3a*, cran., $\times 4.3$; *3b*, pyg., $\times 3.3$ (445*).

Dolgaia WALCOTT & RESSER, 1925 [**D. megalops*]. Like *Blainia* but preglabellar field smaller, glabella larger, and palpebral lobes longer. *U.Cam.*, NE. Eu.—FIG. 215,2. **D. megalops*, N.Zem.; cran., $\times 2.7$ (322*).

Dunderbergella HOWELL, 1945 [**D. typicalis*]. Preglabellar field large, anterior border narrow; glabella short, without furrows. *U.Cam.*, E.USA.—FIG. 214,4. **D. typicalis*, Up.Kittatinny F., N.J.; $\times 3$ (410*).

Grandioculus COSSMAN, 1908 [*pro Megalophthalmus* LORENZ, 1906 (*non* LEACH, 1830; *nec* GRAY, 1832)] [**Liostracus megalurus* DAMES, 1883; SD KOBAYASHI, 1935]. Preglabellar field large; glabella nearly parallel-sided, with 3 pairs of furrows; palpebral lobes long. Pygidium with long tapering narrow axis. *M.Cam.*, E.Asia.—FIG. 214,5. **G. megalurus* (DAMES), China; *5a*, cran., $\times 2.7$; *5b*, pyg., $\times 2.25$ (393*).

Hundwarella REED, 1934 [**H. personata*]. Preglabellar field wide (*sag.*); anterior border strongly developed; palpebral lobes wide and long; glabella with 3 pairs of furrows, outer ends of rear pair directed anteriorly. *M.Cam.*, E.Asia.—FIG. 214,6. **H. personata*, Slate Ser., Kashmir; cran., $\times 3.8$ (452*).

Iranoleesia KING, 1955 [*pro Irania* KING, 1937 (*non* DE FILIPPI, 1863)] [**Irania pisiformis* KING, 1937]. Cranium like that of *Hundwarella* but palpebral lobes narrower and with inner ends of halves of interrupted rear pair of glabellar furrows bifurcate, lower branch being directed posteriorly. Pygidium with wide flat border. *U.Cam.*, S.Asia.—FIG. 214,7. **I. pisiformis* (KING), India; cran., $\times 4$ (418*).

Kaninia WALCOTT & RESSER, 1925 [**K. lata*]. Like *Anomocarella* but with shorter preglabellar field (*sag.*), flatter anterior border, wider fixigenae, and shallower interpleural furrows and more definite flattened border on pygidium. *U.Cam.*, N. Zem.—FIG. 215,3. **K. lata*; *3a,b*, cran., pyg., $\times 1.4$ (488*).

Kaniniella KOBAYASHI, 1938 [**K. concinna*]. Cranium as in *Kaninia* but with very narrow fixigenae and shorter palpebral lobes. *U.Cam.*, W.Can. (B.C.).—FIG. 215,4. **K. concinna*, Plethopeltis Z.; cran., $\times 4.3$ (419*).

Lioparella KOBAYASHI, 1937 [**L. walcoti*]. Preglabellar field long and wide; eye ridges strongly developed. *M.Cam.*, E.Asia.—FIG. 215,5. **L. walcoti* KOBAYASHI, Kiu-lung F., China (Shantung); cran., $\times 1.3$ (488*).

Manchuriella KOBAYASHI (*non* RESSER & ENDO *in* Koba.) 1935 [**M. typha*]. Preglabellar field small, axial and glabellar furrows shallow; palpebral lobes short. Pygidium with narrow border. *M.Cam.*, E. Asia.—FIG. 214,8. **M. typha*, Mapan F.,

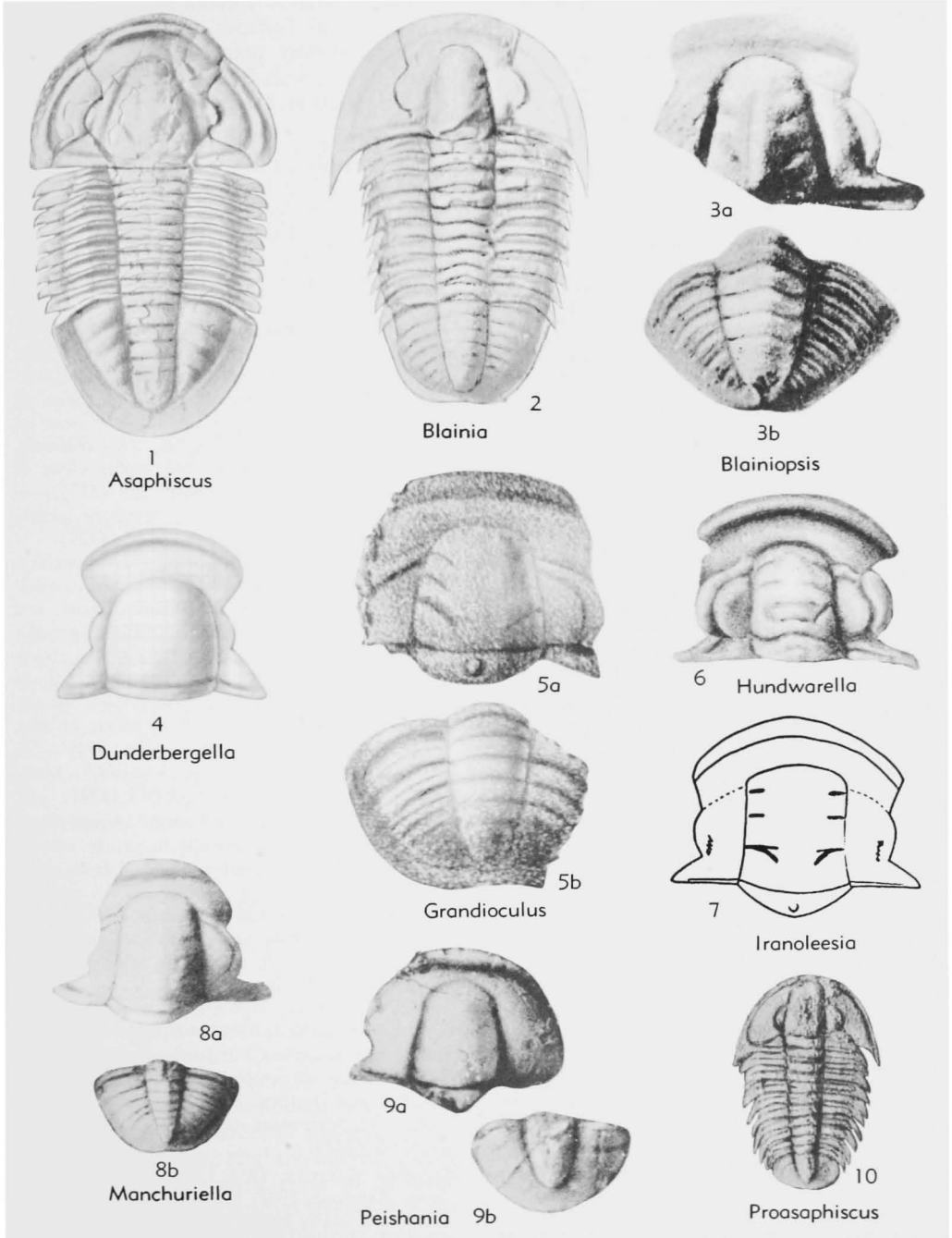


FIG. 214. Asaphiscidae (Asaphiscinae) (p. O290-O292).

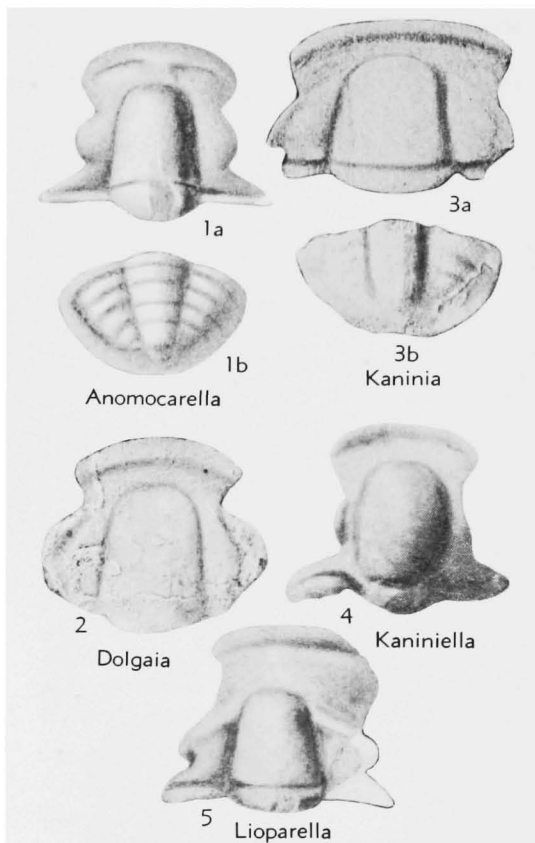


FIG. 215. Asaphiscidae (Asaphiscinae) (p. O290-O291).

Manch.; 8a, cran., $\times 2.3$; 8b, pyg., $\times 1.5$ (37*).

Paraorlovina TCHERNYSHEVA, 1956 [**P. sequens*]. *Up.M.Cam.*, USSR. [Author's assignment.]

Peishania RESSER & ENDO, in ENDO & RESSER, 1937 [**P. convexa*]. Cranidium minutely punctate, convex; preglabellar field short (*sag.*); anterior border slightly convex, anterior border furrow shallow; without distinct glabellar furrows. Thorax with shallow interpleural furrows on segments. *M.Cam.*, E.Asia.—FIG. 214,9. **P. convexa*, Taitzu F., Manch.; cran., pyg., $\times 4.5$ (37*). [*Peishania* KOBAYASHI, 1935, attributed to RESSER & ENDO, is *nom. nud.*—Ed.]

Proasaphiscus KOBAYASHI (*non* RESSER & ENDO in Koba.) 1935 [**P. yabei*]. Cranidium as in *Asaphiscus* but pygidium smaller and with almost no border, interpleural furrows curving more toward rear. *M.Cam.*, E.Asia.—FIG. 214,10. **P. yabei*, Tangshih F., Manch., exoskel., $\times 1.5$ (37*).

Subfamily BLOUNTIINAE Lochman, 1944

[*nom. correct. & transl.* HOWELL, herein (*ex* Blountidae LOCHMAN, 1944)]

Cephalon with exterior furrows well defined to shallow or obsolete, interior furrows

all better marked; eyes small, anterior to center of glabella; fixigenae downsloping, with palpebral areas about 0.3 of glabellar width, posterior areas broadly triangular; librigenae narrow, with short genal spines or rounded angles. Thorax with 7 to 9 segments, pleural furrows narrow, extending nearly to bluntly pointed ends. Pygidium subtriangular, with 5 to 10 segments, border relatively narrow. *U.Cam.*

Blountia WALCOTT, 1916 [**B. mimula*] [= *Stenocombus* RAYMOND, 1937]. Glabella tapering, front rounded, axial and border furrows present. Pygidium moderately convex, axis tapered, furrows faint to obsolete, border distinct, narrow. *U.Cam.* (*Dresbach.*), N.Am.

B. (Blountia). Glabella broad or with subparallel sides, front widely rounded, lateral furrows very faint, axial and border furrows well defined; librigenae with short genal spines. Pygidium with axis sharply tapered to narrow end, 0.75 to 0.83 length of pygidium, with 8 to 11 axial rings, all furrows present but faint on exterior, clear on interior.—FIG. 216,3a,b. **B. (B.) mimula*, Tenn.; exoskeleton, dorsal and profile views of holotype (immature specimen), $\times 8$ (317).—FIG. 216,3c. *B. sp.*, Tenn.; specimen clearly showing 9 thoracic segments, $\times 8.5$ (425).

B. (Homodictya) RAYMOND, 1937 [**H. imitatrix*]. Glabella with sides converging to narrow, rounded front, without lateral furrows, axial and occipital furrows narrow, but distinct, anterior border furrow obsolete on exterior, faint on interior. Pygidium with axis extending 0.7 of length, all except axial furrow obsolete on exterior, faint on interior, border widest at rear. *M.Cam.* (*Dresbach.*), N.Am.—FIG. 216,2. **B. (H.) imitatrix* (RAYMOND), Vt.; 2a,b, cran., dorsal and profile; 2c, pyg.; all $\times 3$ (193).

Blountiella RESSER, 1938 [**Blountia? alemon* WALCOTT, 1916]. Glabella broadly tapering, convex, sides only slightly tapered to rounded front, axial furrow distinct, lateral furrows faint, occipital and border furrows narrow and faint or obsolete on exterior; anterior border vertical, smooth or striate; librigenae with rounded genal angle. Pygidium short and wide, profile low, with vertical border, axis tapered, with 6 or 7 axial rings; pleurae 5 or 6, only axial furrow on exterior, other furrows faint on interior but border furrow obsolete (132). *U.Cam.* (*Dresbach.*), N.Am.—FIG. 216,4. *B. cordillera* DUNCAN, Mont.; 4a,b, cran., dorsal, profile; 4c, librigenae; 4d,e, pyg., dorsal, profile; all $\times 4.5$ (132).

Maryvillia WALCOTT, 1916 [**M. arion*] [= *Protillaenus* RAYMOND, 1937; *Blountina* LOCHMAN, 1944; *Blountiana* SHAW, 1952]. Glabella broad, low, sides nearly parallel, front broadly rounded, all furrows except occipital and posterior border obsolete on

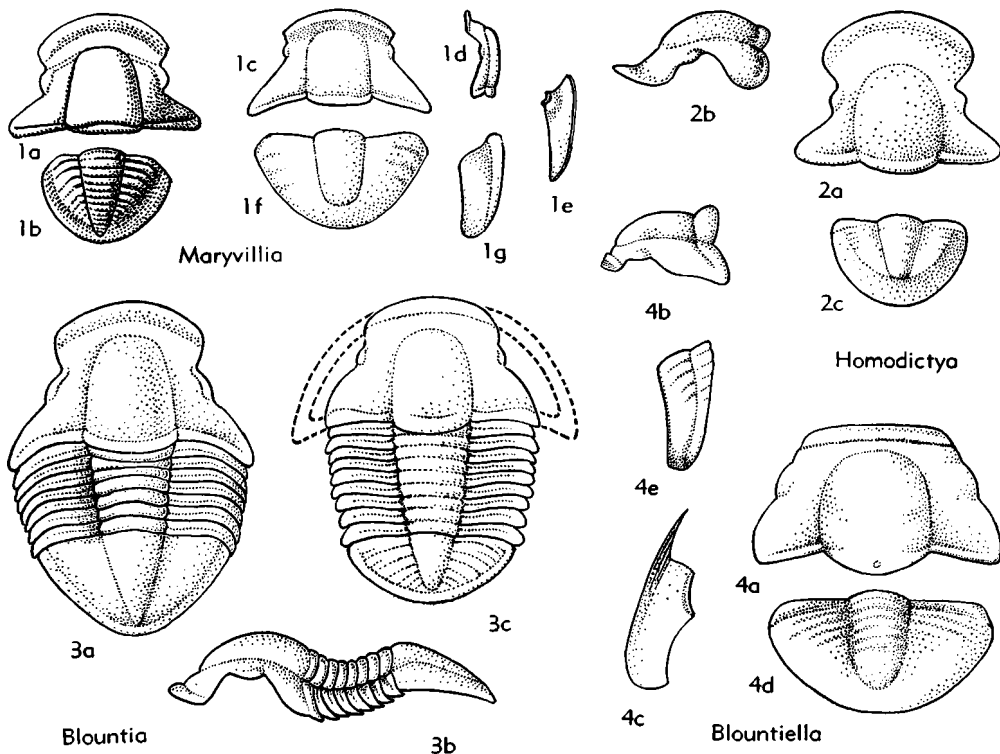


FIG. 216. Asaphiscidae (Blountiinae) (p. O292).

exterior, anterior border furrow also obsolete on interior, others faint; librigenae with short blunt genal spine. Pygidium convex, with nearly vertical border; long tapered axis may extend beyond border furrow, with 7 to 12 axial rings, only faint axial furrow on exterior, all furrows present on interior. (448). *U.Cam. (Dresbach.)*, N.Am.—FIG. 216, 1a, b. **M. arion*, Tenn.; 1a, b, cran., pyg., $\times 4$ (488).—FIG. 216, 1c-g. *M. eleanora* (LOCHMAN), Mont.; 1c, d, cran., dorsal, profile; 1e, librigena; 1f, g, pyg., dorsal, profile; all $\times 4$ (425).

Superfamily BURLINGIACEA Walcott, 1908

[*nom. transl.* POULSEN, herein (*ex Burlingiidae* WALCOTT, 1908)] [=Burlingiidea RICHTER, 1933; Burlingioidae RASETTI, 1951; Burlingioidae HUPÉ, 1953]

Exoskeleton proparian, ovate, very gently convex, heteropygous. Cephalon semicircular in outline, without border; glabella subcylindrical, anteriorly rounded; preglabellar field long, posterior areas of fixigenae wide, laterally expanding; slightly curved palpebral lobes situated very close to glabella, fairly short; anterior and posterior sections of facial sutures almost rectilinear, both extending obliquely backward from cephalic

margins to eyes; librigenae subtrapezoidal. Thorax of 7 to 15 segments; pleural regions wide; flat, truncate pleurae with acute posterior terminations and direct, very wide and shallow pleural furrows. Pygidium greatly varying in size and structure. Character of cephalic doublure, ventral sutures, and hypostoma unknown. *M.Cam.-U.Cam.*

Family BURLINGIIDAE Walcott, 1908

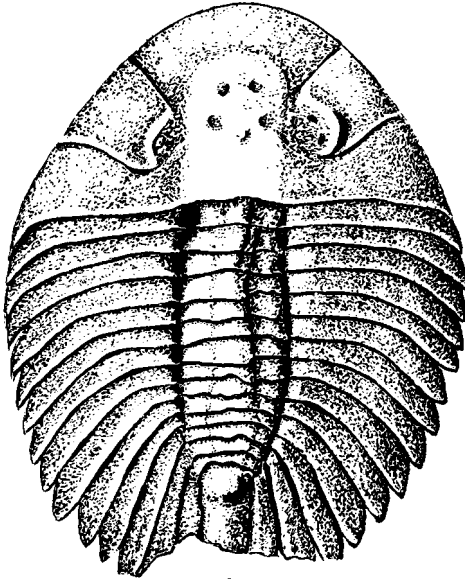
[*nom. correct.* RICHTER, 1933 (*pro Burlingiidae* WALCOTT, 1908)]

Characters of superfamily. *M.Cam.-U.Cam.*

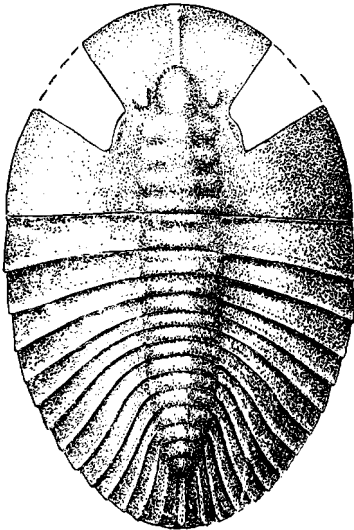
Burlingia WALCOTT, 1908 [**B. hectori*]. Cephalon about 0.3 total length of exoskeleton; occipital furrow and ring indiscernible; glabellar furrows lacking or represented by 2 pairs of pits on anterior half of glabella. Thorax of 14 or 15 segments; posterior half of axis tapering; pleurae strongly curved. Pygidium small, elongate, without defined segments (311, 336). *M.Cam.*, N.Am.-Eu.—FIG. 217, 1. **B. hectori*, W.Can.(B.C.); exoskel., $\times 7.5$ (311).

Schmalenseeia Moberg, 1903 [**S. amphionura*]. Differs from *Burlingia* in its longer cephalon, well-defined occipital furrow and ring, 3 pairs of

strongly impressed lateral furrows, thorax of 7 or 8 segments, almost rectilinear pleurae, evenly tapering axis, and fairly large, wide pygidium of about 7 segments, segmentation being similar to that of thorax (331, 336). *M.Cam.-U.Cam.*, Swed. —FIG. 217,2. **S. amphionura*, U.Cam., Swed.; exoskel. without librigenae, $\times 24$ (331).



1
Burlingia



2
Schmolenseeia

FIG. 217. Burlingiidae (p. O293).

Superfamily KOMASPIDACEA Kobayashi, 1935

[*nom. transl.* HENNINGSMOEN, herein (*ex* Komaspidae KOBAYASHI, 1935)] [=Telephidaceae STUBBLEFIELD, 1950; Telephoideae HUPÉ, 1953] [Superfamily name based on *Telephus* BARRANDE, 1852 (*non* GISTEL, 1848) is not permissible.]

Exoskeleton opisthoparian, small, ellipsoidal. Glabella short, tapering to broadly quadrate, anterior lobe expanding slightly in some, with 3 pairs of lateral furrows, posterior pair commonly transglabellar, all 3 pairs becoming obsolete in late genera; preglabellar field narrow or absent, anterior border furrow tending to become obsolete; palpebral lobes prominent, arcuate, eyes medium-sized in early genera, becoming very large in later genera; librigenae bearing short to medium-sized stout genal spines. Thorax with 9 or fewer segments. Pygidium micropygous, narrowly transverse to triangular, with prominent convex axis extending nearly full length, border narrow, border furrow narrow. Surface finely to coarsely granulate. *M.Cam.-U.Ord.*

Early members are rather generalized ptychopariid in appearance, but showing trends towards the characteristic telephinid appearance, with very large eyes, diminutive posterior parts of fixigenae, and lack of both preglabellar field and anterior border furrow; eyes may be small (Glaphuridae) but forms so distinguished agree with some telephinids in having longitudinal lateral glabellar furrows.

Family KOMASPIDIDAE Kobayashi, 1935

[*nom. correct.* HENNINGSMOEN, 1951 (*pro* Komaspidae KOBAYASHI, 1935)]

Exoskeleton opisthoparian, isopygous. Glabella broadly tapering to quadrate, with sides slightly converging forward, parallel, or (in late genera) diverging forward to rounded front, with 2 or 3 pairs of lateral furrows that become obsolete in late genera; preglabellar field narrow or absent; palpebral lobes and eyes large, extending more than half of full length of glabella, arcuate or broad, palpebral furrows deep; fixigenae horizontal or downsloping, posterior areas short (*tr.*); librigenae with eye platforms narrow or absent, genal spines short or long and recurved. Thorax with wide convex axis, number of segments unknown; pleurae narrower than axis, blunt-ended, with small spines. Pygidium

short, transverse, with convex axis wider than pleural fields, extending nearly full length of pygidium, tapering moderately to rounded end; median spine and nodes may be present; furrows well defined, border narrow. Surface smooth or granulose. Derived from Ptychopariidae. *Up.M.Cam.-L. Ord.*

Komaspis KOBAYASHI, 1935 [**K. typa*]. Glabella convex, tapering, with 3 pairs of well-defined lateral furrows, posterior pair complete; preglabellar field narrow, anterior border furrow faint, anterior border narrow, rimlike; eyes about 0.6 of glabellar length, slightly in front of center of glabella; fixigenae downsloping, with palpebral areas slightly less than 0.5 of glabellar width (97). *M.Cam.(Taitzuan)*, NE.Asia.—FIG. 218,1. **K. typa*, S.Korea; 1*a,b*, cran., dorsal, profile, $\times 2$ (97).

Benthampsis POULSEN, 1947 [**B. problematica*]. Glabella convex, broadly subquadrate, with sides parallel nearly to front and then diverging slightly, without lateral furrows; anterior border furrow faint or obsolete, no preglabellar field, anterior border rimlike; occipital furrow probably obsolete; eyes more than 0.5 of glabellar length, slightly behind center of glabella; fixigenae downsloping, with palpebral areas about 0.5 of glabellar width. Pygidium with low broad axis, tapering rapidly to narrow end, 0.7 of length of pygidium; axial furrows very shallow, all other furrows obsolete; 3 or 4 axial rings and interpleural grooves on inner surface. Outer surface unknown (175). *Up. L.Ord.*, W.Arct.N.Am.—FIG. 218,6. **B. problematica*, Ellesmere I.; 6*a-c*, cran., dorsal, front, profile, $\times 3$ (175).

Carolinites KOBAYASHI, 1940 [**C. bulbosa*] [= *Dimastoccephalus* STUBBLEFIELD, 1950; *Keidelia* HARRINGTON & LEANZA, 1957]. Glabella convex, subquadrate, expanding to slightly bulbous front, without lateral furrows; axial furrows deep, with posterior sinuous inbend; no preglabellar field, anterior border furrow merging with preglabellar furrow; eyes extending nearly full length of glabella; fixigenae horizontal or downsloping, with node at each inner posterior corner; palpebral areas about 0.6 of glabellar width; librigenae without eye platforms, border furrow narrow, librigenal spines long, recurved. Pygidium with wide axis, slightly tapered to broad end, axial segments 3 or 4, terminal merging into steep posterior slope, each ring with low axial node or spine, terminal axial spine may be present; pleurae 3 or 4, broad, faintly defined, with node or short spine where curvature steepens, border furrow shallow, border rimlike (258). *Up.L.Ord.*, N.Am.-Arg.-Ire.-Austral.-Tasm.—FIG. 218,7. *C. gena-*

cinaca Ross, Utah; 7*a-c*, cran., dorsal, front, profile, $\times 10$; 7*d*, librigena, $\times 6$; 7*e-g*, pyg., dorsal, back, profile, $\times 10$ (258).

Dartonasps B. M. MILLER, 1936 [**D. knightii*] [= *Schmidiaspis* KOBAYASHI, 1944]. Glabella broadly quadrate, sides parallel to rounded front or diverging slightly to expanded front, with 2 or 3 pairs of lateral furrows, faint exteriorly, posterior pair strong interiorly, may meet at mid-length; no preglabellar field, anterior border furrow faint or obsolete, anterior border a narrow rectangle in front of glabella; eyes extending nearly full length of glabella; fixigenae downsloping, with palpebral areas about 0.3 of glabellar width; librigenae with narrow eye platforms and short to medium diverging genal spines. Pygidium with wide axis, tapered throughout to broad end, with 3 or 4 axial rings; 3 broad pleurae; narrow border furrow and border (150, 239). *U.Cam.(Francon.)*, N.Am.-Arct.Asia.—FIG. 218,4. **D. knightii*, Wyo.; 4*a-c*, cran. (with librigena), dorsal, profile, front, $\times 2$; 4*d-f*, pyg., dorsal, profile, back, $\times 2$ (150, 239).

Goniophrys Ross, 1951 [**G. prima*]. Glabella convex, tapering, no lateral furrows; preglabellar field narrow or absent, anterior border furrow distinct; eyes large, strongly bowed, with point of flexure anterior to center of glabella; fixigenae downsloping, with palpebral areas 0.7 of glabellar width; librigenae with very narrow eye platforms and long curved genal spines. Thorax with wide convex axis; pleurae low, 0.5 of width of axis. Pygidium with wide axis, tapered nearly full length to narrow end, 3 axial rings; 3 broad faint pleurae, faint border furrow, rimlike border (258). *L.Ord.*, W.N.Am.—FIG. 218,5. **G. prima*, Utah; 5*a-c*, cran. (with librigena), dorsal, front, profile, $\times 6$; 5*d-f*, pyg., dorsal, back, profile, $\times 6$ (258).

Irvingella ULRICH & RESSER in WALCOTT, 1924 [**I. major*] [= *Irvingellina*, *Parairvingella* KOBAYASHI, 1938]. Glabella convex, subquadrate, tapering, with 2 or 3 pairs of lateral furrows, posterior pair complete; preglabellar field narrow or absent, anterior border furrow faint or obsolete; eyes large, bowed, with point of flexure near center of glabella; fixigenae downsloping, with palpebral areas 0.5 or more of glabellar width; librigenae with eye platforms narrow anteriorly, wider posteriorly, genal spines of medium size. Pygidium subrectangular, with axis tapered nearly full length to rounded end, 2 axial rings and terminal; no pleurae, faint border furrow, rimlike border, commonly sinuous (48, 239, 335). *U.Cam.(Francon.)*, N.Am.-S.Am.-W.Eu.-Arct.Asia-E.Asia-C.Asia.—FIG. 218,2. **I. major*, Wis.; 2*a,b*, cran. (with librigena), dorsal, profile, $\times 1$; 2*c,d*, pyg., dorsal, profile, $\times 3$ (48, 363).

Irvingelloides KOBAYASHI, 1935 [**Irvingella?* *orientalis* KOBAYASHI, 1934]. *L.Ord.*, Korea.

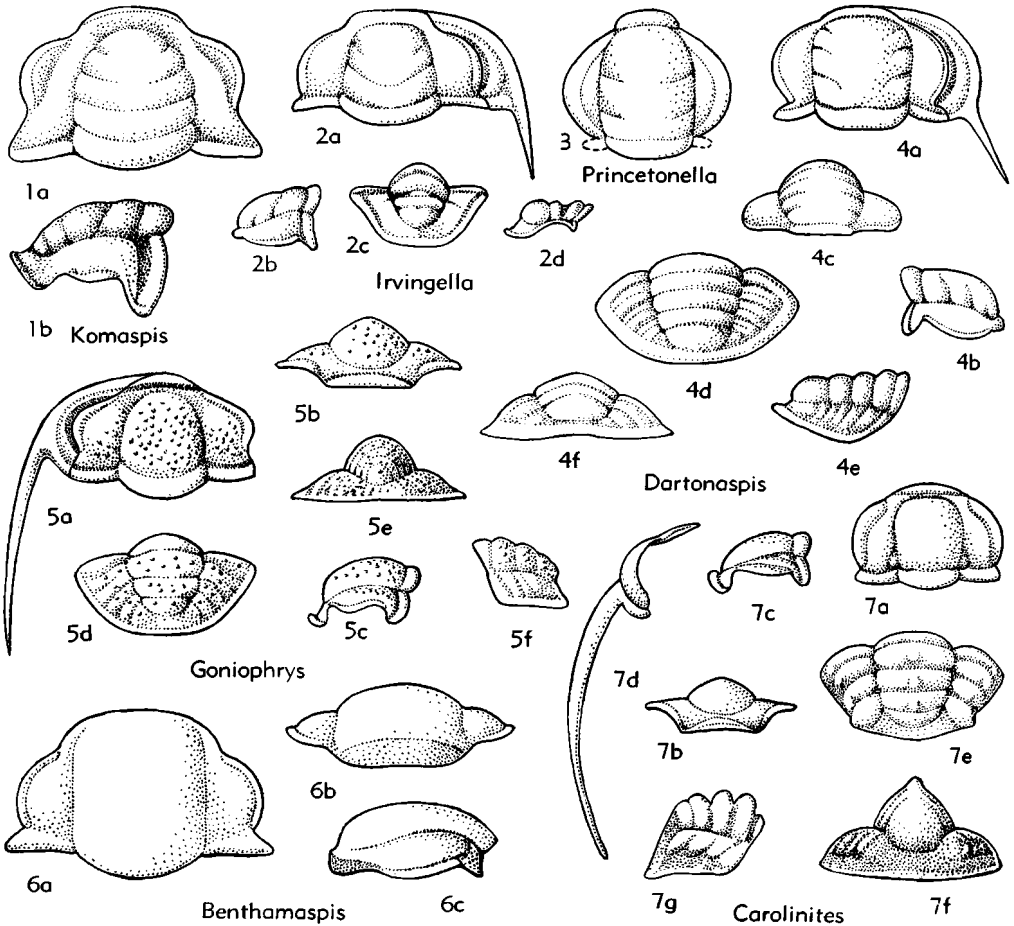


FIG. 218. Komaspidae (p. 0295-0296).

Princetonella LOCHMAN, 1953 [*pro Calypotomma* RESSER, 1942 (*non* TATTERSALL, 1909)] [**Calypotomma typicale* RESSER, 1942]. Glabella convex, subquadrate, sides parallel to rounded corners, with 2 pairs of faint lateral furrows; no preglabellar field, anterior border furrow running into preglabellar furrow, anterior border a rectangle shorter (*tr.*) than width of glabella; eyes same length as glabella; fixigenae horizontal, with palpebral areas 0.3 or less of glabellar width (239). *U.Cam.* (*Francon.*), W.N.Am.—FIG. 218,3. **P. typicalis* (RESSER), Mont.; cran., $\times 4$ (239).

Family ELVINIIDAE Kobayashi, 1935

[*nom. transl. & correct.* HENNINGSMOEN, 1951 (*ex* Elvininae KOBAYASHI, 1935)]

Exoskeleton opisthoparian, subisopygous. Glabella broad subquadrate to quadrate, with 3 pairs of strong to faint lateral furrows; preglabellar field and anterior border

furrow present or absent; palpebral lobes wide, palpebral furrows and eye ridges usually prominent; eyes above medium size, 0.5 to 0.7 of length of glabella; fixigenae horizontal or downsloping; librigenae with wide eye platforms and short genal spines. Thorax unknown. Pygidium subtriangular to transverse, axis and pleural fields about same in width, axis tapered slightly to broadly rounded end, length variable; border furrow distinct, border narrow, commonly rimlike. Surface smooth or granulate. Derived from Ptychopariidae (same ancestor as for Komaspidae). *U.Cam.*

Elvinia WALCOTT, 1924 [**Dikelocephalus roemeri* SHUMARD, 1861] [= *Moosia* WALCOTT, 1925]. Glabella broad subquadrate, sides tapered to semi-straight front, posterior pair of lateral furrows

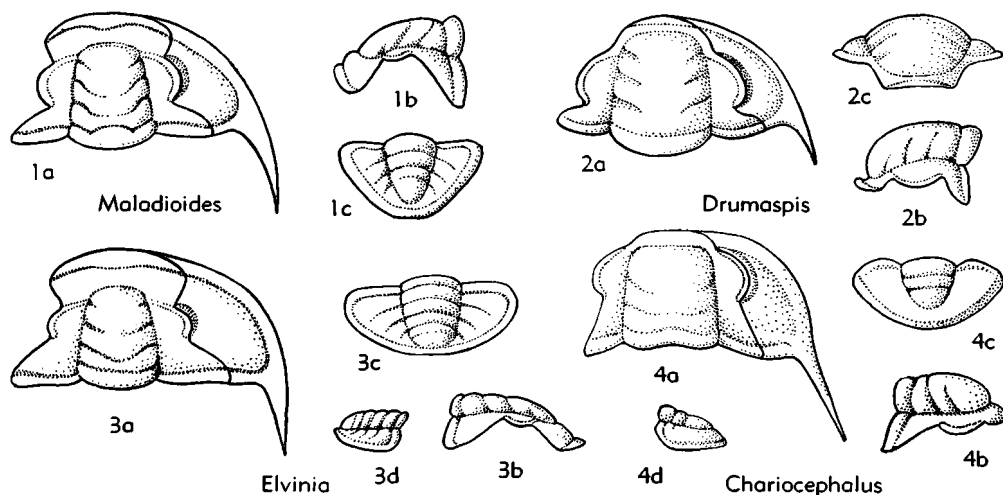


FIG. 219. Elviniidae (0296-0297).

complete; eyes anterior to center of glabella; fixigenae slightly downsloping, with palpebral areas 0.5 of glabellar width, posterior area straplike, long (*tr.*). Pygidium transverse, with axis slightly tapered to broadly rounded end, nearly full length, 3 or 4 axial rings; 3 low broad pleurae, narrow rimlike border (15). *U.Cam.(Francon.)*, N.Am.-S.Am.—FIG. 219,3. **E. roemeri* (SHUMARD), Tex.; *3a,b*, cran., dorsal (with librigena), profile, $\times 0.7$; *3c,d*, pyg., dorsal, profile, $\times 0.7$ (15).

Chariocephalus HALL, 1863 [**C. whitfieldi*]. Glabella large, quadrate, anterior corners rounded, front straight, lateral furrows faint; preglabellar field absent, anterior border furrow obsolete; eye ridges faint to obsolete, eyes opposite anterior 0.3 of glabella with anterior ends even with front of glabella; fixigenae slightly downsloping, with palpebral areas 0.3 of glabellar width, posterior area a steep convex, short (*tr.*) triangle; librigenae with eye platforms tapered to zero anteriorly. Pygidium transverse, axis with rounded end, 0.7 length of pygidium, with 2 axial rings; furrows obsolete on pleural fields, border furrow obsolete, narrow border steep to vertical (8, 53). *U.Cam.(Francon.)*, Wis.—FIG. 219,4. **C. whitfieldi*; *4a,b*, cran., dorsal (with librigena), profile, $\times 4$; *4c,d*, pyg., dorsal, profile, $\times 4$ (8).

Drumaspis RESSER, 1942 [**D. walcotti*]. Glabella subquadrate, sides tapered slightly, front straight, posterior pair of lateral furrows may be complete; narrow preglabellar field may be present; eyes opposite or slightly anterior to center of glabella; fixigenae downsloping, with palpebral areas about 0.3 of glabellar width, posterior area straplike, short (*tr.*); librigenae with eye platforms narrow anteriorly. Pygidium unknown

(239). *U.Cam.(Francon.)*, W.USA-C.USA.—FIG. 219,2. **D. walcotti*, Idaho; *2a-c*, cran., dorsal (with librigena), profile, front, $\times 4$ (239).

Maladioides KOBAYASHI, 1933 [**M. asiaticus*]. Glabella broad, subquadrate, sides tapered to rounded front, posterior pair of lateral furrows long, arcuate; eyes opposite or slightly anterior to center of glabella; fixigenae horizontal, with palpebral areas less than 0.5 of glabellar width, posterior area straplike, medium in length (*tr.*). Pygidium subtriangular, with axis tapered nearly full length, 3 axial rings; 3 broad, poorly defined pleurae; border furrow and border narrow (95). *Low.U.Cam.(Changshan.)*, E.Asia.—FIG. 219,1. **M. asiaticus*, S.Manich.(Liaotung Pen.); *1a,b*, cran., dorsal (with librigena), profile, $\times 2$; *1c*, pyg., $\times 2$ (95).

Taishania SUN, 1935 [**T. taianensis*]. *Low.U.Cam.(Changshan.)*, China (Shantung).

Family TELEPHINIDAE Marek, 1952

[=Telephidae ANGELIN, 1854] [Family name based on *Telephus* BARRANDE, 1852 (*non* GISTEL, 1848) is not permissible.]

Exoskeleton elongate elliptical in outline except for projecting genal spines, micro-pygous. Cephalon convex, wider than long; convex glabella narrowing forward; posterior glabellar furrows may be represented by short longitudinal depressions and anterior pair of furrows by smooth area; pair of spines may occur on frontal lobe; occipital ring convex, commonly with backwardly directed median spine; convex eye surfaces forming large part of librigenae, long and curved, with many tiny facets, en-

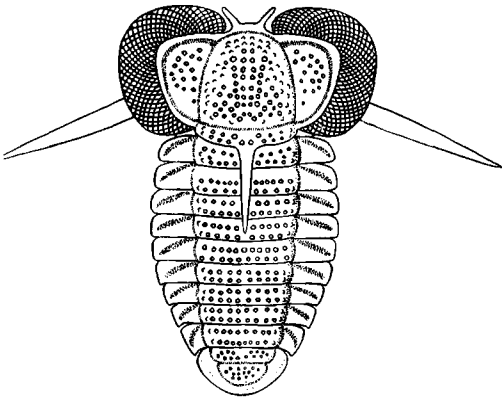


FIG. 220. *Telephina spinifera* WHITTINGTON (Telephinidae), M.Ord., Va.-Tenn.; exoskel. (reconstr.), $\times 2.5$ (496n).

closing crescentic palpebral lobe with prominent ring; narrow cephalic border outside eye lobes and extended anteriorly; short, forward and slightly downwardly directed pair of spines on anterior border; long slim genal spines, with or without a short spine behind the genals; narrow (*exsag.*) posterior border, cut by outward and backwardly directed posterior sections of facial sutures. Thorax (known in one species only) of 9 segments, with wide axis, narrow (*tr.*) pleurae, and broad diagonal pleural furrows. Pygidium small, semicircular in outline; convex, axis with 2 or 3 rings that may bear paired spines; pleural fields narrow, unfurrowed; terminal axial spine may be present. Surface tuberculate, with pattern of anastomosing raised lines (302). *M.Ord.*-*U.Ord.*

Telephina MAREK, 1952 [*pro Telephus* BARRANDE, 1852 (*non Telephus* GISTEL, 1848)] [**Telephus fractus* BARRANDE, 1852]. Characters of family. *M.Ord.*-*U.Ord.*, E.N.Am.-W.Eu.-Austral. — FIG. 220. *T. spinifera* (ULRICH), M.Ord., Va.-Tenn.; exoskel. (reconstr.), $\times 2.5$ (496n).

Family GLAPHURIDAE Hupé, 1953

Exoskeleton subelliptical in outline, opisthoparian, micropygous. Cephalon rather strongly convex, wider than long (*sag.*); glabella semielliptical to nearly semicircular in outline, posterior part bearing pair of short, rather deeply indented longitudinal glabellar furrows; preglabellar field present or absent; librigenae may bear slender, out-

wardly directed genal spines; occipital ring distinct. Thorax with 10 segments (*Glaphurus*). Pygidium small, with distinct but short, tapering axis. Surface tuberculate. *M.Ord.*

Glaphurus RAYMOND, 1905 [**Arionellus pustulatus* WALCOTT, 1877]. Glabella evenly rounded in front, separated from anterior margin by wide (*sag.*) preglabellar field, anterior border furrow, and convex border, with 2 pairs of glabellar furrows, anterior pair short and obliquely transverse, posterior pair gently arcuate and longitudinal; fixigenae wide (*tr.*), convex, sloping downward, palpebral lobes small but prominent, anterior sections of facial sutures converging slightly forward, posterior sections strongly diverging to margins just behind genal spines; librigenae subtriangular in shape, downsloping, with outwardly directed slender genal spines at posterior extremities; cephalic border convex, margin spinose. Hypostoma shield-shaped, with convex lateral and posterior borders, convex middle body, and crescentic posterior lobe. Thorax with 10 segments; pleurae relatively wide (*tr.*), anterior ones with spinose terminations. Pygidium small; axis convex, with 2 rings and terminal; pleural fields with single pair of anterolateral pleural furrows. Surface tuberculate and bearing short spines, glabella with prominent but low paired spines (79, 302). *M.Ord.*, E.USA (Vt.-Va.-Ala.). — FIG. 221, 1. **G. pustulatus* (WALCOTT), Chazy, Vt.; 1a, exoskel. (reconstr.), $\times 6$; 1b, ceph., profile, $\times 6$ (496n).

Glaphurina ULRICH, 1930 [**G. lamottensis*]. Only cranidium known, like *Glaphurus*, but lacking deep anterior glabellar furrows and preglabellar field, anterior cephalic border not spinose, external surface with smaller, low tubercles (302). *M.Ord.*, E.USA (Vt.-Va.-Tenn.)-E.Can. (Mingan I.). — FIG. 221, 2. **G. lamottensis*, Chazy, Vt.; cran., $\times 3$ (302*).

Superfamily RAYMONDINACEA Clark, 1924

[*nom. transl.* LOCHMAN-BALK, herein (*ex* Raymondininae CLARK, 1924)]

Exoskeleton typically opisthoparian, elliptical, heteropygous. Facial sutures with posterior sections running beyond lateral border furrow before turning backward to cut posterior margins, extending straight outward or curving forward, with tendency to approach anterior sections with which fusion may occur; anterior sections converging, straight, or diverging widely forward; glabella tapering to quadrate, front rounded or straight, lateral furrows present or absent, preglabellar field present or absent; eye ridges and occipital spine may be pres-

ent, eyes medium in size to small, position variable; fixigenae with palpebral areas variable in width, posterior areas long (*tr.*), commonly subrectangular to quadrate in shape; librigenae with medium to short genal spines or blunt genal angles. Thorax with 7 or fewer segments; axis narrower than blunt-ended pleurae. Pygidium transverse, ovate or semicircular, axis tapering nearly full length, narrower than pleural fields, with all furrows commonly well defined. Surface smooth or granulose. Polyphyletic derivation. *U.Cam.*

Family RAYMONDINIDAE Clark, 1924

[*nom. transl.* LOCHMAN-BALK, herein (*ex Raymondinidae* CLARK, 1924)]

Characters of superfamily. *U.Cam.*

Subfamily RAYMONDININAE Clark, 1924

[=Pilgrimidae HUPÉ, 1953]

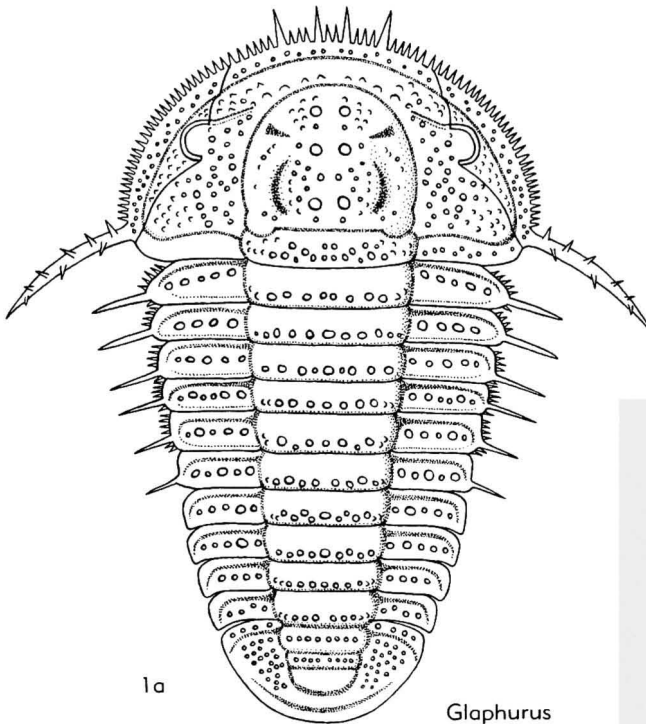
Glabella narrowly tapering to subquadrate, with 2 or 3 pairs of short lateral furrows; preglabellar field present or absent; eyes below medium size to small, anterior to center of glabella; fixigenae horizontal, with palpebral areas 0.3 to 0.75 of

glabellar width, posterior areas widening or narrowing (*sag.*) outward; librigenae with genal spines or blunt genal angles. Thorax unknown. *U.Cam.*

Raymondina T. H. CLARK, 1924 [**R. respecta*] [= *Raymondia* KOBAYASHI, 1935]. Strongly convex, subquadrate glabella with broadly rounded front, 2 pairs of faint lateral furrows, posterior pair appearing in some as 2 connected pits; anterior border furrow may be very faint; eyes below medium size; fixigenae with palpebral areas 0.2 of glabellar width; librigenae narrow, genal angles narrow. Thorax and pygidium unknown (188, 192). *U.Cam.*(*Trempeal.*), E.Can.—FIG. 222.5. **R. respecta*, Que.; 5a,b, cran., dorsal (with librigena), profile, $\times 4$ (188, 192).

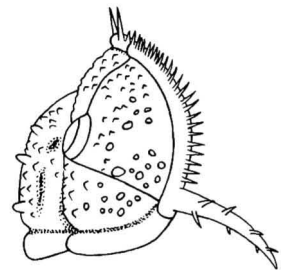
Amquia RASETTI, 1946 [**A. truncata*]. Narrowly tapering glabella without lateral furrows; anterior border furrow deep, anterior border modified; eye ridges distinct; fixigenae with palpebral areas more than 0.7 of glabellar width; librigenae narrow elongate, with bluntly pointed genal angles. Thorax and pygidium unknown (193). *U.Cam.*(*Dresbach.*), E.Can.—FIG. 222.9. **A. truncata*, Que.; 9a,b, cran., dorsal (with librigena), profile, $\times 8$ (193).

Brassicicephalus LOCHMAN, 1940 [**B. pulchellus*]. Subquadrate glabella with rounded front; pre-

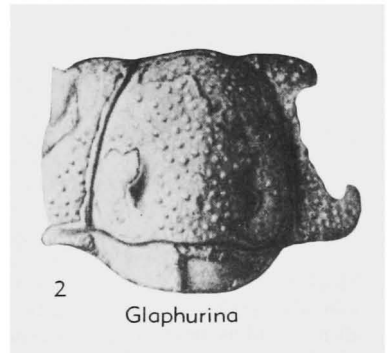


1a

Glaphurus



1b



2

Glaphurina

FIG. 221. Glaphuridae (p. O298).

