

**ANODONTINATAX, NEW SUBGENUS (ACARI: UNIONICOLIDAE: UNIONICOLA),  
IN HOLARCTIC FRESH-WATER MUSSELS (UNIONIDAE: ANODONTINAE),  
WITH A RE-EVALUATION OF RELATED TAXA**

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**ABSTRACT**—Three new species (*Unionicola clarki*, *belli* and *smithae*) are described for the first time and placed in a new subgenus, *Anodontinatax*. Related species, *U. wolcottii* (Piersig), *U. mitchelli* Conroy and *U. intermedia* (Koenike), are re-evaluated and also placed in this new subgenus. The subgenus *Anodontinatax* is intermediate in morphology between the subgenus *Pentatax* Thor (in *Unionicola*) and the genus *Vietsatax* Uchida and Imamura, and thus *Vietsatax* is reduced in rank to a subgenus in *Unionicola*.

#### INTRODUCTION

Previously *Unionicola wolcottii* (Piersig), *U. mitchelli* Conroy and *U. intermedia* (Koenike) have been placed in the subgenus *Pentatax* Thor (Cook 1974, Vidrine 1985a). This placement does not represent the unique synapomorphies of this group, especially the synapomorphies shared with *Vietsatax* Uchida and Imamura (Vidrine 1984). This paper erects a new subgenus for this group and provides descriptions of three new species. The many synapomorphies between this new subgenus and the genus *Vietsatax* are also re-evaluated.

The author has examined the types in the Marshall Collection of the Field Museum of Natural History, Chicago (MC-FMNH). Also preserved lots of mussels have been examined for mites from: The Academy of Natural Sciences of Philadelphia (ANSP); The Ohio State University Museum, Columbus (OSUM); The United States National Museum (Smithsonian Institution), Washington (USNM); The Museum of Zoology of the University of Michigan, Ann Arbor (MZUM); and The National Museum of Canada, Ottawa (NMC). The fresh-water mussels have recently been re-evaluated by Burch (1975), Clarke (1981a and b, and 1985) and Davis and Fuller (1981).

Holotypes and representative paratypes are deposited in the Canadian National Collections and Biosystematics Institute, Agriculture Canada, Ottawa (CNC). Additional paratypes are in the Marshall Collection in the Field Museum of Natural History and the author's collection.

Terminology for adult structures follows that used by Vidrine (1985a). Measurements are expressed in microns in the format, mean (range). All bars on figures equal 100 microns (0.1 mm).

