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SYSTEMATICS OF THE NEARCTIC GENUS *PSEUDIRON* (EPHEMEROPTERA: HEPTAGENIIDAE: PSEUDIRONINAE)

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ABSTRACT

The genus *Pseudiron* is redescribed and the subimagos are described for the first time. *Pseudiron meridionalis* Traver is synonymized with *P. centralis* McDunnough leaving *Pseudiron* a monotypic genus. *Pseudiron centralis* is redefined, and its biology, ecology, distribution, and geographic variation in the Central United States and Canada is discussed.

RESUMEN

Se redescrive el género *Pseudiron meridionalis* Traver y los subimagos son descritos por primera vez. Se sinonimiza *Pseudiron meridionalis* Traver con *P. centralis* McDunnough, lo que deja a *Pseudiron* como género monotípico. Se redefine *Pseudiron centralis* y se discute su biología, ecología, distribución, y variación geográfica en las partes centrales de Estados Unidos, y en Canadá.

McDunnough (1931) established the genus *Pseudiron* for *P. centralis* based on female imagos. The nymph was first described and tentatively referred to *Pseudiron* by Spieth (1938), and with additional specimens available, Burks (1953) subsequently complemented the nymphal description and accepted Spieth's generic assignment of the nymph. The genus has been assigned to various subfamilies and/or families. McDunnough (1931) originally noted that the genus had typical heptageniid venation and was close to *Siphloplecton*. Traver (*in* Needham, Traver and Hsu, 1935) assigned *Pseudiron*, along with *Metretopus* and *Siphloplecton*, to the subfamily Metretopinae, while Lestage (1938) included *Pseudiron* and *Siphloplecton* in Siphloplectonidae. Burks (1953) assigned *Pseudiron* to the family Ametropidae (sic), in which he also included *Metretopus* and *Siphloplecton*. Edmunds and Traver (1954) established the subfamily Pseudironinae in Heptageniidae for *Pseudiron*. This arrangement has been uniformly followed in subsequent classifications (Demoulin, 1958; Edmunds, et al., 1963; Koss and Edmunds, 1974; Edmunds et al., 1976; Berner, 1978; and McCafferty and Edmunds, 1979) and is based upon internal and external morphology, and studies on the eggs.

Except for generic descriptions of the adult and nymph of *Pseudiron*

by Edmunds et al. (1976), taxonomic accounts of the genus have been limited. Collections of more specimens in recent years, including reared adults, allows a more definitive description of the genus. Included herein is a redescription of the genus based on the holotype, paratypes and series of recently collected specimens from various localities throughout its geographic range.

MATERIALS AND METHODS

All measurements were made using a calibrated ocular micrometer and are given to the nearest 0.5 mm. Leg measurements of male imagos were as follows: the femora were measured from the apex of the trochanter to the apex of the femur along the dorsal surface; the tibiae and tarsi were measured from base to apex along the dorsal surface. Each of the five tarsal segments were measured and numbered from one (basal) to five (apical) and then arranged according to descending length as shown in the generic description.

To determine fecundity, female imagos were dissected, and all eggs were removed and counted under a dissecting microscope.

Localities, stages (N for nymph; A for adult which includes both imago and subimago), and deposition of examined specimens are given in the treatment to facilitate access to specimens for future reference. Abbreviations for depositories are as follows: University of Alberta (UA), Canadian National Collection (CNC), Florida State Collection of Arthropods (FSCA) [including Florida A&M University (FAMU)], Illinois Natural History Survey (INHS), Purdue University (PU), and University of Utah (UU).

Genus *Pseudiron* McDunnough

Pseudiron McDunnough, 1931:91; Traver, 1933:123; Traver, 1935:436; Spieth, 1938:3; Burks, 1953:148; Berner, 1959:46; Edmunds, Allen and Peters, 1963:13; Edmunds, Jensen, and Berner, 1976:208.

Species included: *Pseudiron centralis* McDunnough (= *Pseudiron meridionalis* Traver).

Imago.—Length: ♂ body 11-14 mm; ♂ fore wings 12-14 mm; ♀ body 11-15 mm; ♀ fore wings 12-14 mm. Head: eyes separated dorsally by width approximately 1.3x that of median ocellus, extend ventrally to frontal margin; frontal margin not produced ventrally. Thorax: pronotum with broad U-shaped posteromedian emargination; fore wing (Fig. 1) with basal costal cross veins well developed, stigmatic cross veins anastomosed. Hind wings (Fig. 2) with obtuse costal projection; 3-4 cubital intercalaries; length 0.30-0.35x length of fore wings. Male fore leg; tibiae (3.2-3.5 mm) 0.75-0.85x length of femora; tarsi 1.5-1.7x length of femora, 2.0-2.4x length of tibiae; tarsal segments in order of descending length: 2=3, 4, 1, 5; basal tarsal segment 0.7-0.8 as long as segment 2. Hind legs: tibiae (2.0-2.3 mm) 0.45-0.55x length of femora; tarsi 0.6-0.7x length of femora, 1.25-1.3x length of tibiae; tarsal segments in order of descending length: 1=2, 3=5, 4; basal tarsal segment fused or partially fused to tibiae. Claws (Fig. 4) on all legs dissimilar, 1 blunt and pad-like, and 1 hooked with small opposing hook. Male genitalia (Fig. 5): posterior margin of genital plate deeply concave, distinctly produced at bases of forceps. Genital forceps four seg-

mented; combined length of segments 3 and 4 approximately 0.66x length of segment 2; segment 1 approximately 0.20-0.25x length of segment 2. Basal half of penes fused, apical half widely divergent and rod-shaped (Fig. 5); titillators absent. Cerci 2.0-2.4x length of body. Female ninth sternum with shallow cleft at apex (Fig. 3).

