The Subterranean Asellids (*Caecidotea*) of Illinois (Crustacea: Isopoda: Asellidae)

JULIAN J. LEWIS
and
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ABSTRACT

Lewis, Julian J., and Thomas E. Bowman. The Subterranean Asellids (*Caecidotea*) of Illinois (Crustacea: Isopoda: Asellidae). *Smithsonian Contributions to Zoology*, number 335, 66 pages, 32 figures, 1981.—The state of Illinois is inhabited by 7 species of subterranean asellid isopods of the genus *Caecidotea* Packard. Three of these are previously known species, *C. kendeighi*, *C. packardi*, and *C. stygia*; 4 are described as new, *C. beattyi*, *C. lesliei*, *C. meisterae*, and *C. whitei*. Detailed accounts are given of these species and also of *C. antricola*, which occurs in Missouri counties adjacent to Illinois; *C. tridentata*, erroneously reported from Illinois; and the epigean *C. spatulata*, omitted from Williams' 1970 review of North American epigean species. Each account includes a full synonymy, a review of the species' published history, an illustrated description, and discussions of the habitat and geographic range. Three of the species are characterized as phreatobites, inhabitants of the upper layer of groundwater, and are recorded from drain tiles, ditches, springs, and wells. Four species are troglobites, inhabitants of the more open waters of limestone caves or springs in the Ozark Plateaus and Interior Low Plateaus provinces of western and southern Illinois.

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Contents

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Introduction

A recent survey of the subterranean invertebrates of Illinois (Peck and Lewis, 1978) reported the presence in that state of 6 described and at least 3 undescribed species of the asellid isopod genus *Caecidotea*. The combination of the obvious need for a review of the Illinois species of *Caecidotea* and the availability of the extensive collections of Peck and Lewis and others led us to prepare the present work. We present herein descriptions of 3 known and 4 new species of *Caecidotea* from subterranean waters of Illinois. The epigean *C. spatulata* Mackin and Hubricht, 1940, erroneously considered a subterranean species by these authors, is also included because Williams (1970) omitted it from his review of North American epigean species. In addition we give descriptions of *C. tridentata* Hungerford, 1922, erroneously reported from Illinois (Dexter, 1954; Fleming, 1972a; Peck and Lewis, 1978), and of *C. antricola* Creaser, 1931, which occurs in Missouri counties adjacent to Illinois. The known distribution of subterranean species of *Caecidotea* in Illinois and adjacent states is shown in Figure 1.

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Previous authors have reported 6 species of subterranean asellids from Illinois, but we consider only 3 of these species to have been correctly identified. Correct and incorrect Illinois records are listed below.

INCORRECT RECORDS

Identification	*Identifier*	*Correct Identification*
Asellus alabamensis (Stafford, 1911)	Fleming (1972a)	*Caecidotea whitei*, new species
Asellus stygius (Packard)	Forbes (1876)	*Caecidotea kendeighi* Steeves and Seidenberg, 1971
Caecidotea stygia (Packard)	Packard (1888) in part	*Caecidotea kendeighi*
Asellus tridentatus (Hungerford)	Dexter (1954)	*Caecidotea kendeighi*
Asellus tridentatus	Fleming (1972a) in part	*Caecidotea kendeighi*
Asellus spatulatus (Mackin and Hubricht)	Fleming (1972a)	*Caecidotea kendeighi* (Illinois specimens) *Caecidotea nodulus* (Williams, 1970) (Maryland specimens)

CORRECT RECORDS

Asellus kendeighi	Steeves and Seidenberg (1971)
Caecidotea packardi (Mackin and Hubricht)	Mackin and Hubricht (1940)
Caecidotea stygia	Peck and Lewis (1978)

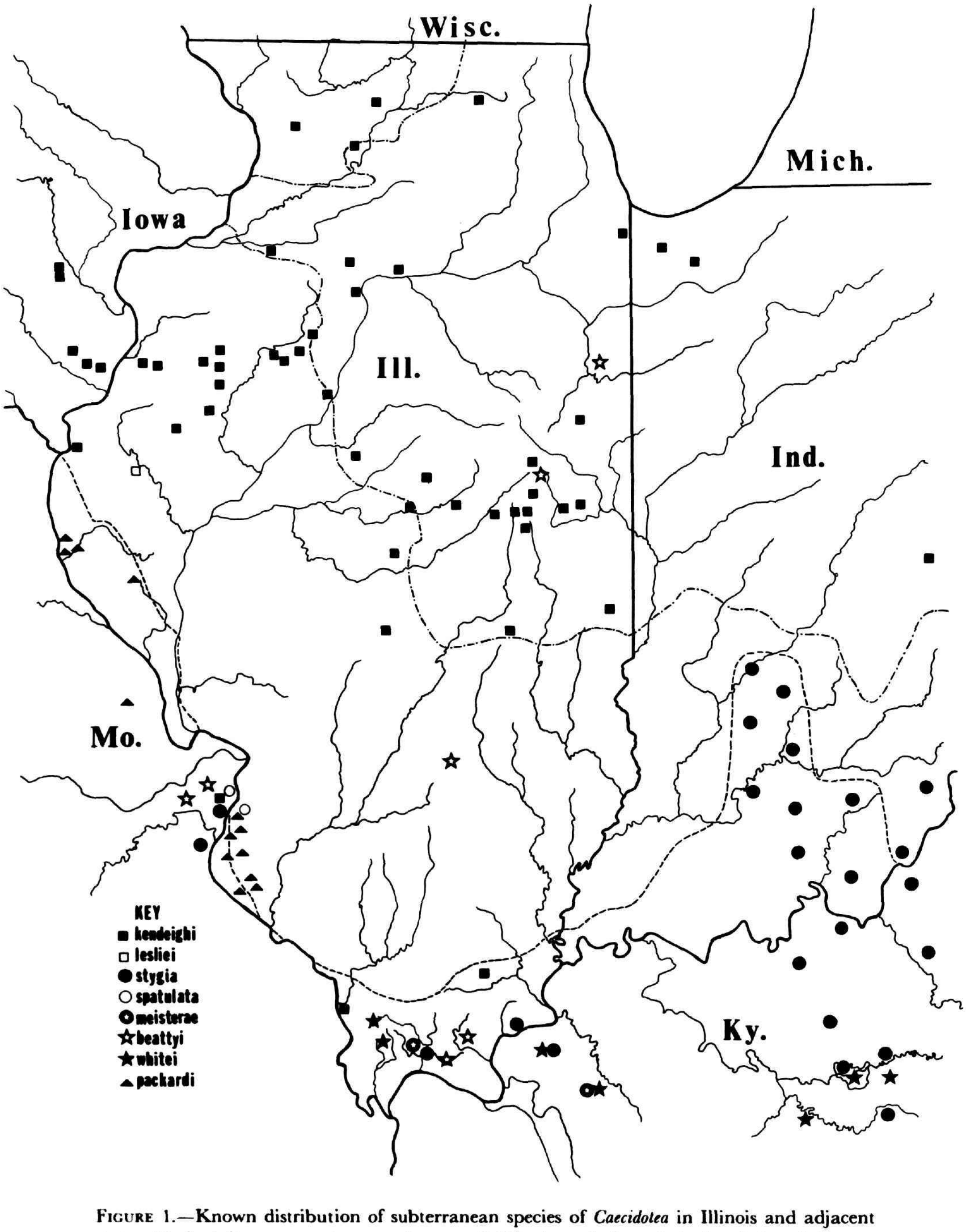

FIGURE 1.—Known distribution of subterranean species of *Caecidotea* in Illinois and adjacent states (dashed line = maximum advance of Illinoian glacier; dashed-and-dotted line = maximum advance of Wisconsinan glacier).

We use the term "subterranean" to characterize asellid isopods with eyes vestigial or lacking and with little or no body pigment. Some authors have classified all such asellids as "troglobitic" (e.g., Steeves, 1963a; Fleming, 1972a), but we prefer to reserve this term for those species that primarily inhabit limestone caves. Species that are primarily taken from subterranean, but non-cave groundwater habitats (e.g., drain tiles) in unconsolidated deposits are more appropriately classified as phreatobites. As discussed in detail by Holsinger (1978), the distinction between troglobites and phreatobites is often not clear, since a given species may be found in a number of different types of habitats. For example, *Caecidotea kendeighi*, primarily recorded from habitats typical of phreatobites (i.e., drain tiles, wells, and ditches), is also known from caves, springs, and mines, habitats more typical of troglobites.

Limestone or dolomite is present (Figure 2) in several parts of Illinois, but caves are found primarily in the areas that escaped glaciation (such as southern and northwestern Illinois) or lay barely within the limits of glaciation (western Illinois). Caves in the southern part of the state lie in an extension of the Interior Low Plateaus physiographic province called the Shawnee Hills, a region of sandstone-capped hills and limestone-floored valleys. Caves found along the western fringe of Illinois lie within the Ozark Plateau Province, and a few small caves also occur in the "Driftless Area" of northwestern Illinois. Additional non-cave groundwater habitats occur in the unconsolidated deposits of the parts of the Coastal Plain and Central Lowlands provinces that are found in Illinois (Figure 3). In these regions drain tiles have been placed underground to drain wet or swampy areas for agricultural use, and subterranean isopods are commonly found at the drain outlets or the ditches into which they empty. If drain tiles were not present, the hypotelminorheic habitat (areas of surface seepage often inhabited by subterranean organisms) discussed by Holsinger (1978) might be commonplace in Illinois.

Further information on the regional geology of Illinois can be obtained from Bretz and Harris (1961); Harris et al. (1977); or references therein.

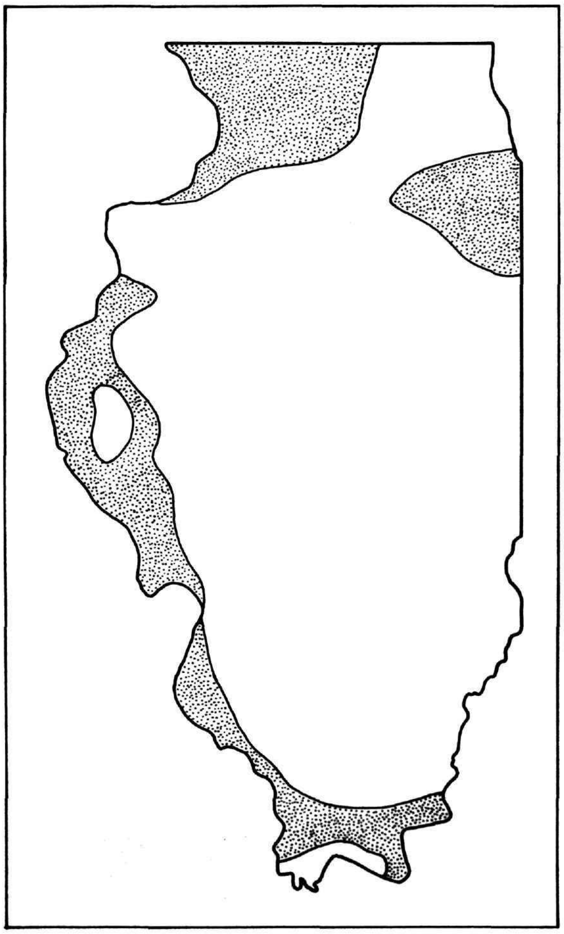

FIGURE 2.—Regions of Illinois (stippled) where limestone or dolomite is most available for cave formation (from Bretz and Harris, 1961).

ACKNOWLEDGMENTS.—Many biologists and cave explorers have assisted in the field work for this project, but we are especially grateful to John White, Kathryn Kerr, and Margaret A. Meister. This study benefited greatly from the loan of specimens from the Illinois Natural History Survey (INHS) arranged by Larry M. Page and the donation of the extensive collections of Leslie Hubricht and Laurence E. Fleming to the National Museum of Natural History from which

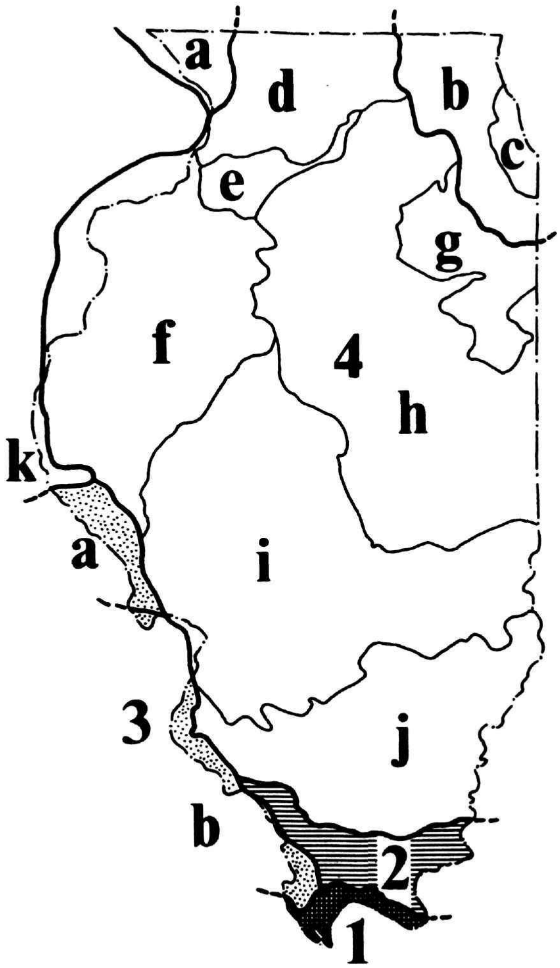

FIGURE 3.—Physiographic divisions of Illinois (from Willman et al., 1975): (1) Coastal Plain Province (crosshatching); (2) Interior Low Plateaus Province, Shawnee Hills Section (lined); (3) Ozark Plateaus Province (stippled, *a* = Lincoln Hills Section, *b* = Salem Plateau Section); (4) Central Lowlands Province (*a* = Wisconsin Driftless Section; Great Lakes Section: *b* = Wheaton Morainal Country, *c* = Chicago Lake Plain; Till Plains Section: *d* = Rock River Hill Country, *e* = Green River Lowland, *f* = Galesburg Plain, *g* = Kankakee Plain, *h* = Bloomington Ridged Plain, *i* = Springfield Plain, *j* = Mount Vernon Hill Country; *k* = Dissected Till Plains Section).

we drew extensively. We also thank Anne C. Cohen for arranging the figures. John R. Holsinger, Stewart B. Peck, and Anne C. Cohen read the manuscript.

The first author wishes to thank the Department of Zoology, Southern Illinois University; the Department of Biological Sciences, Old Dominion University; and the Department of Invertebrate Zoology (Crustacea), Smithsonian Institution, for the use of their facilities.

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This work is the result of approximately equal effort by each of us, and we should be considered coauthors rather than junior and senior authors.

Taxonomic Characters in *Caecidotea*

A typical *Caecidotea*, *C. kendeighi*, with the principal parts labeled, is shown in Figure 4.

For identification of species of *Caecidotea*, reliance has been placed on a limited series of characters in the ♂: the gnathopod, pleopods 1 and 2, and the uropods. In some cases original descriptions are confined mainly to accounts of these characters. We agree that these are the most reliable characters, but they are not the only useful ones and are not free of problems.

GNATHOPOD.—In some species (e.g., *C. stygia*, *C. bicrenata*) the ♂ gnathopod becomes fully differentiated at an unknown number of instars later than pleopods 1 and 2. Hence a ♂ that is judged to be sexually mature from its pleopods may still lack palmar processes on its gnathopods. Some collections, especially small ones, lack older ♂ with fully developed palmar processes. Since descriptions of many subterranean species of *Caecidotea* are based on very limited material, it is possible that some species described as lacking palmar processes may be based on ♂ whose gnathopods are not fully differentiated.

In *C. kendeighi*, the ♂ has all 3 palmar processes (proximal, mesial, and distal). Changes that occur with growth are shown in Figure 5. In the smallest ♂ examined (5.2 mm) the proximal process is represented by an articulated spine, a small mesial process is present, and the distal process is lacking. A 6.0 mm ♂ has added a small distal

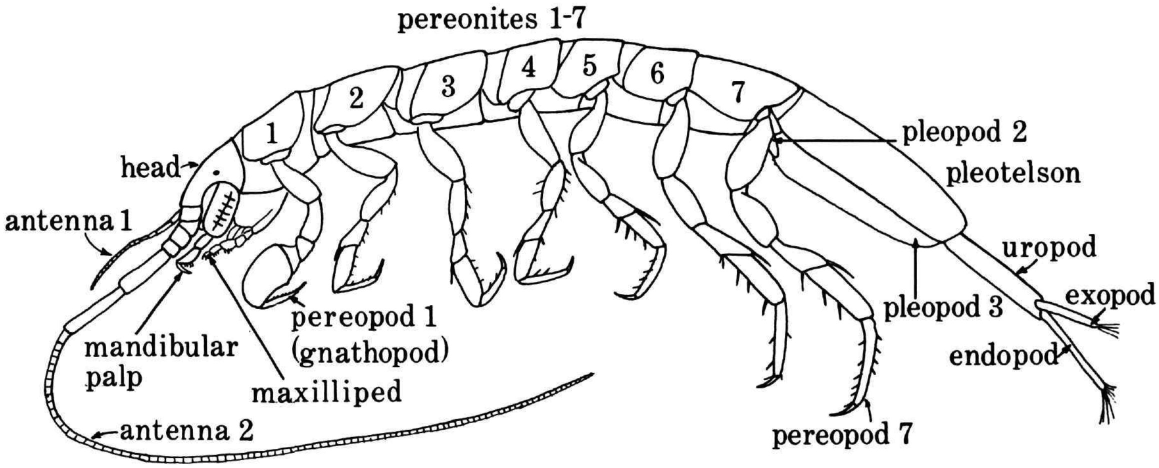

FIGURE 4.—*Caecidotea kendeighi* ♀, lateral view, with major structures labeled.

process. In a 9.7 mm ♂ a proximal process has replaced the proximal spine, and the distal process is bicuspate. In a large adult ♂ (11.5 mm) both mesial and distal processes are bicuspate. Clearly, characterizing a species as having uni- or bicuspate palmar processes should be based on fully mature ♂.

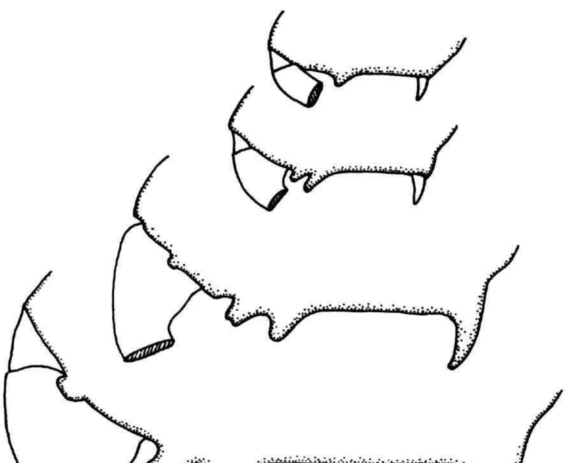

FIGURE 5.—*Caecidotea kendeighi*, McDonough Co., Illinois, development of ♂ gnathopod palm, setae omitted (body lengths, mm, top to bottom = 5.2, 6.0, 9.7, 11.5; *d* = distal process; *m* = mesial process; *p* = proximal process).

PLEOPOD 1.—In the second couplet of his key to North American epigean species of *Asellus* (= *Caecidotea*), Williams (1970) separated species having a long pleopod 1 with long plumose distal setae from those with a shorter pleopod 1 with short nonplumose distal setae. The importance of these 2 structural patterns is also emphasized in his discussion of phylogenetic relationships in North American epigean asellids. These 2 patterns are found in Illinois subterranean species. Long plumose distal setae are present in *C. lesliei*, *C. packardi*, *C. spatulata*, and *C. tridentata*. Short nonplumose setae occur in *C. antricola*, *C. beattyi*, *C. kendeighi*, *C. meisterae*, *C. stygia*, and *C. whitei*; however, pleopods of these species (except *C. kendeighi*) differ from those of epigean species in having on the lateral margin a row of setae, some of them longer than the distal setae. Species with long lateral setae on ♂ pleopod 1 also have basic similarities in ♂ pleopod 2 and fit into Steeves' (1963a, 1966) "*Stygius* group."

PLEOPOD 2.—The tip of the endopod of pleopod 2 is generally considered to be the most reliable taxonomic character in *Caecidotea*. The anterior surface has an open groove or fissure, which is thought to be prolonged into a tubular cannula. Several processes that may be present at the endopod tip are named according to their position relative to the fissure: mesial, lateral, and caudal. It has been generally assumed that processes with the same name in different species are homologous. This is undoubtedly true in many instances, especially in the case of the cannula, but remains unproven in others.

We have refrained from designating as named processes the insignificant bumps on the endopod tips of some species, and we do not call the tip itself a caudal process when its elements are subterminal. Consequently our names for processes do not always agree with those of other workers. Two characteristic tips with the parts labeled are shown in Figure 6.

Pleopod 4.—Little attention has been given thus far to the taxonomic value of this appendage. In the Illinois *Caecidotea* we have found 2 patterns of false sutures or "lines" in the exopods (Figure 7), which we designate A and B. In pattern A, 2 false sutures arise proximally on the medial margin, one running in a semicircular course to an incision on the apical margin, the other running obliquely to a point slightly distal to the midlength on the lateral margin. Species with pattern A are *C. kendeighi*, *C. lesliei*, *C. spatulata*, and *C. tridentata*. In pattern B a single false suture arises proximally on the medial margin and follows a sigmoid course, ending on the distal half of the lateral margin. Species with pattern B are *C. antricola*, *C. beattyi*, *C. meisterae*, *C. packardi*, *C. stygia*, and *C. whitei*.

The false sutures may be faint and difficult to see. Careful adjustment of the illumination or staining may be necessary to make them visible.

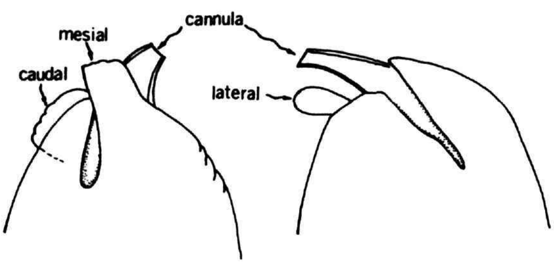

Figure 6.—Endopod tips of ♂ pleopod 2, with processes labeled: left, *Caecidotea lesliei*; right, *C. whitei*.

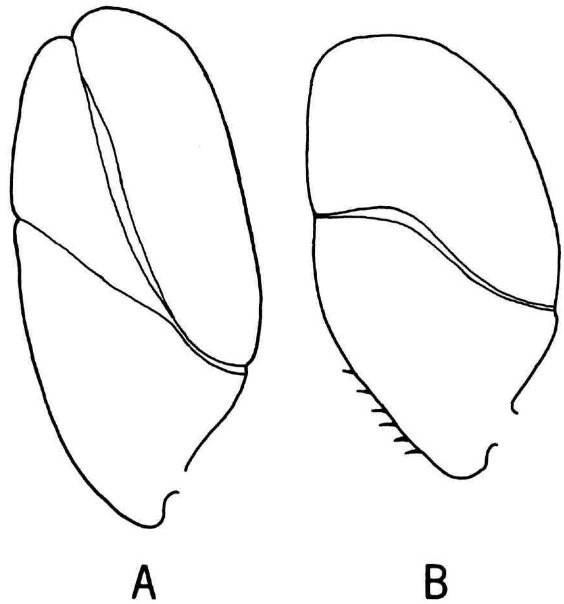

Figure 7.—The 2 types of pleopod 4 exopods in Illinois subterranean species of *Caecidotea*: left, pattern A, with 2 false sutures and apical incision; right, pattern B, with single sigmoid false suture.

In addition to the false sutures, the presence or absence of spines on the proximal part of the lateral margin is a useful taxonomic character. Spines are present in *C. kendeighi*, *C. packardi*, *C. spatulata*, *C. stygia*, and *C. tridentata*.

Pleopod 5.—In contrast to pleopod 4, we have found only a single pattern of false sutures in the exopod of pleopod 5. Two false sutures arise near the midlength of the lateral margin. The more proximal one runs a sinuous course to the proximal part of the medial margin; the other runs transversely across the exopod. Spines are present on the proximal part of the lateral margin in *C. packardi*, *C. spatulata*, and *C. tridentata*; they are absent in other Illinois subterranean species.

Antenna 1.—The pattern of esthetes on the distal flagellar segments of antenna 1 has been given little attention in asellid taxonomy, although the possible taxonomic value of this pattern was pointed out by Creaser (1931). In the Illinois subterranean species of *Caecidotea*, with the exception of *C. beattyi*, *C. meisterae*, and *C. whitei*, the esthete series is interrupted. Each of the distal 3–4 segments bears an esthete; preceding it is a segment lacking an esthete, and preceding the latter segments is a segment with an esthete. To indicate such a pattern we use a formula, e.g., 3-0-1 or 4-0-1. In *C. beattyi*, *C. meisterae*, and *C. whitei* the esthete series is continuous; the distal 3–5 segments each bears an esthete. Males tend to have more segments with esthetes than ♀, and large ♂ may have more than small ♂.

MAXILLA 1.—The presence of 5 terminal setae on the inner lobe of maxilla 1 is constant, with rare exceptions, in the genus *Caecidotea*. We have found a similar constancy in the armature of the outer lobe: all 10 species have 13 apical spines. How widespread and constant this number is in other species of *Caecidotea* remains to be seen. It is difficult to determine accurately the correct number of spines because of the crowding and large amount of overlapping, but we have found it helpful to vary the position of the maxilla 1 on a temporary slide mount so that it can be viewed at various angles.

Keys to Illinois Subterranean Species of *Caecidotea*

We have prepared 2 keys to the species considered herein excluding *C. antricola* and *C. tridentata*, since they do not occur in Illinois. The first key follows the conventional format for a dichotomous key and depends on characters of the differentiated adult ♂. The second, a pictorial key (Figure 8), uses as far as possible characters that may be seen in either sex. Using the pictorial key, one should be able to identify ♂ of all the species and ♀ of *C. lesliei*. For ♀ of the other species, the key should narrow the choice to 2 possibilities.

KEY TO MATURE MALE SUBTERRANEAN *Caecidotea* OF ILLINOIS

1. Cannula tapering to a point, distinct, extending unobscured beyond lateral process (Figures 10*i,j*; 13*q,r*; 19*h,i*, 24*e–g*). Longest setae of pleopod 1 occur along lateral margin (Figures 10*f*, 13*o*, 19*f*, 24*d*). Eyes absent (Figures 9*a*, 13*a*, 18*b*) 2
   Cannula apically flattened, somewhat indistinct, partly hidden by other processes (Figures 15*f–h*; 17*d,e*; 22*h,i*; 23*q–s*). Longest setae of pleopod 1 occur along distal margin (Figures 15*c*, 17*b*, 22*f*, 23*o*). Eyes present or absent 5
2. Pleopod 1 apex obliquely truncate (Figure 24*d*) .... ***C. stygia*** Packard
   Pleopod 1 apex broadly rounded (Figures 10*f*, 13*o*) 3
3. Palm of pereopod 1 with distinct proximal process . ***C. beattyi***, new species
   Palm of pereopod 1 without proximal process 4
4. Palm of pereopod 1 propus straight or slightly concave, distal process conical (Figure 29*c*) .... ***C. whitei***, new species
   Palm of pereopod 1 propus convex, distal process bicuspid (Figure 19*a*) .... ***C. meisterae***, new species
5. Palm of pereopod 1 propus with distinct proximal process (Figure 14*n*). Eyes and pigment usually present (Figure 14*a–d*) .... ***C. kendeighi*** (Steeves and Seidenberg)
   Palm of pereopod 1 propus with proximal spine, proximal process absent (Figures 16*k,l*; 22*a*; 23*k*) 6
6. Pleopod 4 with pattern B (Figure 7B). Uropods linear (Figure 22*n*) .... ***C. packardi*** (Mackin and Hubricht)

Pleopod 4 with pattern A (Figure 7A). Uropods spatulate (Figures 17*k*, 23*y*) 7

7. Eyes present. Pleopod 2 endopod tip with narrow lateral process; mesial process hooked at apex (Figure 23*q,r,s*) .... ***C. spatulata*** (Mackin and Hubricht)

Eyes absent. Pleopod 2 endopod tip without lateral process; mesial process with truncate apex (Figure 17*d,e*) .... ***C. lesliei***, new species

Caecidotea antricola Creaser

FIGURES 9, 10, 12*c*

Caecidotea antricola Creaser, 1931:1–7, pls. 1, 2.—Miller, 1933: 102, 104.—Van Name, 1936:473–476; 1940:133.—Mackin and Hubricht, 1940:390, 394.—Levi, 1949:3.—Nicholas, 1960a:131.—Steeves, 1969:52,53.—Peck and Lewis, 1978:44, 55.

Asellus antricolus.—Hubricht, 1950:16.—Mackin, 1959:875.—Steeves, 1966:392, 394–396, 398–401, figs. 7–13.—Fleming, 1972a:227, 231; 1973:294, 300.—Lewis, 1974:8, 15.—Pflieger, 1974:37.—Craig, 1975:3.—Kenk, 1975:333; 1977:7.—McDaniel and Smith, 1976:58.

Asellus antricola.—Dearolf, 1953:227.—Bresson, 1955:51.

Asellus alabamensis.—Chappuis, 1957:42.

"Blind isopod".—Mohr and Poulson, 1966:68, 150, 151 [photographs].

Conasellus antricolus.—Henry and Magniez, 1970:356.

Acellus atricolus.—Miller, 1974:14.

[Not *Asellus antricolus*.—Fleming, 1972a:245.] [Kentucky, record.]

HISTORY.—The first record of *Caecidotea antricola* was Creaser's (1931) description of specimens from River Cave, Camden Co., Missouri. Although the description is rather long and detailed, the male second pleopod tip was described only as "armed at apex with three teeth," and only a small drawing of the entire second pleopod was given. Although Creaser pointed out that the validity of the genus *Caecidotea* was uncertain, he placed his new isopod in that genus and gave a key to the known species.

In an argument for synonymizing *Caecidotea* with *Asellus*, Miller (1933) included *C. antricola* in a table comparing 45 asellid species and subspecies.

Van Name (1936) repeated Creaser's (1931) description and later (1940) added a new locality for the species in St. Louis Co., Missouri.

Mackin and Hubricht (1940) noted the similarities of *C. antricola* to *C. packardi* and *C. acuticarpa* Mackin and Hubricht (1940). Levi (1949) likewise compared *C. conestogensis* with *C. antricola*.

Hubricht (1950) included *Asellus antricolus* in a checklist of Ozark cave invertebrates and gave as its range "caves east of the Crystal City Escarpment" without adding new specific localities. Dearolf (1953) gave records of *A. antricola* from 7 Missouri caves in his checklist of invertebrates from 75 U.S. caves.

Bresson (1955) included *A. antricola* in a list of 27 known nearctic asellids. Chappuis (1957) recorded it as *Asellus alabamensis* from caves in Crawford and Jefferson counties, Missouri. Mackin (1959) included *A. antricolus* in a list of cave asellids. Nicholas (1960a) compiled a checklist of the troglobites of the U.S., which included *C. antricola*. Nicholas restricted the range of the species to the "Type locality and St. Louis Co., Missouri," apparently unaware of Dearolf's (1953) records.

Mohr and Poulson (1966) included 2 photographs of the species in their book on cave animals.

