A New Subterranean Aquatic Beetle from Texas (Coleoptera: Dytiscidae-Hydroporinae)[1]

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ABSTRACT

The 1st blind, depigmented, aquifer-adapted water beetle of the family Dytiscidae is described from North America. *Haideoporus texanus* Young and Longley (n. genus, n. sp.) is superficially similar to *Morimotoa phreatica* Uéno from Japan, but differs in possessing minute, apparently nonfunctional eyes, and in sensory setal vestiture and structure of the tarsi and external male genitalia. The remarkable similarity of the fore and middle coxae and the relationship of the prosternal process to the metasternum among *Haideoporus, Morimotoa,* and *Siettitia* (a cave-adapted genus from southern France) is thought to be due to convergence as an adaptation to subterranean life parallel to the condition seen in many cave carabids (Coleoptera: Carabidae). The world fauna of subterranean aquatic beetles and the associates of *Haideoporus* are discussed.

Cave or aquifer-adapted aquatic beetles are extremely rare. The 1st cave dytiscid discovered was *Siettitia balsentensis* (Fig. 3) described in 1904 by Abeille de Perrin from southern France. Since then a 2nd species of *Siettitia* has been described from southern France (Guignot 1925, 1931–33, a *Uvarus* from Africa (Peschet 1932), *Morimotoa phreatica* (Fig. 1) from Japan (Uéno 1957), and *Troglogugiuotus concii* from a cave in Venezuela (Sanfillipo 1958). In other families, Jeannel (1950) described a cave-adapted elmid (Coleoptera: Elmidae) from the Congo, and Uéno (1957) also described the remarkable *Phreatodytes relictus,* a noterid from Japan. The discovery of a truly cavernicolous dytiscid from artesian wells in Texas is, thus, not only interesting but of possible significance to biogeography.

All the insects mentioned above are truly adapted to a subterranean cavernicolous or artesian aquifer existence and show reduction or loss of eyes, decreased pigmentation, loss of hind wings, lengthened antennae and other appendages, and greatly elongated sensory setae on the appendages and body. Other aquatic beetles reported from caves, wells, or other underground water seem to have been carried in accidentally by streams, flood water, or in some other manner.

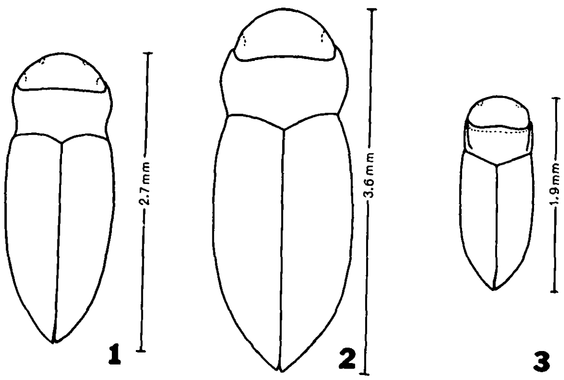
A few dytiscids show indications of incipient adaptation to an underground existence. This is especially marked in *Hydroporus rufiplanulus* Fall, which has reduced eyes and is somewhat depigmented. This species as well as other members of the subgenus *Sternoporus* (*oblitus* group) are characteristic of small streams and springs where they burrow in the sandy or gravelly bottoms and can be recovered even during dry periods by digging. *Agabus seriatus* (Say), also a characteristic inhabitant of small streams and springs, can apparently survive in wet gravel several feet below the surface. The subspecies of the latter species, however, show little or no adaptation to a subterranean life. In Florida, *Hydroporus clypealis* Sharp, occurs regularly in caves and sinkholes near Gainesville, but cave specimens seem indistinguishable from those from hypogeal streams (Young 1954).

Haideoporus GENUS NOV.

