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***NEUROCORDULIA (PLATYCORDULIA) XANTHOSOMA (WILLIAMSON)*  
IN TEXAS (ODONATA: LIBELLULIDAE: CORDULIINAE)**

Curtis E. Williams<sup>1</sup>

The rarity of a species is usually judged by the number of specimens in collections, both private and institutional, and the number of places where it has been found or seen. On this basis, *Neurocordulia xanthosoma* (Williamson) is rare. Its crepuscular habits, its brown coloration, and its habitat requirements, coupled with the habits of most collectors, have been its protection. Nevertheless, because of its apparent special requirements and man's modification of, and encroachment on, its environment, it may soon be a species of the past.

It was first collected in 1907, when Oklahoma was still Indian Territory, near Wister, now of Le Flore County, by Mr. E. B. Williamson on June 4, and on August 2 by Frank Collins, a boy helper living in the area. Mr. Williamson described it in 1908 as *Platycordulia xanthosoma*, n.gen., n.sp. Since then it has been reported from two counties in southeastern Kansas (Kennedy, 1917), seven additional counties in Oklahoma (Ortenburger, 1927; Bird, 1932; Pritchard, 1936; Byers, 1937; Bick, 1951; Bick & Bick, 1957), and from Marion County in northeastern Texas (Harwell, 1951). The nymphs from the Mississippi River at Alma, Wisconsin, and Fairport, Iowa, described as of this species by supposition (Byers, 1937) have proven to be *Neurocordulia molesta* Walsh (Needham & Westfall, 1955:355). Although Needham & Westfall (1955:355, 360) accepted the opinion of R. S. Hodges, who made an extensive study (unpublished) of the genus *Neurocordulia*, and treated *Platycordulia* as a subgenus, some odonatologists still question the change in status because of marked differences in the wing venation as first pointed out by Williamson.

My first introduction to *Neurocordulia (Platycordulia) xanthosoma* was on June 20, 1971, in McLennan County on Lake Creek, a spring-fed stream flowing from a reservoir by the same name. A large thunder-shower was approaching, casting its dark shadow over the area, and had caused the dragonflies to cease flying. Then I saw one flitting in and out among exposed tree roots in the shadows of the vertical bluff-bank of the creek. It flew up and down, in and out of a maze of roots, thus slowly and completely covering a section of the bank. When I netted it I thought it was a teneral male of some common species and was not impressed with my "catch." However, I placed it in an envelope with my usual stick in the bottom to prevent the eyes from being crushed, then in my cooler to keep it alive and inactive. Later, while photographing it, I realized that it was not teneral and was different from any other dragonfly in my collection.

Upon learning how little was known of the habits and life history of this species, I began paying special attention to it during the remainder of the 1971 season and of each of the following years through 1975.

COLLECTION AND OBSERVATION SITES

Since my original discovery I have observed many individuals and taken additional specimens in Texas as follows: McLENNAN Co.—Lake Creek (stream): June 21 (several observed before sunup) 1971; June 29 (1♂) 1972; June 15 (observed one for several hours), June 23 (one observed), August 3 (1♀), August 9 (two seen) 1973. Lake Waco (cove and island): May 14-16 (15 exuviae), May 19 (2♂, 7♀), May 21 (2♀ + 1 exuvia), May 23 (2♂ + 3 exuviae). June 4 (3♀ with exuviae), June 24 (many foraging and 1 mating pair) 1975. Hog Creek: May 27 (1♀ observed ovipositing), June 10 (3 seen), July 3 (many foraging at dawn) 1974; May 13 (6♂ 1♀ and more seen) 1975. South Bosque

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River: June 19 (2♂) 1972; May 24 (2♂), June 11 (3♂), June 12 (3♂), June 14 (2♂), and June 26 (1♀ and several more individuals seen) 1973; June 15 (8 exuviae) 1974 with S. Dunkle. FALLS Co.—Brazos River, near Marlin: May 15, (1 teneral ♂) 1975.