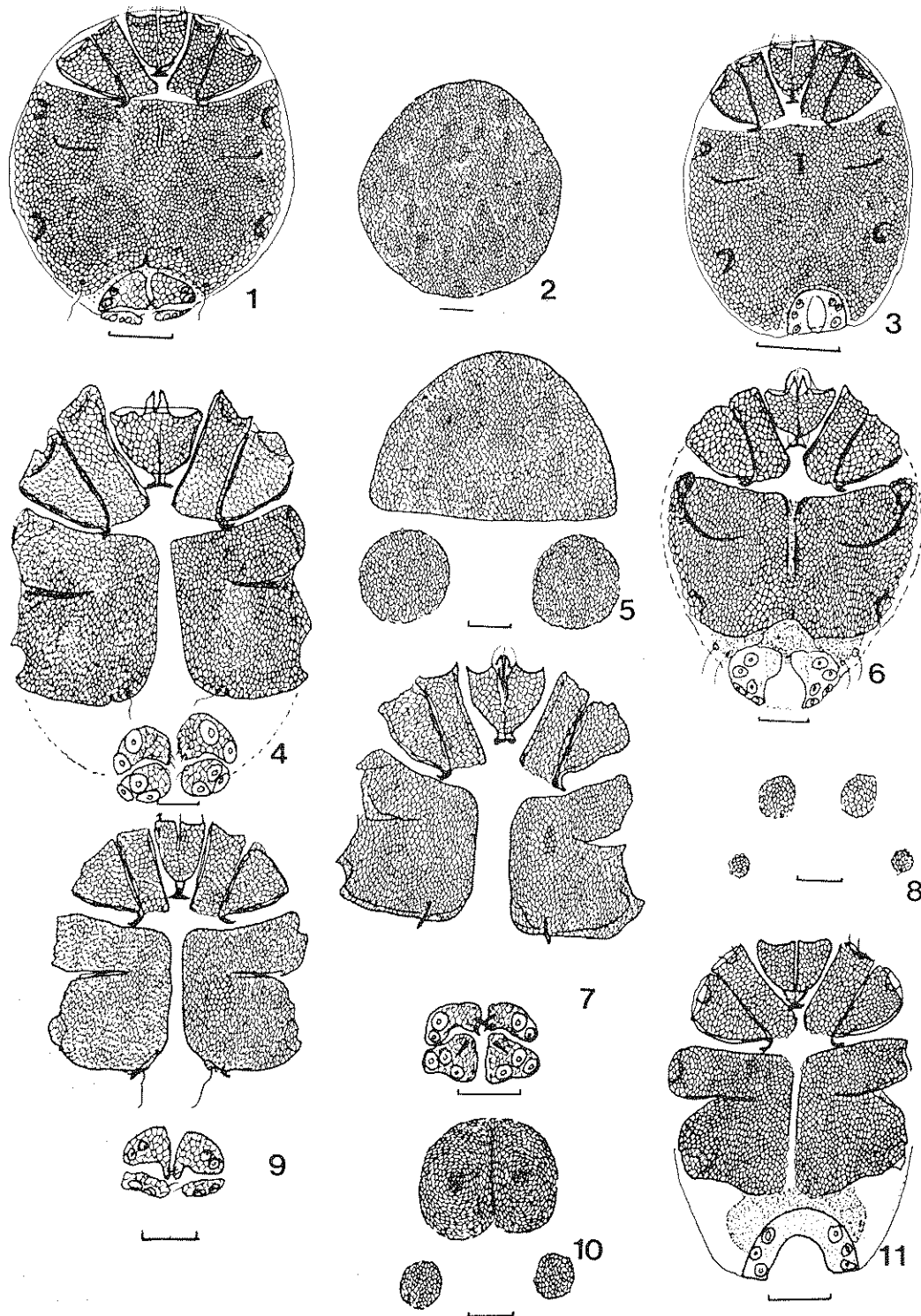
#### RESULTS

##### *Anodontinatax* new subgenus

**TYPE SPECIES** — *Unionicola intermedia* (Koenike 1882).

**DIAGNOSIS** — Character states of the genus *Unionicola*; dorsum usually with a dorsal shield (figs. 2, 5, and 10); dorsum and venter exhibiting hexagonal ultrastructure in secondarily sclerotized areas; female genital field with 2 pairs of acetabular plates, one pair on either side of the genital opening; anterior female acetabular plates with two acetabula each and an inner flap with 2 or 3, short, stout setae, posterior plates with 3 acetabula each and a single, inner, slightly elongate seta (figs. 13, 17, and 22); male genital field with one pair of plates fused anteriorly and posteriorly by chitinous bands, each plate with 5 acetabula (figs. 3, 6, and 11); tarsal claws of all walking legs deeply bifid with the dorsal prong longer than the ventral prong (figs. 28 and 33); fourth walking legs of males sexually dimorphic, especially the Ge and Ti (figs. 29, 31, and 32); first and third walking legs of near equal length.

**REMARKS** — *Anodontinatax* is distinguished from members of *Pentatax* by the sexual dimorphism of the male fourth walking legs. The females may be



Figs. 1-11. *Unionicola clarki* n. sp.: 1. female venter; 2. female dorsal shield; 3. male venter; *U. smithae*: 4. female venter; 5. female dorsal plates; 6. male venter; *U. parasitica* (Uchida and Imamura): 7. female venter; 8. female dorsal plates; *U. mitchelli* Conroy: 9. female venter; 10. female dorsal plates; and 11. male venter.

distinguished by the tarsal claw structure of the walking legs. Females of *Anodontinatax* commonly reside in their mussel hosts (Unionidae: Anodontinae) throughout the year, while the males are present in mussels for only a short time and usually may be collected as free-swimming mites. Eggs are deposited in the mantle and foot epithelia of the hosts. All species apparently can be numerous in a single host individual. *Anodontinatax* is known from North America, Europe, and Asia, exclusive of southeast Asia and Japan (Vidrine 1980 and Vidrine and Bereza 1978).

**SPECIES INCLUDED** — *U. intermedia* (Koenike), *U. wolcotti* (Piersig) and *U. mitchelli* Conroy. Three new species are described from North America in this paper. *U. intermedia* occurs in Europe and Asia, while all other species occur in North America.

1. *Unionicola (Anodontinatax)*  
*wolcotti* (Piersig 1900)

**DIAGNOSIS** — Character states of the subgenus; male lacking an obvious dorsal shield; female dorsal shield with 4 plates (as in fig. 8); male and female with posterior group of coxal plates distinctly bordered and not elongate; male and female genital fields not fused with posterior coxal plates; Ta of pedipalp with 2 clawlets of near equal size and not separated by a wide gap; fourth walking leg of male with Ge bearing 2, elongate setae and a dense, distal cluster of 6-8 pectinate setae, and with Ti bearing 9-11 pectinate setae in a ventral mass.

**MALE** (2 specimens): Length including capitulum 625 (600-650); length of posterior coxal group 230 (220-240); dorsal lengths of pedipalp segments: Ti 85; Ta 50; dorsal lengths of leg segments: leg I: TFe 155 (150-160); Ge 210 (200-220); Ti 175 (170-180); Ta 160; leg IV: TFe 205 (190-220); Ge 180 (170-190); Ti 240; Ta 180.

**FEMALE** (8 specimens): Length including capitulum 886 (750-1000); length of posterior coxal group 276 (230-280); genital field 207 (170-250) long; anterior dorsal plates 87 (80-100) in diameter; dorsal lengths of pedipalp segments: Ti 132 (125-145); Ta 73 (65-82); dorsal lengths of leg segments: leg I: TFe 178 (160-210); Ge 256 (230-310); Ti 219 (190-260); Ta 188 (160-210); leg IV: TFe 234 (190-280); Ge 299 (260-350); Ti 384 (330-475); Ta 291 (250-350).