Diagnosis.—A subterranean dytiscid showing the basic characteristics of the subfamily Hydroporinae and tribe Hydroporini but blind, depigmented, lacking hind wings, and with lengthened body and leg setae and with anterior and middle coxae enlarged and globular and the prosternal process not reaching metasternum between the middle coxae. Similar superficially to *Morimotoa* (Fig. 1) from Japan, but with small degenerate eyes displaced forward at side of head, the sensory setal vestiture of elytra reduced, and the anterior tarsi and genitalia of the male differently constructed. In *Morimotoa* the ♂ anterior tarsi are angulate in relation to the tibia and equipped with a few adhesive pads on the basal 2 segments only; in *Haideoporus* the ♂ and ♀ anterior tarsi are more or less squarely articulated with the tibia and equipped with rows of small, overlapping adhesive pads on the basal 2 segments and the base of the deeply bilobed third segment as in many species of *Hydroporus.* The external ♂ genitalia of *Morimotoa* are unique among the Hydroporinae, the parameres being asymmetrical with the left paramere (considered in position of copulation) smaller than the right, and the aedeagus broad and apparently bifurcate at the tip. In *Haideoporus* the genital parameres (Fig. 6) are symmetrical and the aedeagus narrowed to the tip (Fig. 4–5), as usual in Hydroporinae.

In *Haideoporus, Morimotoa* and *Siettitia* the anterior and middle coxae are very large and globular, and the prosternal process does not meet the metasternum between the middle coxae as usual in the genus *Hydroporus.* These peculiarities may not, however, truly indicate a close relationship among these genera but may rather be biomechanical adaptions to moving in very restricted spaces. Together with the deep excisions between the prothorax and the posterior thorax, a somewhat similar adaptation

[1] Received for publication Sept. 29, 1975.



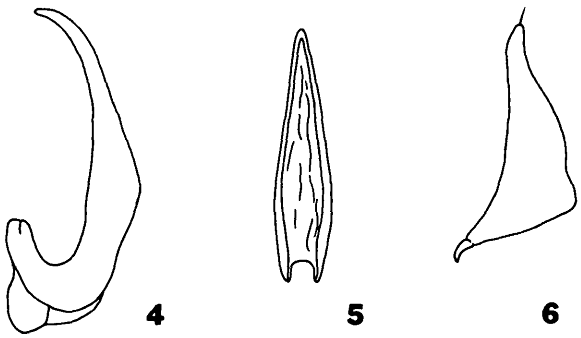


FIG. 1.—Dorsal outline of *Morimotoa phreatica*.
FIG. 2.—Same of *Haideoporus texanus* (holotype male).
FIG. 3.—Same of *Siettitia balsentensis*.
FIG. 4.—Lateral aspect of aedeagus of holotype of *Haideoporus texanus*.
FIG. 5.—Ventral aspect of aedeagus of holotype of *Haideoporus texanus*.
FIG. 6.—Right paramere of holotype of *Haideoporus texanus* (genitalia oriented in copulatory position).

occurs in *Pseudanopthalmus* and other cave carabids (Coleoptera: Carabidae).

Type-species: *Haideoporus texanus* Young and Longley, sp. nov. (Fig. 2, 7, 8).

Haideoporus texanus SP. NOV.

Diagnosis.—A small (3.4–3.7+ mm long) elongate ovate somewhat flattened dytiscid (Fig. 2, 7, 8), clearly a member of the subfamily Hydroporinae and the tribe Hydroporini, but differing from all known North American species of these groups in the enlarged fore and middle coxae and the shortened prosternal process which does not reach the metasternum between the middle coxae. Superficially similar in the latter character to the subfamily Vatellinae or tribe Vatellini (*Derovatellus* and *Macrovatellus*) but distinct in the structure of the metathorax of which the episternum reaches the middle coxal cavity and forms a part of its socket (concealed beneath middle leg on Fig. 8) and by the distinctly pseudotetramerous anterior tarsi of both sexes. Also differing from all known North American aquatic beetles in the reduced, apparently nonfunctional eyes (Fig. 9), reduced body pigmentation, and in the greater development of fine sensory setae on the elytra, pronotum, legs and maxillary palpi. Hind wings are lacking and the elytra may be fused together in the midline.

