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William Louis Stern

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Peter H. Raven and David P. Gregory

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# A REVISION OF THE GENUS *GAURA* (ONAGRACEAE)<sup>1</sup>

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and

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<sup>1</sup>This paper is respectfully dedicated to Dr. Philip A. Munz, who has contributed so much to our knowledge of the family Onagraceae during a lifetime of devoted study, on the occasion of his 80th birthday, 1 April 1972.





## A REVISION OF THE GENUS *GAURA* (ONAGRACEAE)

Among the 11 genera of Onagraceae, tribe Onagreae, *Gaura* can be recognized by the divided sporogenous tissue in its anthers; its predominantly vespertine flowering; nutlike, indehiscent capsules; and, in most species, the presence of a flap of sterile tissue near the base of each filament (Raven, Brittonia 16: 276–288. 1964; Carlquist and Raven, Amer. J. Bot. 53: 378–390. 1966). It is probably most closely related to the other genera with divided sporogenous tissue: *Calylophus*, *Clarkia*, *Heterogaura*, and perhaps *Hauya*. Like *Calylophus*, the genus *Gaura* centers in the southern plains of the United States and adjacent Mexico, especially in and around Texas, with a few mostly derivative species endemic beyond this region.

*Gaura* first became known to science through one of these derivative species, *G. biennis*. Linnaeus grew this species in the botanical garden at Uppsala from seeds that were collected in eastern Pennsylvania and brought to him by his student Peter Kalm, who collected in the area from 1748 to 1750. Linnaeus described the new genus in a thesis defended by another of his students, Leonhard Joh. Chenon, and published it in 1751. Here and in his later references to *Gaura*, Linnaeus erroneously included as a synonym Plukenet's "*Lysimachia lutea angustifolia virginiana*, flore minore," a concept that Plukenet had presented in his *Almagestum botanicum* . . . in 1696. The Virginian plants that Plukenet had were actually the plant that we now know as *Oenothera biennis* L. or a related species, and it is clear that Linnaeus based his concept of *Gaura* entirely on the living plants that he had grown himself from Kalm's seeds.

Additional species of *Gaura* were discovered along the eastern seaboard of the United States, and by the expeditions associated with the names of Alexander von Humboldt and Martín de Sessé y Lacasta and José Mariano Mociño in Mexico. Still more were added by David Douglas, Thomas Nuttall, and Thomas Drummond, among others, in their botanical explorations west of the Mississippi. By 1864, Rothrock was able to list 13 species in his synopsis of the group (Proc. Amer. Acad. Arts 6: 347–354), in which he established the genus with its present circumscription by separating the monotypic Californian *Heterogaura* and reaffirming the distinctive characteristics of Spach's genus *Stenosiphon*. The latter comprises a single species of the southern plains of the United States which we consider more closely allied to *Oenothera* than to *Gaura* (Raven, Brittonia 16: 276–288. 1964), whereas *Heterogaura* is now usually considered a derivative of



*Clarkia*. They were confused with *Gaura* at one time only because of their nutlike, indehiscent fruits, which are in fact entirely different in structure.

Joseph Rothrock was a prespicacious observer. The material he had has now been increased many hundredfold, and yet the 13 species he recognized are all included in the present revision, all but one with the same names. In addition, the main groupings of species he set up appear reasonable, although we have subdivided two of them in the light of a more complete understanding of the species involved. After the publication of Rothrock's synopsis, a few more species of *Gaura* were discovered, and a great deal of information was accumulated about the species that he knew. In 1938, P. A. Munz provided a much more extensive revision as one of his invaluable "Studies in Onagraceae" (Bull. Torrey Bot. Club 65: 105-122, 211-228. 1938), presenting in convenient form a critical review of what had been accomplished in the more than 70 years since the publication of Rothrock's brief synopsis. In 1965, Dr. Munz emended his 1938 treatment slightly in reviewing the genus *Gaura* again, this time for his monograph of the North American species of the family (N. Amer. Fl. II. 5: 1-231).

Our own studies of the genus *Gaura* have occupied much of our attention for the past 15 years. During the course of our work, we have studied all of the species in the field, usually at several or in some cases up to hundreds of localities. We have observed their pollination systems and floral biology at one or more localities. All of the species have been grown in the experimental garden, and hybrids have been made in many of the possible combinations. Hundreds of determinations of chromosome number and meiotic configuration have been made (Raven and Gregory, Brittonia 24: 71-86. 1972). All of this information has been brought to bear in the present paper upon the taxonomy of the genus, and it has naturally made possible some consolidation and reorganization of the taxa, as well as the recognition of a few hitherto undetected species. Our experimental data will not, however, be presented in the current paper, which is designed to provide a basis for subsequent publications on different aspects of the genus *Gaura*.

### PHYLOGENETIC RELATIONSHIPS

We have in the current paper divided the 21 species of *Gaura* we recognize into eight sections. We visualize these sections as homogeneous groups of closely related species, and important evolutionary units. Insofar as possible, we have set them up so as to be directly comparable with the sections recognized by Lewis and Lewis in their outstanding monograph of the genus *Clarkia* (Univ. Calif. Publ. Bot. 20: 241-392. 1955). In his



1938 revision, Munz grouped the species of *Gaura* into only two sections, one including only *G. mutabilis*. Although this species has yellow flowers, a long floral tube, and is pollinated by hawkmoths, we do not consider it much more distinct than some of the other sections we have recognized here, and we believe that sections based upon small, closely related assemblages of species provide a useful basis for discussions of a genus for which sufficient information is available to make the recognition of such sections possible.

Within *Gaura*, a clumped, perennial habit is clearly primitive, and is shared with the more generalized members of the relatively closely related genus *Calylophus*. Rhizomatous perennials and also annuals are specialized in this respect. The fruits of all species of *Gaura* are fundamentally similar, with thick, tough walls and usually four ovules (occasionally up to eight) and very thin partitions between the locules that do not persist to maturity. Within this fundamental ground plan, we have assumed that more complex morphologies have been derived: ornate shape (sections *Campogaura*, *Xenogaura*), an evident stipe (section *Stipogaura*), or obvious wings on the angles (section *Pterogaura*). In addition, the obviously 4-angled fruits of section *Gaura* are held to be more specialized than the more nearly terete ones of what we would regard as generalized species.

These two trends—in habit and fruit shape—are correlated not only with one another but also with other morphological features and with the geographical distribution of the respective groups in suggesting a pattern of phylogeny for the genus as a whole. Only a few species have elongate, subterete fruits lacking wings, stipes, or other obvious elaborations (figs. 1–4). Three of these—*Gaura mutabilis* (section *Gauridium*) and *G. macrocarpa* and *G. boquillensis* (section *Xerogaura*)—are clumped perennials. These three species are colonial, occurring in scattered localities in west Texas, Nuevo León, and Coahuila, and south through Chihuahua to the Sierra Madre Occidental and the Trans-Mexican Volcanic Belt. *Gaura mutabilis* is the only species of the genus with yellow flowers. It has a floral tube that is very narrow and 26–42 mm long, in contrast to the other species of the genus, in which the floral tube is 1.5–15 mm long. At the base of each filament, there is no scale closing the mouth of the floral tube, as there is in all other species of the genus. This species is the only member of the genus that is regularly pollinated by hawkmoths, and it may be primitive in its long floral tube and lack of scales, as well as in its yellow flowers. All of these features are found in some species of the related genus *Calylophus*.

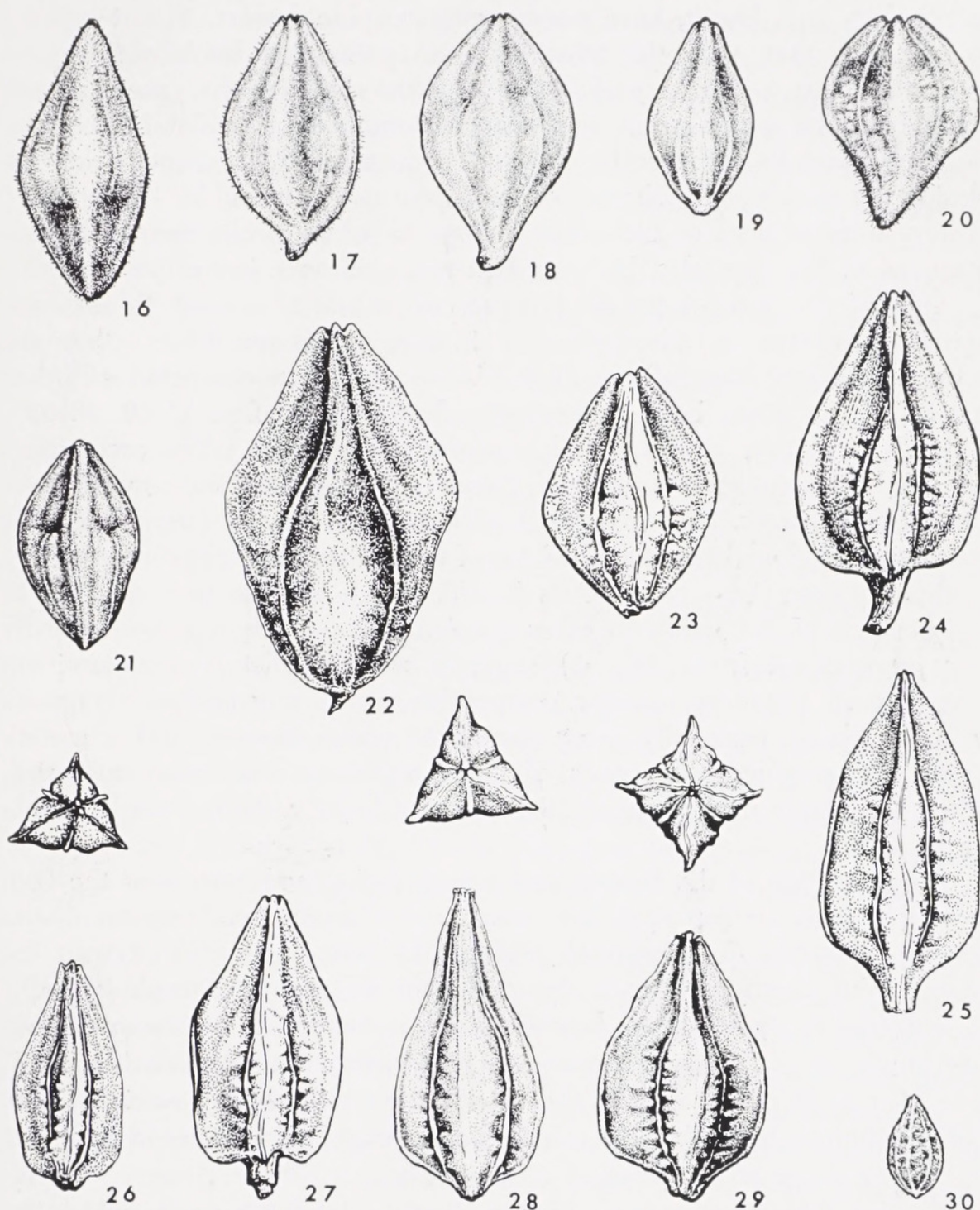
The two species of section *Xerogaura* differ from *Gaura mutabilis* in their white flowers, relatively short floral tube, and scale at the base of each