**NOTES** — This species was re-evaluated by Mitchell (1957), where he reported the types in the Marshall Collection in the Field Museum of Natural History. I have examined these lots, and 5 species are in these lots. *U. wolcotti* is amply figured in Wolcott (1899), Marshall (1933) and Mitchell (1957). Males and females were measured from Twin Lakes, Charlevoix,

Michigan, 6 August 1894 (R. Wolcott) (MC-FMNH). Additional females were measured from my lots from: *Anodontoides ferussacianus* (Lea) from Muskingum River at Lowell, Washington County, Ohio, 24 September 1969; *Anodonta imbecilis* Say, *A. couperiana* Lea and *A. cataracta* Say from Savannah River, South Carolina; *A. grandis* Say from Ouachita River at Ink, Polk County, Arkansas, 12 August 1978 (D.R. Clark, W. Bell and M.F. Vidrine); *A. kennerlyi* Lea (NMC 67481) from First Nanaimo Lake 20 km west of Nanaimo, British Columbia, Canada, 30 July 1972 (A.H. Clarke); and *A. wahlamatensis* Lea (= *A. nuttalliana* Lea) (NMC 16072) from Cultus Lake, British Columbia, Canada, 15 March 1960 (A.B. Rudlich).

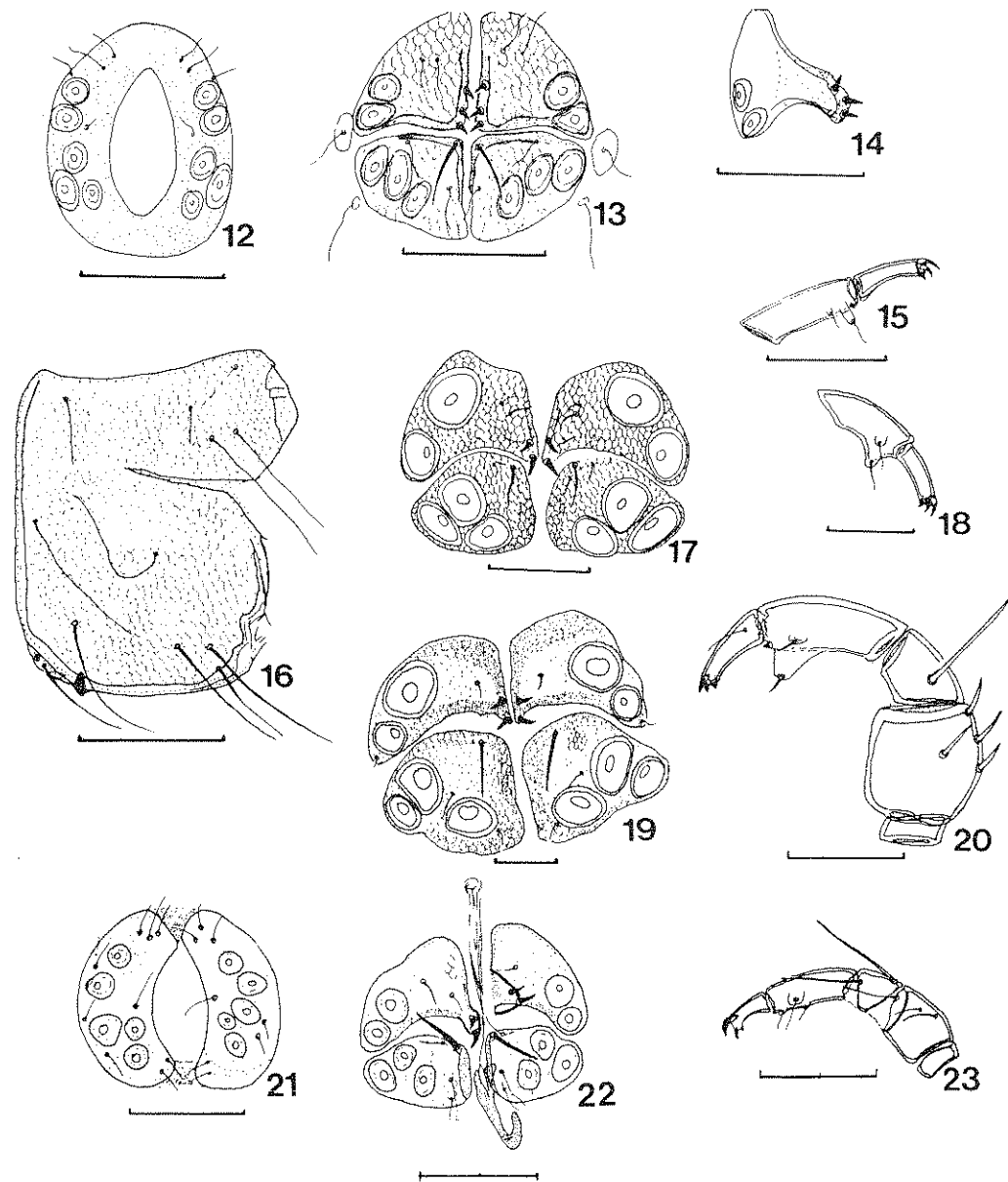
**REMARKS** — *U. wolcotti* is a sibling species with *U. intermedia* (Wolcott 1899, Marshall 1933, Mitchell 1957 and Vidrine 1980). *U. intermedia* commonly occurs in *Anodonta* spp. in Europe and Asia (Mitchell and Pitchford 1953, Mitchell 1957 and Hevers 1978). The females of *U. wolcotti* and *U. intermedia* are apparently indistinguishable, while the males are separated based upon the structure of the fourth walking legs (Mitchell 1957). *U. intermedia* is adequately figured in Hevers (1978), but the female dorsum is not figured. I have examined specimens from Holland and Poland, and the females possess dorsal plates that are nearly identical to *U. wolcotti*. Prior to Conroy (1982), all North American members of this group were collectively treated as *U. wolcotti*. This paper elaborates on the diversity in this group. *U. wolcotti* is apparently a parasite of *Anodonta* spp. in North America.