Mature nymph.—Body length 11-16 mm. Head capsule subtriangular, 1.2-1.3x as wide as long; anterior and lateral margins convex, glabrous; posterior margin straight; eyes not extending to posterolateral angle. Mouthparts adapted for predation (Fig. 7-12). Labrum (Fig. 6) 0.5-0.6 as

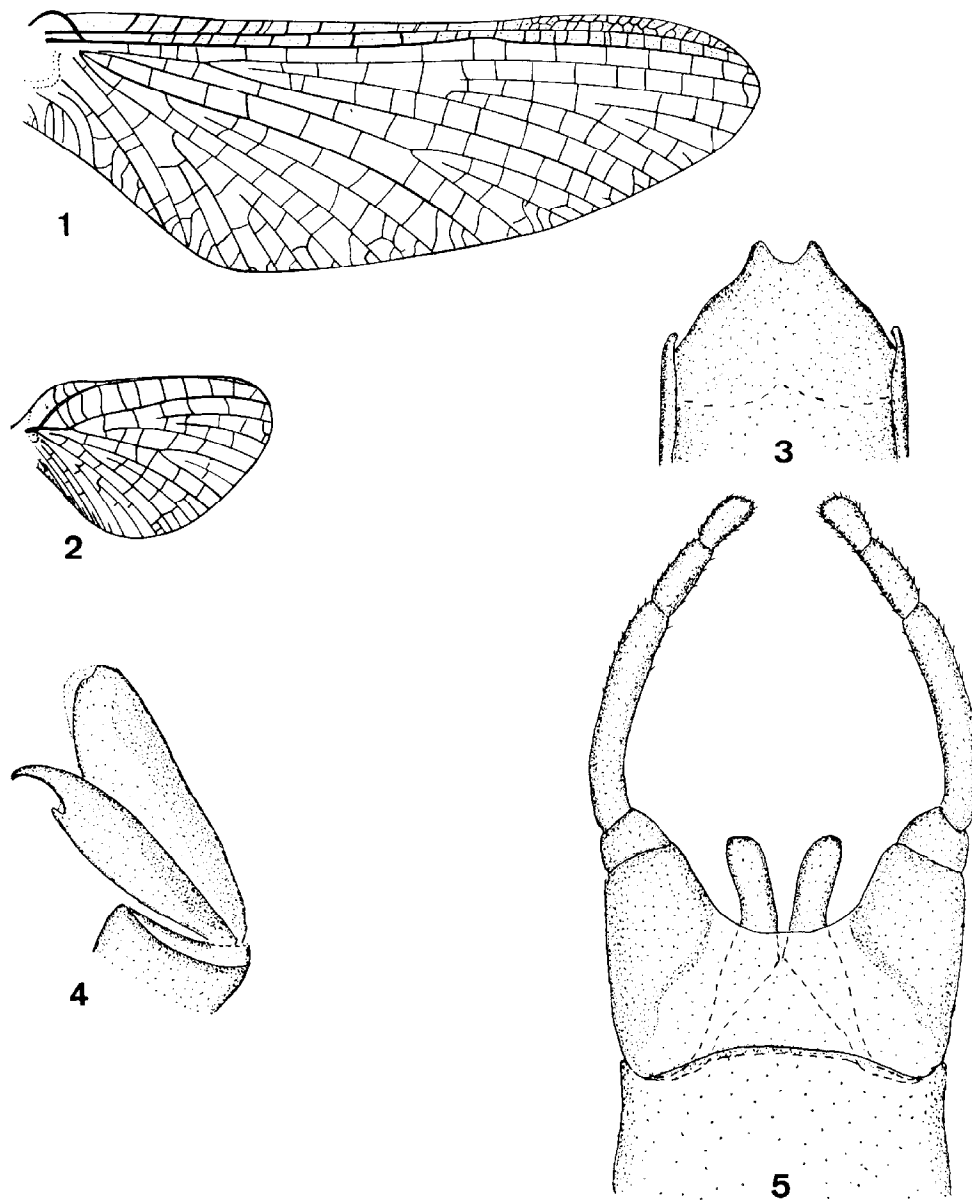


Fig. 1-5. *Pseudiron centralis*. Fig. 1-2, 4-5. ♂ imago: 1, fore wing; 2, hind wing; 4, fore claw; 5, genitalia, ventral view. Fig. 3, 9th sternum of imago.