FIGURES 1-15. Mature fruits of species of *Gaura*. Fig. 1. *G. mutabilis*.—Fig. 2. *G. macrocarpa*.—Fig. 3. *G. boquillensis*.—Fig. 4. *G. parviflora*.—Fig. 5. *G. coccinea*.—Fig. 6. *G. villosa* subsp. *villosa*.—Fig. 7. *G. villosa* subsp. *parksii*.—Fig. 8. *G. calcicola*.—Fig. 9. *G. filipes*.—Fig. 10. *G. mckelveyae*.—Fig. 11. *G. sinuata*.—Fig. 12. *G. drummondii* (*G. odorata* of many authors).—Fig. 13. *G. lindheimeri*.—Fig. 14. *G. angustifolia*, 4-sided fruit.—Fig. 15. *G. angustifolia*, 3-sided fruit.





FIGURES 16-30. Mature fruits of species of *Gaura*, and of *Stenosiphon*. Fig. 16. *G. neomexicana* subsp. *neomexicana*.—Fig. 17. *G. neomexicana* subsp. *coloradensis*.—Fig. 18. *G. longiflora* (Marion Co., Illinois).—Fig. 19. *G. longiflora* (Harris Co., Texas).—Fig. 20. *G. biennis*.—Fig. 21. *G. demareei*.—Fig. 22. *G. suffulta* subsp. *suffulta*.—Fig. 23. *G. suffulta* subsp. *nealleyi* (*G. suffulta* var. *terrellensis*).—Fig. 24. *G. suffulta* *nealleyi*.—Fig. 25. *G. hexandra* subsp. *gracilis*.—Fig. 26. *G. hexandra* subsp. *hexandra*.—Fig. 27. *G. brachycarpa*.—Fig. 28. *G. triangulata*, 3-sided fruit.—Fig. 29. *G. triangulata*, 4-sided fruit.—Fig. 30. *Stenosiphon linifolius*.



filament. Otherwise, they resemble *G. mutabilis* vegetatively and in fruit morphology and, like it, have nearly actinomorphic flowers. It is tempting to speculate that, with the transition from pollination by hawkmoths to pollination by noctuids and other medium-sized moths, predominant throughout the entire genus except for *G. mutabilis*, the floral tube was shortened and then the scales evolved because of their adaptive role in closing the mouth of the shortened floral tube against possible "illegitimate" visitors such as bees or flies. The change to white petals seems to have occurred at this time also, but its adaptive significance is not clear.

One of the most interesting points of similarity among these three species, primitive on other grounds, is that they have flowers that are actinomorphic or essentially so (figs. 31–33). With one exception, all other species of the genus have zygomorphic flowers (e.g., figs. 35–36, 58–63), a floral trend that represents an obvious specialization. The exceptional species is the autogamous annual *Gaura parviflora*, the only member of section *Schizocarya*. The very small flowers of this species (fig. 34) do not have well developed scales at the base of the anthers, but, as pointed out by Rothrock (Proc. Amer. Acad. Arts 6: 348. 1864), they do have papillae in the position of the scales in other species. This, taken together with its very generalized fruits (fig. 4) suggests strongly that *Gaura parviflora* was derived from an ancestor comparable to *G. macrocarpa*. It grows in moist places, especially along streams in plains country, and is a rank weed that produces thousands of fruits under favorable circumstances, when the plants may be up to 3 m tall, with juicy stems 3 cm or more in diameter.

Specialization of the flowers and a progressive modification of the fruit toward a more or less stipe-like base resulted in the evolution of *Gaura coccinea* (section *Campogaura*), widespread and variable throughout the plains from southern Canada to south-central Mexico. Morphologically, *G. coccinea* is similar to *G. boquillensis*; but unlike all species mentioned previously, it is a polyploid complex, comprising populations with  $n = 7$ ,  $n = 14$ ,  $n = 21$ , and  $n = 28$ . The extensive recombination associated with polyploidy may have played a role in the success of this species in achieving the widest range of any member of the genus.

Section *Stipogaura* consists of five closely related species in which the base of the fruit is attenuated into a stripe, and in which the fruit is sometimes also winged at the angles (figs. 6–11). Four species are clumped diploid perennials, and of these *G. villosa* is a large, densely pubescent perennial of the sand dunes of western Texas and adjacent states. One of the others, *G. filipes*, is characteristic of dry, sandy habitats in the southeastern United States, thus occurring beyond the range of any member



of the genus mentioned up to this point. The fifth species of section *Stipogaura*, *G. sinuata*, is an aggressively rhizomatous tetraploid ( $n = 14$ ) that often becomes a weed in relatively rich, light soils, as in central Texas.

The single species of section *Xenogaura*, *G. drummondii* (*G. odorata* of many authors) is uniformly tetraploid and also an aggressive rhizomatous weed. To a certain extent, its fruits (fig. 12) combine the characteristics of those of *G. coccinea* with those of section *Stipogaura*, and we visualize an allotetraploid origin for it between these two groups. The diploids of section *Stipogaura* are less tightly clumped than are the more generalized species of the genus, and some (e.g., *G. mckelveyae*, *G. villosa*) have a tendency to become rhizomatous in light soils.

The remaining two sections are relatively large and clearly specialized within the genus. Section *Gaura* has six species. Of these, only one—*G. lindheimeri* of the black-soil prairies of east Texas and adjacent Louisiana—is perennial. It may even be secondarily perennial, and one could readily imagine how its loose clumps could be derived from the persistence and budding of the sort of taprooted annual or biennial plants that make up the rest of the section. Of these, the self-incompatible *G. longiflora* (*G. filiformis*) is widespread in the the central United States. Populations similar to it seem to have given rise to *G. neomexicana*, a self-compatible relict species found in several disjunct areas along the east flank of the Rocky Mountains from southeastern Wyoming to New Mexico; to *G. biennis*, a complex structural heterozygote that occurs in openings in the deciduous forest of eastern North America; and to *G. demareei*, a localized species of southwestern Arkansas. Less closely related is the autogamous *G. angustifolia*, a very common species in sandy areas of the Coastal Plain of the southeastern United States.

*Gaura lindheimeri* and *G. demareei* have departed from the usual mode of pollination in the genus. Their flowers open near sunrise, instead of near sunset, and they are pollinated by bees instead of by the medium-sized moths that visit the flowers of other white-flowered outcrossing species of the genus. Their flowers are larger than those of their immediate relatives, a factor that is probably correlated with the increased caloric reward that is necessary for their pollinators to be active at the lower temperatures of early morning (Heinrich and Raven, *Science* 176: 597–602. 1972).

The final section of *Gaura*, section *Pterogaura*, consists entirely of annual species with winged fruits and some tendency (especially in *G. suffulta* subspecies *nealleyi*) for the formation of a stipe also. Of the four species of this group, two have relatively large flowers and are outcrossing, and two are autogamous. The former center in and around Texas, the latter extend far beyond its borders, one (*G. hexandra* subspecies *hexandra*) as



far as Guatemala and the other (*G. triangulata*) into Oklahoma. *Gaura triangulata* is a complex structural heterozygote, and, with *G. biennis* (section *Gaura*), one of two that has originated independently within the genus.

In both of the widespread autogamous taxa in section *Pterogaura* (*G. hexandra* subspecies *hexandra*, *G. triangulata*), 3-merous flowers predominate (figs. 26, 28, 29, 61, 63), and they are likewise common in *G. angustifolia* (section *Gaura*). In our experience, these plants are virtually never visited by insects, and thus agree with other populations in Onagraceae (*Camissonia*, *Ludwigia*; cf., Raven, Contr. U.S. Natl. Herb. 37: 376, 377. 1969) in which the evolution of flowers with reduced numbers of parts seems to have followed the elimination of insect visitors and rather strict autogamy.

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Vermont, Burlington (VT); University of Cambridge (CGE); Gray Herbarium, Cambridge (GH); New England Botanical Club, Cambridge (NEBC); Southern Illinois University, Carbondale (SIU); University of North Carolina, Chapel Hill (NCU); Field Museum of Natural History, Chicago (F); University of Cincinnati (CINC); Pomona College, Claremont (POM); Rancho Santa Ana Botanic Garden, Claremont (RSA); Texas A & M University, College Station (TAES); Botanical Museum and Herbarium, Copenhagen (C); Oregon State University, Corvallis (OCS); Southern Methodist University, Dallas (SMU); Duke University, Durham, North Carolina (DUKE); Michigan State University, East Lansing (MSC); Royal Botanic Garden, Edinburgh (E); North Dakota State University, Fargo (NDA); University of Arkansas, Fayetteville (UARK); Herbarium Universitatis Florentinae, Firenze (F); Colorado State University, Ft. Collins (CS); Agricultural Experiment Station, Gainesville (FLAS); Conservatoire et Jardin Botaniques, Genève (G); State University of Iowa, Iowa City (IA); L. H. Bailey Hortorium, Ithaca, New York (BH); Cornell University, Ithaca (CU); Kent State University, Kent, Ohio (KE); Royal Botanic Gardens, Kew (K); University of Tennessee, Knoxville (TENN); University of Southwestern Louisiana, Lafayette (LAF); University of Kansas, Lawrence (KANU); Komarov Botanical Institute of the Academy of Sciences of the U.S.S.R., Leningrad (LE); University of Kentucky, Lexington (KY); University of Nebraska State Museum, Lincoln (NEB); British Museum (Natural History), London (BM); University of California, Los Angeles (LA); Linnaean Herbarium, London (LINN); Texas Technical University, Lubbock (TTC); University of Wisconsin, Madison (WIS); Kansas State University, Manhattan (KSC); Instituto de Biología, México, D. F. (MEXU); Instituto Politécnico Nacional, México, D. F. (IPN); University of Minnesota, Minneapolis (MIN); West Virginia University, Morgantown (WVA); Botanische Staatssammlung, München (M); Tulane University, New Orleans, Louisiana (NO); New York Botanical Garden, Bronx (NY); University of Oklahoma, Norman (OKL); University of Notre Dame, South Bend, Indiana (ND); National Museum of Canada, Ottawa (CAN); Plant Research Institute, Ottawa (DAO); Muséum National d'Histoire Naturelle, Paris (P); University of Pennsylvania, Philadelphia (PENN); Academy of Natural Sciences, Philadelphia (PH); Carnegie Institute, Pittsburgh (CM); Botanical Research Institute, Pretoria (PRE); Texas Research Foundation, Renner (LL); Missouri Botanical Garden, St. Louis (MO); California Academy of Sciences, San Francisco (CAS); Stanford University, Stanford, California (DS); National Herbarium of New South Wales, Sydney (NSW); Florida State University, Tallahassee (FSU); University of South Florida, Tampa (USF); Pennsylvania State University, University Park (PAC); University of Illinois, Urbana (ILL); Illinois State Natural History Survey, Urbana (ILLS); U.S. National Museum, Washington, D.C. (US); Naturhistorisches Museum, Wien (W); Botanischer Garten und Institut für Systematische Botanik der Universität Zürich (Z).