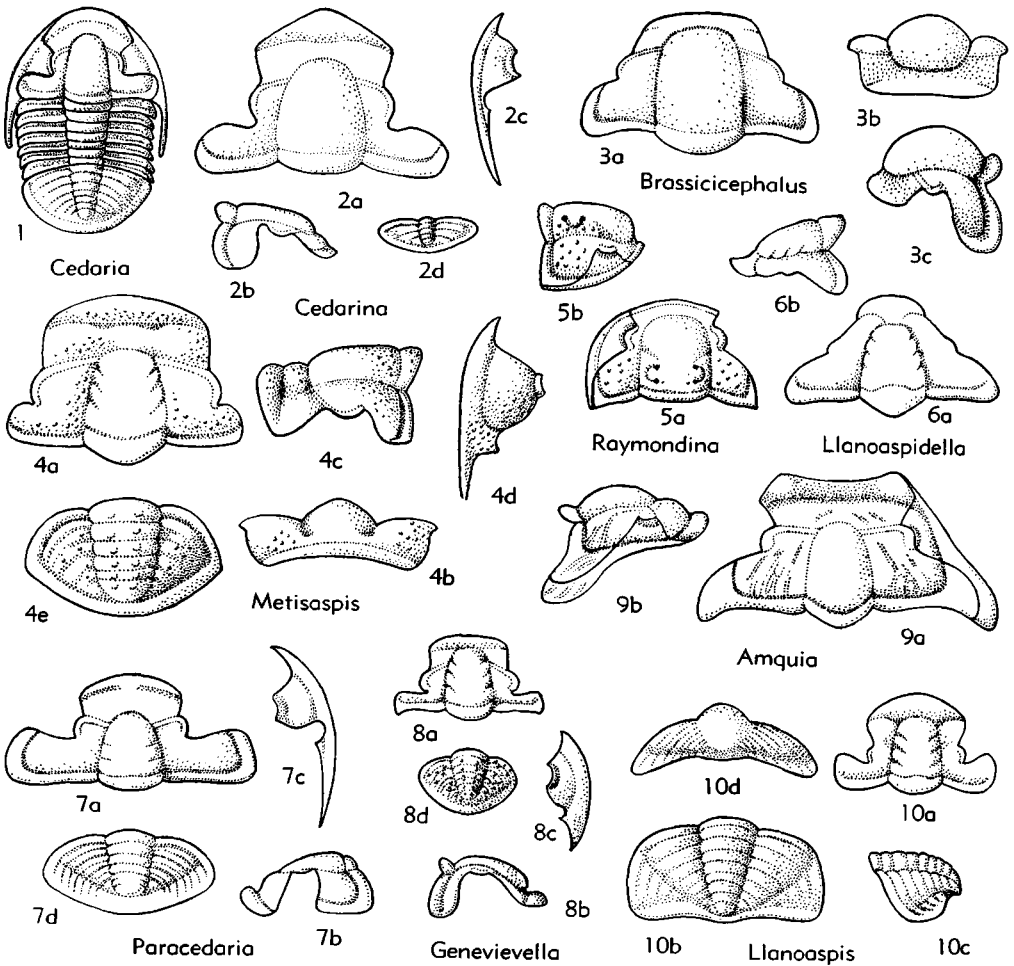


FIG. 222. Raymondinidae (p. O299-O301).

glabellar field very narrow or absent, anterior border furrow faint or obsolete; eye ridges narrow; fixigenae with palpebral areas 0.5 to 0.75 of glabellar width; librigenae, thorax and pygidium unknown (132). *U.Cam.(Dresbach.)*, N. Am.—FIG. 222,3. **B. pulchellus*, Mo.; 3a-c, cran., dorsal, front, profile, $\times 6$ (132).

Llanoaspidella TASCH, 1951 [**L. warriorsmarkensis*]. Tapering glabella, front nearly straight, with 3 pairs of short lateral furrows; preglabellar field interrupted at mid-length (*sag.*) by extension of anterior border, anterior border furrow broken and curved back to preglabellar furrow; eyes small; fixigenae with palpebral areas more than 0.5 of glabellar width, posterior areas subtriangular. Librigenae, thorax, and pygidium unknown (291). *U.Cam.(Dresbach.)*, E.USA.—

FIG. 222,6. **L. warriorsmarkensis*, Pa.; 6a,b, cran., dorsal, profile, $\times 2.75$ (291).

Paracedaria DUNCAN in LOCHMAN & DUNCAN [*pro Pilgrimia* DUNCAN, 1944 (*non* OSBORN, 1925)] [**Pilgrimia montanensis* DUNCAN in LOCHMAN & DUNCAN, 1944]. Tapering glabella, front narrowly rounded, with 2 pairs of faint lateral furrows; eye ridges distinct; fixigenae with palpebral areas 0.5 of glabellar width; librigenae narrow, with long genal spines. Pygidium broadly transverse, axis tapered to rounded end, 5 or 6 axial rings, 4 pleurae, pleural furrows and interpleural grooves turning sharply back at faint border furrow and continuing onto border (132). *U.Cam.(Dresbach.)*, W.USA.—FIG. 222,7. **P. montanensis* (DUNCAN), Mont.; 7a,b, cran., dorsal, profile, $\times 2$; 7c, librigena, 7d, pyg., $\times 3$ (132).

Subfamily CEDARIINAE Raymond, 1937

[*nom. transl.* LOCHMAN-BALK, 1953 (*ex* Cedariidae RAYMOND, 1937)]

Tapering glabella with 3 pairs of faint or obsolete lateral furrows; preglabellar field present; eyes of medium size, opposite or very slightly anterior to center of glabella; fixigenae horizontal, with palpebral areas about 0.3 of glabellar width, posterior areas widening (*sag.*) outward; librigenae with medium-length genal spines. Thorax of 7 segments. *U.Cam.*

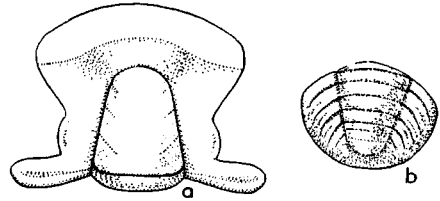


FIG. 223 **Arcuolimbus convexus* PALMER (Cedariidae), *U.Cam.*(*Dresbach.*), Tex.; *a,b*, cran., pyg., $\times 4$ (440).

Cedaria WALCOTT, 1924 [**C. prolifica*]. Facial sutures with anterior and posterior sections tending to approach each other so as to meet and fuse below eyes; no glabellar furrows. Pygidium semicircular, with long, low, tapered axis, 5 or 6 axial rings, 4 or 5 pleurae, and shallow border furrow (321). *U.Cam.*(*Dresbach.*), N.Am.—FIG. 222.1. **C. prolifica*, Ala.; exoskel., $\times 1$ (321).

Cedarina LOCHMAN, 1940 [**C. vale*]. Facial sutures with anterior sections diverging only slightly; glabella smooth or with 3 pairs of very faint lateral furrows. Pygidium narrowly transverse; axis tapered, with 2 to 5 axial rings; 3 pleurae; narrow border furrow, border may have pair of small anterior marginal spines (132). *U.Cam.*(*Dresbach.*), N.Am.—FIG. 222.2. **C. vale*, Mo.; *2a,b*, cran., dorsal, profile; *2c*, librigena; *2d*, pyg.; all $\times 3$ (132).

Subfamily LLANOASPIDINAE Lochman, 1944

[*nom. correct.* LOCHMAN-BALK, herein (*ex* Llanoaspidinae LOCHMAN, 1944)] [=Genevievellidae HUPÉ, 1953]

Glabella tapering to subquadrate, with 3 pairs of short lateral furrows; preglabellar field present or absent; eyes below medium size, posterior to center of glabella; fixigenae upsloping, with palpebral areas 0.5 of glabellar width to equal, posterior areas may widen (*sag.*) outward; librigenae with short genal spines. Thorax unknown. *U.Cam.*

Llanoaspis LOCHMAN, 1938 [**L. modesta*]. [=Rogerswillia HUPÉ, 1955]. Tapering to subquadrate glabella, front flatly rounded; no preglabellar field, anterior border furrow running straight into or curving back to axial furrows, anterior border may undulate; eye ridges faint; fixigenae with palpebral areas 0.5 to 0.7 of glabellar width. Pygidium broadly transverse, with 6 to 8 axial rings and 6 pleurae, interpleural grooves curving back across faint border furrow on to border, posterior margin sinuous (132). *U.Cam.*(*Dresbach.*), N.Am.—FIG. 222.10. **L. modesta*, Tex.; *10a*, cran.; *10b-d*, pyg., dorsal, profile, back; all $\times 3$ (132).

Arcuolimbus PALMER, 1954 [**A. convexus*]. Tapering glabella with front broadly rounded; preglabellar

field present, anterior border furrow narrow and sinuous; eye ridges faint; fixigenae with palpebral areas more than 0.3 of glabellar width, posterior areas narrow (*exsag.*), medium in length (*tr.*). Pygidium nearly circular, strongly convex; with 6 axial rings and terminal; pleural fields steeply sloping, with 5 pleurae, shallow pleural furrows; no border furrow, posterior margin curving upward to median line. Surface smooth. *U.Cam.*(*Dresbach.*), C.USA.—FIG. 223. **A. convexus*, Tex.; *a,b*, cran., pyg., $\times 4$ (440).

Genevievella LOCHMAN, 1936 [**G. neunia*] [=Stenelymus RAYMOND, 1937]. Tapering glabella with broadly rounded front; preglabellar field narrow or absent, anterior border furrow broad; eye ridges distinct; fixigenae with palpebral areas about 0.5 of glabellar width. Pygidium semicircular; axis tapered to narrow end, with 4 to 6 axial rings; 4 or 5 pleurae, interpleural grooves curving back and fading out on border; no border furrow (123, 132). *U.Cam.*(*Dresbach.*), N.Am.—FIG. 222.8. **G. neunia*, Mo.; *8a,b*, cran., dorsal, profile; *8c*, librigena; *8d*, pyg.; all $\times 3$ (123).

Metisaspis RASETTI, 1946 [**M. hispida*]. Low tapering glabella with truncate front; preglabellar field present; eye ridges distinct; fixigenae with palpebral areas same in width as glabella. Pygidium ovate; axis tapered slightly to rounded end, with 6 axial rings; 4 pleurae, interpleural grooves curving back to shallow border furrow; border narrow (193). *U.Cam.*(*Dresbach.*), E. Can.—FIG. 222.4. **M. hispida*, Que.; *4a-c*, cran., dorsal, front, profile; *4d*, librigena, *4e*, pyg.; all $\times 2$ (193).

**Superfamily NORWOODIACEA
Walcott, 1916**

[*nom. transl.* LOCHMAN-BALK, herein (*ex* Norwoodiidae WALCOTT, 1916)] [=Norwoodiidea RICHTER, 1933]

Exoskeleton proparian or gonatoparian, micropygous or heteropygous. Glabella mostly tapering forward, with or without lateral furrows; preglabellar field present, with or without boss in front of glabella; cephalic border distinct. Thorax varying

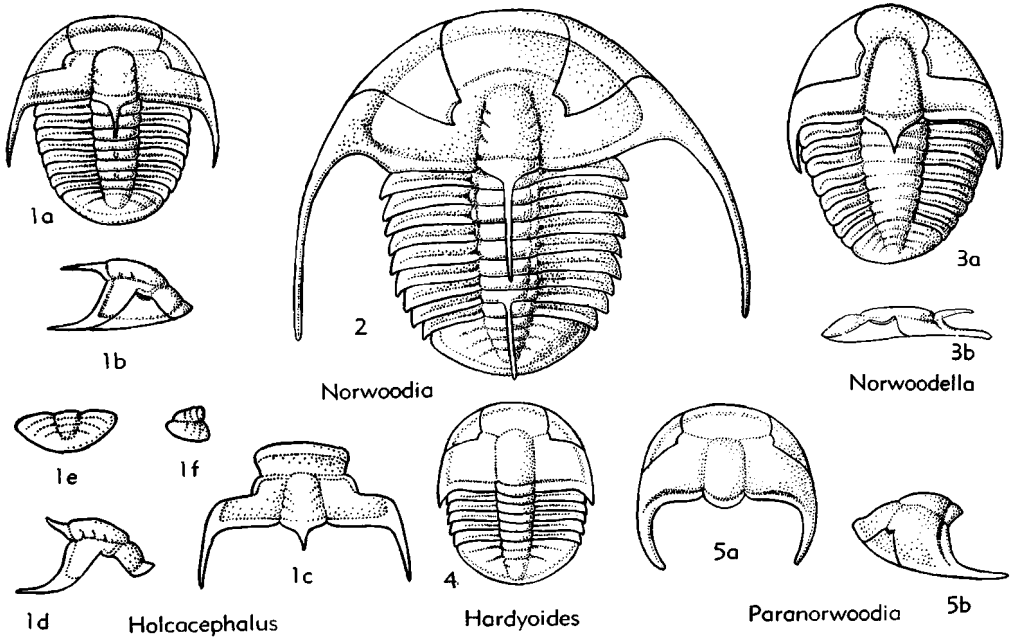


FIG. 224. Norwoodiidae (p. 0302-0303).

widely in number of segments (5 to 42), axis subequal in width to pleurae or narrower. Pygidium transverse to subcircular, generally small. *M. Cam.-L. Ord.*

Family NORWOODIIDAE Walcott, 1916

[*nom. correct.* RICHTER, 1933 (ex Norwoodiidae WALCOTT, 1916)]

Exoskeleton proparian, ovate, heteropygous. Glabella tapering to parallel-sided, lateral furrows present or absent; eye ridges and occipital spine may be present; eyes below medium size to small, opposite anterior part of glabella; fixigenae horizontal or slightly downslowing; librigenae triangular. Thorax with 5 to 9 segments, axis narrower than pleurae, pleural furrows distinct, axial nodes or spines commonly present. Pygidium transverse, with axis tapered nearly full length to rounded end, narrower than pleural fields, border narrow. Outer surface granulose or smooth. Polyphyletic derivation. *U. Cam.-L. Ord.*

Norwoodia WALCOTT, 1916 [**N. gracilis*] [= *Whitfieldina* RESSER, 1937]. Glabella with 3 pairs of short, faint lateral furrows, axial and occipital furrows distinct; preglabellar field long (*sag.*), anterior border furrow commonly broad, fixigenae with palpebral areas 0.5 of glabellar width, posterior areas very large, with long slender genal

spines. Thorax with 9 segments, some with axial spine. Pygidium small, with 3 axial rings and 3 pleurae, narrow border furrow and border (316). *U. Cam. (Dresbach.)*, N. Am.—FIG. 224, 2. **N. gracilis*, Ala.; exoskel., $\times 4$ (316).

Hardyoides KOBAYASHI, 1938 [**H. minor*] [= *Levisaspis* RASETTI, 1943]. Glabella parallel-sided or with sides diverging slightly to rounded front, lateral furrows short and faint, visible only on interior; anterior and lateral border furrows broad, very shallow; eye ridges faint, narrow; occipital node may be present; eyes very small, opposite front of glabella; fixigenae with palpebral areas 0.5 of glabellar width, posterior areas large, quadrate, with short, flat genal spines. Thorax with 5 segments. Pygidium narrow-transverse, 3 or 4 axial rings and pleurae, all furrows tending to obsolescence, border narrow (187). *L. Ord. (Tremadoc.)*, N. Am.—FIG. 224, 4. **H. typicalis* (RASETTI), Que.; exoskel., $\times 5$ (187).

Holcacephalus RESSER, 1938 [**H. granulatus*] [= *Norwoodina* LOCHMAN, 1940]. Glabella tapering, with 3 pairs of short deep lateral furrows, short occipital spine; eye ridges distinct, nearly straight, eyes opposite anterior 0.3 of glabella; fixigenae with palpebral areas as wide as glabella or wider, posterior areas rectangular, with genal spines of medium size. Thorax with 8 segments, bearing axial spines on 3, 5, and 7. Pygidium small, with 3 axial rings and 3 pleurae, border furrow faint, border narrow (126, 127). *U. Cam. (Dresbach.)*, N. Am.—FIG. 224, 1c-f. **H. granu-*

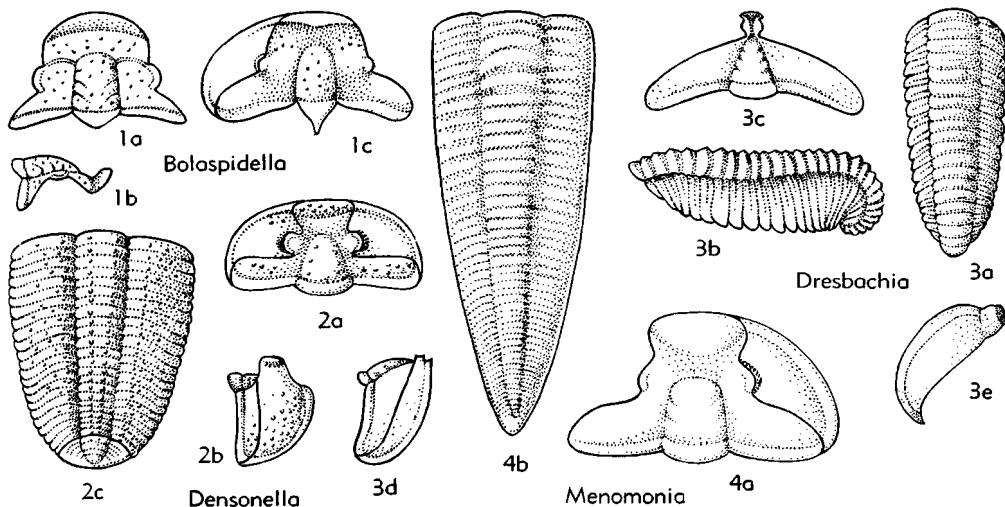


FIG. 225. Menomoniidae (p. O303-O304).

latus, Tenn.; 1c,d, cran., dorsal, profile, $\times 6$; 1e,f, pyg., dorsal, profile, $\times 6$.—FIG. 224, 1a,b, *H. tenerus* (WALCOTT), Utah; 1a, exoskel., $\times 6$; 1b, ceph., profile, $\times 6$ (316).

Norwoodella RESSER, 1938 [**Norwoodia saffordi* WALCOTT, 1916]. Glabellar furrows, anterior and lateral border furrows obsolete on exterior, faint or obsolete on interior, all other furrows faint on exterior; frontal area about 0.3 of length of glabella; fixigenae with extremely narrow palpebral areas, posterior areas long (*tr.*) with stout medium-sized genal spines. Thorax with 8 segments. Pygidium very small, with 3 axial rings and 3 pleurae, border furrow obsolete, border very narrow (126). *U.Cam.*(*Dresbach.*), N.Am.—FIG. 224,3. **N. saffordi* (WALCOTT), Tenn.; 3a, exoskel., $\times 4$; 3b, cran., profile, $\times 4$ (235, 316).

Paranorwoodia RASETTI, 1945 [**P. venusta*]. Glabella parallel-sided to rounded front, without lateral furrows; axial, anterior and lateral border furrows shallow; no occipital spine; eye ridges faint, eyes very small, opposite front of glabella; fixigenae with palpebral areas wider than glabella, posterior areas large, subquadrate, with short, thick, curved genal spines. Pygidium unknown (189). *U.Cam.*(*Trempeal.*), E.Can.—FIG. 224,5. **P. venusta*, Que., 5a,b, ceph., dorsal, profile, $\times 6$ (189).

Family MENOMONIIDAE Walcott, 1916

[*nom. correct.* RICHTER, 1933 (*ex Menomonidae* WALCOTT, 1916)]

Exoskeleton micropygous, gonatoparian, elongate-elliptical. Facial sutures with anterior sections running straight forward or

diverging slightly, posterior sections cutting exactly through center of genal angles; glabella truncate-tapering to subtriangular, with 2 or 3 pairs of short lateral furrows; preglabellar field depressed, anterior border commonly upturned or rimlike, occipital spine may be present; eyes small, anterior to center of glabella, may be stalked; fixigenae upsloping to elevated, with palpebral areas of variable width, posterior areas of medium to great length (*tr.*); librigenae triangular to rectangular. Thorax with 42 or fewer segments, axis and pleurae subequal in width, pleurae blunt-ended. Pygidium subcircular, axis extending nearly full length with 1 to 3 axial rings; pleural regions slightly narrower, furrows faint. Surface granulose. Derived from Ptychopariidae. *M.Cam.-U.Cam.*

Menomonina WALCOTT, 1916 [**Conocephalites calymenoides* WHITFIELD, 1878]. Glabella truncate-tapering, with 2 pairs of lateral furrows; preglabellar field concave, anterior border wide, convex; eyes small, opposite front of glabella; fixigenae steeply upsloping, with palpebral areas 0.7 of glabellar width, posterior areas long (*tr.*); librigenae large, triangular. Thorax with 42 segments. Pygidium minute; axis convex, with 2 or 3 axial rings; pleural regions low, narrow (316). *U.Cam.*(*Dresbach.*), N.Am.—FIG. 225,4. **M. calymenoides* (WHITFIELD), Wis.; 4a, cran., dorsal (with librigena), $\times 2$; 4b, thorax and pyg.; $\times 2$ (316).

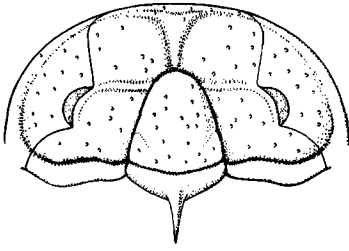


FIG. 226. **Deiracephalus aster* (WALCOTT) (Menomoniidae), *U.Cam.*(Dresbach.), Tenn.; ceph., $\times 4$ (488).

Bolaspidella RESSER, 1937 [**Ptychoparia housensis* WALCOTT, 1886] [= *Hysteropleura*, *Apedopyanus* RAYMOND, 1937; *Deltophthalmus* RESSER, 1938; *Deissella* HOWELL & DUNCAN, 1939; *Howellaspis* LOCHMAN & DENSON, 1944]. Glabella truncate tapering, lateral furrows strong to faint; preglabellar field horizontal, flat or slightly convex, anterior border strongly convex; eye ridges distinct to faint; occipital spine may be present; fixigenae steeply upsloping to elevated, so that eyes may appear stalked, with palpebral areas about same in width as glabella, posterior areas long; librigenae elongate triangular. Thorax with at least 15 segments. Pygidium very small, with 3 axial rings, 3 pleurae (132, 213). *Up.M.Cam.*-*Low.U.Cam.*(Dresbach.), N.Am.—FIG. 225, *1a,b*. *B. wellsvillensis* (LOCHMAN & DENSON), *Up.M.Cam.*, Utah; *1a,b*, cran., dorsal, profile, $\times 4$ (132).—FIG. 225, *1c*. *B. macgerriglei* (RAYMOND), Vt.; cran. (with librigena), $\times 4$ (213).

Coenaspis RESSER, 1938 [**C. spectabilis*]. Glabella short, tapering, with 2 pairs of lateral furrows; preglabellar field depressed, anterior border furrow narrow, border narrow, rimlike; eyes small, anterior to center of glabella; occipital spine may be present; fixigenae steeply upsloping, eyes appearing stalked, with palpebral areas same in width as glabella, posterior areas wide, triangular, long (*tr.*); librigenae, thorax, and pygidium unknown. Surface with granules of 2 sizes (235). *U.Cam.*(Dresbach.), E.N.Am.

Deiracephalus RESSER, Feb. 1935 [**Acrocephalites? aster* WALCOTT, 1916] [= *Asteraspis* KOBAYASHI, Nov. 1935 (obj.)]. Glabella subtriangular, with 3 pairs of short lateral furrows; preglabellar field downsloping, with median ridge that interrupts anterior border furrow, anterior border rimlike; occipital spine present; eye ridges straight, eyes small, nearly opposite center of glabella; fixigenae upsloping, with palpebral areas 0.7 of glabellar width, posterior areas wide, triangular, long (*tr.*); librigenae triangular, lateral border furrow narrow, genal angles rounded. Thorax and pygidium unknown. Surface granulose (235). *U.Cam.*(Dres-

bach.), S.USA.—FIG. 226. **D. aster* (WALCOTT), Tenn.; ceph., $\times 4$ (488).

Densonella SHAW, 1952 [*pro Millardia* WALCOTT, 1916 (non THOMAS, 1911)] [**Millardia semele* WALCOTT, 1916]. Glabella subtriangular, with 3 pairs of short lateral furrows; preglabellar field concave, anterior border upturned; eyes opposite front of glabella, fixigenae strongly elevated, so that eyes appear stalked, with palpebral areas about equal in width to glabella, posterior areas very long (*tr.*); librigenae rectangular. Thorax with 23 segments, pleurae slightly wider than axis. Pygidium small, with axis and pleural fields same in width, 2 or 3 axial rings (316). Surface granulose with longitudinal rows of granules on glabella and thoracic axis. *U.Cam.*(Dresbach.), N.Am.—FIG. 225, 2. **D. semele* (WALCOTT), Utah; *2a,b*, ceph., dorsal, profile, $\times 4$; *2c*, thorax and pyg., $\times 4$ (316).

Dresbachia WALCOTT, 1916 [**D. amata*]. Glabella triangular, with 3 pairs of short diagonal lateral furrows; preglabellar field a very narrow (*tr.*) flat strip, anterior border a small rim; eyes in front of glabella opposite preglabellar field; fixigenae modified, with palpebral areas developed as vertical strips on each side of preglabellar field bearing horizontal palpebral lobes at top, posterior areas wide (*sag.*), very long (*tr.*), subrectangular; librigenae rectangular, with elevated eyes at inner angle. Thorax with about 32 segments, pleural furrows short. Pygidium minute (316). *U.Cam.*(Dresbach.), N.Am.—FIG. 225, 3. **D. amata*, Wis.; *3a,b*, thorax and pyg., dorsal, profile; *3c*, cran.; *3d*, ceph., profile; *3e*, librigena; all $\times 3.5$ (316, 447).

Family BOLASPIDIDAE Howell, nov.

Preglabellar field wide (*sag.*), bearing a boss in front of glabella; glabella subtriangular or gently tapering, lateral furrows shallow or absent; border well developed, more or less thickened; palpebral lobes small; axial and occipital furrows distinct; occipital ring with or without a spine. *M.Cam.*

Bolaspis RESSER, 1935 [**Alokistocare? labrosum* WALCOTT, 1916]. Glabella subtriangular, bearing one or more pairs of lateral furrows; cranium bluntly subtriangular in outline, somewhat resembling *Acrocephalops* but anterior portion narrower; each fixigena wider than glabella; border thickened and prominent; occipital ring heavy, in some forms bearing a spine. Surface punctate or granulose. *M.Cam.*, NW.USA.—FIG. 227, 4. **B. labrosa* (WALCOTT), Meagher F., Mont.; cran., $\times 1.3$ (488).

Acrocephalops POULSEN, 1927 [**A. gibber*]. Glabella rather narrow, gently tapering; lateral

furrows present; each fixigena about as wide as glabella; cranium bluntly subtriangular in form, anterior portion narrower than in the other genera of family except *Bolaspis*; border thickened, but not so much as in *Eldoradia*; no occipital spine. Surface granulate or lined. *M.Cam. Arct.N.Am.*—FIG. 227,1. **A. gibber* POULSEN, Cape Wood F., N.W.Greenl.; cran., $\times 8$ (445).

Eldoradia RESSER, 1935 [**Ptychoparia? linnarssoni* WALCOTT, 1884]. Front half of cranium more quadrate than in *Acrocephalops* and *Bolaspis*; each fixigena wider than glabella, which tapers gently and bears faint lateral furrows or none; border ill defined, anterior furrow faint; small palpebral lobes located about in line with front of glabella; no spine on occipital ring. Surface punctate. *M.Cam., W.USA.*—FIG. 227,3. **E. linnarssoni* (WALCOTT), Eldorado F., Nev.; cran., $\times 3$ (457).

Rawlinsella SHAW, 1956 [**Acrocephalites? glomeratus* WALCOTT, 1916]. Glabella tapering slightly, bluntly rounded in front; axial furrows deep, with pits at anterolateral angles of glabella; each fixigena as wide as glabella; border widest in middle, tapering laterally. *M.Cam., W.USA.*—FIG. 227,2. **R. glomerata* (WALCOTT), Buck Spring R., Wyo.; cran., $\times 2$ (488).

Superfamily MARJUMIACEA
Kobayashi, 1935

[*nom. transl.* LOCHMAN-BALK, herein (*ex* Marjumidae KOBAYASHI, 1935)]

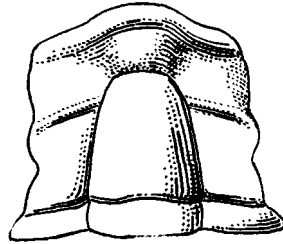
Exoskeleton opisthoptarian, medium-sized, ellipsoidal, mostly heteropygous (isopygous in Coosellidae). Glabella tapering forward or quadrate, with 2 or 3 pairs of lateral glabellar furrows; preglabellar field may be absent, anterior border furrow distinct, but variable in width and depth; librigenae generally bearing short to medium-length genal spines. Thorax containing up to 14 pleurae with blunt or somewhat falcate extremities, distinctly forward. Pygidium transverse, with axis extending nearly full length, border narrow or absent, border furrow narrow or obsolete. Surface smooth or finely granulate. *M.Cam.-L.Ord.*

Family MARJUMIIDAE Kobayashi, 1935

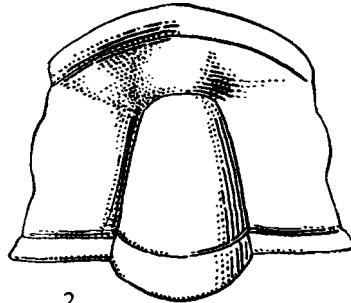
[*nom. correct.* HENNINGSMOEN, 1951 (*pro* Marjumidae KOBAYASHI, 1935)] [=Punctulariidae RAYMOND, 1937; Talbotiidae, HUPÉ, 1953]

Exoskeleton opisthoptarian, elliptical, heteropygous. Glabella narrowly to broadly tapering forward, front rounded, lateral furrows present or absent, other furrows well defined; occipital spine may be pres-

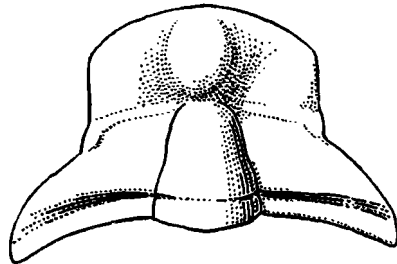
ent; eye ridges commonly present, eyes medium in size, about opposite center of glabella; fixigenae horizontal, sloping slight-



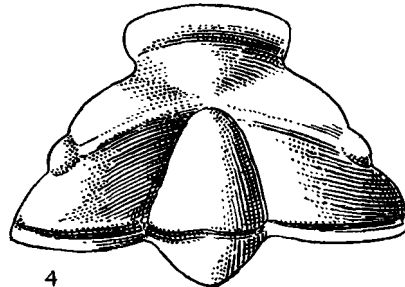
1 *Acrocephalops*



2 *Rawlinsella*



3 *Eldoradia*



4 *Bolaspis*

FIG. 227. Bolaspididae (p. 0304-0305).

ly upward or downward, with palpebral areas 0.25 to 0.5 of glabellar width, posterior areas straplike; librigenae with medium to short genal spines. Thorax with 14 or fewer segments; axis convex, with one or more axial spines; pleurae wider and lower than axis, ends blunt or falcate. Pygidium transverse; axis convex, tapered nearly full length to broadly rounded end, may be wider or narrower than pleural fields, all furrows distinct except faint or obsolete border furrow; axial rings and pleurae 3 or 4; as many as 5 pairs of short marginal spines. Surface finely granulose, rarely punctate, inner surface commonly punctate, with or without prominent anastomosing venations on cephalon. Polyphyletic derivation from various genera of Ptychopariidae. *M.Cam.-U.Cam.*

Marjumia WALCOTT, 1916 [**M. typha*]. Glabella narrowly tapering, with 3 pairs of lateral furrows; eye ridges distinct; fixigenae with palpebral areas less than 0.5 of glabellar width, posterior areas long (*tr.*); librigenae with broad eye platforms and short, flat genal spines. Thorax with 14 segments, pleurae falcate. Pygidium with axis and pleural fields of same width, border very narrow, 1 to 4 pairs of marginal spines (317). *Up.M.Cam.*, N.Am.—FIG. 228,1. **M. typha*, Utah; exoskel. $\times 1$ (317).

Aposolenopleura RAYMOND, 1937 [**A. dunbari*] [= *Punctularia* RAYMOND, 1937]. Glabella convex tapering, with 2 or 3 pairs of short faint lateral furrows; preglabellar field may be very narrow; eye ridges faint; fixigenae with palpebral areas about 0.5 of glabellar width, posterior areas medium in length (*tr.*). Librigenae, thorax, and pygidium unknown (188, 189). *U.Cam.(Trempeal.)*, E.USA.—FIG. 228,10a,b. **A. dunbari*, Vt.; 10a,b, cran., dorsal, profile, $\times 3$ (188).—FIG. 228,10c,d. **A. quebecensis* (RASETTI), Que.; 10c,d, cran., dorsal, profile, $\times 8$ (189).

Bellaspis RASETTI, 1945 [**B. billingsi*]. Glabella broadly tapering, with 2 pairs of faint lateral furrows; palpebral furrows well defined, eye ridges faint or absent; fixigenae with palpebral areas about 0.25 of glabellar width, posterior areas medium in length (*tr.*). Librigenae, thorax, and pygidium unknown (189). *U.Cam.(Trempeal.)*, E.N.Am.—FIG. 228,6. **B. billingsi*, Que.; 6a,b, cran., dorsal, profile, $\times 5$ (189).

Bemaspis FREDERICKSON, 1949 [**B. gouldi*]. Glabella convex, keeled, truncate-tapering, with 2 pairs of short diagonal lateral furrows; with preglabellar field and distinct anterior border furrow, anterior border narrow; eye ridges faint, palpebral furrows shallow, palpebral rims present, eyes below medium size, opposite center of

glabella; fixigenae horizontal, with palpebral areas almost 0.5 of glabellar width, posterior areas triangular, medium in width (*exsag.*), 0.75 of length (*tr.*) of occipital ring. Librigenae, thorax, and pygidium unknown. Surface finely granulose. *U.Cam.(Francon.)*, C.USA(Okla.).

Crepichilella WILSON, 1951 [**C. antietaensis*]. Glabella narrowly tapering, with 3 pairs of lateral furrows, anterior border furrow may have median inward bend; eyes slightly posterior to center of glabella; fixigenae with palpebral areas a little less than 0.3 of glabellar width, posterior areas long (*tr.*). Librigenae, thorax, and pygidium unknown (363). *U.Cam.(Francon.)*, E.N.Am.

Deadwoodia RESSER, 1938 [**Ptychoparia (Liostracus) panope* WALCOTT, 1890]. Glabella broadly tapering, with 2 pairs of very faint lateral furrows; eye ridges narrow; fixigenae with palpebral areas 0.5 of glabellar width, posterior areas of medium length (*tr.*); librigenae with slender genal spines. Pygidium unknown (363). *U.Cam.(Francon.)*, N.Am.—FIG. 228,9. *D. duris* (WALCOTT), Pa.; 9a-c, cran., dorsal, profile, front, $\times 2$; 9d, librigena, $\times 2$ (497).

Dellea WILSON, 1949 [**D. wilbernsensis* (= **Ptychoparia suada* WALCOTT, 1890)]. Glabella tapering, with 2 or 3 pairs of faint lateral furrows; eye ridges narrow; fixigenae with palpebral areas about 0.3 of glabellar width, posterior areas medium in length (*tr.*); librigenae with slender genal spines. Thorax unknown. Pygidium with axis and pleural fields of same width, axis 0.75 of length of pygidium, border narrow (363). *U.Cam.(Francon.)*, N.Am.—FIG. 228,8. **D. suada* (WALCOTT), Tex.; 8a,b, cran., dorsal, profile; 8c, librigena; 8d, pyg.; all $\times 2$ (363).

Eshelmania WILSON, 1951 [**E. snoburgensis*]. Glabella elongate, tapering, with 3 pairs of lateral furrows; eye ridges narrow; fixigenae with palpebral areas about 0.3 of glabellar width, posterior areas long (*tr.*). Librigenae, thorax, and pygidium unknown (363). *U.Cam.(Francon.)*, E.N.Am.

Lecanopleura RAYMOND, 1937 [**L. interrupta*]. Glabella narrowly tapering, no lateral furrows or eye ridges, eyes slightly anterior to center of glabella; fixigenae with palpebral areas about 0.25 of glabellar width, posterior areas medium in length (*tr.*). Librigenae, thorax, and pygidium unknown (213). *Up.M.Cam.-U.Cam.*, E.N.Am.

Modocia WALCOTT, 1924 [**Arionellus (Crepicephalus) oweni* MEEK & HAYDEN, 1861] [= *Armonia* WALCOTT, 1924; *Meisia* RESSER, 1937; *Semnocephalus* RESSER, 1942]. Glabella tapering, narrowly rounded in front, with 3 pairs of faint to obsolete, short lateral furrows; anterior border furrow straight or with median inward bend; eye ridges faint or absent, eyes below medium size; fixigenae downslowing, with palpebral areas about 0.5 of glabellar width, posterior areas subtriangular, long (*tr.*); librigenae rectangular, with

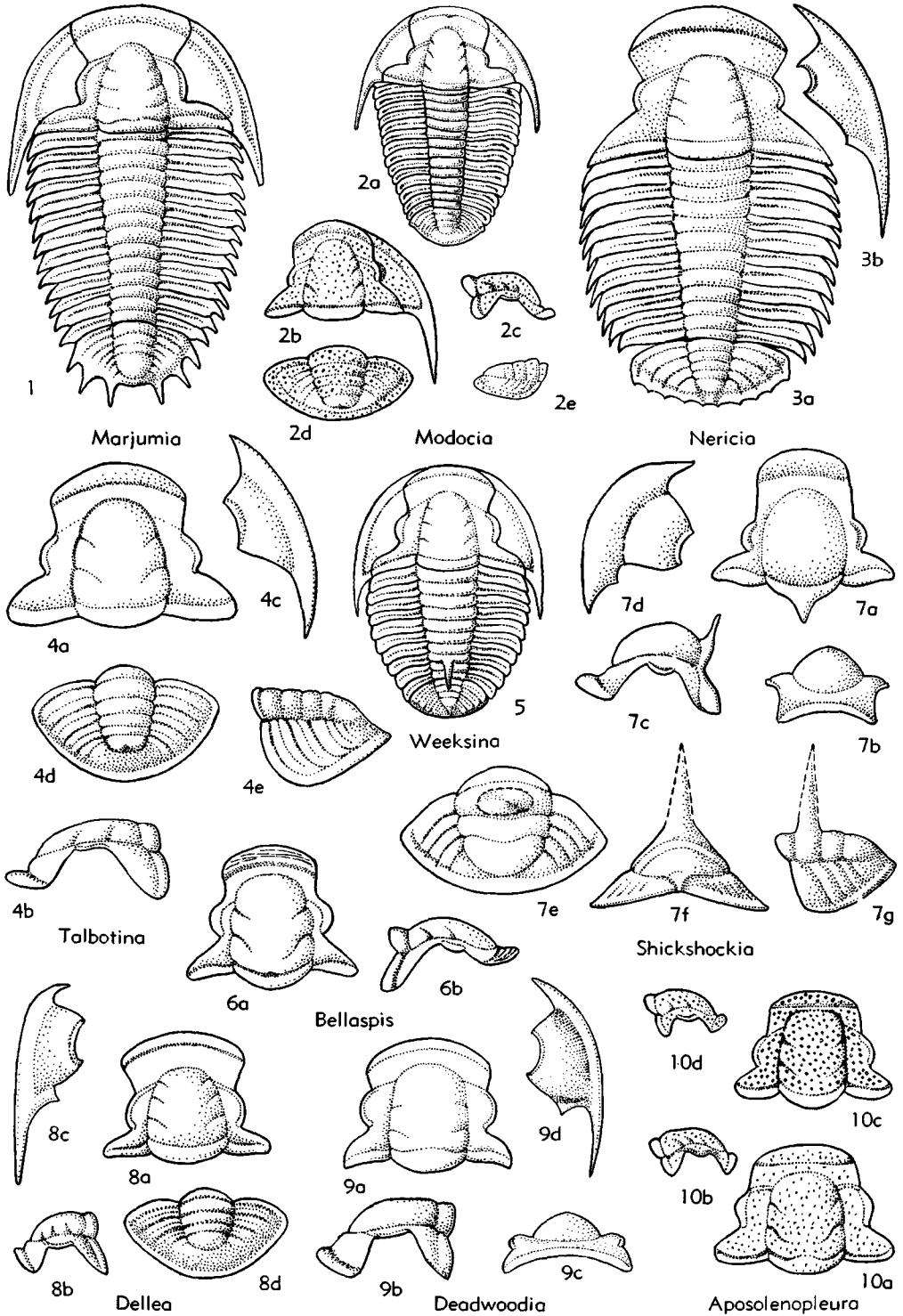


FIG. 228. Lonchocephalidae, Marjumiidae (p. 0279-0280, 0306-0309).

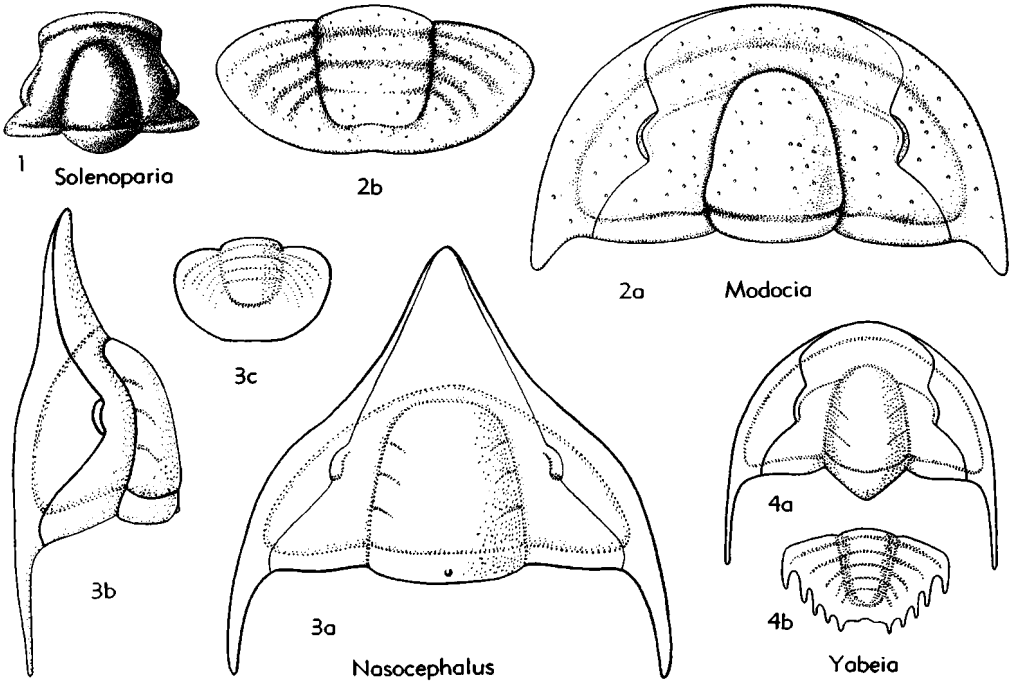


FIG. 229. Marjumiidae (p. O308-O309).

genal spines variable in length. Thorax with 14 segments, pleurae blunt. Pygidium narrowly transverse, with convex axis about same in width as pleural fields, with 3 axial rings and terminal, may have median indentation; 3 pleurae with deep pleural furrows, interpleural grooves faint to distinct, border furrow obsolete, narrow poorly defined border, may have pairs of very small anterior marginal spines (132, 162, 321). *Up.M. Cam.-U. Cam.*, N. Am.—FIG. 228, 2a. *M. elongata* (WALCOTT), Dresbach., Ala.; exoskel., $\times 1$ (317).—FIG. 228, 2b-e. *M. metisensis* (WALCOTT), *Up.M. Cam.*, Que.; 2b, c, cran., dorsal (with librigena), profile, $\times 2$; 2d, e, pyg., dorsal, profile, $\times 2$ (308).—FIG. 229, 2. **M. oweni* (MEEK & HAYDEN), *Up.M. Cam.-Low.U. Cam.* (Dresbach.), Wyo.; 2a, b, ceph., pyg., $\times 4$ (162, 321).

Nasocephalus WILSON, 1954 [**N. nasutus*]. Glabella low, broadly tapering, front moderately rounded or nearly straight, with 3 pairs of short lateral furrows; occipital spine or small node present; preglabellar field narrow or absent, anterior border wide, may be markedly prolonged; eye ridges narrow, faint, eyes slightly below medium size, opposite center of glabella; fixigenae horizontal or slightly upsloping, with palpebral areas about 0.3 of glabellar width, posterior areas narrow, short (*tr.*); librigenae narrow, elongate, with short flat genal spines. Pygidium small, transverse,

convex; axis and pleural fields of same width, with 3 axial rings and terminal, 2 or 3 interpleural grooves, pleural furrows very faint or obsolete, no marginal furrow. Surface smooth. *Low.U. Cam.* (Dresbach.), SE. N. Am.-NW. Eu.—FIG. 229, 3. **N. nasutus*, Tex.; a, b, ceph., dorsal, profile, $\times 4$; 2c, pyg., $\times 4$ (364).

Neotaenicephalus KOBAYASHI, 1955 [**N. obsoletus*]. Glabella tapering, with straight front, no lateral furrows; eye ridges very faint, with pair of anterior pits in axial furrows; fixigenae upsloping, with palpebral areas 0.5 of glabellar width, posterior areas narrow (*exsag.*), triangular. *L. Ord.* (Tremadoc.), W. Can. (B. C.).

Nericia WESTERGÅRD, 1948 [**N. quinquedentata*]. Glabella narrowly tapering, with 3 pairs of faint lateral furrows; eye ridges narrow, eyes slightly anterior to center of glabella; fixigenae with palpebral areas 0.5 of glabellar width, posterior areas subtriangular, long (*tr.*); librigenae with medium-length, slender genal spines. Thorax with 12 segments, pleurae with short spines. Pygidium with axis narrower than pleural fields, border furrows faint, interpleural grooves running on to border, 5 pairs small marginal spines (336). *Up.M. Cam.*, W. Eu.—FIG. 228, 3. **N. quinquedentata*, Swed. (Ullavi); 3a, incompl. exoskel., $\times 2$; 3b, librigena, $\times 2$ (336).

Obrucheviaspis IVSHIN, 1953 [**O. inornata*]. Similar to *Dellea*, *U.Cam.*, SW.Sib.

Shickshockia RASETTI, 1946 [**S. cristata*]. Glabella broadly tapering, narrowly rounded in front, lacking lateral furrows; no eye ridges, occipital spine present; fixigenae with palpebral areas 0.25 of glabellar width, posterior areas of medium length (*tr.*); librigenae with very short genal spines. Strong axial spine on one or more thoracic segments. Pygidium with convex axis, wider than pleural regions, large axial spine on 1st ring, border narrow (193). *U.Cam.(Dresbach.)*, E.N. Am.—FIG. 228,7. *S. cristata*, Que.(Gaspé); 7a-c, cran., dorsal, front, profile; 7d, librigena; 7e-g, pyg., dorsal, back, profile; all $\times 2.5$ (193).

Solenoparia KOBAYASHI, 1935 [**Ptychoparia (Liostracus) toxeus* WALCOTT, 1905]. Glabella convex, tapering to narrowly rounded front, without lateral furrows; frontal area wide (*tr.*); fixigenae convex, downsloping, eye ridges faint, eyes slightly in front of glabellar mid-length, palpebral areas about 0.5 of glabellar width, posterior areas triangular. Pygidium subtriangular, with axis and pleural fields about equally wide, 5 to 7 axial rings and pleurae, interpleural grooves distinct, pleural furrows faint to obsolete; border very narrow, border furrow faint. Surface granulose. *M. Cam.*, Asia-W.Austral.—FIG. 229,1. **S. toxea* (WALCOTT), China(Shantung); cran., $\times 3$ (488).

Taenicephalina RASETTI, 1945 [**T. lechevalieri*]. Glabella short, tapering, with 3 pairs of faint short lateral furrows, deep axial furrows; eye ridges faint, eyes below medium size; fixigenae downsloping, with palpebral areas about 0.3 of glabellar width, posterior areas triangular, 0.7 of length (*tr.*) of occipital ring. Librigenae, thorax and pygidium unknown. Surface smooth (189). *U.Cam.(Trempeal.)*, E.Can.(Que.).

Urbanaspis IVSHIN, 1956 [**U. notabilis*]. Similar to *Deadwoodia*, *U.Cam.*, SW.Sib.

Vermilionites KOBAYASHI, 1955 [**V. bisulcatus*]. Glabella narrow, tapering, no lateral furrows; eye ridges present, eyes above medium size; fixigenae with palpebral areas about 0.3 of glabellar width, posterior areas straplike. Surface sparsely granulose. *L.Ord.(Tremadoc.)*, W.Can.(B.C.).

Yabeia RESSER & ENDO, in ENDO & RESSER, 1937 [**Y. laevigata*]. Glabella narrow, tapering, lateral furrows faint or absent; anterior border furrow obsolete; eye ridges faint or absent, eyes below medium size; fixigenae with palpebral areas 0.5 of glabellar width, posterior areas medium in length (*tr.*). Pygidium subtriangular, axis convex, wider than low flat pleural regions, interpleural grooves and border furrow obsolete, narrow pleural furrows run to base of short marginal spines (5 pairs) (37). *M.Cam.*, NE.Asia.—FIG. 229,4. **Y. laevigata*, Manch.; 4a,b, cran., pyg., $\times 4$ (37). [*Yabeia* KOBAYASHI, 1935, attributed to RESSER & ENDO, is *nom. nud.*—ED.]