wide as head capsule, anterior margin with broad shallow U-shaped median emargination, densely pilose. Mandible (Fig. 7, 8): outer incisor stout, forked and serrate (Fig. 8); inner incisor smaller, basal half broad, flared and with lateral serrations (Fig. 8); molar region reduced with long pectinate spines (Fig. 8). Maxillae (Fig. 10, 11): galea-lacinia with stout crown spines, one broadly serrate; long subapical and lateral spines; palpi four-segmented; segments 1 and 2 subequal length; segment 3 approximately 0.20x length of segment 2, 0.45x length of segment 4; palpi sparsely pilose; segment 3 flexible, somewhat membranous, not as sclerotized as other segments. Lingua of hypopharynx truncate (Fig. 9); greatly reduced; superlinguae lobe-like with minute apical hairs (Fig. 9). Labium (Fig. 12) with narrow deep V-shaped separation between glossae; glossae distinctly broader than paraglossae; palpi two-segmented, segments subequal in length; apical segment 0.20-0.25x as broad as basal segment. Pronotum (Fig. 18) widest posterolaterally, greatly flared laterally with prominent posterolateral projection extended beyond base of developing

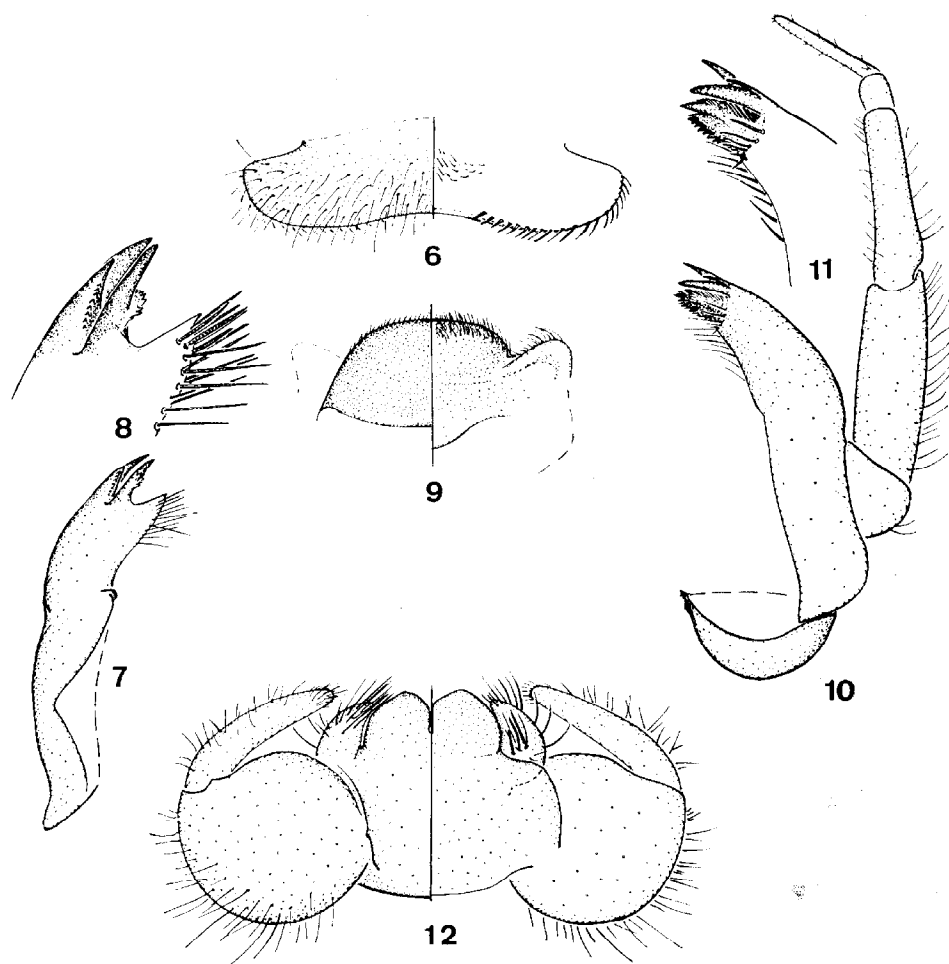


Fig. 6-12. *Pseudiron centralis*, mature nymph: 6, labrum; 7, left mandible; 8, enlarged incisor and molar area of left mandible; 9, hypopharynx; 10, left maxilla; 11, enlarged apex of galea-lacinia; 12, labium. In Fig. 6, 9, 12, dorsum on left, venter on right.

fore wing; deep rectangular median incision with thick hairs (Fig. 18); anterior margin broad, U-shaped. Fore legs: femora with sparse minute hairs on anterior (leading) margin, glabrous dorsally, posterior margin fringed with long setae; tibiae, tarsi, and claws distinctly bowed; tibiae with moderately long, sharp, pointed subapical spine, tibiae 0.6-0.65x length of femora, 0.75-0.8x length of tibiae. Middle and hind legs: similar to fore legs in armature; tibiae of hind leg 0.5-0.55x length of femora, tarsi 0.4-0.5x length of femora, 0.7-0.8x length of tibiae. Claws (Fig. 13-16) long, slender with prominent constriction at approximately 2/3 distance from base (Fig. 13, 15). Gills on abdominal segment 1 with lamella reduced to short slender filament, fibrilliform portion well developed, longer than lamella; gills on segments 2-7 (Fig. 17) with broad lamellae, lamellae tapered apically; lamellae with slender filament arising from ventral surface approximately 1/3 distance from base (Fig. 17), fibrilliform portion well developed. Abdomen: terga with short, thick posterior spines; segments 8-9 with small acute posterolateral projection. Lateral margins of terminal filaments and mesal margins of cerci densely setaceous; minute spines at articulation of each segment.