## SYSTEMATIC TREATMENT

### GAURA L.

*Gaura* L., [Diss. Bot. Nova Plant. Gen. (p.p. L. H. Chenon) 47. 1751]  
Sp. Pl. 1: 347. 1753; Gen. Pl. ed. 5. 163. 1754.

*Gauridium* Spach, Hist. Vég. 4: 379. 1835. Lectotype: *Gauridium mutabile*  
(Cav.) Spach = *Gaura mutabilis* Spach.



*Schizocarya* Spach, Nouv. Ann. Mus. Hist. Nat. 4: 325, 381. 1835; Ann. Sci. Nat. (Paris) II. 4: 170, 283. 1835. Lectotype: *Schizocarya micrantha* Spach = *Gaura parviflora* Dougl.

Annual, biennial, or perennial herbs, sometimes woody near the base. Leaves gradually decreasing in size upward, the basal or rosette leaves largest, lyrate, and gradually narrowed to a winged petiole, the cauline leaves subsessile, usually with an acuminate apex; pubescence on leaves thickest or present only along the veins, especially the midrib, and around the margins. Inflorescence a spicate raceme, sharply delimited, not leafy, more or less conspicuously pedunculate, the flowers bracteate. Flowers borne laterally, usually strongly zygomorphic, the petals opening to approximately a flat plane and all held in the upper half of the flower, the stamens and style projecting slightly forward and mostly confined to the lower quarter or half of the flower, or more rarely the flowers actinomorphic, opening either near sunset or near sunrise and fading within a single day, usually 4-merous but less commonly 3-merous. Floral tube narrow, mostly 0.75–1.5 mm in diameter at its apex, usually lanate in upper half within, the lower half swollen and secreting nectar. Petals usually white, flushed with reddish after pollination, usually sharply clawed. Stamens twice as many as the sepals, subequal. Each filament usually with a scale ca. 0.3–0.5 mm long near its base, these scales nearly closing the mouth of the hypanthium; anthers usually reddish, the sporogenous tissue divided by sterile tissue into discrete packets. Style with the same sort of pubescence in the same area as the floral tube, the hairs interlocking. Stigma deeply 4-(3-)lobed, usually held beyond the anthers in outcrossing species. Fruit an indehiscent, nutlike capsule with hard, woody walls, basically 4-(3-)locular but the septa incomplete and fragile, not evident at maturity; fruit with 1 ovule per locule basically but the whole fruit often with only 1 ovule and occasionally as many as 8. Seeds ovoid, mostly 2–3 mm long and 1–1.5 mm thick, soft, smooth, usually flattened on some or all of the sides, top, and bottom by crowding within the fruit, yellowish to pale brown. Basic chromosome number,  $x = 7$ . Self-incompatibility characteristic of 13 of the 21 species.

TYPE SPECIES: *Gaura biennis* L.

The sympatric occurrence of species of *Gaura* is indicated in table 1, which incorporates our own observations as well as those of Bryan (Southw. Naturalist 8: 10–14. 1963). Naturally occurring hybrids have been observed only between *G. lindheimeri* and *G. longiflora* (rather frequently) and between *G. calcicola* and *G. coccinea* (one plant; Raven and Gregory, Brittonia 24: 71–86. 1972). They also probably occur at some localities where *G. drummondii* and *G. coccinea* grow together.

The distribution maps presented in this paper generally include only

TABLE 1. Sympatric occurrence of species of *Gaura*.<sup>1</sup>

	<i>G. biennis</i>	<i>G. boquillensis</i>	<i>G. brachycarpa</i>	<i>G. calicicola</i>	<i>G. coccinea</i>	<i>G. drummondii</i>	<i>G. hexandra gracilis</i>	<i>G. h. hexandra</i>	<i>G. lindheimeri</i>	<i>G. longiflora</i>	<i>G. macrocarpa</i>	<i>G. mekelveyae</i>	<i>G. mutabilis</i>	<i>G. neomexicana coloradensis</i>	<i>G. n. neomexicana</i>	<i>G. parviflora</i>	<i>G. sinuata</i>	<i>G. suffulta nealleyi</i>	<i>G. s. suffulta</i>	<i>G. triangulata</i>	<i>G. villosa parksii</i>	<i>G. v. villosa</i>
<i>G. biennis</i>	●																					
<i>G. boquillensis</i>	o	●																				
<i>G. brachycarpa</i>	o	o	●																			
<i>G. calicicola</i>	o	o	o	●																		
<i>G. coccinea</i>	x	x	x	<sup>2</sup>	●																	
<i>G. drummondii</i>	o	o	x	x	<sup>3</sup>	●																
<i>G. hexandra gracilis</i>	o	o	o	o	x	o	●															
<i>G. h. hexandra</i>	o	o	o	o	x	x	<sup>4</sup>	●														
<i>G. lindheimeri</i>	o	o	o	o	o	o	o	o	●													
<i>G. longiflora</i>	<sup>5</sup>	o	o	o	x	o	o	o	<sup>6</sup>	●												
<i>G. macrocarpa</i>	o	o	o	o	x	o	o	o	o	o	●											
<i>G. mekelveyae</i>	o	o	o	o	o	o	o	o	o	o	o	●										
<i>G. mutabilis</i>	o	o	o	o	o	o	o	x	o	o	o	o	●									
<i>G. neomexicana coloradensis</i>	o	o	o	o	x	o	o	o	o	o	o	o	o	●								
<i>G. n. neomexicana</i>	o	o	o	o	x	o	o	o	o	o	o	o	o	<sup>7</sup>	●							
<i>G. parviflora</i>	x	o	x	x	x	x	o	o	o	x	o	x	o	x	o	●						
<i>G. sinuata</i>	o	o	x	o	x	x	o	o	o	o	o	o	o	o	o	x	●					
<i>G. suffulta nealleyi</i>	o	o	o	o	x	o	o	o	o	o	x	o	o	o	o	o	o	●				
<i>G. s. suffulta</i>	o	o	x	x	x	x	o	o	o	o	o	o	o	o	o	x	x	<sup>8</sup>	●			
<i>G. triangulata</i>	o	o	o	o	x	o	o	o	o	o	o	o	o	o	o	o	x	o	x	●		
<i>G. villosa parksii</i>	o	o	x	o	o	o	o	o	o	o	o	o	o	o	o	x	o	o	o	o	●	
<i>G. v. villosa</i>	o	o	o	o	x	o	o	o	o	o	o	o	o	o	o	o	o	o	x	o	<sup>9</sup>	●

<sup>1</sup> *Gaura angustifolia*, *G. demareei*, and *G. filipes*, which we have not observed growing with other species of the genera, are not included in the table. Numbers in the table refer to the notes. Unless otherwise noted, x signifies sympatric occurrence without hybridization.

<sup>2</sup> One hybrid individual found; Raven & Gregory, *Brittonia* 24: 71-86, 1972.

<sup>3</sup> Hybridization probable but difficult to confirm owing to close similarity of parents.

<sup>4</sup> Autogamous and occurring in mixed colonies.

<sup>5</sup> Sympatric occurrence and hybridization almost certain but difficult to confirm owing to very close similarity of parents.

<sup>6</sup> Hybridization frequent but species remain largely distinct.

<sup>7</sup> Allopatric subspecies.

<sup>8</sup> Broadly intergrading subspecies.

<sup>9</sup> Allopatric subspecies.





- Flowers zygomorphic, usually strongly so; fruits variable, 4–13 mm long, often thicker; widespread.
- Fruits more or less abruptly constricted to a thick cylindrical stipe nearly half the length of the body; perennial species.
- Plants from a branching woody caudex; fruits not conspicuously bulging above, 4–8.5(–9) mm long, (1–)1.5–3 mm thick; bracts 2–5 mm long, 0.4–1.1 mm wide..... **5. G. COCCINEA**
- Plants aggressively rhizomatous; fruits conspicuously bulging above, 7–13 mm long, 3–5 mm thick; bracts 2–8 mm long, 0.8–2 mm wide..... **11. G. DRUMMONDII**
- Fruits not abruptly constricted to a thick cylindrical stipe; mostly annual or biennial species from a taproot.
- Flowers 3-merous; fruits 3-angled.
- Plant usually simple below, 6–18 dm tall; fruit narrowly ellipsoid or ellipsoid; coastal plain from Florida to North Carolina ..... **13. G. ANGUSTIFOLIA**
- Plant usually branched at the base, 1.5–6.5(–10) dm tall; fruits ellipsoid or ovoid.
- Sepals very finely strigulose or subglabrous; pollen ca. 50 percent aborted; north-central Texas and Oklahoma ..... **21. G. TRIANGULATA**
- Sepals strigulose or glandular pubescent; pollen mostly fertile.
- Sepals 3–10 mm long; inflorescence usually glandular-pubescent; Mexico and Guatemala ..... **19b G. HEXANDRA subsp. HEXANDRA**
- Sepals 10–15 mm long; inflorescence strigulose; Texas and adjacent states..... **20. G. BRACHYCARPA**
- Flowers 4-merous; fruits 4-angled.
- Sepals with long erect hairs; flowers opening near sunrise; petals 10.5–15 mm long; perennial; southeast Texas and Louisiana..... **12. G. LINDHEIMERI**
- Sepals with appressed pubescence, or flowers opening near sunset and much smaller; annual or biennial.
- Biennial from a stout taproot; meadows of Colorado, Wyoming, and New Mexico..... **14. G. NEOMEXICANA**
- Annual, occasionally persisting through mild winters.
- Fruits broadly winged on the angles and deeply furrowed between the angles; plants rarely to 1 m tall, usually well branched from the base.
- Sepals 6–12 mm long, glandular-pubescent, subglabrous, or strigulose; Mexico to Arizona and New Mexico.. **19. G. HEXANDRA subsp. GRACILIS**
- Sepals 10–21 mm long, glabrous or strigulose; Texas and adjacent states, but not known from Mexico or New Mexico.
- Sepals glabrous; bracts 2.5–6.5 mm long ..... **18. G. SUFFULTA subsp. SUFFULTA**