Family COSELLIDAE Palmer, 1954

[*emend.* LOCHMAN, 1956]

Exoskeleton opisthoparian, isopygous. Glabella short to elongate tapering, with rounded front, 3 pairs of faint to obsolete lateral furrows; anterior border furrow variable in width and depth; palpebral lobes and shallow palpebral furrows present, eye ridges faint to obsolete, eyes of medium size, opposite center of glabella; fixigenae variable in position, with palpebral areas 0.3 to 0.5 of glabellar width, posterior areas straplike, narrow (*exsag.*), 0.5 to 0.7 length (*tr.*) of occipital ring; librigenae narrowly rectangular, with genal spines or rounded genal angles. Thorax with 11 to 13 segments, axis and pleurae about same in width (*tr.*), ends of pleurae bluntly or sharply pointed. Pygidium semicircular, with convex axis tapered to a broadly rounded end, commonly with median indentation, short postaxial ridge present; 3 or 4 axial rings and terminal, 3 or 4 pleurae; pleural furrows broad, distinct; interpleural grooves obsolete or narrow, shallow; border furrow obsolete; border of medium width to wide. Outer surface finely granulose to smooth. Derived from Ptychopariidae. *U.Cam.(Dresbach.)*.

Coosella LOCHMAN, 1936 [**C. prolifica*]. Glabella of medium length, tapering to narrow rounded front, lateral furrows faint; frontal area 0.25 length of cranium, anterior border furrow broad and shallow; eye ridges faint; fixigenae horizontal, with palpebral areas 0.3 to 0.5 of glabellar width, posterior areas 0.7 of length (*tr.*) of occipital ring; librigenae with short genal spines or rounded angles. Thorax with 11 or 12 segments, deep furrow in center of pleurae. Pygidium with axis 0.6 to 0.7 of length; pleural fields slightly narrower than axis, 4 pleurae with wide pleural furrows and obsolete or narrow interpleural grooves located near next posterior pleural furrow; border of medium width with posterior median inbend. Surface finely granulose (123, 162). *U.Cam.(Dresbach.)*, N.Am.—FIG. 230,3. **C. prolifica*, Mo.; 3a,b, ceph., pyg., $\times 2.7$ (123).

Coosia WALCOTT, 1911 [**C. superba*]. Glabella low, elongate, tapering to rounded front, lateral furrows obsolete on exterior, all other furrows faint; frontal area about 0.3 length of cranium, border wider than preglabellar field, broad shallow anterior border furrow; eye ridges obsolete; fixigenae horizontal or slightly upslowing, with palpebral areas 0.3 of glabellar width, posterior areas 0.5 length (*tr.*) of occipital ring; librigenae

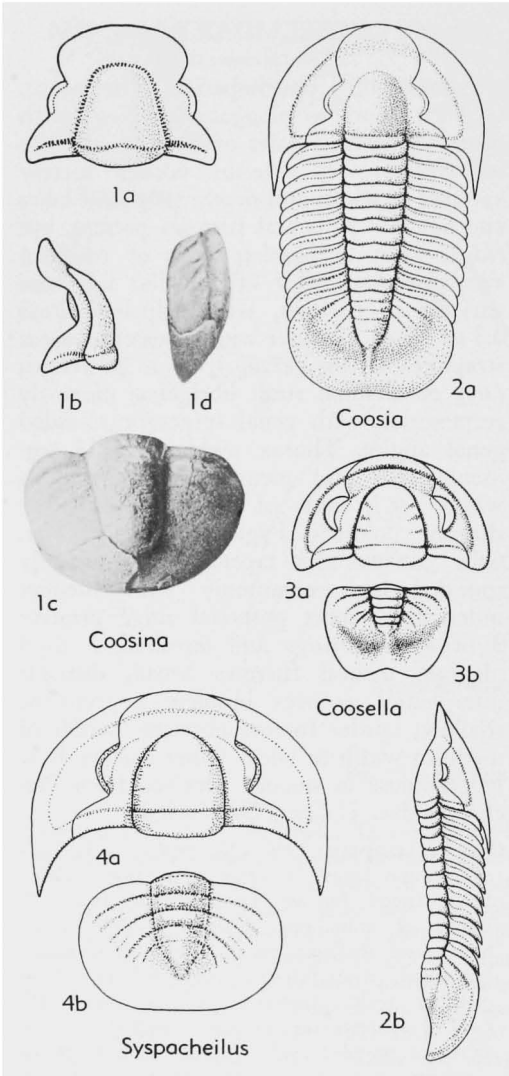


FIG. 230. Coosellidae (p. 0309-0310).

with wide marginal furrow, wide border and broad-based flat genal spines. Thorax with 12 segments, pleurae with pointed ends, pleural furrow on anterior portion of pleurae. Pygidium with axis 0.5 to 0.7 of length, pleural fields slightly wider than axis, 3 or 4 pleurae; all furrows faint to obsolete on exterior but on interior are broad pleural furrows and 2 short shallow interpleural grooves located near next posterior pleural furrow; border medium to wide, flat to concave, with slight posterior median inward bend. Surface smooth (129, 162). *U.Cam.(Dresbach.)*, N.Am.—FIG. 230,2. **C. superba*, Ala.; 2a,b, exoskel., dorsal, profile, $\times 0.7$ (488).

Coosina RASETTI, 1956 [**Maryvillia ariston* WALCOTT, 1916 (*partim*)]. Cranidium low, with

tapering glabella, no lateral furrows; frontal area with ill-defined broad shallow anterior border furrow, other furrows shallow; eye ridges very faint, eyes of medium size, slightly anterior to center of glabella; fixigenae downsloping, with posterior areas short, broadly triangular. Pygidium semi-circular, with wide stout axis, extending 0.75 of its length, 4 or 5 axial rings, postaxial ridge present; pleural fields regularly convex, with 3 or 4 broad pleurae, furrows faint to obsolete on exterior and faint on interior; border medium in width, downsloping, border furrow obsolete. Surface smooth. *U.Cam.(Dresbach.)*, N.Am.—FIG. 230,1. **C. ariston* (WALCOTT), Tenn.; 1a,b, cran., dorsal, profile; 1c,d, pyg., dorsal, profile, all $\times 1.5$ (488).

Sypsacheilus RESSER, 1938 [**S. typicalis*]. Glabella short, broad-based, tapering to narrow rounded front, lateral furrows faint to obsolete; frontal area about 0.2 length of cranidium, narrow distinct anterior border furrow; eye ridges faint; fixigenae horizontal or downsloping, with palpebral areas 0.3 to 0.5 of glabellar width, posterior areas 0.7 length (*tr.*) of occipital ring. Thorax with 13 segments, pleural furrows deep, running to ends of bluntly rounded tips. Pygidium with axis 0.7 of its length; pleural fields slightly narrower than axis, with 4 pleurae, pleural furrows broad, distinct, 2 or 3 narrow shallow interpleural grooves; border medium in width, flat or slightly concave. Surface finely granulose (162). *U.Cam.(Dresbach.)*, N.Am.—FIG. 230,4. *S. camurus* LOCHMAN, Mo.-Tex.; 4a,b, cran., pyg., $\times 2$ (440).

Family PAGODIIDAE Kobayashi, 1935

[*nom. correct.* HENNINGSMOEN, 1951 (*pro* Pagodidae KOBAYASHI, 1935)]

Exoskeleton opisthoptarian, heteropygous. Glabella convex, subcylindrical to quadrate, lateral furrows, palpebral furrows and eye ridges may be present; preglabellar field usually absent; occipital spine may be present; eyes above medium size to small, opposite or anterior to center of glabella; fixigenae variable in shape and slope; librigenae with genal spine. Thorax unknown. Pygidium transverse; axis tapered nearly full length; 2 to 6 axial rings and pleurae; border furrow and border narrow. Surface smooth or granulose. Derived from Ptychopariidae. *M.Cam.-L.Ord.*

Pagodia WALCOTT, 1905 [**P. lotos*]. Glabella subquadrate, sides nearly parallel to broad straight front, with 2 pairs of short shallow lateral furrows; eye ridges faint, eyes about medium in size; fixigenae downsloping, with palpebral areas slightly more than 0.3 of glabellar width, posterior areas stout, long (*tr.*). Pygidium transverse; axis narrower than pleural regions, with 4 axial

rings; 3 broad curved pleurae with faint pleural furrows; border narrow (315). *U.Cam.(Fengshanian)*, E.Asia.—FIG. 231,8. **P. lotos*, China (Shantung); 8a,b, cran.; 8c, librigena; 8d,e, pyg.; all $\times 4$ (315).

Aojia RESSER & ENDO, in ENDO & RESSER, 1937 [**A. spinosa*]. Glabella parallel-sided, front broadly rounded, with 2 pairs of short faint lateral furrows; occipital spine, palpebral furrows, and faint eye ridges present; eyes above medium size; fixigenae horizontal, with palpebral areas about 0.3 of

glabellar width, posterior areas small, triangular. Pygidium transverse, with axis twice width of pleural fields; 3 or 4 axial rings and pleurae; border furrow very faint, narrow border may have anterior pair of small spines (37). *M.Cam.(Taitzuian)*, NE.Asia.—FIG. 231,3. **A. spinosa*, Manch.; 3a, cran., $\times 6$; 3b,c, pyg., $\times 6$ (37). [*Aojia* KOBAYASHI, 1935, attributed to RESSER & ENDO, is *nom. nud.*—ED.]

Bienella LOCHMAN, 1944 [**B. problematica*]. Glabella subrectangular, front flatly rounded, with-

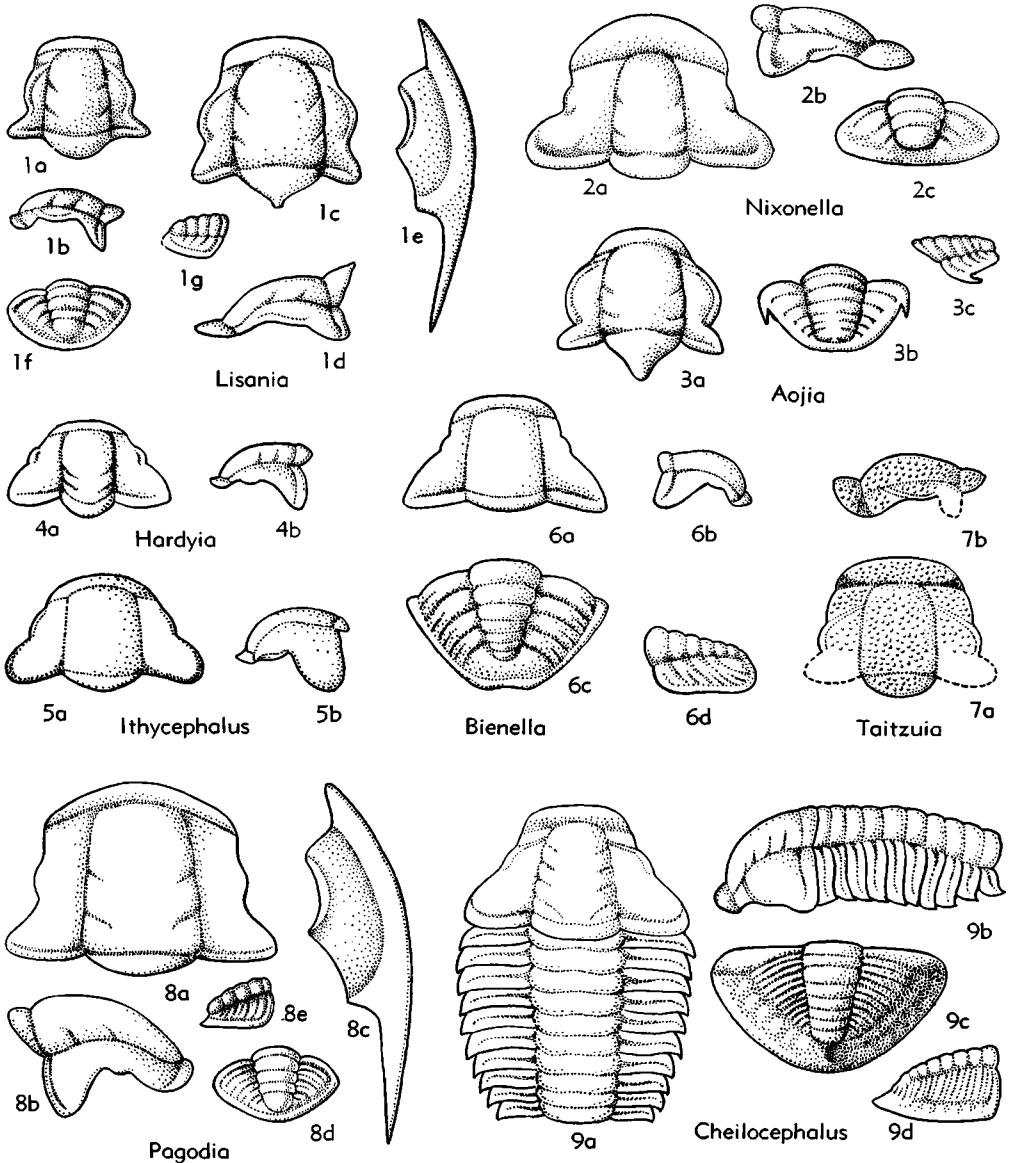


FIG. 231. Pagodiidae, Cheilocephalidae (p. 0310-0312).

- out lateral furrows, no palpebral furrows or eye ridges, eyes small; fixigenae downsloping, with palpebral areas 0.3 of glabellar width, posterior areas large, long (*tr.*) triangular. Pygidium subtriangular, with axis somewhat narrower than pleural regions, 6 axial rings; 3 or 4 wide pleurae; border narrow, with sinuous median inward bend (132). *U.Cam.*(*Dresbach.*), N.Am.—FIG. 231, 6. **B. problematica*, Mont.; *6a,b*, cran., $\times 9$, $\times 8$; *6c,d*, pyg., $\times 9$, $\times 8$ (132).
- Girandia** KOBAYASHI, 1944 [**G. typa*] [= *Giradia* KOBAYASHI, 1944]. *Up.M.Cam.*, Sib.
- Hardyia** WALCOTT, 1924 [**H. metion*]. Glabella rectangular, sides parallel to nearly straight front, with 2 pairs of short lateral furrows; fixigenae horizontal, with palpebral areas 0.5 of glabellar width, posterior areas long (*tr.*); triangular. Librigenae, thorax, and pygidium unknown (321). *L.Ord.*, W.N.Am.—FIG. 231, 4. **H. metion*, Alba.; *4a,b*, cran., $\times 6$ (321).
- Itthycephalus** RESSER, 1938 [**I. typicalis*]. Glabella low, rectangular, sides parallel to slightly rounded front, without lateral furrows; anterior border furrow running into preglabellar furrow; eyes medium in size, anterior to center of glabella; fixigenae downsloping, with palpebral areas about 0.5 of glabellar width, posterior areas bluntly rounded, triangular, longer (*tr.*) than occipital ring; posterior border furrow obsolete. Librigenae thorax and pygidium unknown (235). *U.Cam.*(*Dresbach.*), E.N.Am.—FIG. 231, 5. **I. typicalis*, Tenn.; *5a,b*, cran., $\times 7$ (425).
- Kiowaia** FREDERICKSON, 1949 [**K. timberensis*]. Glabella parallel-sided, tumid, with 2 pairs of shallow arcuate lateral furrows; no preglabellar field, shallow anterior border furrow tangent to preglabellar furrow, eye ridges faint, eyes below medium size, posterior to center of glabella; fixigenae downsloping, with palpebral areas 0.25 of glabellar width, posterior areas narrow (*exsag.*), straplike, short (*tr.*). Librigenae, thorax and pygidium unknown. Outer surface smooth (48). *U.Cam.*(*Francon.*), C.USA.
- Lisania** WALCOTT, 1911 [**Anomocarella? bura* WALCOTT, 1905]. Glabella parallel-sided, front slightly rounded with 2 pairs of faint lateral furrows; palpebral furrows and eye ridges present, occipital spine may be present; eyes slightly above medium size; fixigenae downsloping, with palpebral areas about 0.3 of glabellar width, posterior areas small and short (*tr.*). Pygidium transverse, with axis and pleural fields of same width; 3 axial rings; 3 pleurae; border furrow shallow, border narrow (315). *M.Cam.*, E.Asia.—FIG. 231, *1a,b*. **L. bura* (WALCOTT), China(Shantung); *1a,b*, cran., $\times 5$ (488).—FIG. 231, *1c-g*. *L. alala* (WALCOTT), China(Shantung); *1c,d*, cran.; *1e*, librigena; *1f,g*, pyg.; all $\times 4$ (315).
- Nixonella** LOCHMAN, 1944 [**N. montanensis*]. Glabella parallel-sided, front broadly rounded, with 2 pairs of faint lateral furrows; palpebral furrows and eye ridges faint, eyes of medium size; fixigenae horizontal, with palpebral areas 0.5 to 0.7 of glabellar width, posterior areas long (*tr.*), stout, triangular. Pygidium transverse, with axis same as pleural fields in width, 2 axial rings; 2 pleurae; border narrow (132). *U.Cam.*(*Dresbach.*), N.Am.—FIG. 231, 2. **N. montanensis*, Mont.; *2a,b*, cran., $\times 10$; *2c*, pyg., $\times 10$ (132).
- Taitzuaia** RESSER & ENDO, 1937 [**T. insueta*]. Glabella parallel-sided, front nearly straight, without lateral furrows; palpebral furrows and eye ridges present, eyes of medium size; fixigenae horizontal, with palpebral areas less than 0.5 of glabellar width, posterior areas unknown. Librigenae and pygidium unknown (37). *M.Cam.*(*Taitzuaian*), NE.Asia.—FIG. 231, 7. **T. insueta*, Manch.; *7a,b*, cran., $\times 3$ (37). [Authorship of genus should be cited as RESSER & ENDO, in ENDO & RESSER, 1937.]

Family CHEILOCEPHALIDAE Shaw, 1956

Exoskeleton opisthoparian, elliptical, macropygous. Facial sutures cedariiiform; glabella elongate, lateral furrows and eye ridges present; preglabellar field absent; eyes below medium size; fixigenae downsloping; librigenae unknown. Thorax with more than 9 segments, axis and pleurae of same width (*tr.*). Pygidium broadly semicircular, axis tapered nearly full length, with 5 to 7 axial rings; border furrow distinct, border medium in width. Surface smooth. Derived from Ptychopariidae. *U. Cam.*

Cheilocephalus BERKEY, 1898 [**C. saint croixensis*] [= *Pseudolisania* KOBAYASHI, 1935; *Bernicella* FREDERICKSON, 1949]. Glabella subrectangular, front nearly straight, up to 4 pairs of faint lateral furrows; eye ridges narrow, eyes small, opposite anterior 0.3 of glabella; fixigenae with palpebral areas 0.3 to 0.25 of glabellar width, posterior areas broadly triangular. Thorax with more than 9 segments. Pygidium semicircular; with axis wider than pleural fields, 5 to 7 axial rings and pleurae, interpleural grooves distinct, pleural furrows somewhat weaker, both in some species crossing shallow border furrow onto medium wide border (124, 317). *U.Cam.*(*U.Dresbach.-Francon.*), N.Am.—FIG. 231, 9. *C. brevibolus* (WALCOTT), *Dresbach.*, Tenn.; *9a,b*, cran. and thorax, $\times 3$; *9c,d*, pyg., $\times 3$ (317).

Superfamily LEIOSTEGIACEA Bradley, 1925

[*nom. transl.* LOCHMAN-BALK, herein (*ex* Leiostegiidae BRADLEY, 1925)]

Exoskeleton opisthoparian, heteropygous. Glabella subrectangular to quadrate, rarely broad-based tapering, lateral furrows faint to obsolete; preglabellar field very narrow or usually absent; palpebral furrows and eye ridges commonly present, eyes above or below medium size, position variable; fixigenae horizontal; librigenae may bear genal spines. Thorax with 9 or fewer segments. Pygidium broadly transverse to subtriangular; axis tapered nearly full length, may continue in terminal spine; furrows commonly faint or obsolete; border furrow and border present or absent. Surface smooth or finely granulose. Derived from Ptychopariidae. *M.Cam.-L.Ord.*

Family LEIOSTEGIIDAE Bradley, 1925

Characters of superfamily. *M.Cam.-L.Ord.*

Subfamily LEIOSTEGIINAE Bradley, 1925

[*nom. correct.* LOCHMAN-BALK, herein (*pro* Leiosteginae KOBAYASHI, 1935); *nom. transl.* KOBAYASHI, 1935 (*ex* Leiostegiidae BRADLEY, 1925)] [=Lloydidae KOBAYASHI, 1935 (*as* Lloydidae); Ordoisinae Lu, 1954]

Glabella tapering to rectangular; pygidium broadly transverse or semicircular, with pair of marginal spines or lacking spines. *U.Cam.-L.Ord.*

Lloydia VOGDES, 1890 [**Bathyurus bituberculatus* BILLINGS, 1860]. Glabella subquadrate to tapering, front rounded, with 2 pairs of anterior pits, one pair at corners of glabella and another pair slightly farther back in axial furrow; no preglabellar field; eyes below medium size, posterior to center of glabella; librigenae with rounded genal angles or short genal spines. Thorax with 9 segments. Pygidium broadly transverse to semicircular (11, 207). *L.Ord.*, N.Am.-S.Am.

L. (Lloydia). Glabella, moderately convex, broad-based tapering, with posterior pair of arcuate lateral furrows; eyes slightly behind center of glabella; fixigenae with palpebral areas very narrow, posterior areas short (*tr.*). Pygidium with axis and pleural fields of equal width, 5 to 7 axial rings, border furrow well defined (11, 207). *L.Ord.*, E.N.Am.—FIG. 232.1. *L. (*L.*) *bituberculata* (BILLINGS), Beekmantown., Que.; 1*a,b*, cran., $\times 1$; 1*c,d*, pyg., $\times 1$ (425).

L. (Leiostegium) RAYMOND, 1913 [**Bathyurus quadratus* BILLINGS, 1860]. Glabella low subrectangular, lacking lateral furrows; palpebral furrows shallow; eye ridges narrow, eyes

opposite posterior 0.3 of glabella; fixigenae with palpebral areas about 0.5 of glabellar width, posterior areas short (*tr.*). Pygidium with axis narrower than pleural fields, 4 to 6 axial rings, all furrows tending to be obsolete, border furrow on interior only, rarely a pair of posterior border spines (207). *L.Ord.*, N.Am.-S.Am.—FIG. 232.2. *L. (*L.*) *quadratum* (BILLINGS), Beekmantown., Que.; 2*a,b*, cran., $\times 1$; 2*c,d*, pyg., $\times 1$ (425).

Ambonolium RAYMOND, 1924 [**A. lioderma*] [= *Ambonstium* KOBAYASHI, 1941]. Glabella low, broadly tapering, with posterior pair of very faint lateral furrows; no preglabellar field; eyes slightly anterior to center of glabella; fixigenae with palpebral areas very narrow, posterior areas medium in length (*tr.*). Pygidium broadly transverse; axis narrower than pleural fields, 12 faint axial rings; pleural furrows and interpleural grooves obsolete; very faint border furrow and narrow border (210). *U.Cam.*(*Trempeal.*), E.N.Am.—FIG. 232.6. *A. *lioderma*, Vt.; 6*a,b*, cran., $\times 2$; 6*c,d*, pyg., $\times 2$ (210).

Cholopilus RAYMOND, 1924 [**C. vermontanus*]. Glabella low, broad subquadrate, front straight, without lateral furrows; no preglabellar field; palpebral furrows distinct, eyes above medium size, posterior to center of glabella; fixigenae with narrow palpebral areas, posterior areas small. Pygidium transverse, axial furrows very faint posteriorly, axis same in width as pleural fields, axial rings and pleurae 2 or 3, very faint, no border furrow (210). *L.Ord.*, E.N.Am.—FIG. 232.5. *C. *vermontanus*, Beekmantown., Vt.; 5*a,b*, cran. (with librigena), $\times 4$; 5*c*, pyg., $\times 2.3$ (210).

Chuangia WALCOTT, 1911 [**Ptychoparia? batia* WALCOTT, 1905] [= *Schantungia* LORENZ, 1906 (*non Shantungia* and *Shantungia* WALCOTT, 1905, ICZN pend.); *Shantungia* WALCOTT, 1913; *Chuangia* KOBAYASHI, 1936]. Glabella moderately convex, truncate-tapering, with 2 or 3 pairs of faint lateral furrows; preglabellar field very narrow; palpebral furrows and eye ridges narrow; eyes of medium size, posterior to center of glabella; fixigenae with palpebral areas 0.6 of glabellar width, posterior areas narrow, long (*tr.*). Pygidium broadly transverse, axis narrower than pleural fields; low short postaxial ridge present; only axial furrows visible on exterior but 3 axial rings and long terminal seen on interior; 3 broad faint pleurae, no border furrow (315). *Low.U. Cam.*(*Changshanian*), NE.Asia.—FIG. 232.4. *C. *batia* (WALCOTT), China(Shantung); 4*a,b*, cran., $\times 1$; 4*c,d*, pyg., $\times 1$ (315).

Chuangiella KOBAYASHI, 1935 [**C. elongata*]. *U. Cam.*(*Fengshanian*), Korea.

Chuangiopsis Sivov, 1955 [**C. sibirica*]. *U.Cam.*, Siberia. [Author's assignment.]

Evansaspis KOBAYASHI, 1955 [**Leiostegium (Evansaspis) glabrum*]. Glabella rectangular, anterior

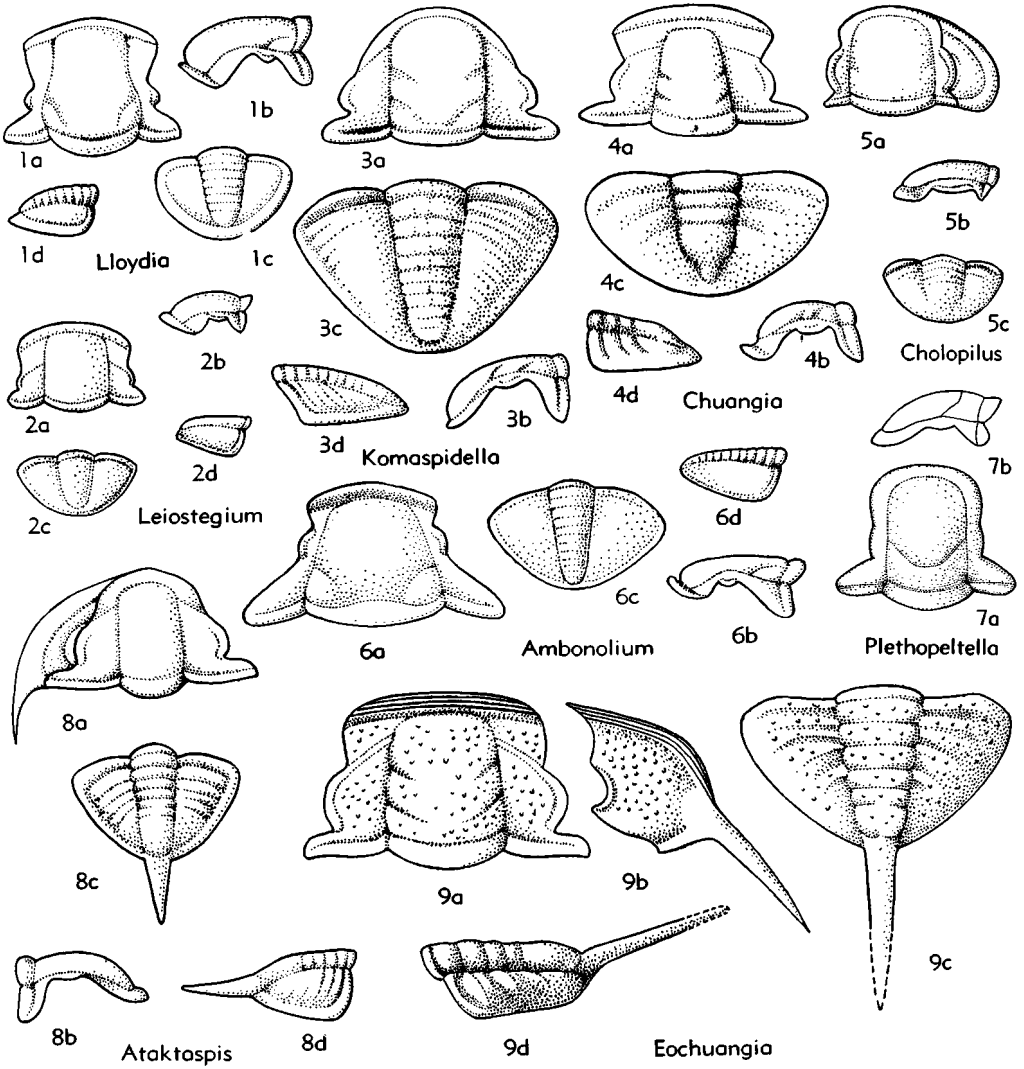


FIG. 232. Leiostegiidae (p. 0313-0315).

lobe slightly expanded, no lateral furrows; no preglabellar field; eye ridges absent, eyes just above medium size, posterior to center of glabella; fixigenae with palpebral areas about 0.5 width of glabellar area, posterior areas short (*tr.*). Pygidium broadly transverse; axis narrower than pleural fields, with 6 axial rings (posterior 2 faint) and terminal; pleural fields convex, smooth; narrow border furrow; border medium in width, convex; posterior margin curved, with pair of round, straight, medium-length spines at posterolateral corners. *L.Ord.*, W.N.Am.

Idamea WHITEHOUSE, 1939 [**I. venusta*]. Glabella convex, subrectangular, front rounded, without lateral furrows; no preglabellar field; eyes of medium size, posterior to center of glabella; fixi-

genae with palpebral areas about 0.5 of glabellar width. Pygidium broadly transverse, axis narrower than pleural fields; 5 or 6 axial rings, 3 or 4 pleurae; border furrow shallow, border medium (340). *U.Cam.*, Austral.

Kassinus IVSHIN, 1953 [**K. kassinii*]. Glabella moderately convex, truncate-tapering, with 3 pairs of diagonal lateral furrows; preglabellar field narrow, anterior border furrow distinct, anterior border medium in width, convex; palpebral furrows and eye ridges present, eyes medium in size, posterior to center of glabella; fixigenae with palpebral areas 0.5 of glabella width, posterior areas triangular; librigenae and pygidium unknown. *M. Cam.*, SW.Sib.

Komaspidella KOBAYASHI, 1938 [**Agraulos? thea*

WALCOTT, 1890]. Glabella low quadrate, front rounded, with 2 or 3 pairs of shallow lateral furrows; no preglabellar field; palpebral furrows and eye ridges faint, eyes of medium size, posterior to center of glabella; fixigenae with palpebral areas less than 0.5 of glabellar width, posterior areas narrow long (*tr.*). Pygidium triangular; axis long, narrower than pleural fields; 5 to 7 faint axial rings and pleurae, very faint pleural furrows and interpleural grooves; no border furrow, very narrow border (186). *U.Cam.* (Dresbach.), N.Am.—FIG. 232,3. **K. thea* (WALCOTT), Wis.; 3a,b, cran., $\times 3$; 3c,d, pyg., $\times 3$ (186).

Ordosia LU, 1954 [**O. fimbriicauda*]. Glabella moderately convex, truncate-tapering, with 2 or 3 pairs of short lateral furrows; narrow, restricted, concave preglabellar field; short occipital spine; faint eye ridges, eyes of medium size, opposite center of glabella; fixigenae with palpebral areas 0.75 of glabellar width, posterior areas narrow, long (*tr.*). Pygidium broadly semielliptical; axis about same in width as pleural fields, axis convex, tapered nearly full length, 7 or 8 axial rings, may have minute median axial nodes; 6 or 7 pleurae with distinct interpleural grooves and faint pleural furrows; border furrow narrow, distinct; border medium in width, concave. Surface smooth. *Up.M.Cam.* (Kushanian), NE.Asia. FIG. 233,1. **O. fimbriicauda*, Inner Mongolia (Tsingshuiho dist.); a,b, cran., pyg., $\times 5$ (426).

Perischodory (*sic*) RAYMOND, 1937 [**P. grandgei*]. Cephalon unknown. Pygidium broadly transverse, axis narrower than pleural fields, 6 axial rings and long terminal, pleural fields smooth, narrow border furrow, narrow convex border, a pair of rounded, medium-size, curved spines at anterolateral corners. Surface smooth. *L.Ord.*, Vt.

Subfamily EOCHUANGIINAE Kobayashi, 1935

[*nom. correct.* LOCHMAN-BALK, herein (*pro* Eochuanginae KOBAYASHI, 1935)]

Glabella subrectangular to quadrate. Pygidium subtriangular with terminal axial spine. *M.Cam.-U.Cam.*

Eochuangia KOBAYASHI, 1935 [**E. hana*]. Glabella low truncate-tapering, front nearly straight, with 2 pairs of faint lateral furrows; no preglabellar field; narrow palpebral furrows, diagonal eye ridges, eyes above medium size, slightly posterior to center of glabella; fixigenae with palpebral areas 0.5 of glabellar width, posterior areas very narrow, medium in length (*tr.*). Pygidium subtriangular, axis narrower than pleural fields, with 5 axial rings; 3 broad pleurae crossed by 1 or 2 narrow ridges and broad interpleural grooves (97). *M.Cam.* (Taitzuan), NE.Asia.—FIG. 232, 9. **E. hana*, China; 9a, cran.; 9b, librigena; 9c,d, pyg.; all $\times 1.5$ (97).

Aktaspis LOCHMAN & DUNCAN, 1944 [**A. modesta*]. Glabella low subrectangular, front rounded,

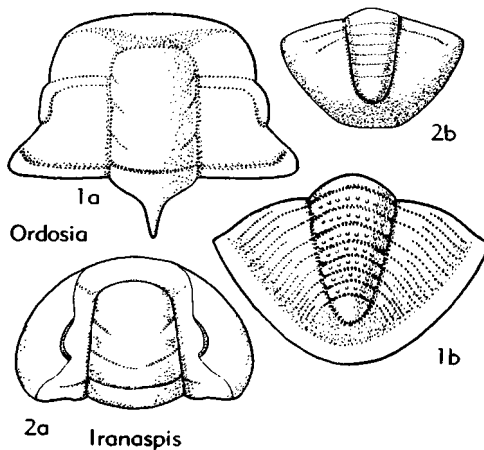


FIG. 233. Leiostegiidae (p. 0315).

without lateral furrows; no preglabellar field; palpebral furrows shallow, eye ridges narrow, eyes of medium size, posterior to center of glabella; fixigenae with palpebral areas 0.5 of glabellar width, posterior areas narrow, quite long (*tr.*). Pygidium triangular; axis narrower than pleural fields, with 3 to 5 axial rings and long terminal, with faint furrows; 1 to 4 broad faint pleurae; border furrow faint, border narrow (132) *U.Cam.* (Dresbach.), N.Am.—FIG. 232,8. **A. modesta*, Mont.; 8a,b, cran. (with librigena), $\times 5$; 8c,d, pyg.; $\times 5$ (132).

Subfamily IRANASPIDINAE Lochman, nov.

Glabella broadly rectangular. Pygidium semicircular, without spines. *U.Cam.-L.Ord.*

Iranaspis KING, 1937 [**I. harrisoni*]. Glabella low, rectangular, front slightly rounded, posterior lateral furrows faint, complete, 2nd pair very faint and short; no preglabellar field, diagonal anterior border furrow in front of fixigenae only; eyes of medium size, slightly posterior to center of glabella; fixigenae with palpebral areas 0.3 of glabellar width, posterior areas medium in length (*tr.*); librigenae elongate, with rounded genal angles. Pygidium low, smooth on outer surface, faint furrows on inner surface; axis of medium width, tapering nearly full length, 6 axial rings and terminal, pleural fields wider than axis, bearing 3 faint interpleural grooves; border furrow, narrow and shallow, border narrow, flat to down-sloping. *Up.U.Cam.*, Iran.—FIG. 233,2. **I. harrisoni*, PaVashtah; 2a,b, ceph., pyg., $\times 2$ (418).

Plethopeltella KOBAYASHI, 1943 [**Plethopeltis resseri* KOBAYASHI, 1933]. Glabella low, rectangular, front corners rounded, posterior lateral furrows complete, very faint; no preglabellar field or anterior border furrow; eyes of medium size, slightly

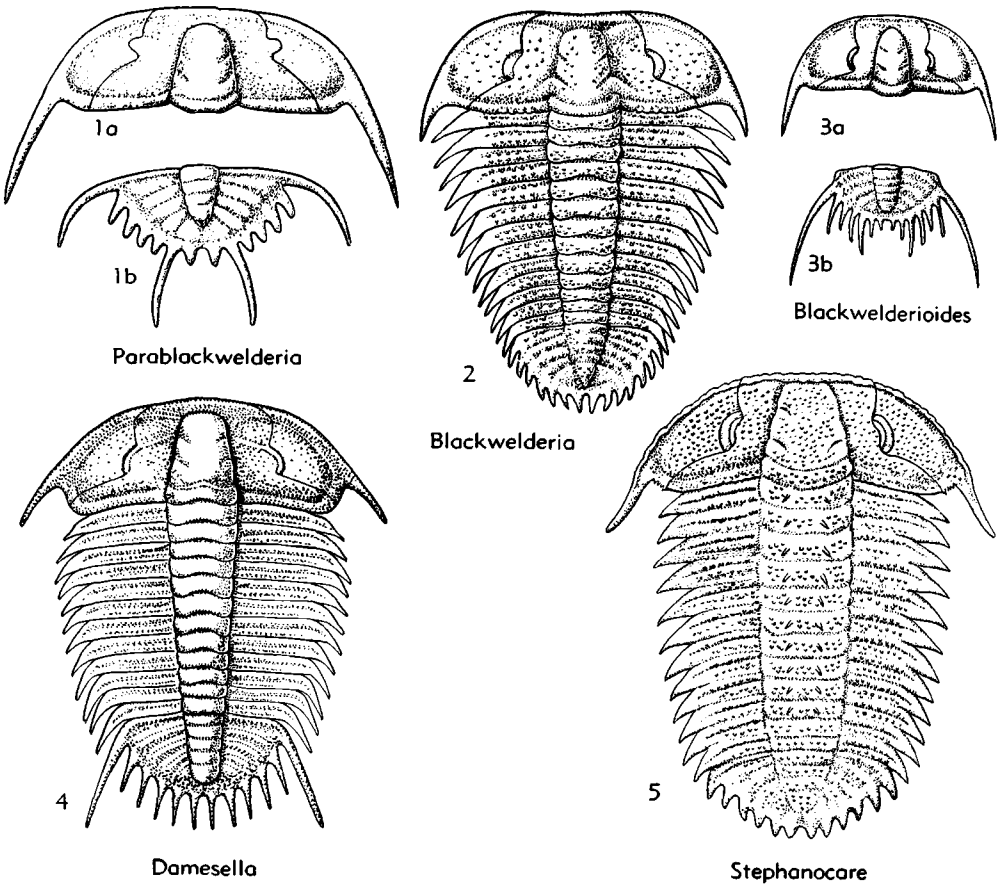


FIG. 234. Damesellidae (p. 0317-0318).

behind center of glabella; fixigenae with palpebral areas about 0.2 of glabellar width, posterior areas medium in length (*tr.*); librigenae, thorax, and pygidium unknown (102). *L.Ord.*, NE.Asia. —FIG. 232,7. **P. resseri* (KOBAYASHI), Wawanian, S.Manch.; 7*a,b*, cran., $\times 1.5$ (102).

Superfamily DAMESELLACEA Kobayashi, 1935

[*nom. transl.* LOCHMAN-BALK, herein (*ex* Damesellidae KOBAYASHI, 1935)]

Exoskeleton opisthoparian, medium-sized, ellipsoidal, subisopygous. Glabella narrow to broad-based, tapering forward, with rounded or truncate anterior extremity, bearing deep to faint lateral furrows; preglabellar field usually narrow or absent, anterior border furrow distinct; librigenae bearing short to medium-length genal spines. Thorax with 13 or fewer segments.

Pygidium transverse, with rapidly tapered axis, extending nearly full length; border narrow; border furrow obsolete or extending only along posterior margin; 1 to 7 pairs of pleural pygidial spines of variable lengths. Surface finely to coarsely granulose; short marginal spines may be present on cephalon. *Up.M.Cam.-U.Cam.*

Family DAMESELLIDAE Kobayashi, 1935

Exoskeleton opisthoparian, subisopygous. Glabella tapering, with 2 or 3 pairs of lateral furrows; palpebral rim and furrow present, eye ridges present or absent, eyes variable in size and position; preglabellar field present or absent; fixigenae upsloping, with wide palpebral areas, posterior areas triangular, of variable length; librigenae subrectangular, with stout genal

spines, may be lateral in position. Thorax with 10 to 13 segments; axis convex; pleurae flat, ending in spines, 1.5 to 2 times width (*tr.*) of axis, with broad pleural furrow in center. Pygidium semicircular to transverse; axis convex, extending nearly full length to rounded end, with 3 or 4 axial rings and terminal; 5 or 6 pleurae ending in spines of variable length along margin, interpleural grooves obsolete except for faint anterior pair or line of granules, pleural furrows broad; border furrow shallow or obsolete, border narrow or absent. Surface with granules and small spines. *Up.M.Cam.-Low.U.Cam.*

Subfamily DAMESELLINAE Kobayashi, 1935

Glabella moderately convex, narrow tapering, front slightly rounded to nearly straight; eyes of medium size, opposite or behind center of glabella; fixigenae slightly upsloping; librigenae wide, subquadrate. *Up.M.Cam.*

Damesella WALCOTT, 1905 [**Cheirus paronai* AIRAGHI, 1902 (= *Damesella blackwelderi* WALCOTT, 1905)]. Glabella with 3 pairs of short diagonal lateral furrows; no preglabellar field, anterior border furrow running into preglabellar furrow, narrow convex border; eye ridges long, diagonal, eyes behind mid-length of glabella; fixigenae with palpebral areas 0.7 to equal width of glabella, posterior areas of medium width (*exsag.*), long, with deep posterior border furrow; librigenae with genal spines in lateral or longitudinal position. Thorax with 12 segments. Pygidium semicircular; 4 axial rings and terminal; pleural fields slightly convex, equal to axis in width, with 5 to 7 pleurae, 6 to 8 marginal spines of variable length, of which anterior pair may be longest. Surface with granules of several sizes. *Up.M.Cam.*, E.Asia.—FIG. 234,4. **D. paronai* (AIRAGHI), Wentsui Sh., China(Shantung); exoskel., $\times 0.7$ (419).

Blackwelderia WALCOTT, 1906 [**Calymene sinensis* BERGERON, 1899]. Glabella with 2 or 3 pairs of lateral furrows; preglabellar field present, anterior border furrow concave, anterior border rimlike; eye ridges very faint or obsolete, eyes opposite center of glabella; fixigenae with palpebral areas about equal to glabella in width, posterior areas of medium width (*exsag.*), as long or longer than occipital ring; librigenae with short to medium-length genal spines. Thorax with 13 segments. Pygidium semicircular; 4 axial rings and terminal; pleural fields moderately convex, same as axis in width, 5 pleurae with faint anterior interpleural grooves; border furrow shallow,

border narrow, with 7 pairs of subequal to variably long marginal spines. Surface with coarse granules, a fringe of small nodes on posterior margin of librigenae. *Up.M.Cam.*, E.Asia.—FIG. 234,2. **B. sinensis* (BERGERON), Kushanian, China (Shantung); exoskel., $\times 1.3$ (419).

Blackwelderioides HUPÉ, 1955 [**Stephanocare? monkei* WALCOTT, 1911]. Glabella with narrow, rounded front, 2 pairs of short lateral furrows; preglabellar field straight, narrow; eye ridges obsolete, eyes opposite center of glabella; fixigenae with palpebral areas 0.7 of glabellar width, posterior areas of medium width (*exsag.*), as long or longer than occipital ring; librigenae with short genal spines. Thorax unknown. Pygidium transverse; 4 axial rings and terminal; pleural fields wider than axis, low, with 5 pleurae that bear broad deep pleural furrows running into base of spines; border furrow obsolete, border narrow, poorly defined, with 7 or 8 pairs of marginal spines, anterior pair much longer than others. Surface very finely granulose or smooth. *Up.M.Cam.*, E.Asia.—FIG. 234,3. **B. monkei* (WALCOTT), Kushanian, China(Shantung); *3a,b*, ceph., pyg., $\times 1.3$ (419).

Stephanocare MONKE, 1903 [**S. richthofeni*; SD WALCOTT, 1913]. Glabella nearly straight in front, with 2 pairs of lateral furrows; no preglabellar field, anterior border furrow running into preglabellar furrow, border rimlike; eye ridges obsolete, eyes posterior to center of glabella, fixigenae with palpebral areas 0.5 of glabellar width, posterior areas of medium width (*exsag.*), same in length (*tr.*) as occipital ring; librigenae with short, laterally directed genal spines. Thorax with 12 segments. Pygidium narrow semicircular; 3 axial rings and terminal; pleural fields low, narrower than axis, with 6 pleurae ending in marginal spines, 4 shallow pleural furrows; no border furrow or border. Outer surface densely granulose, pair of short median spines on axis of thoracic segments, posterior margin and anterior and lateral borders of cephalon fringed with short spines and nodes (65). *Up.M.Cam.*, E.Asia.—FIG. 234,5. **S. richthofeni*, Kushanian, China(Shantung); exoskel., $\times 2$ (419).

Subfamily DREPANURINAE Hupé, 1953

Glabella convex, tapering to broad-based truncate-tapering; eyes small, opposite or in front of mid-length of glabella; fixigenae steeply upsloping to elevated; librigenae elongate, rectangular. *Up.M.Cam.-Low.U.Cam.*

Drepanura BERGERON, 1899 [**D. premesnili*]. Glabella broad-based tapering, front nearly straight, with 2 pairs of short deep lateral furrows; no preglabellar field, shallow border furrow running into preglabellar furrow, anterior border rimlike;

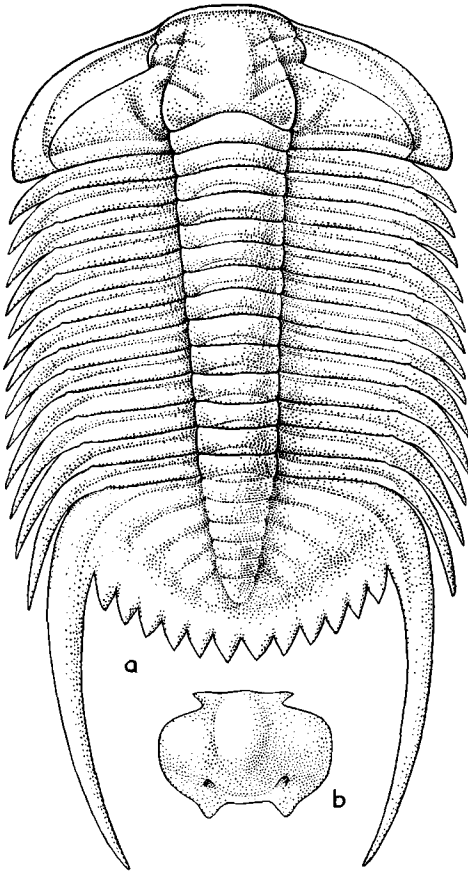


FIG. 235. *Drepanura premesnili* BERGERON (Damesellidae), *Low.U.Cam.*, China; *a, b*, exoskel., hypostoma, $\times 1.5$ (377).

eyes slightly anterior to center of glabella, faint diagonal eye ridges; fixigenae with palpebral areas 0.3 of glabellar width or slightly less, posterior areas of variable width (*exsag.*), length (*tr.*) equal to occipital ring; librigenae with medium-length genal spines or blunt genal angles. Hypostoma subquadrate, with small anterior wings, oval central lobe, semicircular posterior lobe wide at sides with pair of posterior projections, bearing 2 deep pits joined by furrow. Thorax with 13 segments. Pygidium semicircular; 3 to 5 axial rings and terminal; pleural fields moderately convex, about equal to axis in width, with 5 pleurae, anterior pair enlarged, 5 pleural furrows, anterior pair continuing into spines; no border furrow, border very narrow, with 7 to 9 marginal spines, anterior pair enlarged. Surface granulate (65). *Up.M.Cam.-Low.U.Cam.*, E.Asia.-W.Eu.—FIG. 235. *D. premesnili*, Kushanian, China (Shantung); *a*, exoskel., $\times 1.5$; *b*, hypostoma, $\times 1.5$ (419).