Discussion.—The illustrations of three-segmented maxillary palpi of *Pseudiron* by Spieth (1938) and Jensen (1972) are incorrect. The nymphs have four segments of the maxillary palpi.

Pseudiron can be distinguished from all other genera of Heptageniidae

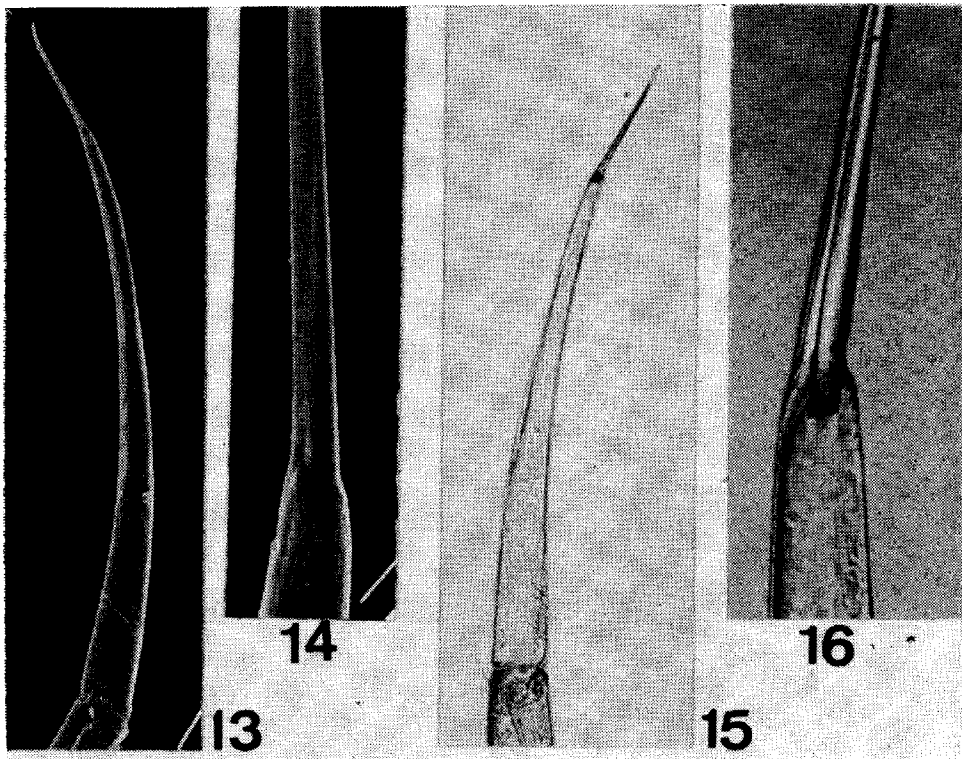


Fig. 13-16. *Pseudiron centralis*, nymphal claw. 13-14, Scanning electron micrographs: 13, whole claw (35x); 14, enlarged constriction of claw (190x). Photomicrographs: 15, whole claw (31x); 16, enlarged constriction of claw (200x).