Steeves (1966) partly redescribed *Asellus antricolus* using specimens from Crevice Cave, Perry Co., Missouri, since the type-specimens had been damaged. Several new records for the species were given for Missouri, along with a single Arkansas locality. In the same paper Steeves proposed a phylogeny of 13 troglobitic asellids, expressing the belief that *A. antricolus* was most closely related to *A. alabamensis*. Steeves (1969) again mentioned *Caecidotea antricola* in a historical review of American asellids.

In a revision of asellid classification Henry and

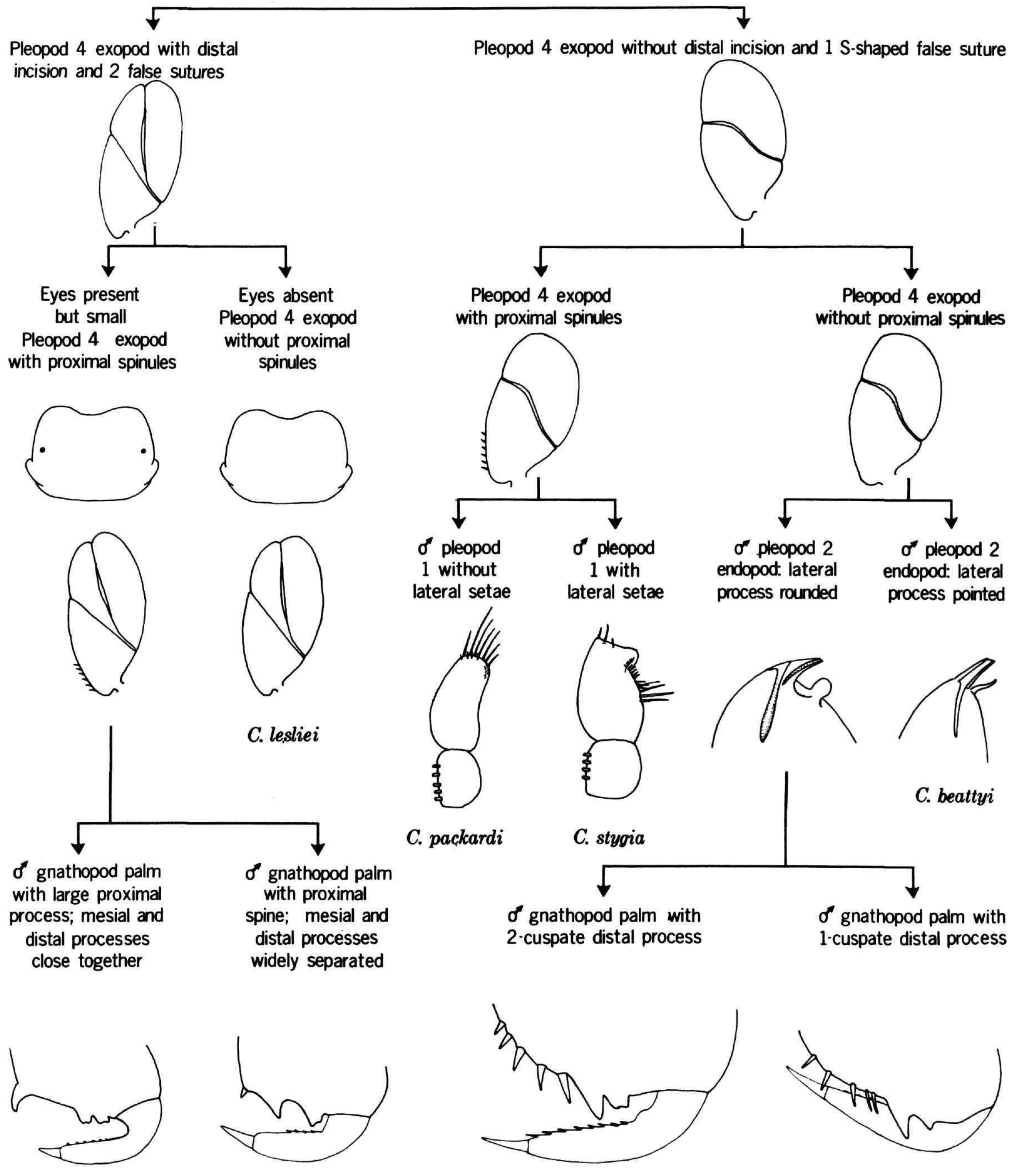

FIGURE 8.—Pictorial key to subterranean *Caecidotea* of Illinois.

Magniez (1970) divided the North American *Asellus* among 3 genera (*Asellus*, *Conasellus*, *Pseudobaicalasellus*) and included *Conasellus antricolus* in a list of 34 species assigned to *Conasellus*.

Fleming (1972a) compared *A. antricolus* to *A. extensolingualus* Fleming (1972) and listed 8 new localities, including an erroneous one in Kentucky. The following year Fleming (1973) included *A. antricolus* in a checklist and key to the species of *Asellus*.

Asellus antricolus appeared in checklists of invertebrates of Mystery Cave (Lewis, 1974), inhabitants of Missouri springs (Pflieger, 1974), and subterranean invertebrates of Missouri (Craig, 1975).

In an aquatic microhabitat study conducted in Tumbling Creek Cave, Taney Co., Missouri, Miller (1974) compiled a list of the aquatic species known from the cave including *Acellus atricolus* [sic].

Kenk noted the occurrence of *Asellus antricolus* with the flatworms *Macrocotyla lewisi* Kenk (1975) and *Sphalloplana evaginata* Kenk (1977) in caves in Perry Co., Missouri.

McDaniel and Smith (1976) reported *A. antricolus* from 5 caves in Arkansas.

MATERIAL EXAMINED.—ARKANSAS. *Benton Co.:* Logan Cave, Civil War Cave, leg. Mark Schram (no date). MISSOURI. *Perry Co.:* Mystery Cave, 5 mi (8 km) SE Perryville, stream pools in North Upper Passage, leg. J. Lewis, 6 May 1972, 1♀ (10.0 mm), 1♂ (13.6 mm); 20 May 1972, 2♂. *LaClede Co.:* Ratcliffe Cave, leg. J. Vineyard, 1 Aug 1974, 1♂, 1♀. *Pulaski Co.:* Folly Cave, 6 mi (9.7 km) S St. Robert, leg. J. Gardner, 2 Mar 1979, 2♂, 1♀. Stockpen Cave, leg. J. Gardner, 28 Nov 1978, 1♀, 2♂. *Crawford Co.:* Jagged Canyon Cave, in small quiet pool with muddy substrate, leg. J. Gardner, 4 Oct 1978, 1♂ (11 mm). *St. Louis Co.:* small cave, Fern Glen, leg. L. Hubricht. *St. Genevieve Co.:* Kohm's Cave, leg. J. Lewis, 12 Apr 1975, 1♀.

DESCRIPTION.—Large, eyeless, unpigmented. Length up to about 15 mm in specimens examined (Steeves (1966) reported length to 20 mm); body slender, linear, about 5.1× as long as wide; coxae visible in dorsal view. Margins of head, pereonites, and telson very setose; dorsum of pereonites with many small spines. Head about 1.6× as wide as long; anterior margin concave; postmandibular lobes moderately produced. Telson about 1.3× as long as wide; sides subparallel; caudomedial lobe slightly produced.

Antenna 1 reaching middle of last segment of antenna 2 peduncle; flagellum with about 10 to 14 segments; esthete formula 3-0-1 or 4-0-1. Antenna 2 reaching anterior margin of pereonite 7, last segment of peduncle about 1.5× length of preceding segment; flagellum with about 90 segments.

Mandibles with 4-cuspate incisors and lacinia; spine row with 17 spines in left mandible, 20 spines in right mandible; distal segment of mandibular palp with elongate plumose setae. Maxilla 1, outer lobe with 13 robust apical spines and 2 plumose setae, 1 subterminal; inner lobe with 5 apical plumose setae. Maxilliped with about 6 retinacula.

Pereopod 1 of ♂, propus about 1.4× as long as wide; palmar margin with small triangular proximal process and large bicuspid distal process; dactyl flexor margin with proximal slightly produced boss and distal row of spines, size varying with age. Pereopod 1 of ♀, propus about 1.7× as long as wide; palm with robust spine proximally, and low, slightly produced, bicuspid distal process. Pereopod 4 of ♂ and ♀ similar, sexual dimorphism moderate, mesial margin of dactyl with about 2 spines.

Pleopod 1 longer than pleopod 2; protopod about 0.6× length exopod, with about 8 retinacula. Exopod about half as wide as long, with about 6 long setae on proximal lateral margin tapering to row of short setae along distal lateral margin, apex with several setae along margin and subterminally. ♂ pleopod 2 exopod, proximal segment with about 5 plumose setae; distal segment oval, with about 18 long plumose setae along margin of distal part. Endopod with broadly rounded basal apophysis; tip ending in 3 processes: (1) lateral process extending almost perpendicular to axis of endopod, slightly S-shaped, tapering distally to rounded point; (2) cannula

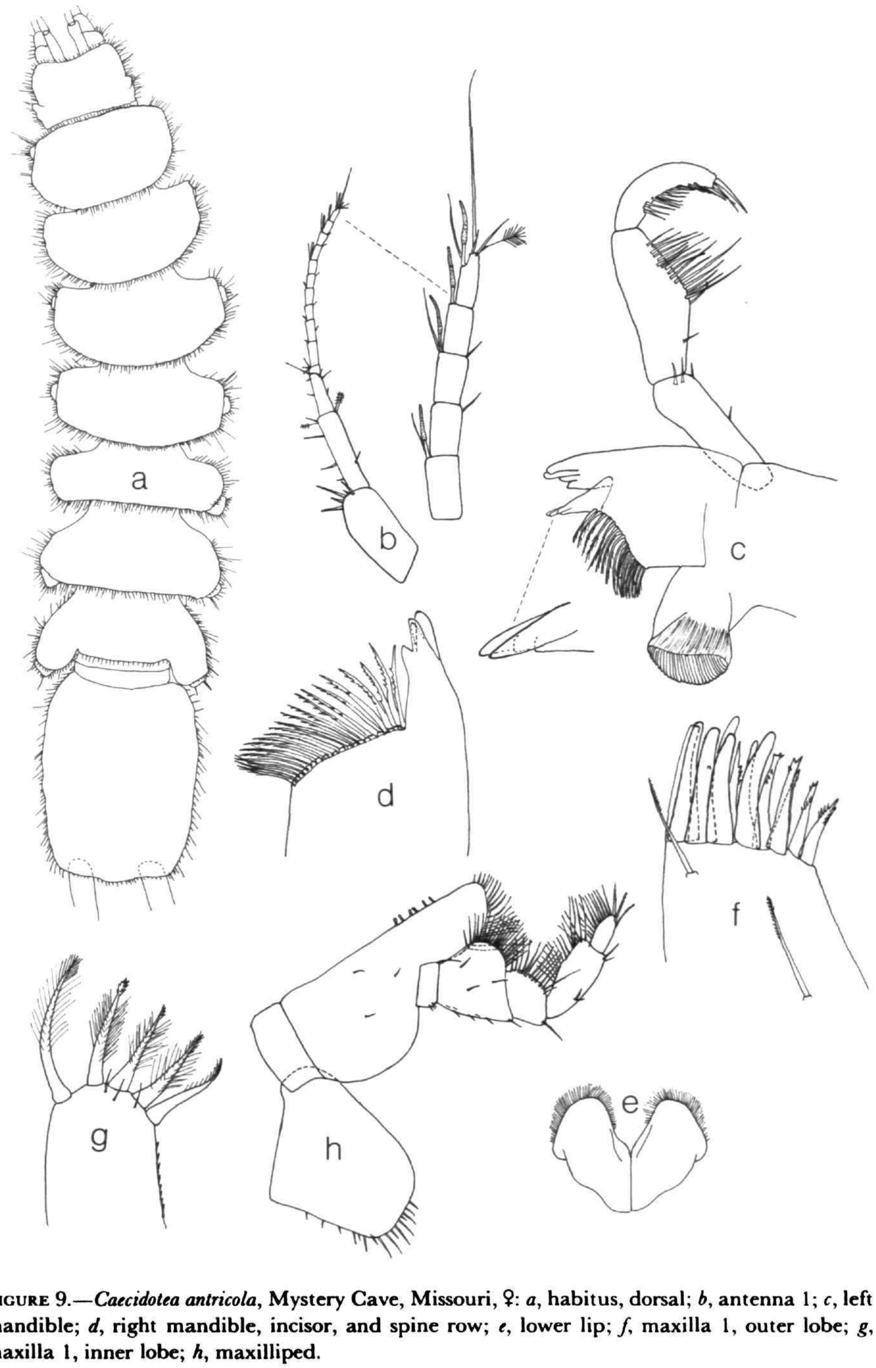

FIGURE 9.—*Caecidotea antricola*, Mystery Cave, Missouri, ♀: *a*, habitus, dorsal; *b*, antenna 1; *c*, left mandible; *d*, right mandible, incisor, and spine row; *e*, lower lip; *f*, maxilla 1, outer lobe; *g*, maxilla 1, inner lobe; *h*, maxilliped.

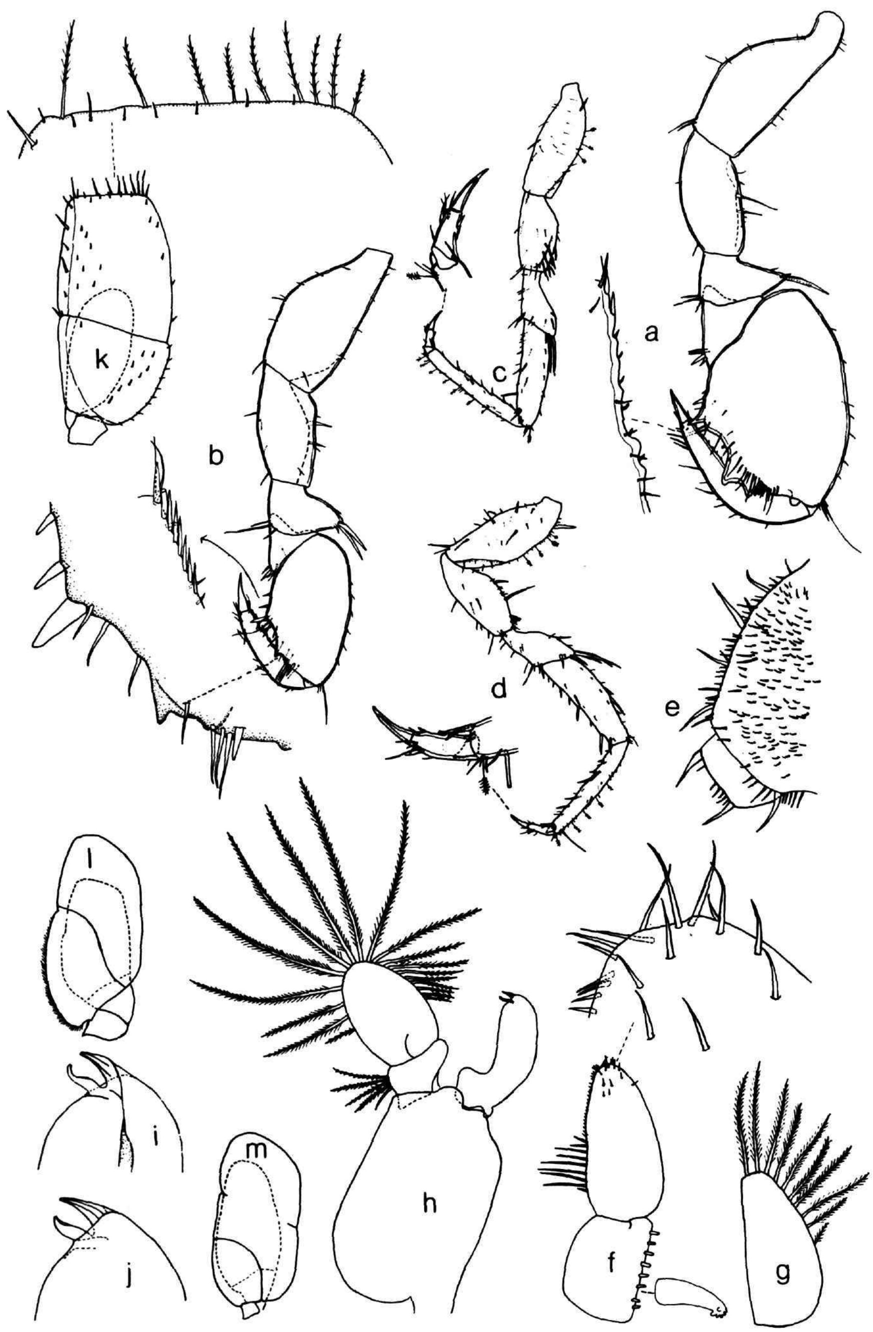

FIGURE 10.—*Caecidotea antricola*, Mystery Cave, Missouri (*a,d,f,h–m* = 13.6 mm ♂; *b,c,e,g* = 10.0 mm ♀): *a,b*, pereopod 1; *c,d*, pereopod 4; *e*, left side of pereonite 7 and coxa, dorsal; *f*, pleopod 1; *g,h*, pleopod 2; *i*, pleopod 2 endopod tip, anterior; *j*, same, posterior; *k*, pleopod 3; *l*, pleopod 4; *m*, pleopod 5.

FIGURE 11.—Collection sites for *Caecidotea* spp.: *a*, entrance passage of Cricket Cave, Union Co., Illinois, type-locality of *C. whitei*; *b*, drain tile outlet 3 mi (4.8 km) N of Mayview, Champaign Co., Illinois, type-locality of *C. kendeighi*; *c*, drain tile outlet in Lawrence, Kansas, a typical collection locality for *C. tridentata*; *d*, entrance to unnamed cave on White Hill, Johnson Co., Illinois, type-locality for *C. meisterae*; *e*, stream passage in Cricket Cave, Union Co., Illinois, habitat of *C. whitei*; *f*, outlet of covered spring in Dixon Springs State Park, Pope Co., Illinois, type-locality of *C. beattyi*; *g*, stream passage in North Upper Passage, Mystery Cave, Perry Co., Missouri, typical habitat of *C. antricola*.

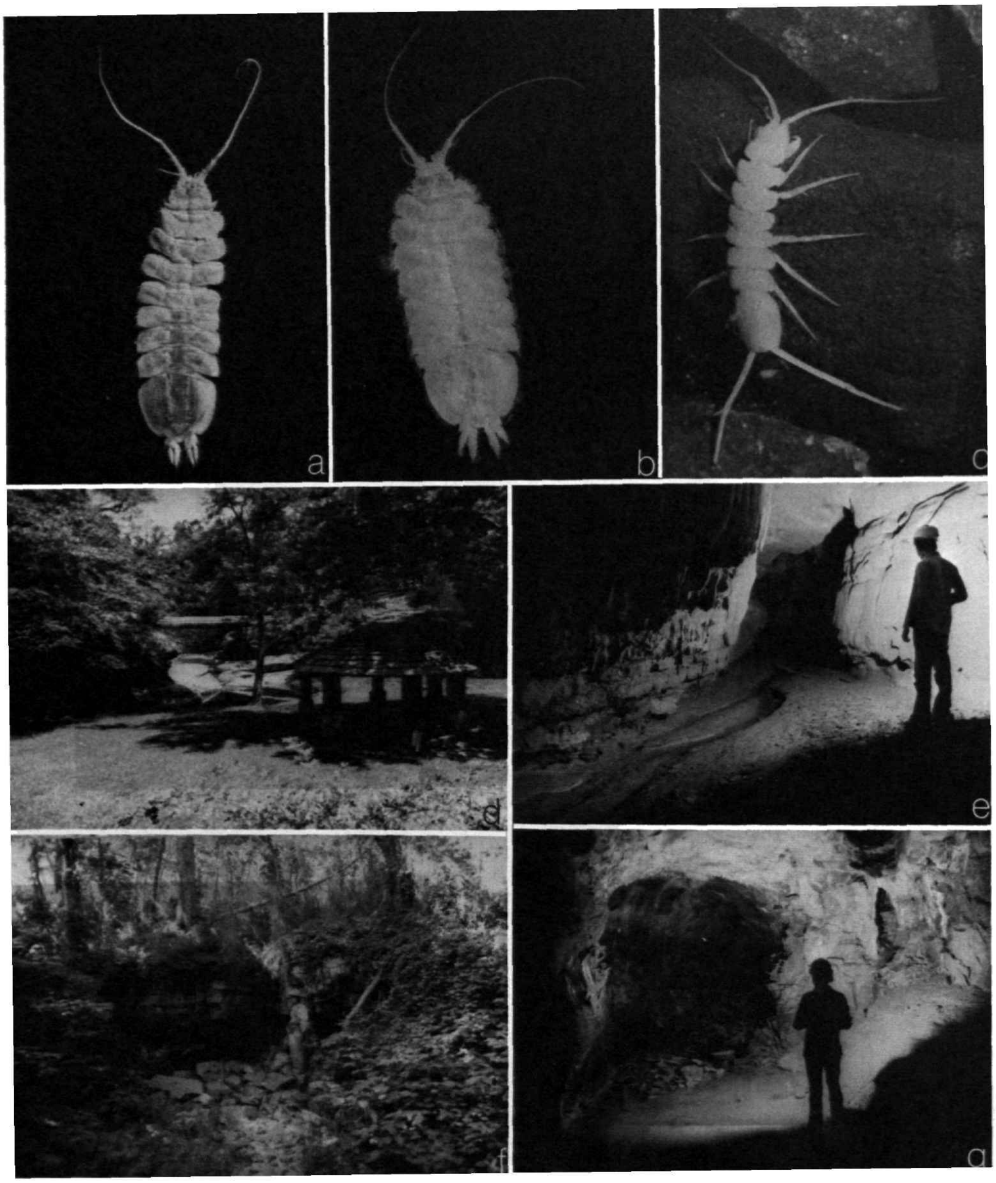

FIGURE 12.—Examples of *Caecidotea* occurring in Illinois and eastern Missouri: *a*, *C. brevicauda* (pereopods removed), a troglophile, from a spring, Jackson Co., Illinois; *b*, *C. brevicauda*, from Illinois Caverns, Monroe Co., Illinois; *c*, *C. antricola*, a troglobite, from Mystery Cave, Perry Co., Missouri. Collection sites for *Caecidotea* spp.: *d*, covered spring in Dixon Springs State Park, Pope Co., Illinois, type-locality of *C. beattyi*; *e*, stream passage in Layoff Cave, Hardin Co., Illinois, habitat of *C. stygia*; *f*, downstream entrance to same; *g*, stream passage in Cricket Cave, Union Co., Illinois, type-locality of *C. whitei*.

distal to and parallel with lateral process, length about equal to lateral process, beakshaped; (3) caudal process broadly rounded, comprising apex of endopod bearing other processes. Pleopod 2 of ♀ with about 10 long plumose setae. Pleopod 3 exopod, proximal segment about 0.7× length of distal segment, apical margin with about 9 plumose setae. Pleopod 4 exopod type B, without proximal spinules on lateral margin. Uropod rather setose, very elongate, at least 0.5× length of body, protopod about 1.3× length of endopod and at least 5× length of exopod.

VARIATION.—The size of this species is highly variable. Specimens from the Perry Co., Missouri, area are the largest and most robust examined, and specimens from Arkansas are much less robust in appearance. In comparison with the Perry County population described herein, the following differences have been noted in Arkansas specimens: (1) ♂ pereopod 1, palmar margin of propus processes less robust; (2) ♂ pleopod 1, proximal segment with 4 to 6 retinacula on mesial margin, lateral margin of some individuals with a seta; distal segment, setae of lateral margin forming a continuously tapering row rather than a sharply demarcated row of long, then short setae as illustrated (Figure 10*f*); (3) ♂ pleopod 2, protopod in some individuals with 1 or 2 setae on mesial margin; exopod with setae present as illustrated (Figure 9*h*) but with some variation in numbers; endopod tip processes generally as illustrated (Figure 10*i,j*), curvature of lateral process slight in some specimens, cannula likewise less robust.

ETYMOLOGY.—The origin of the name was not given by Creaser (1931), but obviously indicates an inhabitant of caves.

RELATIONSHIPS.—Relationships of *C. antricola* are discussed under *C. beattyi*, the species which is closest to it morphologically.

HABITAT.—*Caecidotea antricola* is an inhabitant of cave streams and pools (Figure 11*g*), where it can be found under stones, crawling across gravel or mud-bottom pools, or occasionally in drip pools.

RANGE.—We have examined *C. antricola* from 1 Arkansas and 6 Missouri counties; this species appears to be endemic to the Salem Plateau section of the Ozark Plateau province. This region is underlain by Ordovician sedimentary rocks, largely limestone and dolomite (Vineyard and Feder, 1974). In Missouri alone more than 3500 caves are known, providing ample suitable habitats for the dispersal of *C. antricola.* Fleming (1972a) erroneously reported this species from Kentucky.

REMARKS.—Lewis (1974) published a checklist of the invertebrate fauna of Mystery Cave, including a number of aquatic invertebrates. In the Perry County region included in that paper, *C. antricola* is usually associated with the amphipods *Gammarus troglophilus* Hubricht and Mackin, 1940, *Crangonyx forbesi* (Hubricht and Mackin, 1940) and *Bactrurus brachycaudus* Hubricht and Mackin, 1940, the isopod *Caecidotea brevicauda* (Forbes, 1876), and the turbellarians *Macrocotyla lewisi* Kenk, 1975, *Sphalloplana evaginata* Kenk, 1977, and *Phagocata gracilis* (Haldeman, 1840). Although crayfish have been recorded from caves in which *C. antricola* is known (Peck and Lewis, 1978), the isopod is usually scarce in the habitats occupied by the crayfish. Other animals distributed through the caves and springs of the Ozarks of Missouri and associated with *C. antricola* are listed by Pflieger (1974).

Caecidotea beattyi, new species

FIGURE 13

Caecidotea sp. no. 3 Peck and Lewis, 1978:44.

MATERIAL EXAMINED.—ILLINOIS. *Pope Co.:* Dixon Springs State Park, runoff stream from wellhouse, leg. Julian J. Lewis, 8 Apr 1975 (4.7 mm ovig. ♀ paratype, USNM 171184) and 17 Jul 1976 (3♀, 4.1, 4.5, 6.5 mm; 2♂, 3.2, 10.1 mm). The 10.1 mm ♂ is the holotype (USNM 172789); the other specimens are paratypes (USNM 172790). *Champaign Co.:* Upper Salt Fork, 2 mi (3.2 km) SE Rantoul, 25 Jun 1975, leg. W. Ettinger, 1♂ (INHS). *Fayette Co.:* Farina, Kaskaskia Drive, well, leg. Bob Britton, 12 Sep 1977, 1♂, pereonites with slight pigmentation (INHS). *Iroquois Co.:* tributary of Iroquois River, 3 mi (4.8 km) W Pittwood, 17 Sep 1975, leg. J. A. Boyd and L. M. Page, 3♂, 1♀ (INHS). *Massac Co.:* Main Ditch, 1 mi (1.6 km) NE Mermet, 27 Apr 1976, leg. J. A. Boyd and L. M. Page, 18♂, 35♀ (18 ovig.) (INHS). MISSOURI. *St. Louis Co.:* spring on Kiefer Creek, 0.6 mi (.97 km) NW Fern Glen, 22 Mar 1942, leg. L. Hubricht, 7♂, 25♀ (USNM). Castlewood, seep, 13 Apr 1942, leg. L. Hubricht, 4♂ (USNM).

DESCRIPTION.—A medium-sized species, eyeless, slightly pigmented. Length up to at least 11.5 mm; body slender, linear, about 7.7× as long as wide in holotype, about 4.7× as long as wide in ovigerous ♀. Pereonites 1–3 of ovigerous ♀ slightly expanded in dorsal aspect; coxae visible in dorsal view. Margin of head only slightly setose, margins of pereonites and telson moderately setose. Head about 1.3× as wide as long, anterior margin slightly concave, postmandibular lobes slightly produced. Telson about 1.5× as long as wide, posterior margin convex, caudomedial lobe low and broad, not obviously developed. Dorsal surface of head and pereonites with very fine scattered purple pigment, apparently less noticeable with maturity.

Antenna 1 reaching almost to end of last segment of antenna 2 peduncle; flagellum of about 7–10 segments, esthete formula 3-0-0 or 4-0-0. Antenna 2 reaching from pereonite 7 to middle of telson; last segment of peduncle about 1.4× length of preceding segment; flagellum with up to 54 segments.

Mandibles with 4-cuspate incisors and lacinia mobilis; spine-row of 10 spines (left) or 12 spines (right); palp with 2 large apical spines. Maxilla 1, apex of outer lobe with 13 large spines and 2 setae, 1 subterminal, 1 medial; inner lobe with 5 apical setae, variously plumose. Maxilliped with 6 retinacula on right, 5 on left; outer lobe with about 11 lateral spines.

Male pereopod 1 propus about 1.4× as long as wide; palm concave, with stout articulated triangular proximal process and broad bidentate distal process. Dactyl flexor margin with proximal rounded boss, small mesial process, 4 very weak spines. Female pereopod 1 more slender, propus about 1.7× as long as wide; palm with 1 large proximal spine and 1 robust seta; dactyl flexor margin with smaller boss, mesial process lacking, 4 mesial spine teeth in row. Pereopod 4 more spinose in male than female, carpus more robust in male, 1 mesial spine on dactyl of female, 2 in male.

Male pleopod 1 larger than pleopod 2; protopod about 0.7× length of exopod, with 9 retinacula on both sides; exopod about 0.6× as wide as long, lateral margin distinctly S-shaped, proximal convex part bearing 8 long setae; distal concave part bearing 10 setae decreasing in length distally; distolateral lobe serrulate. Male pleopod 2, proximal segment of exopod with 1 short seta proximally and 5–6 longer plumose setae distally; distal segment of exopod triangular, with 7 medial and distal plumose setae and 10 lateral nonplumose setae, with row of spinules at base of row of nonplumose setae. Endopod slender, curving laterally, ending in conspicuous conical cannula and shorter, more slender sigmoid lateral process, both directed subparallel to axis of endopod, the 2 processes separated by an angle of about 30°. Female pleopod 2 exopod oval, about 2× as long as wide; lateral margin with 12 plumose setae. Male pleopod 3 exopod about 1.8× as long as wide, with 11 distal plumose setae; distal segment about 2.2× length of proximal segment. Pleopod 4 with B pattern, without proximal spines.

Male uropods distinctly spatulate, triangular in cross section; female uropods similar, shorter, and more cylindrical in cross section. Male protopod about 1.1× length of endopod, 4.2× length of exopod; female protopod about 1.1× length of endopod, 1.9× length of exopod.

ETYMOLOGY.—The new species is named for Dr. Joseph A. Beatty, Southern Illinois University, in gratitude for his encouraging JJL's studies of the subterranean fauna of Illinois.