Parablackwelderia KOBAYASHI, 1942 [**Blackwelderia spectabilis* RESSER & ENDO, 1937]. Glabella tapering, with 2 pairs of short faint diagonal lateral furrows; preglabellar field and anterior border furrow present, anterior border rimlike; eye ridges faint, eyes opposite anterior 0.25 of glabella; fixigenae with palpebral areas 0.7 of glabellar width, posterior areas wide (*exsag.*), longer (*tr.*) than occipital ring; librigenae with medium-length genal spines. Pygidium semicircular; 3 axial rings and terminal; pleural fields moderately convex, equal to axis in width, with 5 pleurae, 5 pairs of pleural furrows; no border furrow, narrow flat border with 7 pairs of marginal spines of variable length. Surface unknown. *Up.M.Cam.*, E.Asia.—FIG. 234, I. **P. spectabilis* (RESSER & ENDO), Kushanian, Manch.; *a, b*, cep., pyg., $\times 7$ (419). [Authorship of type species should be cited as RESSER & ENDO, in ENDO & RESSER.—Ed.]

Family KAOLISHANIIDAE Kobayashi, 1935

[*nom. transl. et correct.* LOCHMAN-BALK, herein (*ex Kaolishaniinae* KOBAYASHI, 1935)] [=Mansuyinae HUPÉ, 1955]

Exoskeleton opisthoparian, subisopygous. Glabella truncate-tapering to quadrate, with lateral furrows; preglabellar field present or absent, anterior border convex, narrow; eye ridges present or absent, narrow palpebral rims and palpebral furrows present, eyes of medium size, variable in position; fixigenae very slightly upsloping, with palpebral areas 0.3 to 0.5 of glabellar width, posterior areas triangular, about equal to occipital ring in length (*tr.*); librigenae rectangular, genal spines short to medium length. Thorax unknown. Pygidium semicircular to subrectangular; axis convex, tapering slightly to rounded end; 4 to 7 axial rings and terminal; pair of large straight or curved spines originating from pleural fields incorporate posterior 0.5 of 1st segment and anterior 0.5 or all of the 2nd segment, interpleural grooves and pleural furrows present or obsolete; border furrow obsolete, border only along posterior. Surface coarsely or finely granulate. *U.Cam.*

Kaolishania SUN, 1924 [**K. pustulosa*]. Glabella moderately convex, broad, with nearly straight front, posterior lateral furrows deep and arcuate; no preglabellar field, anterior border furrow running into preglabellar furrow; eye ridges distinct, eyes opposite center of glabella; fixigenae with palpebral areas about 0.3 of glabellar width, posterior areas medium in width (*exsag.*); librigenae elongate rectangular, with long genal

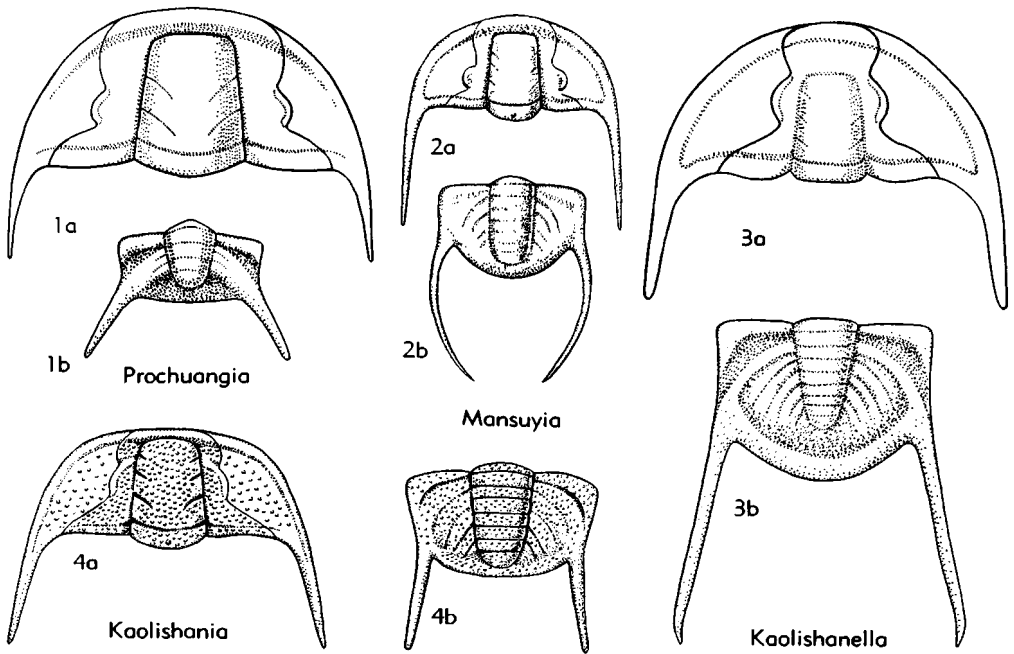


FIG. 236. Kaolishaniidae (p. 0318-0319).

spines, posterior and lateral border furrows fading into base of spines. Pygidium subrectangular; axis tapered nearly full length, with 6 axial rings and terminal; moderately convex, pleural fields same in width as axis, interpleural grooves obsolete, with 5 pairs of distinct curved pleural furrows, spines extended from posterior 0.5 of 1st pleurae and anterior 0.5 of 2nd pleurae; narrow flat border (288). *U.Cam.(Kaolishan.)*, E.Asia.—FIG. 236,4. **K. pustulosa*, China(Shantung); 4a,b, ceph., pyg., $\times 4$ (478).

Kaolishaniella SUN, 1935 [**K. transita*]. Glabella low, with rounded front, lateral furrows faint; preglabellar field present; no eye ridges, eyes opposite anterior 0.3 of glabella; fixigenae with arcuate palpebral areas, 0.3 of glabellar width, posterior areas of medium width (*exsag.*); librigenae narrow, rectangular, with short genal spines. Pygidium semicircular; axis tapered, 0.7 of length of pygidium, with 7 axial rings and terminal; pleural fields low, wider than axis, with 7 pleurae separated by curved interpleural grooves, anterior 2 segments crossed by pleural furrows, spines developed from 2nd segment; border flat (289). *U.Cam.(Kaolishan.)*, E.Asia.—FIG. 236,3. **K. transita*, China(Hopei); 3a,b, ceph., pyg., $\times 2$, (478).

Mansuyia SUN, 1924 [*emend.* SUN, 1935] [**M. orientalis*] [= *Paramansuyella* ENDO in ENDO & RESSER, 1937]. Glabella convex, narrow, with rounded front, lateral furrows faint; no pre-

glabellar field, broad shallow anterior border furrow, narrow upturned anterior border; eye ridges faint, eyes opposite posterior 0.3 of glabella; fixigenae with palpebral areas 0.5 of glabellar width, posterior areas narrow (*exsag.*); librigenae narrow, rectangular, with long slender genal spines. Pygidium semicircular; axis tapered nearly full length, with 4 axial rings and terminal, may have 2 faint additional rings; pleural fields low, same in width as axis, with 4 pleurae and 4 or 5 pleural furrows, interpleural grooves obsolete, spines developed from posterior 0.5 of 1st pleurae and anterior 0.5 of 2nd pleurae; border undeveloped (288, 289). *U.Cam.(Kaolishan.)*, E.Asia.—FIG. 236,2. **M. orientalis*, China(Shantung); 2a,b, ceph., pyg., $\times 1.3$, $\times 2$ (a, 478; b, 419).

Prochuangia KOBAYASHI, 1935 [**P. mansuyi*]. Glabella low, front nearly straight, lateral furrows very faint; no preglabellar field, broad shallow anterior border furrow, narrow anterior border; no eye ridges, eyes almost opposite posterior 0.3 of glabella; fixigenae with palpebral areas 0.5 of glabellar width, posterior areas below medium width (*exsag.*); librigenae with short genal spines. Pygidium subrectangular, axis tapered nearly full length, with 4 axial rings and terminal; pleural fields low, about same in width as axis, anterior pair of pleural furrows distinct, all others and interpleural grooves obsolete, spines developed from posterior 0.5 of 1st pleurae and entire 2nd pleurae; border undeveloped (97).

U.Cam. (Changshan.), E.Asia.-S.Asia.—FIG. 236, 1. **P. mansuyi*, S.Korea; *1a,b*, ceph., pyg., $\times 1.5$ (419).

Superfamily PTYCHASPIDACEA Raymond, 1924

[*nom. correct.* LOCHMAN-BALK, 1956 (*pro* Ptychaspidae RAYMOND, 1924)] [=Ptychaspidoidea HUPÉ, 1953]

Exoskeleton opisthoparian, medium-sized, ellipsoidal, subsopygous. Glabella broad-based, rectangular to tapering forward, in some with expanded anterior lobe, with 2 or 3 pairs of lateral glabellar furrows, posterior pairs commonly transglabellar; preglabellar field narrow or absent, anterior border furrow tending to be obsolete; librigenae with medium-length to long genal spines. Thorax with 12 or fewer segments. Pygidium ovoid to narrow transverse; with border furrow shallow to obsolete, margin bearing 1 to 5 pairs of pleural spines in some genera. Surface finely or coarsely granulose, marked by imbricating ridges. *U.Cam.*

Family PTYCHASPIDIDAE Raymond, 1924

[*nom. correct.* LOCHMAN-BALK, 1956 (*pro* Ptychaspidae RAYMOND, 1924)] [=Euptychaspidae HUPÉ, 1953]

Exoskeleton opisthoparian, isopygous. Glabella tapering, subquadrate or subrectangular, anterior lobe swollen in late genera, with 3 or 4 pairs of lateral furrows, posterior pair commonly deep and complete, middle pair may be likewise; preglabellar field and anterior border furrow may be lost; palpebral furrows and eye ridges usually distinct, eyes of medium size or below, position variable; fixigenae horizontal or upsloping; librigenae with wide eye platforms and stout genal spines. Thorax unknown. Pygidium broadly transverse to semicircular; axis tapered nearly full length, may have postaxial ridge; pleural fields wider than axis; border furrow shallow or obsolete. Surface granulose, ridged or punctate. Derived from Ptychopariidae. *U.Cam.*

Ptychaspis HALL, 1863 [**Dikelocephalus miniscaensis* OWEN, 1852; SD MILLER, 1889] [=*Asioptychaspis* KOBAYASHI, 1933; *Fengshania* SUN, 1935]. Glabella subrectangular to subquadrate, front rounded, anterior lobe commonly swollen; anterior border furrow obsolete; eyes opposite or in front of mid-length of glabella; fixigenae upsloping,

with palpebral areas slightly more than 0.3 of glabellar width, posterior areas stout, of medium length (*tr.*). Pygidium with all furrows distinct, 4 or 5 axial rings, 4 or 5 pleurae, border flat. Surface granulose, irregular ridges invariably on border of cephalon and in some also on genae and glabella (8, 156). *U.Cam.* (Francon.), N.Am.-E.Asia.—FIG. 237,5a-e. **P. miniscaensis* (OWEN), Wis.; *5a,b*, cran.; *5c*, librigena; *5d,e*, pyg.; all $\times 0.7$ (53).—FIG. 237,5f-j. *P. granulosa* (OWEN), Wis.; *5f,g*, cran., $\times 1.2$, $\times 1$; *5h*, librigena, $\times 1$; *5i,j*, pyg., $\times 1$ (8, 53).

Anderssonella KOBAYASHI, 1936 [*pro Anderssonia* SUN, 1924 (*non* STREBEL, 1908; *nec* KLUGE, 1914)] [**Ptychaspis* (*Anderssonia*) *fengtienensis* SUN, 1924] [=*Andersonia* KOBAYASHI, 1930; *Sumina* STRAND, 1943 (*obj.*)]. Glabella subrectangular or tapering forward, front rounded; anterior border furrow well defined; eye ridges faint, eyes opposite or slightly behind mid-length of glabella; fixigenae upsloping, with palpebral areas less than 0.5 of glabellar width, posterior areas unknown. Pygidium semicircular, all furrows distinct, with 5 axial rings and 5 broad pleurae separated by interpleural ridges rather than grooves that curve across flat border to margin (288). *U.Cam.*, E. Asia.—FIG. 237,7. **A. fengtienensis* (SUN), China (Fengtien); *7a,b*, cran., pyg., $\times 4$ (288).

Changia SUN, 1924 [**C. chinensis*]. Glabella rectangular, front straight, posterior part low, anterior lobe swollen, with 3 pairs of lateral furrows; frontal area 0.25 of length (*sag.*) of cranium, anterior border furrow obsolete; eyes of medium size, opposite center of glabella; fixigenae upsloping, with palpebral areas 0.5 of glabellar width, posterior areas 0.75 of length (*tr.*) of occipital ring; librigenae with obsolete lateral border furrows and medium-length slender genal spines. Pygidium semicircular, with short postaxial ridge extending to margin, 4 axial rings and terminal with 1 or 2 faint axial rings; 4 or 5 pleurae, with shallow pleural furrows; border furrow obsolete. Surface smooth (288). *U.Cam.* (Fengshan.), E. Asia.—FIG. 238,1. **C. chinensis*, China (Shantung); *1a,b*, ceph., pyg., $\times 1$ (478).

Conaspis HALL, 1863 [**Conocephalites perseus* HALL, 1863; SD WALCOTT, 1914]. Glabella parallel-sided or tapering, front rounded; anterior border furrow distinct, palpebral furrows present, eye ridges very weak, eyes opposite center of glabella; fixigenae horizontal, with palpebral areas 0.3 of glabellar width, posterior areas narrow, of medium length (*tr.*). Pygidium narrowly semicircular, furrows shallow, especially border furrow; 3 axial rings, 3 broad pleurae; border narrow (156). *U.Cam.* (Francon.), C.USA.—FIG. 237,1. **C. perseus* (HALL), Wis.; *1a,b*, cran.; *1c*, librigena; *1d*, pyg.; all $\times 1.5$ (53, 156).

Coreanocephalus KOBAYASHI, 1935 [**C. kogonensis*]. Glabella low, truncate-tapering, front nearly

straight with 2 pairs of shallow complete arcuate lateral furrows; frontal area about 0.25 of length (*sag.*) of cranium, anterior border furrow obsolete; eyes of medium size, opposite center of glabella; fixigenae upsloping, with arcuate palpebral areas about 0.5 of glabellar width, posterior areas

of medium width (*exsag.*), 0.75 of length (*tr.*) of occipital ring; librigenae with medium-length genal spines, lateral border furrows obsolete. Pygidium unknown. Surface smooth (97). *U.Cam.* (*Fengshan.*), E.Asia.—FIG. 238,2. **C. kogensis*, S.Korea; ceph., $\times 1.5$ (419).

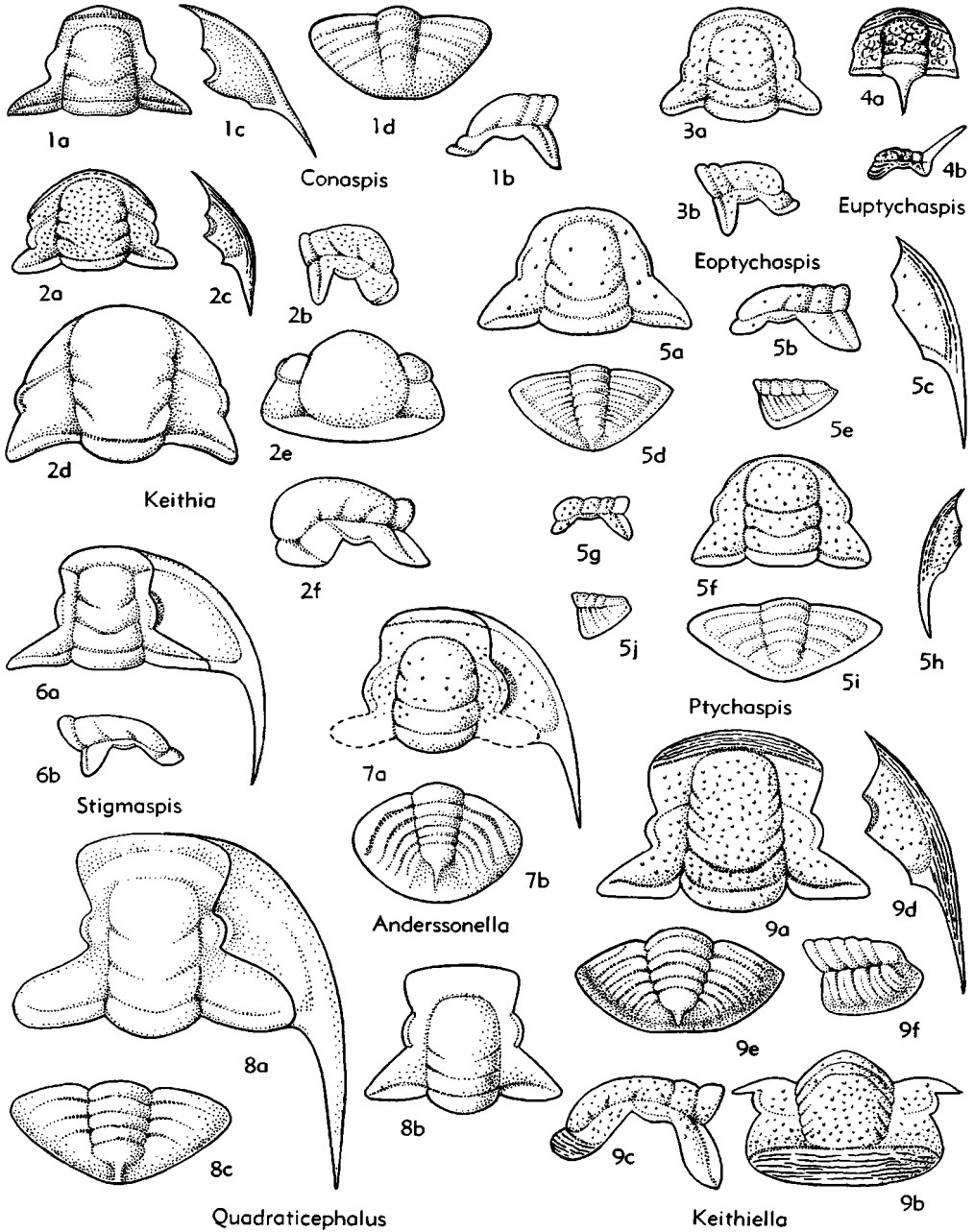


FIG. 237. Ptychaspididae (p. 0320-0322).

- Eoptychaspis** NELSON, 1951 [**E. cylindrica*]. Glabella parallel-sided, subquadrate, front rounded; anterior border furrow very faint; eyes opposite center of glabella; fixigenae horizontal, with palpebral areas more than 0.3 of glabellar width, posterior areas of medium width and length (*tr.*). Librigenae and pygidium unknown (156). *U.Cam.* (Francon.), C.USA.—FIG. 237.3. **E. cylindrica*, Wis.; 3*a,b*, cran., $\times 1.3$, $\times 1$ (156, 425).
- Euptychaspis** ULRICH in BRIDGE, 1930 [**E. typicalis*]. Glabella parallel-sided, subquadrate, sides parallel to swollen anterior lobe; anterior border furrow obsolete; frontal area convex, ridged; short stout occipital spine; eye ridges faint, eyes below medium size, slightly behind mid-length of glabella; fixigenae slightly upsloping, with palpebral areas more than 0.5 of glabellar width and posterior areas about same in width (*tr.*). Librigenae and pygidium unknown. Surface reticulate (303). *U.Cam.* (Trempeal.), W.USA-C.USA.—FIG. 237.4. **E. typicalis*, Mo.; 4*a,b*, cran., $\times 4$ (303).
- Keithia** RAYMOND, 1924 [**K. schucherti*]. Glabella parallel-sided, subquadrate, sides tapered to rounded front or diverging to swollen anterior lobe; no preglabellar field, anterior border furrow running into axial furrows; eye ridges faint, eyes below medium size, behind mid-length of glabella; fixigenae upsloping, with palpebral areas almost 0.5 of glabellar width, posterior areas triangular, long (*tr.*). Pygidium unknown (188, 189). *U.Cam.* (Trempeal.), E.N.Am.—FIG. 237.2*a-c*. *K. connexa* RASSETTI, Que.; 2*a,b*, cran., $\times 2$; 2*c*, librigena, $\times 2$ (188).—FIG. 237.2*d-f*. *K. similis* RASSETTI, Que.; 2*d-f*, cran., dorsal, front, profile, $\times 3$ (188).
- Keithiella** RASSETTI, 1944 [**Arionellus cylindricus* BILLINGS, 1860]. Glabella parallel-sided, subquadrate, front rounded; no preglabellar field, anterior border furrow running into axial furrows; eye ridges faint, eyes slightly behind mid-length of glabella; fixigenae upsloping, with palpebral areas almost 0.5 of glabellar width, posterior areas subtriangular, long (*tr.*). Pygidium narrowly semi-circular, all furrows distinct except shallow border furrow; 4 or 5 axial rings, 5 broad pleurae separated by interpleural ridges crossing flat border to margin (188, 192). *U.Cam.* (Trempeal.), E.N.Am.-?S.Am.—FIG. 237.9. **K. cylindrica* (BILLINGS), Que.; 9*a-c*, cran., dorsal, front, profile; 9*d*, librigena; 9*e,f*, pyg.; all $\times 3.5$ (188, 192).
- Quadricephalus** SUN, 1924 [**Q. walcotti*]. Glabella parallel-sided, subrectangular, front nearly straight; anterior border furrow shallow or obsolete, preglabellar field downsloping; eyes of medium size, slightly in front of mid-length of glabella; fixigenae upsloping, with palpebral areas more than 0.3 of glabellar width, posterior areas large, subtriangular, long (*tr.*). Pygidium broadly transverse, furrows shallow, no border furrow; 4 axial rings, 3 broad pleurae, interpleural grooves extending to margin. Surface ridged or punctate (37, 288). *U.Cam.* (Fengshanian), E.Asia.—FIG. 237.8*a*. **Q. walcotti*, China (Shantung); cran. (with librigena) $\times 1$ (288).—FIG. 237.8*b,c*. *Q. teres* RESSER & ENDO, in ENDO & RESSER (1937), Manch.; 8*b,c*, cran., pyg., $\times 4$ (37).
- Saukioides** KOBAYASHI, 1952 [*pro Pseudosaukia* KOBAYASHI, 1951 (non RASSETTI, 1944)] [**Pseudosaukia sumi* KOBAYASHI, 1951] [= *Jeholaspis* KOBAYASHI, 1953 (obj.)]. Glabella parallel-sided subrectangular, sides converging to rounded front, with 2 pairs of lateral furrows; no preglabellar field, anterior border furrow obsolete, anterior border of medium width, convex; eyes medium in size, opposite center of glabella; fixigenae upsloping, with palpebral areas about 0.5 of glabellar width, posterior areas same in length (*tr.*) as occipital ring. Pygidium broadly transverse; 3 axial rings and terminal; 4 broad pleurae, with obsolete pleural ridges, and 4 pairs of pleural furrows, shallow distally; border furrow very shallow, border narrow downsloping. Surface smooth. *U.Cam.* (Fengshan.), E.Asia.—FIG. 238, 4. **S. sumi* (KOBAYASHI), Manch.; 4*a,b*, cephal., pyg., $\times 2$ (419).
- Stigmaspis** NELSON, 1951 [**S. hudsonensis*]. Glabella parallel-sided, subrectangular, front straight; no preglabellar field, faint anterior border furrow running into axial furrows; eyes of medium size, opposite center of glabella; fixigenae upsloping, with palpebral areas less than 0.3 of glabellar width, posterior areas subtriangular, long (*tr.*). Pygidium unknown (156). *U.Cam.* (Francon.), C.USA.—FIG. 237.6. **S. hudsonensis*, Wis.; 6*a,b*, cran., (with librigena), $\times 1$ (156).
- Wuhuia** KOBAYASHI, 1933 [**Solenopleura belus* WALCOTT, 1905]. Glabella parallel-sided, tapering, front broadly rounded, with 2 pairs of short, distinct, arcuate lateral furrows; anterior border furrow narrow, curved; eye ridges obsolete, eyes of medium size, opposite center of glabella; fixigenae horizontal, with palpebral areas 0.3 of glabellar width, posterior areas straplike, medium in width (*tr.*). Pygidium semicircular; 4 axial rings and terminal; 5 pleurae with pleural furrows; border furrow obsolete, border narrow, ill-defined. Surface granulose (315). *U.Cam.* (Fengshan.), E.Asia.—FIG. 238.3. **W. belus* (WALCOTT), China (Shantung); 3*a,b*, cran., $\times 3$; 3*c,d*, pyg., $\times 3$ (419).

Family SAUKIIDAE Ulrich & Resser, 1930

[*nom. transl.* LOCHMAN-BALK, 1956 (ex Saukiinae ULRICH & RESSER, 1930)]

Exoskeleton opisthoparian, subisopygous. Glabella quadrate to rectangular, with 2 or 3 pairs of lateral furrows, posterior pair usually complete, 2nd pair likewise in some;

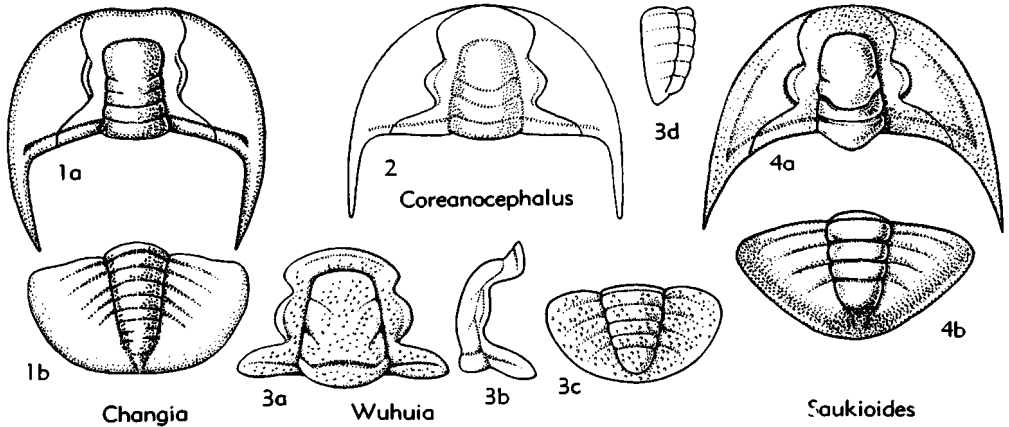


FIG. 238. Ptychaspidae (p. O320-O322).

preglabellar field present or absent, anterior border furrow may be obsolete; eyes above medium size, posterior to center of glabella, eye ridges usually obsolete, arcuate palpebral furrows deep, palpebral rims prominent; occipital spine may be present; fixigenae with arcuate palpebral areas, 0.3 to 0.5 of glabellar width, posterior areas very narrow (*exsag.*), straplike; librigenae wide, quadrate, with genal spines; hypostoma elongate rectangular, with short anterior wings, convex ovoid central lobe, narrow semicircular posterior lobe, narrow lateral and posterior rim, and pair of elongate pits at outer corners of posterior lobe. Thorax with 12 segments; axis strongly convex; pleurae slightly longer than axis, with ends bluntly pointed, deep pleural furrow running diagonally from anterior to center of segments. Pygidium elliptical to circular; axis tapered to rounded end, posterior axial furrow obsolete, with postaxial ridge; interpleural grooves and pleural furrows curving abruptly backward on to border; no border furrow, border of variable width. Surface smooth or granulose. Derived from *Conaspis*. *U.Cam.*

Saukia WALCOTT, 1914 [**Dikellocephalus lodensis* WHITFIELD, 1880, based on librigena (= *Saukia ornata* ULRICH & RESSER, 1933, based on cranium, *vide* LOCHMAN, 1956)] [= *Sinosaukia* SUN, 1935]. Glabella rectangular, sides diverging slightly forward, front nearly straight, posterior part low, anterior lobe convex, with 2 pairs of lateral furrows, posterior pair complete; no preglabellar field, anterior border furrow narrow, straight and paralleling preglabellar furrow or running into it

at corners of glabella, anterior border narrow; fixigenae narrow, with posterior areas about 0.5 of length (*tr.*) of occipital ring; librigenae with narrow posterior and lateral border furrows meeting, long slender genal spines. Pygidium ovoid; axis wider than pleural regions, convex, tapering 0.75 of length, with postaxial ridge reaching margin, 4 axial rings and terminal; pleural fields low, merging into narrow sloping border, with 4 pairs of interpleural grooves and 5 pairs of parallel pleural furrows lying anteriorly on each segment. Surface coarsely granulose. *U.Cam.* (*Trempeal.*), N. Am.-NE. Asia.—FIG. 239, 1. *S. acuta* ULRICH & RESSER, Wis.; exoskel., $\times 1.3$ (461, 487).

Calvinella WALCOTT, 1914 [**Dikellocephalus spiniger* HALL, 1863]. Glabella low, rectangular, sides converging slightly to straight squared front, posterior glabellar furrows usually complete, 2nd pair short, faint; slender occipital spine; preglabellar field absent, anterior border furrow diagonal at sides to corners of glabella, convex anterior border narrow; fixigenae narrow, with posterior areas 0.75 of length (*tr.*) of occipital ring; librigenae with posterior and lateral border furrows fading into base of medium-length genal spines. Pygidium nearly circular; axis narrow, same in width as pleural fields, convex, tapered rapidly 0.5 of length, with narrow postaxial ridge fading on to border, 3 axial rings and terminal with one faint ring, pleural fields low, merging into medium to broad concave border, 4 pairs of interpleural grooves, 5 pairs of pleural furrows close to anterior edge of each segment, may touch interpleural grooves on edge of border; posterior margin may bend inward on median line. Surface granulose. *U.Cam.* (*Francon.-Trempeal.*), N. Am.-NE. Asia.—FIG. 239, 2. **C. spiniger* (HALL), Trempeal.; Wis.; 2a, ceph., $\times 1$; 2b, pyg., $\times 1$ (461 mod.; 487 mod.).

Lichengia KOBAYASHI, 1942 [**L. onigawara*]. Gla-

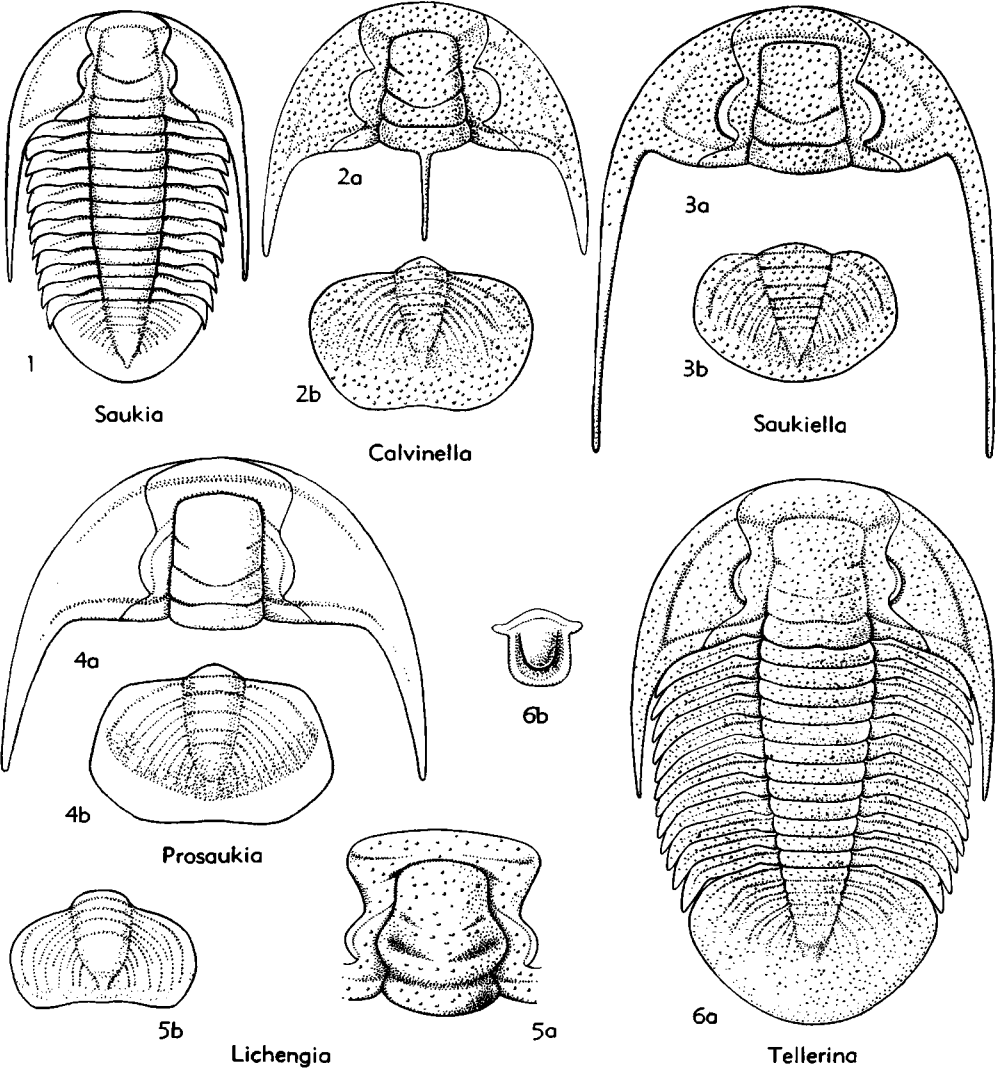


FIG. 239. Saukiidae (p. 0323-0325).

bella moderately convex, quadrate, base broadly expanded and front slightly rounded, with 3 pairs of lateral furrows, posterior pair deep, complete, 2nd short, diagonal, anterior pair very faint: eye ridges faint, preglabellar field very narrow, anterior border furrow deep at sides, obsolete at center, anterior border of medium width, down-sloping; fixigenae with posterior areas unknown. Pygidium transverse elliptical, sides curving abruptly backward, posterior margin nearly straight with slight median inward bend; axis convex, wider than pleural fields, tapering 0.6 of its length, with narrow post-axial ridge extending nearly to margin, 3 axial rings and terminal with 1 or 2 faint rings; pleural fields low, merging

into medium-width concave border, 3 pairs of interpleural grooves and parallel shallow pleural furrows. Surface granulate. *U. Cam. (Fengshan.)*, NE. Asia.—FIG. 239, 5. **L. onigawara*, China (Shansi); *5a, b*, cran., pyg., $\times 1.5$ (*a*, 419; *b*, 478). *Prosaukia* ULRICH & RESSER, 1933 [*Dikelocephalus misa* HALL, 1863] [= *Stenosaukia* RAYMOND, 1938]. Glabella low, quadrate to rectangular, sides converging slightly, front nearly straight, with 2 pairs of distinct lateral furrows, posterior pair complete; occipital spine may be present; eye ridges faint, preglabellar field present, narrow anterior border furrow distinct, anterior border narrow, fixigenae with posterior areas almost 0.5 of length of occipital ring; librigenae with me-

dium-length genal spines, posterior border furrows running into spine bases, not meeting lateral furrows. Pygidium transverse elliptical, lateral margins curving abruptly backward, posterior margin slightly curved with median flattening; axis convex, slightly wider than pleural fields, tapering 0.75 of length, with narrow postaxial ridge extending to margin, 3 or 4 axial rings and terminal with one faint ring; pleural fields low, merging into concave border of variable width, 4 (rarely 5) pairs of interpleural grooves and 5 parallel, evenly spaced pleural furrows crossing border nearly to margin. Surface smooth or granulate. *U.Cam.(Francon.-Trempeal.)*, N.Am.-NE.Asia.—FIG. 239,4. **P. misa* (HALL), Francon., Wis.; 4a,b, ceph., pyg., $\times 1.3$ (461 mod.; 487 mod.)

Saukiella ULRICH & RESSER, 1933 [**Dikelocephalus pepinensis* OWEN, 1852 (= *Saukiella typicalis* ULRICH & RESSER, 1933)]. Glabella low, rectangular, sides diverging slightly forward, front straight, posterior pair of lateral furrows complete, 2nd pair strong and complete to obsolete; preglabellar field extremely narrow, anterior border furrow distinct, anterior border medium in width; fixigenae with posterior areas about 0.5 of length of occipital ring; librigenae with continuous lateral and posterior border furrows and long slender genal spines. Pygidium ovoid to circular; axis convex, wider than pleural fields, tapering 0.7 of length, with short postaxial ridge, 4 axial rings and terminal with one faint axial ring; pleural fields low, curving down to narrow flat border, 4 pairs of narrow shallow interpleural grooves and 5 pairs of deep parallel pleural furrows. Surface finely granulate. *U.Cam.(Francon.-Trempeal.)*, N.Am.-NE.Asia.—FIG. 239,3. **S. pepinensis* (OWEN), Trempeal., Wis.; 3a,b, ceph., pyg., $\times 1$ (461 mod.; 487 mod.).

Tellerina ULRICH & RESSER, 1933 [**Dikellocephalus crassimarginatus* WHITFIELD, 1882]. Glabella low, rectangular, front nearly straight, posterior glabellar furrow complete, 2nd pair short, faint; no preglabellar field, anterior border furrow shallow, occurring only at sides and slanting backward to corners of glabella, anterior border medium in width; fixigenae with posterior areas 0.7 of length (*tr.*) of occipital ring; librigenae with united lateral and posterior border furrows running into bases of short broad genal spines. Pygidium subcircular; axis convex, wider than pleural fields, tapering 0.7 of length, with short, broad postaxial ridge, 4 to 5 axial rings and terminal with 1 faint ring; pleural fields low, merging into broad flat border, 4 pairs of interpleural grooves curving on to border, 5 pairs of pleural furrows, anterior on segments, fading out on edge of border. Surface finely granulate. *U.Cam.(Trempeal.)*, N.Am.-NE.Asia.—FIG. 239,6. **T. crassimarginatus* (WHITFIELD), Wis.; 6a, exoskel., $\times 0.7$; 6b, hypostoma, $\times 1$ (487, 488).

Family EUREKIIDAE Hupé, 1953

[=Maladiinae HURÉ, 1953]

Exoskeleton opisthoparian, heteropygous. Glabella truncate-tapering to quadrate, with 2 pairs of lateral furrows; eye ridges present or obsolete, palpebral rims and palpebral furrows usually well developed, eyes about medium in size, position variable, preglabellar field may be very narrow or restricted; fixigenae horizontal, with palpebral areas of variable width, posterior areas triangular to straplike; librigenae quadrangular, with short blunt genal spines. Pygidium transverse to semicircular; axis convex, tapered nearly full length, 1 to 5 axial rings and terminal; 3 or 4 pleurae, interpleural grooves or pleural furrows or both may be present; border furrow obsolete, border ill-defined, narrow, with 4 or 5 pairs of short marginal spines. Surface granulate or smooth. Derived from *Conaspis-Wuhuia* stock. *U.Cam.*

Eurekia WALCOTT, 1924 [**E. granulosa*]. Glabella moderately convex, subquadrate, anterior corners rounded, with deep arcuate lateral furrows; eye ridges obsolete, eyes of medium size, opposite posterior 0.3 of glabella; preglabellar field very narrow or at sides only, anterior border furrow curved, anterior border rimlike; fixigenae very narrow, with arcuate palpebral areas 0.2 of glabellar width, posterior areas very narrow (*exsag.*), of medium length (*tr.*). Pygidium transverse; axis and pleural fields about same in width, with 3 wide axial rings and terminal; 4 pleurae separated by faint interpleural grooves and crossed by broad pleural furrows, 5 pairs of stout marginal spines. Outer surface coarsely granular (321). *U.Cam.(Trempeal.)*, C.USA-W.USA.—FIG. 240, 3. **E. granulosa*, Nev.; ceph., $\times 1.5$ (411).

Bayfieldia T. H. CLARK, 1924 [**B. tumifrons*]. Glabella moderately convex, truncate-tapering, lateral furrows very faint, arcuate; preglabellar field narrow to absent, anterior border furrow narrow, anterior border rimlike; eye ridges obsolete, eyes just below medium size, slightly behind mid-length of glabella; fixigenae very narrow, with arcuate palpebral areas 0.12 of glabellar width, posterior areas very narrow (*exsag.*), of medium length (*tr.*). Pygidium narrowly transverse; axis wider than pleural fields, with 2 wide axial rings and terminal; 3 pleurae separated by faint interpleural grooves and crossed by broad pleural furrows, 4 pairs of small marginal spines. Surface densely granulate (188, 189). *U.Cam.(Trempeal.)*, E.Can.—FIG. 240,5. **B. tumifrons*, Que.; 5a, cran., $\times 2$; 5b, pyg., $\times 2.7$ (188). **Corbinia** WALCOTT, 1924 [**C. horatio*]. Glabella low, narrow, truncate tapering, lateral furrows

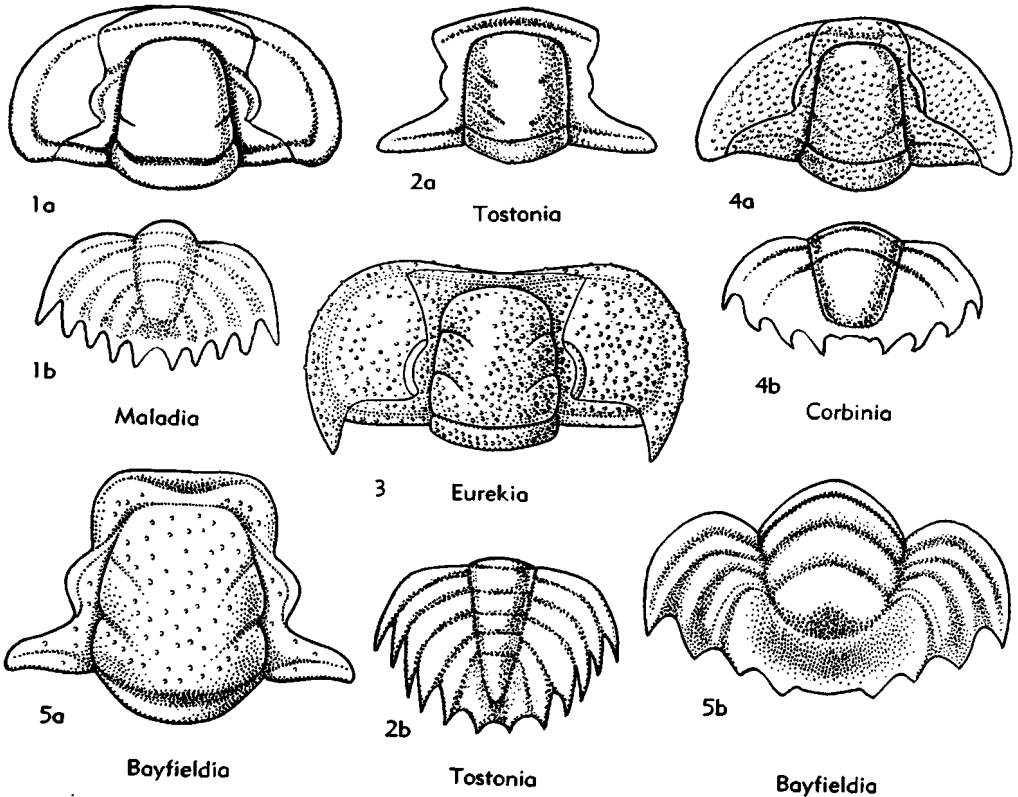


FIG. 240. Eurekaidae (p. 0325-0326).

very shallow; preglabellar field narrow (*sag.*), anterior border furrow curved, anterior border narrow, flattened; eye ridges obsolete, eyes below medium size, opposite center of glabella; fixigenae very narrow, with palpebral areas 0.12 of glabellar width, posterior areas wide (*exsag.*), triangular, of medium length (*tr.*). Pygidium narrowly transverse; axis and pleural fields of same width, 1 anterior axial ring and terminal with several very faint rings; 4 pleurae, interpleural grooves obsolete, 4 pleural furrows, posterior pairs very faint, 4 or 5 pairs of small marginal spines. Surface finely granulate (321). *U.Cam.(Trempeal.)*, C.N.Am.-W.N.Am.—FIG. 240.4. **C. horatio*, Alba.; 4*a,b*, ceph., pyg., $\times 2$ (488).

Maladia WALCOTT, 1924 [**M. americana*]. Glabella moderately convex, truncate-tapering, anterior corners rounded, lateral furrows shallow, arcuate; eyes about medium in size, slightly in front of mid-length of glabella; preglabellar field present; narrow eye ridges distinct; fixigenae with arcuate palpebral areas about 0.3 of glabellar width, posterior areas wide (*exsag.*), triangular, of medium length (*tr.*). Pygidium transverse; axis narrower than pleural fields, with 3 axial rings and long terminal; 5 pleurae, interpleural grooves very broad, deep, may have coalesced

pleural furrows, 5 pairs of stout marginal spines. Outer surface very finely granulate (321). *U.Cam.(Francon.-Trempeal.)*, W.N.Am. — FIG. 240.1. **M. americana*, Idaho; 1*a,b*, ceph., pyg., $\times 1$ (488).

Tostonia WALCOTT, 1924 [**Dicellosephalus iole* WALCOTT, 1884]. Glabella moderately convex, broad, subquadrate, with long deep diagonal lateral furrows; eyes below medium size, slightly behind mid-length of glabella, preglabellar field narrow; eye ridges faint; fixigenae with palpebral areas about 0.3 of glabellar width, posterior areas straplike, of medium length (*tr.*). Pygidium semicircular; axis narrower than pleural fields, with 5 axial rings and pointed terminal; 5 pleurae separated by narrow interpleural grooves, pleural furrows obsolete, 5 pairs of small marginal spines. Surface may be smooth (321). *U.Cam.*, W.N.Am.—FIG. 240.2. **T. iole* (WALCOTT), Nev.; 2*a,b*, cran., pyg., $\times 4$ (488).

Superfamily REMOPLEURIDACEA Hawle & Corda, 1847

[*nom. transl.* RICHTER, 1933, herein (*ex Remopleurides* HAWLE & CORDA, 1847)]

Exoskeleton opisthoparian, medium-sized.

Characters displayed by many genera include tapering glabella with 3 or fewer pairs of lateral furrows not reaching axial furrows; short to long (*sag.*) frontal area crossed by radiating ridges; occipital ring distinct; eye lobes close to glabella; facial sutures opisthoparian, with widely divergent anterior sections. Thorax of 9 to 12 segments, pleurae with diagonal furrows. Pygidium with short axis, pleural fields furrowed, margins spinose. In some genera (Remopleuridinae) glabella occupies entire area between eye lobes and extends forward as tongue, frontal area being short or absent; median suture crossing anterior doublure; in Loganellidae this median suture is lacking and margins of the pygidium are smooth. *U.Cam.-U.Ord.*

Family REMOPLEURIDIDAE Hawle & Corda, 1847

[*nom. correct.* RICHTER, 1933 (ex Remopleurides HAWLE & CORDA, 1847) (*emend.* HUPÉ, 1955; WHITTINGTON, herein)]

Eye lobes long, curved, with extremities adjacent to axial furrows and posterior margins at or near posterior border furrows; facial sutures opisthoparian, median suture across anterior doublure; eye lobes may inclose narrow (*tr.*) palpebral lobes, or glabella may occupy entire space between eye lobes, in front of which glabella narrow; up to 3 pairs of lateral glabellar furrows; frontal area present or absent; librigenae commonly narrow (*tr.*), genal spines originating at variable points on lateral margins. Thorax of 9 to 12 segments; axis convex, pleural furrows diagonal, pleural tips pointed and directed backward. Pygidium with axis not extending full length; pleural fields flattened, furrowed; margin commonly spinose. Doublure of thorax and pygidium extends inward almost to axial furrow; doublure of cephalon may be narrow or extended to full width of librigenae. Outer surface of exoskeleton (including doublure) with raised anastomosing lines or rarely tubercles. *U.Cam.-U.Ord.*

Subfamily REMOPLEURIDINAE Hawle & Corda, 1847

[*nom. transl. et correct.* WHITTINGTON, herein (ex Remopleurides HAWLE & CORDA, 1847)]

Median part of glabella occupying entire area between eye lobes, glabellar tongue varying in length (*sag.*) and convexity; frontal area short (*sag.*) or absent (26, 258, 350, 351). *L.Ord.-U.Ord.*

Remopleurides PORTLOCK, 1843 [**R. colbii*; SD S. A. MILLER, 1889]. Glabellar tongue short (*sag.*), narrow (*tr.*), bent vertically down; 2 faint pairs of lateral furrows present; librigenae triangular in outline, with bases of long genal spines opposite broad (*tr.*), occipital ring. Doublure broad anteriorly, narrower laterally. Hypostoma transversely rectangular, borders convex, with diagonally directed paired oval areas on middle body. Thorax with 11 segments, axis wide (*tr.*), pleurae narrow (*tr.*), with prominent articulating boss and socket immediately outside axial furrows; longer pleural spines on 7th segment and backwardly directed axial spine on 8th segment may be present. Pygidium small, triangular, margin of pleural fields with 2 pairs of spines. *M.Ord.*, Norway-Swed.-Ire.-Scot.-Va.-Asia. — FIG. 241, 1. **R. colbii*, Ire.; 1a, exoskel. (reconstr.), $\times 2$; 1b, hypostoma (exterior), $\times 3$ (496).