Some of these specimens have been deposited in the Florida State Collection of Arthropods, Gainesville, Florida, in the E. B. Williamson Collection, Museum of Zoology, University of Michigan, Ann Arbor, Michigan, and in the Baylor University Collection, Waco, Texas.

SITE 1. McLennan County, Lake Creek. The stream originates at the spillway of Lake Creek Reservoir on Farm to Market Road No. 1860, 5 miles west of Riesel.

SITE 2. McLennan County, South Bosque River. Six miles west of Waco city limits on Highway No. 84. It empties into the southwestern arm of Lake Waco. Generally the banks of the river are steep and heavily overgrown with shrubs, trees and weeds.

SITE 3. McLennan County, Hog Creek. This stream flows into the west side of Lake Waco north of the mouth of South Bosque River.

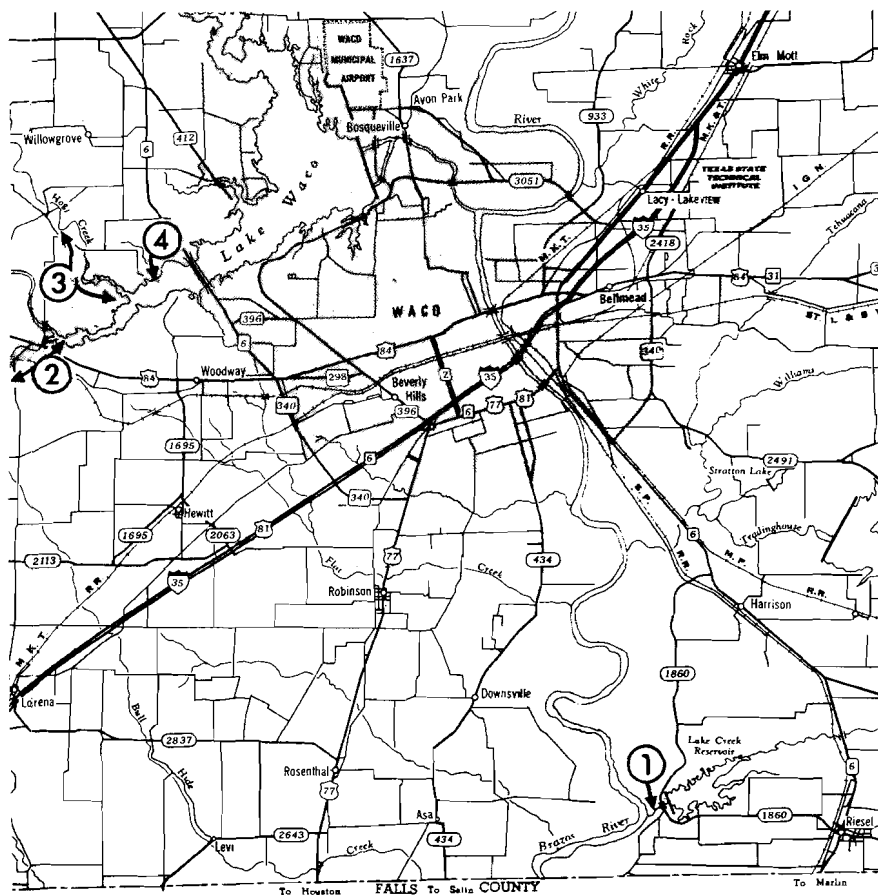


Fig. 1. Map of the vicinity of Waco, Texas. Collecting sites 1-4 in McLennan County: (1) Lake Creek; (2) South Bosque River; (3) Hog Creek; (4) Lake Waco—cove and island.

SITE 4. McLennan County, Lake Waco. Cove and island on the west side of the lake about a mile northeast of the mouth of Hog Creek. The bottom of the cove is gravel with a heavy overlay of mud and debris.