Holotype Male.—Total length 3.68 mm; length of elytron 2.48 mm; greatest width near middle of elytra 1.4 mm; width of pronotum at apex slightly less than 1.1 mm; width of pronotum at base slightly more than 1.1 mm; length of pronotum at midline 0.72 mm; greatest width of pronotum near middle 1.3 mm; length of prosternal process 0.32 mm; length of metasternum plus inner laminae of hind coxae (from base of metasternum between middle coxae to apex of inner laminae of hind coxae) 1.6 mm. *Dorsal aspect of body* elongate, ovate, the pronotum narrowed anteriorly and posteriorly, the elytra nearly parallel-sided from near base to about apical ⅓ but strongly narrowed at the base conforming to the narrowed pronotal base (Fig. 7). *Lateral aspect,* the body somewhat flattened with bases of pronotum elytra, and mesosternum forming a right angle (thus

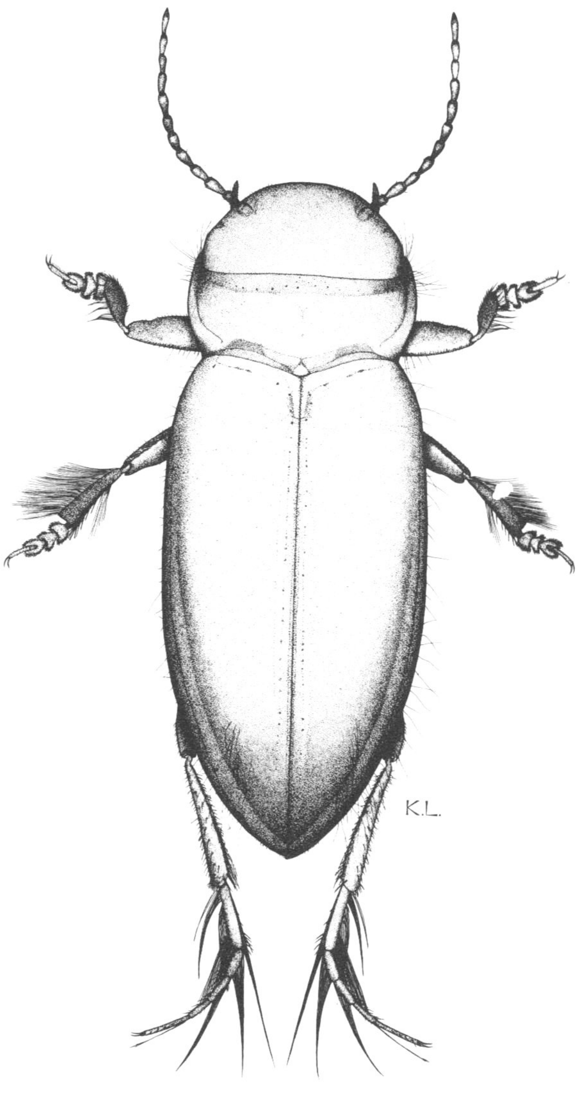


FIG. 7.—*Haideoporus texanus* dorsal aspect of paratype female.

an excision) in which the fore and middle tibiae are received. *Head* broad, almost as wide as pronotum at apex, clypeus and vertex with rather coarse microsculpture with irregular hexagonal reticulations; a peculiar little lens-like structure (Fig. 9) on each side of head just behind antennae evidently representing a reduced eye which has the surface vaguely faceted but without indications of ommatidia beneath surface (ommatidia should be clearly visible, if present, through the nearly transparent cuticle); labrum with a nearly semi-circular excision on anterior margin with a sieve-like fringe of setae; meshes of reticulation of labrum more transversely elongate on unincised portion than on clypeus; punctation of vertex, and labrum moderately fine, very sparse and irregularly distributed; irregular rows of coarser, setate punctures extending back from frontoclypeal junctures, and a nearly straight row of 6–8 punctures extending nearly straight back onto vertex on either side in a feeble impression; vertex with another pair of feeble impressions extending back from just