Amphytrion HAWLE & CORDA, 1847 [*pro Caphyra* BARRANDE, 1846 (*non Caphyra* GUÉRIN, 1832)] [**Caphyra radians* BARRANDE, 1846 (= *A. murchisonii* HAWLE & CORDA, 1847)] [= *Brachypleura* ANGELIN, 1854]. Like *Remopleurides* but cephalon with broad, flat border in front of eyes and glabellar tongue, border continuous laterally with broad genal spines; glabella with 3 pairs of lateral furrows, tongue extremely narrow (*tr.*) and short (*sag.*); anterior sections of facial sutures uniting just before reaching anterior margin of border. Hypostoma subsquare in outline, with oval areas on posterolateral parts of middle body. Thorax with relatively wide (*tr.*) pleurae drawn out into long spines; median axial spine on 8th segment. Pygidium with short axis and long (*sag.*, *exsag.*) pleural fields, 2 pairs of spines on posterior margin. *U.Ord.*, Boh.-Swed. — FIG. 242, 1. **A. radians* (BARRANDE), Boh.; exoskel. (reconstr.), $\times 0.8$ (79).

Hypodicranotus WHITTINGTON, 1952 (**Remopleurides striatulus* WALCOTT, 1875). Like *Remopleurides* but glabellar tongue projects farther in front of eye lobes, 3 pairs of lateral glabellar furrows present; with broad lateral cephalic spines in addition to short genal spines. Hypostoma very long, deeply forked, without borders. *M.Ord.*, N. Am. — FIG. 241, 2. **H. striatulus* (WALCOTT); N.Y.-Ont.; 2a, b, lateral and ventral view of exoskel. (outline of pygidium restored), $\times 3$ (351*).

Remopleuridiella ROSS, 1951 [**R. caudilimbata*]. Like *Remopleurides* but posterior sections of facial sutures more divergent; narrow, convex cephalic border extending around glabellar tongue; genal spines arising far forward. Pygidium with 4 or 5 pairs of spinose pleurae. *L.Ord.*, Utah. — FIG. 242, 2. **R. caudilimbata*; 2a-c, cran. (profile), librigena, pyg., $\times 4$ (463*).

Robergia WIMAN, 1905 [**Remopleurides microphthalmus* LINNARSSON, 1875]. Length of eye lobes (*exsag.*) less than 0.5 of cephalon (*sag.*); gla-

bella narrow posteriorly, expanding between eye lobes, glabellar tongue long (*sag.*) and broad (*transv.*); 3 pairs of deep lateral furrows pres-

ent; with narrow cephalic border and double anteriorly and laterally; genal spines originating opposite mid-point of eye lobes; posterior sections

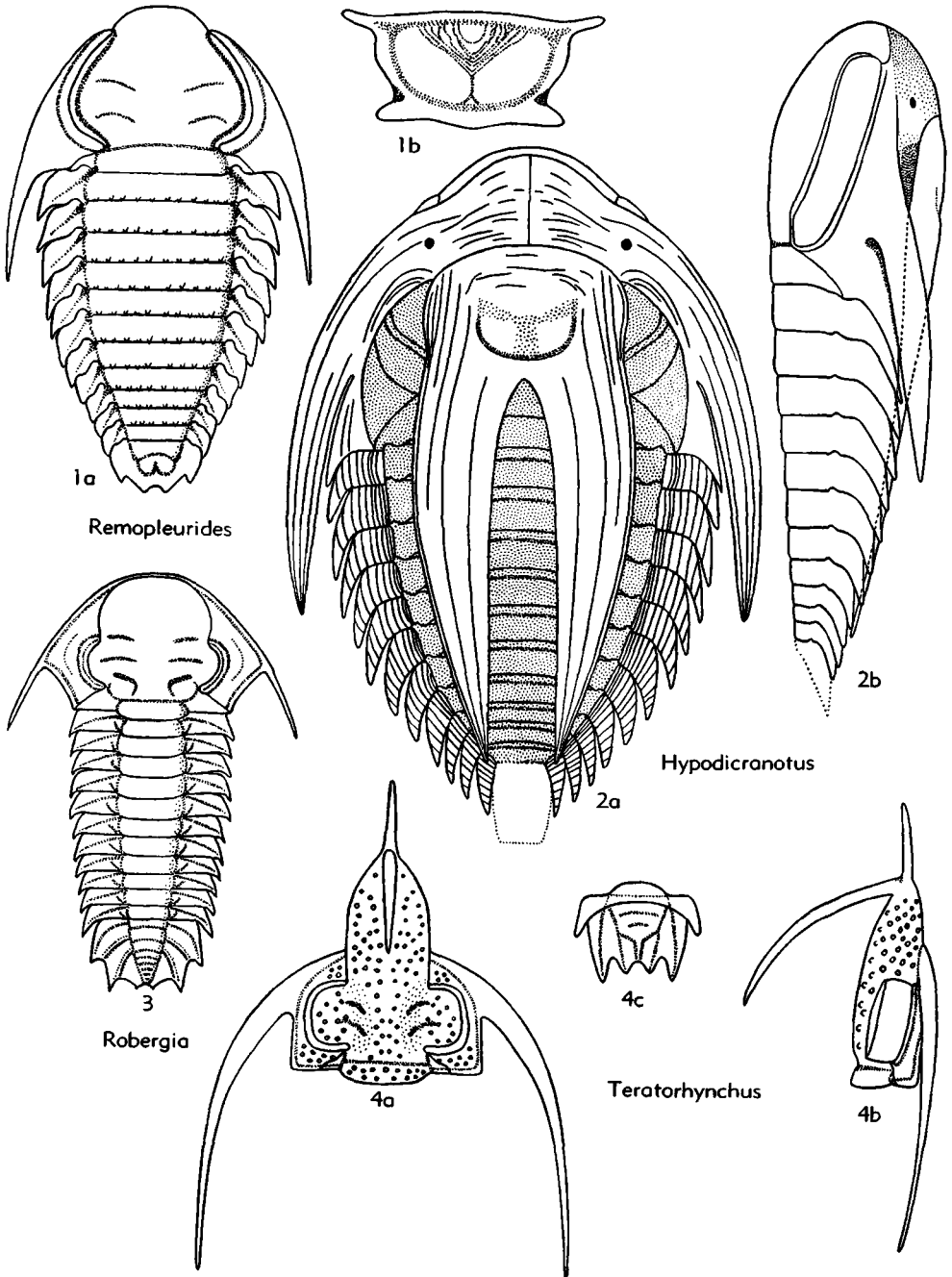


FIG. 241. Remopleurididae (p. 0327-0329).

of facial sutures running out to posterolateral corners of fixigenae. Thorax of 11 segments; pleurae transversely directed, terminating in small posteriorly directed spines, with deep diagonal pleural furrows. Pygidium with length about equal to width; axis extending close to posterior margin; pleural fields flat, with 3 pairs of pleural furrows and posterior spines. *M.Ord.*, Norway-Swed.-Scot.-Va.-Ala.-Okla.-Manch. — FIG. 241,3. *R. deckeri* B. N. COOPER, Okla.; exoskel (reconstr.), $\times 4$ (496n).

Teratorhynchus REED, 1903 [**Remopleurides* (*T. bicornis*)]. Maximum width of glabella almost twice length; glabellar tongue subcylindrical, tapering and rounded anteriorly, length 1.5 to 3 times posterior part of glabella so that it projects in front of rest of cephalon; glabellar tongue with 2 anterior median spines, one directed forward, the other curving upward and backward; with shallow longitudinal depressions bending across glabella between extremities of eye lobes, and within these depressions 2 pairs of lateral glabellar furrows, posterior the longer; librigenae narrow (*tr.*), genal spines originating opposite anterior ends of eye lobes. Width of each thoracic pleura about equal to width of axis. Pygidium with 2 pairs of spines on posterior margin. Surface tuberculate. *M.Ord.*, Scot.—FIG. 241,4. **T. bicornis*; 4a,b, ceph., dorsal and right lateral; 4c, pyg.; all $\times 2$ (496).

Subfamily RICHARDSONELLINAE Raymond, 1924

[*emend.* WHITTINGTON, herein] [=Kainellidae ULRICH & RESSER, 1930; Macropygidiae KOBAYASHI, 1937]

Anterior sections of facial sutures widely divergent; frontal area long (*sag.*), may include preglabellar field, which may bear radiating ridges, pits in anterior border furrow. *U.Cam.-M.Ord.*

Richardsonella RAYMOND, 1924 [**Dikelocephalus megalops* BILLINGS, 1860] [=Protapatokephalus RAYMOND, 1937]. Like *Kainella* but glabella tapering slightly forward, reaching only slightly in front of eye lobes, which are longer (*exsag.*), equalling 0.5 or more of length of cephalon (*sag.*); with 2 pairs of lateral furrows or none; anterior sections of facial sutures less strongly divergent, posterior sections extending far out, parallel to and just in front of posterior border furrows. Pygidium relatively shorter, pleurae less strongly curved and pleural furrows shallow (188). *U.Cam.*, Que.-Vt.—FIG. 242,3. **R. megalops* (BILLINGS), Que.; 3a,b, cran. (librigena partially reconstr.), pyg., $\times 2.5$ (79).

Apatokephalus BRÖGGER, 1896 [**Trilobites serratus* BOECK, 1838; SD BASSLER, 1915] [=Diplapatokephalus RAYMOND, 1937]. Glabella convex, broad where it occupies entire space between palpebral furrows, narrower and rounded where it projects

a short distance in front of eye lobes, with 3 pairs of lateral furrows; short preglabellar area (*sag.*); anterior border convex; large, deep pits in anterior border furrow; librigena narrow (*tr.*), with long, slender genal spines originating at posterolateral corners. Thorax of 12 segments; long median axial spine on 8th segment; deep diagonal pleural furrows, pleural tips long, pointed. Pygidium with convex axis; pleural fields with 5 pairs of spinose pleurae, curving outward-backward. Surface of glabella and pygidial axis tuberculate (281). *L.Ord.*, S.Am.-N.Am.-Eng.-Norway-Swed.-Ger.—FIG. 243,2. **A. serratus* (BOECK), Swed.; 2a,b, ceph., pyg., $\times 2$ (496n).

Erobergia COOPER, 1953 [**Robergia marginalis* RAYMOND, 1925]. Cranidium like *Robergia* except that anterior sections of facial sutures apparently diverge and palpebral rims are longer, broader, and sharply curved posteriorly; anterior border broad (*sag.*), convex, deep border furrow with pits. Pygidium like *Apatokephalus*, with 4 long, paired spines on margins. Surface with fine ridges in Bertillon pattern and small tubercles (26). *M.Ord.*, Tenn.—FIG. 242,5. **E. marginalis* (RAYMOND); 5a, cran., $\times 2.7$; 5b, pyg., $\times 2$ (26*).

Kainella WALCOTT, 1925 [**Hungaia billingsi* WALCOTT, 1924]. Glabella subparallel-sided or tapering slightly forward, with 2 or 3 pairs of diagonally directed lateral furrows; long (*sag.*) frontal area; genal regions broad (*tr.*); cephalon with wide convex border and long genal spines arising at posterolateral corners; eye lobes (*exsag.*) about 0.3 of length of cephalon, with broad palpebral rim; posterior sections of facial sutures running outward-backward to reach posterior margins at about 0.5 of width of posterior borders; anterior border furrow with close-spaced pits; radiating, anastomosing ridges crossing preglabellar field and reaching furrow between these pits. Pygidium with length about equal to width; axis with about 6 rings; 3 pleural furrows in pleural fields directed backward and slightly inward; 3 pairs of spines on posterior margin (321). *L.Ord.*, N.Am.-S.Am.—FIG. 243,3. *K. meridionalis* KOBAYASHI, Arg.; 3a,b, ceph., pyg., $\times 1$ (496, n).

Macropyge STUBBLEFIELD IN STUBBLEFIELD & BULMAN, 1927 [**M. chermi*] [=Gladiatoria HUPÉ, 1955]. Glabella narrowing forward, deep basal lateral furrows isolating triangular basal lobe, 2 further faintly defined lateral glabellar furrows; frontal area including only narrow (*sag.*) anterior border; genal spines arising at posterolateral corners of wide (*tr.*) genae; long eye lobes; anterior sections of facial sutures only moderately divergent. Thorax of 9 segments. Pygidium with relatively short axis; pleural fields prolonged back to form long, broad terminal spine; 1st 2 pleural furrows present (114). *L.Ord.*, Br.I.-Utah.—FIG. 243,1. **M. chermi*, Tremadoc., Br.I.; exoskel., $\times 1$ (496, n).

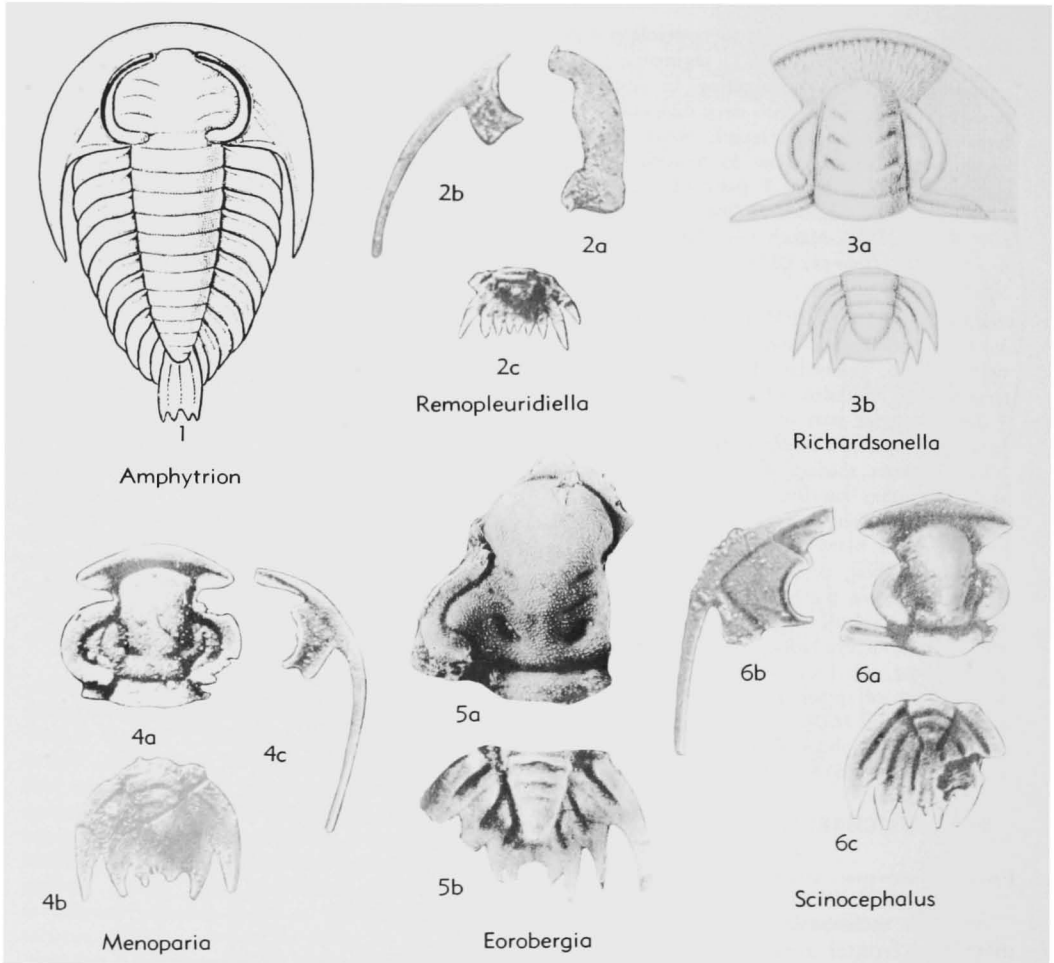


FIG. 242. Remopleurididae (p. O327-O330).

Menoparia Ross, 1951 [**M. genalunata*]. Like *Apatokephalus* but small crescentic area between lateral margins of glabella and palpebral furrows; 2 pairs of lateral furrows; no preglabellar field in mid-line, short (*exsag.*) laterally; genal spines originating on lateral margins opposite mid-point of eye lobes. Axis of pygidium with fewer rings; pleural fields with 4 pairs of marginal spines, inner pair minute (258). *L.Ord.*, Utah.—FIG. 242,4. **M. genalunata*; 4a, cran., $\times 8$; 4b, pyg., $\times 6$; 4c, librigena, $\times 8$ (258*).

Pseudokainella HARRINGTON, 1938 [**P. keideli*] [= *Parakainella* KOBAYASHI, 1953]. Like *Kainella* but glabella tapering markedly forward; anterior sections of facial sutures less divergent; preglabellar field shorter (*sag.*). Thorax of 12 segments, long median axial spine on 8th segment; deep diagonal pleural furrows. Pygidium like that of *Apatokephalus*, wider than long, 4 pairs of spinose pleurae, directed diagonally outward and back-

ward (55). *L.Ord.*, Arg.-Korea.—FIG. 244. **P. keideli*, Tremadoc., S.Am.; exoskel., $\times 13.5$ (59*). **Scinocephalus** Ross, 1951 [**S. solitecti*]. Like *Apatokephalus* but anteromedian part of glabella strongly inflated, posterolateral part outside posterior lateral furrows depressed, extending out to palpebral furrows, median and anterior glabellar furrows short, shallow; librigenae broad, genal spines originating opposite anterior end of eye lobes, double extending in to margin of eye lobes. Pygidium with short, convex axis, long pleural fields with 3 pairs of backwardly curving spinose pleurae, minute median marginal spine (258). *L.Ord.*, Utah.—FIG. 242,6. **S. solitecti*; 6a, cran., $\times 8$; 6b, librigena, $\times 4$; 6c, pyg., $\times 4$ (258*).

Tramoria REED, 1899 [**T. punctata*]. Only cranium known, apparently like *Apatokephalus* but glabella with posterior pair of furrows only and part in front of eye lobes shorter; anterior sections of facial sutures less divergent. ?*L.Ord.*, Ire.

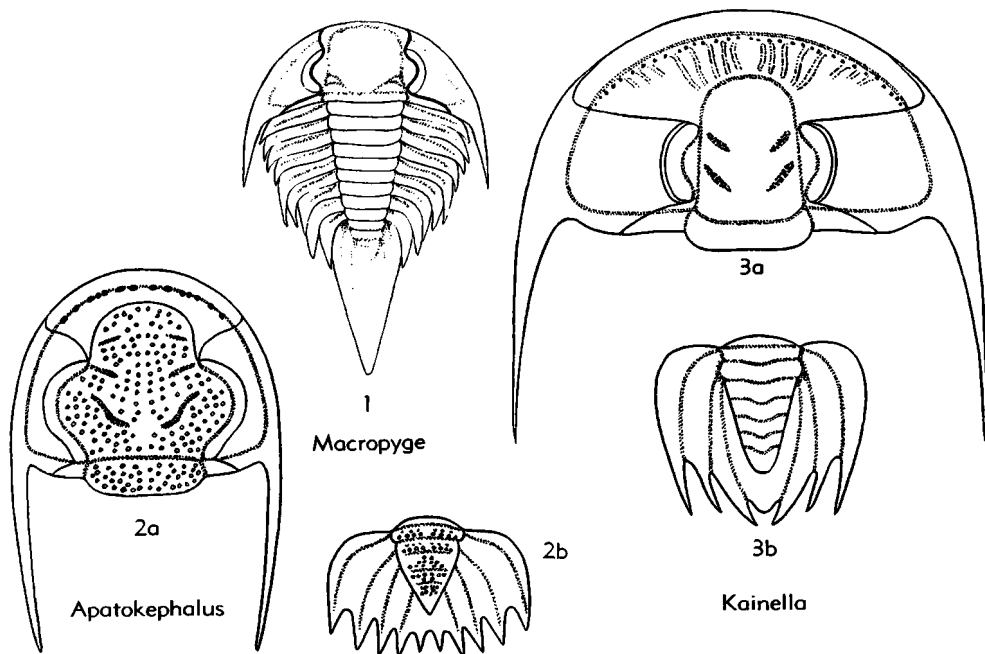


FIG. 243. Remopleurididae (p. O329).

Lingukainella KOBAYASHI, 1953 [**L. robusta*]. Doubtful value, based on single pygidium of *Kainella* type bearing 2 pairs of pleural spines and median posterior spine. ?*L.Ord.*, B.C.

Hukasawaia KOBAYASHI, 1953 [**Richardsonella* (*H.*) *cylindrica*]. Based on cranidium said to be like *Richardsonella* but lacking preglabellar field; cranidium resembles that of *Menoparia*. *L.Ord.*, Korea.

?*Lichapyge* CALLAWAY, 1877 [**L. cuspidata*]. Only pygidium known, in type species $\frac{1}{8}$ inch long; outline subtriangular, length of axis about 0.5 of total pygidial length, continued to margin by postaxial ridge; 1st 2 pleural furrows and interpleural grooves subparallel, curving to point backward, tips of 1st 2 pleurae pointed; other furrows on remainder of pleural regions. *L.Ord.*(*Tremadoc.*), Eng.-Ger.

Subfamily UNCERTAIN

Apatokephalina SIVOV, 1955 [**A. bruta*]. *U. Cam.*, W.Sib. [Author's assignment to family.]

Artokephalus SIVOV & JEGOROVA, 1955 [**A. minimus* SIVOV, 1955]. *U. Cam.*, W.Sib. [Author's assignment to family.]

Portentosus JEGOROVA, 1955 [**P. brevis*]. *U. Cam.*, W.Sib. [Author's assignment to family.]

Family LOGANELLIDAE Rasetti, nov.

Exoskeleton opisthoparian subisopygous to micropygous. Glabella subrectangular,

occipital ring simple; glabellar furrows unconnected with axial furrows; frontal area short to long (*sag.*); border furrow present or obsolete; eyes small to medium-sized, close to glabella, median or posterior in position; anterior facial sutures strongly divergent, frontal portion dorsal-intramarginal; librigenae wide, fused together through doublure. Thorax of 11 or 12 segments; macropleural segments may be present. Pygidium wide and short; margin entire; axis elevated, of 5 to 7 rings; pleural fields furrowed; border flat or concave. Probably derived from ptychopariids through *Wilbernia* or similar forms; also closely related to early Remopleurididae (*Richardsonella*) (188, 189). *U. Cam.*

Loganellus DEVINE, 1863 [**L. quebecensis* (= *Olenus?* *logani* DEVINE, 1863)] [= *Highgatea* RAYMOND, 1937]. Glabella convex, tapered; preglabellar field short (*sag.*) or absent; border elevated; eyes small, at level of glabellar mid-point; eye ridges distinct. Thorax of 11 or 12 segments, one of which macropleural; pleurae extended into spines. Pygidium subtriangular, with narrow border. *U. Cam.*(*Trempeal.*), N.Am.—FIG. 245, 1. **L. logani* (DEVINE), Que.; exoskel., $\times 2$ (448n). *Laizonella* RASETTI, 1944 [**Dikelocephalus planifrons* BILLINGS, 1860]. Glabella flat, subrectangu-

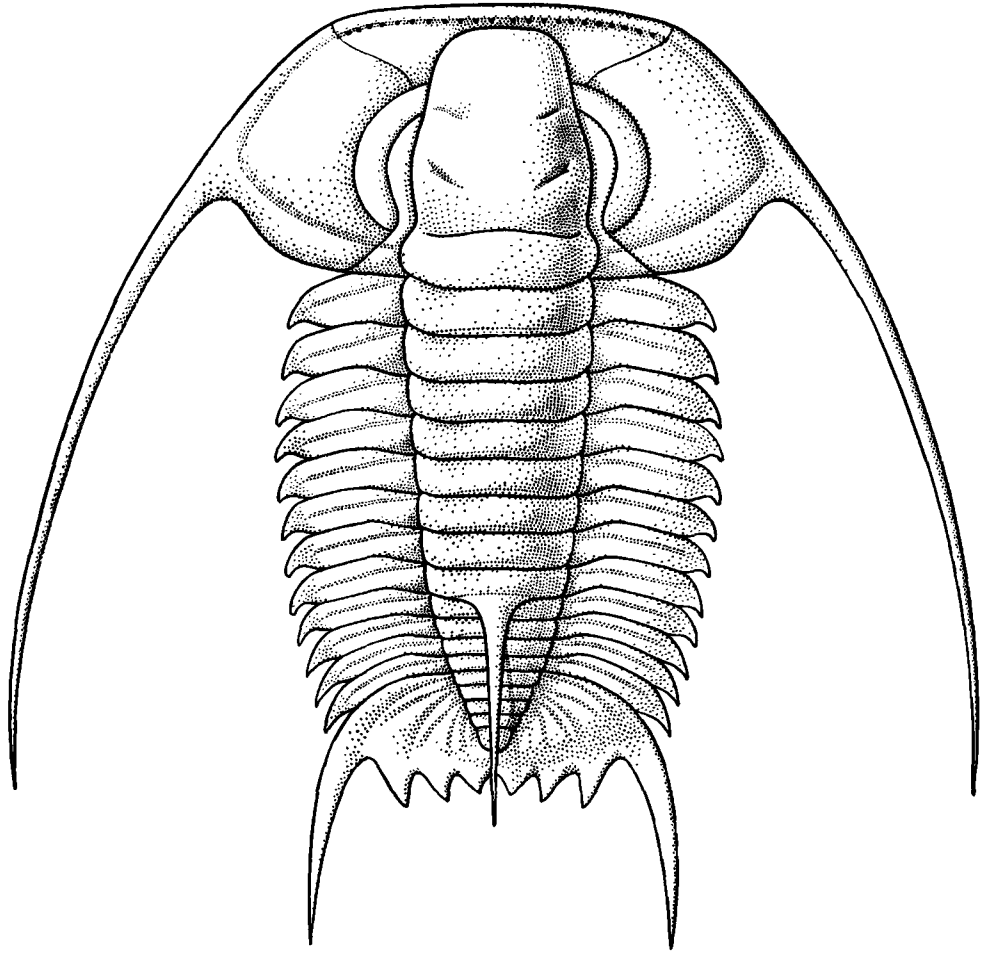


FIG. 244. **Pseudokainella keideli* HARRINGTON (Remopleurididae), L.Ord., Arg.; exoskel., $\times 13.5$ (59*).

lar, frontal area long (*sag.*) and wide, lacking border; eyes medium-sized, close to dorsal furrow, posterior in position. *U.Cam. (Trempeal.)*, N.Am.

—FIG. 245,2. **L. planifrons* (BILLINGS), Que.; 2*a,b*, cran., pyg., $\times 1.5$ (448n).

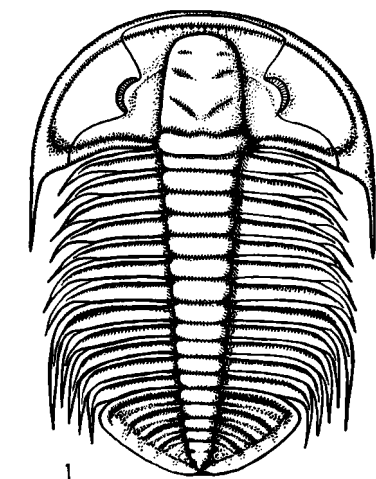
Levisella ULRICH in RASETTI, 1944 [**Dikelocephalus oweni* BILLINGS, 1860]. Glabella subrectangular, of low convexity; preglabellar field of medium length (*sag.*), border convex, wider mesially; eyes as in *Lauzonella*. Thorax of 11 segments; 5th macropleural (*L. brevifrons* RASETTI). *U.Cam. (Trempeal.)*, N.Am.—FIG. 246, **L. oweni* (BILLINGS), Que.; *a-c*, cran., pyg., united librigenae, $\times 2$ (448n).

Family HUNGAIIDAE Raymond, 1924

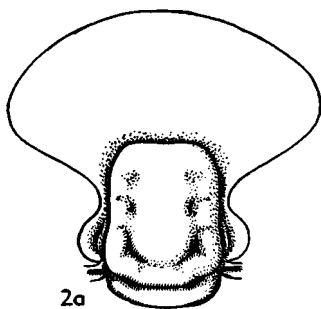
[*nom. transl.* KOBAYASHI, 1935 (*ex Hungiinae* RAYMOND, 1924)]

Exoskeleton opisthoptarian, subisopygous.

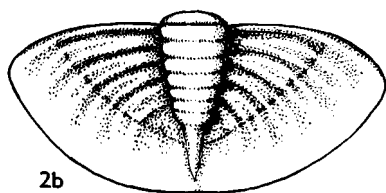
Glabella tapering with rounded front; eye ridges may be present; palpebral rims and palpebral furrows narrow; eyes about medium in size, behind center of glabella; frontal area of variable width, consisting of wide flat or concave anterior border furrow and narrow anterior border; fixigenae upsloping, narrow, with palpebral areas arcuate and posterior areas narrow (*exsag.*), long, with a pair of faint posterior alae present in some; librigenae wide, flat or concave, with narrow convex border and short genal spine. Hypostoma rounded, with short anterior wings, globose central lobe, and pair of deep pits in posterior marginal furrow. Pygidium subquadrate; axis narrow, convex, short, with postaxial ridge,



1
Loganellus



2a



2b

Lauzonella

FIG. 245. Loganellidae (p. O331).

axial rings 3 or 4; pleural fields wider than axis, pleurae and pleural furrows curved abruptly backward, ending in prominent spines on posterior margin, lacking border furrow and border. Surface finely granulate; a few genal caeca prominent on cephalon. *U.Cam.*

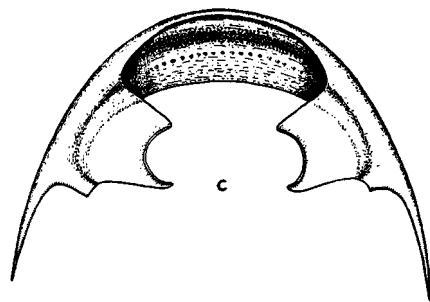
Hungaia WALCOTT, 1914 [*Dikelocephalus magnificus* BILLINGS, 1865]. Glabella convex, broad-based tapering, with 3 pairs of faint lateral



a



b



c

FIG. 246. **Levisella oweni* (BILLINGS) (Loganellidae), *U.Cam.*(Trempeal.), Que.; a-c, cran., united librigenae, pyg., $\times 1.5$ (448n).

furrows, posterior pair complete, shallow axial furrows obsolete posteriorly; eye ridges faint, eyes below medium size, opposite posterior 0.3 of glabella; frontal area concave, 0.40 of length (*sag.*) of cranidium; fixigenae with palpebral areas less than 0.3 of glabellar width, posterior areas very narrow (*exsag.*), 0.7 of length (*tr.*) of occipital ring, posterior alae weak or absent; librigenae wide, concave, lateral marginal furrow obsolete, with short blunt genal spines. Thoracic segments geniculate, with broad deep pleural furrows running to flat-spaced ends. Pygidium with convex axis, tapered 0.40 of its length to rounded end, with postaxial ridge extending 0.40 or more of length, with 3 axial rings and terminal; pleurae 4, with broad shallow pleural furrows extending into base of posterior spines, 3 or all 4 of pleurae in some forms ending in flat-pointed spines along posterior margin (188). *U.Cam.*(Trempeal.), *W. N.Am.-E.N.Am.-S.Am.*—FIG. 247. **H. magnifica* (BILLINGS), Que.; a,b, ceph., pyg., $\times 0.6$ (79, 288).

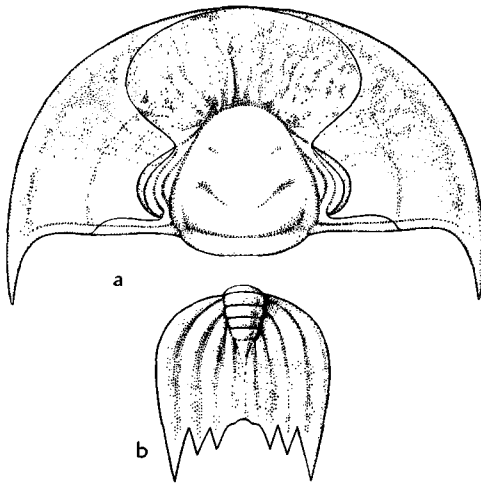


FIG. 247. **Hungaia magnifica* (BILLINGS) (Hungaiidae), U.Cam.(Trempeal.), Que.; a, b, cephal., pygidium, $\times 0.7$ (79).

Superfamily UNCERTAIN

Family DICERATOCEPHALIDAE Lu, 1954

Anterior corners of cranium with prominent spines, as long as main part of cranium, and curving almost to meet in front; glabella tapering forward; occipital ring with long, mesial spine; fixigenae about as wide as glabella; eyes small, opposite posterior half of glabella; librigenae narrow, with long genal spines. Pygidium wider than long, with poorly defined axial furrows, and with ridge parallel to posterior margin, separating wide border with terrace lines from remainder of pygidium. *U. Cam.*

Diceratocephalus Lu, 1954 [**D. armatus*]. Characters of family. *U. Cam.*, S.Manch.—FIG. 405, 2. **D. armatus*; cran., $\times 2$ (406n).

Suborder ASAPHINA Salter, 1864

[*nom. transl.* HARRINGTON & LEANZA, 1957 (ex *Asaphini* SALTER, 1864)] [Type—*Asaphus* BRONGNIART, 1822]

Exoskeleton opisthoparian, subisopygous. Librigenae separated anteriorly by median suture or fused; doublure broad; glabella with faint lateral glabellar furrows or smooth, commonly with glabellar tubercle; eye ridges rarely present, faint. Thorax with 6 to 9 segments. Pygidium more or less equal to cephalon in size. Tuberculate ornamentation rare. *Up.M. Cam.-U.Ord.*

Superfamily ASAPHACEA

Burmeister, 1843

[*nom. transl.* HENNINGSMOEN, 1951 (ex *Asaphidae* BURMEISTER, 1843)]

Thoracic segments generally 8 (in a few genera 7). Eyes commonly more or less conical, short or moderate in length; eye ridges present in a few genera, faint or scarcely discernible. Pygidium rounded or with terminal spine (in *Taihungshaniidae* with pair of spines). *U. Cam.-U.Ord.*

Family ASAPHIDAE Burmeister, 1843

Librigenae separated anteriorly by a median suture; glabella well defined to obsolete, considerably longer than frontal area; lateral glabellar furrows mostly weak or absent; most genera with distinct glabellar tubercle; eyes generally somewhat distant from axial furrows; faint, almost obsolete eye ridges known only in 2 genera. Doublure commonly broad; posterior margin of hypostoma varying from pointed to deeply notched. Thorax of 8 segments; pleural furrows generally diagonal, if present. Panderian organs developed as notches or separate openings, but absent in some (*Ogygiocaridinae*, *Symphysurininae*). External margin of pygidium varying from rounded to pointed, in some genera with terminal spine; paired pygidial spines present only in single genus of uncertain affinities. Dorsal surface of carapace with small pits, terrace lines, or both; no tuberculate or granulate ornamentation. Family tends toward loss of apparent segmentation of cephalon and pygidium, obsolescence of axial furrows, and deep notching of posterior margin of hypostoma. *U. Cam.-U.Ord.*

Subfamily ASAPHINAE Burmeister, 1843

[*nom. transl.* M'COV, 1850 (ex *Asaphidae* BURMEISTER, 1843)]

Glabella commonly expanded in front of eyes; posterior lateral glabellar furrows commonly strong, obliquely directed, mostly deeper than part of axial furrows laterally delimiting posterior lateral glabellar lobe; glabellar tubercle situated immediately in front of occipital furrow or of area corresponding to this furrow; posterior border furrow generally distinct. Panderian organs developed as notches or separate openings. Anterior wings of hypostoma broad (*tr.*), more or less quadrangular in outline; posterior margin of hypostoma with deep

notch (except *Aulacoparia*). Pygidium with ribs of pleural fields unfurrowed, if present, or rarely with faint furrows; posterior margin rounded, without spine. *L.Ord.*(*U. Tremadoc.*)-*U.Ord.*

Asaphus BRONGNIART in BRONGNIART & DESMAREST, 1822 [*non Asaphus* BRONGNIART in DESMAREST, 1817 (suppressed, ICZN Opinion 510)] [**Entomotrachites expansus* WAHLENBERG, 1821 (= *Entomolithus paradoxus a expansus* LINNÉ, 1768, suppressed, ICZN opinion 296)]. Cephalon and

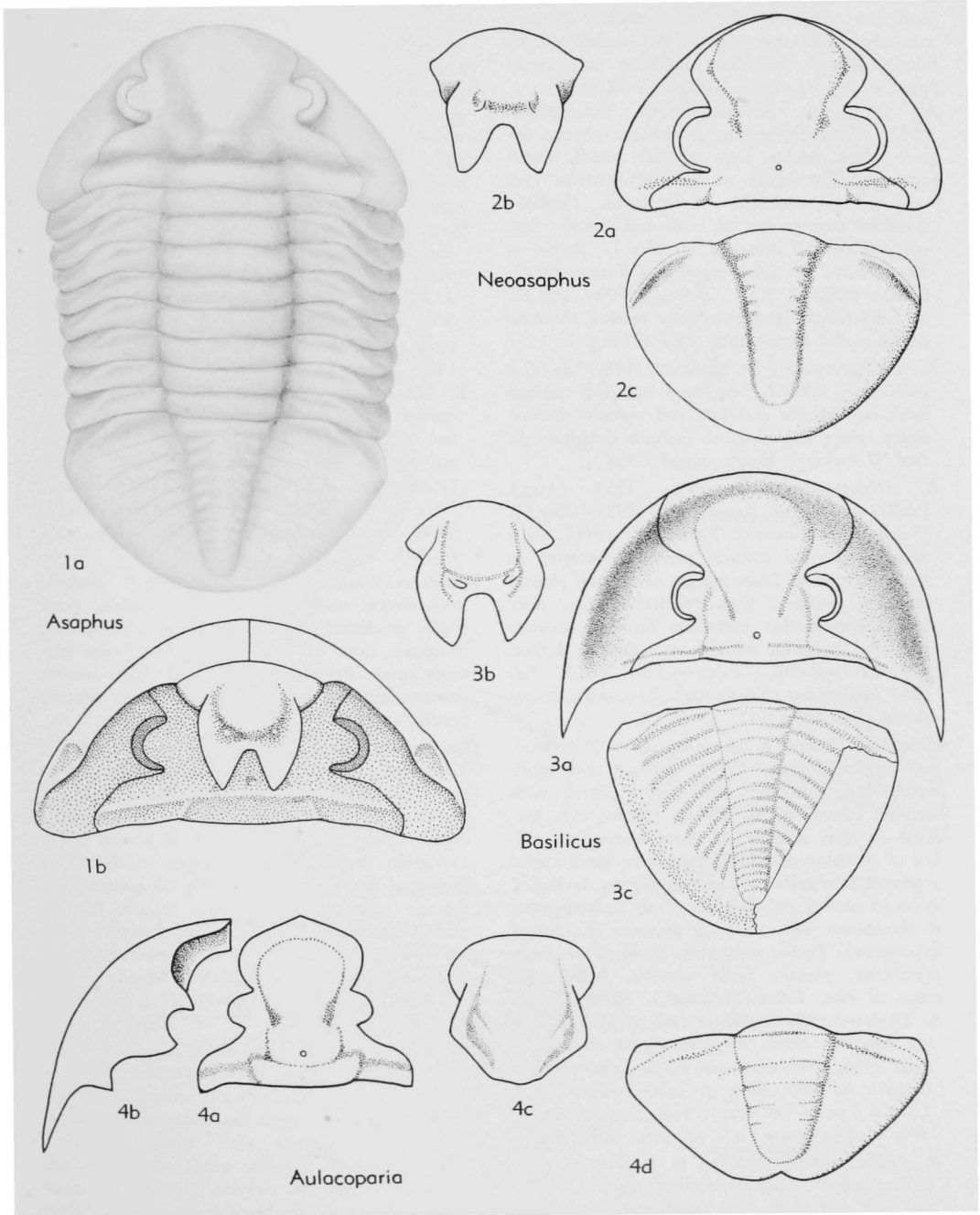


FIG. 248. Asaphidae (Asaphinae) (p. 0336).

pygidium without any trace of border. Glabella long, reaching external cephalic margin, frontal area absent or very narrow; posterior margin of librigenae typically convex, genal angles rounded or (rarely) pointed (adult specimens only in 1 or 2 species with genal spines). Lateral corners of hypostoma more or less protruding. Librigenal panderian organs developed as notches. Pygidial axis long, prominent; pleural fields smooth or very faintly ribbed; pygidial doublure moderately broad. *L.Ord.*(*U.Arenig.*)-*M.Ord.*, NW.Eu.

A. (*Asaphus*) [= *Schizophorus* BALASCHOVA, 1953]. Panderian organs on thoracic pleurae developed as notches. Eyes relatively small, length approximately equal to distance between eyes and posterior margin of cephalon. Cephalic doublure without median hook and vincular furrow. *L.Ord.*(*U.Arenig.*-*L.Llanvirn.*), Balt.—FIG. 248,1a. **A. (A.) expansus* (WAHLENBERG), Swed.; exoskel., $\times 1.5$ (414n).—FIG. 248,1b. *A. (A.) fallax* ANGELIN; ceph., ventral, showing doublure and hypostoma, $\times 1.5$ (414n).

A. (*Onchometopus*) FR. SCHMIDT, 1898 [**A. (O.) volborhi*]. Like *A. (Asaphus)* but with median hook on cephalic doublure and vincular furrow along whole extension of cephalic doublure. *L.Ord.*(*U.Arenig.*), Ingermanland(USSR).

A. (*Neosaphus*) JAANUSSON, 1953 (Aug.) [= *Trematophorus* BALASCHOVA, 1953 (Dec.)]. [**Asaphus ludibundus* TÖRNQUIST, 1884]. Panderian organ on thoracic pleurae developed as separate opening. Inner margin of thoracic pleural doublure concave. Eyes relatively large, their length considerably exceeding distance between eyes and posterior margin of cephalon. *L.Ord.*(*Llanvirn.*)-*M.Ord.*, Balt.—FIG. 248,2. **A. (N.) ludibundus* (TÖRNQUIST), 2a-c, ceph., hypostoma, pyg., $\times 1$ (414).

Aulacoparia HINTZE & JAANUSSON, 1956 [**Asaphellus? venta* HINTZE, 1953]. Frontal area moderately long; cephalic axis well defined, with occipital furrow in all known species; eyes medium in size, situated at about transverse mid-line of cephalon or slightly behind it; genal angles produced into spines. Panderian organs developed as broad notches on librigenae (only known genus of Asaphinae with rounded posterior margin of hypostoma). Thorax unknown. Pygidial axis long, prominent; pleural fields smooth, with mere traces of ribs. *L.Ord.*(*M.Canad.*), N.Am.(Utah).

A. (*Aulacoparia*). Cephalon and pygidium without concave border. Pygidium with short postaxial field, doublure narrow, its inner margin concave on both sides of axis.—FIG. 248,4. **A. (A.) venta* (HINTZE); 4a,b, cran., librigena, $\times 4$; 4c, hypostoma, $\times 5$; 4d, pyg., $\times 1.5$ (407).

A. (*Aulacoparina*) HINTZE & JAANUSSON, 1956 [**Asaphellus? quadrata* HINTZE, 1953]. Cephalon and pygidium with more or less distinct concave border; postaxial field of pygidium mod-

erately long; pygidial doublure fairly broad, with inner margin on both sides of axis straight or feebly convex.

Basilicus SALTER, 1849 [**Asaphus tyrannus* MURCHISON, 1839]. Only known genus of Asaphinae with marginal position of facial suture in front of glabella. Cephalon surrounded by convex rim; glabella long; preglabellar field narrow; eyes rather large, situated slightly behind transverse mid-line of cranium; genal angles with spines. Lateral margin of the hypostoma broadly rounded, posterior margin deeply notched. Pygidium with well-defined concave border; inner part of the pygidial pleural fields with strong, rounded ribs; pygidial doublure moderately broad, as in *Asaphus*. *L.Ord.*-*M.Ord.*, N.Am.-Eu.

B. (*Basilicus*). Pygidium long, with subparabolic outline; postaxial field short. Cephalic border rounded. *M.Ord.*(*Llandeil.*), Wales.—FIG. 248,3. **B. (B.) tyrannus* (MURCHISON); 3a, ceph., $\times 0.7$; 3b, hypostoma, $\times 1$; 3c, pyg., showing at right shape of inner margin of doublure, $\times 0.7$ (466).

B. (*Basilicella*) KOBAYASHI, 1934 [**Asaphus barrandei* HALL, 1851]. Pygidium with more or less subcircular outline; postaxial field moderately long. Cephalic border angular. *M.Ord.*(*Blackriver*). E.C.U.S.A., *L.Ord.*(*U.Tremadoc.*), ?Arg.—FIG. 249,3. **B. (B.) barrandei* (HALL); 3a-d, cran., librigena, hypostoma, pyg., $\times 1$ (414n).

Eoisotelus WANG, 1938 [**E. orientalis*]. Glabella long, almost reaching margin of cephalon; genal angles produced into spines in the type species; librigenae more or less evenly convex; eyes relatively small. Pygidium with pleural fields smooth or very faintly ribbed, and broad, deeply concave border. *L.Ord.*, China.

Ogmasaphus JAANUSSON, 1953 [**Asaphus praetextus* TÖRNQUIST, 1884]. Like *Pseudoasaphus* but cephalon with considerably narrower frontal area and pygidium with distinct flattened border and moderately strong ribs on inner part of pleural fields. Panderian organs of type species notchlike on librigenae and developed as separate openings on thoracic pleurae; inner margin of the thoracic pleural doublure straight. Pygidial doublure moderately broad (broader than in *Asaphus*, narrower than in *Pseudoasaphus*). *M.Ord.* Scand.—FIG. 249,2. **O. praetextus* (TÖRNQUIST); 2a, ceph., $\times 2$; 2b, pyg. showing at left shape of inner margin of doublure, $\times 1.5$ (414n).

Plectasaphus JAANUSSON, 1953 [**Asaphus plicicostis* TÖRNQUIST, 1884]. Glabella and frontal area much as in *Ogmasaphus*; cephalon and pygidium without border; librigenae with straight to faintly concave posterior margin, genal angles pointed. Panderian organs on thoracic pleurae and inner margin of thoracic doublure as in *Asaphus* (*Neosaphus*). Hypostoma as in *Asaphus*. Pygidial pleu-

ral regions evenly convex, their inner part with 3 or 4 conspicuous short (*tr.*) rounded ribs; pygidial doublure broad. *M.Ord.*(*Llandeil.*), Swed.—FIG. 249, I. **P. plicicostis* (TÖRNQVIST); carapace, ×2 (414n).