SITE 5. (not shown on map, about 10 mi. south of Site No. 1) Falls County, Brazos River. Four miles west of Marlin where it is crossed by Highway No. 7.

Each of the streams at Sites 1-3 has a rock and gravel bottom except in the deeper pools where the current is not swift and mud collects. At Site 5 the Brazos River has a mud bottom.

In almost every case where the *xanthosoma* were located, a vertical bank was involved. It is my belief that these banks are normally one of their habitats. On the days that the river was bankfull, they were driven from these places by the water, and I happened to find a place where they re-located along steep banks which were not flooded. In looking for *xanthosoma*, I tried to find them under all kinds of weather conditions, and just after the huge rain with the river full had to be an unusual condition. But, that was the only time I found them in any quantity. Many other times I have looked for *xanthosoma* in vain.

#### FLIGHT AND FORAGING

The time largest numbers of *N. xanthosoma* can be seen is at dawn and at dusk. The males and females fly together at these periods.

During the dawn and evening flights they are usually unmolested while foraging. Especially in the early morning, large numbers of small insects are on the wing. On several mornings before and until shortly after sunrise, the air above Hog Creek and South Bosque River was dense with swarming males of a tiny mayfly, *Choroterpes nanita* Traver. *N. xanthosoma* were flying in numbers, apparently haphazardly, in and out of the clouds of these insects and feeding upon them. At a later date I observed them feeding among a mating swarm, all males, of a slightly larger mayfly, *Tricorythodes explicatus* (Eaton), over a gravel road which runs along the lake shore and within 40 feet of the cove. This site was at least half a mile from Hog Creek, the nearest stream. Surely with the air so dense with these mayflies and with no competition from other dragonflies, the *xanthosoma* could eat their fill in the short time they foraged.

At times, the *xanthosoma* encounter competition or themselves become the prey. I have seen them at the first light of dawn and also at 8:30 in the evening flying low over the water of a small stream flowing into the South Bosque River. They appeared to be foraging and were making trips up and down the stream for a distance of 50 yards or more. Several *Anax junius* were also hawking low over the water, but a little higher than the *xanthosoma*, and were observed catching or trying to catch them.

Between the dawn and dusk flights the *xanthosoma* may continue their foraging but more cautiously and inconspicuously. At Lake Creek on June 15, 1973, I observed one from 2:00 to 6:00 p.m. Across the narrow stream from where I sat, the bank was low and vertical, and above it was a thick growth of weeds, tall grass and shrubs. Clouds were moving across the sky, so conditions were alternating between sunshine and shadow. When a large cloud obscured the sun for as long as one to three minutes, *xanthosoma* would come out of some grass and weeds growing beneath a shrub and start foraging at the edge of the weeds and grass. Sometimes the foraging would include the vertical bank of the stream. As it dipped in and out of the weeds, it was also flying sideways, and a distance of 20-30 feet at the edge of the weeds or vertical bank would be covered in 10 to 15 seconds. As soon as the sun came out, it immediately returned to cover beneath the shrub. Several times there was only a second or two of foraging before the sun came out again and cover was sought immediately. Here at Lake Creek there were many larger dragonflies, including some *Epicordulia princeps*, patrolling their territories. On two occasions, a *xanthosoma* was observed trying to fly down to the water, or to the vertical bank above the water. It was attacked immediately by two or three of the patrolling dragonflies, and driven away. On the South Bosque River where the *xanthosoma* occurred, there were very few larger species, and the *xanthosoma* were not molested

while flying in the shadows, even though the sun was shining. Perhaps for protection, those at Lake Creek have adopted a different manner of foraging because as soon as the sun disappeared behind a cloud, the other dragonflies stopped flying and offered no threat.