RELATIONSHIPS.—*Caecidotea beattyi* is closest morphologically to *C. antricola* from caves in Missouri and Arkansas, described above. The ♂ pleopod 2 and gnathopod are similar in the 2 species, but the proximal process of the gnathopod palm is larger in *C. beattyi. Caecidotea antricola* lacks the

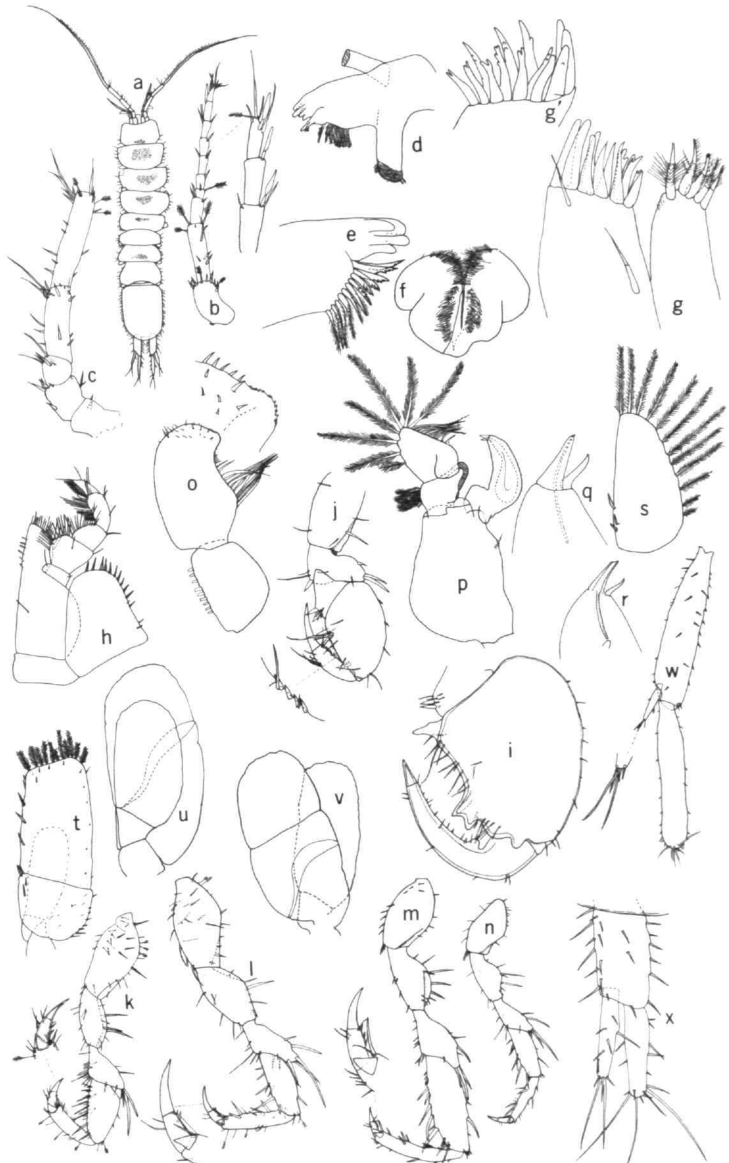

FIGURE 13.—*Caecidotea beattyi* (*a–c,g,j,l,n,s,x* = 4.7 mm ♀; *d–f,h,u,v* = 6.5 mm ♀; *i,k,m,o–q,t,w* = 10.1 mm ♂ holotype; *r* = 3.2 mm ♂): *a*, habitus, dorsal; *b*, antenna 1; *c*, antenna 2, proximal segments; *d*, left mandible; *e*, right mandible, incisor, and spine row; *f*, labium; *g*, maxilla 1 (some spines not shown); *g'*, maxilla 1, outer lobe; *h*, maxilliped; *i,j*, pereopod 1; *k*, pereopod 4; *l*, pereopod 5; *m,n*, pereopod 7; *o*, pleopod 1; *p*, pleopod 2, posterior; *q*, pleopod 2, endopod tip, posterior; *r*, same, anterior; *s*, right pleopod 2 exopod; *t*, pleopod 3; *u*, pleopod 4; *v*, pleopod 5; *w,x*, uropod.

concave lateral margin and serrulate distolateral lobe of pleopod 1, characteristic of *C. beattyi*. In *C. beattyi* the cannula and lateral process of pleopod 2 are terminal, and no caudal process is present; in *C. antricola* the apex of the endopod forms a caudal process behind the subterminal cannula and lateral process.

Caecidotea beattyi is lightly pigmented, whereas *C. antricola* is unpigmented. This difference is correlated with the different habitats of the 2 species; *C. antricola* is confined to caves, but *C. beattyi* appears to be a phreatobite, sometimes occurring above ground.

HABITAT.—The type-locality is a small runoff stream issuing from what is apparently a well or spring, covered by a gazebo (Figures 11*f*, 12*d*). A permanent metal cover conceals the source of the water. The runoff from the pipe extending out of the gazebo flows a few feet into a small stream that flows along a sandstone bluff through picnic grounds in the state park.

The well, ditch, and stream collections suggest that *C. beattyi* is a phreatobite inhabiting shallow groundwater, from which it is occasionally discharged. At the Massac Co. locality several drain tiles empty into Main Ditch at the site where *C. beattyi* was taken.

RANGE.—*Caecidotea beattyi* is generally distributed through the basin of the Wabash River, although it is not restricted to this drainage (Figure 1). This species has penetrated far into the glaciated region, the Iroquois Co. population living about 257 km (160 mi) from the closest Illinoian glacial boundary and 145 km (90 mi) from the Wisconsinan boundary. Willman and Frye (1970) discuss the stratigraphy of the unconsolidated deposits (till, outwash, alluvium) present over *C. beattyi*'s range.

Caecidotea beattyi occurs primarily within the Central Lowlands Province, but also has been taken from the Shawnee Hills Section of the Interior Low Plateaus Province and the northern margin of the Coastal Plain Province. According to the physiographic divisions illustrated by Willman et al. (1975, after Leighton et al., 1948), the Massac Co. population apparently falls within the southern part of the Shawnee Hills Section. A more precise analysis using the natural divisions of Schwegman (1973) places this locality within the Bottomlands Section of the Coastal Plain Province.

REMARKS.—Several other noteworthy invertebrates have been taken from the type-locality. The spring stream and main stream are the only Illinois localities of the amphipod *Synurella bifurca* (Hay, 1882) and another, undescribed, amphipod, *Stygobromus* sp. Two other common species, the isopod *Caecidotea intermedia* (Forbes, 1876) and the flatworm *Phagocata gracilis* (Haldeman, 1840; see Kenk, 1970) also occur in the spring stream.

An ovigerous female paratype carried about 17 young, approximately 1 mm in length, in her brood pouch, apparently near ready for release.

Caecidotea kendeighi (Steeves and Seidenberg)

FIGURES 4, 5, 14, 15

Asellus stygius.—Forbes, 1876:11–13, 22, figs. 19, 20.—Underwood, 1886:359.—Hay, 1891:150 [partim].—Bresson, 1955:51.—Poulson, 1964:753.

Cecidotea stygia.—Packard, 1885a:85.

Caecidotea stygia.—Packard, 1888:32, 33; 1894:729, 730.—Richardson, 1905:433–435.—Banta, 1910a:247.—Pratt, 1916:377.—Creaser, 1931:5.—Van Name, 1936:466–468.—Nicholas, 1960a:132.

Caecidotea (Asellus) stygia.—Garman, 1892:240.

Asellus tridentatus.—Dexter, 1954:256.—Fleming, 1972a:254; 1973:301, 302.—Page, 1974:91.

Asellus (Proasellus) stygius.—Bresson, 1955:51.

Asellus (cave) sp.—Seidenberg, 1969:1, 34, 35, 52–139.

Asellus sp.—Seidenberg, 1970:1, 2.

Asellus spatulatus.—Fleming, 1972a:244 [Illinois specimens].

Asellus kendeighi Steeves and Seidenberg, 1971:231–234.—Page, 1974:90.

Caecidotea kendeighi.—Lewis and Bowman, 1977:973.—Peck and Lewis, 1978:45, 54.

HISTORY.—The first reference to *Caecidotea kendeighi* was Forbe's (1876) report that *Asellus stygius*

> is found quite frequently in deep wells of central Illinois, in company with, but much more abundant than, *Crangonyx mucronatus*.
>
> After a long period of heavy rains during the last summer had greatly swelled the subterranean streams which these species inhabit, they appeared at the surface in springs, and

even at the mouths of tile drains, in such numbers that a hundred could be taken in an hour. A few females were observed with eggs at this time (July).

Forbes (1876) expressed his belief that *Caecidotea* should be synonymized with *Asellus* and to this end prepared a lengthy redescription of *Asellus stygius*, comparing it with *Asellus aquaticus*. The ♂ pereopod 1 was described as follows:

> The propodus of the first pair of feet in the male is very large, broad-oval, two thirds as wide as long. A strong curved spine is situated at the proximal end of the palm, and two truncate, stout teeth separated by a rounded emargination, near the distal end.

Although Forbes did not state the specific source of his specimens, it is apparent from the description of the first pereopod that the animal involved is the central Illinois species *Caecidotea kendeighi*, not *C. stygia*. Forbes' illustrations of the ♂ pleopods 1 and 2 fit *C. kendeighi* rather than *C. stygia*.

Many authors have followed Forbes' (1876) belief that the species present in central Illinois was *Caecidotea stygia* and included Illinois in their description of the range of that species. Their references are listed here, but since they are only indirectly concerned with *C. kendeighi*, discussion is deferred to the section of this paper dealing with *C. stygia*. In some cases it is difficult to ascertain whether *C. kendeighi* or *C. stygia* is being referred to in a paper. The following papers contain accounts or illustrations of *C. stygia* which appear referable to *Caecidotea kendeighi* (in part): Packard (1885a; 1888; 1894), Underwood (1886), Hay (1891), Garman (1892), Richardson (1905), Pratt (1916), Creaser (1931), Van Name (1936), Bresson (1955), Nicholas (1960a), and Poulson (1964). Packard (1888) noted that the specimens of *C. stygia* from Illinois were "the most aberrant."

Dexter (1954) reported the collection of specimens identified by J. G. Mackin as *Asellus tridentatus* (with *Lirceus garmani*) from a drainage stream in Champaign Co., Illinois. The collection was made from the lower surface of a piece of corregated cardboard, which Dexter felt was an unusual habitat for the "cave-dwelling" *A. tridentatus*.

An unpublished dissertation discussing 4 species of asellids in Illinois (Seidenberg, 1969) included the then undescribed *C. kendeighi*, which was termed "*Asellus* (cave) sp." Seidenberg apparently considered the species to be a cavernicole despite the fact that it was unknown from caves. The major part of this paper dealt with 3 other species. An abstract by Seidenberg (1970) summarized the findings of the dissertation. Seidenberg (1970) reported that *Asellus* sp. was a subterranean isopod, taken from a drain tile discharge, and with the following characteristics: (1) late spring and summer breeding period; (2) "typical troglobitic organism exhibiting reduced fecundity, duration of development, growth rate, and greater sensitivity to temperature"; and (3) longer survival time out of water in air with 100% relative humidity than other species tested.

Steeves and Seidenberg (1971) published a short description of *Asellus kendeighi*. Ovigerous females were noted only during June and July, carrying a maximum of 21 eggs.

Fleming (1972a) reported *Asellus tridentatus* from LaSalle Co., Illinois. Fleming (1973), apparently unaware of the description of *C. kendeighi*, followed the records of Dexter (1954) for *A. tridentatus* in a synonomy for the species and noted that *A. tridentatus* has a continuous distribution through the central U.S. Page (1974) included both *A. kendeighi* and Dexter's (1954) *A. tridentatus* record in a checklist of Illinois Malacostraca.

Lewis and Bowman (1977) described *Caecidotea carolinensis* and pointed out the similarity between the male first pleopods of their new species and those of *C. kendeighi*.

Peck and Lewis (1978) listed *Caecidotea kendeighi* in a checklist of Illinois subterranean invertebrates and suggested that the species was probably common in the Illinois Basin. Fleming's (1972a) LaSalle Co., Illinois, record was repeated, and although no further records were listed, Hubricht's misidentifications (of *C. kendeighi* et al. as *C. tridentata*) were reported as *C. tridentata*, indicating that the species was widespread through the midwestern states.

MATERIAL EXAMINED.—ILLINOIS. *Bureau Co.:* 0.5

mi (0.8 km) E Lone Tree, in ditch by drain tile outlet, leg. Larry M. Page (LMP) and James A. Boyd (JAB), 12 Jul 1974, 3♂, 9♀ (INHS). *Carroll Co.:* Smith Park Cave, 1 mi (1.6 km) W Mt. Carroll, leg. S. Peck, 1 Nov 1965, 4♂,2♀. *Champaign Co.:* 2 mi (3.2 km) NW Rantoul, drain outlet, leg. M. A. Morris, 2 Feb 1975, 8♂, 2♀ (INHS). 3 mi (4.8 km) N Mayview (type-locality), drain outlet, leg. CWR and LMP, 9 Jun 1974, 1♀ (INHS); same locality, leg. J. J. Lewis (JJL), 21 Jul 1976, 17♂, 7♀ (USNM). 1 mi (1.6 km) SW Thomasboro, Saline Branch, leg. M. Wetzel, 1 Apr 1974, 1♂ (INHS). Champaign, drain tile, leg. AJS, no date, 9♂, 1♀ (USNM 278862). Champaign, ditches, leg. HHR and Burks, 21 Mar 1939, 2♀ (INHS); 107 E. Bell Fountain Ave., open well, leg. L. A. Dailey, 5 Jun 1939, 1♂, 1♀ (INHS). 1 mi (1.6 km) E Bondville, tile outlet, Kaskaskia River, leg. LMP, 24 May 1974, 8♂, 2♀ (INHS). 1 mi (1.6 km) S Urbana, end of drain tile, leg. HHR, 13 Feb 1932, 2♂ (INHS). Seymour, leg. T. H. Frison and HHR, 27 May 1929, 5♂, 1♀ (INHS). Sherrard, leg. Dan Zwicker, 12 Feb 1938, 3♂, 2♀ (INHS). Urbana, N Crystal Lake in sinkhole, leg. HHR, 13 Feb 1932, 1♂ (INHS). Savoy, leg. C. O. Mohr, 6 May 1936, 29♂, 5♀ (INHS). Seymour, leg. T. H. Frisson and HHR, 22 Mar 1930, 10♂, 7♀ (INHS). Urbana, leg. HHR, 16 Feb 1932, 1♀ (INHS); Urbana, R. R. Parks, Jun 1939, 1♂, 2♀ (INHS). Savoy, drainage ditch, leg. H. J. Van-Cleave, 9 May 1942, 5 (USNM 108592). *Christian Co.:* Spring Creek, 4 mi (6.4 km) E Taylorville, leg. LMP and JAB, 6 Aug 1975, 1♀ (INHS). *Coles Co.:* Greasy Creek, muddy stream, 2 mi (3.2 km) W Bushton, leg. LMP and CWR, 23 Mar 1975, 2♂, 2♀ (INHS). *Cook Co.:* 2 mi (3.2 km) S Lansing, outlet of drain, leg. Leslie Hubricht (LH), 21 Apr 1942, 73 (USNM 108609). *Dewitt Co.:* 1 mi (1.6 km) N Weldon, Friend Creek ditch, tile outlet, leg. LMP, 24 May 1974, 1♂, 1♀ (INHS). Weldon Spring State Park, covered spring, in milk carton, leg S. Peck, 16 May 1966, 1♂, 1♀. *Edgar Co.:* Catfish Creek, 0.5 mi (0.8 km) S Mays, Leg. LMP, 16 Oct 1974, 2♂, 6♀ (INHS). *Fulton Co.:* 1.4 mi (2.3 km) S Avon, outlet of drain, leg. LH, 4 May 1941, 47 (USNM 108583). *Hancock Co.:* Wildcat Cave stream, 1 mi (1.6 km) N Hamilton, leg. LH, 25 Apr 1942, 11 (USNM 108596). Wildcat Springs, spring and cave above creek, 0.5 mi (0.8 km) N Hamilton, leg. LMP and R. Evers, 14 May 1975, 3♂, 3♀ (INHS). *Henderson Co.:* 3 mi (4.8 km) E Biggsville, outlet of drain, leg. LH, 25 Apr 1942, 20 (USNM 108595). 1.7 mi (2.7 km) W Biggsville, outlet of drain, leg. LH, 25 Apr 1942, 17 (USNM 108598). *Henry Co.:* Atkinson, in well, leg. H. D. Allison, Apr 1942, 1♂ (INHS). *Iroquois Co.:* Coon Creek (Iroquois Drive), 2 mi (3.2 km) S Darrow, leg. LMP and L. Cordes, 10 Sep 1977, 2♂ (INHS). Prairie Creek, 0.5 mi (0.8 km) N L'Erable, leg. JAB and LMP, 17 Sep 1975, 2♂, 1♀ (INHS). Pigeon Creek, Cissna Park, leg. B. M. Burr and JAB, 13 Nov 1975, 2♂, 1♀ (INHS). *Kane Co.:* Coon Creek, 1.5 mi WSW Hampshire, field tile, leg. W. Vinikour and R. Anderson, 1 May 1975, 2♀ (INHS). *Kankakee Co.:* Wiley Creek at IL Highway 113, 5.1 mi (8.2 km) NW center of Kankakee, leg. J. Clamp, 11 May 1978, 6♂♀ (NCSM C125). *Knox Co.:* 5.1 mi (8.2 km) N St. Augustine, outlet of drain, leg. LH, 4 May 1941, 70 (USNM 108580). 2.0 mi (3.2 km) N Abingdon, outlet of drain, leg. LH, 4 May 1941, 2 (USNM 108579). 1.6 mi (2.6 km) SW Galesburg, leg. LH, 4 May 1941, 2 (USNM 108582). *LaSalle Co.:* just N Peru, Gustave Engelhaupt Farm, outlet of drain, leg. LH, 3 May 1941, 250♂♀ (USNM 108852). *Macon Co.:* Long Point Slough, 1.5 mi (2.1 km) N Niantic, leg. LMP and JAB, 26 Aug 1975, 2♀ (INHS). *McClean Co.:* 4 mi (6.4 km) SE Heyworth, tributary Long Point Creek, large drain outlet, 24 May 1974, 15♂, 20♀ (INHS). *McDonough Co.:* 4.8 mi (7.7 km) N Macomb, outlet of drain, leg. LH, 4 May 1941, 930♂♀ (USNM 108851). 5.9 mi (9.5 km) N Macomb, outlet of drain, leg. LH, 4 May 1941, 68 (USNM 108584). *Knox Co.:* drain tile, 1.5 mi N Abingdon, leg. JJL, 24 Jul 1976, 2♂, 1♀. *Ogle Co.:* Pines Park [= White Pines State Park?], leg. Frison and Ross, 9 Dec 1932, 7♂, 7♀ (INHS). *Peoria Co.:* Rocky Glen, leg. Burks and Riegel, 17 Apr 1939, 1♀ (INHS). 1.5 mi (2.4 km) NE Laura, outlet of drain, leg. LH, 4 May 1941, 120 (USNM 108858). 3.1 mi (5.0 km) W Princeville, leg. LH, 4 May 1941, 20

(USNM 108577). *Piatt Co.:* 1 mi (1.6 km) E White Heath, ditch by drain tile mouth, leg. W. V. Brigham, 5 May 1973, 1♂, 2♀ (INHS). *Putnam Co.:* 2 mi (3.2 km) N Putnam, Senachwine Creek, leg. JAB and LMP, 12 Jul 1974, 2♂, 1♀ (INHS). *Saline Co.:* N edge Harrisburg, roadside ditch, leg. LMP and E. L. List, 20 Jan 1974, 1♂ (INHS). *Stark Co.:* 3 mi (4.8 km) SE Wyoming, ditch, leg. LMP and JAB, 12 Jul 1974, 1♂ (INHS). *Stephenson Co.:* 3 mi (4.8 km) E Ridott, Pecatonica River, near spring, leg. LMP and LJS, 5 Sep 1974, 7♂, 9♀ (INHS). *Tazewell Co.:* 3 mi (4.8 km) S Hopedale, roadside ditch on Sugar Creek Drive, leg. LMP, 15 Sep 1977, 2♀ (INHS). *Union Co.:* 2.5 mi (4.0 km) NE Aldridge, seep near McCann School, leg. LH, 14 Apr 1940, 7 (USNM 108586). *Vermillion Co.:* 1.5 mi (2.4 km) N Fithian, tributary Stony Creek, tile outlet, leg. CWR and LMP, 9 Jun 1974, 1♀ (INHS). Oakville, tile outlet on W side of Oak St., leg. J. J. Lewis, 21 Jun 1978, 4♂, 3♀ (USNM). *Warren Co.:* 2.0 mi (3.2 km) SE Cameron, outlet of drain, leg. LH, 25 Apr 1942, 92 (USNM 108597). 5.2 mi (8.4 km) E Biggsville, outlet of drain, leg. LH, 25 Apr 1942, 68 (USNM 108594). *Will Co.:* Joliet, drilled well, leg. J. G. Brown, 9 Oct 1953, 1♂, 3♀ (INHS). *Winnebago Co.:* 3 mi (4.8 km) SE Seward, Mill Creek, leg. LMP and LJS, 5 Sep 1974, 1♀ (INHS). 2.5 mi (4.0 km) SSE Wempletown, tile outlet, leg. LMP and LJS, 4 Sep 1974, 2♀ (INHS). INDIANA. *Henry Co.:* 3.8 mi (6.1 km) N Knightstown, outlet of drain, leg. LH, 17 Apr 1942, 5 (USNM 108610) and 92 (USNM 108611). *Lake Co.:* 3.8 mi (6.1 km) SE Merrellville, outlet of drain, leg. LH, 20 Apr 1942, 64 (USNM 108607). *Porter Co.:* 0.5 mi (0.8 km) E Deep River, outlet of drain, leg. LH, 20 Apr 1942, 70 (USNM 108608). IOWA. *Des Moines Co.:* 3.6 mi (5.8 km) E Middletown, outlet of drain, leg. LH, 25 Apr 1942, 1 (USNM 108593). 0.2 mi (0.3 km) NW Danville, outlet of drain, leg. LH, 24 Apr 1942, 42 (USNM 108601). *Henry Co.:* 1.4 mi (2.3 km) SE New London, outlet of drain, leg. LH, 24 Apr 1942, 54 (USNM 108602). 1.7 mi (2.7 km) S Swedesburg, outlet of drain, leg. LH, 24 Apr 1942, 8 (USNM 108603). *Washington Co.:* 1.0 mi (1.6 km) S Haskins, outlet of drain, leg. LH, 24 Apr 1942, 18 (USNM 108599). 0.5 mi (0.8 km) S Haskins, outlet of drain, leg. LH, 24 Apr 1942, 28 (USNM 108600). MISSOURI. *St. Louis Co.:* Kirkwood, Osage Hills Golf Course, outlet of drain near hole 17, leg. LH, 13 Jun 1937, 31 (USNM 108588).

The following description supplements the brief original description of Steeves and Seidenberg (1971), the illustrations of which do not show some of the setae that are present on the ♂ gnathopod, pleopods 1 and 2, and the uropod. The setae on the distal exopod segment of the ♂ pleopod 2 are much longer than in their figure 3 and are plumose. Furthermore, *A. kendeighi* is not albinistic and blind as stated in the original description.

DESCRIPTION.—A large species with small eyes and light reddish-brown dorsal pigmentation. Length commonly 7–10 mm, largest individual examined 12.2 mm; reported up to 14.9 mm by Steeves and Seidenberg (1971). Body slender, linear, about 6.9× longer than wide; coxae visible in dorsal view. Margins of head, pereonites, and telson moderately setose. Head about 1.7× as wide as long; anterior margin concave; postmandibular lobes somewhat produced, broadly rounded; posterior margin of head slightly concave. Telson about 1.7× as long as wide, sides parallel, caudomedial lobe not pronounced.

Antenna 1 reaching to beginning of distal segment of antenna 2 peduncle; flagellum of about 10–12 segments; esthete formula 4-0-1. Antenna 2 reaching pereonite 7, last segment of peduncle about 1.3× length of preceding segment; flagellum of about 65–70 segments.

Mandibles with 4-cuspate incisors and lacinia mobilis; left mandible spine row with 12, right with 13 spines; palp with 2 apical spines. Maxilla 1, outer lobe with 13 spines, 1 subterminal seta and one medial lower seta; inner lobe with 5 apical setae, varying in plumosity, and 6 very slender subterminal setae. Maxilliped with 5–6 retinacula on right, 6–7 on left.

Male pereopod 1 propus about 1.6× as long as wide. Palm slightly concave with large proximal process, slightly bicuspate under high magnifica-

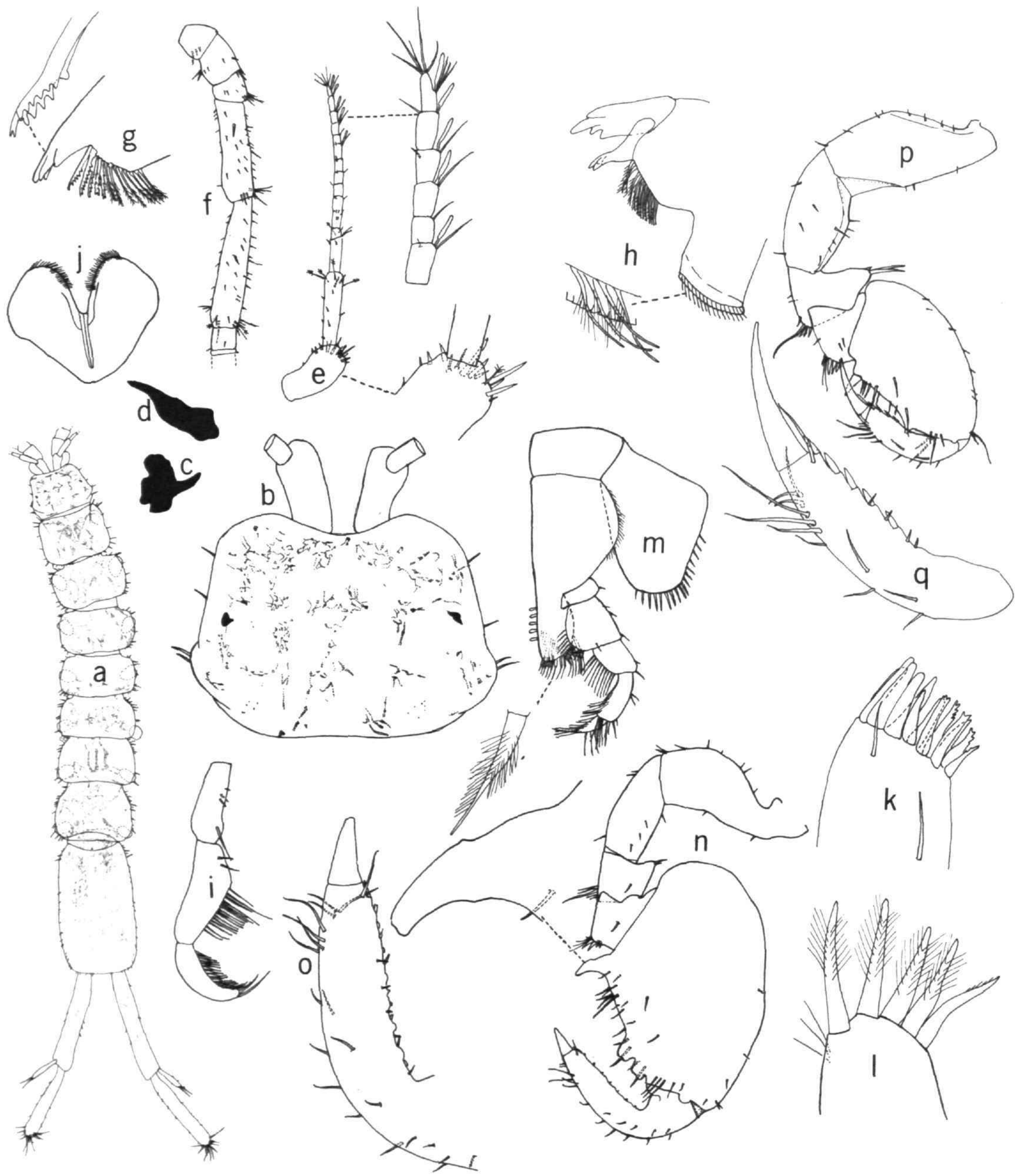

FIGURE 14.—*Caecidotea kendeighi* (*a–d,n,o* = 10.5 mm ♂; *e,f* = 12.2 mm ♂; *g–m,p,q* = 9.2 mm ♀): *a*, habitus, dorsal; *b*, head, dorsal; *c,d*, left and right eyes; *e*, antenna 1; *f*, antenna 2, proximal segments; *g,h*, right and left mandibles; *i*, mandibular palp; *j*, labium; *k,l*, maxilla 1, outer and inner lobes; *m*, maxilliped; *n*, pereopod 1; *o*, pereopod 1, dactyl; *p*, pereopod 1; *q*, pereopod 1, dactyl.

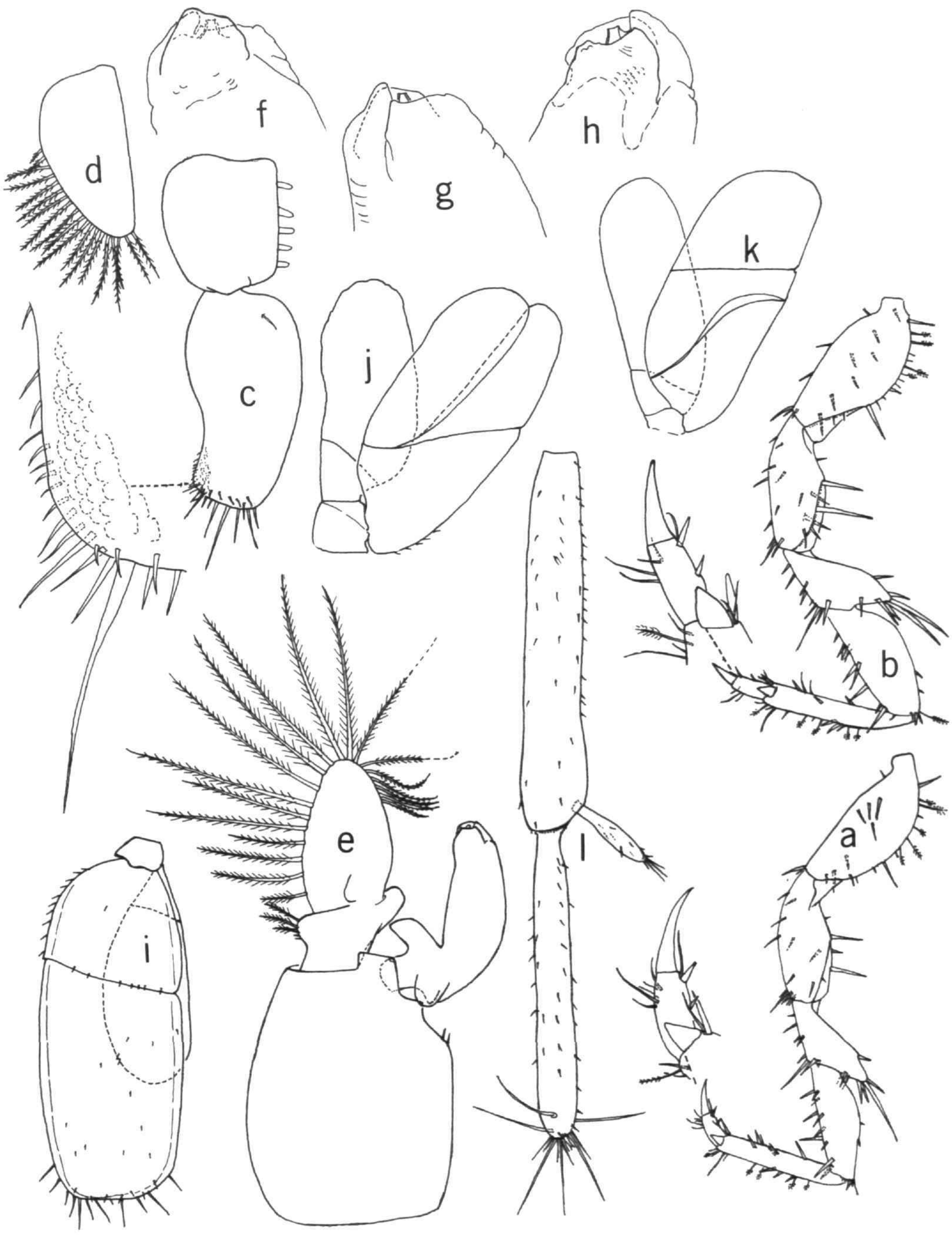

FIGURE 15.—*Caecidotea kendeighi* (*a,d* = 9.2 mm ♀; *b,c,h–k* = 10.5 mm ♂; *e–g,l* = 12.2 mm ♂): *a,b*, pereopod 4; *c*, pleopod 1; *d,e*, pleopod 2; *f*, pleopod 2, endopod tip, posterior; *g,h*, same, anterior; *i*, pleopod 3; *j*, pleopod 4; *k*, pleopod 5; *l*, right uropod.

tion; mesial short, broad, bicuspate process crowding distal lower, broad, slightly bicuspate process. Dactyl flexor margin with rounded boss; dactyl with 8 weak distal medial spines. Female pereopod 1 propus more slender than ♂, about 1.9× as long as wide; palm slightly concave with large proximal spine and small distal triangular process. Dactyl flexor margin with small rounded boss, dactyl with 5–6 distal spines. Pereopod 4 similar in both sexes, moderately setose; dactyl of ♂ and ♀ with 2 medial spines.