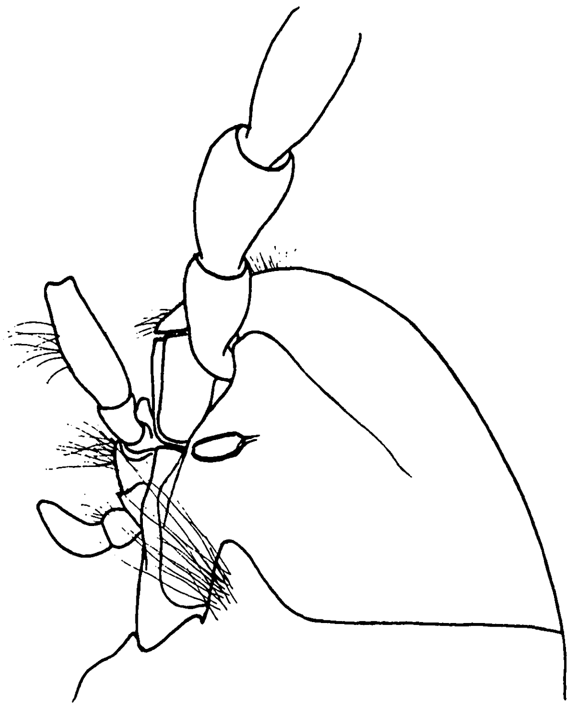


FIG. 9.—Left lateral aspect of head of paratype of *Haideoporus texanus* showing the reduced eye or eye-like organ.

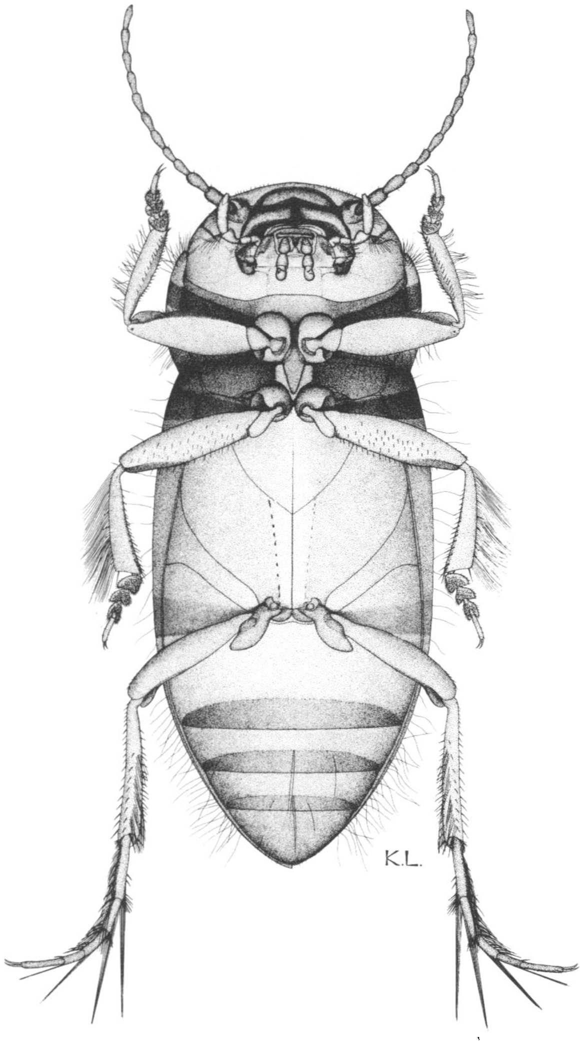


FIG. 8.—Ventral aspect of same.