Pseudoasaphus FR. SCHMIDT, 1904 [**Ptychopyge*

globifrons EICHWALD, 1857; SD REED, 1930] [= *Pseudoasaphus* FR. SCHMIDT, 1904, *nom. null.*]. Cephalon and pygidium with more or less distinct (in some species poorly defined), concave border. Frontal area moderately long; eyes large, as in *Asaphus* (*Neosaphus*); genal angles pointed

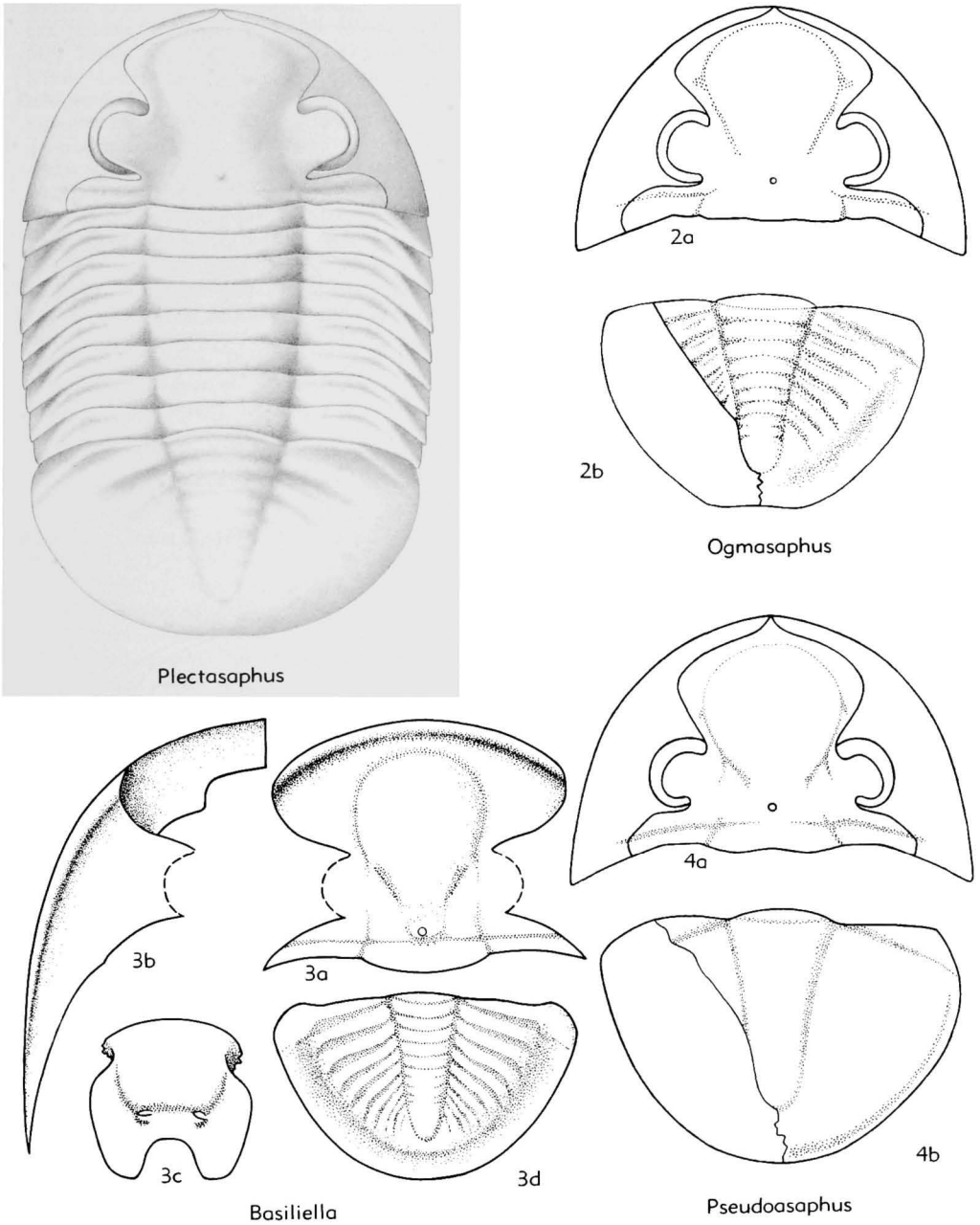


FIG. 249. Asaphidae (Asaphinae) (p. 0336-0337).

or with genal spines. Hypostoma as in *Asaphus*. Panderian organs developed as notches or separate openings on librigenae and as separate openings on thoracic pleurae. Inner margin of the thoracic pleural doublure slightly to moderately convex. Pygidium with pleural fields smooth or bearing faint ribs on inner parts, doublure broad, and outer surface generally with strong ornamentation of terrace lines. *L.Ord.*(*Llanvirn.*)-*M.Ord.*, Baltoscandia.—FIG. 249,4. **P. globifrons* (EICHWALD); 4a, ceph., $\times 1.5$; 4b, pyg., showing at left

shape of inner margin of doublure, $\times 1.5$ (468). **Pseudobasilicus** REED, 1931 [**Ptychopyge lawrowi* FR. SCHMIDT, 1898]. Exoskeleton rather flattened, cephalon and pygidium with a broad flattened border. Frontal area moderately long; eyes large, as in *Asaphus* (*Neoasaphus*); librigenae broad, with genal spines. Lateral terminations of thoracic pleurae, unlike all other Asaphinae, pointed and curved backward, resembling short spines. Panderian organs and inner margin of thoracic pleural doublure as in *Ptychopyge*. Inner part of pygidial

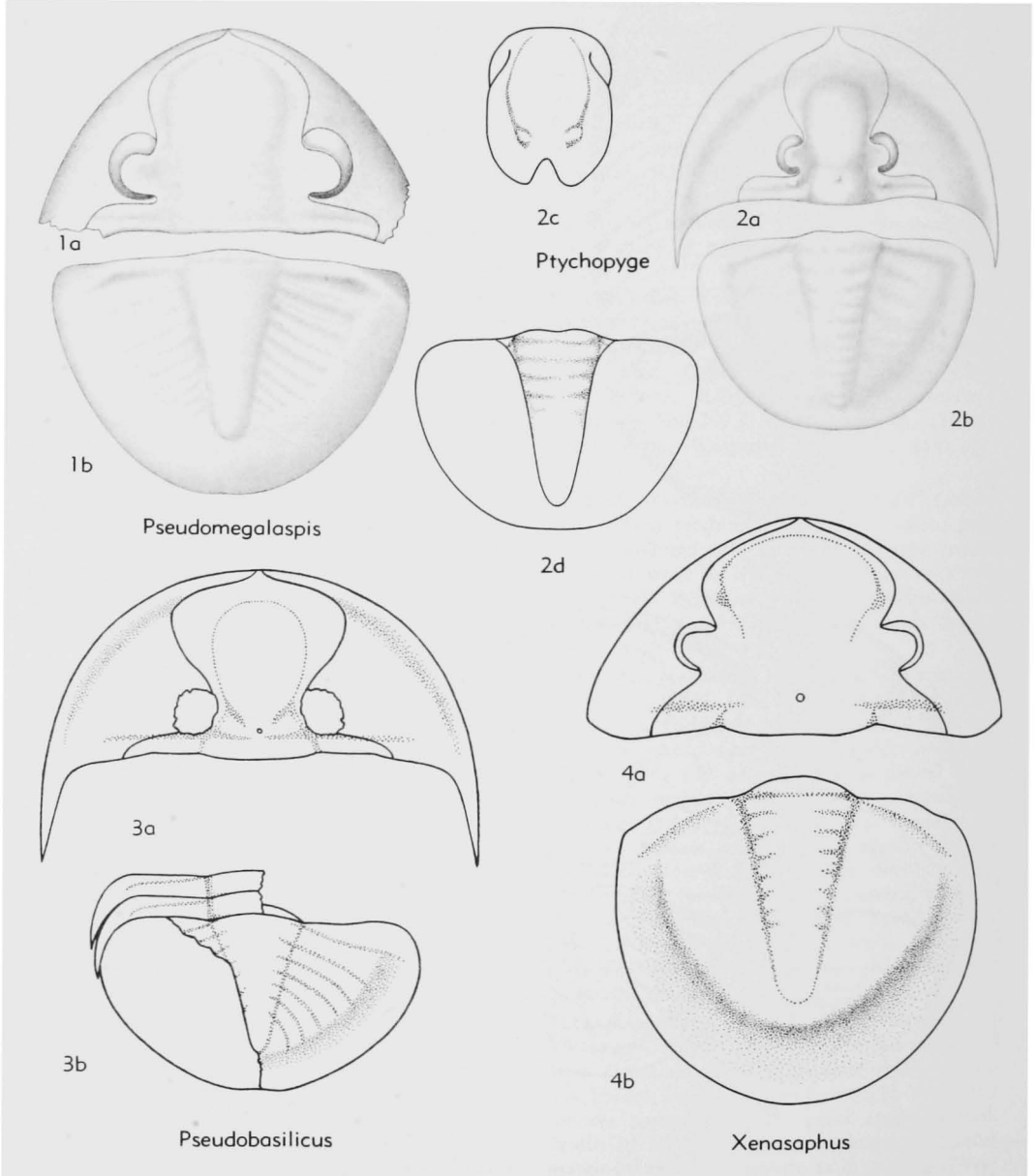


FIG. 250. Asaphidae (Asaphinae) (p. 0338-0339).

pleural fields with conspicuous rounded ribs that reach border (one species without ribs); pygidial doublure very broad, as in *Ptychopyge*. *M.Ord.*, Baltoscandia.—FIG. 250,3. **P. lawrowi* (FR. SCHMIDT); 3a, ceph.; 3b, parts of 2 hindmost thoracic segments and pygidium showing at left shape of pygidial doublure, $\times 1$ (468). [*Pseudo-basilicus* REED, 1930 (*nom. nud.*), did not include *Ptychopyge lawrowi* as species assigned to genus.—C.J.S.]

Pseudomegalaspis JAANUSSON, 1953 [**Megalaspis formosa* TÖRNQUIST, 1884]. Cephalon and pygidium without trace of concave border. Genal angles produced into spines. Hypostoma as a whole as in *Asaphus*. Posterior lateral glabellar furrows poorly developed; eyes large, as in *Asaphus* (*Neoasaphus*). Thoracic axis narrow, its width considerably less than 0.3 of total width of thorax. Panderian organs on thoracic pleurae and inner margins of thoracic pleural doublure, as in *A.* (*Neoasaphus*), their development on librigenae unknown. Pygidium with axis rather flattened; inner part of pleural fields with faint, slightly furrowed ribs; doublure narrow, its inner margin more or less parallel to outer margin of pygidium. *M.Ord.*(*Llandeil.*), Scand.—FIG. 250, 1. **P. formosa* (TÖRNQUIST); a,b, ceph., pyg., $\times 1$ (414).

Ptychopyge ANGELIN, 1854 [**Asaphus angustifrons* DALMAN, 1827; SD proposed JAANUSSON, 1956 (ICZN pend.)]. Cephalon and pygidium with flattened border. Glabella comparatively narrow; frontal area long to moderately long; eyes relatively small, generally as in *Asaphus* (*Asaphus*); characteristic nodes typically developed behind eyes (may be present also in *Pseudoasaphus*); posterior margins of librigenae concave, genal angles produced into spines. Hypostoma with comparatively short (*tr.*) notch in posterior margin, lateral margin more or less evenly rounded, without a distinct protruding corner. Thoracic axis narrow, its width considerably less than 0.3 of total width of thorax; lateral terminations of thoracic pleurae straight. Panderian organs developed as separate openings on librigenae and thoracic segments. Inner margin of thoracic pleural doublure strongly convex. Inner part of the pygidial pleural fields with faint, rounded, unfurrowed ribs; pygidial doublure very broad. *L.Ord.*(*Arenig.-L. Llanvirn.*). Baltoscandia.—FIG. 250,2. **P. angustifrons* (DALMAN); 2a, ceph., $\times 1$; 2b, pyg., $\times 1$ (414n); 2c, hypostoma, $\times 1.5$ (424); 2d, pyg., ventral view showing shape of doublure (414n).

Xenasaphus JAANUSSON, 1953 [**Asaphus devexus* EICHWALD, 1840]. Cephalon without trace of border; frontal area very short; eyes relatively small, as in *Asaphus* (*Asaphus*); posterior margin of librigenae convex, genal angles rounded or faintly pointed. Hypostoma essentially as in

Asaphus. Thorax with long and deep articulating furrows. Panderian organs developed as broad notches on librigenae and as separate openings on thoracic pleurae. Pygidium with broad, deeply concave border; postaxial field moderately long; inner part of pygidial pleural fields smooth or with very faint traces of unfurrowed ribs; doublure moderately broad, as in *Asaphus*. *M.Ord.* (*Llandeil.*), Est., Ingermanland (Leningrad district).—FIG. 250,4. **X. devexus* (EICHWALD); 4a, ceph. (reconstr.), $\times 1$ (414); 4b, pyg., $\times 1$ (468).

Subfamily ISOTELINAE Angelin, 1854

[*nom. transl.* JAANUSSON, herein (*ex* Isotelidae ANGELIN, 1854)]

Glabella, if defined, slightly tapering forward, parallel-sided, or somewhat expanding in front of eyes; glabellar tubercle immediately in front of or at some distance from occipital furrow or of area corresponding to it, distance between this tubercle and occipital furrow (with some exceptions) smaller than length (*sag.*) of occipital ring. Anterior wings of hypostoma more or less triangular. Panderian organs generally developed as separate openings. Ornamentation of terrace lines mostly poorly developed or absent. [The tendency toward obsolescence of axial furrows is more common in this subfamily than in others. The tribes here distinguished may not represent natural units.] *L.Ord.*(*Arenig.*)-*Up.U.Ord.*

Group A

Posterior margin of hypostoma strongly concave to deeply notched (including genera in which hypostoma is still unknown, but which probably have similar shape of hypostomal posterior margin). *L.Ord.* (*Arenig.*)-*Up.U.Ord.*

Isotelus DEKAY, 1824 [**I. gigas*]. Cephalon and pygidium mostly with poorly defined flattened border. Frontal area moderately long, cephalic axis ill defined, almost obsolete in several species, slightly expanding in front of medium-size eyes situated somewhat behind transverse mid-line of cranidium; no posterior border furrow; genal angles rounded, pointed, or with short genal spines. Hypostoma almost parallel-sided, posterior margin with broad (*tr.*), deep notch; anterior lobe short. Thoracic axis considerably broader than pleurae. Pygidial axis broad, poorly defined, almost obsolete in several species; pleural fields smooth or very faintly ribbed. *M.Ord.-U.Ord.* N. Am.-Sib.-N.Eu.-Greenl.—FIG. 251,2. **I. gigas*; 2a, carapace, $\times 1$ (496); 2b, hypostoma, $\times 0.7$ (414n).

Anataphrus WHITTINGTON, 1954 [**A. borraeus*].
 No border on cephalon or pygidium, axial furrows obsolete; foremost portions of facial sutures very close to external cephalic margins; eyes large, their mid-point slightly behind the transverse mid-line of cephalon; no posterior border furrow;

genal angles rounded. Thoracic axis considerably broader than pleural regions; pleural furrows absent. Pygidium smooth, axis completely obsolete. *U.Ord.*, N.Am.-Greenl.-Baffin I.—FIG. 251,4. **A. borraeus*; 4a,b, ceph., 8th thoracic segment and pyg., $\times 3$ (496).

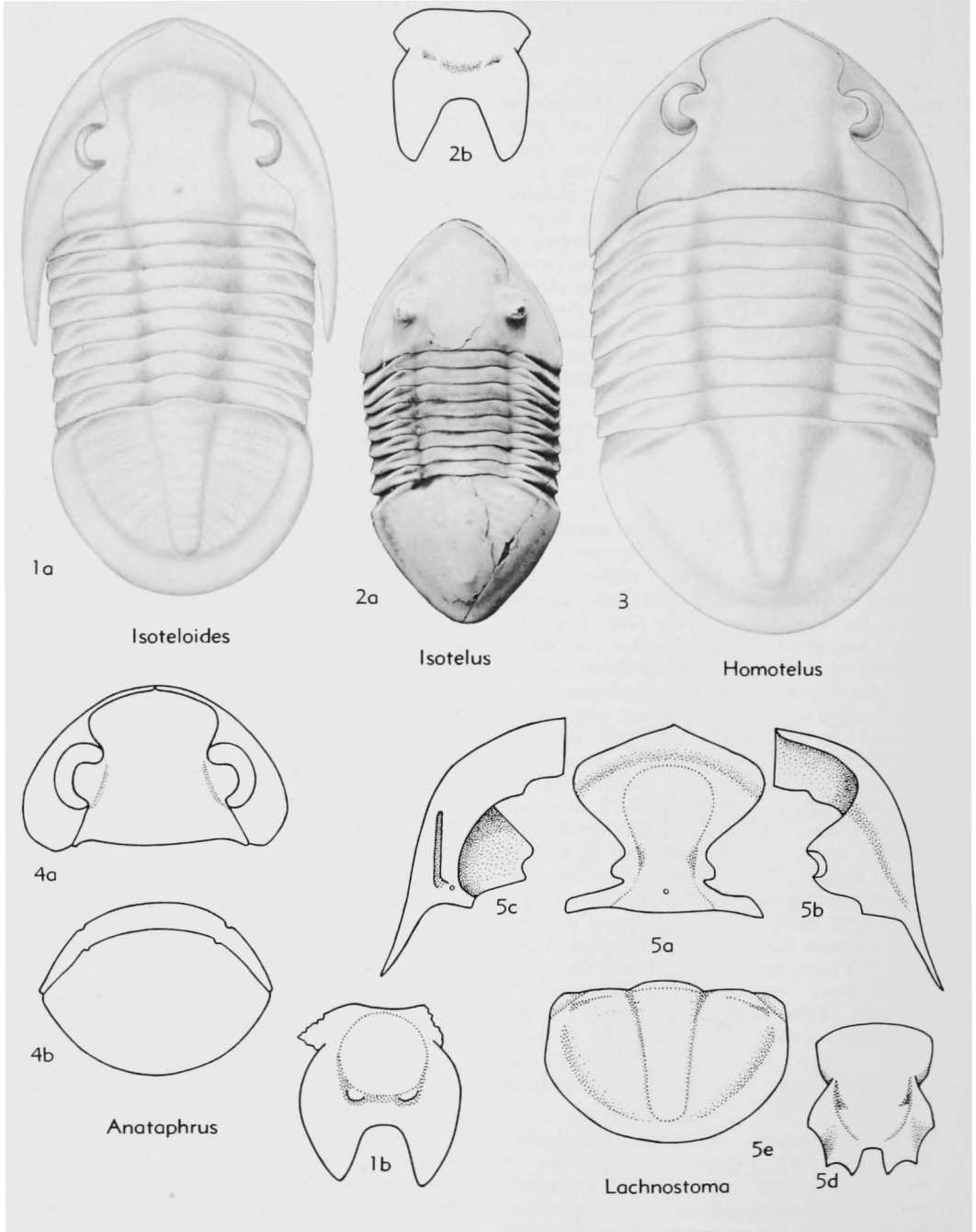


FIG. 251. Asaphidae (Isotelinae) (p. O339-O340).

- Ectenaspis* RAYMOND, 1920 [**Megalaspis beckeri* SLOCUM, 1913]. Anterior part of cephalon produced into long, tonguelike process; cephalic axis not distinguished; no distinct cephalic border or posterior border furrow; eyes on long stalks; genal corners rounded. Hypostoma unknown. Thoracic axis well defined, considerably broader than pleurae. Pygidium triangular, with faint narrow flattened border posteriorly; axis well defined, triangular. *U.Ord.*(*Maquoketa*). USA (Iowa).—FIG. 252,4. **E. beckeri* (SLOCUM); carapace, $\times 1$ (496n).
- Homalopyge* JAANUSSON, 1956 [**Asaphus stacyi* FR. SCHMIDT, 1898]. Cephalon and pygidium without trace of border and axial furrows on dorsal surface of carapace; eyes small, considerably behind transverse mid-line of cranium; no posterior border furrow; librigenae relatively narrow, genal angles rounded; foremost portions of facial sutures at some distance from external cephalic margins. Thorax and hypostoma unknown. Pygidial doublure moderately broad. *L.Ord.*(*Llanvirn*). Baltoscandia.—FIG. 252,3. **H. stacyi* (FR. SCHMIDT); *3a*, ceph., $\times 0.7$; *3b*, pyg., showing at left shape of inner margin of doublure, $\times 0.7$ (414).
- Homotelus* RAYMOND, 1925 [**H. ulrichi*] [= *Homotelus* RAYMOND, 1920, *nom. nud.* (no fig. of type species)]. Cephalon without trace of border; cephalic axis poorly defined, expanding in front of eyes; no frontal area, glabella reaching cephalic margin; eyes of moderate size, slightly in front of transverse mid-line of cranium; no posterior border furrow; genal angles pointed in type species. Hypostoma as in *Isotelus*. Thoracic axis about twice width of pleurae in dorsal view. Pygidium with narrow, poorly defined, flattened border; axis wide (*tr.*) anteriorly, comparatively well defined, pleural fields smooth. *U.Ord.*(*Eden*). N.Am.(Ohio).—FIG. 251,3. **H. ulrichi*; carapace, $\times 1.5$ (496).
- Isoteloides* RAYMOND, 1910 [**I. whitfieldi*]. Cephalon and pygidium with well-defined, flattened border; frontal area moderately long, in type species slightly shorter than 0.25 of total length of cephalon; glabella rather well defined, slightly expanding in front of moderately large eyes situated at about transverse mid-line of cephalon; faint posterior border furrow may be present; genal angles produced into spines. Hypostoma in type species with broadly rounded lateral margin and broad (*tr.*) notch in posterior margin. Thoracic axis about as broad as pleurae. Pygidial axis rather well defined, moderately broad; pleural fields in type species with faint ribs. *L.Ord.*(*U. Canad.*), N.Am.-Greenl.—FIG. 251,1. **I. whitfieldi*; *1a*, carapace (reconstr.), $\times 2$ (414n); *1b*, hypostoma, $\times 2$ (414n).
- Lachnostoma* ROSS, 1951 [**L. latucelsum*]. Frontal area moderately long, cephalic axis rather poorly defined, slightly expanding in front of eyes, which are small, situated well behind transverse mid-line of cephalon; no posterior border furrow; librigenae broad, with poorly defined flattened border and relatively long genal spines; librigenal doublure with conspicuous furrow. Hypostoma with rather broad lateral border, pointed lateral corner, short and narrow (*tr.*) notch in posterior margin, and short pointed process between notch and lateral corner. Thoracic axis distinctly narrower than corresponding pleurae; pleural furrows absent. Pygidium with well-defined flattened border and equally well-defined relatively narrow axis; pleural fields very faintly ribbed to smooth; doublure narrow, with inner margin on both sides of axis parallel to external margin of pygidium. *L.Ord.*(*U. Canad.*). USA (Utah).—FIG. 251,5. **L. latucelsum*; *5a*, cran., $\times 2$; *5b,c*, librigena, dorsal, ventral, $\times 1.5$; *5d*, hypostoma, $\times 2$; *5e*, pyg., $\times 1.5$ (407).
- Lannacus* TJERNVIK, 1956 [**Megalaspides nericiensis* WIMAN, 1905]. Like *Megalaspides* but with broad flattened pygidial border. *L.Ord.*(*Arenig.*), Swed.—FIG. 252,2. **L. nericiensis* (WIMAN); carapace (reconstr.), $\times 1$ (414n).
- Megalaspides* BRØGGER, 1886 [**Megalaspis dalecarlicus* HOLM, 1882]. Cephalon with distinct flattened border; frontal area moderately long (in type species 0.16 of total length of cephalon); glabella fairly distinct, more or less parallel-sided; eyes moderately large, at or slightly behind mid-line of cranium; posterior border furrow absent or faint; genal angles produced into spines. Lateral margin of hypostoma evenly rounded, posterior margin with broad (*tr.*), short notch. Thoracic axis considerably narrower than pleurae. Pygidium with axis commonly flattened and rather poorly defined; without border; pleural fields smooth; doublure narrow, with inner margin on both sides of axis more or less parallel to external margin. *L.Ord.*(*Arenig.*), Baltoscandia.—FIG. 252,1. **M. dalecarlicus* (HOLM); *1a*, carapace (reconstr.), $\times 1$ (414n); *1b*, hypostoma, $\times 2$ (484a).
- Nileoides* RAYMOND, 1920 [**Nileus perkinsi* RAYMOND, 1910]. Cephalon without trace of border; cephalic and pygidial axial furrows completely obsolete, those of thorax very faint; eyes large, close to posterior cephalic margin; foremost portions of facial sutures very close to external cephalic margins and nearly parallel to them; no posterior border furrow. Thoracic axis much broader (*tr.*) than pleurae; pleural furrows absent; shape of genal angles and hypostoma unknown. Pygidium incompletely known. *M.Ord.*(*Chazy*). USA.(Vt.-N.Y.).—FIG. 253,3. **N. perkinsi* (RAYMOND), ceph., $\times 1$ (414n).
- Ogygitoides* KOBAYASHI, 1934 [**O. raymondi*]. Cephalon and pygidium with poorly defined concave border; preglabellar field fairly long, 0.20 to 0.25 of total length of cranium; cephalic axis

comparatively narrow, fairly well-defined, parallel-sided or slightly tapering forward; eyes moderately large, at about transverse mid-line of cranium; no posterior border furrow; genal spines long and anteriorly rather broad. Hypostoma unknown. Thoracic axis considerably narrower than pleurae.

Pygidial axis well-defined, narrow, pygidial pleural fields smooth. *M.Ord.*, S.Korea.—FIG. 253, I. **O. raymondi*; 1a,b, ceph., 2 hindmost thoracic segments and pyg., $\times 1$ (414n). *Parabasilicus* КОВАЛЫШИН, 1934 [**P. typicalis*]. Type species poorly known. *M.Ord.*, S.Korea.

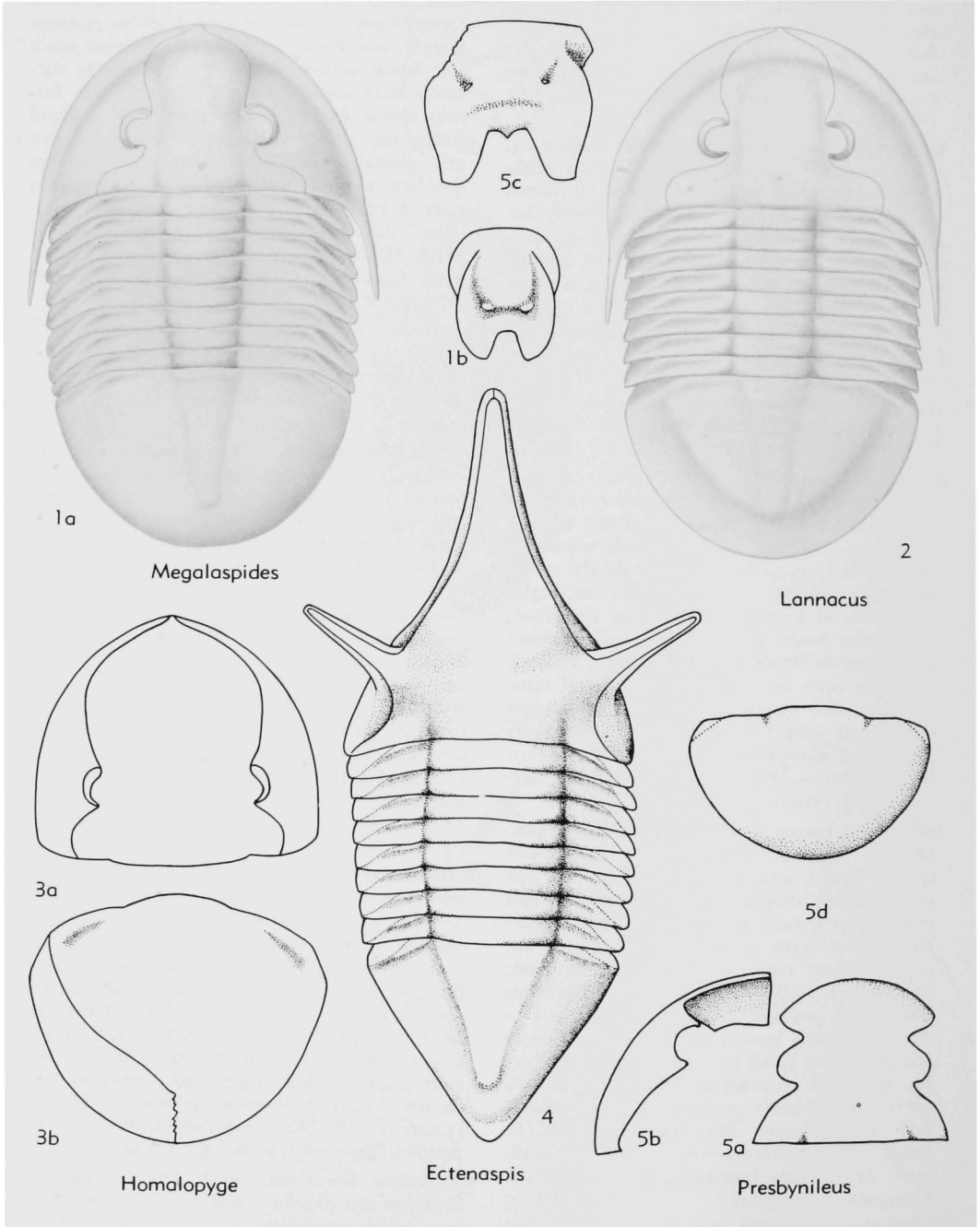


FIG. 252. Asaphidae (Isotelinae) (p. 0341-0343).

- Presbynileus** HINTZE, 1954 [pro *Paranileus* HINTZE, 1953 (non KOBAYASHI, 1951)] [**Paranileus ibexensis* HINTZE, 1953]. Cephalon and pygidium without trace of border and with almost completely obsolete axial furrows; foremost portions of facial sutures close to external cephalic margins and nearly parallel to them; eyes of moderate size, at transverse mid-line of cranium; no posterior border furrow; genal angles rounded. Thorax unknown. Pygidial pleural regions smooth, doublure moderately broad. *L.Ord.(M.Canad.-U.Canad.)*, N.Am.
- P. (Presbynileus)**. Carapace rather strongly convex. Hypostoma with deeply notched posterior margin and short, pointed median spine; lateral corners slightly protruding, broadly rounded. *L.Ord.(M.Canad.-U.Canad.)*, N.Am. (Utah). — FIG. 252,5. *P. (*P.*) *ibexensis* (HINTZE); 5a, cran., $\times 3.5$; 5b,c, librigena, hypostoma, $\times 4$; 5d, pyg., $\times 2$ (407).
- P. (Protopresbynileus)** HINTZE, 1954 [pro *Pseudonileus* HINTZE, 1953 (non KOBAYASHI, 1951)] [**Pseudonileus willdeni* HINTZE, 1953]. Exoskeleton moderately convex. Posterior margin of hypostoma slightly notched, posterior and lateral furrows well developed, middle furrow absent. *L.Ord.(M.Canad.)*, N.Am.(Utah). — FIG. 254,1. *P. (*P.*) *willdeni* (HINTZE); 1a, cran., $\times 1.5$; 1b,c, librigena, hypostoma, $\times 3$; 1d, pyg. showing at right shape of inner margin of doublure, $\times 6$ (407).
- Pseudogygites** KOBAYASHI, 1934 [**Asaphus canadensis* CHAPMAN, 1856]. Cephalon and pygidium with well-defined flattened border; preglabellar field long, slightly less than 0.25 of total length of cephalon; cephalic axis distinctly defined, expanding in front of eyes, which are comparatively small, situated well behind transverse mid-line of cranium, their length about equal to distance between eyes and posterior cephalic margin; posterior border furrows rather distinct; genal angles produced into spines. Thoracic axis moderately broad, about same in width as pleurae. Pygidium with prominent axis, pleural fields with numerous strong unfurrowed ribs that almost reach external margin; doublure apparently narrow. [May not belong to this subfamily.] *M.Ord.* or *U.Ord.* (*Utica*), Can. — FIG. 253,5. *P. *canadensis* (CHAPMAN); 5a, ceph., $\times 1$; 5b, pyg., $\times 0.7$ (449).
- Ptyocephalus** WHITTINGTON, 1948 [*P. *vigilans*] [= *Kirkella* KOBAYASHI, 1942 (non GUNNELL, 1933)]. Cephalic outline more or less pentagonal; preglabellar field moderately long, 0.15 to 0.2 of total length of cephalon; cephalic axis rather poorly defined, nearly parallel-sided; eyes of moderate size, slightly behind transverse mid-line of cranium; no posterior border furrow; librigenae narrow, genal angles rounded; all species with conspicuous furrow on librigenal doublure. Hypostoma of peculiar shape, widest (*tr.*) near anterior end of comparatively very broad lateral border, notch in posterior margin relatively narrow (*tr.*) and short; no middle furrow. Pygidium more or less pentagonal in outline, with wide, flattened border which is broadest (*tr.*) anteriorly and decreases in width posteromedially; axis poorly defined, wide (*tr.*), facets narrow (*tr.*) and long; doublure broad. [May not belong to this subfamily.] *L.Ord.(U.Canad.)*. N.Am. — FIG. 253, 4. *P. yersini* (HINTZE), Utah; 4a, cran., $\times 4$; 4b,c, librigena, hypostoma, $\times 3$; 4d,e, pyg., dorsal, ventral, $\times 2$ (407).
- Stenorhachis** HINTZE & JAANUSSON, 1956 [**Isoteloides? genaliticurvatus* HINTZE, 1953]. Preglabellar field long, slightly more than 0.5 of length of cephalic axis, which is narrow, flattened, almost parallel-sided or slightly tapering forward; eyes small, far from axial furrows and well behind transverse mid-line of cephalon; faint posterior border furrow present; librigenae broad, with shallow, poorly defined concave border and long genal spines. Hypostoma and thorax unknown. Pygidium comparatively broad, with distinct concave border; axis narrow, fairly prominent; pleural fields with mere traces of ribs; doublure moderately broad. *L.Ord.(U.Canad.)*, USA. (Utah). — FIG. 253,2. *S. *genaliticurvata* (HINTZE); 2a, cran., $\times 2$; 2b,c, librigena; pyg., showing at right shape of inner margin of doublure, $\times 4$ (407).
- Trigonocerca** Ross, 1951 [**T. typica*]. Preglabellar field narrow, cephalic axis poorly defined, slightly expanding in front of eyes, which are moderately large, situated slightly behind transverse mid-line of cranium; no posterior border furrow; librigenae with poorly defined flattened border and genal spines. Hypostoma with concave posterior margin and short pointed median spine; lateral corners pointed, protruding; posterior furrow distinct, no middle furrow. Thorax unknown. Pygidium triangular, with short terminal spine and narrow border; axis rather poorly defined; pleural fields smooth or very faintly ribbed; doublure narrow, with inner margin parallel to external margin. *L.Ord.(U.Canad.)*, N.Am. — FIG. 254,3. *T. piochensis* (HINTZE), Utah; 3a, cran., $\times 4$; 3b,c, librigena, hypostoma, $\times 2$; 3d,e, pyg., dorsal, ventral, $\times 2.5$ (407).
- Trigonocercella** HINTZE, 1953 [**T. acuta*]. Cephalon strongly elongated, cephalic axis poorly defined; eyes comparatively small, slightly behind transverse mid-line of cranium; foremost part of facial sutures close to external cephalic margins and almost parallel to them; librigenae without trace of border and with genal spines. No posterior border furrow. Hypostoma with deeply notched posterior margin and strongly protruding lateral corners; no posterior furrow, middle furrow partly obsolete. Thorax unknown. Pygidium without border, with poorly defined axis and compara-

tively long terminal spine; pleural fields smooth. *L.Ord.(U.Canad.)*, N.Am.(Utah).—FIG. 254,2. **T. acuta*; 2a, cran., $\times 3$; 2b,c, librigena, hypostoma, $\times 4$; 2d, pyg., $\times 3$ (407). *Vogdesia* RAYMOND, 1910 [**Isotelus? bearsi* RAYMOND, 1905]. Cephalic axis long, almost reaching

anterior margin, cephalic axial furrows poorly defined; eyes rather large, situated at about transverse mid-line of cranium, stalked on type species; no posterior border furrow; librigena with poorly defined, slightly concave border and rounded genal corners. Hypostoma and thorax un-

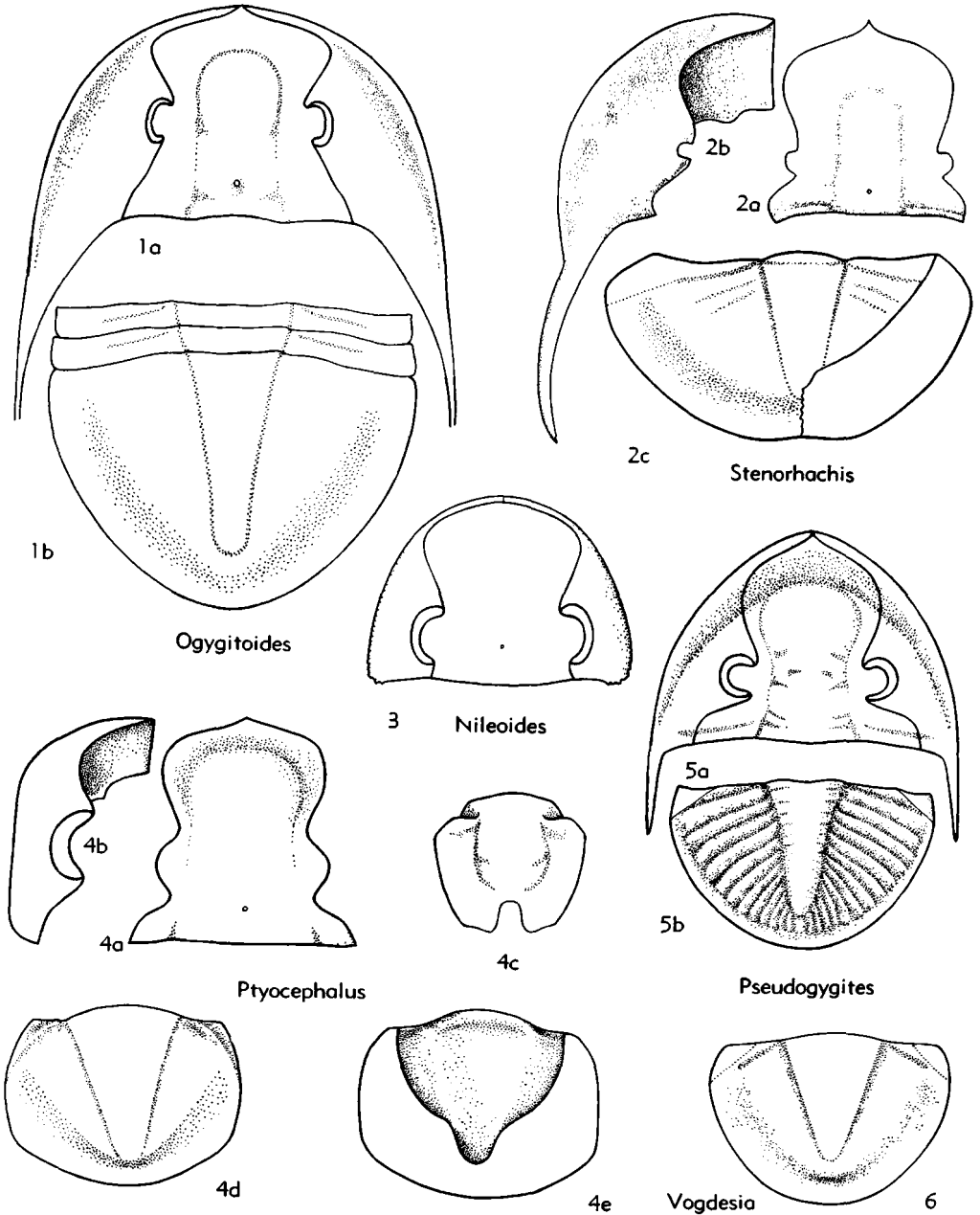


FIG. 253. Asaphidae (Isotelinae) (p. O341-O344).

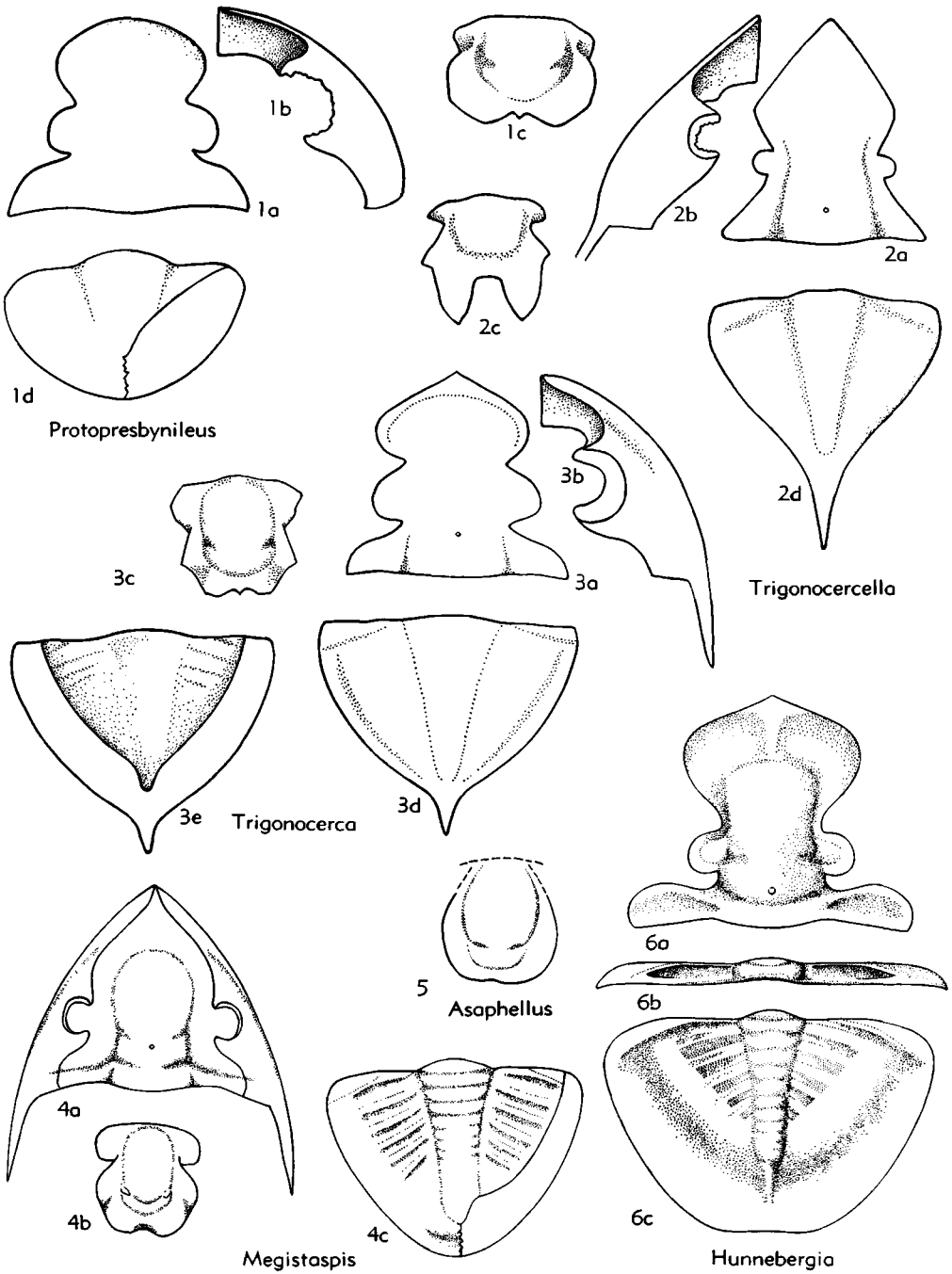


FIG. 254. Asaphidae (Isotelinae) (p. 0343-0347).

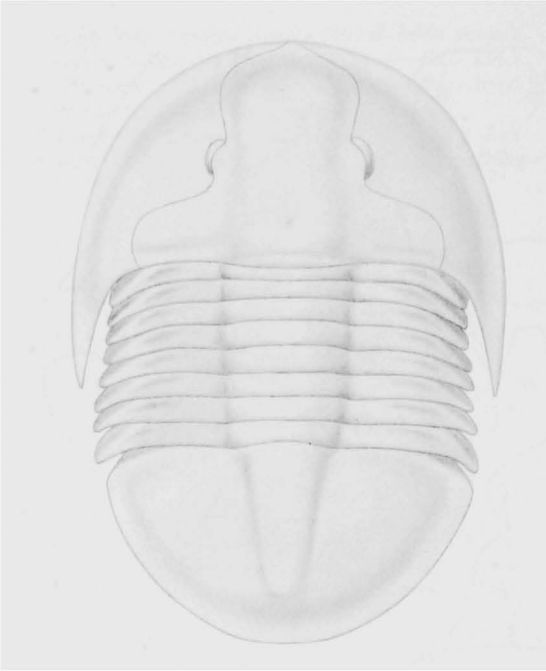


FIG. 255. **Asaphellus homfrayi* (SALTER) (Asaphidae), L.Ord.(Tremadoc.), Eng.; carapace (reconstr.), $\times 1.5$ (414).

known. Pygidium with faintly concave border; axis flattened, broad, triangular; pleural fields smooth. *M.Ord.*(*Chazy.*), N.Am.—FIG. 253,6.
**V. bearsi* (RAYMOND); pyg., $\times 1.5$ (414n).

Group B

Posterior margin of hypostoma pointed, rounded, straight, or only faintly concave. *L.Ord.*(*Tremadoc.*-*Llanvirn.*).

Asaphellus CALLAWAY, 1877 [**Asaphus homfrayi* SALTER, 1866] [= *Hemigyraspis* RAYMOND, 1910]. Cephalon and pygidium with concave border; frontal area moderately broad (in type species about 0.13 of total length of cranium); cephalic axis flattened, mostly poorly defined; eyes small, slightly in front of transverse mid-line of cranium; posterior border furrow distinct; genal angles produced into spines. Hypostoma with slightly concave to rounded posterior margin. Thoracic axis considerably narrower than pleurae. Pygidium fairly broad, flattened, with narrow well-defined axis, pleural fields with very faint to obsolete ribs; doublure narrow, as in *Megistaspis*. *L.Ord.*(*Tremadoc.*), Eng.-Wales-E.N.Am.-?N.Arg.—FIGS. 254,5; 255. **A. homfrayi* (SALTER), Eng.; 254,5, hypostoma, $\times 1.5$ (421); 255, carapace (reconstr.), $\times 1.5$ (414n).

Hoekaspis KOBAYASHI, 1937 [**Megalaspis metacensis* HOEK, 1912]. Cephalon and pygidium with flattened border; frontal area narrow; glabella

slightly expanding in front of eyes; facial sutures intramarginal in front of glabella; glabellar tubercle situated immediately in front of area corresponding to occipital furrow; eyes moderately large, slightly in front of transverse mid-line of cranium; genal spines long. Hypostoma with slightly acuminate posterior margin. Thorax with axis somewhat narrower than pleurae. Pygidium with prominent axis; pleural fields with faint ribs, border well distinguished; doublure narrow, as in *Megistaspis*. Development of panderian organs unknown. [May not belong to this subfamily.] *L.Ord.*(*Llanvirn.*), N.Arg.-Bol.—FIG. 256. *H. megacantha* (LEANZA); carapace (reconstr.), $\times 1.4$ (59*).

Hunnebergia TJERNVIK, 1956 [**H. retusa*]. Cephalon and pygidium with wide, flattened border; frontal area broad, 0.25 to 0.3 of total length of cranium; glabella slightly tapering forward; eyes moderately large, somewhat behind transverse mid-line of cranium; posterior border furrow distinct; genal angles produced into spines. Hypostoma poorly known, apparently with rounded posterior margin. Thoracic axis comparatively very narrow, pleural terminations pointed. Pygidium flattened, axis narrow, inner part of pleural fields with faint ribs, postaxial field moderately

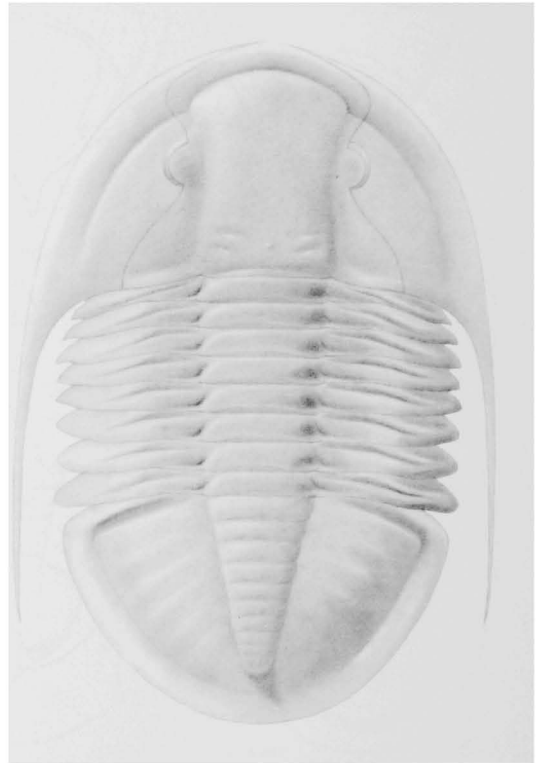


FIG. 256. **Hoekaspis megacantha* (LEANZA) (Asaphidae), L.Ord.(Llanvirn.), Arg.; carapace (reconstr.), $\times 1.4$ (59*).

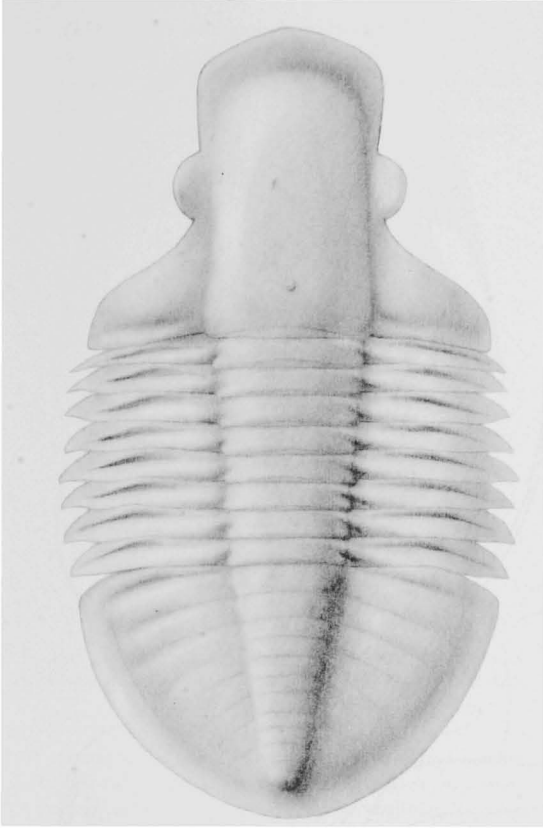


FIG. 257. **Megalaspidella (Megalaspidella) kayseri* KOBAYASHI (Asaphidae, L.Ord.(Arenig.), Arg.; carapace lacking librigenae (reconstr.), $\times 1.7$ (59*).

long; doublure wide. Development of pandernerian organs unknown. [May not belong to this subfamily; represents an early member of Asaphinae.] L.Ord.(L.Arenig.), Swed.—FIG. 254,6. **H. retusa*; 6a-c, cran., thoracic segment, pyg., $\times 1$ (484a).