2. *Unionicola (Anodontinatax)*  
*mitchelli* Conroy 1982

(Figs. 9-11, 16, 21-23, 26, 27, 31 and 32)

**DIAGNOSIS** — Character states of the subgenus; male dorsum with a large, lightly sclerotised plate; female dorsum with 3 plates, the anterior plate appearing as 2 fused plates (fig. 10); posterior coxal group of female with distinct borders (fig. 9); posterior coxal group of male with distinct borders and fused by secondary sclerotization to the genital field (fig. 11); anterior female acetabular plates bearing 2, short, stout setae on inner flap (fig. 22); Ta of pedipalp bearing 2, widely separated clawlets, the dorsal clawlet distinctly longer than the ventral clawlet (fig. 23); first walking leg Ge with 2 pairs of long setae (fig. 26); fourth walking leg of male with Ge bearing 6-9 distal, pectinate setae, and Ti bearing a ventral mass of 9-13, pectinate setae (fig. 31).

**MALE** (7 specimens): Length including capitulum 579 (500-625); length of posterior coxal group 241 (200-280); dorsal lengths of pedipalp segments: Ti 81 (75-86); Ta 39 (32-50); dorsal lengths of leg segments:



Figs. 12-23. *Unionicola clarki* n. sp.: 12. male genital field; 13. female genital field; 14. lateral view of anterior acetabular plate; 15. female distal pedipalp segments; *U. mitchelli* Conroy: 16. female posterior coxal group; *U. smithae* n. sp.: 17. female genital field; 18. female distal pedipalp segments; *U. parasitica* (Uchida and Imamura): 19. female genital field; 20. female pedipalp; *U. mitchelli*: 21. male genital field; 22. female genital field; and 23. female pedipalp.

leg I: TFe 119 (100-130); Ge 159 (135-170); Ti 140 (125-150); Ta 128 (110-140); leg IV: TFe 203 (180-220); Ge 169 (150-180); Ti 206 (185-225); Ta 172 (160-185).

FEMALE (12 specimens): Length including capitulum 923 (700-1100); length of posterior coxal group 302 (250-350); genital field 222 (180-250) long; anterior

dorsal plate 231 (180-270) long, 328 (270-390) wide; dorsal length of pedipalp segments: Ti 124 (105-140); Ta 59 (50-65); dorsal lengths of leg segments: leg I: TFe 176 (140-200); Ge 251 (200-290); Ti 216 (180-250); Ta 185 (150-200); leg IV: TFe 252 (205-280); Ge 288 (230-320); Ti 372 (300-420); Ta 274 (230-310).

NOTES — Conroy (1982) described two males from Fort Whyte Nature Reserve, Manitoba, Canada. In this study, specimens were measured from: Lincoln, Nebraska (MC-FMNH), October 1894 (R. Wolcott); *A. grandis* from an irrigation canal off Rte. U.S. 190, Kinder, Allen Parish, Louisiana, 3 July 1976 (B.J. and M.F. Vidrine); *A. grandis* from St. Croix River, Pierce County, Wisconsin (U.S. Army Corps of Engineers Mississippi River Project), July 1978 (S.L.H. Fuller); *A. imbecilis* from Bayou Dorcheat at Rte. LA 2, Webster Parish, Louisiana, 14 August 1978 (D.R. Clark, W. Bell and M.F. Vidrine); and *A. hallenbecki* Lea from Mosquito Creek at Rte. U.S. 90, Gadsden County, Florida, 19 July 1977 (D.J. Bereza and M.F. Vidrine).

REMARKS — The female of this species was previously unknown. It is apparently quite different from females of *U. wolcotti* and *U. intermedia*, especially in the structure of the dorsal plates. The males are more sclerotized than the other species, but the range of variation and the many synapomorphies cause difficulty in separating them. The dorsal shield and structure of the pedipalp Ta are useful in separating *U. mitchelli* from other species. *U. mitchelli* is apparently another parasite of *Anodonta* spp. in North America.

### 3. *Unionicola (Anodontinatax) clarki* new species (Figs. 1-3, 12-15, 28 and 33)

DIAGNOSIS — Character states of the subgenus; male and female dorsum covered by a large dorsal plate that is fused with the coxae by secondary sclerotization (fig. 2); posterior coxal groups fused along midline (fig. 1 and 3); body strongly dorsoventrally flattened; female anterior acetabular plates with 3, short, stout setae on inner flap (fig. 13); pedipalp Ta with 2 clawlets that are not separated by a gap (fig. 15); first walking leg Ge with a pair of long setae and a pair of short setae (fig. 28); male fourth walking leg Ge bearing 6-8, pectinate setae distally, and Ti bearing 11-19, short, pectinate setae in a ventral mass (fig. 33).