Male pleopod 1, protopod about 0.6× length of exopod, with 5–6 retinacula. Exopod about 1.9× length of protopod, lateral margin concave, distally with 6 long setae interspersed with about 13 smaller setae, and distolateral row of minute setae. Male pleopod 2, exopod proximal segment with 3 short plumose setae and 2 minute setae, distal segment oval with about 19 long plumose setae, distal setae generally more elongate than proximal setae; endopod with rather elongate basal apophysis, inner margin of endopod rather straight, tip ending in 4 processes, cannula extending distally, not reaching beyond caudal process, apically blunt; caudal process low, broadly rounded, truncate distally; lateral process fingerlike, extending slightly beyond caudal process; mesial process not extending to apex of cannula, broad, sides parallel, apically slightly concave. Female pleopod 2 with 19 plumose setae laterally. Pleopod 3, protopod about 0.6× length of exopod; exopod with 10 setae distally. Pleopod 4 with pattern A; proximal spines present.

Uropod about 1.6× length of telson; protopod about 1.2× length of endopod, 4.2× length of exopod.

ETYMOLOGY.—Named in honor of Dr. S. Charles Kendeigh.

RELATIONSHIPS.—Steeves and Seidenberg (1971) regarded *Caecidotea kendeighi* as a species unrelated to other asellids; however, this species seems to clearly fit the diagnosis of the *hobbsi* group as defined by Steeves (1966). The addition of *C. kendeighi* to the *hobbsi* group would greatly extend the known range of this group, now limited to Florida, Georgia, and southeastern Tennessee. The presence of eyes, the long proximal process on the ♂ gnathopod palm, and the morphology of the ♂ pleopods 1 and 2 distinguish *C. kendeighi* from other species of the *hobbsi* group.

HABITAT.—The majority of the records of *C. kendeighi* are from the outlets of drain tiles, leading into drainage ditches, used to drain wet fields for agricultural use (Figure 11*b*). Drain tiles provide ideal conditions for the collection of phreatobites.

C. kendeighi has also been taken from a single cave locality, Wildcat Cave in Hancock County, in 1942 and 1975. Its occurrence there on 2 widely separated occasions suggests that this is a permanent population. Specimens from Wildcat Cave do not differ morphologically from those taken from soil habitats.

RANGE.—*Caecidotea kendeighi* is found throughout the Illinois Basin, but exhibits no marked correlation with any stratigraphic unit (Figure 1). This species is associated with numerous tributaries of the Ohio and Mississippi rivers, most notably the Illinois River basin, and it has been suggested previously by Peck and Lewis (1978) that coarse stream sediments may have provided a means of dispersal into the glaciated lowlands the species inhabits. Peck and Lewis noted that *C. kendeighi* is only rarely taken in the coal field region of east-south central Illinois, a generalization which still seems to be true with a few exceptions. This may be a product of a lack of collecting. Competition with *C. beattyi* is also a possible explanation for its rarity there.

The soil habitats from which *C. kendeighi* is normally collected occur in areas of loess with depths from 0 to 300 inches, along with the Pleistocene sediments of the Wedron and Glasford Formations. The Union Co. locality occurs in an area where alluvium is present (Willman and Frye, 1970).

The vast majority of available collections of *C. kendeighi* were taken from the Central Lowlands Province, where the species occurs as far as 320 km (200 mi) northwards from the Illinoian glacial boundary and 240 km (150 mi) from the Wisconsinan boundary. The species seems to be widespread in the area covered by the Wisconsin glacier, despite the limited time available for dispersal into the area. Its presence in Union and Saline counties, south of the Illinoian glacial boundary, suggests the possibility that glacial refugia for the species occurred there, from which northward dispersal occurred after the ice had retreated. Such dispersal from a refugium has been suggested for the amphipod *Bactrurus mucronatus* (Forbes, 1876), which often occurs with *C. kendeighi*, by Peck and Lewis (1978).

Holsinger (1978, 1980) argues that some small species of subterranean crustaceans might have survived in groundwater refugia during glacial conditions. His theory offers an explanation alternative to postglacial migration for the occurrence of *C. kendeighi* in glaciated areas.

Caecidotea lesliei, new species

FIGURES 6, 16, 17

MATERIAL EXAMINED.—ILLINOIS. *McDonough Co.:* outlet of field drain tile, 3.0 mi (4.8 km) S of Colmar, leg. Leslie Hubricht, 4 May 1941, ♂ holotype 10.8 mm (USNM 172788), 3♂, 6♀ (1 ovig.) paratypes (USNM 108578).

DESCRIPTION.—Eyeless, some specimens with faint scattered light brown pigment after 37 years in alcohol. Body linear, pereonites 2–4 slightly expanded in ovigerous female, about 5.6× as long as wide; largest ♂ 10.8 mm (holotype); largest ♀ (nonovigerous) 9.8 mm. Coxae barely visible in dorsal view. Lateral margins of head sparsely setose, of pereonites moderately setose. Head almost twice as wide as long, anterior margin slightly concave. Postmandibular lobes barely evident in ♀, moderately developed in ♂. Telson about 1.6× as long as wide, lateral margins subparallel, caudomedial lobe quite low.

Antenna 1 reaching about midlength of the last peduncle segment of antenna 2, flagellum of 9–10 segments, esthete formula 3-0-1. Antenna 2 reaching to 4th or 5th pereonite, flagellum with about 50 segments.

Mandibles with 4-cuspate incisors and lacinia, spine-row with 9 and 11 spines in left and right mandibles. Middle segment of palp with double row of longer and shorter spines. Maxilla 1, apex of outer lobe with 13 large spines and 3 setae, 2 subterminal; inner lobe with 5 apical plumose setae. Maxilliped with 6 retinacula on right side, 5 on left.

Male pereopod 1 propus about 1/3 longer than wide, palm defined by short articulated spine, with 2 processes, a more proximal pointed triangular mesial process and a slightly shorter truncate distal process; dactyl flexor margin with a few weak spines. Female pereopod 1 with smaller propus; palm more oblique, defined by articulated spine, with rudimentary triangular mesial process but without distal process; dactyl with 5 spines on flexor margin, larger than those of ♂. Pereopod 4 somewhat more robust in ♂ than in ♀, but not markedly so.

Male pleopod 1 protopod about 0.7 length of exopod, with 5 retinacula. Exopod about twice as long as wide, with single basal seta; lateral margins slightly convex in proximal third, nearly straight and subparallel in distal two-thirds; distal margin armed with long setae and at the corners with short setae. Male pleopod 2, exopod proximal segment with 4 setae, distal segment with about 18 lateral and distal setae; endopod with pointed lateral basal apophysis, tip ending in 3 processes: (1) rather broad cannula curved medially, extending beyond other processes; (2) broad mesial process with truncate apex, directed obliquely laterad, overlapping anteriorly base of cannula; (3) broad, well-sclerotized caudal process with a few tubercles on lateral part. Female pleopod 2 with about 14 marginal setae. Pleopod 3 exopod sparsely setose on lateral margin of proximal segment and apical margin of distal segment; endopod with a few pustules on lateral margin. Pleopod 4 exopod pattern A, without proximal spines; endopod with a few pustules on lateral margin. Pleopod 5 exopod without proximal spines on lateral margin; endopod with a few pustules on lateral margin.

Female uropod protopod about 2.6× as long as wide; endopod slightly longer than protopod, exopod slightly shorter than protopod, both rami

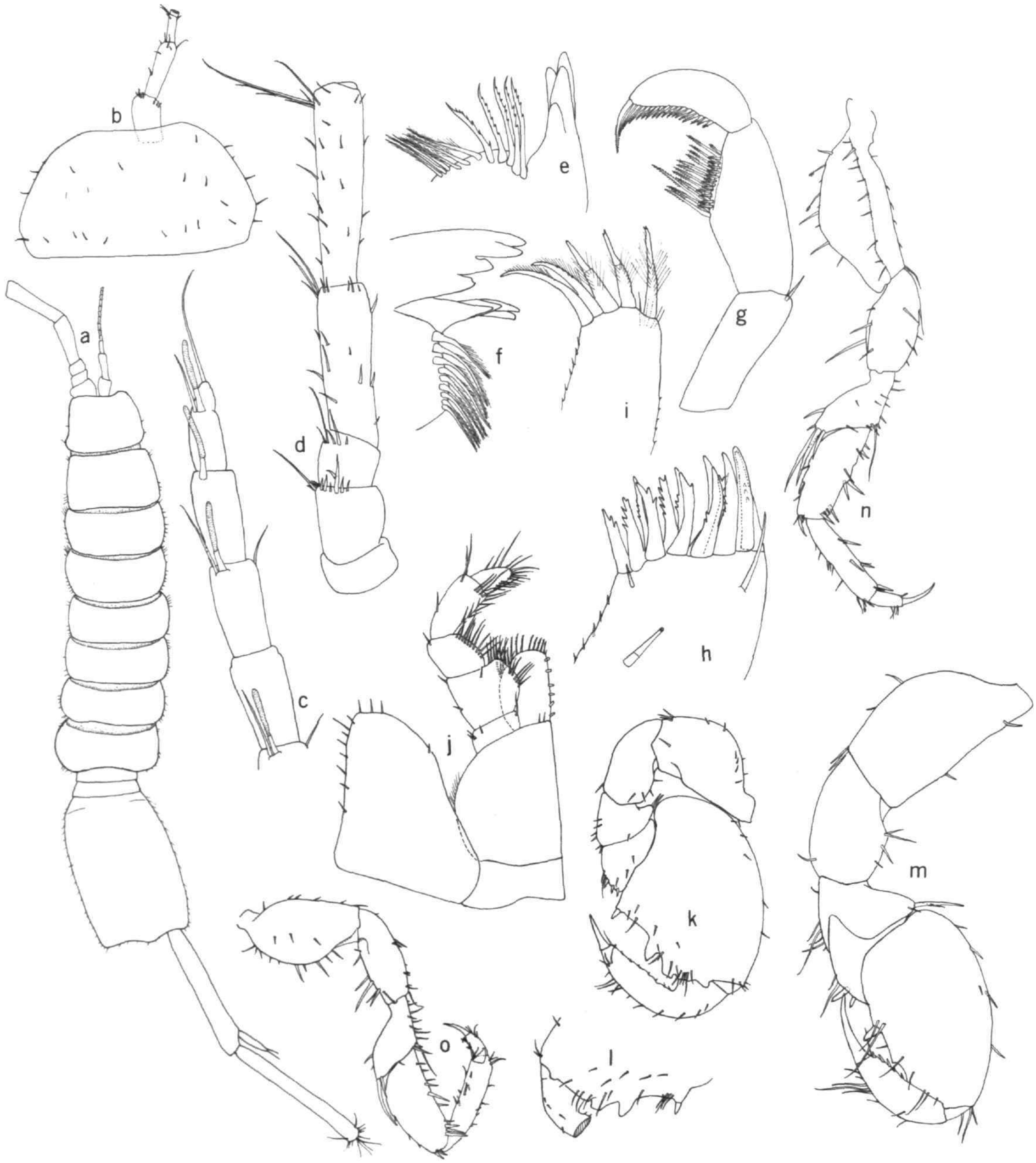

FIGURE 16.—*Caecidotea lesliei* (*a,e–l,o* = ♂; *b–d,m,n* = ♀): *a*, habitus, dorsal; *b*, head, dorsal; *c*, antenna 1, distal segments; *d*, antenna 2, proximal segments; *e,f*, right and left mandible, incisors, and spine rows; *g*, left mandibular palp; *h,i*, maxilla 1, outer and inner lobes; *j*, maxilliped; *k*, pereopod 1, medial; *l*, pereopod 1, lateral; *m*, pereopod 1; *n,o*, pereopod 4.

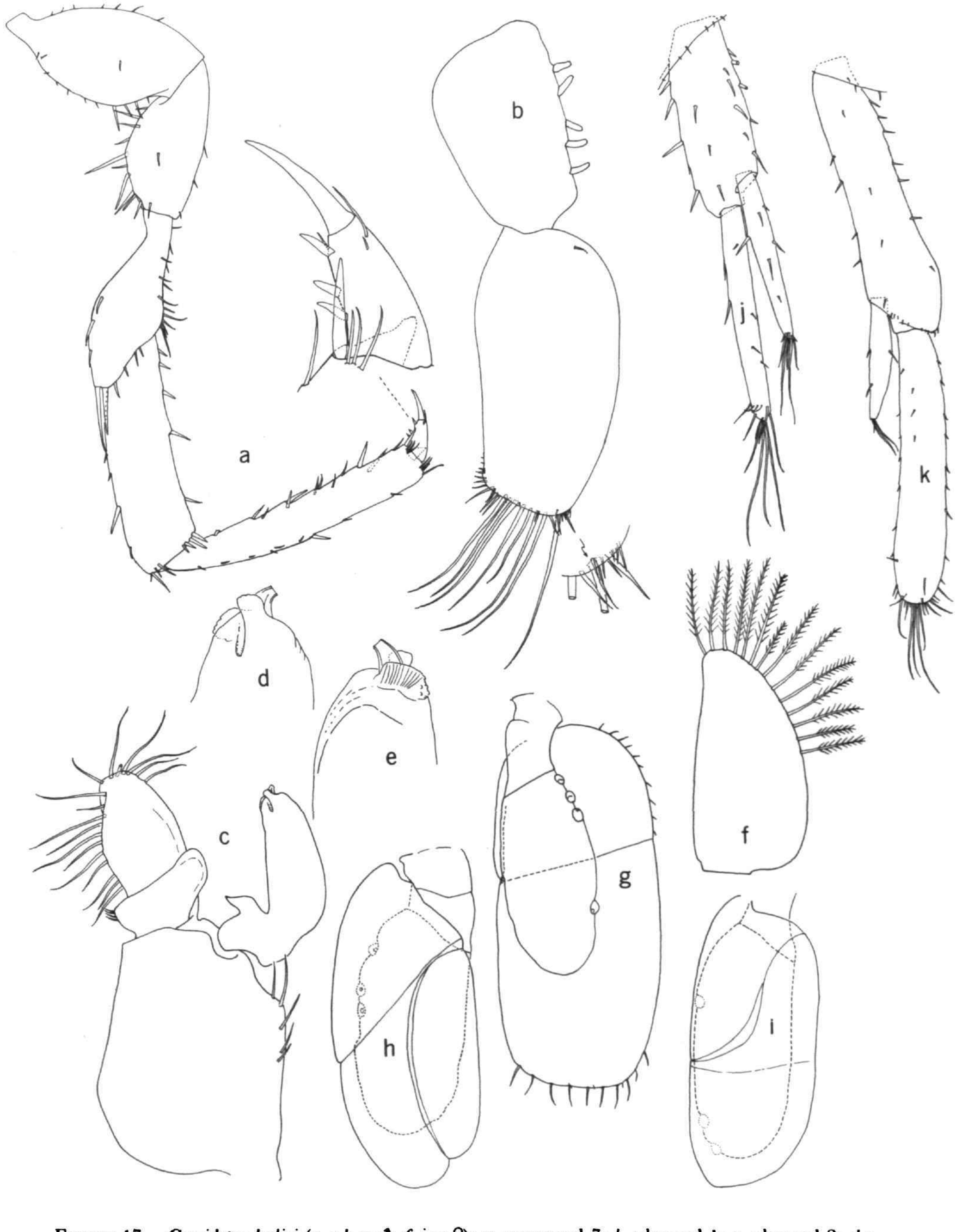

FIGURE 17.—*Caecidotea lesliei* (*a–e,k* = ♂; *f–j* = ♀): *a*, pereopod 7; *b*, pleopod 1; *c*, pleopod 2; *d,e*, pleopod 2, endopod tip, anterior and posterior; *f*, pleopod 2; *g*, pleopod 3; *h*, pleopod 4; *i*, pleopod 5; *j,k*, uropod.

linear, sparsely armed. Male endopod spatulate, subequal to protopod; exopod less than half as long.

ETYMOLOGY.—The new species is named after Leslie Hubricht in recognition of his many contributions to biospeleology.

RELATIONSHIPS.—*Caecidotea lesliei* is most similar to *C. tridentata*, from which it differs in having a proximal articulated spine rather than a proximal process on the palm of the ♂ gnathopod, a nearly straight rather than a distally concave lateral margin on the exopod of the ♂ pleopod 1, a longer cannula, and a truncate rather than hooked mesial process on the ♂ pleopod 2 endopod. *Caecidotea lesliei* also resembles *C. spatulata*, but differs in its lack of eyes and of a lateral process on the ♂ pleopod 2 endopod.

HABITAT.—The occurrence in a drain tile suggests that *C. lesliei* is a phreatobite rather than a troglobite.

DISTRIBUTION.—Known only from the type-locality.

Caecidotea meisterae, new species

FIGURES 18–20

Asellus antricolus.—Fleming, 1972a:245 [Twin Level Cave, Kentucky, record].
Asellus alabamensis.—Fleming, 1972a:247, 248 [part].
Caecidotea sp. no. 2.—Peck and Lewis, 1978:44.

HISTORY.—The only published records of *Caecidotea meisterae* are several records of *Asellus alabamensis* and 1 of *A. antricolus* (Fleming, 1972a) referable to *C. meisterae* and a reference in a checklist of the subterranean invertebrates of Illinois (Peck and Lewis, 1978).

MATERIAL EXAMINED.—ILLINOIS. *Johnson Co.*: unnamed cave at White Hill, leg. Julian J. Lewis and Margaret A. Meister, 1 Nov 1975 (10.6 mm ♂ and 4 ovigerous ♀, 8.3, 8.7, 9.7, 11.0 mm in length). The 10.6 mm ♂ is the holotype (USNM 172791), and the 4♀ are paratypes. KENTUCKY. *Caldwell Co.*: Cave Street Cave, leg. J. Holsinger, 7 Jul 1965, 1♂, 1♀. Lisanbys Cave, 1.9 km (1.2 mi) W Princeton Court House, leg. J. Holsinger, 9 Jul 1965, 3♂, 4♀; leg. J. R. Holsinger, Ginny Tipton, et al., 12 Jun 1978, 1♂, 4♀. *Christian Co.*: Thomas Cave, leg. Richard LaVal, 4 Jul 1964, 1♂. *Crittenden Co.*: Cannon Cave, leg. Barr and Andrews, 8 Jul 1965, 7♂, 6♀. *Hart Co.*: Burd Cave, leg. R. M. Norton, 18 Sep 1965, 2♂, 2♀. *Livingston Co.*: McElroys Cave, leg. J. Holsinger, 8 Jul 1965, 1♂, 2♀. *Logan Co.*: Robertson Cave, leg. J. Holsinger, 13 Aug 1965, 11♂, 7♀. *Todd Co.*: Haddon Cave, leg. Barr and Andrews, 16 Jul 1965, 2♂, 1♀. Sharon Grove Cave, Sharon Grove, leg. T. C. Barr, 30 Jun 1978, 8♂, 11♀. Twin Level Cave, leg. R. M. Norton, 18 Apr 1964. *Trigg Co.*: Taylor Cave, leg. J. Holsinger, T. C. Barr, 12 Aug 1965, 4♂, 17♀.

DESCRIPTION.—A medium-sized rather robust species, eyeless, unpigmented. Length up to at least 11 mm; body linear, pereonites slightly expanded in ovigerous females from dorsal aspect, about 4.3× as long as wide (9.5 mm ♀). Coxae visible in dorsal view. Lateral margins of head and pereonites moderately setose. Head about as long as wide, anterior and posterior margins slightly concave, postmandibular lobes low and rounded. Telson about 1.3× as long as wide, posterior margin slightly convex, caudomedial lobe low and not obviously developed.

Antenna 1 flagellum of about 8 segments, esthete formula 4-0-0. Antenna 2 (broken off in all type-specimens), last segment of peduncle about 1.6× length of preceding segment; flagellum with about 75 segments.

Mandibles with 4-cuspate incisors and 5-cuspate lacinia mobilis, with about 15–16 dentate spines or plumose setae in spine row (Figure 18*d,e*); palp with single large apical spine. Maxilla 1, apex of outer lobe with 13 large spines and 2 setae, 1 subterminal and 1 medial; inner lobe with 5 apical plumose setae. Maxilliped with 6 retinacula on right side, 7 on left; outer lobe with about 17 lateral spines and setae.

Male pereopod 1 propus about 1.4× as long as wide; palm convex, with large mesial process crowding lower bidentate distal process (Figure 20). Dactyl flexor margin with low rounded boss proximally and about 9 spines interspersed with

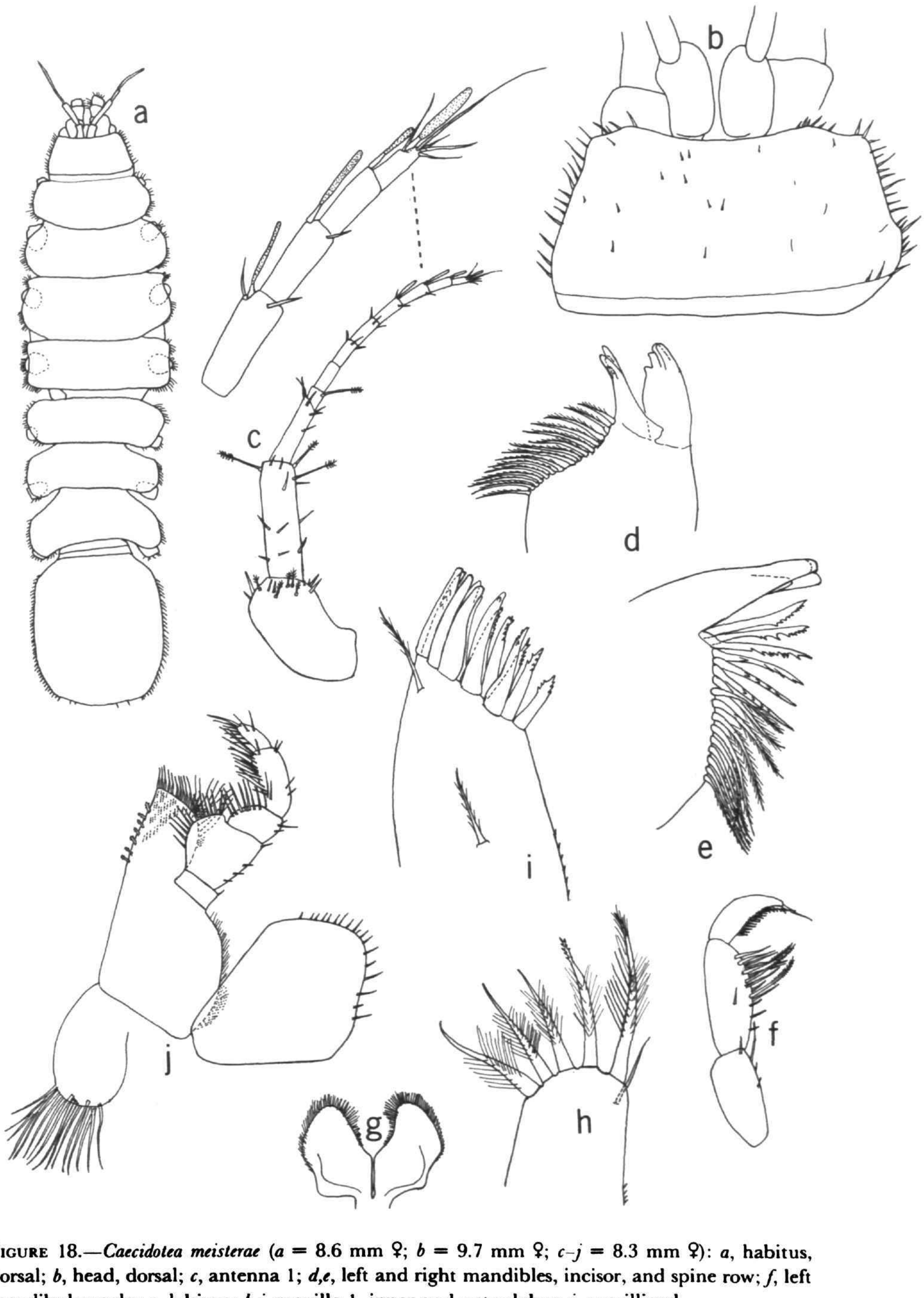

FIGURE 18.—*Caecidotea meisterae* (*a* = 8.6 mm ♀; *b* = 9.7 mm ♀; *c–j* = 8.3 mm ♀): *a*, habitus, dorsal; *b*, head, dorsal; *c*, antenna 1; *d,e*, left and right mandibles, incisor, and spine row; *f*, left mandibular palp; *g*, labium; *h,i*, maxilla 1, inner and outer lobes; *j*, maxilliped.

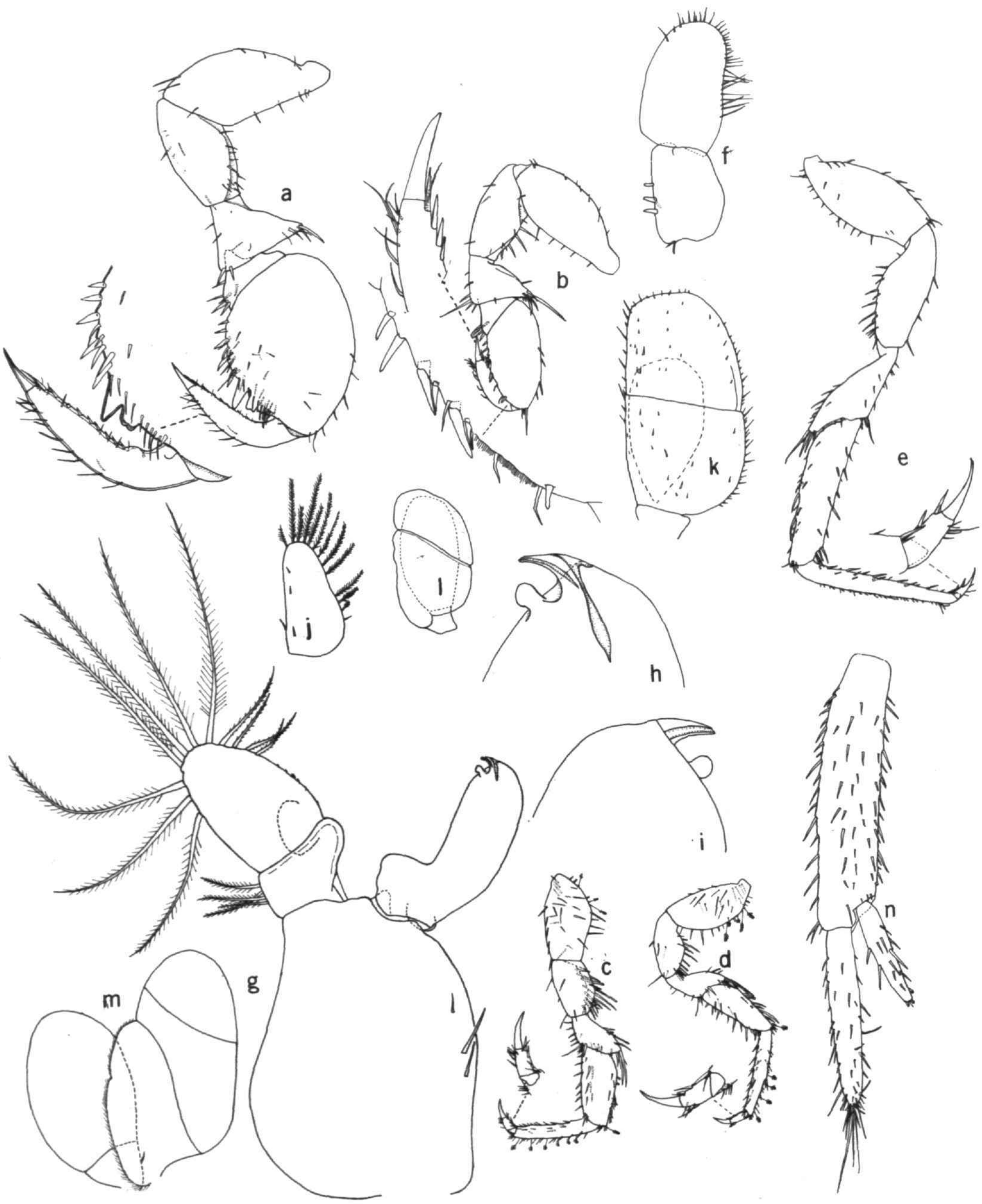

FIGURE 19.—*Caecidotea meisterae* (*a,c,f–i* = 10.6 mm ♂ holotype; *b,d,j–m* = 8.3 mm ♀; *e* = 11.0 mm ♀): *a,b*, pereopod 1; *c,d*, pereopod 4; *e*, pereopod 7; *f*, pleopod 1; *g*, pleopod 2, anterior; *h,i*, pleopod 2, endopod tip, anterior and posterior; *j*, pleopod 2; *k*, pleopod 3; *l*, pleopod 4; *m*, pleopod 5; *n*, uropod.

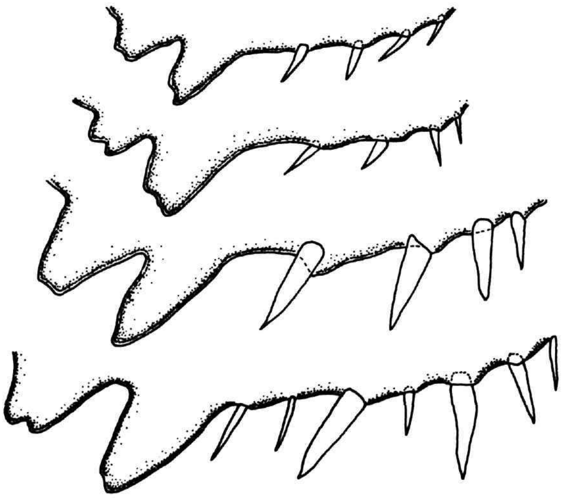

FIGURE 20.—*Caecidotea meisterae*, palms of ♂ pereopod 1 propus, setae omitted (top to bottom: from McElroy's Cave, Livingston Co., Kentucky; Haddon Cave, Todd Co., Kentucky; Taylor Cave, Trigg Co., Kentucky; Cannon Cave, Crittenden Co., Kentucky).

small setae. Female pereopod 1 more elongate, propus about 1.9× as long as wide, palm lacking processes, but with 2 large mesial process-like spines. Dactyl with 4 spines on flexor margin. Pereopod 4 similar in both sexes, with many spines and setae, dactyl with 2 spines in ♂ and ♀.