Megalaspidella KOBAYASHI, 1937 [**M. kayseri*]. Like *Megistaspis*, but with considerably shorter frontal area, occupying 0.12 to 0.16 of total length of cranium; posterior border furrow generally well defined. Lateral margin of hypostoma evenly rounded, posterior margin rounded or faintly pointed. [Subgeneric classification somewhat uncertain at present.]

M. (Megalaspidella) [= ?*Plesiomegalaspis* THORAL, 1946; ?*Ogygitella* HARRINGTON & LEANZA, 1957]. Glabella parallel-sided or faintly tapering forward; posterior margin of pygidium rounded. L.Ord.(Arenig.), N. Arg.-?Fr.-?N.Afr.—FIG. 257. **M. (M.) kayseri*, Arg.; carapace lacking librigenae (reconstr.), $\times 1.7$ (59*).

M. (Kayseraspis) HARRINGTON, 1938 [**K. asaphelloides*]. Glabella strongly tapering forward, pygidium with terminal spine. L.Ord.(Arenig.),

N.Arg.—FIG. 258. **M. (K.) asaphelloides* (HARRINGTON), carapace (reconstr.), $\times 1.8$ (59*).

Megistaspis JAANUSSON, 1956 [pro *Megalaspis* ANGELIN, June 1851 (non BLEEKER, May 1851)] [**Trilobites limbatus* BOECK, 1838] [= *Rhinaspis* REMELÉ, 1885, nom. nud. (non PERTY, 1830)]. Cephalon and pygidium with concave border, distinct in most species, weak to obsolete in some large species; frontal area 0.25 or more of total length of cranium; eyes mostly small; occipital furrow and posterior border furrow distinct in some species, obsolete in others; cephalic axis well defined, slightly tapering forward or parallel-sided; genal angles produced into spines. Hypostoma with strongly convex anterior body and broad lateral margin that protrudes slightly laterally, posterior body triangular or trapezoidal, posterior margin concave, rounded, or with a short terminal spine. Thoracic axis narrow. Ribs on pygidial pleural fields, if developed, with distinct longitudinal furrow; pygidial doublure narrow. L.Ord.(Arenig.-Llanvirn.), Baltoscandia.

M. (Megistaspis). Cephalic outline more or less triangular. Posterior margin of hypostoma faintly concave. Thoracic axial rings strongly convex, articulating furrow deep. All known species lack-

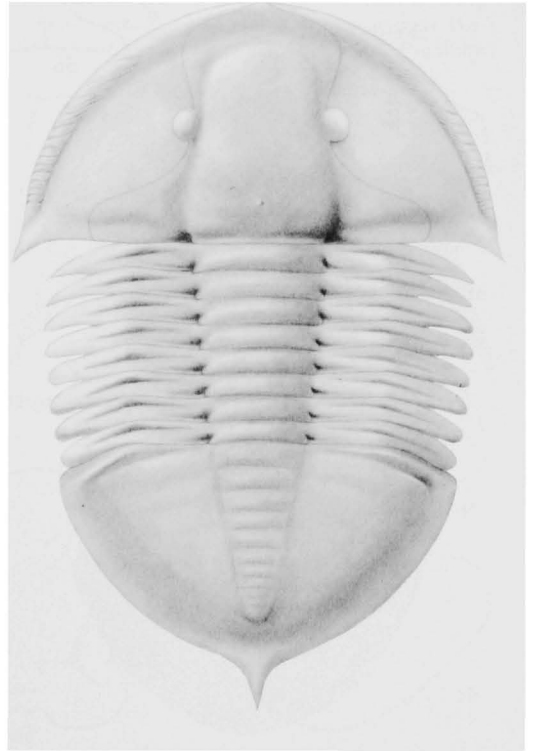


FIG. 258. **Megalaspidella (Kayseraspis) asaphelloides* (HARRINGTON) (Asaphidae, L.Ord.(Arenig.), Arg.; carapace (reconstr.), $\times 1.8$ (59*).

ing terminal pygidial spine. *L.Ord.(U.Arenig.)*.
 —FIG. 254,4a,b. *M. (M.)* sp. cf. *M. (M.)*
elongata (FR. SCHMIDT); 4a, ceph., $\times 1$; 4b,
 hypostoma, $\times 1.5$ (414).—FIG. 254,4c. **M.*
(M.) limbata (BOECK); pyg. showing at right

shape of inner margin of doublure, $\times 0.7$ (414).
M. (Megistaspidella) JAANUSSON, 1956 [**Entomos-*
tracites extenuatus WAHLENBERG, 1821]. Anterior
 part of cephalon produced into an elongate,
 tonguelike process. Posterior body of hypostoma

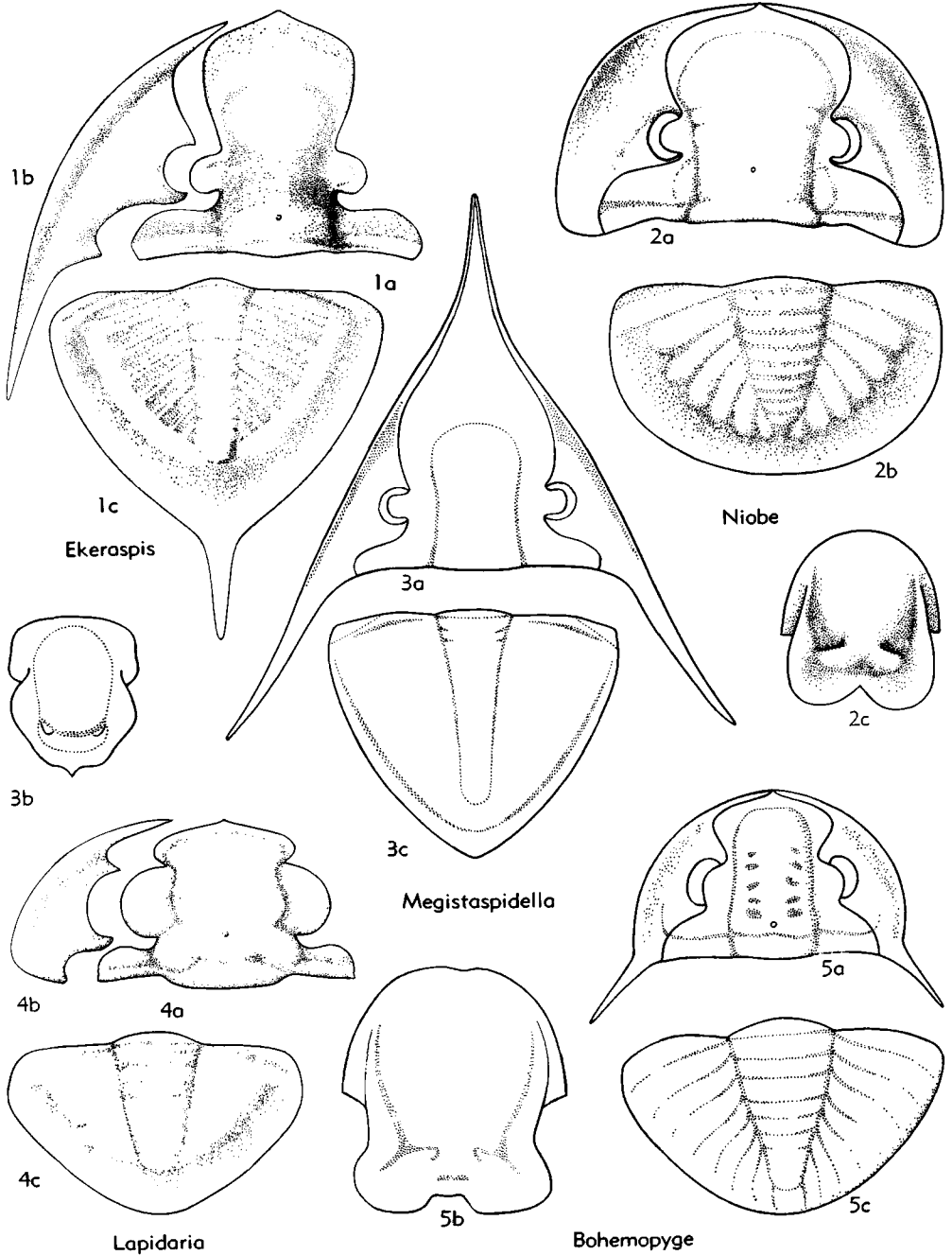


FIG. 259. Asaphidae (Isotelinae, Niobinae) (p. 0349-0350).

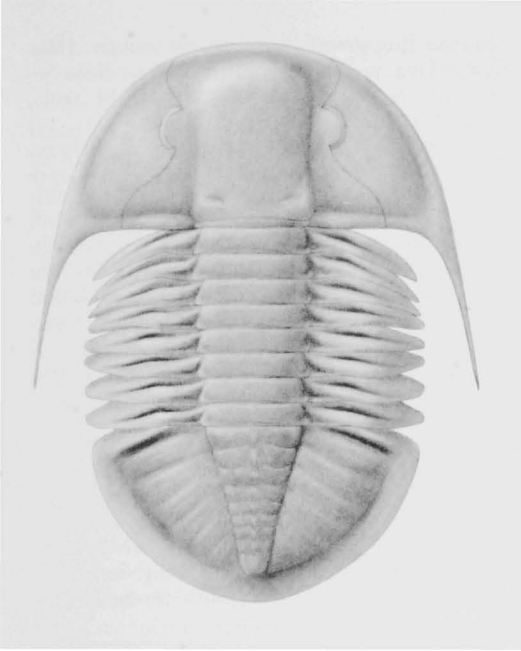


FIG. 260. **Niobides armatus* HARRINGTON & LEANZA (Asaphidae), L.Ord.(Arenig.), Arg.; carapace (reconstr.), $\times 1.2$ (59*).

triangular, mostly with short terminal spine. Thoracic axial rings moderately convex, articulating furrow moderately deep or shallow. Pygidial outline triangular to parabolic, in some species with terminal spine. L.Ord.(U.Arenig.-Llanvirn).—FIG. 259,3. **M. (M.) extenuata* (WAHLENBERG); 3a, ceph., $\times 1$; 3b, hypostoma, $\times 2$; 3c, pyg., $\times 1$ (414).

M. (Ekeraspis) TJERNVIK, 1956 [**Plesiomegalaspis (Ekeraspis) armata*]. Cephalic outline more or less semicircular; eyes moderately large. Pygidium with terminal spine. Posterior margin of hypostoma straight to faintly convex. [Subgeneric classification of species resembling *M. (E.) armata* but lacking the terminal pygidial spine is still uncertain.] L.Ord.(L.Arenig.)—FIG. 259,1. **M. (E.) armata* (TJERNVIK); cran., librigena, pyg., $\times 1$ (484a).

Niobides HARRINGTON & LEANZA, 1957 [**N. armatus*]. Cephalon and pygidium with flattened border, narrow on cephalon, moderately wide and well defined on pygidium; facial sutures marginal in front of glabella; cephalic axis more or less parallel-sided, frontal area narrow; eyes of moderate size, somewhat in front of transverse mid-line of cranium; glabellar tubercle not recognizable, its location unknown; posterior border furrow distinct; genal angles produced into spines. Hypostoma with entire posterior margin. Thoracic axis moderately broad. Pygidium with long strongly tapering axis; pleural fields with faint ribs. Development of the panderian organs unknown.

[May not belong to this subfamily.] L.Ord.(Arenig.), N.Arg.—FIG. 260. **N. armatus*; carapace (reconstr.), $\times 1.2$ (59*).

Notopeltis HARRINGTON & LEANZA, 1957 [**Megalaspidella orthometopa* HARRINGTON, 1938]. Anterior part of cephalon with distinct border; frontal area narrow; facial sutures intramarginal in front of glabella, which is long, almost parallel-sided or slightly tapering forward; eyes of moderate size, in front of transverse mid-line of cranium; posterior border furrow distinct; genal angles produced into spines. Posterior margin of hypostoma entire, acuminate. Pygidium without flattened border, axis long, prominent, postaxial field narrow; pleural fields with weak to almost obsolete furrowed ribs. L.Ord.(U.Tremadoc.), N.Arg.—FIG. 261. **N. orthometopa* (HARRINGTON); carapace (reconstr.), $\times 2.8$ (59*).

Paramegalaspis THORAL in JAANUSSON, 1956 [**Megalaspis (Paramegalaspis) immarginata* THORAL, 1935] [= *Megalaspis (Paramegalaspis)* THORAL, 1935 (*nom. nud.*; no type species); *Dolerasaphus* HARRINGTON & LEANZA, 1957]. Cephalon and pygidium without border; frontal area moderately long, 0.20 to 0.25 of total length of cephalon; eyes of moderate size, situated at about transverse mid-line of the cranium; cephalic axis more or less parallel-sided; posterior border furrow fairly distinct; genal angles produced into spines. Posterior margin of hypostoma rounded. Pygidium

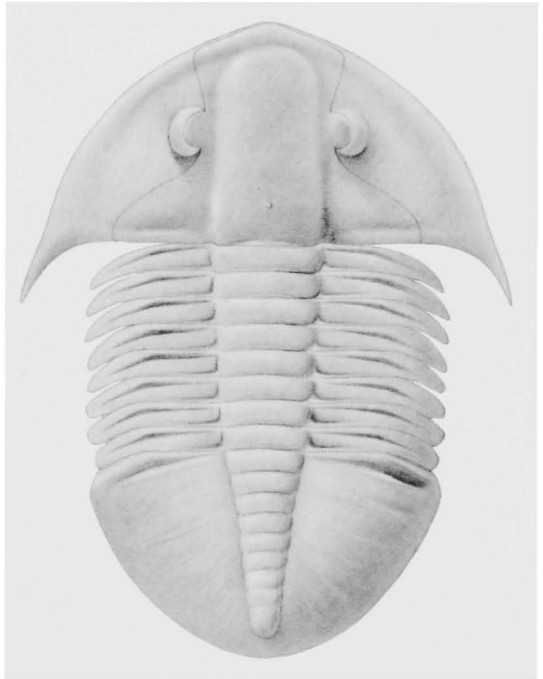


FIG. 261. **Notopeltis orthometopa* (HARRINGTON) (Asaphidae), L.Ord.(U.Tremadoc.), Arg.; carapace (reconstr.), $\times 2.8$ (59*).

with flattened axis, pleural fields with weak to obsolete furrowed ribs, doublure narrow, as in *Megistaspis*. *L.Ord.*(*Tremadoc.*), Fr.-N.Arg.

Subfamily NIOBINAE Jaanusson, nov.

Cephalic axis prominent, tapering forward in early species, parallel-sided or expanded in front of eyes in late species; distance between glabellar tubercle and occipital furrow on area corresponding to it mostly equal to or longer than length of the occipital ring; librigenae mostly very broad (*tr.*), larger than in any other asaphid group; posterior border furrow generally distinct. Posterior margin of hypostoma rounded, straight, or with short narrow (*tr.*) notch; in late representatives hypostomal outline is characteristically somewhat trapezoidal, being widest (*tr.*) close to its posterior margin; anterior wings fairly broad (*tr.*), triangular. Panderian organs developed as separate openings, except for some Upper Cambrian species, which have a narrow doublure and apparently no panderian organs. Thorax without macropleurae. External pygidial margin rounded. *U. Cam.-L.Ord.*

Niobe ANGELIN, 1851 [*Asaphus frontalis* DALMAN, 1827; SD VOGDES, 1890]. Cephalic outline commonly somewhat trapezoidal; axis long, frontal area short; eyes of moderate size, situated at transverse mid-line of cranium close to glabella; genal angles rounded. Pygidial doublure generally rather wide, pleural ribs extending beyond inner margin of doublure, their well-defined terminations bulging outward; pygidial border distinct, flattened or concave. Early members with slightly tapering to parallel-sided glabella and rounded to more or less straight posterior margin of hypostoma; evolution tends toward widening of glabella in front of eyes and formation of triangular notch in posterior margin of hypostoma. *L.Ord.* (*Tremadoc.-Llanvirn.*), Eu.—FIG. 259,2. **N. frontalis* (DALMAN); 2a, ceph. (reconstr.), $\times 1.5$; 2b, hypostoma, $\times 1$; 2c, pyg., $\times 1.5$ (414n).

Bohemopyge PŘIBYL, 1950 [*Ogygia discreta* BARRANDE, 1872] [= *Ptychocheilus* NOVÁK, 1883 (*non* AGASSIZ, 1855; *nec* BOETTGER, 1880)]. Cephalon with faint concave border; glabella slightly tapering forward, frontal area short; glabellar tubercle fairly close to occipital furrow; eyes fairly large, at about transverse mid-line of cranium moderately distant from axial furrows; genal angles produced into spines. Hypostoma broadest posteriorly, with short trapezoidal notch. Pygidium without border; axis prominent, long; pleural fields with flattened ribs, separated by distinct

furrows that almost reach external margin. [May not belong to this subfamily.] *L.Ord.*, Boh.—FIG. 259,5. **B. discreta* (BARRANDE); 5a, ceph., $\times 2$; 5b,c, hypostoma, pyg., $\times 0.7$ (437).

Lapidaria TJERNVIK, 1956 [*L. tenella*]. Eyes large; glabella expanded in front of eyes, frontal area short; librigenae with broad, convex posterior areas (alae) and flattened borders; genal angles rounded. Hypostoma and thorax unknown. Pygidium with distinct, wide, concave border; long, prominent axis; almost smooth pleural fields. *L.Ord.* (*Arenig.*), Swed.—FIG. 259,4. **L. tenella*; 4a-c, cran., librigena, pyg., $\times 3$ (484a).

Niobella REED, 1931 [*Niobe homfrayi* SALTER, 1866]. Like *Niobe* but pygidial doublure narrow in early species and moderately wide in latest species; pygidial pleural ribs (if developed) flattened, merging smoothly into outer part of pygidial surface or at slightly outside line corresponding to inner margin of doublure; ribs mostly with shallow pleural furrow. Evolutionary trend as in *Niobe*. *U. Cam.-L.Ord.*, Eu.-?N.Am.(Newf.).—FIG. 262,7. *N. homfrayi smithi* STUBBLEFIELD; 7a,b, ceph., pyg., $\times 1.3$ (421).

Niobina LAKE, 1946 [*N. davidis*]. Resembling *Niobe* but pygidial pleural fields with pleural and interpleural furrows about equal in distinctness; occipital ring, occipital furrow, and posterior border furrow narrow, distinct; position of glabellar tubercle and development of panderian organs unknown. Hypostoma with pointed terminal end. *L.Ord.*(*U.Tremadoc.*), Eng.-Swed.-N.Arg.

Norinia TROEDSSON, 1937 [*N. convexa*]. Only cranidia known with certainty. Like *Niobe* or *Niobella* but with more lateral position of eyes. *L.Ord.*, Asia(E.T'ienShan).—FIG. 262,2. **N. convexa*; cran., $\times 2$ (486a).

Yuepingia LU, 1956 [*Y. niobiformis*]. Like *Niobella* but with larger eyes and with genal spines. Only cranidia, librigenae, and pygidia known. *U. Cam.*, SW.China. [Published as *Yüpingia*.]

Subfamily OGYGIOCARIDINAE Raymond, 1937

[*nom. correct.* JAANUSSON, *hercin* (*ex* Ogygiocarinae RAYMOND, 1937) [= Ogygiinae RAYMOND, 1913; invalid as based on junior homonym.]

Glabella prominent, slightly tapering forward, parallel-sided, or expanded in front of eyes; occipital ring or area corresponding to it considerably constricted in middle; glabellar tubercle immediately in front of occipital ring; posterior border furrow generally distinct. Hypostoma with rounded or pointed posterior margin and narrow (*tr.*) triangular anterior wings. Type genus apparently without panderian organs, in other genera presence or absence of these organs unknown. Posterior margin of pygidium rounded. *L.Ord.*(*Llanvirn.*)-*M.Ord.* (*Llandeil.*).

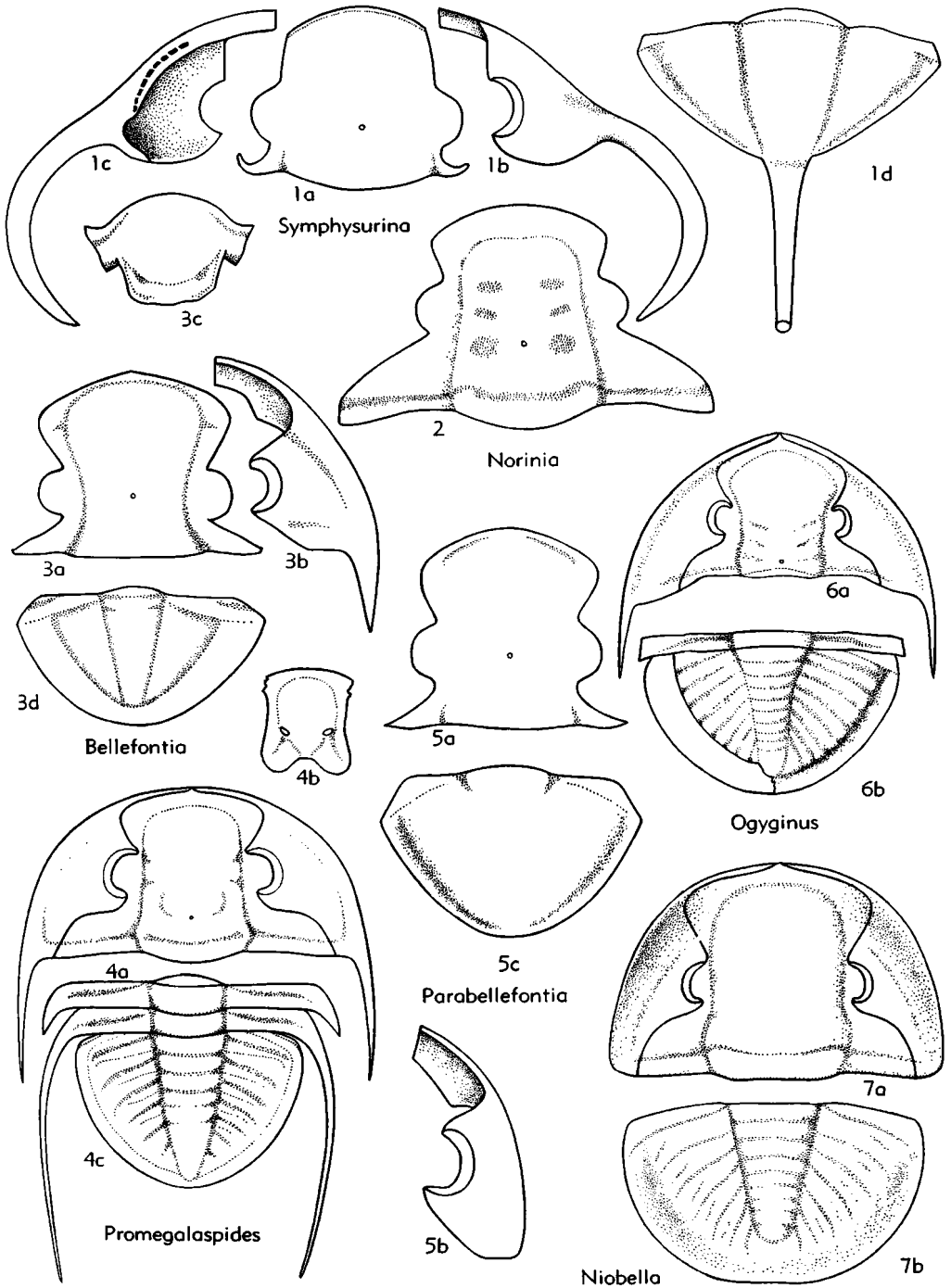


FIG. 262. Asaphidae (Niobinae, Ogygiocaridinae, Promegalaspidinae, Symphysurinae) (p. 0350-0353).

Ogygiocaris ANGELIN, 1854 [*nom. conserv.*, proposed HENNINGSMOEN, JAANUSSON, RILEY & STUBBLEFIELD, 1956 (ICZN pend.)] [**Trilobus dilatatus* BRÜNNICH, 1789]. Facial sutures intramarginal

in front of glabella; frontal area narrow; glabella slightly expanding in front of eyes. Posterior margin of hypostoma pointed. Pygidial pleural fields with flattened, unfurrowed ribs that continue on inner part of faint, flattened border. *L.Ord.* (*Llanvirn.*)-*M.Ord.* (*Llandeil.*), N.Eu., N.Arg.—FIG. 263,2. *O. sarsi* ANGELIN; 2a, carapace, $\times 0.7$ (473); 2b, hypostoma, $\times 1.5$ (414n).

Homalopteon SALTER, 1866 [**Oxygia portlocki* SALTER, 1849; SD VOGDES, 1925]. Frontal area very short; glabella strongly expanded in front of eyes; facial sutures ?marginal in front of glabella; eyes somewhat in front of transverse mid-line of cranium. Inner part of pygidial pleural fields with distinct pleural and interpleural furrows. [May not belong to this subfamily.] *M.Ord.* (*Llandeil.*), Ire.

Ogyginus RAYMOND, 1912 [**Asaphus corndensis* MURCHISON, 1839]. Frontal area short; glabella moderately expanding in front of eyes; facial sutures intramarginal in front of glabella. Pygidium with distinct, narrow, concave border; pleural fields with 7 to 9 strong, rounded, unfurrowed ribs that reach border. *L.Ord.* (*Llanvirn.*), Eng.—FIG. 262,6. **O. corndensis* (MURCHISON); 6a,b, ceph. (reconstr.), thoracic segment and pyg. showing at left shape of double, $\times 0.7$ (414n).

Ogygiocarella HARRINGTON & LEANZA, 1957 [**Asaphus debuchii* BRONGNIART in BRONGNIART & DESMAREST, 1822 (*non Asaphus debuchianus* BRONGNIART in DESMAREST, 1817; suppression proposed HENNINGSMOEN, JAANUSSON, RILEY & STUBBLEFIELD, 1956, ICZN pend.)]. Like *Ogygiocaris* but facial sutures marginal in front of glabella; pleural ribs of pygidium with distinct pleural furrows. *M.Ord.* (*Llandeil.*), Eng.

Ogygites TROMELIN & LEBESCONTE, 1876 [**Ogygia desmaresti* BRONGNIART in BRONGNIART & DESMAREST, 1822] [*pro Ogygia* BRONGNIART in BRONGNIART & DESMAREST, 1822 (*non Ogygia* BRONGNIART in DESMAREST, 1817, suppression proposed HENNINGSMOEN, JAANUSSON, RILEY & STUBBLEFIELD, 1956, ICZN pend.; *non Ogygia* HÜBNER, 1821)]. Type species poorly known. Differs from other *Ogygiocaridinae* in having only 4 or 5 rounded, unfurrowed ribs on pygidial pleural fields. [May not belong to this subfamily.] *M.Ord.* (*Llandeil.*), Fr.

Subfamily PROMEGALASPIDINAE Jaanusson,
nov.

Cephalic axis more or less parallel-sided or expanding in front of eyes; position of glabellar tubercle as in Niobinae; fixigenae with alae narrow to obsolete; posterior border furrow distinct. Posterior margin of hypostoma generally with broad notch, which is short in early species and long in late species. Pandertian organs developed as short (*tr.*) notches in early species and as separate openings in late species. Outer part

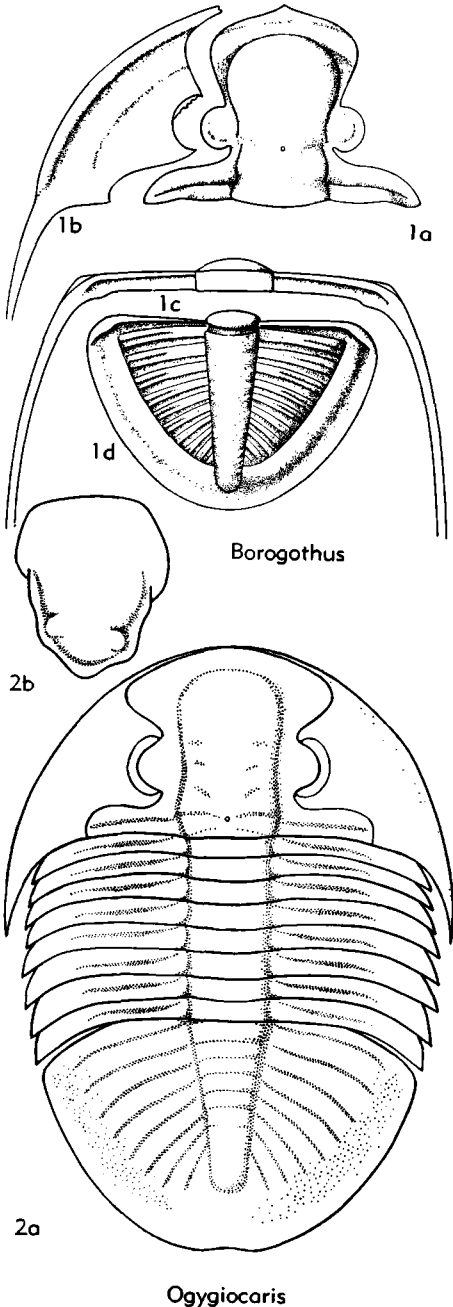


FIG. 263. Asaphidae (Ogygiocaridinae, Promegalaspidae (p. O352-O353)).

of pleurae of 8th thoracic segment produced into long, backward-directed spines, forming macropleurae. External pygidial margin rounded. *U.Cam.-L.Ord.(Arenig.)*.

Promegalaspides WESTERGÅRD, 1939 [**P. kinnekullensis*]. Glabella parallel-sided or slightly tapering forward. Notch in posterior margin of hypostoma short. Thoracic and pygidial axis moderately broad. *U.Cam., Swed.*—FIG. 262,4. **P. kinnekullensis*; 4a-c, ceph., hypostoma, pyg. with 2 last thoracic segments, $\times 1.5$ (414n, 491a).

Borogothus TJERNVIK, 1956 [**Megalaspis stenorhachis* ANGELIN, 1851]. Glabella expanded in front of eyes. Notch in the posterior margin of hypostoma long. Thoracic and pygidial axis narrow. *L.Ord.(Arenig.)*, Scandinavia-Fr.—FIG. 263,1. **B. stenorhachis* (ANGELIN); 1a-d, cran., librigena, 8th thoracic segment, pyg., $\times 1.5$ (484a).

Subfamily SYMPHYSURININAE Kobayashi, 1955

Cephalic axis, if defined, parallel-sided or expanding in front of eyes; generally with glabellar tubercle between eyes. No notches or openings of panderian organs known. Anterior wings of hypostoma quadrangular in genera where known. *L.Ord.*

Symphysurina ULRICH in WALCOTT, 1924 [**S. woosteri*] [= *Symphysurina* WALCOTT, 1923, *nom. nud.*; *Symphysurinella* RAYMOND, 1937; ?*Symphysuroides* RAYMOND, 1937]. Facial sutures marginal in front of glabella, running in front of narrow rim that forms anterior margin of cranium; cephalic axis long, flattened, mostly nearly obsolete; palpebral lobes large, at transverse midline of cranium or somewhat behind it; no posterior border furrow; librigenae with or without depressed border; genal angles rounded, acuminate, or produced into spines. Librigenal doublures with 5 to 9 characteristic pits. Posterior end of pygidium rounded, acuminate, or with terminal spine; pygidial axis long; pleural regions smooth or with some faint ribs anteriorly, and with or without a flattened border; pygidial doublure fairly broad. *L.Ord.(L.Canad.)*, N.Am.-Greenl.-?Swed.—FIG. 262,1. *S. uncaspicata* HINTZE, Utah; 1a-d, cran., librigena, dorsal and ventral, pyg., $\times 3$ (407).

Bellefontia ULRICH in WALCOTT, 1924 [**Hemigyaspis collicana* RAYMOND, 1910]. Cephalic axis flattened, more or less parallel-sided or expanding in front of eyes; facial sutures intramarginal; palpebral lobes large, almost at transverse midline of cranium or slightly behind it, their length generally exceeding distance between posterior end of lobes and the posterior border furrows; genal angles produced into spines. Pygidium with well distinguished, fairly broad flattened border; pleural fields smooth or with faint ribs. *L.Ord.(L.Canad.)*, N.Am.

B. (Bellefontia). Frontal area narrow; posterior end of the pygidium rounded. *L.Ord.(L.Canad.)*, N.Am.—FIG. 262,3. **B. (B.) chamberlaini** CLARK; 3a, cran., $\times 1.5$; 3b-d, librigena, hypostoma, pyg., $\times 2$ (407).

B. (Xenostegium) WALCOTT, 1924 [**Megalaspis belemnurus* WHITE, 1874; SD by suspension of Rules, proposed, Ross, 1956 (ICZN pend.)]. Like *B. (Bellefontia)* but with a longer frontal area, and terminal spine on pygidium. *L.Ord.(L.Canad.)*, N.Am.

Kobayashia HARRINGTON, 1938 [**Xenostegium taurus* WALCOTT; 1924]. Only cranidia and pygidia known. Differs from *Bellefontia* in longer frontal area, narrower glabella in front of eyes, stronger lateral glabellar furrows, and presence of few comparatively strong ribs on inner part of pygidial pleural fields. Size of the palpebral lobes unknown, glabellar tubercle as in other Symphysurinae. *L.Ord.(L.Canad.)*, W.Can.(B.C.).

Parabellefontia HINTZE, 1953 [**P. concinna*]. Differs from *Bellefontia* in almost complete absence of cephalic and pygidial axis, absence of posterior border furrows, and narrower pygidial border; genal angles rounded in adult specimens of type species; anterior border furrow poorly defined to obsolete. Hypostoma and thorax un-

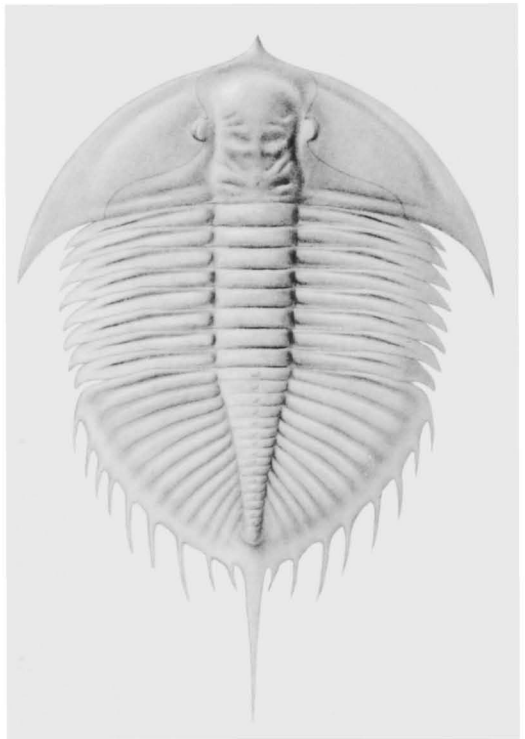


FIG. 264. **Thysanopyge argentina* KAYSER (Asaphidae), *L.Ord.(Arenig.)*, Arg.; carapace (reconstr.), $\times 0.6$ (59*).

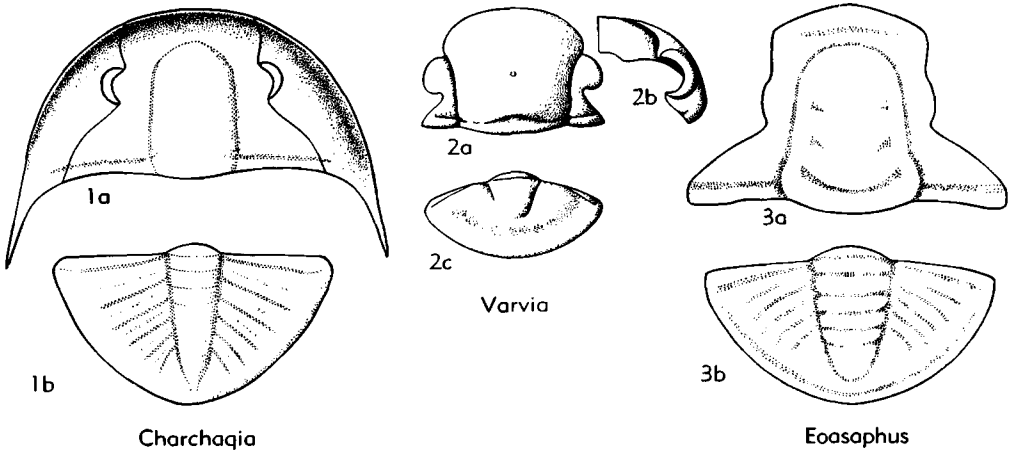


FIG. 265. Asaphidae (Symphysurinae, Subfamily Uncertain) (p. 0354-0355).

known. *L.Ord.*(*L.Canad.*), USA(Utah).—FIG. 262,5. **P. concinna*; 5a-c, cran., librigena, pyg., $\times 3$ (407).

Varvia TJERNVIK, 1956 [**Symphysurus breviceps* ANGELIN, 1854]. Facial sutures marginal in front of glabella; eyes fairly large, about at transverse mid-line of cranidium; cephalic axis long, parallel-sided to somewhat expanding in front of eyes; no frontal area; anterior margin of the cranidium without distinct border; posterior border furrow distinct; librigenae narrow, without border; genal angles rounded. Hypostoma resembling that of *Symphysurus*, with broad lateral border and faintly concave posterior margin. Pygidium broad, with short axis and faint, depressed border. *L.Ord.*(*U.Tremadoc.-L.Arenig.*), Scand.—FIG. 265, 2. *V. breviceps* (ANGELIN); 2a-c, cran., librigena, pyg., $\times 2.5$ (484a).

Subfamily THYSANOPYGINAE Jaanusson, nov.

Similar to early Isotelinae but pygidium with numerous marginal spines; glabella slightly tapering forward to parallel-sided; glabellar tubercle immediately in front of occipital furrow. Development of panderian organs unknown. Posterior margin of hypostoma entire. Ribs on pygidial pleural regions without furrows. *L.Ord.*(*Arenig.*).

Thysanopyge KAYSER, 1898 [**T. argentina*] [= *Basilicoides* HARRINGTON, 1937 (*non* MA, 1938)]. Eyes small, somewhat in front of transverse mid-line of cranidium. Pygidium with about 8 pairs of lateral spines and long terminal spine. *L.Ord.*(*Arenig.*), N.Arg.-Bol.—FIG. 264. **T. argentina*; carapace (reconstr.), $\times 0.6$ (59*).

Australopyge HARRINGTON & LEANZA, 1957 [**A. acanthanura*]. Only hindmost thoracic segments

and pygidium known. Pygidium differs from that of *Thysanopyge* mainly in absence of terminal spine. *L.Ord.*(*Arenig.*), N.Arg.

Zuninaspis HARRINGTON & LEANZA, 1957 [**Z. acuminata*]. Only cranidia known. Differs from *Thysanopyge* mainly in presence of faint preglabellar ridge and more posteriorly situated eyes. *L.Ord.*(*Arenig.*), N.Arg.

Subfamily UNCERTAIN

Charchaquia TROEDSSON, 1937 [**C. norini*] [= *Charchaquia* KOBAYASHI, 1944, *nom. null.*]. Anterior sections of facial sutures running more or less in exsagittal direction to external cephalic margin, their continuation along which or on doubleure being unknown (?marginal); cephalon with narrow, deeply concave border; cephalic axis more or less parallel-sided, smooth, prominent, without glabellar tubercle; frontal area moderately broad; eyes small, well in front of transverse mid-line of cranidium, posterior border furrow distinct; genal angles produced into spines. Hypostoma unknown. Thoracic axis narrow, prominent. Pygidium without border, with narrow, prominent, long axis; pleural fields with distinct interpleural and faint pleural furrows. [May be an early member of Isotelinae.] *U.Cam.*, C.Asia(E.T'ienShan)-?China.—FIG. 265,1. **C. norini*; 1a,b, ceph., pyg., $\times 3$ (414n).

Dolerobasilicus HARRINGTON & LEANZA, 1942 [*pro Basilicoides* MA, 1938 (*non* HARRINGTON, 1937)] [**Basilicus yokusensis* KOBAYASHI, 1937]. Type species poorly known. Posterior margin of hypostoma with notch. Pygidium elongate; axis narrow, prominent; pleural fields with numerous distinct unfurrowed ribs that reach narrow, well-defined, concave border; postaxial field short. *M.Ord.*, Korea.

Eosaphus KOBAYASHI, 1936 (March) [**Liostracus?* *superstes* LINNARSSON, 1875] [= *Anorina* WHITEHOUSE, April, 1936 (obj.)]. Only one specimen (exoskeleton without librigenae) known. Facial sutures probably intramarginal in front of glabella; cephalic axis tapering forward, prominent, without glabellar tubercle; frontal area moderately broad; palpebral lobes narrow, at about transverse mid-line of cranidium; posterior border furrow distinct. Thoracic axis narrow. Pygidium with narrow, flattened border; axis moderately long, prominent; pleural fields with faint flattened ribs. *U.Cam.*, Swed.—FIG. 265,3. **E. superstes* (LINNARSSON); 3a,b, cran., pyg., ×3 (414n).

UNRECOGNIZABLE ASAPHID GENERA

Asaphelloides KOBAYASHI, 1937 [**Megalaspis?* *americana* HOEK, 1912]. Type species, *nom. dubium*. *L.Ord.*, Bol.

Brachyaspis SALTER, 1866 [**Isotelus rectifrons* PORTLOCK, 1843; SD BASSLER, 1915]. May not be an asaphid since presence of median suture is questionable. *Ord.*, Ire.-?Swed.

Columbicephalus KOBAYASHI, 1955 [**C. macrops*]. Only cranidia known. *Ord.*, W.Can.(B.C.).

Gerasaphes CLARKE, 1897 [**G. ulrichana*] [= *Gerasaphus* VOGDES, 1925, *nom. null.*]. Erected on small, immature specimens; genus cannot be defined at present. *Ord.*, USA.

Metoptogyrus RAYMOND, 1937 [**M. grandgei*]. Type species very poorly known. *L.Ord.*, E.USA. (Vt.).

Family TAIHUNGSHANIIDAE Sun, 1931

[*nom. correct.* HENNINGSMOEN, 1951 (ex Taihungshanidae SUN, 1931)]

Carapace as in Asaphidae but with pair of broad, prominent pygidial spines. Librigenae separated anteriorly by median suture; glabellar tubercle in at least one genus (*Asaphellina*); no eye ridges; known genera with short frontal area. Posterior margin of hypostoma entire. Thorax with 8 segments. Panderian organs not known but in

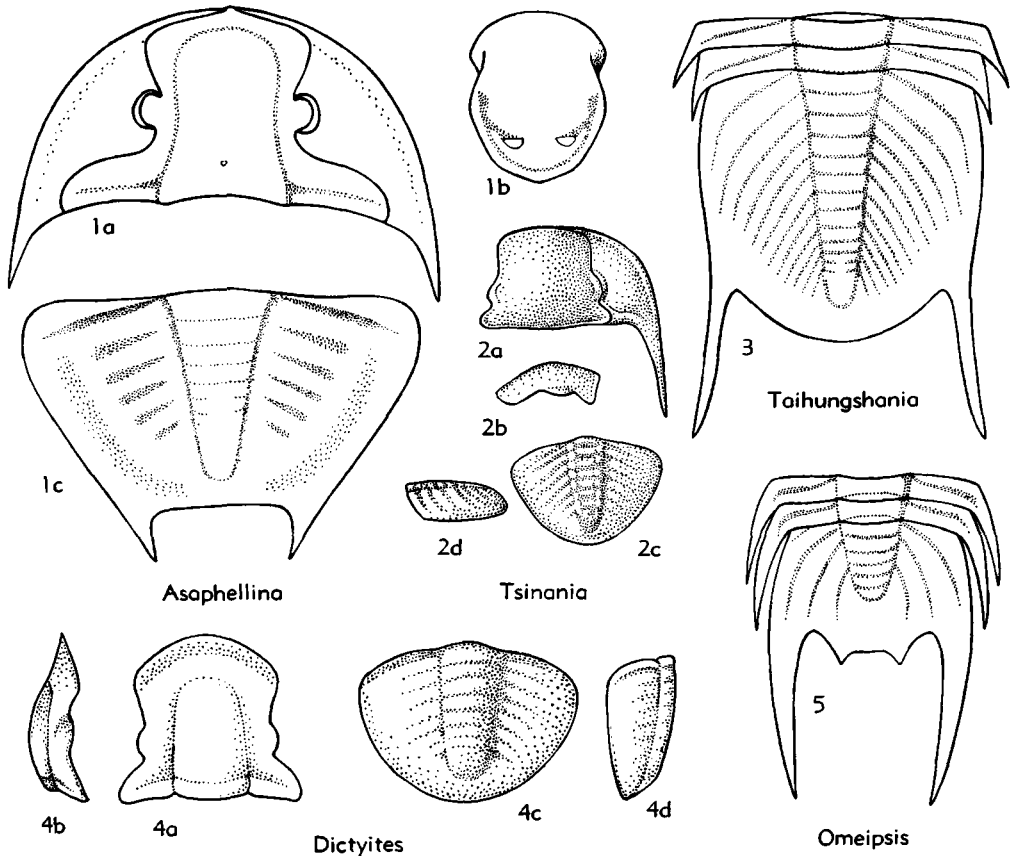


FIG. 266. Taihungshaniidae, Tsinaniidae (p. 0356).

some genera they seem to be absent, judging from published figures. [May belong as subfamily of Asaphidae.] *L.Ord.* (*Tremadoc.-Llanvirn.*).

Taihungshania SUN, 1931 [**T. shui*] [= *Miquelina* THORAL, 1935]. Facial sutures marginal in front of glabella; eyes comparatively small, in front of transverse mid-line of cranidium; glabella more or less trapezoidal in outline, expanding in front of eyes. Lateral terminations of thoracic pleurae pointed and curved posterolaterally. Inner portion of pygidial pleurae with numerous strong ribs; pygidium without border, posterior margin strongly convex between pair of long spines; *L.Ord.* (*Tremadoc.-Llanvirn.*), Fr.-China. — FIG. 266.3. **T. shui*, China; 2 hindmost thoracic segments and pyg., $\times 1.5$ (478).

Asaphellina MUNIER-CHALMAS & BERGERON in BERGERON, 1889 [**A. barroisi*]. Facial sutures intramarginal; eyes moderately large, at about transverse mid-line of cranidium; glabella more or less parallel-sided, with small tubercle in posterior part. Lateral terminations of thoracic pleurae straight. Pygidium with poorly defined flattened border and generally straight posterior margin between pygidial spines, which are short to moderately long and posteromedially directed; inner part of pygidial pleurae with faint to moderately strong, unfurrowed ribs. *L.Ord.* (*Tremadoc.*), Fr.-?USA. (Utah). — FIG. 266.1. **A. barroisi*; *1a,b*, ceph., hypostoma, $\times 1$; *1c*, pyg., $\times 0.7$ (483).

Omeipsis KOBAYASHI, 1951 [**Acidaspis huangi* SUN, 1931]. Facial sutures apparently marginal; eyes small, in front of transverse mid-line of cranidium; glabella parallel-sided or slightly tapering forward. Lateral ends of the thoracic pleurae produced into posteriorly directed, broad spines. Pygidium without border; inner part of pleural fields with few distinct ribs; postaxial field rather long; posterior margin between main pygidial spines produced into 2 short additional pointed spines. *L.Ord.* (*Llanvirn.*), China. — FIG. 266.5. **O. huangi* (SUN); 2 hindmost thoracic segments and pyg. (reconstr.), $\times ?$ (419).

Tungtzuella SHENG in LU, 1957 [**T. kueichowensis*]. Poorly known. *L.Ord.*, C. and SW. China.

Family TSINANIIDAE Kobayashi, 1933

[*nom. correct.* HENNINGSMOEN, 1951 (ex Tsinanidae KOBAYASHI, 1933)]

Exoskeleton opisthoparian, isopygous. Glabella low, sides subparallel or tapering, front rounded; frontal area present, all furrows faint or obsolete; eyes of medium size slightly behind center of cranidium; fixigenae downsloping, with palpebral areas slightly more than 0.5 of glabellar width, posterior areas short; librigenae with wide doublure and long genal spines. Thoracic

segments with deep narrow furrow and broadly falcate ends, small paired anterior projection, number unknown. Pygidium subtriangular, axis low, long, and narrow, with 7 to 9 axial rings; pleural fields wider than axis, with 7 to 9 pleurae; border narrow. Surface smooth. Derived from Asaphiscidae. *U.Cam.*

Tsinania WALCOTT, 1914 [**Illaenurus canens* WALCOTT, 1905] [= *Tsinain* SUN, 1935; *Tsinavia* KOBAYASHI, 1935; *Tsania* KOBAYASHI, 1942]. Cranidium subquadrate, all furrows obsolete. Pygidium rarely with pair of minute anterolateral spines; only axial furrows visible externally but 9 faint furrows on axis and pleural regions seen on interior (107). *U.Cam.* (*Fengshan.*), NE. Asia. — FIG. 266.2. **T. canens* (WALCOTT), China (Shantung); *2a*, cran., and librigena, dorsal (exterior); *2b*, cran., profile; *2c,d*, pyg., ventral (interior), profile; all $\times 1$ (107, 315).