MALE (5 specimens): Length including capitulum 493 (450-600); length of posterior coxal group 255 (225-300); genital field 83 (75-90) long; dorsal lengths of pedipalp segments: Ti 63 (55-75); Ta 38 (35-45); dorsal lengths of leg segments: leg I: TFe 120 (110-150); Ge 162 (150-200); Ti 148 (115-260); Ta 108 (95-140); leg IV: TFe 184 (170-230); Ge 156 (140-200); Ti 189 (170-240); Ta 139 (130-150).

FEMALE (7 specimens): Length including capitulum 609 (475-680); length of posterior coxal group 360 (300-400); genital field 138 (120-150) long; dorsal lengths of pedipalp segments: Ti 83 (55-95); Ta 54 (35-65); dorsal lengths of leg segments: leg I: TFe 115

(95-130); Ge 151 (130-170); Ti 119 (100-130); Ta 94 (75-110); leg IV: TFe 139 (115-150); Ge 170 (135-190); Ti 221 (180-240); Ta 154 (115-170).

NOTES — Holotype (male) (CNC type number 19110) is from *Lasmigona costata* (Rafinesque) from Ouachita River at Rte. U.S. 270, Montgomery County, Arkansas, 12 August 1978 (D.R. Clark, W. Bell and M.F. Vidrine). Additional paratypes were measured from: *L. costata* from Grand River, Grand Rapids, Michigan (MC-FMNH), July and August 1895 (R. Wolcott); *Strophitus undulatus* (Say) from Glover River at Rte. OK 3 and 7, McCurtain County, Oklahoma, 12 August 1978 (D.R. Clark, W. Bell and M.F. Vidrine); and a rice field ca. 3.0 km south of Welsh, Jefferson Davis Parish, Louisiana, July 1984 (M.F. Vidrine).

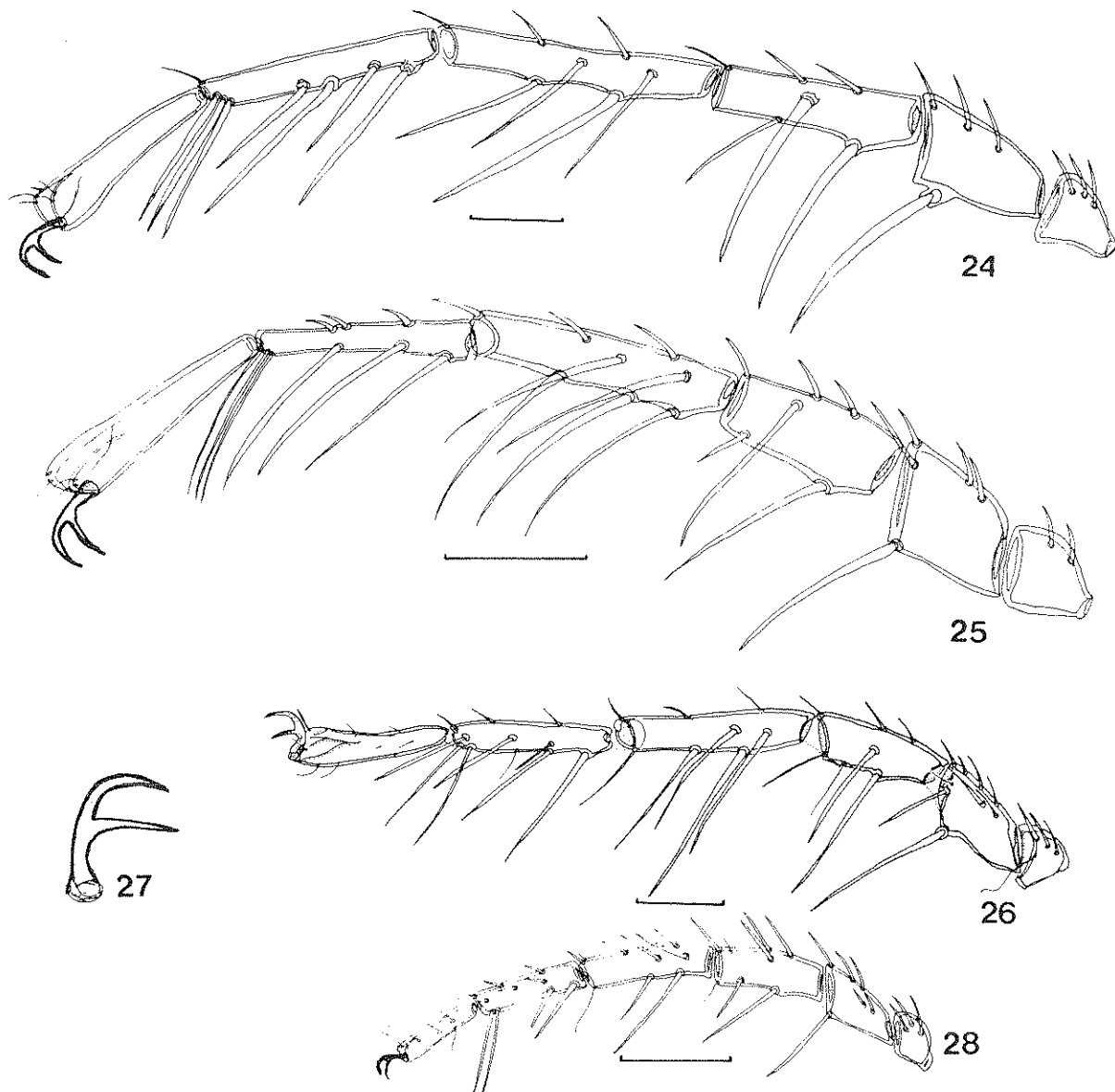
REMARKS — This species is distinct from other species and has extensive secondary sclerotization. The structure of the first walking legs, pedipalps, dorsum and venter are combined to form a diagnosis. It resembles several species in the subgenus *Polyatax* Viets (Vidrine 1985b and c).