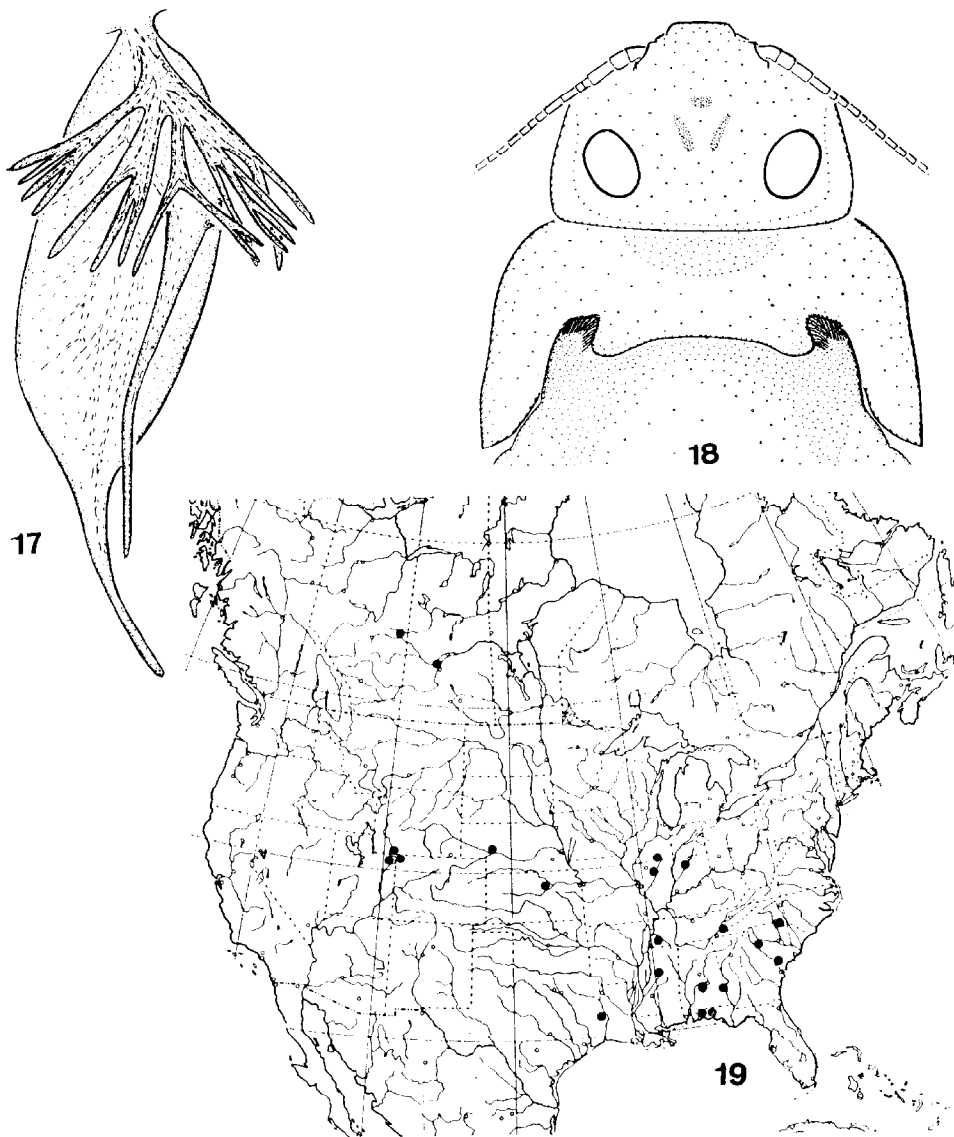


Fig. 17-18. *Pseudiron centralis*, mature nymph. 17, abdominal gill 4; 18, head and pronotum. Fig. 19, geographic distribution of *P. centralis*.

by the following combinations of characters. In the imagos: (1) male eyes are separated dorsally by approximately 1.3x the width of the median ocellus; (2) male fore tarsi are at least twice the length of fore tibiae; (3) basal segment of hind tarsi are fused or partially fused to tibiae; (4) frontal margin of head is not produced ventrally; and (5) apical halves of penes are widely divergent and lack median titillators (Fig. 5). In the nymph: (1) maxillary palpi are four-segmented (Fig. 10); (2) linguae of hypopharynx are truncate and superlinguae are greatly reduced and lobe-like (Fig. 9); (3) glossae are broader than paraglossae (Fig. 12); (4) basal segment of labial palpi is at least four times as broad as the apical segment (Fig. 12); (5) long, slender tarsal claws are equal to

or slightly longer than tarsi and are prominently constricted at approximately 2/3 distance from base (Fig. 14-16); and (6) lamellae of abdominal gills 2-7 have a slender filament arising from the ventral surface at approximately 1/3 distance from the base (Fig. 17).

Pseudiron centralis McDunnough

Pseudiron centralis McDunnough 1931:91; Traver 1933:123; 1935:437; Burks 1953:148; Berner 1959:46; 1977:23; Edmunds, Jensen and Berner, 1976:210.

Pseudiron meridionalis Traver 1935:437; Berner, 1959:46; 1977:23; Peters and Jones, 1973:246; Edmunds, Jensen, and Berner, 1976:210;

NEW SYNONYMY

Male imago (in alcohol). Length: body 11-14 mm; forewings 12-14 mm. Eyes bluish black, greyish orange on live specimens. Head pale yellow. Basal half of ocelli black, apical half white. Antennae pale yellow, scape darker washed with brown. Thorax: pronotum yellow to light brown. Meso- and metanota orange yellow to brown; margins, parapsidal furrows and median of scutellum reddish brown to dark brown. Pleura pale yellow with scattered amber-yellow or brown linings near base of wings and legs. Pro- and metasterna pale to brownish yellow, apophyseal pits amber-yellow to dark brown. Mesosternum yellow to dark brown, apophyscal pits amber-yellow to dark brown. Legs: coxae pale yellow with black-brown mid-apical marking. Femora yellow with median and apical dark brown bands. Tibiae yellow, apex of fore tibiae reddish yellow. Tarsi pale yellow, dorsum of tarsal joints including claws dark brown. Wings: membrane of fore wings hyaline, translucent white between Rs and C; longitudinal and cross veins dark brown, basal 1/2 of vein Sc brownish yellow. Membrane of hind wings hyaline; longitudinal and cross veins light brown, basal 1/2 of vein Rs darker. Abdomen: terga yellow to light brown, darker on terga 1 and 8-10, pale yellow to hyaline along lateral margins. Genitalia: forceps yellow to light brown, dorsum of segmental joints dark brown. Caudal filaments with base faintly tinged with yellow.

Female imago (dried and in alcohol). Length 11-15 mm; fore wings 12-14 mm. Head yellow with or without shades of amber-yellow or dark brown. Color of antennae, ocelli and eyes as in male imago. Thorax: pronotum yellow to ruddy brown. Meso- and metanota yellow to light brown, slightly darker along posterolateral areas; ridges on parapsidal furrows and apex of metascutellum lined with brown. Pleura pale yellow, pleurites thinly margined with dark yellow or brown. Sterna pale yellow, apophyseal pits amber-yellow to light brown. Color and markings of legs as in male imago except brown markings on coxae not as extensive. Wings: fore wings as in male imago except longitudinal veins pale yellow, progressively darker toward apex, and cross veins between veins C and R thickened and dark shiny brown. Membrane of hind wings hyaline, longitudinal and cross veins pale yellow except those between veins MA and C brown. Abdomen: terga pale yellow, anterior margins of terga 2-7 dark brown. Sterna pale yellow. Caudal filaments as in male imago.