- Sepals strigulose; bracts 2–4 mm long  
 ..... 20. *G. BRACHYCARPA*
- Fruits angled but not winged; plants often 1–4 m tall,  
 usually unbranched from the base.
- Sepals 2.5–8 mm long; flowers often 3-merous and  
 4-merous on the same plant; coastal plain  
 from Florida to North Carolina  
 ..... 13. *G. ANGUSTIFOLIA*
- Sepals 8–20 mm long; flowers 4-merous; not on  
 coastal plain.
- Flowers opening near sunrise; sepals 13–20 mm  
 long; pubescence appressed; southwestern  
 Arkansas..... 17. *G. DEMAREEI*
- Flowers opening near sunset (rarely near sun-  
 rise in Louisiana and Alabama); sepals 8–  
 18 mm long; pubescence appressed or  
 spreading.
- Stems densely villous; inflorescence glandular-  
 pubescent; pollen about 50 percent fertile  
 (usually 35–65 percent)..... 16. *G. BIENNIS*
- Stems strigulose or villous; inflorescence ap-  
 pressed- or glandular-pubescent; pollen  
 usually more than 90 percent fertile  
 ..... 15. *G. LONGIFLORA*

## SECTION I. GAURIDIUM

*Gaura* sect. *Gauridium* (Spach) Endl., Gen. 1195. 1840.

*Gauridium* Spach, Hist. Vég. 4: 379. 1835.

Clumped perennial herb, the stems villous, hirtellous, and glandular-pubescent. Inflorescences erect. Flowers nearly actinomorphic, the petals spreading at right angles, the stamens and style projecting outward from the flower; flowers opening near sunset and withering rapidly the next morning. Floral tube sparsely pubescent within. Petals yellow, flushed with red after anthesis, not clawed. Filaments lacking scales. Fruit not reflexing, narrowly ovoid or fusiform, rounded at the base and gradually tapering to a point near the apex, mostly terete but occasionally somewhat 4-angled, the ribs obscure but the 4 main ones broader. Self-compatible. Gametic chromosome number,  $n = 7$ .

TYPE SPECIES: *Gaura mutabilis* Cav. [*Gauridium mutabile* (Cav.) Spach].

DISTRIBUTION: Middle elevations in the Sierra Madre Occidental and Trans-Mexican Volcanic Belt of Mexico, south to the vicinity of Oaxaca; usually in pine or oak forest.

*Gaura mutabilis*, the single species of this section, has an array of what have been interpreted as generalized features within the genus: large, nearly actinomorphic, yellow flowers that lack scales at the base of the

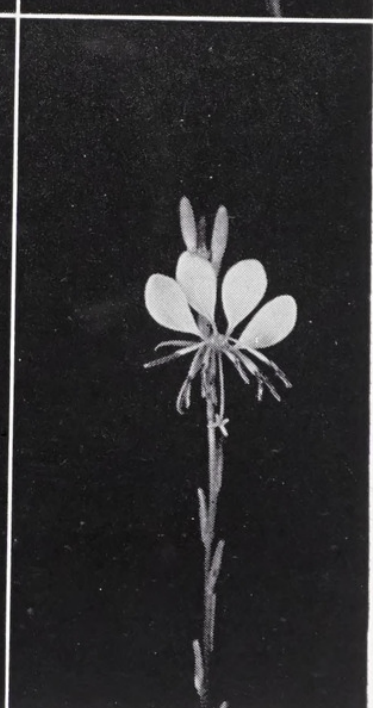
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FIGURES 31-36. Flowers of species of *Gaura*. Fig. 31. *G. mutabilis*.—Fig. 32. *G. macrocarpa*.—Fig. 33. *G. boquillensis*.—Fig. 34. *G. parviflora*.—Fig. 35. *G. coccinea*.—Fig. 36. *G. drummondii* (*G. odorata* of many authors).



filaments and have the longest floral tube in *Gaura*; elongate fruits that are superficially similar to the capsules from which they have been derived; and a Mexican distribution. Viewed in an ecological context, however, the interpretation of these characteristics becomes more difficult, for *G. mutabilis* is the only hawkmoth-pollinated species of the genus, and all or most of the floral features could be associated with this. Furthermore, the species is self-compatible, an obviously secondary characteristic. Despite these cautionary notes, there is enough overall similarity in fruit morphology and habit to *G. macrocarpa* to suggest that *G. mutabilis* is at the very least an ancient offshoot of a primitive group of species of *Gaura*, and to leave it in its customary position at the start of the genus.

1. *Gaura mutabilis* Cav., Ic. 3: 30, pl. 258. 1795. Munz, Bull. Torrey Bot. Club 65: 107. 1938; N. Amer. Fl. II. 5: 183. 1965. Figs. 1, 31.  
*Oenothera anomala* Curtis, Bot. Mag. 11: pl. 388. 1809. Based on *Gaura mutabilis* Cav.  
*Gaura oenotheriflora* Zucc., in Roem., Coll. 140. 1809. Lectotype: cultivated, herb. Zuccagni (FI).  
*Gaura mollis* H.B.K., Nov. Gen. et Sp. 6: 93, pl. 529. 1823. Type: Mexico, 1803–1804, *Alexander von Humboldt* (P).  
*Gauridium mutabile* (Cav.) Spach, Hist. Vég. 4: 380. 1835.  
*Gauridium molle* (H.B.K.) Spach, Hist. Vég. 4: 380. 1835.  
*Gauridium kunthii* Spach, Nouv. Ann. Mus. Hist. Nat. 4: 375. 1835.  
Based on *Gaura mollis* H.B.K.  
*Gaura grandiflora* Rose, Contr. U. S. Natl. Herb. 12: 293. 1909. Type: Papasquiario, Durango, Mexico, 7 August 1898, *E. W. Nelson* 4671 (US 332725. Isotype, K).  
*Gaura gentryi* Standley, Field Mus. Nat. Hist. Bot. Ser. 17: 203. 1937. Type: On rocky outcroppings, Guasaremos, Río Mayo, Chihuahua, Mexico, 26 September 1935, *H. S. Gentry* 1859 (F. Isotypes, GH, K, MO, PH, US).  
*Gaura mutabilis* Cav. f. *glabra* Munz, Bull. Torrey Bot. Club 65: 108. 1938. Based on *Gaura grandiflora* Rose. Munz, N. Amer. Fl. II. 5: 184. 1965.

Clumped perennial herb with a heavy, woody, twisted rootstock; stems erect, branching near the base and again just below the inflorescence, 2.5–8.5 dm tall. Pubescence of very long hairs 3.5–4.5 mm long near the base, scattered upward; shorter erect hairs on the stems, leaves (especially along midrib and margins), and sometimes in the inflorescence; and erect glandular hairs found all over the plant. Leaves narrowly lanceolate to lanceolate, sometimes narrowly elliptic, 1–6(–8) cm long, 0.2–1.8 cm wide, sinuate-

dentate to subentire. Inflorescence unbranched, 5–25 cm long, glandular-pubescent with varying amounts of short erect eglandular hairs; bracts narrowly lanceolate to lanceolate, 2–9 mm long, 1–1.75 mm wide. Floral tube 26–42 mm long. Sepals 11–24 mm long, 1–2 mm wide. Petals 12–25 mm long, 6–15 mm wide. Filaments 5–18 mm long; anthers 3–5 mm long. Style 38–67 mm long. Fruit 7–13 mm long, 2–6 mm thick. Seeds almost always 4, 2.5–4.5 mm long, 1.5–2 mm thick, light reddish brown. Self-compatible, the stigma surrounded by the anthers at anthesis or held well above them. Gametic chromosome number,  $n = 7$ .

TYPE: Described from plants cultivated in the Botanical Garden at Madrid, the seeds of Mexican origin.

DISTRIBUTION (fig. 37): Rocky slopes and outcrops in pine or oak forest, rarely in matorral, 2000–2800 m elevation, from the vicinity of Chihuahua and the upper Río Mayo in Sonora scattered southward in the



FIGURE 37. Range of *Gaura mutabilis*.



Sierra Madre Occidental to the Trans-Mexican Volcanic Belt as far as southern Hidalgo and Puebla; collected once near Oaxaca. Flowers July to September.