### 4. *Unionicola (Anodontinatax) belli* new species

DIAGNOSIS — Character states of the subgenus; dorsum covered by a large dorsal plate; posterior coxal groups fused along midline and lacking well-defined posterior borders; body somewhat dorsoventrally flattened; female anterior acetabular plates with 2, short, stout setae on inner flap; pedipalp Ta with 2 clawlets that are widely separated; first walking leg Ge with 2 pairs of long setae.

FEMALE (12 specimens): Length including capitulum 826 (760-950); length of posterior coxal group 466 (440-520); genital field 165 (150-180) long; dorsal lengths of pedipalp segments: Ti 106 (95-112); Ta 57 (50-63); dorsal lengths of leg segments: leg I: TFe 155 (140-170); Ge 211 (190-230); Ti 174 (150-200); Ta 139 (130-150); leg IV: TFe 194 (170-210); Ge 229 (200-250); Ti 282 (240-320); Ta 205 (180-225).

NOTES — Holotype (female) (CNC type number 19111) is from *Arcidens confragosus* (Say) from Bayou Wauksha at Rte. LA 10, St. Landry Parish, Louisiana, 7 July 1984 (M.F. and Macky Vidrine). Additional paratypes measured include females from: *A. confragosus* from backwater of Neches River at Rte. U.S. 96, Jasper County, Texas, 2 June 1978 (M.F. Vidrine); *L. costata* from Strawberry River at Ret. U.S. 167, Evening Shade, Sharp County, Arkansas, 13 August 1985 (Gail, Macky and M.F. Vidrine); *Lasmigona complanata* (Barnes) from Big Darby Creek below Mount Sterling bridge, Pickaway County, Ohio, 27 August 1975 (E.M. Stern); *Arcidens*



Figs. 24-28. *Unionicola smithae* n. sp.: 24. female first walking leg; *U. parasitica* (Uchida and Imamura): 25. female first walking leg; *U. mitchelli* Conroy: 26. female first walking leg; 27. tarsal claw of first walking leg; *U. clarki* n. sp.: 28. female first walking leg.

(*Arkansia*) *wheeleri* (Ortmann and Walker) (OSUM 1971:145) from Kiamichi River ca. 2.0 km southeast of Clayton at Rte. U.S. 271 bridge, Pushmataha County, Oklahoma, 22 August 1971 (D.H. Stansbery); and Little Sioux River, Okoboji, Iowa, 11 August 1924 (MC-FMNH).

REMARKS — *U. belli* females appear to be intermediate in morphology between females of *U. clarki* and *U. mitchelli*. The pedipalp Ta clawlets (fig. 23) and the first walking leg Ge (fig. 26) resemble *U. belli*,

while the dorsum and venter (figs. 1 and 2) resemble *U. belli*. *U. belli* is apparently a parasite of hosts other than *Anodonta* spp.

5. *Unionicola* (*Anodontinatax*) *smithae* new species (Figs. 4-6, 17, 18, 24 and 29)

DIAGNOSIS — Character states of the subgenus; male dorsum with a single, large plate; female dorsum with 3 plates, the anterior plate greatly enlarged

(fig. 5); posterior coxal group with well-defined borders (figs. 4 and 6); male posterior coxal groups fused along midline and with the genital field by secondary sclerotization; female anterior acetabular plates with 2, short, stout setae on an inner flap (fig. 17); pedipalp Ta with 2 clawlets that are not widely separated and are of near equal size (fig. 18); first walking leg Ge with 2 pairs of long setae (fig. 24); male fourth walking leg Ge bearing 10-11, pectinate setae distally, and Ti bearing 15-16, short, pectinate setae in a ventral mass.

MALE (2 specimens): Length including capitulum 675 (650-700); length of posterior coxal group 303 (280-325); genital field 150 long; dorsal lengths of pedipalp segments: Ti 100; Ta 55; dorsal lengths of leg segments: leg I: TFe 185 (180-190); Ge 270; Ti 205 (190-220); Ta 200; leg IV: TFe 228 (225-230); Ge 210; Ti 323 (320-325); Ta 275.

FEMALE (9 specimens): Length including capitulum 1022 (1000-1200); length of posterior coxal group 378 (350-400); genital field 235 (220-250) long; anterior dorsal plate 375 (280-420) long, 608 (560-700) wide; dorsal lengths of pedipalp segments: Ti 145 (135-150); Ta 86 (80-95); dorsal lengths of leg segments: leg I: TFe 239 (220-250); Ge 332 (320-350); Ti 281 (270-290); Ta 224 (210-240); leg IV: TFe 333 (310-350); Ge 422 (410-440); Ti 569 (550-580); Ta 436 (420-450).