Male pleopod 1 protopod about 0.7 length of exopod, with 3 retinacula on each side; exopod about 1.6× as long as wide, lateral margin very slightly concave, with many lateral and distal setae decreasing in length distally. Male pleopod 2, exopod proximal segment with 4 lateral plumose setae, distal segment with 7 long plumose distolateral setae and 4 shorter plumose medial setae; endopod with rather low, rounded basal apophysis, curving very slightly to the tip ending in 3 laterally directed processes: (1) bulbous lateral process proximal to and slightly shorter than cannula, broadly rounded apically; (2) cannula beaklike, curving slightly towards lateral process, tapering distally; (3) mesial process indistinct, bordering cannula and separated from it by shallow endopodial groove. Female pleopod 2 oval, about twice as long as wide, tapering somewhat distally, distal and lateral margins with 12–13 plumose setae, with gap separating proximal 3 from others, generally decreasing in length proximally towards a single nonplumose seta. Pleopod 3 about 1.9× as long as wide, with many lateral and medial spines and setae. Pleopod 4 exopod of type B, without marginal spines; false suture only slightly sigmoid.

Uropod with many lateral and medial spines and setae, endopod about 0.6× length of protopod, 2.2× as long as exopod; endopod and exopod tapering distally and bearing cluster of long apical setae.

ETYMOLOGY.—This new species is named for Ms. Margaret A. Meister, in gratitude for her assisting in the collection of invertebrates from numerous midwestern caves.

RELATIONSHIPS.—*Caecidotea meisterae* relationships are discussed under the species that it resembles closely morphologically, *C. whitei*.

HABITAT.—The type-locality is a small cave (Figure 11*d*) occupying a ridge called White Hill (at the town of White Hill). The cave consists of a small lower passage containing a few rock-filled pools, and a larger upper passage containing a single small mud-bottom pool where the isopods were collected. None of the Kentucky localities have been visited by us, but all records of *C. meisterae* are from caves, and it is apparently a troglobite.

RANGE.—Bretz and Harris (1961) discussed the geology of White Hill Quarry and a cave contained within the quarry. This quarry, which is reported to expose the Fredonia Limestone and overlying Rosiclare Sandstone, is very near the cave from which *C. meisterae* has been collected. In fact, discussion with local residents revealed plans to expand the quarry toward the area of the cave, which may destroy the cave in the future. The type-locality is presumably in the same Mississippian Limestone exposed in the quarry and formed under a sandstone cap. Bretz and Harris noted that White Hill is the southernmost of a group of isolated hills that may be relics of a pre-Cretaceous topography. White Hill is within the westernmost part of the Interior Low

Plateaus Province, in the southern part of the Shawnee Hills Section (Willman et al., 1975).

Outside of Illinois *C. meisterae* is distributed through caves of western Kentucky eastward to the Mammoth Cave area in the central part of the state. Although we have examined no Tennessee material of this species, it is to be expected in the northwestern part of the state.

REMARKS.—During a 1 Nov 1975 visit, the small mud-bottom pool contained many *Crangonyx packardi* Smith sensu latu (troglobite), an undetermined flatworm (probably *Phagocata gracilis*, troglophile), and several *C. meisterae*. The upper passage apparently fills with water at times, and the animals in the pool are brought into the larger cave passage from some point beyond the crawlway that terminates the cave. During a 25 May 1976 visit, the isopods had disappeared, but several immature *Synurella* were taken (probably *S. dentata* Hubricht, which occurs in other nearby caves and springs). A search of the lower passage at this time revealed no crustaceans of any sort in the small pools there. Several other caves have been investigated in the immediate area, but *C. meisterae* has been found in none of them.

The brood pouch of an 8.7 mm female paratype contained about 50 eggs measuring 0.3 to 0.4 mm in diameter. Although the size is similar to that of *C. whitei* eggs, this is about twice the number of eggs we have found in *C. whitei* or *C. beattyi* paratypes.

Caecidotea packardi Mackin and Hubricht

FIGURES 21, 22

Caecidotea packardi Mackin and Hubricht, 1940:386–388, 390–392, 394, figs. 1, 2, 4, 29, 34.—Van Name, 1942:299, 321, 322 fig. 27.—Nicholas, 1960a:131.—Peck and Lewis, 1978:45, 54.

Asellus packardi.—Hubricht, 1942:35.—Mackin, 1959:875.—Fleming, 1972a:254,255; 1973:294, 298.—Page, 1974: 91.—Evers and Page, 1977:25.

Asellus (Conasellus) packardi.—Birstein, 1951:53, 111.

Asellus Packardi.—Bresson, 1955:51.

Conasellus packardi.—Henry and Magniez, 1970:356.

HISTORY.—The first record of *Caecidotea packardi* is the description by Mackin and Hubricht (1940). Morrison's Cave, Monroe Co., Illinois, was designated the type-locality, and specimens were examined from 3 other caves in St. Clair Co., Illinois. The ♂ pereopod 1, pleopods 1 and 2, and uropod were described and illustrated. Mackin and Hubricht noted the similarity of *C. packardi* to *C. antricola* in body proportions and uropod form, but recognized the closer morphological resemblance of the ♂ pereopod 1 to those of *C. dimorpha*, *C. stiladactyla*, and *C. spatulata*. Most of the specimens of *C. packardi* collected were taken from the undersides of flat stones, rather than from the abundant leaves and logs in the caves, and were thought to be feeding upon bacteria. Specimens with regenerated uropods were common.

Van Name (1942) repeated part of the description of Mackin and Hubricht (1940). Hubricht (1942) relegated the species to the genus *Asellus* in a short report on southern Illinois caves. The type-locality, Morrison's Cave, was described as a large solution cave, enterable by a stairway, with a stream flowing through the cave for an unknown distance. Hubricht noted that "during the World Fair of St. Louis in 1904, a track was laid on the floor of this cave and sight-seers were pushed about on cars." He added that Morrison's Cave was also the type-locality of 2 amphipods, *Gammarus acherondytes* and *G. troglophilus*; other animals present were 3 other crustaceans, 2 mollusks, and an undescribed flatworm.

Birstein (1951) united *Caecidotea* with *Asellus* and assigned *C. packardi* (and 9 other species) to the subgenus *Conasellus*. Bresson (1955) included *Asellus packardi* in a checklist of nearctic asellids. Mackin (1959) listed *A. packardi* in his key to *Asellus*. Nicholas (1960a) included *C. packardi* in a list of U.S. troglobites.

Henry and Magniez (1970) included *Conasellus packardi* in a list of species of *Conasellus*. Fleming (1972a) listed 9 localities for *Asellus packardi* from caves in Monroe and Pike counties and a pumpwell in Adams County. The following year Fleming (1973), in a response to Henry and Magniez (1970), synonymized *Conasellus* with *Asellus* and included *A. packardi* in a checklist and key to the species of *Asellus*.

Page (1974) included *A. packardi* in a list of Illinois Malacostraca and described the range of the species as "cave streams in Monroe and St. Clair counties." Evers and Page (1977) included Illinois Caverns in a report on unusual natural areas in Illinois and gave a brief account of the fauna present in the cave, including *Asellus packardi*.

Peck and Lewis (1978) reported *Caecidotea packardi* from 13 localities in Adams, Monroe, Pike, and St. Clair counties, all of which were caves except a single record from a pumpwell. The species was noted to be an endemic of the part of the Ozark Plateaus Province that extends into Illinois, and its distribution was compared with those of other regional subterranean invertebrates.

MATERIAL EXAMINED.—ILLINOIS. *Adams Co.:* Coe (= Dyers) Spring, Quincy, leg. Burks, Riegel, and Musselman, 8 Jun 1939, 1♂, 1♀ (INHS). Peters Spring, leg. Burks, Riegel, and Musselman, 8 Jun 1939, 2♀ (INHS). Pumpwell 10 mi (16 km) S Quincy, leg. J. G. Weise, 17 Sep 1957, 35♂, 13♀. *Monroe Co.:* Illinois Caverns, ca. 2 mi (3.2 km) S Burksville (also known as Morrison's Cave, Burksville Cave, Eckert's Cave, Mammoth Cave of Illinois), leg. Julian J. Lewis and Margaret A. Meister, 23 Nov 1974, 2♂ (broken, 5.3 mm, 9.8 mm), 1♀ (11.4 mm) (USNM); leg. J. J. Lewis and M. A. Meister, 16 Jun 1975, 1♂ (9.1 mm), 2♀ (7.8, 8.7 mm) (USNM); upstream from entrance on chert in water, leg. W. N. Netherton and D. Coons, 5 Dec 1977 (INHS). Halfmile Cave, leg. W. N. Netherton and D. Coons, 6 Jan 1978 (INHS). Dry Run Cave, in rimstone pool, leg. W. N. Netherton and D. Coons, 10 Jan 1978 (INHS). Fruths Spider Cave, leg. S. Peck, 26 Jun 1965, 1♂. Pautler Cave, leg. S. Peck, 27 Nov 1965, 1♂, 1♀. *Pike Co.:* Croxville Cave, 3.5 mi (5.6 km) NW Barry, leg. S. Peck, 15 Aug 1968, 7♂, 10♀. *St. Clair Co.:* Falling Spring Cave, leg. S. Peck, 28 Nov 1965, 1♂, 1♀. MISSOURI. *Lincoln Co.:* stream in Aker's Cave, 1.5 mi (2.4 km) N Silex, leg. L. Hubricht, 24 Jan 1943, 1♂, 1♀ (USNM).

DESCRIPTION.—Large, eyeless, unpigmented. Length of largest specimen examined 11.4 mm. Body slender, linear, about 4.4× as long as wide; coxae all visible in dorsal view. Margins of head, pereonites, and telson moderately setose. Head about 1.8× as wide as long, anterior margin concave, postmandibular lobes low and not especially produced. Pereonites 1–4 with small anterior shoulder-like projections, most pronounced in pereonite 3; 1–4 slightly laterally expanded in ovigerous females. Telson about 1.2× as long as wide, sides subparallel, tapering from anterior to posterior, caudomedial lobe not pronounced.

Antenna 1 extending to beginning of last peduncular segment of antenna 2; flagellum of about 10 segments; esthete formula 3-0-1. Antenna 2 reaching past posterior of telson, much longer than body; last segment of peduncle about 1.7× length of preceding segment; flagellum of about 90 segments.

Mandibles with 4-cuspate incisors and lacinia mobilis; spine-row of 11.4 mm ♀ with 19 large setae and 1 smaller terminal seta in right mandible, with 20 seta in left mandible; palp with 2 large distal spines. Maxilla 1, apex of outer lobe with 13 spines and 1 seta, 1 subterminal medial seta; inner lobe with 5 plumose setae (1 specimen had 6 plumose setae on right side). Maxillipeds with 5 retinacula on left, 6 on right.

♂ pereopod 1 propus about 1.5× as long as wide, triangular; palm without proximal process, but with proximal defining spine, with large conical mesial process crowding shorter, rounded distal process and distal row of about 6 setae; dactyl flexor margin with rounded boss proximally. ♀ pereopod 1 slightly more elongate than male, little sexual dimorphism in processes of propus, about 12 setae in row; dactyl flexor margin with proximal rounded boss and about 8 distal spines. ♂ pereopod 4 similar to ♀ pereopod 4, ♂ dactyl with 3–4 medial spines and 1 seta, ♀ dactyl with 2 spines and 1 seta.

♂ pleopod 1, protopod about 0.7× length of exopod, with 5 retinacula on each side. Exopod about twice as long as wide with 6 long setae

FIGURE 21.—*Caecidotea packardi*, 11.4 mm ♀: *a*, habitus, dorsal; *b*, antenna 1; *c*, left mandible, incisor, and spine row; *d*, left incisor; *e*, mandibular palp; *f,g*, right mandible, incisor; *h*, labium; *i,j*, inner lobes of right and left maxilla 1; *k*, right maxilla 1, outer lobe; *l*, maxilliped.

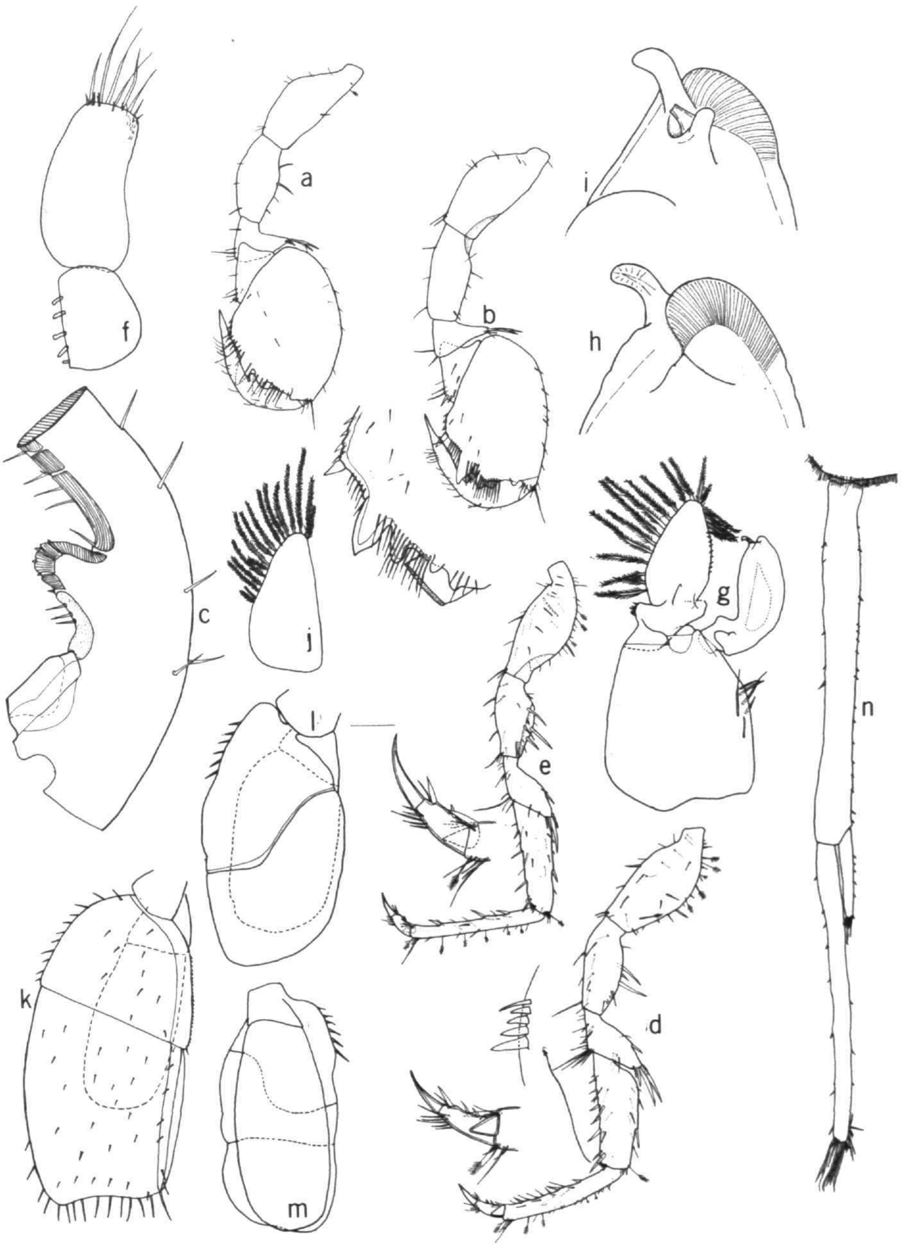

FIGURE 22.—*Caecidotea packardi* (*a,d* = 9.8 mm ♂, Illinois Caverns, Monroe Co., Illinois; *b,e,j,l,m,n* = 11.4 mm ♀, Illinois Caverns; *f,g,k* = fragmented ♂, Illinois Caverns; *h,i* = ♂, Morrison Cave, Monroe Co., Illinois): *a,b*, pereopod 1; *c*, pereopod 1, base of dactyl; *d,e*, pereopod 4; *f*, pleopod 1; *g*, pleopod 2; *h,i*, pleopod 2, endopod tip, posterior and anterior; *j*, pleopod 2; *k*, pleopod 3; *l*, pleopod 4; *m*, pleopod 5; *n*, uropod.

distally and about 9 shorter setae interspersed; lateral margin concave, lacking setae.

♂ pleopod, 2 protopod with about 6 medial setae. Exopod proximal segment with 5 short lateral setae; distal segment with about 20 long plumose marginal setae and 9 setules on medial margin. Endopod with low basal apophysis; tip ending in 4 processes: lateral process conspicuous, digitiform, curving proximad, directed ventrolaterad; mesial process short, apically rounded, directed distad, overlapping base of short cannula directed obliquely laterad; caudal process well sclerotized, broadly rounded, curving slightly laterad.

♀ pleopod 2 with about 16 lateral plumose setae.

Pleopod 3 exopod with slightly concave distal margin. Pleopod 4 exopod type B, with 6 proximal spines on lateral margin.

Uropod very long and slender, cylindrical, 2.4× length of telson; protopod 4.1× length of exopod, 1.3× length of endopod.

ETYMOLOGY.—Not given, but obviously named for Alpheus S. Packard, Jr., pioneer American biospeleologist.

RELATIONSHIPS.—*Caecidotea packardi* fits without difficulty into the *hobbsi* group of Steeves (1966), but beyond that its affinities are uncertain. Several distinctive features—the long digitiform lateral process, the diminished sexual dimorphism in pereopod 1, and the very long slender uropods—set it apart from other known species.

HABITAT.—*Caecidotea packardi* is a troglobite and occurs in stream pools, riffles, and drip pools in limestone caves. It is occasionally flushed from subterranean waters and collected at springs or wells.

RANGE.—The caves which this species inhabits (Figure 1) are discussed in detail by Bretz and Harris (1961). The caves in the southern part of the range are primarily within the Mississippian St. Louis Limestone, while Burton Cave and probably the other Adams County localities are within the Burlington Limestone, also Mississippian in age. The Monroe and St. Clair county localities are within the Salem Plateau Section of the Ozark Plateaus Province, while the Adams County populations are slightly north of the Lincoln Hills Section of the Ozarks, lying within the Dissected Till Plains Section of the Central Lowlands Province (Willman et al., 1975). The single Pike County locality, Croxville Cave, apparently lies within the northernmost corner of the Lincoln Hills.

All of the localities from which *Caecidotea packardi* has been collected occur along the Mississippi River, and some occur in areas that were glaciated. Since some of the caves along the glacial margins probably were filled and buried by glacial deposits, these caves probably have been invaded (or reinvaded) by *C. packardi* since the Sangamon interglacial.

REMARKS.—The presence of *C. packardi* in Burton Cave, Adams Co., suggests dispersal through phreatic interstices, since this cave is rather high on a hill and contains no stream. The only water present is in drip pools containing the amphipod *Stygobromus subtilis* (Hubricht) and *C. packardi*. The entry of caves by subterranean crustaceans via seepage into drip pools has been substantiated by Holsinger (1975). A July, 1976, visit revealed only *S. subtilis* in the cave; the *C. packardi* population is apparently ephemeral.

In Monroe and St. Clair counties, this isopod is less common than other crustaceans occurring in the cave streams there. *Caecidotea packardi* is syntopic with a rather large, slightly depigmented population of the troglophile *Caecidotea brevicauda* (Figure 12*a,b*), along with amphipods *Gammarus minus* (troglophile), *G. pseudolimnaeus* (trogloxene), *G. troglophilus* (troglophile), *G. acherondytes* (troglobite), *Bactrurus brachycaudus* (troglobite); turbellarians *Phagocata gracilis* (troglophile), *Sphalloplana hubrichti* (troglobite); and a gastropod, *Fontigens antroectes* (troglobite). The caves in the Monroe and St. Clair counties area contain the most diverse assemblages of aquatic troglobites known in Illinois.

Caecidotea spatulata Mackin and Hubricht

FIGURE 23

Caecidotea spatulata Mackin and Hubricht, 1940:384, 386–394, figs. 7, 14, 15, 22, 33.—Van Name, 1942:299, 322, 323.—Nicholas, 1960a:132.—Lewis and Bowman, 1977: 973.—Peck and Lewis, 1978:45.

Asellus (Conasellus) spatulatus.—Birstein, 1951:53, 111.

Asellus spatulatus.—Pennak, 1953:429.—Bresson, 1955:51.—Mackin, 1959:876.—Fleming 1972b:491, 495; 1973:294, 299.—Craig, 1975:4.

Conasellus spatulatus.—Henry and Magniez, 1970:356.

Asellus spatulata.—Page, 1974:89, 91.

[Not *Asellus spatulatus*.—Fleming, 1972a:244.] [= *Caecidotea kendeighi* (Illinois specimens) and *C. nodulus* (Maryland specimens).]

HISTORY.—The first record of *Caecidotea spatulata* appeared in the description of the species by Mackin and Hubricht (1940). The description includes illustrations of the ♂ pereopod 1, pleopods 1 and 2, and uropods. Mackin and Hubricht regarded *Caecidotea* as a genus comprised of subterranean species, but placed this epigean inhabitant of temporary pools in *Caecidotea* because of its vestigial eyes and faint pigmentation. The ability of the species to estivate during the summer months when the temporary pools dry up was also noted by Mackin and Hubricht.

Most of the subsequent references to *C. spatulata* are in lists or keys and add little new information to Mackin and Hubricht's (1940) account. Van Name (1942) reiterated the description of *C. spatulata* and reprinted the illustrations accompanying Mackin and Hubricht's (1940) paper. The species has also appeared briefly in the following: a list of species of *Asellus* (*Conasellus*) (Birstein, 1951); a manual of aquatic invertebrates (Pennak, 1953); a list of nearctic *Asellus* (Bresson, 1955); a key to North American Malacostraca (Mackin, 1959); a list of U.S. troglobites (Nicholas, 1960a); a list of species of *Conasellus* (Henry and Magniez, 1970); a list and key to species of *Asellus* (Fleming, 1973); a list of Illinois Malacostraca (Page, 1974); and a list of invertebrates associated with subterranean habitats in Illinois and eastern Missouri (Peck and Lewis, 1978). Fleming (1972b) described *Asellus ancylus* and *A. metcalfi*, comparing them briefly with *A. spatulatus*. Lewis and Bowman (1977) noted that the male pleopod 1 of *C. carolinensis* and *C. spatulata* both have well-developed distolateral lobes.

MATERIAL EXAMINED.—ILLINOIS. *St. Clair Co.:* temporary pools 1 mi S of Falling Springs, leg. Leslie Hubricht, 18 Apr 1937, numerous ♂♀ syntypes (USNM 76270).

DESCRIPTION.—Eyes present, but small. Dorsum sparsely pigmented after 41 years in alcohol. Body linear, length about 14 mm in largest ♂; 8 mm in a ♀ with young; length about 6× width in ♂, 4× width in ♀. Coxae not visible in dorsal view in anterior pereonites, barely visible in pereonites 5–7. Lateral margins of head and pereonites sparsely setose. Head about 1.5× as wide as long; anterior margin moderately concave. Postmandibular lobes small. Telson about 1.4× as long as wide; lateral margins subparallel, caudomedial lobe low.

Antenna 1 reaching past midlength of last peduncle segment of antenna 2; flagellum of 9–10 segments; esthete formula 3-0-1. Antenna 2 about as long as head + pereonites 1–5, flagellum with about 50 segments.

Mandibles with 4-cuspate incisors and lacinia, spine-row with 7 and 12 spines in left and right mandibles. Maxilla 1, apex of outer lobe with 13 stout spines and 2 subterminal setae; inner lobe with 5 apical plumose setae. Right maxilliped with 4 retinacula.

Male pereopod 1 propus 1.5×–1.8× longer than wide; palm defined by short, robust spine, with 2 processes, mesial process near defining spine (in well-differentiated ♂ spine is borne on proximal shoulder of process) and broad, more or less bicuspid distal process; dactyl flexor margin with a few weak spines or without spines. Female pereopod 1 palm with rudimentary mesial process and no distal process; dactyl flexor margin with about 5 spines. Pereopod 4 similar in ♂ and ♀.

Male pleopod 1 protopod about 0.6× length of exopod, with 6–8 retinacula. Exopod about twice as long as wide, with single basal seta; lateral margin with pronounced concavity near distal end lined with setules; distal margin armed with long plumose setae and short nonplumose setae. Male pleopod 2 protopod with 2–4 setae distally on medial margin; exopod proximal segment with 3 setae, distal segment with 18–21 setae; endopod

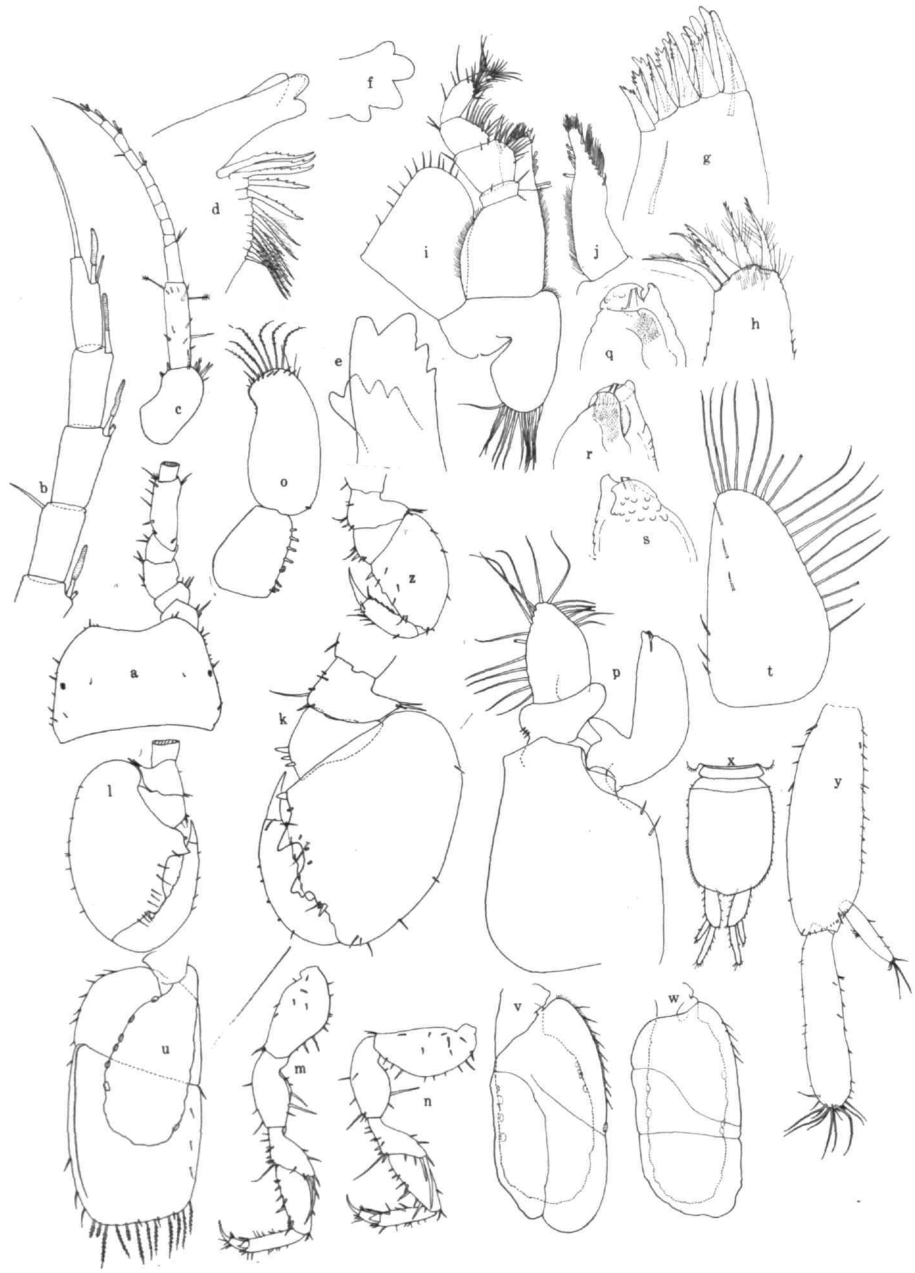

FIGURE 23.—*Caecidotea spatulata* (*a–j,n,t–x,z* = ovigerous ♀; *k,m,o–s,y* = ♂ syntype; *l* = 12.7 mm ♂): *a*, head, dorsal; *b*, antenna 1, distal segments; *c*, antenna 1; *d*, right mandible, incisor, and spine row; *e*, left mandible, incisor, and lacinia; *f*, right mandible, incisor; *g,h*, maxilla 1, outer and inner lobes; *i*, maxilliped; *j*, maxilliped endite, lateral; *k,l*, pereopod 1; *m,n*, pereopod 4; *o*, pleopod 1; *p*, pleopod 2; *q,r,s*, oblique, anterior, and posterior views of endopod tip of pleopod 2; *t*, pleopod 2; *u*, pleopod 3; *v*, pleopod 4; *w*, pleopod 5; *x*, pleon and uropods; *y*, uropod; *z*, pereopod 1.

with narrowly rounded lateral basal apophysis; tip ending in 4 processes (1) straight cannula, directed distolaterally; (2) broad mesial process not reaching apex of cannula, with concave surface and hook at distomedial corner; (3) narrow lateral process extending beyond other processes, hooked medially at tip; (4) broad rounded caudal process, with rounded scales on surface and hooked distolateral corner. Female pleopod 2 with about 18 plumose setae on lateral and distal margins, 3 short setae on anterior surface, and 3 short setae on proximal part of medial margin. Pleopod 3 exopod sparsely setose on lateral margin of proximal segment and apical margin of distal segment; endopod with several pustules on lateral margin and 1 distally on medial margin. Pleopod 4 exopod type A, with about 9 spinules on proximal part of lateral margin; endopod with several pustules on medial and lateral margins. Pleopod 5 exopod with 2 false sutures arising shortly beyond midlength on lateral margin, one transverse, the other running a sinuous course to proximal part of medial margin; endopod with a few pustules on medial and lateral margins.

Female uropod protopod slightly more than twice as long as wide; endopod nearly twice as long as exopod, both rami linear, sparsely armed. Male uropod protopod slightly longer than endopod; exopod about 1/4 length of protopod, much narrower than spatulate endopod.

ETYMOLOGY.—The specific name refers to the shape of the broad, flattened ♂ uropodal endopods.

RELATIONSHIPS.—*Caecidotea spatulata* is similar to *C. tridentata*, especially in the structure of the ♂ pleopods 1 and 2. It differs from the latter in having small eyes. In the ♂ gnathopod the mesial and distal processes are close together in *C. tridentata*, but widely separated in *C. spatulata*.

HABITAT.—*Caecidotea spatulata* is an inhabitant of temporary pools and springs. According to Mackin and Hubricht (1940), "When the pools dry up at the beginning of summer, they burrow into the mud, construct a small cell in which they remain dormant until the pools again fill with water the following spring." This unusual ability, not reported in other asellids to our knowledge, merits a detailed investigation.