REPRESENTATIVE SPECIMENS EXAMINED:

MEXICO. CHIHUAHUA. Colonia Juárez, Jones in 1903 (DS, POM); hills near Chihuahua, Pringle 1125 (BM, BR, COCO, F, G, GH, LE, MSC, RSA, US); high plains between Cusihiuriachic and Guerrero, Pringle 1244 (COCO, F, GH, MEXU, MIN, NO, NY, PH, RSA, US); Culebra Mts., Le Sueur in 1936 (GH, MO, SMU); e foothills of Sierra Madre 13 mi w of General Trias, 5900 ft, Ripley & Barneby 13887 (DS, NY). DURANGO. 3 mi ne of Otinapa, Maysilles 7305 (MICH, RSA); ca. 60 air miles sw of Durango, 2500–2650 m, Maysilles 7792 (MICH); ca. 50 km w of Durango near the highway to Mazatlán, 2550 m, McVaugh 21677 (MICH); near El Salto, Nelson 4570 (POM, US); Papasquiario, Nelson 4671 (GH); Durango and vicinity, Palmer 270 (BM, F, G, GH, MO, NY, US); Palos Colorados on railroad w of Durango, 2400 m, Pennell 18233 (PH, US); Sierra de Registro 13 mi nw of Nombre de Dios, 6300 ft, Ripley & Barneby 14165 (DS); 9 m w of Durango, Waterfall 12560 (GH, MICH, OKLA, US); 28 mi sw of Durango, Waterfall & Wallis 13563 (IA, OKLA, SMU); 5 mi sw of Durango, Waterfall 15416 (OKL, OKLA, SMU). GUANAJUATO. Guanajuato, Dugès 303 (GH); Montapues, Guanajuato and vicinity, Dugès 303A (GH); Cerro de la Batea, Guillemain-Tardyre (K, LE, P); near summit of Montaña de Cubilete, ne of Silao, 8000 ft, Straw & Forman 1450 (MICH, RSA). HIDALGO. Hills near Marquez, 8000 ft, Pringle 7635 (POM, US); Cerro Ventoso, between Pachuca and Real del Monte, 2600 m, Rzedowski 20622 (DS, IPN, ISC, MICH, TEX); Cerro Santa Ana, 10 mi ne of Apam, West B-1 (DS). MEXICO. Santa Fé, Valley of México, Bourgeau 296 (C, GH, NY, RSA, US); 12 mi s of Tlapám, D.F., W. E. & M. S. Manning 531051 (GH); lomas de Mixcoac, D.F., Lyonnet 1471 (US); Villa Obregón, w of San Angel, 8000 ft, D.F., Munz 15056 (GH, MO); Pedrigal, Valley of México, Pringle 6661 (BM, BR, CM, F, G, GH, IPN, ISC, LE, M, MEXU, MIN, MO, ND, NMC, NY, PH, US). MORELOS. Hwy. to Cuernavaca near Morelos Monument, Straw & Gregory 1076 (DAO, GY, MEXU, MICH, RSA). OAXACA. Near Oaxaca, Andrieux 384 (CH). PUEBLA. Santa Bárbara, Nicolás 259 (BY, F, GH, MO, NY, P, US); San Martín, Nelson in 1893 (US); vicinity of San Luis Tultitlanapa, near Oaxaca, Purpus 3388 (BM, F, GH, MO, NY, US); Puerta de Emperador near La Venta, 8300 ft., Sharp 44393 (RSA); Cerro Amalucán, 8 km al e de Puebla, Rzedowski 24135 (DS, IPN). SONORA. Álamos Dist., Arroyo, Algodones valley, Gentry 468 (DS, MICH); Arroyo del Auga Blanca, Distrito Álamos, Gentry 514 (MICH); Sierra de las Papas, Gentry 622 (DS, MICH).

*Gaura mutabilis* is sometimes called “noche buena,” this name contrasting the late opening of its flowers (in full dark after sunset) with those of *G. coccinea* “linda tarde.” It has been in cultivation in botanical gardens ever since its first introduction in the 1790’s. In Mexico, it tends to be colonial, with individual populations widely scattered. There is a small amount of interpopulational variability, especially in pubescence, style length, and fruit shape, but no consistent patterns that appear to require formal taxonomic recognition.



## SECTION II. XEROGAURA

Herbae perennes confertae, caulibus strigulosis, scabris, glandulosis, vel villosis. Inflorescentiae subnutantes. Flores subactinomorphi, stylo subdeclinato, vespertini. Fructi fusiformes, saepe subcurvati, tereti, costibus 4 majoribus, 4 angustioribus.

Clumped perennial herbs, the stems strigulose, scabrous, glandular, or villous, or with various mixtures of these pubescence types. Inflorescences slightly nodding. Flowers nearly actinomorphic, the style slightly declinate; flowers opening near sunset and withering the next morning. Fruit reflexing or not, fusiform, often slightly curved, terete, with 4 main ribs and 4 narrower ones. Self-incompatible. Gametic chromosome number,  $n = 7$ .

TYPE SPECIES: *Gaura macrocarpa* Rothr.

DISTRIBUTION: Washes and sandy flats from the Davis Mountains of west Texas to central Chihuahua, Coahuila, and western Nuevo León.

The white, nearly actinomorphic flowers and elongate fruits of the two species of this section seem clearly to be generalized features within the genus.

2. *Gaura macrocarpa* Rothr., Proc. Amer. Acad. Arts 6: 353. 1864–1865. Munz, Bull. Torrey Bot. Club 65: 115. 1938; N. Amer. Fl. II. 5: 186. 1965. Figs. 2, 32.

Clumped perennial herb with a narrow woody rootstock usually branching several centimeters below the ground level; stems with several branches from the base and occasional branches above, arching slightly outward from the base but then strictly erect, 2–10 dm tall. Pubescence of four kinds of hairs: 1. long (1–1.5 mm) erect hairs near the base of the plant; 2. short, appressed hairs everywhere but heaviest on the ovaries and usually least dense on the branches of the inflorescence; 3. short, scabrous hairs, thick at the base, common around edges of leaves but sometimes dense on stems also; and 4. short, erect, glandular hairs all over the plant, usually heaviest on the branches of the inflorescence. Leaves very narrowly elliptic or usually narrowly lanceolate, 0.5–8 cm long, 0.1–0.8 cm wide, subentire to sinuate-denticulate, the apex mucronate. Inflorescence 10–25 cm long, often with a few branches near the base; bracts narrowly ovate, 1.5–3 mm long, 0.85–1.25 mm wide. Many flowers in a single inflorescence open at one time. Floral tube 9–13 mm long. Sepals 7–9 mm long, 1–2 mm wide. Petals 7–8 mm long, 3–6 mm wide. Stamens projecting forward from the flower. Filaments 4–4 mm long; anthers 4–5 mm long. Style 18–22 mm long. Fruit not reflexing, (9–)13–17 mm long, 2–3 mm thick, with 8 ribs of about equal prominence, although 4 are slightly narrower; fruits sessile.



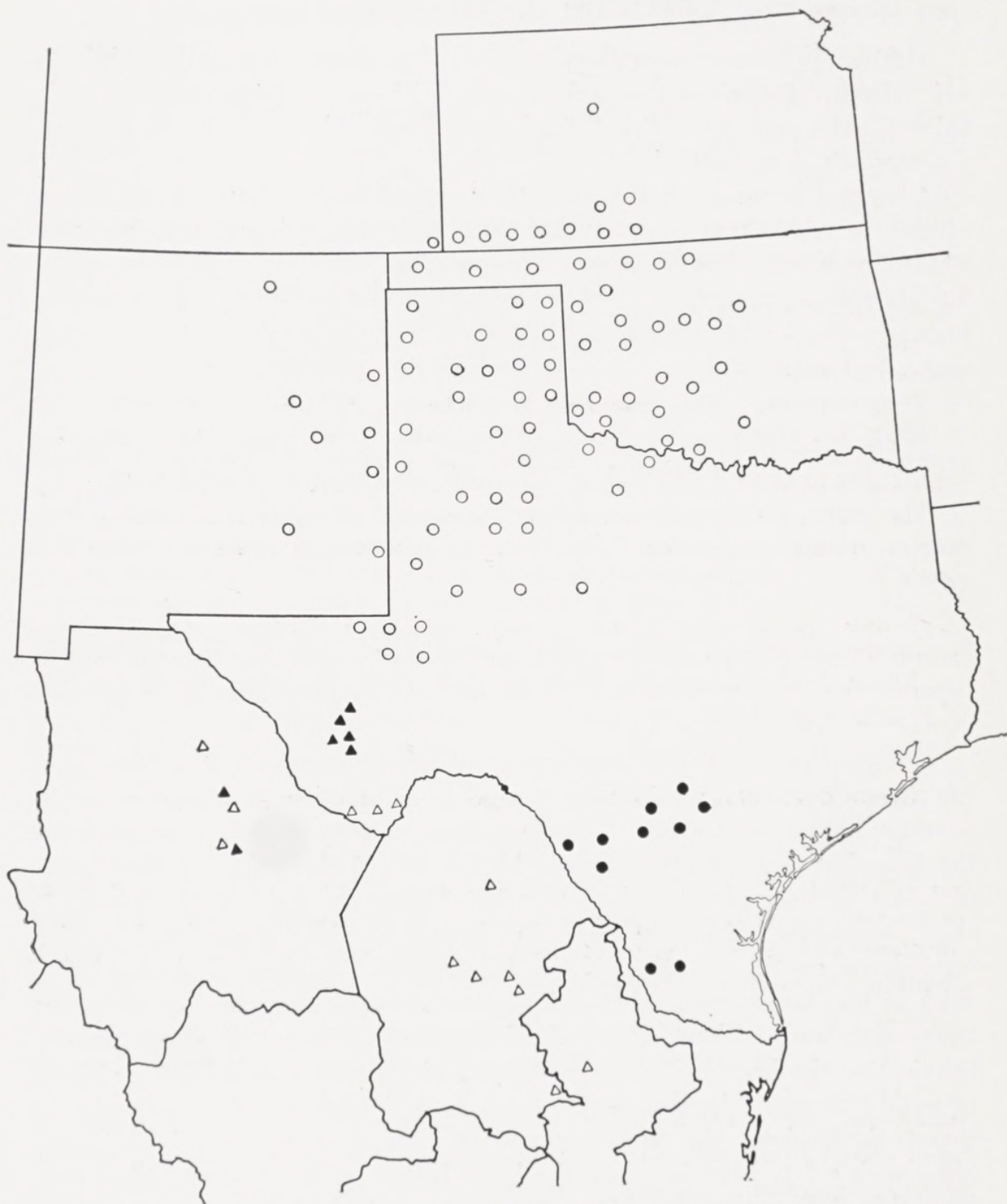


FIGURE 38. Ranges of *Gaura macrocarpa* (filled triangles), *G. boquillensis* (open triangles), *G. villosa* subsp. *villosa* (circles), and *G. villosa* subsp. *parksii* (dots).

Seeds (1-)3-4, 2-3.5 mm long, 1-2 mm thick, yellowish or light brown. Self-incompatible. Gametic chromosome number,  $n = 7$ .

LECTOTYPE: Limpia Canyon ("Valley of the Limpio"), Jeff Davis Co., Texas, 21-26 August 1849, *C. Wright 1079* (US 59209. Isotypes, BM, GH, LE, M, P, PH); Munz, Bull. Torrey Bot. Club 65: 115. 1938.