NOTES — Holotype (male) (CNC type number 19112) is from *L. costata* (NMC 66172) from Cox Creek at Highway 86, E. Zuber's Corners, Waterloo County, Ontario, Canada, 6 June 1970 (B.T. Kidd). Additional female paratypes are from *L. costata* from: Little South Fork, Cumberland River, Kentucky, 21 October 1978; Ouachita River at Rte. U.S. 270, Montgomery County, Arkansas, 12 August 1978 and 15 August 1985 (D.R. Clark, W. Bell, Gail, Macky, and M.F. Vidrine); and Grand River, Grand Rapids, Michigan, July and August 1895 (R. Wolcott) (MC-FMNH).

REMARKS — This large species can be separated from all the other species in this group by its large size, the female dorsal morphology and the male fourth walking leg morphology. It is apparently only found in *L. costata* and is a sibling species with *U. wolcotti* and *U. intermedia*.

Subgenus *Vietsatax* Uchida and Imamura 1938 (in Imamura 1938).

DIAGNOSIS — Character states of the genus *Unionicola*; female dorsum with 4 small plates (fig. 8); female genital field with 2 pairs of acetabular plates, one pair on either side of the genital opening (fig. 19); female anterior acetabular plates with 2 acetabula each and an inner flap with 2, short, stout setae, posterior plates with 3 acetabula each and an inner, slightly

elongate seta; acetabular plates of male elongated and extending up onto the dorsum, 2 pairs of acetabula visible in ventral view, 3 pairs in dorsal view; first walking leg Ge with 3 pairs of long setae (fig. 25); male fourth walking leg sexually dimorphic with numerous setae on the TFe, Ge and Ti (fig. 30); all tarsal claws of walking legs deeply bifid, with the dorsal prong longer than the ventral prong.

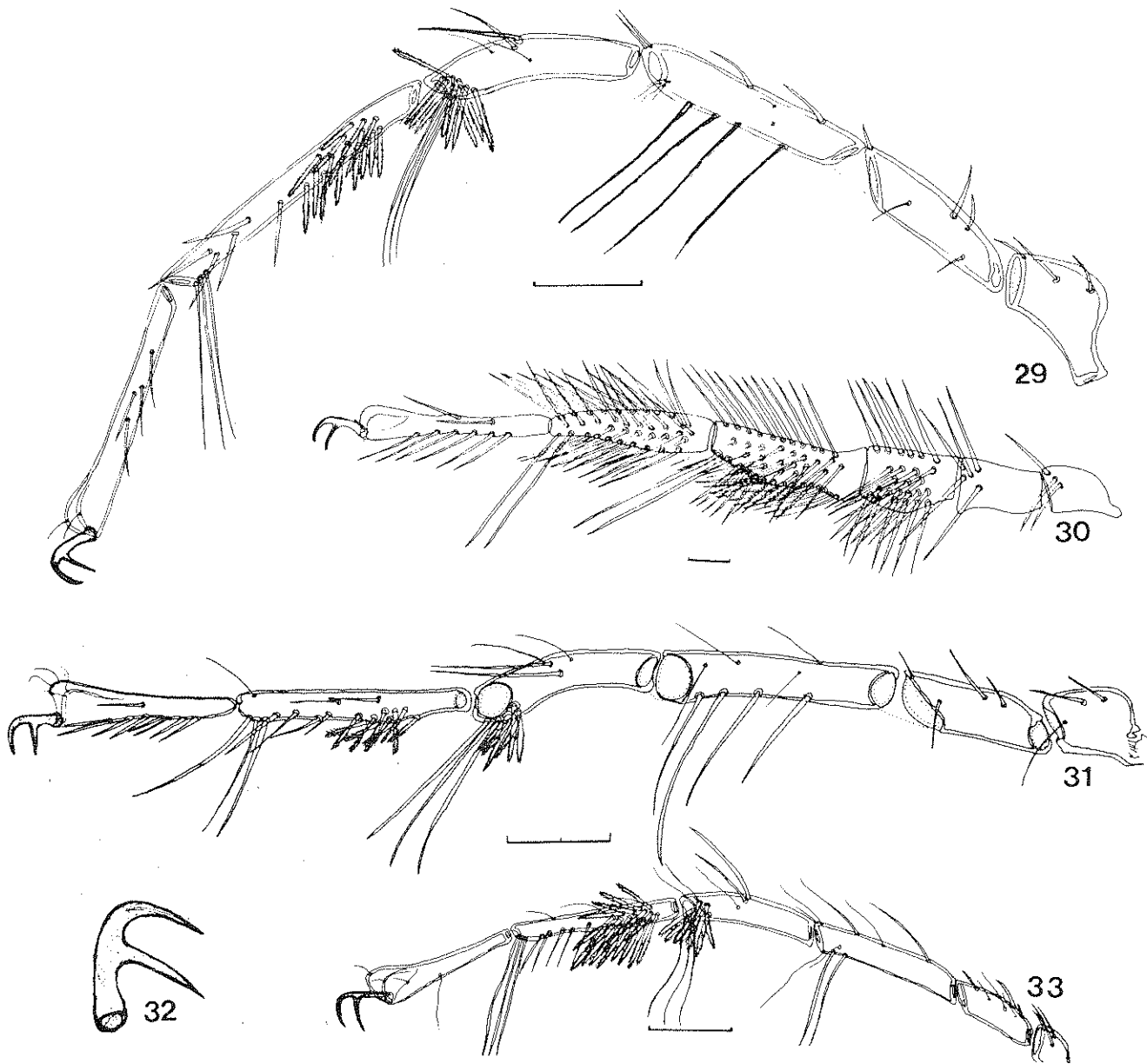
REMARKS — *Vietsatax* was originally described as a full genus (Imamura 1938), and later reduced in rank to a subgenus (Viets 1956). More recently, Cook (1974) considered the male sufficiently divergent and elevated the taxon to a genus. This move has been questioned by Vidrine (1984). The only member of this taxon, *U. (V.) parasitica* (Uchida and Imamura 1938), has been studied in some detail (Uchida and Imamura 1940). It is similar to members of the subgenera *Pentatax* and *Anodontinatax*. The males can be readily distinguished from all other *Unionicola* by the divergent morphology of the genital field. The females, however, are morphologically and behaviorally similar to females of the *Anodontinatax*. The females permanently reside in their hosts and deposit eggs in the mantle and foot epithelia. The males are behaviorally similar to males of the *Anodontinatax* and are only encountered in the mussel hosts during a single season (Uchida and Imamura 1940). The only known hosts for *Vietsatax* are *Anodonta* spp. from Japan. *Vietsatax* is considered to be closely related to *Anodontinatax*, although *Vietsatax* apparently represents a separate phyletic line. Although the male genital field of *Vietsatax* is extremely divergent, the female genital field is almost identical to other members of the genus *Unionicola*. *Vietsatax* is here reduced to the rank of subgenus in *Unionicola*, and the definition of *Unionicola* is modified in order to include the unusual genital field morphology of *Vietsatax*.