RANGE.—Mackin and Hubricht (1940) reported *C. spatulata* from St. Clair County, Illinois, plus St. Louis and Boone counties, Missouri. We have no additional information on the distribution of this species, except that the Illinois and Maryland records of Fleming (1972b) are erroneous.

Caecidotea stygia Packard

FIGURE 24

Caecidotea stygia Packard, 1871:751,752, figs. 132,133.—Smith, 1874:661; 1875:477.—Hubbard, 1880:37, fig. 10.—Stebbing, 1893:377.—Richardson, 1901:553; 1905: 434, 435, figs. 490, 491a,b, 492a,g.—Hay, 1902a:225,226; 1902b:421-424, 426-428, figs. 4, 5a,g.—Ulrich, 1902: 93.—Banta, 1907:76,77; 1910a:246-248, 251,252, 269-280, 283,284, 292-301, 305-308; 1910b:439-488.—Stafford, 1911:575.—Fowler, 1912:522.—Pratt, 1916:377.—Racovitza, 1920:99; 1923:107.—Hungerford, 1922:175, 176.—Chappuis, 1927:61.—Bolivar and Jeannel, 1931: 299, 300, 302, 308.—Creaser, 1931:5.—Giovannoli, 1933a: 621; 1933b:239.—Hoffman, 1933:26.—Van Name, 1936: 32, 466-468, 470-473, fig. 293; 1942:317.—Park et al., 1939:120-125.—Mackin and Hubricht, 1940:383-385, 394,395.—Dearolf, 1953:227.—Nicholas, 1960a:132; 1960b:51,52.—Holsinger, 1963:29; 1976:75.—Steeves, 1969:51,52.—Holsinger and Steeves, 1971:195.—Bowman and Beckett, 1978:294-302, figs. 1-6.—Peck and Lewis, 1978:45, 54,55.

Caecidotea microcephala.—Cope, 1872a:409, 411, 417-420, fig. 109; 1872b:161, 163, 171, 174,175, figs. 109,110; 1878:492, 495-496, 505, fig. 109.

Caecidotea.—Smith, 1873:244,245.—Hobbs et al., 1977:104.

Caecidotaea stygia.—Packard, 1873:95,96; 1885b:3, 8-10, 14; 1888:10-12, 14-16, 19, 24, 29-33, 82, 86, 108-110, 118, 122, 142, 150, 151, pl. 3: figs. 1-8, pl. 4: figs. 1,2, pl. 23: fig. 1 in part.

Asellus stygius.—Underwood, 1886:359.—Hay, 1891:150 [partim].—Miller, 1933:100-102.—Racovitza, 1950:164-176, figs. 1-13.—Pennak, 1953:433,434, fig. 272a.—Chappuis, 1955:164; 1957:38.—Cole, 1959:74.—Mackin, 1959: 875.—Barr, 1961:32.—Minckley, 1961:452-455; 1963:47, 49, 74, 102, table 12.—Poulson, 1963:264; 1964:753, 755, 763.—Steeves, 1963a:470-474, 476, figs. 2-6; 1963b:462; 1965:82,83; 1966:394-396, 401, fig. 7.—Vandel, 1964:159, 461, 496, 512; 1965:127, 391, 419, 433.—Clifford, 1966: 71, 90.—Krekeler and Williams, 1966:394.—Barr, 1967: 160, 188, 190, 192; 1968:60, 92.—Minckley and Cole, 1968:2.—Steeves and Holsinger, 1968:82.—Holsinger, 1969:26; 1976:75.—Seidenberg, 1969:52, 81.—Williams, 1970:1.—Fleming, 1972a:227, 230,231, 249-252; 1972b: 498; 1973:297.—Hobbs, 1973a:11.—Page, 1974:91.—Barr and Kuehne, 1971:70,71, 85.—Craig, 1975:4.

Cecidotaea stygia.—Cope and Packard, 1881:879,880.—Packard, 1885a:85,86.

Caecidotea (Asellus) stygia.—Garman, 1892:240.—Packard, 1894:729,730, 742.

Caecidotaea stygia.—Chilton, 1894:175,176, 252.—Blatchley, 1896:127, 133, 135, 142, 149, 174,175, 207,208.

Caecidothea stygia.—Racovitza, 1925:580-582, figs. 196,197, 200, 201.

Asellus stygia.—Pratt, 1935:439.—Dearolf, 1942:50.

Asellus stygeus.—Hubricht, 1950:16.

Asellus (Caecidotea) stygius.—Chappuis, 1950:179-182, figs. 1-3.

Asellus (Conasellus) stygia.—Birstein, 1951:53, 111.

Asellus (Proasellus) stygius.—Bresson, 1955:51.

isopods.—Barr, 1964:79.

Asellus (= Caecidotea) stygia.—Eberly, 1966:286.

isopod.—Mohr and Poulson, 1966:94,95 [illustration].

Conasellus stygius.—Henry and Magniez, 1970:337, 356, 359.

Asellus, cf. *stygius.*—Cooper and Beiter, 1972:880.

Caecidotea (= Asellus).—Hobbs and Barr, 1972:37.

Asellus styguis.—Fleming, 1973:294.

"isopod".—Hobbs, 1973b: unnumbered [tables 3 and 4].

[For misidentifications of *Caecidotea kendeighi* as *C. stygia,* see synonymy of former.]

HISTORY.—The first appearance of *Caecidotea stygia* in the literature was Packard's (1871) description of the species in an article on the inhabitants of Mammoth Cave, Edmonson Co., Kentucky. Packard felt that this isopod was related to the marine genus *Idotea,* differing from *Idotea* in being eyeless, possessing an 8-merous antenna 1 (instead of 4) and an enlarged head, and lacking a segmented abdomen. The description was accompanied by 2 habitus drawings and single drawings of pereopod 1 and antenna 1, none of which were sufficiently detailed to distinguish the species adequately. Packard apparently described the species from a single specimen lacking the second antennae and uropods, and from his indication of the size of the species ("Length .25 inch"), his specimen was probably immature. Both the new genus and species were described in two paragraphs, but this description was concerned primarily with the relative sizes of body segments and the number of segments in the antennae, which likewise do not serve to separate *C. stygia* adequately from other species.

Cope (1872a) discussed the fauna of Wyandotte Cave, Crawford Co., Indiana, describing *Caecidotea microcephala* from a cave near Wyandotte Cave (Saltpeter Cave) and comparing it to *C. stygia.* Cope's description included a tiny illustration of the mandible and a curious drawing of an entire specimen bearing caudal egg sacs rather than uropods. Cope felt justified in describing the new species because of differences in the size of the head and position of the antennae from *C. stygia.* Cope's (1872a) account was republished twice (1872b; 1878).

Packard (1873) examined Cope's specimens of *C. microcephala* and synonymized the species with *C. stygia.* Examining specimens taken from a well in Orleans, Orange Co., Indiana, Packard ascertained that "the genus is not a member of the family Idotaeidae, but of the Asellidae, and the 'egg-sacs' are uropoda." Packard retained *Caecidotea* as an entity separate from *Asellus* in placing *Caecidotea* in the family Asellidae, noting however that "it seems not difficult to recognize in *Caecidotea* an *Asellus* modified by its subterranean existence."

Smith (1873) concurred with Packard (1873) that the external egg sacs figured by Cope (1872a) attached to *C. microcephala* originated from a lernaean copepod parasitic upon the blind fish found in the cave streams with *Caecidotea.* Smith (1873) also questioned the affinities of *Caecidotea* with *Idotea.* The following year Smith (1874) included *C. stygia* in a list of the freshwater crustaceans of the United States, listed the known collection localities, and repeated his conviction that *Caecidotea* "is evidently very closely allied to *Asellus,* and has no affinity with *Idotea.*" In 1875 Smith listed crustaceans described from Indiana and Kentucky caves, including *Caecidotea stygia,* and briefly discussed their origins. Smith could distinguish no difference between *Caecidotea* and *Asellus* except for the absence of eyes in *Caecidotea.*

Forbes (1876), in a list of Illinois Crustacea, synonymized *Caecidotea* with *Asellus* and redescribed *Asellus stygius,* using specimens of *C. ken-*

deighi collected in central Illinois. Although Forbe's redescription of *Asellus stygius* is relatively long and detailed, it is applicable entirely to *C. kendeighi.*

Hubbard (1880) found *C. stygia* to be common in pools in Mammoth Cave in the company of "a leech, or possibly worm" (see Kenk (1977) for notes on *Sphalloplana* occurring with *Caecidotea*). Hubbard included a dorsal habitus drawing of *C. stygia* and an enlarged view of the first antenna, noting the presence of esthetes and plumose setae.

Cope and Packard (1881) described *Cecidotaea nickajackensis* and compared it with *Cecidotaea stygia.*

Packard (1885a) compared the brains of *Asellus communis* and *Cecidotaea stygia* and found that the "eyeless *Cecidotaea* differs from the eyed form (*Asellus*) in the complete loss of the optic ganglia, the optic nerves, besides the almost and sometimes nearly total loss of the pigment cells and lenses." Packard, who was a firm believer in the inheritance of acquired characters, attributed the losses to disuse in the absence of light.

Underwood (1886) included *A. stygius* in a checklist of American Crustacea and listed the range of the species as Indiana, Illinois, and Kentucky.

Packard's (1888) classic account of the cave fauna of North America included a redescription of *Caecidotaea stygia* and several other references to the species scattered through the paper. Packard pointedly disagreed with Forbes' (1876) synonyomy of *Caecidotea* with *Asellus.* In resurrecting *Caecidotaea*, Packard provided a lengthy description and a number of illustrations for *C. stygia*, unfortunately using specimens from Illinois (*C. kendeighi*) and Pennsylvania (*C. pricei*) in addition to material from Indiana and Kentucky. Packard's drawings illustrate numerous appendages from *C. stygia* including the first figures of the ♂ pleopods 1 and 2, the latter too small to show detail.

In addition to the taxonomic consideration of *Caecidotaea stygia*, Packard (1888) listed records for the species from Illinois, Indiana, Kentucky, and Pennsylvania from caves, wells, springs, and drain tiles. Blind crayfish (see Hobbs and Barr (1972), *Orconectes inermis*) were reported to feed readily on *C. stygia*, although the food of the isopod was unknown. Packard's (1885a) paper concerning the eye and brain of *Caecidotaea* was reprinted in the later paper (Packard, 1888) with illustrations.

Hay (1891) cited *Asellus stygius* in Indiana from both wells and caves, noting the larger size of specimens taken from wells (i.e., *C. kendeighi*).

Garman (1892) discussed the origin of the cave fauna of Kentucky and stated his belief that animals found in caves were already partly adapted to subterranean life. Garman suggested that *C. stygia* existed before the formation of Mammoth Cave and probably did not originate in that cave.

Stebbing (1893) listed the range of *C. stygia* and noted that the absence of eyes did not distinguish it from *Asellus.*

In a lengthy paper on the crustaceans inhabiting subterranean waters in New Zealand, Chilton (1894) reviewed the work of Cope and Packard (1881) and briefly discussed an origin in "underground waters" rather than caves.

Packard's (1894) account concerning the origin of *Caecidotea* (*Asellus*) *stygia* consists of quotes from an earlier paper by Garman (1892).

Blatchley (1896) reported the collection of *Caecidotaea stygia* from several caves in Monroe, Lawrence, and Crawford counties, Indiana, during his 5-week horse-and-wagon trip exploring southern Indiana caves as state geologist. The cave from which Cope secured his specimens for the description of *C. microcephala* was identified as Saltpetre Cave, which is near Wyandotte Cave. The isopods were taken from troughs left in the cave by saltpeter miners.

Richardson (1901) included *C. stygia* in her key to isopods found along the Atlantic Coast with a new record for the species from Graham's Spring, Lexington, Virginia.

Hay (1902a) reported *C. stygia* from Mammoth Cave, where it was associated with *Mancasellus* (= *Lirceus*) *macrurus*, near the mouth of Echo River. In discussing the crustacean fauna of Nickajack Cave, Tennessee, Hay (1902b) reviewed the history of the genus *Caecidotea*, concluding that the validity of the genus was questionable, but retained the genus "on the grounds of convenience." Hay also described *Caecidotea richardsonae*, comparing it with *C. stygia* and *C. nickajackensis*. With this comparison Hay included drawings of a *C. stygia* habitus, the pleotelson and uropods (showing a regenerated uropod), and pereopod 5.

Ulrich (1902) described *C. smithii* and compared it with *C. stygia*.

Richardson (1905) presented a key to the species of *Caecidotea*, including *C. stygia*. Collection records from Virginia, Kentucky, Indiana, and Illinois were repeated along with Hay's (1902b) drawings of *C. stygia*. A small drawing of the pereopod 1 by Richardson (1905, fig. 491c) appears to be of *C. kendeighi*. A lengthy redescription of *C. stygia* by Richardson includes the description of the propodus of the first pereopods as "armed on the inferior margin with two long triangular processes and three short ones."

Banta (1907) published an extensive report on the fauna of Mayfield's Cave, Monroe Co., Indiana, making several interesting observations on the natural history of *Caecidotea stygia*. The isopod was found abundantly throughout the cave both on pool bottoms and the undersides of stones. On occasion *C. stygia* was seen crawling on stream banks and also outside of the cave under stones and dead leaves near the entrance. Both the amphipod *Crangonyx gracilis* and the blind fish *Amblyopsis spelaeus* were seen to prey upon *C. stygia*, and the isopod was noticeably less abundant in the areas of the cave where these species were found. Banta judged the food of the isopod to be decaying leaves, which he fed the animal successfully in the laboratory. Ovigerous females were taken "at different seasons, and quite small individuals are seen at all times, so that this species must breed throughout the year."

Banta (1910a) used specimens of *C. stygia* from Mayfield's Cave in a study of the reactions of isopods (*A. communis* and *C. stygia*) to light. It was found that *C. stygia* is much less responsive to light than *A. communis*; is photokinetic and photonegative; is tolerant of light after lengthy exposure; is more responsive to light after periods of darkness. A second paper (Banta, 1910b) reveals *C. stygia*'s great sensitivity to various sorts of mechanical stimuli (including water currents) and selectivity in food preference. Banta felt that *C. stygia*'s photonegative and rheotactic responses would tend to keep the isopod from straying from subterranean to epigean habitats.

Stafford (1911) described *C. alabamensis* and compared it with *C. stygia*. Fowler (1912), following Richardson (1901), listed a single erroneous record for *C. stygia*. In his manual, Pratt (1916) included *C. stygia*: "the hand being armed with 2 long and 3 short teeth: central United States; in caves and deep wells." Pratt apparently followed Richardson's erroneous description of the male 1st pereopod propus, actually based on specimens of *C. kendeighi*. The above was repeated by Pratt (1935) in the second edition of his manual, but with the species listed as *A. stygia*. Racovitza (1920), in a study of the male 1st pleopod, gave the position of insertion of the distal segment on the sympod in *Caecidotea stygia* as evidence that it is the exopod. In 1923 Racovitza pointed out the primitive state of the female pereopod 1 in *Caecidotea stygia*. In a study of the structure of the asellid 2nd antenna, Racovitza (1925) found that of *Caecidothea* (sic) *stygia* to be typical for the genus *Asellus*. Finally, in a posthumous work, Racovitza (1950) redescribed *Asellus stygius* in detail, using a male and a female from Mammoth Cave that he had obtained in an exchange with the National Museum of Natural History in 1912.

Chappuis (1927) listed *Caecidotea stygia* in his book on underground animals, repeating the localities given by Richardson (1905).

Giovannoli (1933a,b) mentioned the association of *C. stygia* with the amphipods *Eucrangonyx gracilis* and *Crangonyx vitreus* in the Mammoth Cave region.

Hoffman (1933) mentioned *C. stygia* and pointed out that almost nothing was known of the species' biology. Miller (1933) analyzed the differences between *Asellus* and *Caecidotea*, using a table of the species that included *C. stygia*, and synonymized *Caecidotea* with *Asellus*.

Van Name (1936) included *Caecidotea stygia* in a list of species of American asellids. The morphology of the species was discussed, and illustrations of *C. kendeighi* taken from Richardson (1905) repeated. Van Name followed various authors in listing the range of the species through Indiana, Kentucky, Illinois, Virginia, and Pennsylvania. *Caecidotea stygia* was also compared with *C. alabamensis* and *C. nickajackensis*. Van Name (1942) quoted a statement from Mackin and Hubricht (1940) regarding the taxonomy of *C. stygia*.

In a laboratory guide (Park et al., 1939), *C. stygia* appears in a key and as "cave isopod" in a list of suggested experiments with cave animals.

Mackin and Hubricht (1940) described 7 new species of asellids, retaining with a degree of reluctance the use of the genus *Caecidotea*. The morphology of *C. stygia* was compared to *C. dimorpha* and *C. oculata*, and differences in food preferences of *C. stygia*, *C. packardi*, and *C. spatulata* noted.

Dearolf (1942) added another Mammoth Cave collection record for *Asellus stygia*.

Chappuis (1950) recognized *Caecidotea* as a subgenus of *Asellus* and reported on Bolivar and Jeannel's collections of *C. stygia* from Mammoth Cave, Reid's Cave, and Horse Cave, Kentucky, and Marengo Cave, Indiana. He illustrated the marked changes that take place in the male pereopod 1 during growth and stated that determination of species of *Asellus* must be based on the male pleopods 1 and 2, since their morphology remains constant during growth.

In a checklist of Ozark cave invertebrates, Hubricht (1950) apparently accepted the synonymy of *Caecidotea* with *Asellus*, listing "*Asellus stygeus* (Cope). Found in caves east of the Crystal City Escarpment." This notation is evidently a lapsus since the species had been listed by Mackin and Hubricht (1940) correctly spelled as *Caecidotea stygia* Packard (not Cope).

Birstein (1951) discounted the genus *Caecidotea*, partitioned *Asellus* into subgenera, and placed *C. stygia* in the subgenus *Conasellus*.

Dearolf (1953) listed collection records of *Caecidotea stygia* from 2 Kentucky caves and Marvel Cave, Missouri. Pennak (1953) included *Asellus stygius* in a key to the Isopoda, listing the range as "Mo., Ind., and Ky.," and included a habitus drawing of *A. stygius* that bears a strong resemblance to *C. kendeighi*. Bresson (1955) listed the range of *A. stygius* as Illinois, Indiana, Kentucky, and Virginia in a checklist of nearctic asellids. In recording a new collection record from Kentucky, the species was placed in the subgenus *Proasellus*.

Chappuis (1955) mentioned *Asellus stygius* in discussing asellid genera and again (Chappuis, 1957) in describing *Asellus condei*. Cole (1959) noted the occurrence of *A. stygius* in "caves and wells in Kentucky, Tennessee, and Indiana." Mackin (1959) listed *A. stygius* in a key and checklist to U.S. isopods. Nicholas (1960a) included *Caecidotea stygia* in a checklist of U.S. troglobites, listing the range as Kentucky, Indiana, Pennsylvania, and Virginia. In the same year he (1960b) again listed *C. stygia* as widespread throughout Pennsylvania. Barr (1961) reported *A. stygius* from the upper Cumberland region of Tennessee.

Minckley (1961) discussed in some detail the occurrence of *Asellus stygius* in epigean habitats. The species was collected from spring-fed streams where it was a minor but consistent member of the fauna.

In a checklist of Virginia troglobites, Holsinger (1963) indicated that records of *C. stygia* in Virginia and Pennsylvania were erroneous. More recently (Holsinger, 1976), he again stated that Pennsylvania records are incorrect. Minckley (1963) again noted the presence of *A. stygius* in a surface spring-fed stream (Doe Run, Meade Co., Kentucky). Poulson (1963) observed that for specimens of *Amblyopsis spelea* longer than 45 mm, *Asellus stygius* is a major food item.

Steeves (1963a) partly redescribed and illustrated *Asellus stygius* and listed a number of collection localities in Kentucky, Indiana, and Tennessee along with a single record from "Illinois: wells, Monroe Co." Steeves established a *Stygius* group and placed within it 4 species. *Asellus stygius* was believed by Steeves to have closest affinities with *A. bicrenatus*. In a separate paper, Steeves (1963b) mentioned *A. stygius* without adding new information.

Citing Packard (1888), Poulson (1964) reported "the isopod *Asellus stygius* (83) has pigmented eyes with lenses and retinal cells when it lives in wells but lacks these when it lives in caves, even though the optic ganglia and nerves are absent in both cases." This is a reference, in part, to *C. kendeighi*. Poulson also cited data from Banta's (1910a, 1910b) experiments with *A. stygius*.

Vandel (1964, 1965) cited *Asellus stygius* as an example of an ancient species of *Asellus*, because it has not developed the "crochet nuptual" on the male 4th pereopod.

Eberly (1966) noted the common occurrence of *Asellus stygia* in Indiana caves in his description of *Asellus jordani*. Steeves (1965) described *A. barri* and indicated its affinities to *A. stygius*. Clifford (1966) reported *A. stygius* as a minor component of the aquatic fauna in an ecological study of a small stream in Caldwell Hollow, Brown Co., Indiana, where it lives in ground water discharged into the hollow's stream.

Krekeler and Williams (1966) included *A. stygius* in a checklist of Indiana cave animals. Mohr and Poulson (1966) illustrated a typical section of the stream ecosystem in Upper Twin Cave, Lawrence Co., Indiana, including the role of isopods (*C. stygia*) as prey for the fish, crayfish, and flatworms in the cave.

Steeves (1966) attempted to show the affinities of a number of troglobitic asellids, including *A. stygius*, with a dendogram of 13 asellid ♂ pleopod 2 endopod tips arranged in a pattern illustrating proposed lineages. In this evolutionary scheme *A. parvus* preceded *A. alabamensis*, from which arose directly *A. richardsonae*, *A. nortoni*, *A. stygius*, and *A. antricolus* via 4 separate lineages. *Asellus stygius* is shown to give rise to *A. recurvatus* and *A. barri*. *Asellus antricolus* is partly redescribed in this paper, and collections previously identified as *A. stygius* are noted.

Barr (1967) discussed briefly the presence of *A. stygius* in the Mammoth Cave System and noted some of its zoogeographic affinities. The following year Barr (1968) suggested that the food of *A. stygius* consists of bacteria and fungi and cited Banta's (1910b) report on the sensitivity of this isopod to tactile stimuli.

Minckley and Cole (1968) compared the collection locality of *Speocirolana thermydronis* to the epigean habitat of *A. stygius* discussed by Minckley (1961). Steeves and Holsinger (1968) also cited the paper by Minckley (1961), noting the possibilities for dispersal conferred by *A. stygius*'s ability to survive in an epigean habitat. Holsinger (1969) again noted the vagility of *A. stygius* in its apparent ability to migrate under the Mississippi River using subfluvial channels and compared the isopod's range to that of the amphipod *Apocrangonyx subtilis*.

Seidenberg (1969) cited the data of Banta (1907; 1910a; 1910b) concerning *A. stygius*.

Steeves (1969) mentioned *Caecidotea stygia* in discussing the origin and affinities of Appalachian cave asellids. Henry and Magniez (1970) included *C. stygius* in a list of species of *Conasellus*.

Williams (1970) noted that although *A. stygius* had been reported from epigean habitats, the species is typically subterranean and did not fall within the scope of his revision of epigean asellids.

Holsinger and Steeves (1971) relegated Richardson's (1905) Virginia record of *C. stygia* to synonomy with *Asellus pricei*. Cooper and Beiter (1972) reported *A. stygus* and other crustaceans as food of the southern cavefish *Typhlichthys subterraneus*. Fleming (1972a) compared *Asellus stygius* with *A. extensolingualus* and listed new localities for the species. Fleming (1972b) also compared *A. stygius* with *A. paurotrigonus*. Hobbs and Barr (1972) recalled Packard's (1888) reference to *Caecidotea* as the food of the blind crayfish *Orconectes inermis inermis* in Indiana. Fleming (1973) included *Asellus stygius* in a key to the species of the genus. Hobbs (1973a) reported a single cavernicolous species of asellid, *Asellus stygius*, from Indiana in a checklist of the state's cave fauna. Hobbs (1973b) also reported an unidentified isopod from caves in the Lost River karst area of southern Indiana.

Page (1974) included Steeves' (1963a) Monroe Co., Illinois, record in a checklist of Illinois Malacostraca. Barr and Kuehne (1971) analyzed the aquatic ecosystem of the Mammoth Cave system in detail, including *A. stygius*. Craig (1975) followed Fleming's (1972a) record of *A. stygius* for Missouri. Holsinger (1976) noted Nicholas's (1960a) error in reporting *A. stygius* in Pennsylvania. Hobbs et al. (1977) again noted the appetite of the crayfish *Orconectes inermis inermis* for *Caecidotea*.

Bowman and Beckett (1978) reported new localities of *Caecidotea stygia* from Ohio and redescribed the species using specimens from the Cincinnati region.

Peck and Lewis (1978) recorded *Caecidotea stygia* from 3 caves in southeastern Illinois and discussed the zoogeography of this and other subterranean invertebrates in Illinois.

MATERIAL EXAMINED.—ILLINOIS. *Hardin Co.:* Cave Spring Cave, 2 mi NW Rosiclare, leg. E. Lisowski and D. Osterbur, 5 Jun 1976, 3♂, 1♀ (INHS); leg. S. Peck, 24 Oct 1965, 3♂, 6♀. Layoff Cave, Rosiclare, leg. J. Lewis, 17 Feb 1974, 5♂, 9♀; 26 Oct 1974, 3♂, 1♀; leg. J. Lewis and M. Meister, 21 Jun 1977, 4♂, 6♀, 14 juv.; leg. S. Peck, 24 Oct 1965, 2♂, 2♀. Griffith Cave, leg. S. Peck, 2♂, 2♀. *Johnson Co.:* spring 2 mi S Forman, leg. J. A. Boyd and L. M. Page, 27 Apr 1976, 3♂, 1♀.

DIAGNOSIS.—[Since *C. stygia* was redescribed in detail recently (Bowman and Beckett, 1978), we give here a diagnosis rather than a full description.] Eyeless, unpigmented, length up to 16 mm. Antenna 1 esthete formula 3-0-1 or 4-0-1. Palm of ♂ gnathopod without proximal process, but defined by 1 to several spines; mesial process acute or subacute; distal process close to mesial process, rounded or bicuspate. Palmar processes may be rudimentary or absent in ♂ having differentiated pleopods 1 and 2. Pereopod 4 identical in ♂ and ♀. Pleopod 1 of ♂ with 3–5 retinacula; exopod truncate distally, with a few short setae on medial part of distal margin; distolateral corner produced into rounded spinulose lobe; lateral margin straight to slightly concave, armed with setae increasing in length proximally. Endopod tip of ♂ pleopod 2 with slender, pointed, nearly straight cannula, sometimes slightly bent at tip; lateral process slender, digitiform, curved toward cannula; caudal process low, broadly rounded. Pleopod 4 exopod, type B, with spines on proximal part of lateral margin. Uropod rami linear.

ETYMOLOGY.—Not given, but obviously meaning "of the river Styx," referring to the habitat in underground waters.

RELATIONSHIPS.—Several species of *Caecidotea* share the following combination of characters with *C. stygia:* ♂ gnathopod with mesial and distal processes, but without proximal process; ♂ pleopod 1 exopod with short distal setae and longer lateral setae; ♂ pleopod 2 endopod tip with 2 conspicuous processes, cannula and lateral process; pleopod 4 exopod type B. These species include *C. meisterae*, *C. whitei*, and perhaps *C. barri*, *C. bicrenata*, and *C. franzi*, in which pleopod 4 has not been described. Of these species, *C. meisterae* and *C. whitei* differ in lacking spines on pleopod 4 and in having uninterrupted esthete series on antenna 1. In *C. barri* the ♂ pleopod 1 exopod resembles that of *C. stygia* in having a truncate distal margin, but the endopod tips of pleopod 2 of *C. barri* and also *C. franzi* are quite different. The relationships of *C. stygia* cannot be clearly elucidated at the present time.

HABITAT.—*Caecidotea stygia* is primarily an inhabitant of limestone caves, where it is found typically in streams, drip pools, or rimstone dam pools. In these habitats *C. stygia* is often abundant and may be found clinging to the undersides of dead wood or rocks, or crawling across stream or pool bottoms. This species is sometimes reported from springs (Minckley, 1961) or epigean streams, but its occurrence in these habitats is usually the result of being flushed out of caves or other subterranean habitats.

RANGE.—Fleming (1972a) reported *Asellus stygius* from Griffith, Layoff, and Cave Spring caves in Hardin County. These caves are discussed by Bretz and Harris (1961). Griffith and Cave Spring caves are both developed in the Mississippian Fredonia member of the Ste. Genevieve Limestone (Bretz and Harris, 1961; Willman et al.,

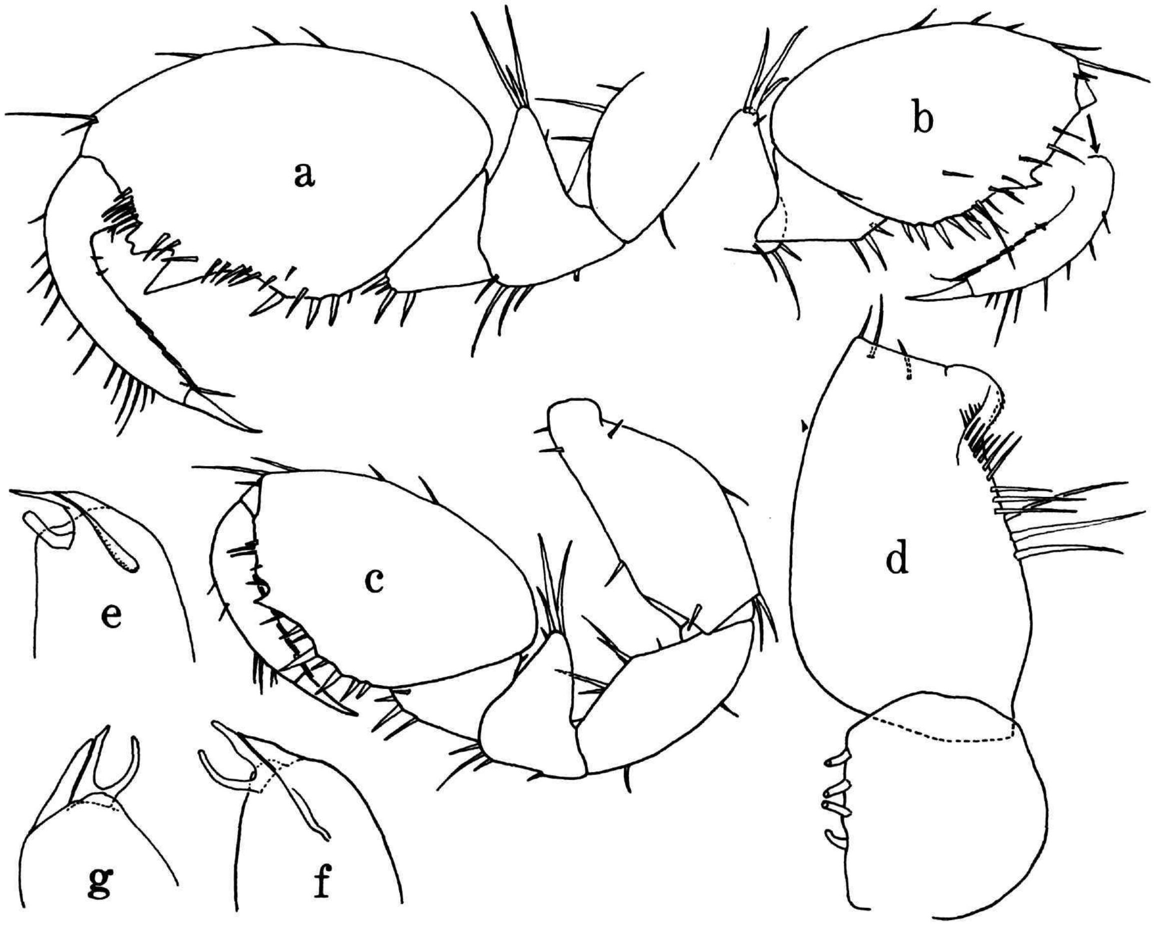

FIGURE 24.—*Caecidotea stygia*, ♂, from Layoff Cave, Hardin Co., Illinois: *a–c*, pereopod 1, 3 different specimens; *d*, pleopod 1; *e*, pleopod 2 endopod tip, anterior; *f*, same, from another specimen; *g*, endopod tip, posterior, from second specimen.