inside the bases of the antennae each with 6–7 coarser, setate punctures curving inward; clypeus and front somewhat protuberant between the inner impressions. *Antennae* 11-segmented, fairly stout, the basal 2 segments thicker and longer than others, the apical segment feebly acuminate; antennae without conspicuous setae, but roughened in places as if with many sensory pits. *Maxillary palpi* 4-segmented, the apical segment bituberculate at apex; outer 2 segments with fan-like groups of longer setae. Labial palpi 3-segmented, the last segment biturberculate, but conspicuous setae lacking on all segments. *Pronotum* with dorsal surface microreticulate much as on head but with meshes of reticulation coarser and somewhat more irregular; punctation rather coarse but sparse and irregularly distributed; usual setate punctures across anterior part of disk behind anterior margin very irregularly distributed and not forming a distinct row and setate punctures along margins denser but much finer (all setae collapsed on surface in dried specimens, but while in liquid all specimens show some conspicuously long setae particularly at anterior angles as indicated in Fig. 7); lateral margin of pronotum indistinct, curving slightly outward at base but disappearing before apices anteriorly; no incised lateral basal lines on pronotum as in *Siettitia* (Fig. 3), but with some fine, very irregular, curving impressions which are very shallow and possibly reflect only the warping of the thin integument in drying. *Elytra* elongate, narrowed at base to join pronotum, then abruptly widening so that lateral margins are nearly parallel from near the basal ⅓ to the apical ⅓ where the margins curve in to the tips; elytra apparently fused along midline; elytral surface microreticulate much as on pronotum, the punctation sparse, irregular, and with mixed small and larger setate punctures; coarser setate punctures in irregular rows along sutures mainly detectable by darkening of cuticle; denser but irregularly distributed setate punctures along margins and extending onto disk toward apices (all setae collapsed as on pronotum, but appearing conspicuously long on all specimens in alcohol). *Hind* wings lacking. *Elytral epiplerae* moderately broad at bases gradually narrowing and disappearing near apical ⅓; inner margin of epipleurae sharp, but surface not conspicuously punctate and apparently without elongate setae. *Pronotal epipleurae* more nearly horizontal than those of elytra, regularly narrowed anteriorly but evident nearly to apices of lateral angles. *Abdomen* with 6 visible sternites at sides, but the 2nd and 3rd fused together and the basal sternite divided by the hind coxae as usual in Hydroporinae; apical sternites with little clumps of elongate setae along posterior margins at midline, last visible sternite simple, not impressed or otherwise conspicuously modified; surface of all sternites and rest of venter with microreticulation much as on dorsum, that of the last visible sternite somewhat denser and more transverse; punctation of sternites and rest of venter shallow; irregular, and difficult to see. *Prosternal process* short, lanceolate at tip (Fig. 8), the base abruptly turned up as usual in Hydroporinae and with small protuberance at anterior end of lower part but without any cross-striation; tip of prosternal process not reaching metasternum as usual in Hydroporinae but separated from it by the large, globular *middle coxae*. *Anterior coxae* conspicuously large and globular. Hind coxae truncate at apices of inner laminae, not overlapping the bases of the trochanters except as tiny rounded lobes. *Trochanters* large, with coarse microsculpture with elongate meshes. *Hind femora* also with coarse microsculpture with elongate meshes and also obliquely cross-ridged with 8 or more shallow, irregular depressions; each femur with several rows of short, stiff setae which are especially strong along inner lower edge of mesofemur. *Fore tibiae* more or less club-like as usual in Hydroporinae, each with a deeply impressed row of setate punctures with long setae on anterior face in apical ⅔ and a brush-like group of strong golden setae on apical ⅔ of inner apical face. *Middle tibiae* each with a few seriate, stout setae on lower face and with a fringe of very long golden setae on outer margin. *Left anterior tarsus* (right anterior tarsus lacking apical 3 segments) with segments expanded as used in males, the 3rd segment deeply bilobed partially hiding the short 4th segment; basal 2 segments and base of bilobed 3rd segment with irregular rows of small, elongate adhesive pads partially overlapping as in many species of *Hydroporus;* basal segments of fore-tarsi not obliquely attached; fore-tarsal claws long, slender, nearly equal in length. *Middle tarsi* similar to fore-tarsi. *Hind-tarsi* slender, 5-segmented, the segments more or less similar in length and each with some elongate setae; tarsal claws not perceptibly modified. *Color* nearly uniformly very light yellowish brown or brownish yellow except as usual at joints and along various sutures; evidently depigmented, not teneral (callow); integument in many places translucent so that internal structures can be seen through it; only evident markings, other than darkened joints and sutures are an irregular transverse row of small dark dots along apex and base of pronotum and others along bases of elytra, along elytra suture, and above epipleurae evidently corresponding to rows of setae. *External genitalia* with aedeagus relatively simple, slightly recurved at tip as in many species of *Hydroporus* (Fig. 4–5), not broad and bifurcate at tip as in *Morimotoa;* parameres simple, elongate, the right and left similar (Fig. 6).