Occasionally during a period of foraging an individual will be seen very briefly perching much like a libelluline, but most of the time they stay on the wing until they retreat to cover in dense stands of tall grass, weeds, or under the lower limbs of trees (some with grapevines growing over them), but usually in the more densely-leaved shrubs. Here they hang-up in a vertical position in much the same manner as species of the Aeshnidae. They are very difficult to locate. Often to flush one out, the shrub must be shaken rather vigorously, and once flushed out it seeks new cover with as little flying as is necessary. They are very reluctant to fly when the sun is high, and one can be approached within an inch before it takes off.

#### MATING AND OVIPOSITION

The first mating pair I observed flew from the direction of a stream and lit near me. The only thing I noted that was different from the usual behavior of libellulines was that they alighted beneath a branch of a densely-leaved shrub which was in the shadow of a large tree. This occurred a little after sunrise. On June 24, 1975, at Lake Waco, I saw another mating pair flying over the water of the cove as the pair approached the island. They lit under the limb of a small hackberry tree. This was at 6:30 a.m., just after the dawn flight. When they flew away after being photographed at a range of 12-14 inches, I lost sight of them.

Many times I have observed females ovipositing in the streams, but so far, not in the lake. However, at about 9:30 one morning I saw a female ovipositing in a large pond-like area of the creek. She flew hurriedly all over the "pond," pausing very briefly here and there to deposit eggs. Normally, oviposition occurs thirty minutes to an hour after the dawn flight. Harwell (1951:205) reported that at Caddo Lake in Marion County, "The female deposited eggs while attended by the male." All the ovipositing females I have seen were alone, not even protected, guarded, or disturbed by a male. The males do not patrol an area nor do they seem to establish a territory.

#### NYPHS AND EXUVIAE

Over the years since the species was described, several collectors have searched in vain for nymphs or exuviae about which there would be no doubt of their identity as *xanthosoma*. After locating two habitats of the adults in McLennan County, I too looked many times and many hours for nymphs, and later for the exuviae near the water and as far as 40 to 50 feet from water, on weeds, rocks, small shrubs, and on tree trunks, without success from 1972 through 1974. I had assumed that *xanthosoma* was strictly a stream dweller. In the winter of 1974 and spring of 1975, I worked very hard searching the two streams, South Bosque River and Hog Creek, which flow into Lake Waco, without finding either nymphs or exuviae.

On June 15, 1974, Sidney W. Dunkle and I searched on foot, then by canoe, along the banks of South Bosque River. On the trunk of a large ash tree leaning from the bank above a place where the water was deepest and pond-like conditions existed, we found four of the coveted exuviae. Later, another was found on a twig in the debris at the base of this tree, and two on the underside of leaves of a poison ivy vine growing up the trunk. At another site, one was found on a dead twig near the edge of the bank about three feet above water. A fuller account of the finding of these exuviae and a description of them will be submitted for publication (Williams & Dunkle, in manuscript).

I took seven adults and saw more on May 13, 1975, a new early record, at Hog Creek. I renewed my efforts to find exuviae, but found none along the streams. Then it occurred to me that they must be emerging mostly in the lake area and later flying up the streams. On May 14, 15 and 16, I examined an area in the general vicinity of the mouths of the river and creek. In a small cove (Site No. 4) measuring about 50 × 25 yards, bounded by the lake shore on two adjacent sides and an island on the third side, I

found 15 *xanthosoma* exuviae: Generally the nymphs had favored the larger tree trunks for emergence, but two exuviae were on plant stems of about one-eighth inch in diameter. All were on plants or trees at the edge of the water or near the shore-line. Most of the exuviae appeared to be a week or more old. After finding these exuviae, I checked the area for several nights about midnight and before dawn but found no teneral emerging. However, I subsequently found exuviae in the daytime. On May 21, just after the first light of dawn, I found an emerged female still clinging to its exuvia, another very teneral female, and two exuviae. On May 23, I searched the area again at dawn and at 5:30 a.m., but did not discover any emerging until 6:10 a.m. and 7:00 a.m. At 7:00 a.m., the moulting occurred on a stem, next to the leaves of a small hackberry tree. On June 4, at 6:00 a.m., I located two teneral, each very near its exuvia, and at 7:15 a.m., one in the process of emerging from its nymphal skin. Each was on a leaf, 3-4 feet above ground, of a small tree 2-5 feet from the water. The three were photographed. To me, the above data on the hours of emergence indicate that *xanthosoma* nymphs do not leave the water until long past midnight, and teneral adults emerge a little before dawn or shortly thereafter. I thought the emergence season had ended in early June but I collected very teneral adults and fresh exuviae as late as June 21.