DISTRIBUTION (Fig. 38): Sandy flats and washes, very local, vicinity of the Davis Mountains in eastern Jeff Davis Co., northeastern Presidio Co., and northern Brewster Co., Texas; near Gallego and Chihuahua, Chihuahua. Flowers, May to July.

REPRESENTATIVE SPECIMENS EXAMINED:

MEXICO. CHIHUAHUA. 7 mi n of Gallego, *Breedlove 15729* (DS); Chihuahua, *Palmer 195* (NY, US).

UNITED STATES. TEXAS. Brewster Co.: Haley Ranch, *Parks & Cory 9278* (POM, TAES); Flats to Sunny Glen, *Sperry T604* (GH, TAES, US); 2 mi e of Alpine, *Warnock 8468* (LL, SMU); Bois d'Arc Spring, *Warnock 127* (PENN). Jeff Davis Co.: Near Fort Davis, *Palmer 34558* (GH, MO, NY, PH, US); 18.3 mi s of Toyahvale, 0.7 mi n of Wild Rose Pass, *Gregory 165* (RSA); 5.8 mi s of Toyahvale, *Gregory 252* (RSA). Presidio Co.: 5 mi w of Alpine, *Gregory 202* (DS, RSA); 2.7 mi n of Marfa, *T. & L. Mosquin 5651* (DAO).

*Gaura macrocarpa* is known only from three disjunct regions and it seems likely, in view of its generalized features, that it is a relatively old species that has survived locally in a few favorable situations. It has been collected only twice in Mexico.

3. *Gaura boquillensis* Raven & Gregory, sp. nov. Figs. 3, 33.

Herba perennis sublignosa copiose multiramosa, 2.5-10 dm alta, strigulosa saepe etiam glandulosa scaberulaque. Folia 0.5-6.5(-13) cm longa, 0.1-1 cm lata, basalia anguste oblanceolata raro spatulata, superiora angustissime elliptica vel anguste lanceolata, saepe linearia, subsessilia, sinuato-dentata vel subintegria, plerumque sinuata. Inflorescentia 8-37 cm longa, stricta, bracteis lanceolatis vel linearibus 1.5-3.5 mm longis, 0.25-0.5 mm latis. Tubus floris 3-8.5 mm longus, intus costibus hispidulus. Sepala 3-9 mm longa, 1-2.5 mm lata. Petala 4-10 mm longa, 2-4.5 mm lata. Filamenta 2-4.5 mm longa; antherae 2-4 mm longae. Stylus 6.5-15 mm longus, basin versus hispidulus. Fructus fusiformis, subarcuatus, 5.5-13 mm longus, 1-2.5 crassus, interdum parte tertia inferiora subattenuata stipaformaque; semina (1-)2-4, 1.5-2.5 mm longa, 0.75-1.25 mm crassa, obovoidea, straminea vel pallide brunnea. Numerus chromosomaticus gameticus,  $n = 7$ .

Clumped perennial herb with a narrow, woody rootstock usually branching several centimeters below the ground level; stems well branched at the base and above, often somewhat woody, the plant very full, 2.5-10 dm tall.



Pubescence very variable, of three kinds of hairs: 1. short, erect glandular hairs, absent or fairly dense on stems and leaves; 2. strigulose pubescence, common everywhere except the branches of the inflorescence; 3. short, scabrous hairs, thick at base, usually sparse on stems and leaves, sometimes dense, absent in inflorescence. Leaves usually narrowly oblanceolate near the base, becoming very narrowly elliptic or narrowly lanceolate upward, or often linear, 0.5–6.5(–13) cm long, 0.1–1 cm wide, sinuate-dentate to subentire. Inflorescence unbranched, 8–37 cm long; bracts lanceolate to linear, 1.5–3.5 mm long, 0.25–0.5 mm wide. Floral tube 3–8.5 mm long. Sepals 3–9 mm long, 1–2.5 mm wide. Petals 4–10 mm long, 2–4.5 mm wide. Filaments 2–4.5 mm long; anthers 2–4 mm long. Style 6.5–15 mm long. Fruit often reflexing at maturity, 5.5–13 mm long, 1–2.5 mm thick, sometimes slightly narrowed in the lower third and then approaching a stipitate condition. Seeds (1–)2–4, 1.5–2.5 mm long, 0.75–1.25 mm thick, yellowish or light brown. Self-incompatible. Gametic chromosome number,  $n = 7$ .

TYPE: Mouth of Boquillas Canyon, Big Bend National Park, Brewster Co., Texas, 20 April 1960, *D. P. Gregory* 232 (RSA 145239. Isotype, NY).

DISTRIBUTION (fig. 38): Washes and sandy canyonsides in the dry mountains near the Rio Grande in southern Brewster Co., Texas, southward to central Chihuahua, Coahuila, and western Nuevo León. Flowers, May and June.

#### REPRESENTATIVE SPECIMENS EXAMINED:

MEXICO. CHIHUAHUA. Plains near Chihuahua, *Pringle* 1497 (GH, MEXU); 5 mi s of Gallego, *Shreve* 7930 (US). COAHUILA. 1 mi e of Múzquiz, *Gould* 11230 (DS); 3 mi above Socorro, *Johnston* 8840 (GH); Monclova, *Marsh* 1679 (F, GH, OKLA, TEX), 1704 (GH); Múzquiz, Santa Anna Canyon, *Marsh* 483 (OKLA, SMU, TEX) 5.6 mi e of Saltillo, *Towner* 55 (DS); 12 mi e of Saltillo, *Canedo et al.* 9072 (DS, DUKE, OKLA, SMU, TEX, TTC); El Puerto de San Lázaro, *Wynal & Mueller* 145 (A, FSU, ILL, MICH, MO, MSC, US); w slope of Sierra de San Vicente, *Schroeder* 132 (GH). NUEVO LEON. Sierra Madre Oriental, Monterrey, *Mueller* 218 (A, POM); 79.9 mi s of Tamaulipas border on road from Nuevo León to Monterrey, *Towner* 37 (DS).

UNITED STATES. TEXAS. Brewster Co.: Boquillas Canyon, *Harrison in* 1919 (WISC), *Warnock in* 1937 (TAES), *Cory* 2139 (POM); Big Bend National Park, *Webster* 4481 (DUKE, G, OKLA, SMU, W); mouth of Santa Elena Canyon, *A. & R. A. Nelson* 5052 (GH), *Innes et al.* 503 (GH); banks of the Rio Grande, in Grand Canyon, *Palmer* 34224 (MIN, NY); Pinnacle Mts., Chisos Mts. area, *Warnock* 1055 (US).

This distinctive new species has been confused with *G. macrocarpa*, but differs markedly in its smaller, more irregular flowers and shorter, somewhat stipitate fruits. It grows in the same general area as *G. macrocarpa*, and the two species may ultimately be found growing together near Gallego or Chihuahua.



## SECTION III. SCHIZOCARYA

*Gaura* sect. *Schizocarya* (Spach) Raven & Gregory, comb. nov.

*Schizocarya* Spach, Nouv. Ann. Mus. Hist. Nat. 4: 325, 381. 1835; Ann. Sci. Nat. (Paris) II. 4: 170, 283. 1835.

Rank annual herb, the stems glandular-pubescent with an admixture of villous pubescence. Inflorescences slender, nodding. Flowers actinomorphic, the petals open only to about 90°, the stamens and stigma erect; flowers opening near sunset and withering the next morning. Filaments with minute scales only. Fruit reflexing at maturity, fusiform, tapering more or less abruptly toward the base, terete, weakly 4-ridged and furrowed in the upper third, 8-ribbed below. Autogamous. Gametic chromosome number,  $n = 7$ .

LECTOTYPE SPECIES: *Gaura parviflora* Dougl. (*Schizocarya micrantha* Spach).

DISTRIBUTION: Weedy places and along streams throughout the central United States, south to central Mexico.

Despite Rothrock's accurate observation in 1864 (Proc. Amer. Acad. Arts 6: 348), the papillae to which the scales at the base of the filaments in *Gaura parviflora* have been reduced have generally been overlooked since. Their presence makes very likely the derivation of this rank annual weed from plants similar to those currently assigned to sect. *Xerogaura* highly probable, in view of the very similar fruits. Presumably the scales, which serve in most species of *Gaura* to exclude all but long-tongued insects from the nectar in the floral tube, have been greatly reduced in *G. parviflora* owing to its strict autogamy, very small flowers, and absence of nectar.

4. *Gaura parviflora* Dougl., in Hook., Fl. Bor.-Amer. 1:208. 1833. Hook., Bot. Mag. 63: t. 3506. 1836. Munz, Bull. Torrey Bot. Club 65: 108. 1938; N. Amer. Fl. II. 5: 184. 1965. Figs. 4, 34.

*Schizocarya micrantha* Spach, Ann. Sci. Nat. (Paris) II. 4: 283. 1835. Lectotype: Austin, Travis Co., Texas, 1833-1834, *Thomas Drummond* 46 (G. Isolectotypes, GH, NY); Munz, Bull. Torrey Bot. Club 65: 110. 1938.

*Gaura micrantha* (Spach) D. Dietr., Enum. Pl. 2: 1297. 1840.

*Gaura hirsuta* Scheele, Linnaea 21: 580. 1848. Type: Prairies between Bastrop and Austin, Bastrop or Travis Co., Texas, 1846, *Ferdinand Roemer* (not seen).

*Gaura australis* Griseb., Abh. Königl. Ges. Wiss. Göttingen. 24: 132. 1879.



Lectotype: Entre Mina Argentina y Yerba Buena, en las cercanías del Cerro de Orcosu, Dpto. Minas, Córdoba, Argentina, 17 Feb. 1876, *Hieronymus* 399 (GOET. Isolectotype, CORD. Neither seen).

*Gaura parviflora* Dougl. var. *lachnocarpa* Weath., *Rhodora* 27: 14. 1925.

Type: Roadside, Austin, Travis Co., Texas, 18 April 1918, *M. S. Young* 95 (GH. Isotype, TEX).

*Gaura parviflora* Dougl. var. *typica* Munz, *Bull. Torrey Bot. Club* 65: 109. 1938.

*Gaura parviflora* Dougl. var. *typica* Munz f. *glabra* Munz, *Bull. Torrey Bot. Club* 65: 110. 1938. Type: Deer Run, 4700 ft, between Kannah and Delta, Meso Co., Colorado, 11 June 1901, *C. F. Baker* 94 (POM 32745. Isotypes, GH, NY, US).