Dictyites KOBAYASHI, 1936 [*pro Dictya* KOBAYASHI, 1933 (*non* MEIGEN, 1803; *nec* AGASSIZ, 1846; *nec* DE CHAUDOIR, 1871)] [**Illaenurus dictys* WALCOTT, 1905]. Cranidium subquadrate, preglabellar field and anterior border separated by shallow anterior border furrow on exterior, axial furrows present on exterior. Pygidium with axial and border furrows exteriorly, up to 9 furrows on axis and pleural fields interiorly (95, 107). *U.Cam.* (*Fengshanian*), NE. Asia. — FIG. 266.4. **D. dictys* (WALCOTT), China (Shantung); *4a,b*, cran., dorsal, profile (exterior); *4c*, pyg., ventral (interior); *4d*, pyg., profile; all $\times 1.5$ (95).

Family NILEIDAE Angelin, 1854

[= *Symphysuridae* POULSEN, 1927]

Exoskeleton opisthoparian, almost isopygous. Glabella very wide, usually unfurrowed, with eyes closely adjoining; librigenae united into a single piece; cephalic doublure continuous. Thorax of 7 or 8 segments. Pygidium smooth or indistinctly segmented, with indistinct border of medium width. Hypostoma wide, with broadly ovate middle body and very wide, flat lateral border. *L.Ord.* (*Tremadoc.*)-*U.Ord.*

Nileus DALMAN, 1827 [**Asaphus (Nileus) armadillo*]. Dorsal exoskeleton strictly parallel-sided, evenly rounded at both ends, strongly and almost evenly convex transversely. Cephalon subreniform, evenly convex, with indistinctly defined, narrow, threadlike border, occipital furrow effaced; glabella slightly convex, almost parallel-sided, indistinctly defined anteriorly; anterior and posterior areas of fixigenae extremely narrow; eyes large, semicircular; librigenae narrow, with rounded, spineless genal angles. Thorax of 8 segments,

with wide, parallel-sided, slightly convex axis and rounded pleural extremities. Pygidium approximately semicircular, with effaced or indistinct axis and unfurrowed pleural fields. Surface apparently smooth but under a strong lens appears

minutely pitted (1, 18, 62, 151). *L.Ord.*(*Tremadoc.*)-*U.Ord.*, Eu.-E.N.Am.-E.Asia.—FIG. 267,1. **N. armadillo*, Swed.; 1a, ceph., ventral showing hypostoma, $\times 1$ (62); 1b, exoskel., $\times 1$ (1). *Barrandia* M'Coy, 1849 [*non* HALL, 1860] [**B.*

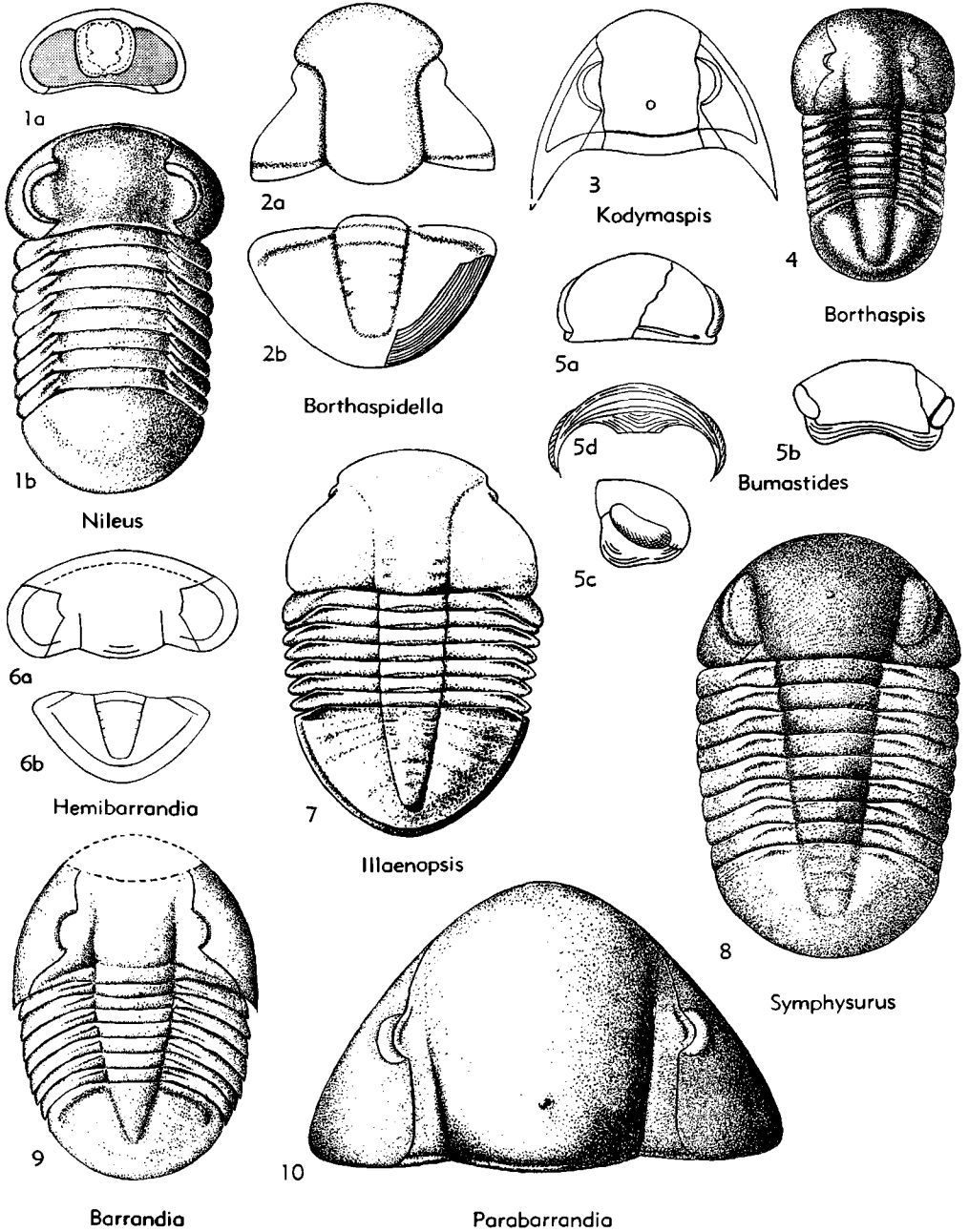


FIG. 267. Nileidae (p. 0356-0358).

- cordai*]. Differs from *Nileus* in having semi-oval or parabolic cephalon, clavate glabella, smaller eyes, thorax with tapering axis and obliquely truncated pleural extremities, and pygidium with well-defined axis (180). *L.Ord.(Tremadoc.)-M.Ord.*, Eu.
- B. (Barrandia)**. Cephalon semioval, gently convex; glabella moderately convex; occipital furrow shallow; posterior area of fixigenae wide; eyes fairly large, moderately curved; librigenae with pointed genal angle; axis slightly less than 0.3 of total thoracic width. Pygidium with indistinct concave border zone (180). *M.Ord.*, Br.I.—FIG. 267,9. **B. (B.) cordai*, Wales; exoskel., $\times 2$ (180).
- B. (Parabarrandia)** PRANTL & PŘIBYL, 1948 [**B. bohémica* NOVÁK, 1884]. Differs from *B. (Barrandia)* in its parabolic convex cephalon; prominent glabella; narrow posterior areas of fixigenae; rounded, spineless genal angles or librigenae gradually produced into broad genal spines; small eyes; wider thoracic axis; and pygidium with wide, flat, well-defined border (180). *L.Ord.(Tremadoc.)-M.Ord.*, Czech.—FIG. 267,10. **B. (P.) bohémica* (NOVÁK), *M.Ord.*, Czech.; ceph., $\times 1$ (180).
- ?**Borthaspidella** RASETTI, 1954 [**B. gaspensis*]. Differs from *Borthaspis* in having well-impressed axial furrows delimiting a better-defined glabella with strongly expanded anterior third (202). *L.Ord.(Tremadoc.)*, E.N.Am., ?C.Asia.—FIG. 267,2. **B. gaspensis*, Can.; 2a,b, cran., pyg. (reconstr.), $\times 3$ (202).
- ?**Borthaspis** STUBBLEFIELD, 1951 [*pro Psilocephalus* SALTER, 1866 (non SWAINSON, 1839)] [**Psilocephalus innotatus* SALTER, 1866] [= *Psilocephalina* STUBBLEFIELD, 1951 (non Hsü, 1948)]. Differs from *Platypeltoides* in having very small eyes placed far forward and 8 thoracic segments; cephalic doublure and hypostoma unknown (114). *L.Ord.(Tremadoc.)*, Wales.—FIG. 267,4. **B. innotata* (SALTER), Wales; exoskel., $\times 1$ (466).
- Bumastides** WEBER, 1948 [**B. bedpakensis*]. Differs from *Nileus* in having wider cephalon without discernible glabella; less curved eyes; vertically standing librigenae; and strongly projecting median posterior extension of doublure (259). *Ord.*, USSR.—FIG. 267,5. **B. bedpakensis*; 5a-c, ceph., dorsal, frontal, lateral, $\times 2$; 5d, cephalic doublure, $\times 2$ (259).
- ?**Hemibarrandia** PRANTL & PŘIBYL, 1950 [**Nileus holoubkovensis* RŮŽIČKA, 1926]. Differs from typical Nileidae in having extremely wide cephalon with wide, raised lateral border becoming indistinct in front of glabella; anterior sections of facial sutures running outward from eyes to meet lateral margins nearly opposite anterior end of palpebral lobes. Surface coarsely granulose. Cephalic doublure and hypostoma unknown (182). *L.Ord.(Tremadoc.)*, Czech.—FIG. 267,6.
- **H. holoubkovensis* (RŮŽIČKA); 6a, ceph., $\times 0.5$; 6b, pyg., $\times 0.5$ (182). [= *Pseudonileus* KOBAYASHI, 1951 (obj.).]
- ?**Illaeonopsis** SALTER, 1866 [**Illaeonopsis thomsoni*]. Differs from *Borthaspis* in having glabella well defined throughout by distinct axial furrows, anterior portion of glabella strongly expanded; much wider posterior areas of fixigenae; minute eyes very close to anterior cephalic margin; extremely narrow librigenae; thorax of 7 segments; pygidium with narrow well-defined border (268). *L.Ord.*, Br.I.-Arg.—FIG. 267,7. *I. stenorhachis* (HARRINGTON), *L.Ord.(Tremadoc.)*, Arg.; exoskel., $\times 3.5$ (59*).
- ?**Lakaspis** KOBAYASHI, 1937 [**Symphysurus apolonia* LAKE, 1906]. Differs from *Symphysurus (Symphysurus)* in having deeply impressed occipital furrow, anterior half of glabella somewhat constricted, wider posterior area of fixigenae, and much smaller eyes (113). *Ord.*, Bol.
- ?**Platypeltoides** PŘIBYL, 1949 [*pro Platypeltis* CALLAWAY, 1877 (non FITZINGER, 1835)] [**Platypeltis croftii* CALLAWAY, 1877]. Differs from *Symphysurus (Symphysurus)* in having eyes of medium size, posterior sections of facial sutures running outward and backward in sigmoid curve delimiting relatively wide posterior areas of fixigenae and meeting posterior margins almost at right angles; thorax of 7 segments; cephalic doublure and hypostoma unknown (114). *L.Ord.(Tremadoc.)-M.Ord.*, Br.I.-Czech.
- ?**Psilocephalina** Hsü, 1948 [**P. lubrica*]. Differs from *Borthaspis* in having genal spines and wider axis of pygidium (76). *L.Ord.(Tremadoc.)*, C. China.
- Symphysurus** GOLDFUSS, 1843 [**Asaphus palpebrosus* DALMAN, 1827; SD BARRANDE, 1852]. Differs from *Nileus* in having semicircular to parabolic cephalon; strongly convex glabella, defined by well-impressed axial furrows; narrower, more convex, tapering thoracic axis; and more evenly convex pygidium, without border and with distinct axis. It differs from *Barrandia* in its narrower exoskeleton, and pygidium shorter than thorax; surface usually covered with fine, raised, insculcating lines (18, 114, 153, 182, 294). *L.Ord.(Tremadoc.)-M.Ord.*, Eu.-N.Am.-S.Am.
- S. (Symphysurus)** [= *Paranileus* KOBAYASHI, 1951 (non HINTZE, 1953)]. Cephalon short, semicircular, transversely convex, with broadly quadrangular glabella delimited by straight axial furrows, effaced occipital furrow, small librigenae with rounded, spineless genal angle, and furrowed thoracic pleurae with rounded extremities (182). *L.Ord.(Tremadoc.)-M.Ord.*, Eu.-N.Am.-S.Am.—FIG. 267,8. **S. (S.) palpebrosus* (DALMAN), *M.Ord.*, Swed.; exoskel., $\times 1$ (modified from 1).
- S. (Kodymaspis)** PRANTL & PŘIBYL, 1950 [**Illaeonius puer* BARRANDE, 1872]. Differs from *S. (Symphysurus)* in having parabolic cephalon,

glabella delimited by undulating axial furrows, well-marked occipital furrow, fairly large librigenae gradually passing into broad, rapidly tapering genal spines, and unfurrowed thoracic pleurae with obliquely backward-curved, pointed extremities (182). *L.Ord.*(*Tremadoc.*)-*M.Ord.*, Eu.—FIG. 267,3. **S. (K.) puer* (BARRANDE), *M.Ord.*, Czech.; ceph., $\times 1$ (182).

Family DIKELOKEPHALINIDAE

Kobayashi, 1936

Exoskeleton opisthoparian, isopygous. Glabella tapering with 1 to 4 pairs of usually deep slitlike lateral furrows, not reaching axial furrows, eye ridges strong, palpebral rims prominent and palpebral furrows well defined, frontal area of variable length (*sag.*), anterior furrow obsolete or very shallow; eyes of medium size to large, behind center of glabella; fixigenae upsloping, of medium width, with arcuate palpebral areas and pair of alae usually present opposite rear part of glabella; librigenae quadrate, with genal spines of variable length. Thorax with at least 8 segments; axis convex; pleurae twice length (*tr.*) of axis, with short pointed ends. Pygidium subcircular to subquadrate; axis extending 0.75 or more of length, with 6 to 8 axial rings; pleural fields usually wider than axis, with 6 to 8 pleurae merging into narrow border, pleural furrows and border furrow obsolete; posterior margin smoothly curved or with 1 or 2 pairs of prominent flat spines. Surface smooth or finely granulose. Bertillon pattern strong on doublures. *L.Ord.*

Dikelocephalina BRØGGER, 1896 [**Centropleura? dicraeura* ANGELIN, 1854; SD VOGDES, 1925]. Glabella convex, tapering, with 3 pairs of deep, slitlike lateral furrows; frontal area 0.3 to 0.5 length of cranium; eyes of medium size to large, behind center of glabella; fixigenae with palpebral areas slightly more than 0.5 of glabellar width, posterior areas very long (*tr.*). Pygidium subquadrate; axis convex, narrow, tapered 0.75 or more of length to narrow pointed end, with 7 or 8 axial rings and long terminal; pleural fields twice width of axis, with 7 pleurae separated by backward-curved interpleural grooves; medium-width border, posterior margin with short, backward-directed spine on each side of median line (96). *L.Ord.*, W.Eu.-E.Asia.—FIG. 268,3c,d. **D. dicraeura* (ANGELIN), Scandinavia; 3c,d, cran., pyg., $\times 1$.—FIG. 268,3a,b. *D. asiatica* KOBAYASHI, Korea; 3a,b, cran., pyg., $\times 1$ (419).

Asaphopsis MANSUY, 1920 [**A. jacobii*]. Glabella moderately convex, broadly tapering, front rounded, with 3 pairs of short, pitlike lateral

furrows; eyes of medium size, slightly behind center of glabella; frontal area slightly more than 0.3 of length (*sag.*) of cranium; fixigenae with palpebral areas slightly less than 0.5 of glabellar width, posterior areas of medium width (*exsag.*), 0.75 of length (*tr.*) of occipital ring. Pygidium subquadrate; axis convex, narrow, tapering 0.83 of length to narrow pointed end, with 7 or 8 axial rings and terminal; pleural fields twice width of axis, with 6 or 7 pleurae separated by backward-curved interpleural grooves running nearly to margin; border narrow, flat or concave, with pair of medium-length spines at posterolateral corners, posterior margin straight. *L.Ord.*, E.Asia-Tasm.—FIG. 268,2. *A. nakamurai* KOBAYASHI, Korea; 2a,b, cran., pyg., $\times 1$ (419).

Asaphopsoides HUPÉ, 1955 [**Dicellocephalus? villebruni* BERGERON, 1895]. Glabella broadly tapering, front somewhat pointed, with 3 pairs of short slitlike lateral furrows; frontal area 0.3 of length (*sag.*) of cranium; eyes large, opposite posterior 0.3 of glabella; fixigenae with palpebral areas 0.5 of glabellar width, length of posterior areas unknown. Pygidium subcircular; axis convex, narrow, tapered 0.75 of length to narrow pointed end, with 7 or 8 axial rings and long terminal; pleural fields twice width of axis, with 7 or 8 pleurae separated by well-defined curved interpleural grooves; medium-width border, posterior margin broadly curved with short spine at each posterolateral corner. *L.Ord.* W.Eu.—FIG. 268,6. **A. villebruni* (BERGERON), Fr.; 6a,b, cran., pyg., $\times 1$ (377).

Birmanites SHENG, 1934 [**Ogygites birmanicus* REED, 1915]. Glabella convex, urceolate tapering, with anterior pair of short oblique lateral furrows and 2 slitlike posterior pairs (latter pairs not shown in figure); frontal area almost 0.5 of length (*sag.*) of cranium; eyes large, slightly posterior to center of glabella; fixigenae with palpebral areas 0.7 of glabellar width, posterior areas narrow (*exsag.*), same in length (*tr.*) as occipital ring, no alae observed; librigenae with short flat genal spines. Thorax with 8 segments. Pygidium subcircular; axis convex, narrow, tapered 0.83 of length to narrow pointed end, with 7 or 8 axial rings and terminal with 1 faint ring; pleural fields twice width of axis, merging into narrow border, with 7 or 8 pleurae separated by broad shallow interpleural grooves running to edge of border; posterior margin smoothly curved. Caecal folds prominent on cephalon. *L.Ord.*, E.Asia.—FIG. 268,7. **B. birmanicus* (REED), Tremadoc., Burma; exoskel. (reconstr.), $\times 1$ (419).

Dactylocephalus Hsü, 1948 [**D. dactyloides*]. Glabella moderately convex, tapering, front narrow rounded, with 2 pairs of arcuate lateral furrows; eyes large, opposite posterior 0.3 of glabella; frontal area about 0.25 of length (*sag.*) of cranium, with very shallow anterior furrow near front; fixigenae with palpebral areas about

0.7 of glabellar width, posterior areas narrow (*exsag.*), same in length (*tr.*) as occipital ring, posterior border furrow nearly obsolete; librigenae with shallow lateral border furrow anteriorly and long slender genal spines. Pygidium subquadrate; axis convex, medium-width, tapered

0.8 of length to narrow rounded end, with 6 axial rings and terminal; pleural fields about same in width as axis, sloping into very narrow border, with 6 pleurae separated by backward-curved interpleural grooves running nearly to margin, short backward-directed spine on each side of

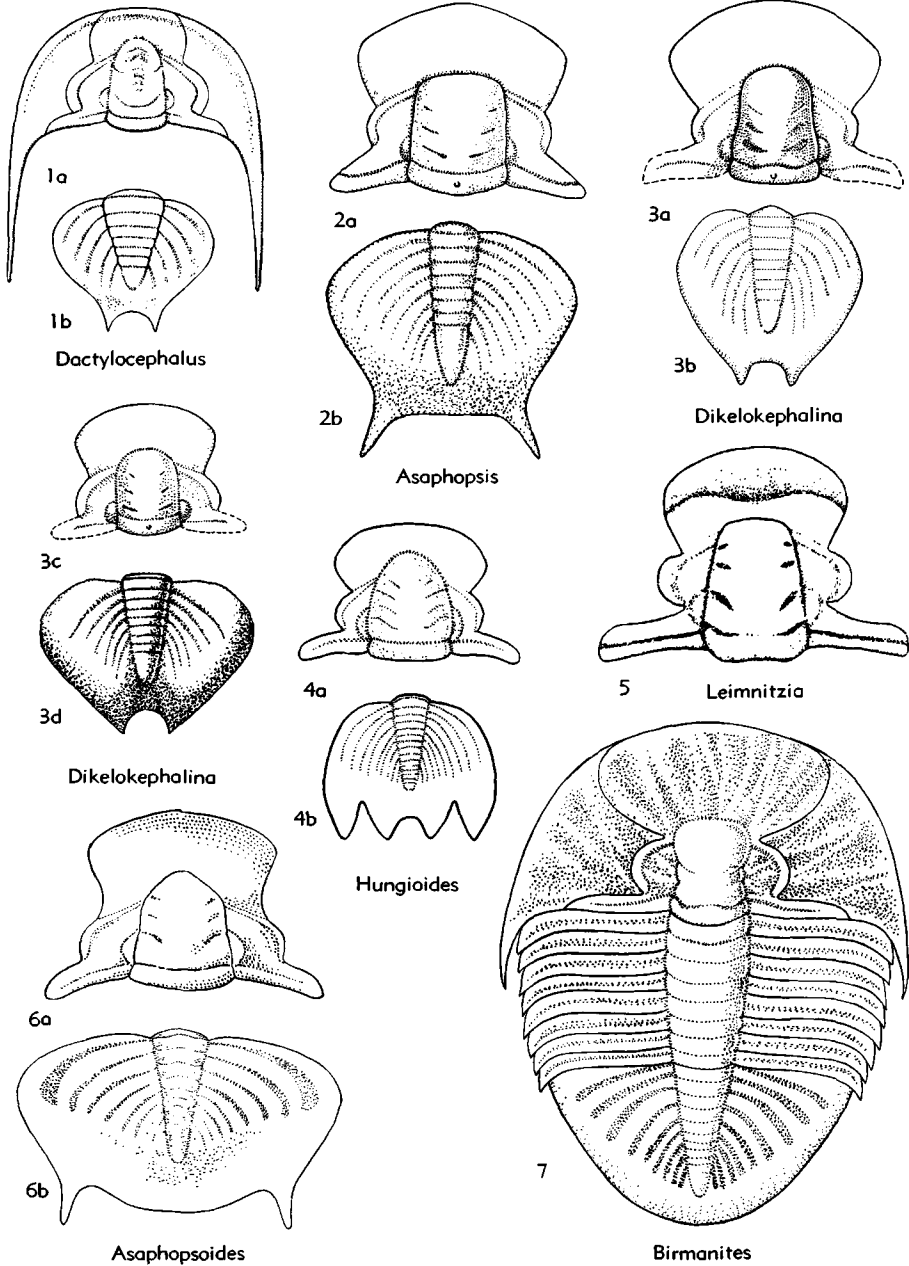


FIG. 268. Dikelocephalinidae (p. 0359-0361).

median line. Concentric wrinkles on cephalon. *L.Ord.*, E.Asia.—FIG. 268,1. **D. dactyloides*, Tremadoc., China (W.Hupeh); *1a,b*, cep., pyg., $\times 1$ (419).

Dikelocephalopsis POLETAEVA, 1955 [**D. amzassen-sis*]. Resembles *Leimitzia*. *L.Ord.* (*U.Tremadoc.*), USSR (HE).

Hungioides KOBAYASHI, 1936 [**Dicellocephalina bohémica* J. PERNER, 1918]. Glabella moderately convex, tapering with narrow rounded front and 4 pairs of slitlike glabellar furrows; eye ridges narrow, eyes of medium size, opposite posterior 0.3 of glabella; frontal area about 0.25 length (*sag.*) of cranidium; fixigenae with palpebral areas almost 0.5 of glabellar width, posterior areas not quite equal in length (*tr.*) to occipital ring. Pygidium subcircular; axis convex, narrow, tapered 0.8 of length to narrow rounded end, with 11 axial rings and terminal with 1 or 2 faint rings; pleural fields twice width of axis, with 10 pleurae separated by backward-curved interpleural grooves; medium-width border extended into 2 pairs of very broad, flat, posterior marginal spines (64). *L.Ord.*, C.Eu.—FIG. 268,4. **H. bohémica* (PERNER), Czech.; *4a,b*, cran., pyg., $\times 1$ (442). [Authorship of type species should be cited as J. PERNER in NOVÁK & PERNER, 1918.]

Leimitzia SDZUY, 1955 [**Conocephalites bavaricus* BARRANDE, 1868]. Glabella low, tapering, with 3 pairs of deep, slitlike lateral furrows; frontal area 0.3 of length of cranidium, anterior border furrow distinct, with prominent median posterior curve; eyes large, about opposite center of glabella; fixigenae with palpebral areas slightly more than 0.5 of glabellar width, posterior areas of medium width, about same in length (*tr.*) as occipital ring. Pygidium subcircular; axis convex, narrow, tapered 0.75 of length to narrow rounded end, with 5 or 6 axial rings and long terminal; pleural fields slightly wider than axis, with 6 pleurae separated by backward-curved interpleural grooves running on to moderately wide, flat border; posterior margin with median inward bend. Outer surface very finely granulose (272). *L.Ord.* (*Tremadoc.*), Eu.—FIG. 268,5. **L. bavarica* (BARRANDE), Tremadoc., Ger.; cran., $\times 1$ (272).

Temnoura RESSER & ENDO, in ENDO & RESSER, 1937 [**T. granosa*] [= *Temnura*, *Temnurus* KOBAYASHI, 1935]. Single pygidium in drift block. *L.Ord.*, Manch.

Superfamily CYCLOPYGACEA

Raymond, 1925

[*nom. transl.* RICHTER & RICHTER, herein (*ex Cyclopygidae* RAYMOND, 1925)]

Exoskeleton gibbous. Cephalon large, without marginal border; glabella large, fused with occipital ring (?except *Ellip-*

sotaphrus); fixigenae reduced to minute band, palpebral lobes not defined; facial sutures cutting posterior margin close to axial furrows, not withdrawing from them along whole contour of glabella; librigenae in most genera reduced, angles rounded, united ventrally by doublure; eyes hypertrophied, visual areas very convex, occupying nearly whole librigenae, continuing to ventral side where they may remain separated or unite (in some species this trend being advanced to different degrees within same genus), with 750 to 3,500 biconvex lenses in each eye. Hypostoma incompletely known; no connective sutures or rostral plate. Thorax with 5 or 6 segments; sides parallel or diverging backward; axis broad, at least anteriorly; pleurae grooved, increasing backward in width (*tr.*). Pygidium of moderate size to large; axis with few rings (up to 5); pleural fields with few ribs, generally no more than 1 or 2 distinct. Surface smooth or with fine striae, few species granulose. Most species small, a few up to 14 cm. in length (3, 4, 211, 218, 255, 343). *Ord.* (*U.Tremadoc.-Ashgill.*).

Family CYCLOPYGIDAE Raymond, 1925

[*nom. conserv.* RICHTER & RICHTER proposed 1955 *pro* Aeglinidae PICTET, 1854 (ICZN pend.)]

Characters of superfamily. *Ord.* (*U.Tremadoc.-Ashgill.*).

Cyclopyge HAWLE & CORDA, 1847 [*nom. subst. pro* *Egle* BARRANDE, 1846 (*non* DESVOIDY, 1830)] [**Egle rediviva* BARRANDE, 1846] [= *Selenopychus* HAWLE & CORDA, 1847; *Aeglina* BARRANDE, 1852 (*obj.*); *Phylacops* COOPER & KINDLE, 1936]. Glabella broad, sides straight, converging forward; with single pair of lateral furrows, directed backward; eyes covering much of ventral surface, separated by 0.3 or less of cephalon width or meeting. Thorax with 6 segments; sides diverging and axis strongly tapering backward. Pygidium large, semicircular; axis narrow, short; pleural regions large; marginal border absent or faint. *Ord.*, E.U.N.Am.—FIG. 269,2. **C. rediviva* (BARRANDE), "d epsilon" Zone, Czech.; exoskel., $\times 1.5$ (3, 4).

Aspidaeglina HOLUB, 1911 [**A. miranda*]. Cephalon imperfectly known, with pair of pits in posterior region of glabella. Thorax as in *Cyclopyge* but axis moderately tapering backward. Pygidium with short triangular axis; scarcely segmented; border depressed, with median border spine. *L.Ord.*, Eu.—FIG. 270,2. **A. miranda*, "d beta" Zone, Czech.; thorax and pyg., $\times 1.5$ (67).

Ellipsotaphrus WHITTARD, 1952 [**Aeglina monophthalma* KLOUČEK, 1917]. Glabella short, narrow-

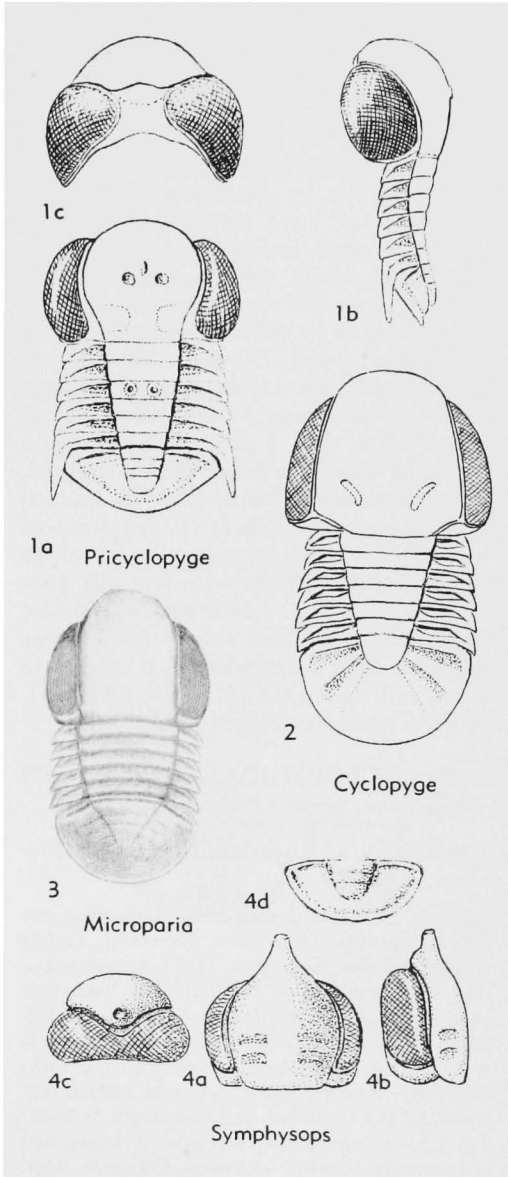


FIG. 269. Cyclopygidae (p. 0361-0362).

ing backward, front broadly rounded, with 2 entire furrows (posterior regarded as occipital furrow) and anterior pair of discontinuous furrows; posterior region of genae considerably elongated; facial sutures uniting dorsally; eyes separating glabella from anterior border, coalesced. Thorax and pygidium imperfectly known. *L.Ord.*, Czech.-Eng.-Wales.—FIG. 270,1. **E. monophthalmus* (KLOUČEK), “d gamma 2” Zone, Czech.; 6a,b, ceph., dorsal, lateral, $\times 4$ (94).

Microparia HAWLE & CORDA, 1847 [**M. speciosa*].

Glabella with straight sides or somewhat convergent forward, without furrows; eyes barely continuing to ventral side or not at all. Thorax with 5 or 6 segments; axis very broad, scarcely tapering backward. Pygidium semicircular; segmentation faint; axis triangular, anteriorly very broad; border faint or absent. *Ord.*, C.Eu.-W.Eu.-E.N.Am.—FIG. 269,3. **M. speciosa*, “d epsilon” Zone, Czech.; exoskel., $\times 1$ (3, 4).

Pricyclopyge RICHTER & RICHTER, 1954 [**Aeglina prisca* BARRANDE, 1872]. Glabella pear-shaped, with 2 centrally located pits; eyes covering much of ventral surface, separated by approximately 0.25 width of cephalon. Thorax with 6 segments; axis strongly tapering backward; 6th segment with pleural spines. Pygidium triangular; axis narrow, 0.7 of length of pygidium, few rings; ribs faint; with marginal border. *Ord.*, C.Eu.-W.Eu.—FIG. 269,1. **P. prisca* (BARRANDE), “d gamma 1” Zone, Czech.; 1a,b, exoskel., dorsal, profile; 1c, ceph., ventral; all $\times 1$ (4).

Psilacella WHITTARD, 1952 [**P. trirugata*]. Imperfectly known. Glabella nearly parallel-sided, front broadly rounded, with 3 pairs of pronounced furrows; eyes presumed to coalesce. Pygidium semicircular; axis triangular, 0.5 of pygidial length, with few rings and ribs. *Ord.*, Scot.-Czech.—FIG. 270, 3. **P. trirugata* WHITTARD, Ashgillian, Scot.; glabella, $\times 3$ (343).

Symphysops RAYMOND, 1925 [**Aeglina armata* BARRANDE, 1872]. Glabella with greatest width at mid-length, produced into frontal spine, with 2 pairs of transverse furrows; eyes coalescent ventrally; posterior region of free cheeks developed as a rather broad band. Pygidium rather small, semicircular; axis of moderate length; few rings and ribs; marginal border narrow. *M.Ord.-U.Ord.*, Eu.-E.N.Am.—FIG. 269,4. **S. armatus* (BARRANDE), “d zeta 1” Zone, Czech.; 4a-c, ceph., dorsal, side, anterior; 4d, pyg., all $\times 1$ (4).

Superfamily CERATOPYGACEA Linnarsson, 1869

[*nom. transl.* POULSEN, herein (*ex* Ceratopygidae LINNARSSON, 1869)]

Opisthoparian, ovate, slightly convex exoskeleton, heteropygous to almost isopygous. Cephalon approximately semicircular; glabella clavate to tapering forward, with median tubercle on posterior part; preglabellar field well developed, cephalic border furrow strongly impressed, adjoining narrow, convex border; librigenae fairly wide, with slender genal spines in direct continuation of lateral border or nearly so. Thorax of 6 to 9 segments (as far as known). Pygidium semicircular to subtriangular, with 1 or 2 pairs of lateral spines originating from an-

terior segments. Cephalic doublure, ventral sutures, and hypostoma imperfectly known; doublures of librigenae apparently separated by median suture in *Proceratopyge*, and hypostoma probably fused with rostral plate in *Hysterolenus*. *Up.M.Cam.-L.Ord.*

Family CERATOPYGIDAE Linnarsson, 1869

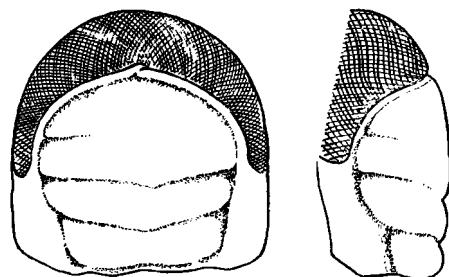
Characters of superfamily. *Up.M.Cam.-L.Ord.*

Ceratopyge HAWLE & CORDA, 1847 [**Olenus forficula* SARS, 1835]. Cephalon slightly less than 0.5 of total length; cranium narrow; glabella slender, slightly expanding forward, truncate in front; occipital furrow strongly impressed; preoccipital lateral glabellar furrows pit-shaped, strongly impressed, other glabellar furrows shallow, almost effaced; palpebral region of fixigenae narrow; palpebral lobes short, strongly curved, situated a little posterior to glabellar center; anterior sections of facial sutures strongly diverging between eyes and anterior border, forming angles of about 90° with posterior sections. Thorax of 6 segments with narrow axis; straight, deeply furrowed pleurae with pointed, outward-directed ends. Pygidium semicircular, somewhat smaller than cephalon, with very narrow, slightly convex border, 5 or 6 axial rings, 2 anterior segments perceptible in pleural fields, and a pair of backward-directed, gently curved spines formed by coalescence of distal parts of 1st and 2nd segment (153). *L.Ord.* (*Tremadoc.*), Norway-Swed.-Arg.—FIG. 271,1. **C. forficula* (SARS), Swed.; 1a,b, ceph., pyg., ×2.8 (153).

Boschchekulia LERMONTOVA, 1951 [**B. lata*]. *U. Cam.*, NE.Kazakhstan.

Diceratopyge TROEDSSON, 1937 [**D. mobergi*]. Differs from *Ceratopyge* in having parallel-sided glabella without glabellar furrows and with rounded front, and more slender pygidial spines originating from posterior pleural band of 2nd segment (301). *U.Cam.*, C.Asia.—FIG. 272,2. **D. mobergi*, *U. Cam.*, China(T'ien-Shan); pyg., ×3 (301).

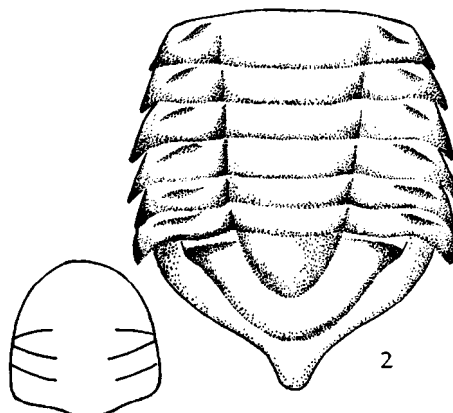
?*Dichelepyge* HARRINGTON & LEANZA, 1952 [**D. pasquali*]. Differs from *Ceratopyge* in having wider cranium, tapering glabella with 3 pairs of well-defined lateral furrows, anterior region of fixigenae crossed by corner furrow in continuation of preglabellar furrow, wider posterior region of fixigenae, palpebral lobes slightly in front of glabellar center, less diverging anterior sections of facial sutures; thoracic segments with extremely oblique proximal part of pleural furrows and long pleural spines; pygidium with concave border, strongly marked segmentation throughout, and 1st and 2nd segment terminating in obliquely backward-directed pleural spines (58). *L.Ord.*



1a

Ellipsotaphrus

1b



3

Psilacella

Aspidaeolina

2

FIG. 270. Cyclopygidae (p. 0361-0362).

(*Tremadoc.*), Arg.—FIG. 272,1. **D. pasquali*, Salta; cran. and 3 thoracic segments; ×6.5 (58). *Dipleuropyge* LERMONTOVA, 1951 [**D. striata*]. Pygidium rather similar to that of *Onychopyge*. *U.Cam.*, Kazakhstan (HE).

Hysterolenus MOBERG, 1898 [**H. törnquisti*]. Differs from *Ceratopyge* in having parallel-sided glabella with rounded front, 4 pairs of distinctly marked lateral glabellar furrows, and larger, subtriangular pygidium with about 10 axial rings, at least 6 defined segments in pleural fields, concave border, and 2nd segment produced into pleural spines (153). *L.Ord.*(*Tremadoc.*), Eu. ?C.Asia.—FIG. 271,4. **H. toernquisti*, Swed.; 4a,b, ceph., pyg., ×1.5; 4c, hypostoma, ×1.3 (153).

Kogenium KOBAYASHI, 1935 [**K. rotundum*]. Pygidium like that of *Proceratopyge*; associated cranium differing from those of typical *Ceratopygidae* in being strongly convex and having wider palpebral regions of fixigenae and more rapidly tapering, considerably sloping lateral extremities of posterior areas (97). *M.Cam.*, E.Asia.

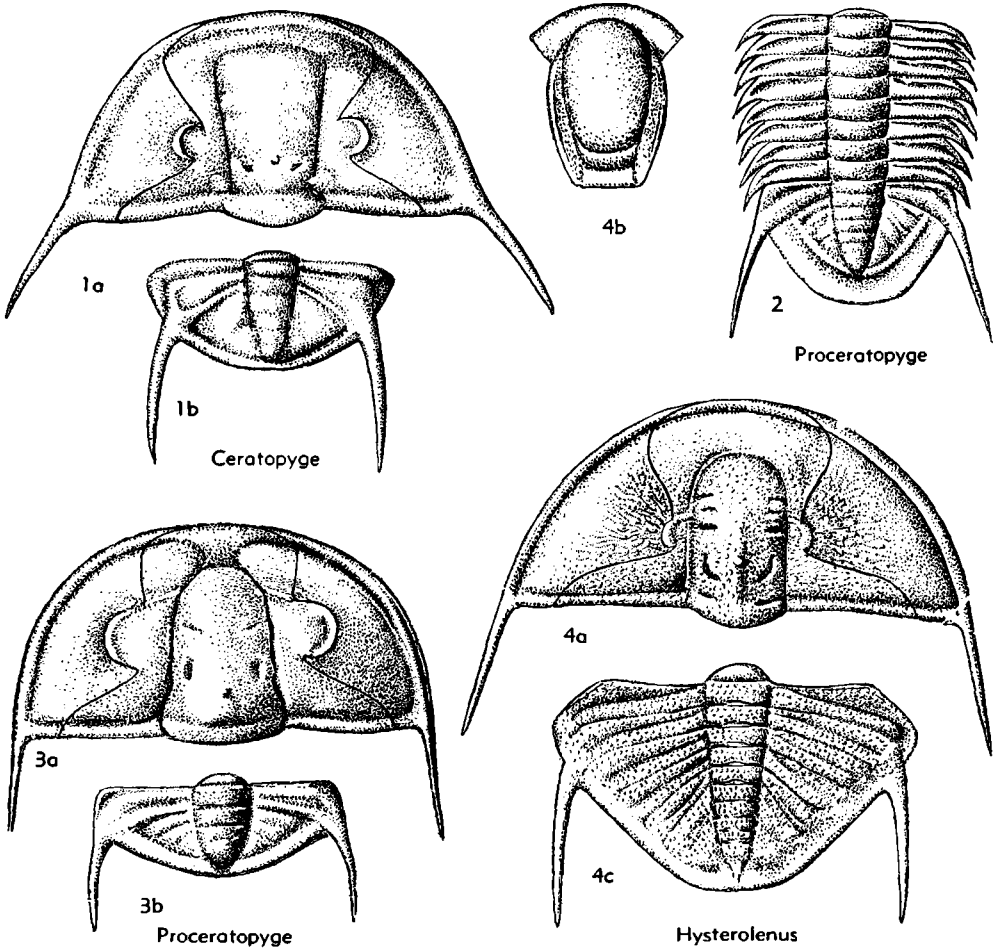


FIG. 271. Ceratopygidae (p. 0363-0364).

Mansuyella ENDO, in ENDO & RESSER, 1937 [**Coosia tokunagai* KOBAYASHI, 1931]. Differs from *Proceratopyge* in wider, more rapidly tapering, more or less truncated glabella and longer preglabellar field (37). *U.Cam.*, E.Asia.

Onychopyge HARRINGTON, 1938 [**O. riojana*] [= *Prionopyge* HARRINGTON & LEANZA, 1942 (obj.)]. Cephalon differing from that of *Ceratopyge* in having larger eyes, less diverging anterior sections of facial sutures, and glabella indistinctly defined anteriorly. Pygidium differing from that of *Proceratopyge* in having indistinct segmentation of pleural fields behind 1st pleura, and much wider border (59). *L.Ord. (Tremadoc.)*, Arg.—FIG. 273. **O. riojana*; a, cran. and librigena, $\times 2$; b, pyg. (holotype) (reconstr.), $\times 1.8$ (59*).

Proceratopyge WALLERIUS, 1895 [**P. conifrons*] [= *Lopnorites* TROEDSSON, 1937]. Differs from *Ceratopyge* in having cephalon about 0.3 of total

length of exoskeleton, wider, tapering to almost parallel-sided glabella, palpebral lobes situated opposite glabellar center, slightly diverging or almost parallel courses of anterior sections of facial sutures between eyes and anterior border; thorax of 9 segments with obliquely backward-directed pleural spines; and larger pygidium with 3 to 11 axial rings, well-segmented pleural fields, concave border, and 1st segment terminating in pleural spines (335, 336). *Up.M.Cam.*, Swed.-Asia-Austral. ?*L.Ord. (Tremadoc.)*, Arg.—FIG. 271,3. **P. conifrons*, M.Cam., Swed.; 3a,b, ceph., pyg., $\times 3$ (336).—FIG. 271,2. *P. magnicauda* WESTERGÅRD, M.Cam., Swed.; incomplete thorax with pyg., $\times 3$ (336).

Pseudohysterolenus HARRINGTON & LEANZA, 1957 [**P. infidus*]. Differs from *Hysterolenus* in having wider, anteriorly subtruncate glabella, very small posterior areas of fixigenae, and short, semi-elliptical pygidium with much wider, strongly

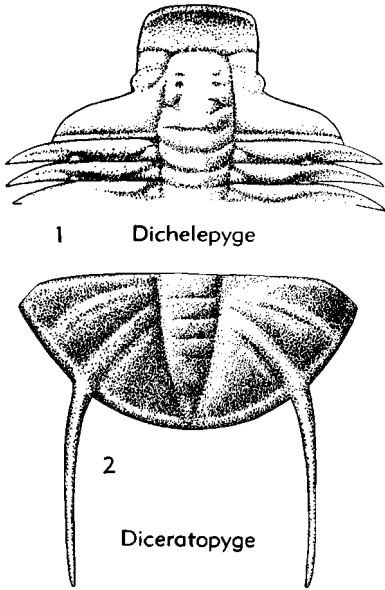


FIG. 272. Ceratopygidae (p. 0363).

tapering axis of 5 rings and short terminal portion, and pleural fields divided into 3 indistinctly defined pleurae, apparently without spines (59). L.Ord.(Tremadoc.), Arg.—FIG. 274. **P. infidus*; a, cran. (holotype) (reconstr.), $\times 6.6$; b, pyg. (exfoliated), $\times 9.2$ (59*).

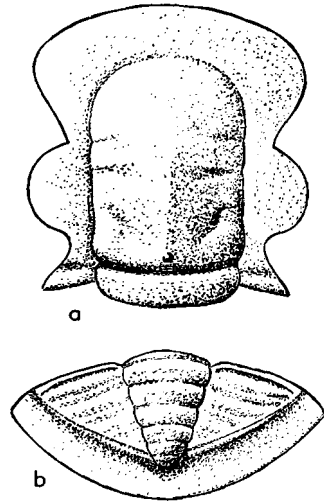


FIG. 274. **Pseudohysterolenus infidus* HARRINGTON & LEANZA (Ceratopygidae), L.Ord.(Tremadoc.), Arg.; a, cran. (reconstr.), $\times 6.6$; b, pyg. (exfoliated), $\times 9.2$ (59*).

Suborder ILLAENINA

Jaanusson, nov.

[Type—Illaenus DALMAN, 1827]

Opisthoptarian trilobites with large or moderately large rostral shield separated by sutures; one family includes, in current delimitation, some genera with anteriorly fused librigenae. Lateral glabellar furrows commonly faint or absent. Doublure broad. Thoracic segments 6 to 10. Pygidium about equal in size to cephalon or somewhat smaller. Tuberculae ornamentation rare. All typical forms lack eye ridges. Ord.-M.Perm.

Superfamily ILLAENACEA

Hawle & Corda, 1847

[nom. correct. HARRINGTON & LEANZA, 1957 (pro Illaenidae WHITTINGTON, 1953, nom. trans. ex Illaenides HAWLE & CORDA, 1847)] [=Scuteloidae HUPÉ, 1953]

Exoskeleton of moderate size. Glabella expanding anteriorly, alae commonly well defined, at least on ventral face of cephalon. Thoracic segments 8 to 10; pleural furrows, if present, approximately parallel to margins of segments. Ord.-Sil.

Family STYGINIDAE Vogdes, 1890

Cephalon and pygidium moderately convex, subequal in size, outline semicircular, genal regions prolonged behind rest of cephalon as broad-based spines. Glabella

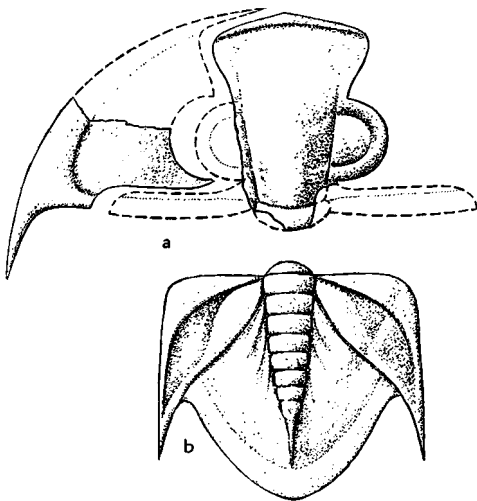


FIG. 273. **Onychopyge riojana* HARRINGTON (Ceratopygidae), L.Ord.(Tremadoc.), Arg.; a, cran., $\times 10$; b, librigena, $\times 2$; c, pyg. (reconstr.), $\times 1.8$ (59*).