6. *Unionicola (Vietsatax) parasitica*  
(Uchida and Imamura 1938)  
(Figs. 7, 8, 19, 20, 25 and 30)

DIAGNOSIS — Character states of the subgenus.

FEMALE (2 specimens): Length including capitulum 950 (900-1000); length of posterior coxal group 305 (280-330); genital field 245 (240-250) long; dorsal lengths of pedipalp segments: Ti 115; Ta 75; dorsal lengths of leg segments: leg I: TFe 183 (180-185); Ge 280 (270-290); Ti 225 (220-230); Ta 183 (175-190); leg IV: TFe 237 (225-250); Ge 350 (340-360); Ti 485 (460-510); Ta 405 (370-440).

NOTES — Types are from *Anodonta beringiana* (Middendorff) from Hokkaido, Japan (Imamura 1938). I found two females in *Anodonta* sp. (ANSP A1101) from Ishikawa, Akan-ko, Kushiro-shicko,



Figs. 29-33. *Unionicola smithae* n. sp.: 29. male fourth walking leg; *U. parasitica* (Uchida and Imamura): 30. male fourth walking leg (redrawn after Uchida and Imamura 1940); *U. mitchelli* Conroy: 31. male fourth walking leg; 32. tarsal claw of fourth walking leg; *U. clarki* n. sp.: 33. male fourth walking leg.

Hokkaido, Japan (G.M. Davis). The females of this species have first walking legs with the Ge bearing 3 pairs of long setae, which separates them from females of the known species in *Anodontinatax*.

#### DISCUSSION

*Pentatax*, *Anodontinatax* and *Vietsatax* share many synapomorphies. All three possess similar

female genital field structures, which is sufficient to group them into the genus *Unionicola*. Each subgenus possesses unique features, especially in the male leg morphology, and thus each represents a separate clade. The genus *Unionicola* is now diagnosed in order to include *Vietsatax*.

The difficulty in obtaining males in the *Anodontinatax* in mussel hosts has caused much taxonomic confusion. In this paper, an effort is made to provide a



basis upon which females can be identified. The dorsum, venter, leg and pedipalp morphology of each species appears unique and sufficient to separate them, except for the females of *U. wolcottii* and *U. intermedia*. However, these two species are considered parapatric. Females of *Vietsatax* apparently have unique chaetotaxy of the first walking leg, and females of *Pentatax* lack the type of bifid tarsal claws of walking legs that is found in *Anodontinatax* and *Vietsatax*.

Studied species in the three subgenera apparently oviposit in the host (mussel) mantle and foot epithelia, and *Anodontinatax* and *Vietsatax* appear host specific to a single group of holarctic mussels (Unionidae: Anodontinae). Unlike many *Unionicola* that permanently reside in their mussel hosts, males of the *Anodontinatax* and *Vietsatax* are free-swimming and only occur in their mussel hosts for a limited period of time.

*Vietsatax* is monobasic and apparently restricted in range to Japan, while *Anodontinatax* occurs in Europe, Asia and North America, a distribution that parallels the distribution of their hosts. The apparent host specificity of these mites indicates that the mites and their mussel hosts represent distinct clades that are separate from their respective related taxa.

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