1975), which lays beneath the Rosclaire Sandstone, and presumably Layoff Cave developed in the same member, although this was not discussed by Bretz and Harris. The Johnson County locality is also in a region where Mississippian limestones prevail, possibly the Ste. Genevieve, and illustrates the ability of this species to disperse westward from the central part of its range past a rather extensive fault zone in Hardin, Pope, and Johnson counties. Preliminary observations of the distribution of *C. stygia* in Illinois by Peck and Lewis (1978) suggested that the fault zone had prevented westward dispersal, but this suggestion no longer appears tenable.

The Illinois localities of *Caecidotea stygia* lie within the Interior Low Plateaus Province, as do most of the localities for this species in Indiana, Kentucky, and Tennessee; however, in Indiana and Ohio, this species occurs in caves and groundwater discharges within the Central Lowlands Province, as reported by Bowman and Beckett (1978).

REMARKS.—In Layoff Cave, Hardin Co., Peck and Lewis (1978) reported 2 invertebrates occurring with *C. stygia*, the amphipod *Crangonyx packardi* sensu latu (troglobite), and the crayfish *Cambarus ornatus* (troglophile). During a 21 Jun 1977 visit to Layoff Cave, a specimen of the spring cavefish *Chologaster agassizi* was also found. In Cave Spring Cave, Hardin Co., *C. stygia* occurs with another isopod, *C. brevicauda* (troglophile), 2 amphipods, *Crangonyx packardi* sensu latu (troglobite) and *Gammarus pseudolimnaeus* (trogloxene), and a crayfish, *Cambarus laevis* (troglophile).

Outside of Illinois *C. stygia* occurs with numerous other troglobites, including amphipods, *Stygobromus* (Holsinger, 1967); flatworms, *Sphalloplana* (Kenk, 1977); crayfish, *Orconectes* (Hobbs and Barr, 1972); and fish, *Amblyopsis* (Woods and Inger, 1957). In a small cave in Cotton Gin Hollow, in Mammoth Cave National Park, Kentucky, *C. stygia* and *C. whitei* are syntopic. Several other subterranean *Caecidotea* are sympatric with *C. stygia* in parts of its range, including *C. barri*, *C. jordani*, *C. meisterae*, and *C. whitei*.

Caecidotea tridentata Hungerford

FIGURES 25, 27

Caecidotea tridentata Hungerford, 1922:175–181, p. 15.—Creaser, 1931:5,6.—Hoffman, 1933:26–33, fig. 1.—Miller, 1933:102.—Van Name, 1936:473, 474, fig. 299.—Mackin and Hubricht, 1940:394.—Leonard and Ponder, 1949: 168, 169, 194, 195, 198, 199, fig. 37.

Asellus tridentatus.—Hubricht, 1950:17.—Pennak, 1953: 434.—Bresson, 1955:51.—Mackin, 1959:875.—Minckley, 1961:452.—Seidenberg, 1969:52, 81, 84, 90, 91.—Steeves, 1969:52.—Williams, 1970:1.—Fleming, 1973 [in part].

Asellus (Conasellus) tridentata.—Birstein, 1951:52, 53, 111.

Conasellus tridentatus.—Henry and Magniez, 1970:356.

[Not *Asellus tridentatus*.—Dexter, 1954:256.—Black, 1971:6, 38.—Holsinger, 1971:323.—Fleming, 1972a:254 (Illinois, record).—Page, 1974:91.—Craig, 1975:4.—McDaniel and Smith, 1976:58.]

[Not *Caecidotea tridentata*.—Peck and Lewis, 1978:45.]

HISTORY.—The first record of *Caecidotea tridentata* is the original description by Hungerford (1922) of isopods pumped from a cistern in Lawrence, Kansas. Hungerford also examined 4 lots of specimens from Topeka, Kansas, in the USNM collections identified as *Caecidotea stygia* and found them to be conspecific with the Lawrence specimens. Accompanying Hungerford's description and illustrations of *C. tridentata* was a key to the 6 known species of *Caecidotea*. The species were divided into 2 groups: (1) those with processes on the ♂ gnathopod palm (*C. nickajackensis*, *C. alabamensis*, *C. tridentata*, and *C. stygia*); (2) those without processes (*C. smithii*, and *C. richardsonae*).

Creaser (1931) included *C. tridentata* in another key to the species of *Caecidotea* accompanying his description of *C. antricola* and pointed out the possible taxonomic significance of the "club shaped setae" (= esthetes) on antennae 1 of *C. smithsii*, *C. richardsonae*, *C. tridentata*, and *C. antricola*. Miller (1933) included *C. tridentata* in a table of asellid species comparing characters in an evaluation of the validity of the genus *Caecidotea*.

Hoffman (1933) reported observations on structure of the brood pouch, number of marsupial young (40–70), molting, longevity, and food habits.

Van Name (1936) published Hungerford's (1922) illustrations and excerpts from his description.

Mackin and Hubricht (1940) compared *C. tridentata* to the Oklahoma species *C. acuticarpa* (Figure 26).

In an annotated checklist of the Crustacea of eastern Kansas, Leonard and Ponder (1949) supplied a number of characters that they felt reliable for the recognition of the species. *C. tridentata* was reported to be "fairly common in cisterns, wells, springs and shallow rocky streams in eastern Kansas," but new specific collection localities were not given. In another checklist of invertebrates known from Ozark caves, Hubricht (1950) reported the range of *Asellus tridentatus* to consist of an area "along the northern fringes of the Ozarks."

Birstein (1951) divided *Asellus* into subgenera, placing *C. tridentata* in the subgenus *Conasellus*.

Pennak (1953) included *A. tridentatus* in his key to the asellids and repeated Hubricht's (1950) range information.

Bresson (1955) put *A. tridentatus* in a checklist of Nearctic asellids and listed the range as "Kansas." Mackin (1959) likewise included *A. tridentatus* in a checklist of *Asellus* associated with a key to North American Malacostraca.

In a paper concerned with the occurrence of subterranean isopods in epigean waters, Minckley (1961) stated his belief that "highly modified cavernicolous asellids" such as *Asellus tridentatus* are found in surface situations only as accidentals. Seidenberg (1969) repeated some of Hoffman's (1933) observations on the ecology of *A. tridentatus*. Steeves (1969) took note of Hungerford's (1922) attempt to group the species into related assemblages.

Henry and Magniez (1970) resurrected *Conasellus* and listed species which they included in the genus, including *Conasellus tridentatus*.

In his revision of the North American epigean *Asellus*, Williams (1970) noted that *A. tridentatus* may be found in surface waters, but is typically subterranean, and he did not deal with the species further.

Black (1971) compiled an annotated checklist of cave life in Oklahoma, listing records for the species from a cave and a spring. The species was classified as a troglophile. Two species, *Asellus tridentatus* and the amphipod *Allocrangonyx pellucidus*, were thought to share a range comprised of a region including south-central Oklahama and the Arbuckle Mountains. Holsinger (1971) also noted the occurrence of the 2 species together in an Oklahoma cave.

Fleming (1972a) listed determinations of *A. tridentatus* from localities in Illinois, Missouri, Arkansas, Oklahoma, and Kansas. The following year Fleming (1973) included *A. tridentatus* in a checklist and key to the genus *Asellus*. In the same paper Fleming presented a diagnosis of the species. Fleming also examined several collections of *Asellus acuticarpus* and concluded that this species is conspecific with *A. tridentatus*.

MATERIAL EXAMINED.—KANSAS. *Douglas Co.*: Lawrence, drain tile runoff stream in town park, leg. Julian J. Lewis, 8 Jul 1977, 15♂, 9♀. Lawrence, drain tile mouth under slab of concrete at head of lake on University of Kansas Campus, leg. Julian J. Lewis, 8 Jul 1977, 1♀. *Franklin Co.*: abandoned well, Wheeler Farm, 5 mi (8 km) SSE Ottawa, leg. Leslie Hubricht, 31 Aug 1941, 12 (USNM 108604). *Miami Co.*: Yates well, 4 mi (6.4 km) SW Osawatomie, leg. Leslie Hubricht, 31 Aug 1941, 3 (USNM 108605). *Shawnee Co.*: Topeka, 1 (USNM 44479). Topeka, gift of E. A. Popenoe, 9 Apr 1912, 15 (USNM 4480).

DESCRIPTION.—Large, eyeless, slightly pigmented. Length up to 19 mm (Hungerford, 1922), largest specimen examined 16.5 mm; body slender, linear, about 3.7× as long as wide; coxae visible in dorsal view. Margins of head, pereonites, and telson moderately setose. Head about 2.2× as wide as long, anterior margin concave; postmandibular lobes produced, rounded. Telson 1.7× as long as wide, sides parallel; caudomedial lobe slightly produced, broadly rounded.

Antenna 1 reaching almost to last segment of peduncle of antenna 2; flagellum of about 11–13 segments; esthete formula 3-0-1. Antenna 2 reaching to telson, last segment of peduncle about 1.4× length of preceding segment; flagellum of about 80 segments.

Mandibles with 4-cuspate incisors and lacinia mobilis; spine-row with 13 spines in left mandible, 16 in right mandible. Maxilla 1, apex of outer lobe with 13 robust spines (12 shown in Figure 24*h*) and 2 subterminal seta, plus 1 medial seta; inner lobe with 5 apical plumose setae and about 5 very slender subterminal lateral setae. Maxilliped with 6–7 retinacula.

Male pereopod 1 propus about 1.4× as long as wide; palm with 3 processes, large finger-shaped proximal process, cone-shaped mesial process crowding lower bidentate distal process. Dactyl with about 6 distal lateral weak spines. Pereopod 4 more spinose distally than proximally, dactyl with 2 lateral spines and 1 medial seta.

Male pleopod 1 larger than pleopod 2; protopod about 0.65 length of exopod, with 5 retinacula. Exopod about 0.6× as wide as long, with 6 long setae on distal margin, with several shorter setae interspersed and lining distal part of concave lateral margin, and 1 medium sized proximal seta. Male pleopod 2, protopod with about 3–4 setae along medial margin; proximal segment

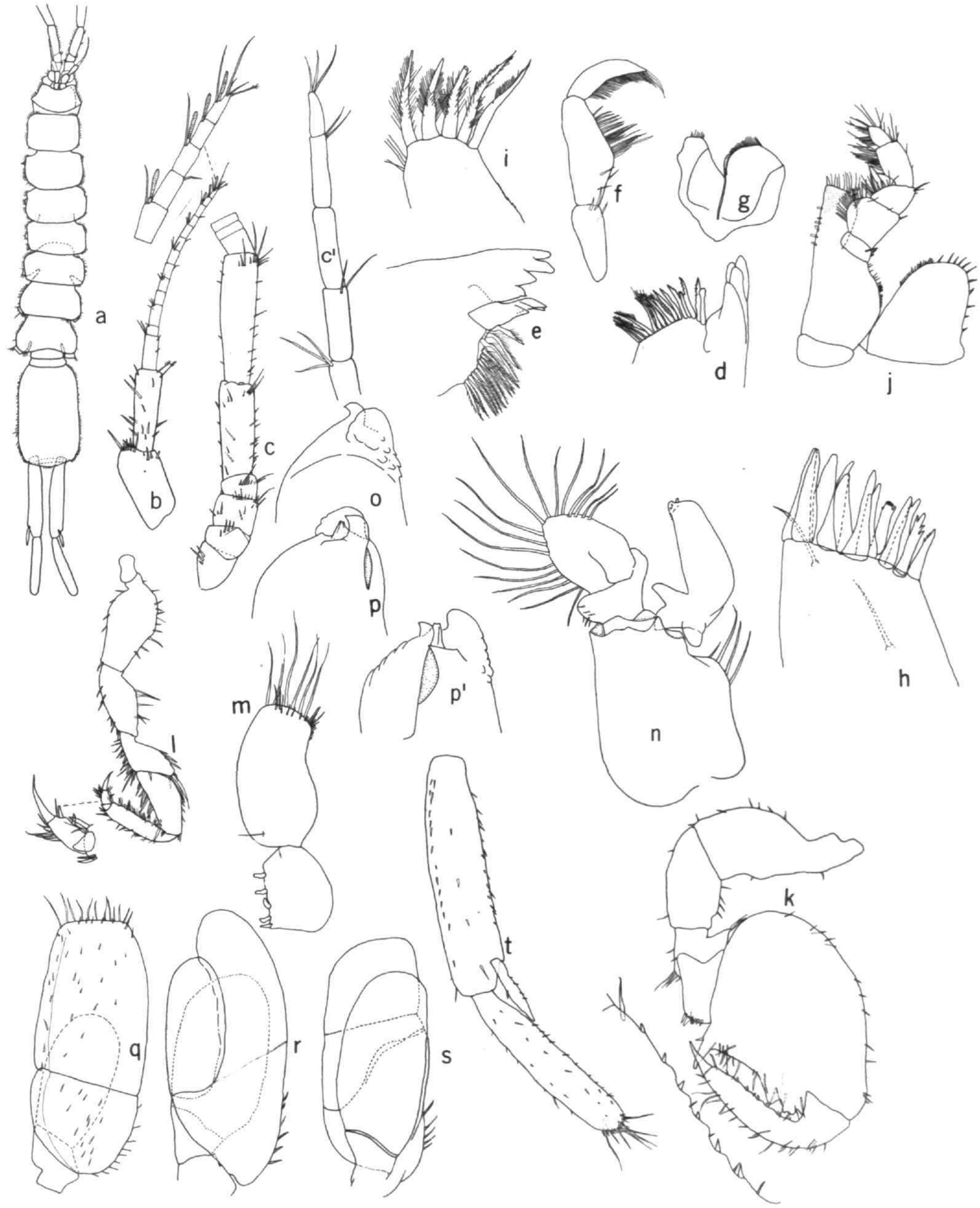

FIGURE 25.—*Caecidotea tridentata*, 16.3 mm ♂ from Topeka, Kansas: *a*, habitus, dorsal; *b*, antenna 1; *c*, antenna 2, proximal segments, *c'*, same, distal segments; *d,e*, incisor and spine row of right and left mandibles; *f*, mandibular palp; *g*, labium; *h,i*, maxilla 1, outer and inner lobes; *j*, maxilliped; *k*, pereopod 1; *l*, pereopod 4; *m*, pleopod 1; *n*, pleopod 2, posterior; *o*, pleopod 2 endopod tip, posterior; *p,p'*, pleopod 2 endopod tip, anterior; *q*, pleopod 3; *r*, pleopod 4; *s*, pleopod 5; *t*, uropod.

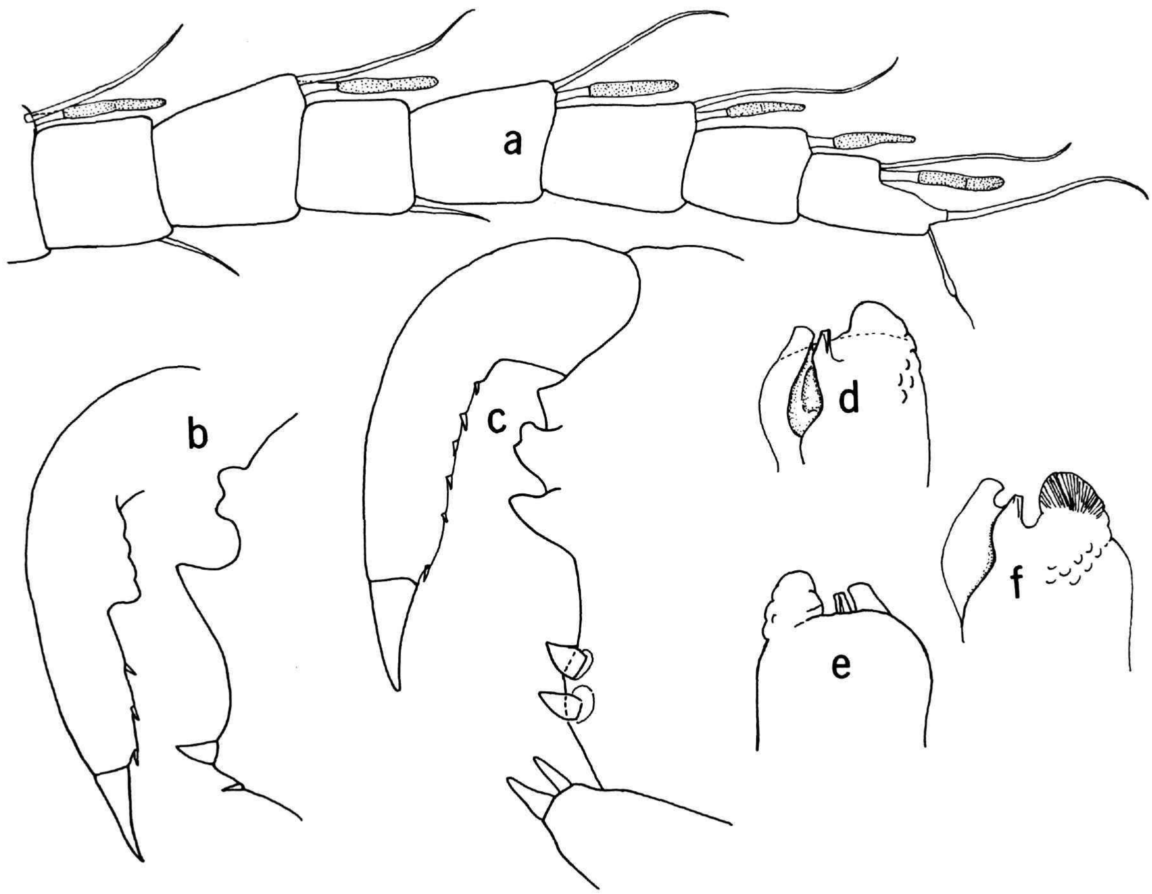

FIGURE 26.—*Caecidotea acuticarpa*, ♂ syntype: *a*, antenna 1, distal segments; *b,c*, pereopod 1, opposable margins of propus and dactyl of 2 specimens; *d,e,f*, pleopod 2 endopod tip, anterior, posterior, and oblique views.

of exopod with 6 short setae, distal segment oval with about 11 lateral plumose setae on margin and 5 shorter nonplumose setae; endopod of moderate size, proximal bosses well developed, tip ending in 3 processes, mesial process curved, beak-shaped, distally rounded; cannula cone-shaped, shorter than mesial process, apically rounded; caudal process large and broadly rounded, with 2-3 small lobes at lateral margin proximally. Pleopod 3 with about 9 setae on lateral margin of proximal segment, distal segment with about 12 long setae along margin of apex with shorter setae interspersed, many setules on inner surfaces of both segments. Pleopod 4 exopod type A, with about 6 setae along proximal part of lateral margin. Pleopod 5 exopod with about 5 setae along proximal part of lateral margin.

Uropod about 1.3× as long as telson; protopod about 3.4× as long as exopod, about 1.3× as long as endopod; endopod spatulate, triangular in cross section.

ETYMOLOGY.—The specific name refers to the 3 processes on the palm of the ♂ gnathopod.

RELATIONSHIPS.—*Caecidotea tridentata* is similar in many respects to *C. spatulata*, especially in the ♂ pleopods 1 and 2, but *C. spatulata* has small eyes, and the mesial process on the ♂ gnathopod is more proximal in position and separated by a

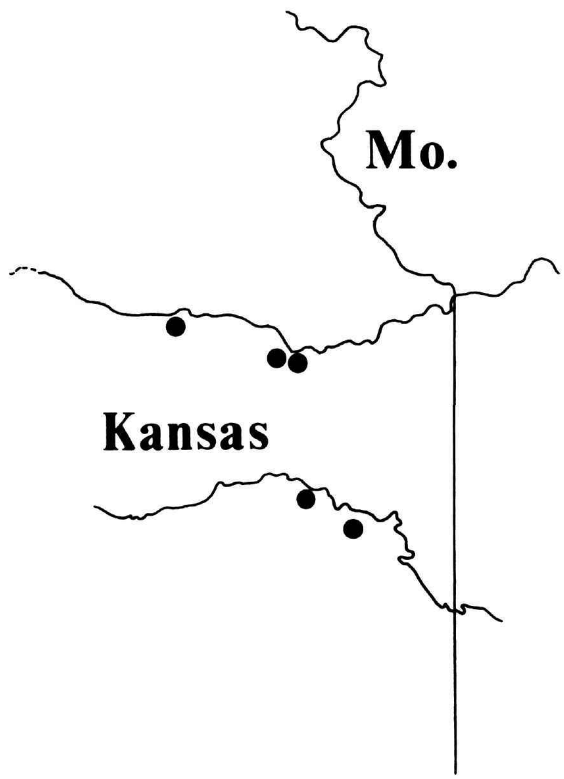

FIGURE 27.—Known distribution of *Caecidotea tridentata* in NE Kansas.

wide gap from the distal process. In *C. tridentata* the 2 processes are quite close.

Fleming (1973) synonymized *Caecidotea acuticarpa* Mackin and Hubricht (1940) with *C. tridentata* after comparing type-material and other specimens of both species. Fleming gave no descriptions or illustrations, stating only, "All comparisons were of the four reliable diagnostic characters: gnathopod, uropod, and first and second pleopods of the male. These structures examined in all specimens of both nominal species were found to be identical."

Since Fleming's opinion is undocumented, we have made our own comparisons, using ♂ syntypes of *C. acuticarpa* from Byrd's Mill Spring, Pontotoc Co., Oklahoma (Figure 26) and specimens of *C. tridentata* from Topeka, Kansas. The ♂ gnathopods are similar, but the long proximal process in *C. tridentata* is represented in *C. acuticarpa* by 1 or 2 stout spines. Mackin and Hubricht (1940) state that both species lack a mesial process, but they interpreted the juxtaposed mesial and distal processes together as a bidentate distal process. The acutely produced carpus in *C. acuticarpa*, from which the specific name is derived, is blunt and not produced in *C. tridentata*. The ♂ pleopod 1 is similar, but the spinules on the exopod lateral margin extend to the proximal end of the concavity in *C. acuticarpa* and only to the distal end in *C. tridentata*. The ♂ pleopod 2 endopod tips differ. The mesial process is beak-shaped in *C. tridentata* and blunt with only a faint indication of a point in *C. acuticarpa*, although Mackin and Hubricht show it as bluntly hooked.

Caecidotea acuticarpa is known only from caves and springs in the Ouachita province of NE Oklahoma, a distinctly different habitat and range from those of *C. tridentata*.

HABITAT.—Many of the published records of *C. tridentata* are, like those given herein for *C. kendeighi*, from drain tiles and ditches (Figure 11*c*). The species should be termed a phreatobite, since it inhabits saturated soil interstices and not caves, and references to it as a troglophile (Black, 1971) or troglobite (Craig, 1975) are inaccurate.

RANGE.—Examination of numerous USNM collections labeled "*Asellus tridentatus*" has led us to the conclusion that this species is endemic to northeastern Kansas, although it may also occur in the plains of adjacent Missouri or Nebraska. All verified localities are from the unglaciated part of the Central Lowlands Province directly south of the margins of the Nebraskan and Kansan glaciations, along the Kansas and Marais de Cynes rivers, both tributaries of the Missouri River (Figure 27). Many of the records given in our synonymy of *C. tridentata* will probably prove to be misidentifications, but they are included pending reexamination of the specimens reported or of specimens from the same localities.

Caecidotea whitei, new species

FIGURES 6, 28, 29, 32

Crustaceans.—Hubricht, 1942:35.
Asellus alabamensis.—Fleming, 1972a:247, 248 [in part].
Caecidotea sp. no. 1.—Peck and Lewis, 1978:44.

HISTORY.—The first record of *Caecidotea whitei* is in the report on Wet (= Cricket) Cave by Hubricht (1942), where he stated that "a large stream runs through the cave containing three species of crustaceans." Although this is not a direct reference, the most common crustacean in the cave is *C. whitei*, and Hubricht presumably took note of it.

Fleming (1972a) identified specimens from Cricket Cave, Illinois, and numerous Kentucky caves as *Asellus alabamensis*, because of the similarity of the ♂ second pleopod endopod tips of the 2 species.

Peck and Lewis (1978) noted that Fleming's determination was erroneous and listed the species as an undescribed troglobite. Two additional cave localities near Cricket Cave were listed for the species.

MATERIAL EXAMINED.—ILLINOIS. *Union Co.*: Cricket (= Wet) Cave, leg. J. J. Lewis, 27 Jul 1976, 23♂, 34♀ (14 ovigerous); leg. L. Hubricht, 13 Jul 1940, 34♂, 69♀. Sensemeyer Cave, leg. J. J. Lewis, 27 Jul 1976, 5♂, 7♀. Roaring Spring, leg. J. J. Lewis, 27 Jul 1976, 10♂, 3♀; leg. L. M. Page, 21 Jan 1976, 20♂, 23♀; leg. Ross and Burks, 17 Oct 1938, 19♂, 18♀; leg. Burks and Riegel, 21 Jun 1939, 6♂, 4♀; leg. Mohr and Burks, 15 May 1940, 8♂, 9♀. Keith (= Musical) Cave, on Green Creek Tributary, 0.8 km (0.5 mi) N Jonesboro, leg. Jeffrey Webb, 19 Dec 1976, 2♂, 1♀; leg. J. J. Lewis, 12 May 1979, 3♂, 4♀. KENTUCKY. *Barren Co.:* Diamond Caverns, leg. J. R. Holsinger and T. C. Barr, 24 Jul 1964, 1♂, 4♀. *Caldwell Co.:* Watson's Cave, 3.2 km (2.0 mi) W Princeton, leg. J. R. Holsinger, Ginny Tipton, et al., 12 Jun 1978, 2♂, 4♀. *Crittenden Co.:* Kinnen Cave, ca. 6.9 km (4.3 mi) SW Marion, leg. J. R. Holsinger et al., 13 Jun 1978, 2♂, 4 ovigerous ♀. *Edmonson Co.:* stream in small cave at mouth of Cotton Gin Hollow, leg. Leslie Hubricht, 12 Jan 1957. *Hart Co.:* Hidden River Cave at Horse Cave, leg. Leslie Hubricht, 30 Aug 1939, 44. *Metcalfe Co.:* Cave Hill Cave, leg. R. M. Norton, 2 Oct 1965, 2♂, 4♀; Route 68 Cave, leg. J. Cooper, 5 Jul 1967, 4♂, 1♀. *Warren Co.:* stream in cave near Laurel Avenue and Cabell Street, Bowling Green, leg. Leslie Hubricht, 25 Dec 1956, 9. TENNESSEE. *Clay Co.:* Sheales Cave leg. L. M. Ferguson and B. L. Ferguson, 25 Jul 1972, 4♂, 2♀.

A 6.2 mm ♂ from Cricket Cave is the holotype (USNM 172775). The other specimens from Cricket Cave and the Lewis collections from Sensemeyer Cave and Roaring Spring are paratypes.

DESCRIPTION.—Small, eyeless, unpigmented. Length of ♂ to 7.0 mm, of ♀ to 7.4 mm. Body slender, linear, about 4.5× as long as wide; coxae visible in dorsal view. Lateral margin of head slightly setose; margins of pereonites and telson moderately setose. Head about 1.7× as wide as long; anterior margin slightly concave; postmandibular lobes broadly rounded; posterior margin straight. Telson about 1.5× as long as wide; sides parallel; caudomedial lobe barely delimited.

Antenna 1 reaching midlength of last segment of antenna 2 peduncle; flagellum of about 7 segments, varying with age; esthete series not interrupted; esthetes present on last 3 (5.7 mm ♀), 4 (5.3 mm ♂), or 5 (5.8 mm ♂) segments. Antenna 2 reaching from pereonite 5 to midlength of telson in different individuals; last segment of peduncle about 1.9× length of preceding segment; flagellum with about 35–40 segments.

Mandibles with 4-cuspate incisors and lacinia mobilis; spine-row of both mandibles with 17 spines; apex of palp with 1 spine. Maxilla 1, apex of outer lobe with 13 spines and 1 subterminal seta; inner lobe with 5 apical plumose setae. Maxilliped with 5–6 retinacula.

♂ pereopod 1 propus about 1.8× as long as wide, palm distal to midlength with large triangular mesial process separated by U-shaped cleft from smaller rounded distal process. Dactyl flexor margin with rounded proximal boss and about 4 distal spines. ♀ pereopod 1 more slender; propus about 2.8× as long as wide, palm lacking large spines or processes; dactyl flexor margin with about 4 distal spines. Pereopod 4 of ♂ much more

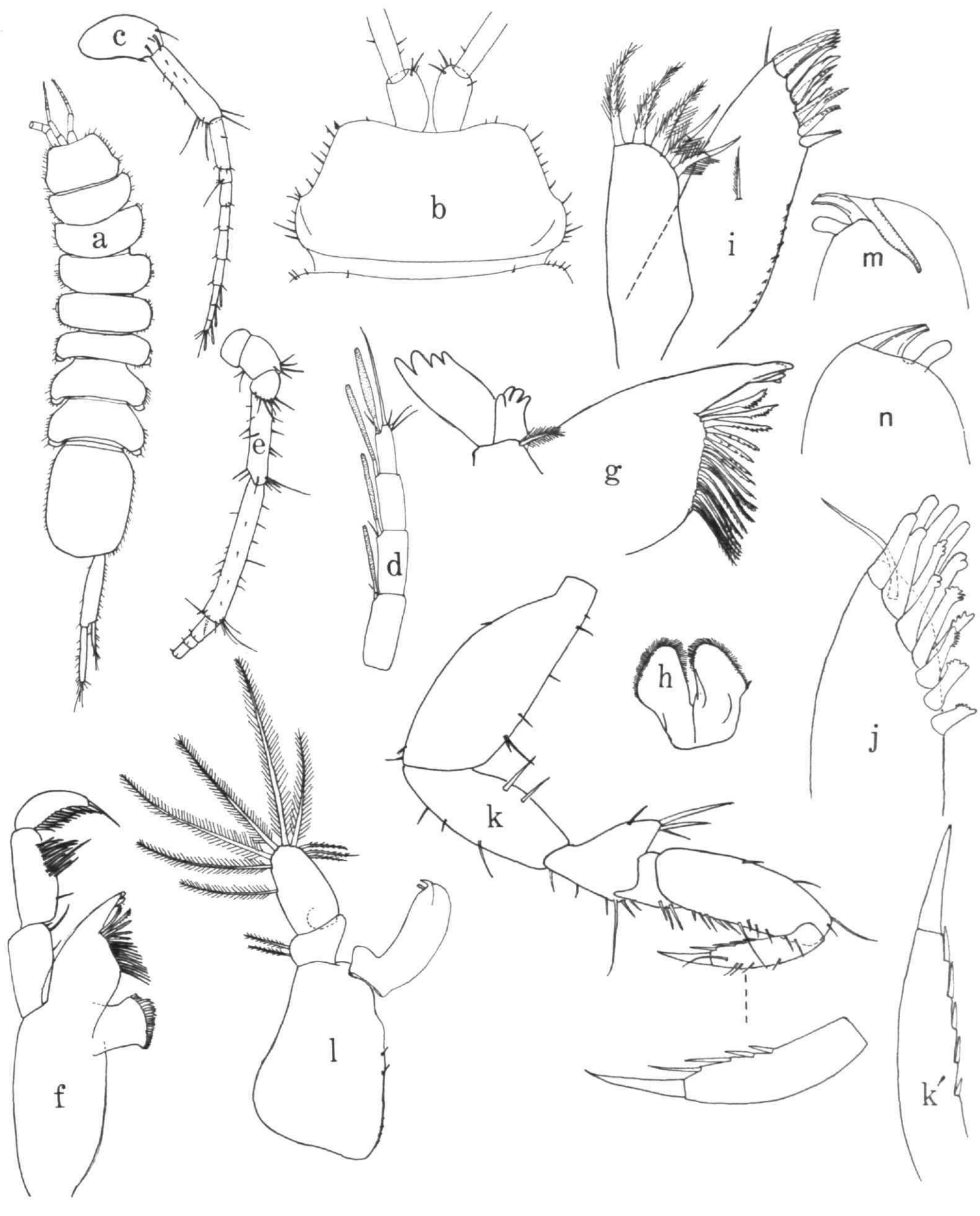

FIGURE 28.—*Caecidotea whitei*, from Union Co., Illinois (*a* = 5.0 mm ♂, Sensemeyer Cave; *b* = 5.0 mm ♂, Cricket Cave; *c,f,h,i,l* = 5.3 mm ♂, Sensemeyer Cave; *d,e,g,j,k* = 6.6 mm ♀, Cricket Cave; *k′,m,n* = 6.1 mm ♂, Roaring Spring): *a*, habitus; *b*, head; *c*, antenna 1; *d*, antenna 1, distal segments; *e*, antenna 2, proximal segments; *f*, right mandible; *g*, left mandible; *h*, labium; *i*, maxilla 1; *j*, maxilla 1, outer lobe; *k*, pereopod 1; *k′*, pereopod 1 dactyl; *l*, pleopod 2; *m,n*, pleopod 2 endopod tip, anterior and posterior.