Emergence often occurs with the nymph in a horizontal position with the ventral side up (Fig. 2), and at heights of 3 inches to 12 feet above ground. On two occasions an exuvia was found about 3 inches above ground on the underside of an exposed horizontal section of the root of a small tree.

Some of the adults taken May 13 on Hog Creek were not teneral. Allowing seven days for the maturing of those that were fully adult as the beginning of emergence for the season, and June 21 as the end, I estimate the period to be at least 46 days and maybe longer. Such a long period indicates that the degree of emergence synchronization is very low in this species. The latest date I saw an adult was August 9, 1973.

The places where the exuviae and emerging teneral were found were all near areas of deeper water or deep pools. During the winter and spring there were downpours of rain



Fig. 2. *Neurocordulia xanthosoma* (Williamson) exuvia. Horizontal position assumed on the underside of a tree limb before the emergence of the adult.

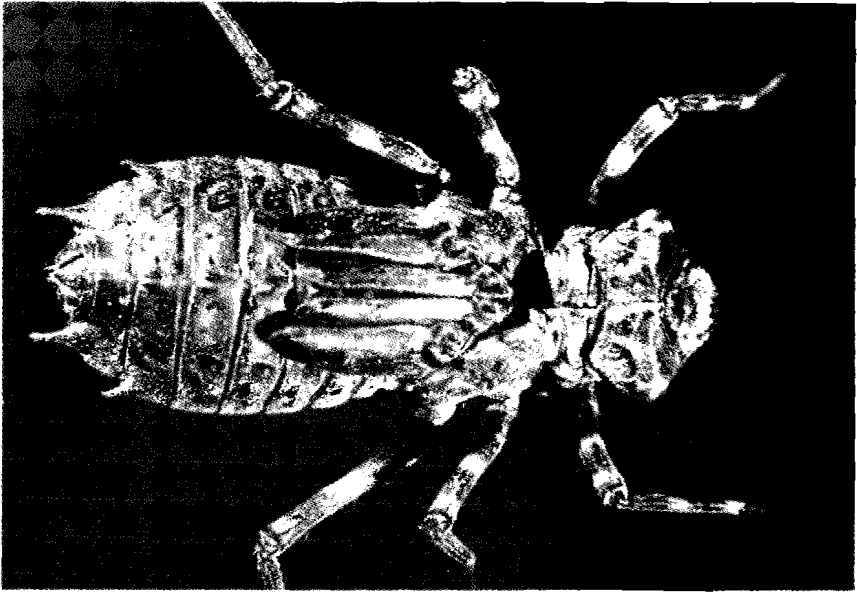


Fig. 3. *Neurocordulia xanthosoma* (Williamson), exuvia, dorsal view.

which made raging torrents of the streams entering the lake. Apparently the currents favored the particular cove where collecting of the immature stages of *xanthosoma* was most successful. The surface of the water was thickly covered with driftwood and debris that had washed down. Possibly nymphs clinging to the debris settled where the water was deepest. It is also possible that nymphs in the later stages of development seek the deeper pools near the mouth of a stream, on the south side of the island, and at a site on the south shore of the cove under a sycamore log, one limb of which was submerged in the water.