Rank annual herb with a heavy taproot up to 3 cm or more in diameter; stems erect, usually unbranched or branching just below the inflorescence, thick and juicy, tapering gradually to the inflorescences, (2-)3-20(-30) dm tall, the basal leaves usually deciduous by the time of flowering and the lower stems then naked. Pubescence up to the base of the inflorescences dense, glandular, with fewer long, spreading hairs, both of which also occur along the main veins and margins of the leaves; surface of leaves strigulose. Leaves narrowly elliptic to narrowly ovate, mostly commonly acuminate, 2-12.5 cm long, 0.5-4 cm wide, slightly sinuate-dentate. Rosette leaves often broadly oblanceolate, up to 15 cm long and 3 cm wide, the blade gradually narrowed into a winged petiole. Inflorescence a series of subterminal dense, spicate racemes 5-45 cm long, glabrous (except for long hairs on edges of floral bracts) to densely covered with a mixture of glandular and eglandular, long hairs, then also with short erect hairs on the ovaries and loosely appressed pubescence on the calyx; bracts narrowly lanceolate to linear, 1.5-5.5 mm long, 0.25-0.5 mm wide. Floral tube 1.5-5 mm long. Sepals 2-3.5 mm long, 0.5-1 mm wide. Filaments 1.5-3 mm long; anthers 0.5-1 mm long, shedding pollen directly on the stigma at or before anthesis. Style 3-9 mm long; lobes of the stigma short. Fruit 5-11 mm long, 1.5-3 mm thick. Seeds 3-4, 2-3 mm long, 1-1.5 mm thick, reddish brown. Autogamous. Gametic chromosome number,  $n = 7$ .

TYPE: Sandy banks of the Walla Walla River, Walla Walla Co., Washington, 10-16 June 1826, *David Douglas* (K. Isotype, BM).

DISTRIBUTION (fig. 39): Weed of cultivated fields, pastures, waste places, and along streams, throughout the interior of North America; in the United States from Indiana, Iowa, southern South Dakota, Montana (very rare), and southeastern Washington to the lower Mississippi River; in Mexico, Nuevo León, Zacatecas, Durango, Sinaloa, and Baja California. Locally



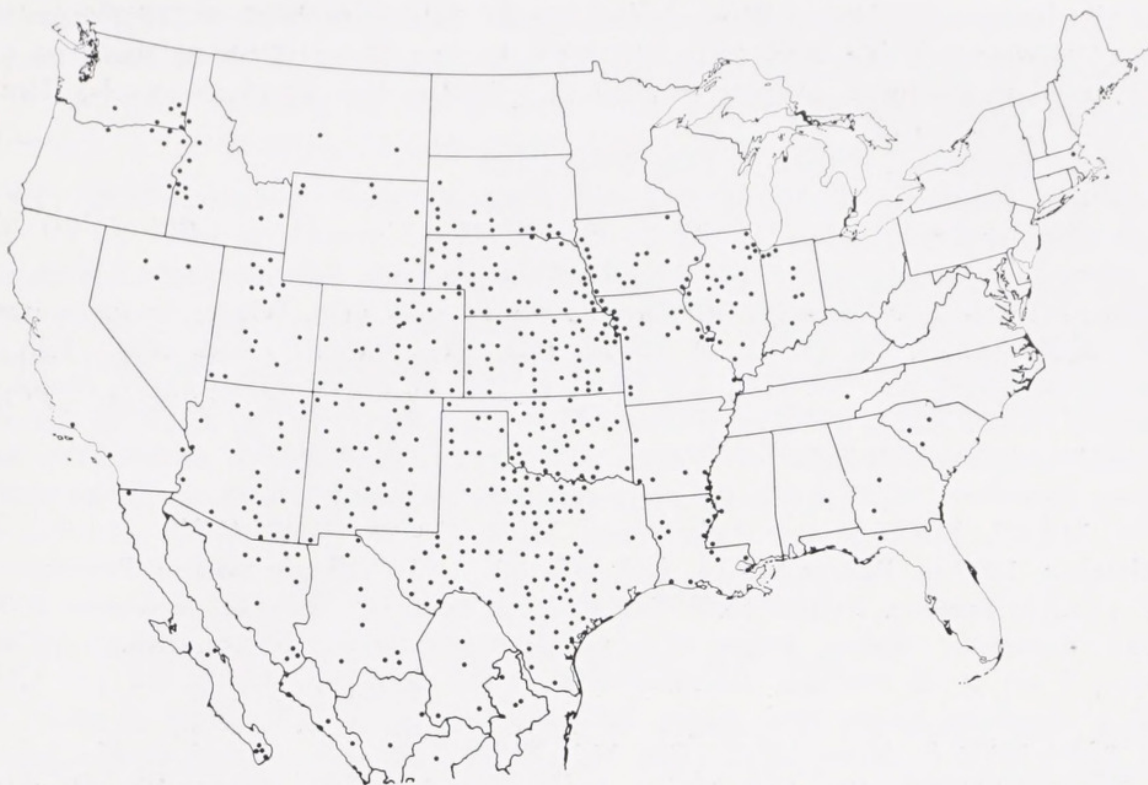


FIGURE 39. Range of *Gaura parviflora* in the United States and Mexico.

established in the United States in Alabama, California, Florida, Georgia, Massachusetts, and Tennessee. Introduced in Argentina (Córdoba, San Luis), China, Okinawa, and northern Australia. Flowers throughout the warm part of the year. In Argentina, *Gaura parviflora* grows in disturbed ground, near roads and houses, in ravines, and along intermittently dry streams at 500 to 1000 m elevation. The earliest collection we have seen from South America is that of Hieronymus, cited above, which was made in 1876.

REPRESENTATIVE SPECIMENS EXAMINED (outside United States only):

ARGENTINA. CÓRDOBA. Dpto. Calamuchita: Valle de los Reartes, *Castellanos* 48 (GH); La Cruz, ca. 850 m, *Gutierrez* 109 (BH). Dpto. Capital: Alrededores de la Ciudad de Córdoba, A. T. *Hunziker* 8108 (RSA); alrededores del cementerio, *Stuckert* 3610 (G, GH). Dpto. Ischilín: Quilino, *Villafañó* 76 (NY, TEX, US). Dpto. Punilla: Valle Hermoso, *Carlson in 1940* (RSA); Sierra de Córdoba, Capilla del Monte, *Barros in 1925* (GH); San Francisco, Sierra de Córdoba, *Hieronymus* 578 (NY); Sierra Chica, *Losser* 226 (BY, F, GH, MO, PH); Dolores, Valle de Punilla, *Nicora* 1673 (POM); San Salvador, 970 m, *Rodrigo* 364 (US). Dpto. San Alberto: Sierra Grande, Mina Clavero *Burkhart* 7328 (F, POM); Sierra Grande, 10 km below El Condor, 1000 m, *Goodspeed* 17242 (GH); Nono, *O'Donnell & Rodriguez* 714 (A). Dpto. San Javier: La Barranca, *Castellanos in 1939* (RSA); Quebrada de Yacanto, *Castellanos in 1927* (RSA); La Población entre Yacanto y Luyaba, A. T. *Hunziker* 11462 (RSA). Dpto. Santa María: Alta Gracia, ca. 600 m, *J. H. Hunziker* 1158 (RSA).



AUSTRALIA. NEW SOUTH WALES. Wiangaree, shire, of Kyogle, *Mackay in 1967* (NSW); banks of Richmond River, nw of Kyogle, *Salasoo in 1963* (NSW). QUEENSLAND. Pittsworth, *White 6662* (BY, GH, NY); Darling Downs District, Jandowae to Dalby road at Pirrinauri, *Doherty in 1959* (K); Millars Vale Creek, Maryvale, *Glen-gallen Shire Council in 1958* (K).

CHINA. CHEKIANG. Chienteh, *Ling 2738* (NY).

JAPAN. OKINAWA. Kadekaru, Kume-jima Island, 1966, *Nakejima 1682* (DS) (seen since about 1954).

MEXICO. BAJA CALIFORNIA. San José del Cabo, *Anthony 330* (BM, DS, F, GH, K, MEXU, MIN, MO, POM, US); Miraflores, *Jones in 1928* (DS, POM); Todos Santos, *Jones 24137* (DAO, DS, DUKE, F, MICH, MO, NY, POM, PH, RSA, SMU, TEX); Misión Guadalupe, near 26°54'N, 112°26'W, ca. 700 m, *Moran 11788* (DS); Mulege, *Palmer 11* (GH, US); Santiago, *Thomas 7804* (DS, RSA); ca. 19 mi w of Tecate on road to Tijuana, *Wiggins & Thomas 471* (DS). CHIHUAHUA. 6 mi s of Ciudad Juárez, *Breedlove 15727* (DS; 20 km s of Ciudad Camargo, 1300 m, *White 2228* (GH, MEXU, MICH); near Lake Santa María, *Nelson 6406* (US); vicinity of Chihuahua, 1300 m, *Palmer 185* (F, GH, MO, NY, US); Valle de Rosario, *Pennington 411* (TEX); Jiménez, *Pringle 7529* (MEXU); 45 mi s of Ahumada, *Moldenke 2088* (DS). COAHUILA. Viesca, *Fisher 3725* (NY); near Saltillo, 1500 m, *Hinton 16798* (GH); 1 mi se of Ocampo, *Johnston 8884* (GH); Múzquiz, *Marsh 946* (F, GH, TEX); Monclova, Gloria Mts., *Marsh 1667* (F, GH, LL, OKLA, TEX); 6 mi w of San Pedro, 4000 ft, *Munz 15041* (GH, MO, POM). DURANGO. 10 mi sw of Ciudad Lerdo, *Munz 15037* (GH, MO, POM); Durango and vicinity, *Palmer 102* (F, GH, MO, NY, US). NUEVO LEÓN. Monterrey, 550 m, *Arsène et al. in 1911* (NY, RSA); Poblado de Higuera, *Hernández et al 16M508* (TEX); 16 km w of Sabinas Hidalgo, *Domínguez & McCart 8266* (TEX). SINALOA. Culiacán, *Rose et al. 14867* (NY, US); Las Palmas, Sinaloa, *González Ortega 4542* (MEXU). SONORA. 7-9 mi w of Navojoa, *Gentry 7976* (DS, MEXU, MICH, US); El Desierto, Río Mayo, *Gentry 3044* (F, GH, MEXU, MO, US); Cochuto, 5100 ft, *Hartman 96* (GH, NY, PENN, PH, US); 35 mi w of Sonoyta, *Keck 4227* (DS, POM); Hermosillo, *Maltby 254* (US); Alamos, *Rose et al. 12961* (NY, US); Arroyo del Pulpito, near Colonia Oaxaca, *White 777* (DS, MICH); Bavispe, Río Bavispe, *White 2902* (GH, MICH); Horconcitos, Río Huachinera, *White 2968* (GH, MICH, PH); Colonia Morelos, 2600 ft, *White 4419* (GH, MICH, NY, US); Moctezuma, *White 299* (GH, MICH); 42 mi e of Caborca, *Moldenke 1536* (DS). ZACATECAS. 26 mi se of Sombrerete, *Breedlove 14341* (DS).