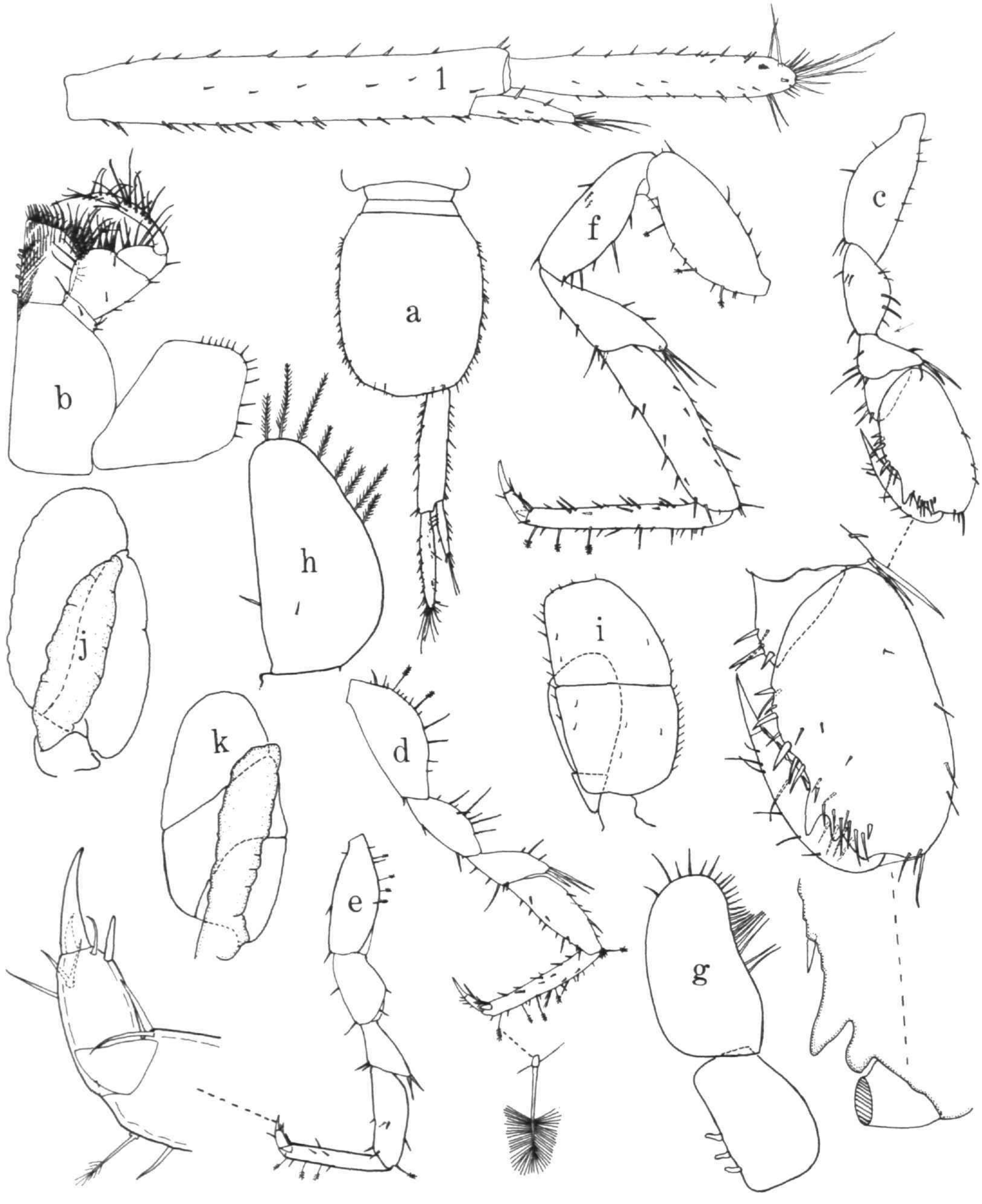

FIGURE 29.—*Caecidotea whitei*, from Union Co., Illinois (*a,f* = 5.0 mm ♂, Sensemeyer Cave; *b* = 4.6 mm ♂, Cricket Cave; *c,j,k* = 6.1 mm ♂, Roaring Spring; *d* = 6.8 mm ♂, Cricket Cave; *e* = 6.4 mm ♀, Cricket Cave; *g,i* = 5.3 mm ♂, Sensemeyer Cave; *h* = 6.6 mm ♀, Cricket Cave): *a*, pleon and uropod; *b*, maxilliped; *c*, pereopod 1; *d,e*, pereopod 4; *f*, pereopod 7; *g*, pleopod 1; *h*, pleopod 2; *i*, pleopod 3; *j*, pleopod 4; *k*, pleopod 5; *l*, uropod.

setose than that of ♀, dactyl medially with 2 spines and 1 seta, ♀ with 1 spine and 1 seta.

♀ pleopod 1 about 1.2× length of pleopod 2; protopod about 0.7× length of exopod, with 3 retinacula. Exopod about 0.6× as wide as long; apical setae short, nonplumose; lateral margin with concavity bearing longer setae. ♂ pleopod 2 protopod medial margin with about 4 proximal spinules and 2 setae at midlength. Proximal exopod segment with 2–3 lateral setae; distal segment oval, with 6 long and 3–4 shorter setae. Endopod slender, with low proximal bosses; slightly concave laterally, with 2 apical processes; cannula curving laterally, beak-shaped; lateral process extending parallel to and nearly equal in length to cannula, cylindrical, apex bluntly rounded to truncate. ♀ pleopod 2 about 1.9× as long as wide, with 8 plumose setae on apex and distal half of lateral margin. Pleopod 3 exopod about twice as long as wide, with many lateral setae, fewer on apex and medial margin. Pleopod 4 with type B exopod lacking proximal marginal spines.

Uropod about 1.3× length of telson; protopod about 1.4×–1.5× length of endopod, 2.3×–4.2× length of exopod.

ETYMOLOGY.—Named after John White, prominent Illinois speleologist, who aided the first author in making many collections in Illinois caves.

RELATIONSHIPS.—*Caecidotea meisterae* is closest morphologically to *C. whitei*. The features of the ♂ pleopod 2 endopod tip are nearly identical in both species, although in *C. meisterae* the cannula is generally more pointed and the lateral process more expanded distally. The ♂ gnathopod propus of *C. meisterae* is ovate and more robust than the slender propus of *C. whitei*. Both species lack proximal processes along the palm, but have mesial and distal processes. In *C. whitei* the mesial process is low and subtriangular; it is similar in *C. meisterae*, but larger and more prominent, often developing into an uneven, bicuspate process (Figure 20). The distal process in *C. whitei* is only apparent in rather mature specimens, and then is low and rounded. In *C. meisterae* this process is quadrate and ranges from slightly to markedly bicuspate. The uropods of large ♂ *C. meisterae* are robust and somewhat spatulate, in contrast to the slender, cylindrical uropods of *C. whitei*.

Although we have chosen to treat this material as 2 species, it is possible that intermediate forms will be found proving them to be conspecific. The differences cited above have been consistent thus far, and of the large number of specimens of *C. whitei* examined from the type-locality and elsewhere, none contain large, robust specimens typical of *C. meisterae* collections. This seems to rule out the possibility that *C. whitei* is actually an immature *C. meisterae*.

Fleming (1973) considered the material we have described as *C. whitei* and *C. meisterae*, along with *C. jordani* as *Asellus alabamensis*. Fleming compared the type-material of *C. jordani* with topotypic material of *A. alabamensis* (placed in the USNM by H. R. Steeves, III) and other specimens consdered to be conspecific with this species, including Illinois material. His conclusion was that *C. jordani* was a synonym of *A. alabamensis*. We have reexamined the type-material and topotypes and believe that *C. jordani* is a valid species (Figure 30). Of the assemblage previously considered as *A alabamensis*, *C. jordani* is the only species which possesses a proximal process on the ♂ gnathopod. This large, subtriangular process is prominent and readily separates *C. jordani* from all "*alabamensis*" species but *C. beattyi*, which also possesses a proximal process. *C. jordani* may be separated from *C. beattyi* by the much smaller distal biscuspate process on the ♂ gnathopod and the absence of the distolateral lobe present on the pleopod 1 of *C. beattyi*. *C. jordani* is also unique in possessing a 4-0-1-0-1 to 6-0-1-0-1 antenna 1 esthete formula. *C. jordani* is similar to *C. antricola*, *C. meisterae*, and *C. whitei* in the morphology of the endopod tip, the ovate exopod of the first pleopod and the type B pleopod 4. *C. jordani* is apparently a phreatobite, which does not occur in the numerous caves of the Monroe Co., Indiana karst.

We are reasonably sure that the material examined from Illinois, Indiana, and Kentucky is not *Asellus alabamensis* as reported by Fleming

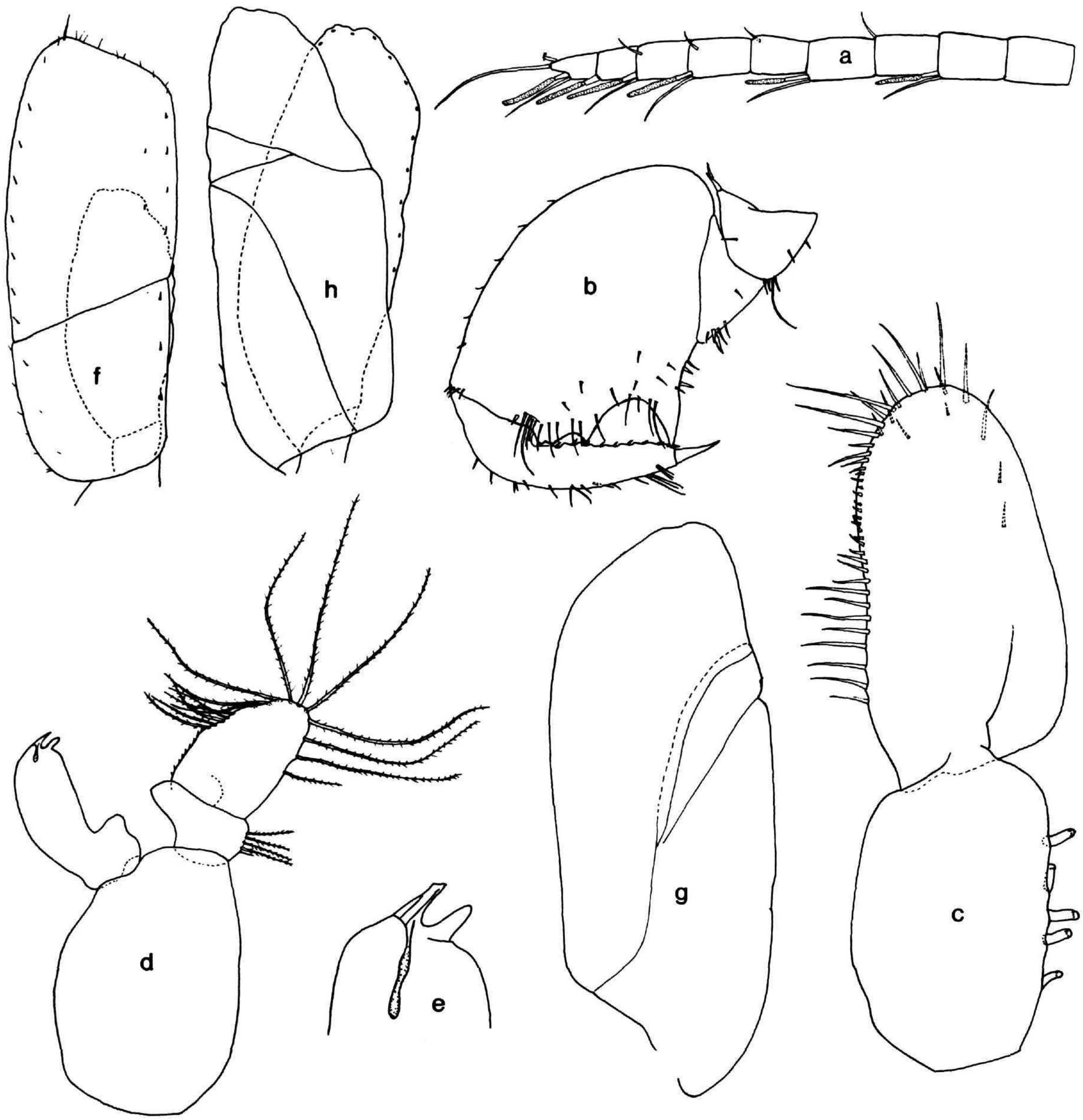

FIGURE 30.—*Caecidotea jordani*, ♂ paratype: *a*, antenna 1, distal segments; *b*, pereopod 1, medial; *c*, pleopod 1; *d*, pleopod 2; *e*, pleopod 2, endopod tip; *f*, pleopod 3; *g*, pleopod 4; *h*, pleopod 5.

(1972a), but uncertainty still remains as to the taxonomic status of this species. The original description (Stafford, 1911) is insufficent to characterize the species, and the type-material has been lost. Steeves (1964) deposited material from Morgan Co., Alabama, as topotypes of *A. alabamensis*, but the type-locality was a well in Auburn, Lee Co., Alabama. Examination of Steeve's topotypes (Figure 31) revealed a marked disimilarity between the first pleopod of the topotypes and that illustrated by Stafford (1911). Stafford's drawing, although small, clearly illustrates a prominent distolateral lobe, such as that possessed by *C. beattyi*, which is not like that of the topotypes. The morphology of the topotypes more closely resembles that of specimens of *C. bicrenata* that have not reached maturity in their development of the gnathopod processes. Furthermore, the Morgan Co. locality from which the topotypes were taken lies in the cave region of northern Alabama from which *C. bicrenata* was described, rather than the Piedmont from which *A. alabamensis* was described. Until topotypes that more adequately resemble the original description can be collected from the Piedmont in the vicinity of Lee Co., it seems best to consider *C. alabamensis* as

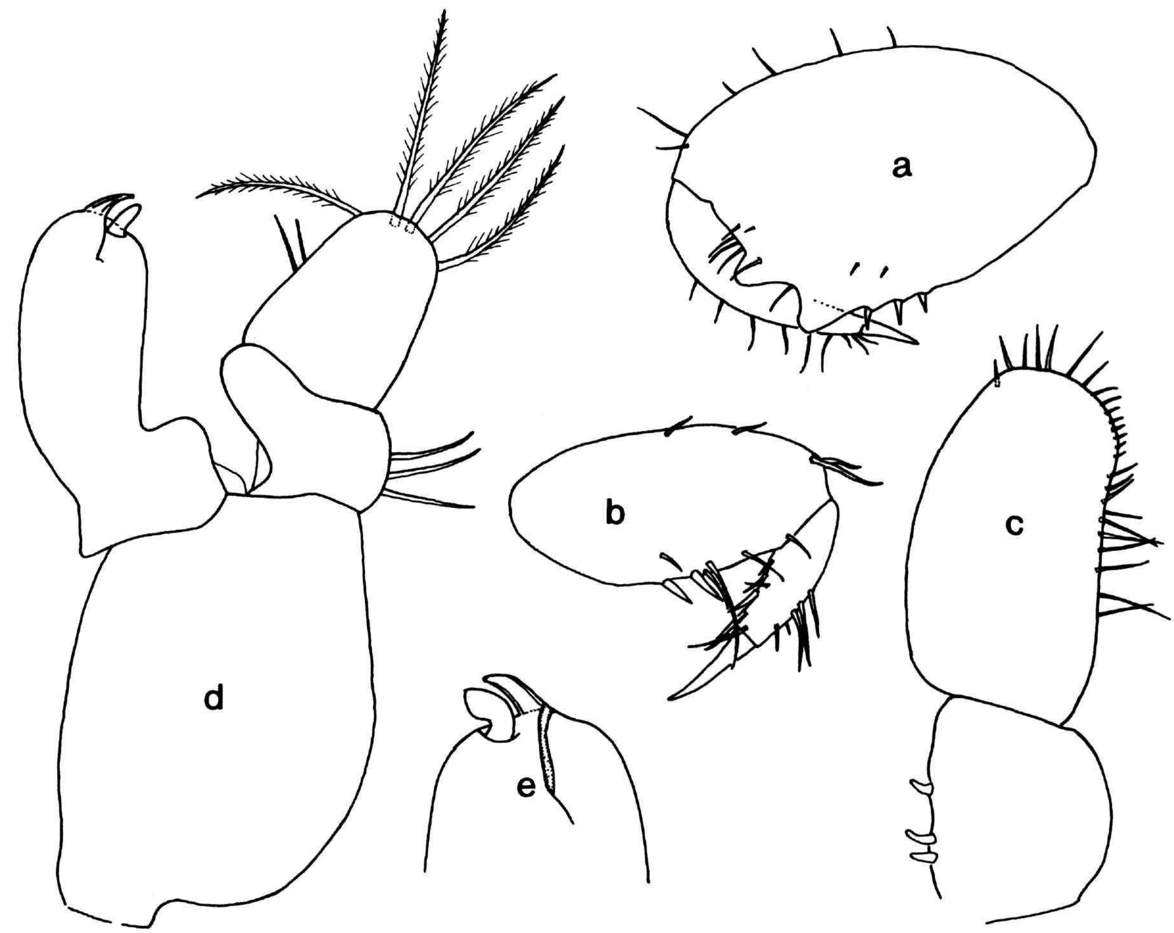

FIGURE 31.—*Caecidotea alabamensis*, ♂ "topotypes": *a,b*, pereopod 1 of 2 different specimens; *c*, pleopod 1; *d*, pleopod 2; *e*, pleopod 2, endopod tip of different specimen.

a separate, probably phreatobitic, species. Similarly, *C. bicrenata* can be recognized, at least for the time being, as a separate species inhabiting caves in northern Alabama.

Bresson (1955) redescribed *A. alabamensis* from Tennessee specimens which appear to be conspecific with material we have examined from central and southern Tennessee. According to the scenario which is proposed for *C. alabamensis*, Bresson's specimens cannot be referred to this name, but also they are neither *C. whitei* nor *C. meisterae*. We prefer not to attempt the application of either an old or new name to Bresson's asellid until the systematics of *Caecidotea* in the southern part of the Interior Low Plateaus cave region can be studied further.

HABITAT.—The Illinois localities listed above for *C. whitei*, except for Keith Cave, are parts of the same small cave system (Figure 32). The type-locality, Cricket Cave, is entered by a large, 25-foot-deep pit which intersects a large walking passage containing the stream. This stream is usually a few inches deep; however, when the cave was visited during December, 1973, the water had risen nearly a foot due to a snow melt. Only a single *C. whitei* was taken on this visit, despite a thorough search. On a July, 1976, visit, a large *C. whitei* population was found under stones in the stream and in mud-bottom pools (water temperature about 13° C). Sensemeyer cave is a few hundred feet from Cricket Cave; *C. whitei* is much less common in the gravel-filled pool examined in this cave. Roaring Spring, east of the 2 caves, is a stream flowing from the collapsed, unenterable part of the sysem.

RANGE.—Bretz and Harris (1961) discuss the geology of the type-locality, Cricket Cave, along with Roaring Spring and Sensemeyer Caves. These 3 caves are hydrologically connected in Mississippian Salem limestone; water from the caves returns to the surface at a spring which feeds a tributary stream of Mill Creek (Figure 32). In Illinois, *C. whitei* is known only from caves and springs in Union Co.

Caecidotea whitei is also known from caves of northwestern Kentucky, through the Mammoth Cave area in the central part of the state, to north central Tennessee. All of the known localities of this species occur within the Mississippian limestones of the Interior Low Plateaus Province, but the Illinois localities are very near the eastern margin of the Salem Plateau Section of the Ozark Plateaus Province.

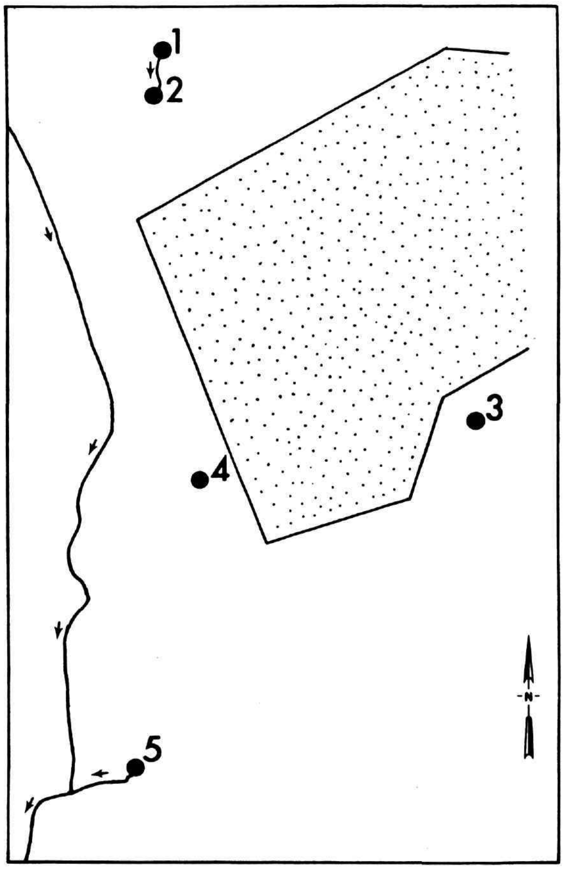

FIGURE 32.—*Cecidotea whitei*, Illinois localities (except Keith Cave). Stippled area is a cultivated field; caves are in forest margins of field; water flows from Roaring Spring (1) into Roaring Spring Cave (2) and then enters Cricket Cave (4) surfacing at spring (5) on a tributary of Mill Creek; Sensemeyer Cave (3) has a small stream that probably flows into Cricket Cave. (Generalized from Bretz and Harris, 1961.)

REMARKS.—In addition to *C. whitei* (the dominant member of the community), a troglophilic isopod, *C. brevicauda* (Forbes), is also found in the caves and springs of Union Co. *Caecidotea brevi-*

cauda is uncommon in Cricket Cave, but more abundant in Roaring Spring. The amphipods *Gammarus minus*, *G. pseudolimnaeus*, *G. troglophilus* (troglophiles or trogloxenes), and *Crangonyx packardi* sensu lata (troglobite) also occur in Cricket Cave, but are not common. The flatworms *Sphalloplana* (probably *S. hubrichti*, troglobite) and *Phagocata gracilis* (troglophile) are also present.

Some specimens of *C. whitei* were found to be infested with Chytridiomycetes, especially on the pereopods. Ciliate protozoans were also occasionally found attached to the pereopods.

The brood pouches of 2 females were examined. One contained 26 embryos, each between 0.3 to 0.4 mm in diameter; the other had 20 immatures, 0.7 to 1.0 mm in length.

Discussion

At present 7 obligate subterranean species of *Caecidotea* are known from Illinois. Of these, only *C. lesliei* is endemic to Illinois; *C. beattyi*, *C. kendeighi*, *C. meisterae*, *C. packardi*, *C. stygia*, and *C. whitei* are found both in Illinois and in adjacent states. *C. spatulata* is an epigean species.

The ranges of the 7 asellids are not easily correlated with surface drainage patterns. With the exception of *C. lesliei*, which is known from a single locality, the species are distributed over several drainage basins, with ranges up to 480 km (300 mi) in species such as *C. stygia* and *C. kendeighi*.

Four physiographic provinces occur within Illinois, and there are some correlations between these provinces and the ranges of the species of *Caecidotea*. Caves occur mostly in the Ozark Plateaus and Interior Low Plateaus (ILP) provinces of western and southern Illinois, hence it is to be expected that cave-inhabiting species would be restricted to these regions in Illinois. Most of the Illinois species are primarily inhabitants of single provinces, although they may inhabit fringe regions of other provinces. Of the cavernicolous species, *C. packardi* inhabits the Ozarks; *C. meisterae*, *C stygia*, and *C. whitei* are ILP dwellers. Most of Illinois consists of glacial till plains of the Central Lowlands Province, and here are found *C. beattyi*, *C. kendeighi*, and *C. lesliei*. *Caecidotea beattyi* inhabits parts of 3 provinces, primarily the Central Lowlands, but also the ILP and Coastal Plain.

The 7 asellids may be separated into 2 groups according to their habitat preferences: (1) inhabitants of nonconsolidated deposits, (2) inhabitants of caves. The nonconsolidated deposit inhabitants may be considered phreatobitic rather than troglobitic, and are usually recorded from drain tiles, ditches, wells, and other places where shallow groundwater can be sampled. This group includes *C. beattyi*, *C. kendeighi*, and *C. lesliei* (and the Kansas species *C. tridentata*). The cave inhabitants, generally regarded as troglobites, may be taken from limestone caves or springs. This group includes *C. meisterae*, *C. packardi*, *C. stygia*, and *C. whitei*.

The 2 groups of species tend to differ morphologically. The phreatobites tend to be more elongate, lightly pigmented, and in some cases have small eyes. The uropods of well-differentiated adult ♂ are spatulate and triangular in cross section.The cave species lack pigment and eyes; reports of vestigial eyes in *C. stygia* are probably all referable to *C. kendeighi*. The uropods of fully developed ♂ are not spatulate and are round or oval in cross section.

Several subterranean species of *Caecidotea* are sympatric in Illinois, but they have not been found to occur together. Elsewhere, *C. stygia* and *C. whitei* are syntopic in Mammoth Cave National Park, Kentucky. Co-occurrence of troglophilic species with troglobitic species of *Caecidotea*, however, is common.The troglophile *C. brevicauda* co-occurs with *C. packardi* in western Illinois, with *C. antricola* in eastern Missouri, and with *C. whitei* in southwestern Illinois.

The existence of several species of subterranean asellids in parts of Illinois far within the boundaries of massive Pleistocene glaciations requires an explanation. Two solutions have been proposed: (1) the isopods survived in groundwater under the glacial ice, as suggested for the amphipods *Stygobromus allegheniensis* and *S. borealis* in the NE United States (Holsinger, 1978) and for *S. canadensis* in Alberta, Canada (Holsinger, 1980); (2) they dispersed north from populations existing south of the limits of glaciation as or after the glaciers receded.

Most authors have favored the second explanation. Peck and Lewis (1978) suggested that phreatobitic crustaceans inhabiting the Illinois Basin may have dispersed rapidly through coarse stream sediments from the southern glacial maxima to their present ranges. Both *C. kendeighi* and the amphipod *Bactrurus mucronatus* occur in localities in the Shawnee Hills at the edge of the Illinoian glacial maximum, which could have served as glacial refugia.

North American asellids are limited to the Austral Region with the exception of 2 species: (1) *Asellus* (*Asellus*) *alaskensis* Bowman and Holmquist (1975), an epigean species that occurs in the Noatak and Selawik lowlands, Alaska, a region just north of the Arctic Circle that escaped glaciation during the Pleistocene (other members of *Asellus* (*Asellus*) inhabit cool Eurasian waters); (2) *Salmasellus steganothrix* Bowman (1975), a blind subterranean species known from Jasper and Banff National Parks, Alberta, a possible driftless area (Clifford and Bergstrom, 1976). We have identified specimens from Castleguard Cave, Banff National Park, which lies under the Columbian Field glacier. It is the only subterranean asellid known from Canada. The absence of subterranean species of *Caecidotea* from boreal areas suggests that these species might not have been able to survive the severe conditions in subglacial groundwater. There, in addition to the low temperature, they would have had to contend with a scarcity of food, low oxygen supply, and the mechanical hazards of stream scouring by melt water and abrasion by suspended silt.

The food available to subterranean animals consists of surface materials that are brought in by biotic (e.g., guano) or abiotic (e.g., washed-in detritus) means. Input of food by either method would be severely limited, if not impossible, beneath a glacier; however, large amounts of organic material crushed beneath the advancing glacier would supply at least an initial food supply. The overlying ice would restrict diffusion of oxygen to subglacial water, causing anaerobic or near-anaerobic conditions to develop; however, the well-known low metabolism of subterranean crustaceans, possibly further decreased in the frigid subglacial water, would have increased their chances for survival despite the low food and oxygen supplies. As the subterranean waters gradually cooled during the Pleistocene, subterranean crustaceans might have gradually evolved the ability to tolerate the low temperature of subglacial waters.

One of Holsinger's (1978) arguments in favor of subglacial refugia is the distance required by the dispersal hypothesis for species of *Stygobromus* now living in glaciated area. Holsinger states that the case of *S. allegheniensis* migrating from southern Pennsylvania to the vicinity of Lake Ontario in 10,000 to 15,000 years "may be stretching credence." From the southern boundary of Pennsylvania to Lake Ontario is about 400 km (250 mi). To migrate this distance in 10,000 years an amphipod would have to move an average of about 11 cm/day, or less than 10× its body length for a 13 mm *S. allegheniensis*, a feat that hardly stretches credence. Illinois is about 600 km north to south; to migrate the length of the state in 10,000 years would require an average daily move of about 16 cm, or about 16 body lengths for a 10 cm *Caecidotea kendeighi*.

The 2 explanations are not mutually exclusive, and it is not necessary to give the same explanation for all instances of present distribution in glaciated areas. For 1 species the explanation could be postglacial dispersion, and for another species it could be subglacial survival. Different explanatons could even be applied to different populations of the same species.

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