These suppositions were verified when I visited the cove and island on December 20 and 22, 1975. The water-level was very low, and some of the logs which normally were completely submerged had one end visible near the shore and the other end extending out into the water. Many of the logs, 4 to 8 inches in diameter and 4 to 12 feet in length, were pulled ashore. I found that the bark was loose and could be removed easily. Seventeen *xanthosoma* nymphs were found clinging to the logs beneath the bark. They were black like the logs, and were clinging with legs outspread and body tightly pressed against the logs. I found five on the outer surface of logs and other debris. Another was taken from the under-surface of a large rock. Most were taken from the deeper water off the cove-side of the island, although about one-third the total were taken from the water off the opposite shore of the island. Three were taken along the lakeshore across the cove from the island.

The nymphs and some of the water-soaked bark were put in an aquarium in daylight, and soon the nymphs were clinging to the under surface of the bark which was resting on the bottom. Inspections after dark revealed that all nymphs were out crawling on the sandy bottom. The aquarium was in an unheated building, and the water temperature was 50 degrees F, about the same temperature as the water in the lake.

Measurements of length and width were taken of all nymphs. Length stated is from tip of folded labium to tip of anal appendages, and width is the width of abdomen at its widest point. Length and width of the smallest nymph was 6.5 and 5.0 mm, and the



Fig. 4. Island and cove, Lake Waco, where nymphs were first found on December 20, 1975.

largest nymph was 23.0 and 11.0 mm. Wing-pads of the larger specimens were 6.0-6.5 mm in length and reached to slightly beyond the junction of abdominal segments 6 & 7. Wing-pads of the smallest specimens are scarcely discernible, and the dorsal hooks are like tiny dots, however the lateral spines are very well developed on the smallest specimen.

Because of the great variation found in the degree of development of these nymphs, I suspect that the larval development of *xanthosoma* requires at least two years, or that the long period of emerging adults and of egg laying may account for the range of size of the nymphs at the end of the breeding season. Some of the nymphs appeared to be in their final instar.

#### REDESCRIPTION OF THE FEMALE

The following description of the female is based on two specimens, and is more detailed than that published for the allotype (Kennedy, 1917).

Face yellow, with labrum more brown than yellow. Vertex yellow, darker on front. Occiput is brighter yellow. Eyes pale, with dark brown line along rear margin.

Thorax a lighter brown than abdomen, a pubescence on dorsum and entire sides softens the color and details. A pale yellow spot surrounds the spiracle. Yellow middorsal carina similar to that of male.

Wing venation similar to that of male, except for a longer anal loop. Crossveins in midbasal spaces may be 0, 1, or 2. Number of cells in the triangle of front wing 3 in 3 wings, 5 in 1 wing, and of all hind wings 2. Brown spots on all antenodal and postnodal crossveins out to tips of wings, darker on postnodals. Crossvein in hind wing triangle heavily marked with brown. Brown spot on subnodus of each fore and hind wing. In hind wing, a brown spot between fourth antenodal crossvein and distal angle of triangle. A larger spot of brown at base of hind wing begins between first paranal cell and rear end of membranule, leaving this paranal cell mostly clear. It then extends forward to cubitus and outward to proximal angle of triangle. This spot also covers rear of