Allotype Female.—Very similar to male, but integument somewhat more opaque, possibly more thoroughly hardened; color very similar except apices of abdominal sternites 3–5 darker brown (cross-banded) as shown in Fig. 8; fore-tarsi relatively broad for a female, just perceptibly narrower than in male, adhesive pads similar; total length 3.4 mm; greatest width near middle length of elytron 1.4^+ mm; length of elytron 2.4 mm; width of pronotum at base nearly the same as apex; length of pronotum at midline about 0.7 mm; greatest width of pronotum near middle 1.2^+ mm; length of pronotal process about 0.32 mm; length of metasternum plus inner laminae of hind coxae 1.4^+ mm.

Paratypes.—All very similar to holotype or allotype, range in length from about 3.6–3.76 mm. Dates of collections are as follows: Oct. 28, 1973 (1); April 7–9, 1974 (1); May 29 to June 3, 1974 (1); Sept. 9, 1974 (1); Sept. 22–23, 1974 (1); Sept 27 to Oct. 2, 1974 (1); Sept. 30 to Oct. 4, 1974 (1); Oct. 7–9, 1974 (1); Oct. 20, 1974 (1); Feb. 19–21, 1975 (1); May 7–9, 1975 (1); May 21–23, 1975 (1); May 26–28, 1974 (1); May 30 to June 2, 1975 (3); June 5–7, 1975 (1); June 16–18, 1975 (1); June 23–26, 1975 (2); June 26–30, 1975 (1); July 22, 1975 (1); Sept. 17, 1975 (1); Oct. 15, 1975 (1); Oct. 25, 1975 (1); Dec. 9, 1975 (1); Jan. 9, 1976 (1-teneral).

Type-Locality.—Holotype (Fig. 2) from an artesian well at the Aquatic Station, Southwest Texas State University near San Marcos, Hays Co., TX, collected June 12, 1974 by Joe Kolb (NMNH Type Number, 73502). Allotype same data except collected Oct. 21–23, 1974. Figured paratype (Fig. 7, 8, 9) with same data as holotype but collected Sept. 9, 1974, delineated by K. Litchfield. Other paratypes same data as type but various dates.

Location of Types—The holotype and allotype are deposited in the National Museum of Natural History (NMNH), Smithsonian Institution, Washington, DC.

Paratypes will be distributed as follows: University of Michigan Museum of Zoology, Ann Arbor, MI (2); Southwest Texas State University, Aquatic Entomology Collection, San Marcos, TX (2); Texas Tech Museum, Texas Tech University, Lubbock, TX (2); British Museum (Natural History), London; (2); Museum National d'Histoire Naturelle, Paris (2); Zoologische Sammlung des Bayerischen Staats, Munich (2); Florida State Collection of Arthropods, Division of Plant Industry, Gainesville, FL (2); Field Museum, Chicago, IL (1); California Academy of Science, San Francisco, CA (1); Museum of Comparative Zoology, Harvard University, Cambridge, MA (1); American Museum of Natural History, NY (1); Snow Museum, University of Kansas, Lawrence (1); Rijks Museum of Natural History, Leyden, Netherlands (1); Aquatic Entomology Collection, Indiana University, Bloomington (1-damaged). Specimens will be distributed to other museums if they become available.

HABITAT AND ASSOCIATES OF *Haideoporus*

The known habitat of *Haideoporus texanus* is the subterranean waters in the San Marcos area. The ground water in this area is part of the San Marcos pool of the Edwards Aquifer. The Edwards Aquifer in Texas parallels the Balcones Escarpment that was formed by extensive faulting in Createaceous age limestone. The largest concentration of caverns in Texas occurs along and adjacent to this Escarpment and aquifer. Many of the caverns are partially filled with water. Chemical analyses of the waters of this aquifer indicate an excellent water quality. Two analyses of the waters from the type-locality indicate water quality (Table 1).

This well has produced an amazing diversity of troglobitic organisms. One turbellarian, 2 gastropods (one undescribed), one ostracod, 2 copepods, 2 isopods, one thermosbaenacean, 8 amphipods (5 being described), one decapod (shrimp), and the Texas Blind Salamander, *Eurycea* (=*Typhlomolge*) *rathbuni* Stejneger.