Male and female subimago (in alcohol). Head color and markings, eyes, ocelli and antennae as in imago. Thorax: nota color and markings as in imago except lateral areas of scutellum dark smoky brown. Pleura and

sterna as in imago except mesofurcasternite slightly more extensive. Color and markings as in imago except femoral banding when present not as pronounced; tarsi smoky yellow to light brown. Wings: membrane of fore and hind wings translucent greyish white, apical third faintly shaded with brown; apical margins with short hairs; longitudinal and cross veins pale yellow except cross veins in apical third of fore wings brown. Abdomen: color and markings as in imago. Male genitalia: genital forceps amber-yellow to light brown, darker distally. Caudal filament yellow, amber yellow to brown at base. Segments densely covered with short hairs.

Mature nymph (in alcohol). Body length, 11-16 mm. Head pale yellow, vertex and areas between ocelli pale yellow to brown. Eyes black. Outer half of lateral ocelli greyish white, inner half black; median ocellus black. Antennae pale yellow. Mouthparts: inner incisor of mandibles with 5-6 teeth-like lateral serrations; molar region with 12-16 long pectinate setae (Fig. 8). Galea-lacinia of maxillae with 7-12 long pectinate subapical setae. Thorax: pronotum pale yellow, slightly darker medially, flared lateral margins translucent pale yellow. Mesonotum yellow, anterior margin and sclerites near anterior base of fore wing pads dark yellow to greyish brown. Metanotum pale yellow. Sterna yellow, prosternum paler. Legs pale yellow, apical 2/3 of claws amber yellow to greyish brown; ventral articular points of trochanter and femora dark shiny brown; femora with brown post-median band; tibio-tarsal joints brown dorsally. Abdomen: terga pale yellow, terga 8 chocolate brown; terga 2-7 either with or without anterior and sublateral brown markings, most pronounced on terga 2-3 and becoming progressively less intense on terga 4-7; terga 2-9 with a small amber-yellow to dark brown sclerotized area near posterolateral corners. Sterna pale yellow, sterna 8 brown, pale yellow medially. Gills pale yellow, darker along base of trailing edge of lamellae ranging from yellow to brown. Caudal filaments pale yellow.

Discussion.—The genus *Pseudiron* has previously included two species, *P. centralis* and *P. meridionalis*. McDunnough (1931) first described *P. centralis* from 3 female imagos collected from Kansas (USA), and Manitoba (Canada). Traver (1935) (in Needham, Traver and Hsu) subsequently redescribed the species based on the paratypes and additional collection of female imagos from Kansas. The male imagos of the species were first reported by Burks (1953).

Pseudiron meridionalis was described by Traver (1935) from a single male imago collected from the Chattahoochee River, Atlanta, Georgia.

While examining the collection of *Pseudiron* from various localities in Canada and United States, in preparation for the revision of the mayflies of Florida, it became apparent that *P. centralis* and *P. meridionalis* are the same species. The reddish brown color that Traver (1935) used to distinguish *P. meridionalis* from *P. centralis* results from sexual dimorphism. Traver was understandably handicapped by having only a male specimen on which to base the description of *P. meridionalis*, and *P. centralis* was known at the time only from female imagos. The two species are herein synonymized, with *P. centralis* as senior synonym.

The redescription of *P. centralis* is based on the paratypes, and recently collected specimens including reared adults.

Pseudiron centralis exhibits an interesting geographic gradation of color and pigmentation. In the following discussions, specimens of *P.*

centralis collected from a given geographic area (geographic subdivisions adapted from Edmunds et al., 1976) are referred to as follows: northern forms for Alberta and Saskatchewan Provinces (Canada), and Colorado, Utah and Wyoming (United States); southwestern forms for Southwest U.S.; central forms from Central U.S.; and southeastern forms for Southeast U.S. The northern forms are generally darker and more heavily pigmented than the central and southeastern forms. Only one specimen (a female imago collected from Green River, Utah) from the southwest was available, and was uniformly pale yellow, similar to most of the southeastern forms. Apparently the pigments of this particular specimen faded.

The northern nymphs have a darker brown frons and vertex compared to the uniformly pale brown to amber-yellow of the central forms, and yellow in the southeastern forms. The anterolateral corners of the mesonotum of the northern nymphs are washed with dark brown, amber-yellow to light brown in the central forms, and pale yellow in the southeastern forms with the exception of two immature nymphs from Florida which have the mesonotal corners brown. The northern nymphs have a darker femoral band than the central nymphs while this brown median band is rarely present among the southeastern nymphs; if present, it is a light brown femoral band. Abdominal pigmentation shows a similar geographic cline as the median femoral band. The abdominal terga of the northern nymphs have extensive brown markings which gradually becomes less extensive among the central forms to almost absent in the southeastern forms, except for a few individuals which have the anterior markings washed with reddish brown. Abdominal tergum 8 of the nymph ranges from uniformly chocolate brown among the northern forms to brown in the central forms and light brown or yellow in the southeastern forms. A few nymphs from Kansas however, have the color of abdominal tergum 8 similar to the northern forms, and a few of the southeastern nymphs have the same uniformly light brown terga as the central forms.