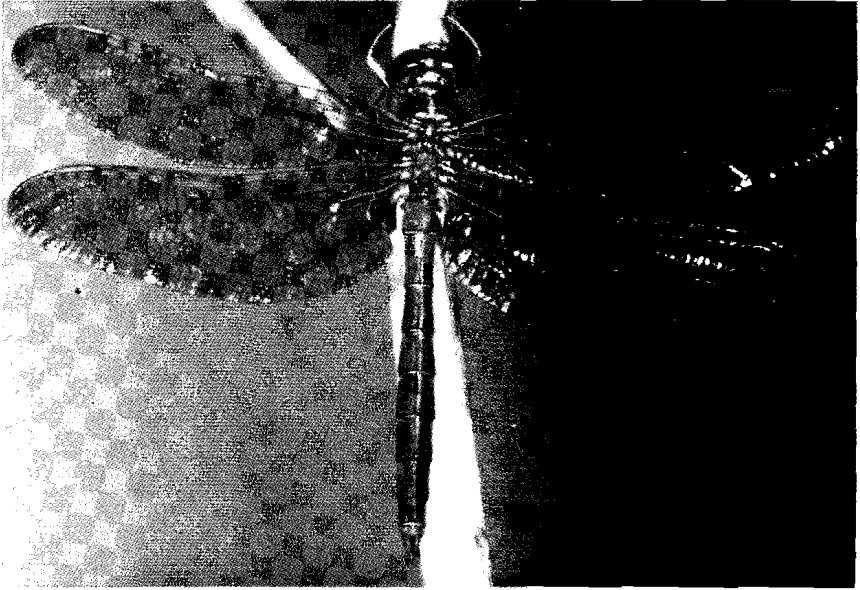


Fig. 5. *Neurocordulia xanthosoma* (Williamson), adult male, dorsal view.

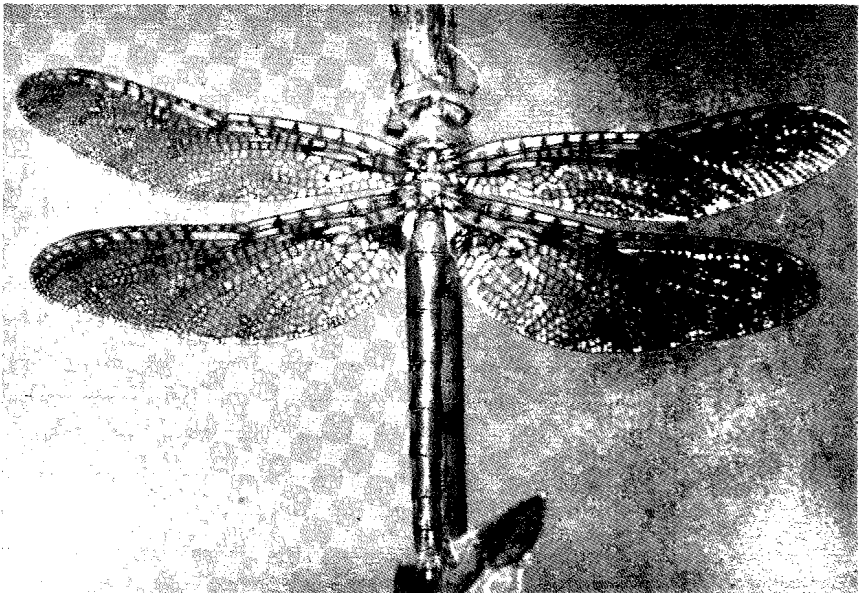


Fig. 6. *Neurocordulia xanthosoma* (Williamson), adult female, dorsal view.