CONCLUSIONS CONCERNING RELATIONSHIPS OF *Haideoporus*

Haideoporus appears to be a very ancient, highly specialized insect, not clearly related to any of the New World groups of Dytiscidae-Hydroporinae. If the common coxal and prosternal characteristics of *Morimotoa, Siettitia,* and *Haideoporus* are indicative of relationship, the present distribution of these genera must have been established before the separation of Japan and North America from Eurasia because it seems impossible to account for the spread of these wingless, subterranean aquifer-adapted beetles across even a narrow sea. However, we conclude that the adaptation of the coxae and prosternum in these genera is a parallel adaptation to an underground life similar to that seen in some cave Carabidae, as are obviously adaptive characteristics of reduction or loss of eyes and hind wings, decreased pigment, and increase in sensory setae and length of appendages.

The occurrence of *Haideoporus* in Texas suggests that other cave or aquifer-adapted Dytiscidae may occur in North America. The Old Appalachian fauna of beetles in the Eastern part of the United States contains several remarkable hypogeal relicts among the Dytiscidae such as the species of *Agabetes* and *Hoperius* with no known relatives and the species of *Matus* with close relatives only in Australia. Abeille de Perrin (1905) trapped *Siettitia* by placing small traps baited with meat in deep wells. Morimoto captured *Morimotoa* and *Phreatodytes* by pumping up water from wells and straining it through a plankton net.

Haideoporus was captured by placing a 500 μ mesh nylon net over the discharge from the flowing artesian well at the Aquatic Station, Southwest Texas State University (formerly the Federal Fish Hatchery at San Marcos). The well was drilled in 1895 and the source of water is a 1.5-m cavern at the depth of 59.5 meters. The cavern is one of many located along the Balcones Escarpment. The lower portions of caverns in this area are filled with water from the extensive Edwards Aquifer that parallels the Balcones Escarpment for most of its length. The escarpment has numerous faults and caverns along its length. The major fault in the area is the San Marcos Fault. San Marcos Springs, a 1st magnitude spring located ca. 0.6 km from the well discharges an avg. 4.56 cm/s (1956–1974), United States Geological Survey. The aquifer is the source

Table 1.—Physiochemical analysis of Artesian well at S.W.T.S.U.

Date	Time	Water temp	Turb. (J.T.U.)	Spec. cond. (μmhos)	Susp. solids (mg/l)	Total diss. solids (mg/l)	Total res. (mg/l)	*p*H	Diss. oxygen (mg/l)	M.O. alk. (mg/l)	CO_2 (%)
15-V-74	16:00	23.0	0.0	605	—	—	—	6.94	5.82	255	59
17-VI-74	13:45	23.0	1.0	600	2.0	356	358	6.91	5.62	252	64

Date	Time	B.O.D. (mg/l)	NO_3-N (mg/l)	NO_2-N (mg/l)	Total PO_4-P (mg/l)	Dis. PO_4-P (mg/l)	Mg (mg/l)	Ca (mg/l)	K (mg/l)	(mg/l) Na
15-V-74	16:00	—	1.19	0.0	0.01	0.015	—	—	—	—
17-VI-74	13:45	0.85	1.69	0.0	0.01	0.010	16	78	1.8	10.1

of water for both the well and springs. The flow of the springs is slightly more than 200 times that of the well. It is likely that the number of organisms discharged from the springs is also ca. 200 times as great. Extension of these methods and perhaps the invention of others may reveal other remarkable subterranean insects.

ACKNOWLEDGMENT

We thank Mr. Joe Klob and T. R. Phillips for assistance in collecting the beetles and Mr. Ken Litchfield for the preparation of the drawings. Dr. Paul J. Spangler of the National Museum of Natural History kindly loaned us specimens of *Morimotoa* and *Siettitia* and read the manuscript in preparation. Mr. R. Pope and Mr. P. Hammond of the British Museum (Natural History) also helped with the loan and exchange of material for comparison.

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