Although the adults are not as well represented as the nymphs, either numerically or geographically in the collections, there exists a similar geographic pattern of variations in color and pigmentation. Like the nymphs, the northern adults are generally darker and more extensively pigmented than the central and southeastern forms. The female imagos of the northern forms have areas between the eyes, ocelli and antennae washed with brown, and the posterior margin and frontal carina black while the central and southeastern females have uniformly amber-yellow to pale yellow head. The thorax of the northern female imagos invariably has the pronotum tinged with brown, and the sternal apophyseal pits dark brown. The pronotum of the central forms are mostly tinged with amber-yellow, rarely with pale brown, and the sternal apophyseal pits are amber-yellow, while the southeastern forms have the pronotum uniformly pale yellow except for two female imagos from Tennessee which are tinged with amber-yellow, and the sternal apophyseal pits are pale yellow. The northern adults, and a few southeastern ones as well, have a prominent brown median band on the femora, while the central forms and most of the southeastern forms, lack the femoral band. Markings of the abdominal terga of adults do not show as distinct a geographic clinal variation as in the nymphs but the northern forms generally have more extensive brown marks than the central and southeastern forms, both of which either have terga which are

uniformly pale yellow or thinly washed with brown on the anterior margins. The northern male imagos particularly the specimens from Canada, have the entire abdominal terga thinly washed with brown; the anterior margins and the entire surface of terga 8-10 are much darker. The abdominal terga of the females are not as extensively washed with brown as the males, especially on terga 1-2. Terga 3-10 have brown narrow markings confined to the anterior margin.

Other variations—such as the whitish granulations on the head, thorax and abdomen of the adults, and brown or amber yellow submedian streaks on the abdominal terga—randomly occur throughout the geographic distribution of the species. For most nymphs the dark brown marking on the base of the trailing edge of the gill lamellae occurs on gill 7, but several nymphs from Canada have this brown mark on gills 5-7. Nymphs from Florida do not have marking on the gills.

Biology and Ecology.—In a detailed study of the life history and abundance of *P. centralis* in the Sand River in east-central Alberta, Canada, Soluk and Clifford (1984) observed that the species has a univoltine summer life cycle and the eggs remain dormant for approximately nine months. The first instar larvae appeared in late April and matured in less than eight weeks. Adult emergence occurred from late June to late July. Collection records indicate that the species appears to have the same emergence period throughout its geographic range except in Florida where emergence appears to occur earlier from mid-March to early May, based on FAMU collection records representing about a ten year record of collecting in the northwestern section of the state.

In the Blackwater River, Northwest Florida, the adults of *P. centralis* emerge about mid-day (J. G. Peters, pers. comm.).

Egg fecundity of *P. centralis* is quite variable. Soluk and Clifford (1984) counted 467 and 626 eggs from two female imagos collected from Canada. I recorded a total of 692 eggs from a single female imago from Tennessee. Female imagos from Florida apparently have higher number of eggs as I counted 1553, 1670 and 1724 eggs from three dissected specimens.

The nymphs of *Pseudiron* are mostly associated with sandy river beds in medium to large rivers over much of North America (Edmunds et al., 1976). In the Sand River, Alberta, the nymphs were associated with three types of substrates (shifting sand, marginal sand, and gravelly sand) in the river bed, and exhibited a shift in their association with the types of sandy substrate during development (Soluk and Clifford, 1984). Accordingly, Stage I nymphs (lacking wing pads) were associated with sand areas, and stage III (wing pads longer than the distance between them) and stage IV (darkened wing pads) nymphs with shifting sand areas. The shift of the older nymphs to shifting sand substrates appears to be a mechanism that allows the nymphs to exploit either the greater prey availability or the lower number of potential predators and competitors in these areas (Soluk, 1983). In the Blackwater River, Northwest Florida, *P. centralis* has mostly been collected in shifting sand, strong current, and in deeper areas of the river.

The nymphs of *P. centralis* feed primarily on chironomid larvae. In the Sand River, Alberta, the nymphs were the only epibenthic predators that occupied areas of actively shifting sand (Soluk and Clifford, 1984). In the Blackwater River, Northwest Florida, two predaceous, sand dwelling-

species, a mayfly, *Dolania americana* Edmunds and Traver, and a dragonfly, *Progomphus obscurus* (Rambur) coexist with *P. centralis* nymphs. There is a dietary overlap among these three carnivores but partitioning of resources and lessening of potential competition is achieved through differential microhabitat utilization (Tsui and Hubbard, 1979). Nymphs of *P. centralis* inhabit the sand surface while *D. americana* and *P. obscurus* actively burrow into the substrates.

A discussion of the nymphal habits of *Pseudiron* by Edmunds et al., (1976) indicated that the nymphs lie on top of the sand, facing the current, with all three pairs of legs directed posteriorly and anchored in the sand. My observations however, showed the legs to be more laterally directed, spread in a spider-like fashion with claws anchored in the sand (see Plate III, Peters and Jones, 1973). The claws have a prominent constriction near the apex (Fig. 13-16) and inside it is a mass of nerve cells. Additionally, distal to the constriction is a flexible portion of the claws. The functional significance of these nerve cells and flexible distal portion of the claws is unknown.