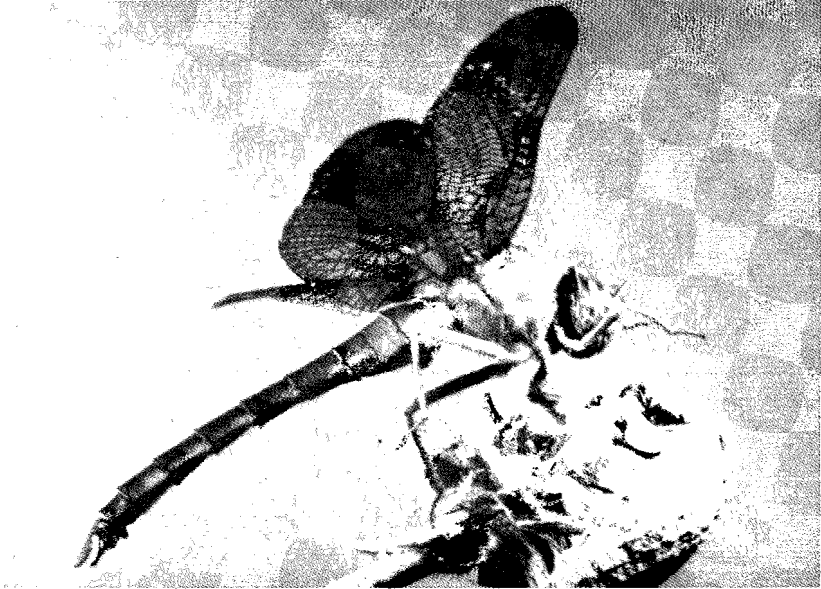


Fig. 7. *Neurocordulia xanthosoma* (Williamson), adult male, lateral view.



Fig. 8. *Neurocordulia xanthosoma* (Williamson), adult female, lateral view.

membranule for one-third its length. Upper two-thirds of membranule, white. This white continues rearward along inner border of membranule to its junction with wing margin, bordering brown spot with a thin line of white. Color in wings is more brown than yellow, which causes wings to appear spotted where the color is concentrated.

Abdomen shining golden brown and almost bare of hairs. First three basal segments similar to those of male (Figs. 5, 6), swollen most at junction of segments 2 and 3, narrowed posteriorly on 3, thereafter parallel-sided or slightly tapering to segment 10 which is narrower and yellower. Viewed laterally (Figs. 7-8), from apex of segment 3, abdomen tapers regularly through segment 8, not depressed, segments 9 and 10 narrower. Lateroventral carinae well developed on segments 5 to 9, weak and shorter on 4. Just above the carina on each side of these segments is a pale yellow spot extending from the base of the segment to half its length. Seen from above, these appear as narrow, half-length yellow edges.

Caudal appendages sparsely covered with long brown hairs, yellow at base, either yellow or brown beyond. In dorsal view, they are straight-sided on outer margins and convex on inner margins, widest at a point about mid-length, and terminate in a sharp point.

The subgenital plate (Fig. 9) terminates in two rounded lobes which are separated by a semi-circular notch, distal ends of lobes barely surpass hind margin of segment 8. Near these lobes, on the sternum of segment 9, spaced apart by a distance equal to width of the notch, are two small elongate styli which are bent rearward. Between the styli is a dense growth of white hairs. The shape of the lobes and notch may become distorted during the drying process.

#### VARIATION

Males are slightly smaller than females. Of 14 males and two females described above, measurements in millimeters are as follows: total length: ♂ 48.0-52.0, average 50.11; ♀



Fig. 9. *Neurocordulia xanthosoma* (Williamson), ventral aspect of abdominal segments 8-10 of the female, showing the vulvar lamina before the specimen was dried.

51.0-52.5, average 51.75; length of abdomen: ♂ 34.5-38.0, average 36.4; ♀ 37.0-39.0, average 38.0; anal appendages (cerci): 2.5; length of hind wing: ♂ 35.0-37.0, average 35.7; ♀ 40.0.

Often I have wondered about the great variation in the extent of color in the wings. I am now convinced that this is entirely governed by age, because all of the specimens taken late in their season have the wings completely suffused with color, while early in the season most of them do not. The color seems to accumulate very slowly throughout their life.

The number of crossveins in the midbasal space of front and hind wings is not of sufficient constancy to be reliable for use in a key. Of 41 males, one male had no crossveins in the midbasal space, four had one in one wing, two had one in two wings, four had one in three wings, and 30 had one in all four wings. Of 10 females, one had no crossveins in the midbasal space, eight had one in all four wings, and one had two in each left wing, and one in each right wing.

The number of cells in the triangles seems to be more stable with three in the forewings of all but one wing of one female with five, and two in the hind wings of all but one wing of one male with three. Needham & Westfall (1955:354) record the number as three-four in the front wings and three in the hind wings.

#### ACKNOWLEDGMENTS

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