Geographic Distribution (Fig. 19). The genus *Pseudiron* has a wide geographic distribution occurring in Central and Southeast United States west to Utah and Wyoming, and across Western and Central Canada. *Pseudiron*, a boreal endemic, probably had undergone the same dispersal mechanisms as the Nearctic mayfly genera *Siphloplecton* and *Baetisca*, which have similar distributional patterns (see Berner, 1978; Pescador and Berner, 1981). The Pleistocene glaciations probably pushed *Pseudiron* southward to its present geographic extension, and populations eventually moved back northward perhaps via the Mississippi drainage after the Pleistocene ice sheet retreated. A similar dispersal process has been attributed to *Siphloplecton* by Berner (1978) and for *Baetisca* by Pescador and Berner (1981).

Specimens Examined.—CANADA: ALBERTA: Sand R nr mouth 54°22'N, 111° 2'W, 25 VII 1977 (A, reared) (FSCA), 15 & 23 VI 82 (N,A, reared) (UA); Milk R at Writing, Stone Prov. Pk, 21 VII 82 (N,A, reared) (UA). SASKATCHEWAN: Saskatchewan R at Saskatoon, 8 XII 70 (N) (FSCA). UNITED STATES: FLORIDA: Okaloosa Co., Blackwater R, FAMU Biol. Sta. 4 1/4 mi NW Holt, 31 I 71 (N), 22 II 71 (N), 13 III 71 (A, reared), 23 IV 71 (A, reared), 8 IV 72 (N), 1 V 74 (A, reared), 1 V 74 (A, reared), 1 V 75 (A, reared), 15 IV 76 (N,A), 16 IV 77 (N), 3 V 77 (A), 9 V 77 (N,A, reared), 22 IV 78 (N), 3 IV 79 (A, reared); Blackwater R at Bryant bridge 3 mi NW Holt, 20 II 71 (N); Blackwater R, Kennedy bridge 6 mi W Blackman 23 IV 74 (N,A); Blackwater R, Peaden bridge 4 1/2 mi NW Cannon Town, 28 IV 76 (A,N), 11 V 84 (A, reared); Santa Rosa Co., Blackwater R, Riley Landing, 3 mi NW Holt, 24 IV 71 (N), 7 IV 84 (A) (all specimens, FAMU); Walton Co., at light 1/2 mi W Defuniak Springs Hwy 90, 20 IV 60 (A) (FSCA). ILLINOIS: Clinton Co., Centralia, at light, 17 VI 47 (A) (INHS); Lee Co., Prophetstown dredging sandy bottom of Rock R 15 yds from bank, 21 V 25 (N) (INHS); Dixon, at light, 26 VI 47 (A) (INHS); Rock Falls, Rock R. at light, 26 VI 67 (A) (INHS); Wabash Co., Mt Carmel, at light, 18 VI 47 (A) (INHS); Whiteside Co., Prophetstown, Rock R 26 VI 67 (A) (INHS); Winnebago Co., Rockford, 2 VI 49 (A) (INHS). INDIANA: Pike Co., White R nr Petersburg Plant, 2 V 75 (N) (PU). IOWA: County 77, 3 VII 39 (A) (INHS). KANSAS:

Douglas Co., Lawrence, 26 VI 30 (A) (CNC); Sedgewick Co., Arkansas R, 2.8 mi S Bentley, 6 VI 75 (N) (SBSK); Saline Co., Saline R, New Cambria, 10 VI 76 (N) (SBSK). MISSISSIPPI: Leflore Co., Tallahatchie R at Greenwood, 6 VI 56 (A) (FSCA). NEBRASKA: Lincoln Co., South Platte R at North Platte, 6 VII 81 (A) (UU); Keith Co., Ogallala at light nr Plate R, 22 VI 81 (A) (UU). TENNESSEE: Shelby Co., Business District at store windows, 7 VI 56 (N) (FSCA). TEXAS: Jasper Co., small stream at bridge on Farm Rd. 256, 10 mi SE Colmesneil, 4 V 77 (N) (PU). UTAH: Green R Hideout Canyon, 3 X 47 (A) (UU). WYOMING: Sweetwater Co., Blacks Fort R at Hwy I 80 W Green R, 17 VII 68 (N) (UU).

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THE IMPACT OF PHOSPHATE MINING ON
CULEX NIGRIPALPUS AND *CULEX SALINARIUS*
(DIPTERA: CULICIDAE) POPULATIONS IN
CENTRAL FLORIDA

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ABSTRACT

The seasonal distribution and abundance of *Culex nigripalpus* Theobald and *Cx. salinarius* Coquillett were compared in mined and unmined areas of the central Florida phosphate region. Total *Culex* spp. populations were significantly higher in mined than in unmined areas, but seasonal trends were similar in both locations. The 2 species demonstrated very little seasonal overlap, with *Cx. salinarius* being most numerous from March through June and *Cx. nigripalpus* dominating from June through November. Within the mined region, no difference was seen in adult *Culex* spp. population levels between waste clay and waste sand areas.

RESUMEN

Se comparó la distribución y abundancia estacional de *Culex nigripalpus* Theobald y de *C. salinarius* Coquillett en áreas minadas y no minadas de la región fosfatera del centro de la Florida. El total de poblaciones de