*Gaura parviflora* was probably originally a native of the shortgrass prairie in the interior of the United States, and spread widely from there as a weed of cultivated and waste areas. Owing to its strict autogamy, it easily becomes established from a single fruit. It has been cultivated as a curiosity in botanical gardens since at least the 1840's. The small differences in pubescence that have been reflected in the naming in infra-specific taxa are consistent with what would be expected in an autogamous species and do not deserve formal taxonomic recognition.

According to information kindly sent by Mr. S. L. Everist this species is now extensively naturalized in southeastern Queensland, Australia. The first known collection was made at Charter's Towers in the North Kennedy



District, where it has not persisted, in 1929. The Pittsworth collection, cited above, was obtained in 1930, and from this locality the plant has spread out over an extensive area. In 1950 it was collected at Roma, in the Maranoa District, its westernmost station. It was first noted at Goondiwindi in the Darling Downs District, its southernmost locality in Queensland, in 1956, and had spread into the vicinity of Kyogle in New South Wales by 1963, as shown by specimens cited above. All of the collections from the north end of the range of this species in Queensland, excluding the 1921 record (where the plant failed to persist), have been made since 1960 and a collection from Mulgildie, now the northernmost limit of the plant in Australia, was made for the first time in 1969. Mr. Everist has suggested that it is quite possible that *Gaura parviflora* has still not reached the northern limits of its range in Queensland.

#### SECTION IV. CAMPOGAURA

*Gaura* sect. *Campogaura* Raven & Gregory, sect. nov.

Herbae perennes confertae, caulibus subglabris vel strigulosis, saepe etiam villosis. Inflorescentiae nutantes. Flores valde zygomorphi, vesperini. Fructi 4-angulati, parte superiore 4-costato, 4-angulato, ad basin attenuato, tereto.

Clumped perennial herb, the stems subglabrous or strigulose, often also villous. Inflorescence nodding. Flowers strongly zygomorphic, the stamens in the lower half; flowers opening near sunset and withering late the next morning. Fruit not reflexing, 4-angled, with 4 sharp ridges and 4 furrows alternating on the pyramidal upper half, constricted sharply below, the base terete, narrowing gradually toward the bottom but at least half the diameter of the top throughout. Self-incompatible. Gametic chromosome numbers,  $n = 7, 14, 21, 28$ .

TYPE SPECIES: *Gaura coccinea* Pursh

This distinctive species of the prairies and plains (hence the sectional name) is clearly related to the species of sections *Stipogaura* and *Xerogaura*. It is probably one parent of the tetraploid *Gaura drummondii*.

5. *Gaura coccinea* Pursh, Fl. Amer. Sept. 2: 733. 1814. (Nom. nud., Fraser's Cat. 1813.) Munz, Bull. Torrey Bot. Club 65: 220. 1938; N. Amer. Fl. II. 5: 194. 1965. Figs. 5, 35.

*Gaura odorata* Sessé ex Lag., Gen. et Sp. Nov. 14. 1816. Type: Described from plants cultivated in the Royal Botanical Garden at Madrid, the seed brought from Mexico in 1804 by *Martín de Sessé y Lacasta*. See discussion on pp. 54, 55.



- Gaura epilobioides* H.B.K., Nov. Gen. et Sp. 6: 93. 1823. Type: Near Actopan, Hidalgo, Mexico, May 1803, *Alexander von Humboldt* (P. Isotype, B. Photographs, F, GH, POM, US).
- Gaura coccinea* Pursh  $\beta?$  *integerrima* Torr., Ann. Lyceum Nat. Hist. New York 2: 200. 1828. Type: Major Long's Creek, near Stead, Union Co., New Mexico, 1 August 1820, *Edwin James* (NY).
- Gaura parvifolia* Torr., Ann. Lyceum Nat. Hist. New York 2: 201. 1828. Type: Major Long's Creek, near Stead, Union Co., New Mexico, 1 August 1820, *Edwin James* (NY).
- Gaura?* *suffrutescens* Moc. & Sessé ex Ser., in DC., Prod. 3: 45. 1828. Type: Fl. Mex. Ic. (ined.), t. 374 (G-DC).
- Gaura bracteata* Ser., in DC., Prod. 3: 45. 1828. Type: In gardens, San Angel, México, Mexico, Fl. Ic. (ined.), t. 373 (G-DC).
- Gaura multicaulis* Raf., Atl. Jour. 146. 1832. Based on *Gaura coccinea* Pursh  $\beta?$  *integerrima* Torr.
- Gaura marginata* Lehm., in Hook., Fl., Amer.-Bor. 1: 208. 1834. Type: Plains of the Saskatchewan River, Canada, *T. Drummond* (Isotypes, BM, BR, NMC).
- Gaura glabra* Lehm., in Hook., Fl. Amer.-Bor. 1: 209. 1834. Type: Vicinity of Fort Carleton, Saskatchewan, *T. Drummond* (Isotypes, BM, BR, LE).
- Schizocarya kunthii* Spach, Nouv. Ann. Mus. Hist. Nat. 4: 383. 1835. Based on *Gaura epilobioides* H.B.K.
- Gaura coccinea* Pursh var. *glabra* (Lehm.) Munz, Bull. Torrey Bot. Club 65: 224. 1938.
- Gaura spicata* Sessé & Moc., Pl. Nov. Hisp. ed. 1. 56. 1888. Type: Vicinity of Mexico City, D. F., Mexico, June.
- Gaura induta* Wooton & Standl., Contr. U. S. Natl. Herb. 16: 153. 1913. Type: Dry, clay hills near Pecos, 2010 m, San Miguel Co., New Mexico, 15 August 1908, *P. C. Standley* 4933 (US 498956. Isotypes, GH, NY).
- Gaura linearis* Wooton & Standl., Contr. U. S. Natl. Herb. 16: 154. 1913. Type: Gypsum soil near Lakewood, Eddy Co., New Mexico, 6 August 1909, *E. O. Wooton* (US 564593).
- Gaura coccinea* Pursh var. *parvifolia* (Torr.) Rickett, Kew Bull. 1934: 57. 1934. Munz, Bull. Torrey Bot. Club 65: 223. 1938; N. Amer. Fl. II. 5: 196. 1965.
- Gaura coccinea* Pursh var. *typica* Munz, Bull. Torrey Bot. Club 65: 221. 1938.
- Gaura coccinea* Pursh var. *epilobioides* (H.B.K.) Munz, Bull. Torrey Bot. Club 65: 222. 1938. Munz, N. Amer. Fl. II. 5: 195. 1965.
- Gaura coccinea* Pursh var. *arizonica* Munz, Bull. Torrey Bot. Club 65:



225. 1938. Type: Globe, Gila Co., Arizona, 17 May 1919, *Alice Eastwood* 8657 (GH). Munz, N. Amer. Fl. II. 5: 196. 1965.

Clumped perennial herb, from a deep, thick taproot, often branching several centimeters below the ground and giving rise to underground stems, or branching only at the surface or not at all; underground stems often becoming horizontal or nearly so and giving rise to new plants; stems 1–12 dm tall, the plants varying from full and copiously branched at the base, little above, to strict and little branched at the base, copiously above. Entire plant densely strigulose with long spreading trichomes often present near the base to subglabrous with strigulose pubescence on ovary, outside of floral tube, and sepals, and sometimes at edges of lower leaves also. Leaves linear to narrowly elliptic, 0.7–6.5 cm long, 0.1–1.5 cm wide, entire to remotely and coarsely serrate. Inflorescence 8–47(–65) cm long, the peduncle 1–6.5 cm long, strict or well branched; bracts subulate, 2–5 mm long, 0.4–1.1 mm wide. Floral tube 4–11(–13) mm long. Sepals 5–9 (–10) mm long, (0.75–)1–1.5(–2) mm wide. Petals white fading to orange-red to deep maroon, very rarely pale cream, 3–7(–8) mm long, 2–4 mm wide. Filaments cream, 3–6.5(–7) mm long; anthers yellow to light or deep red, (2.5–)3–5(–5.5) mm long. Style (9.5–)10–21(–21.5) mm long. Fruit 4–8.5(–9) mm long, (1–)1.5–3 mm thick at the thickest point. Seeds (1–)3–4, 1.5–3 mm long, 1–1.5 mm thick, light to reddish brown. Self-incompatible. Gametic chromosome numbers,  $n = 7, 14, 21, 28$  (with intermediate numbers and supernumerary chromosomes occasionally found).

TYPE: Near Mandan, Morton Co., North Dakota, 22 June to 5 July 1811, *John Bradbury* (PH).

DISTRIBUTION (fig. 40): Frequent in light, sandy soil, usually at middle elevations and ascending to about 3000 m in Mexico; local in the Kootenay District of British Columbia, and from the valley of the North Fork of the Saskatchewan River at about 53°40'N lat. near Edmonton, Alberta, and about 52°40'N lat. near Battleford, Saskatchewan south throughout southern Alberta, Saskatchewan, and Manitoba, and through Montana, North Dakota, and western Minnesota south, mainly east of the Continental Divide to central Colorado, northwestern Missouri, western Oklahoma, central and western Texas, southern Utah, southernmost Nevada, and northeastern San Bernardino County, California, then southward through northeastern Sonora and the mountains of Chihuahua, Coahuila, Nuevo León, and Tamaulipas to the Trans-Mexican Volcanic Belt (where abundant); rare in southern Puebla and northern Oaxaca at about 17°N lat. Introduced and collected once each in Chiapas, Mexico, in Rio Grande do Sul, Brazil, and in Wales. Also a sporadic weed in Wisconsin, Illinois, Indiana, Michigan, New York,



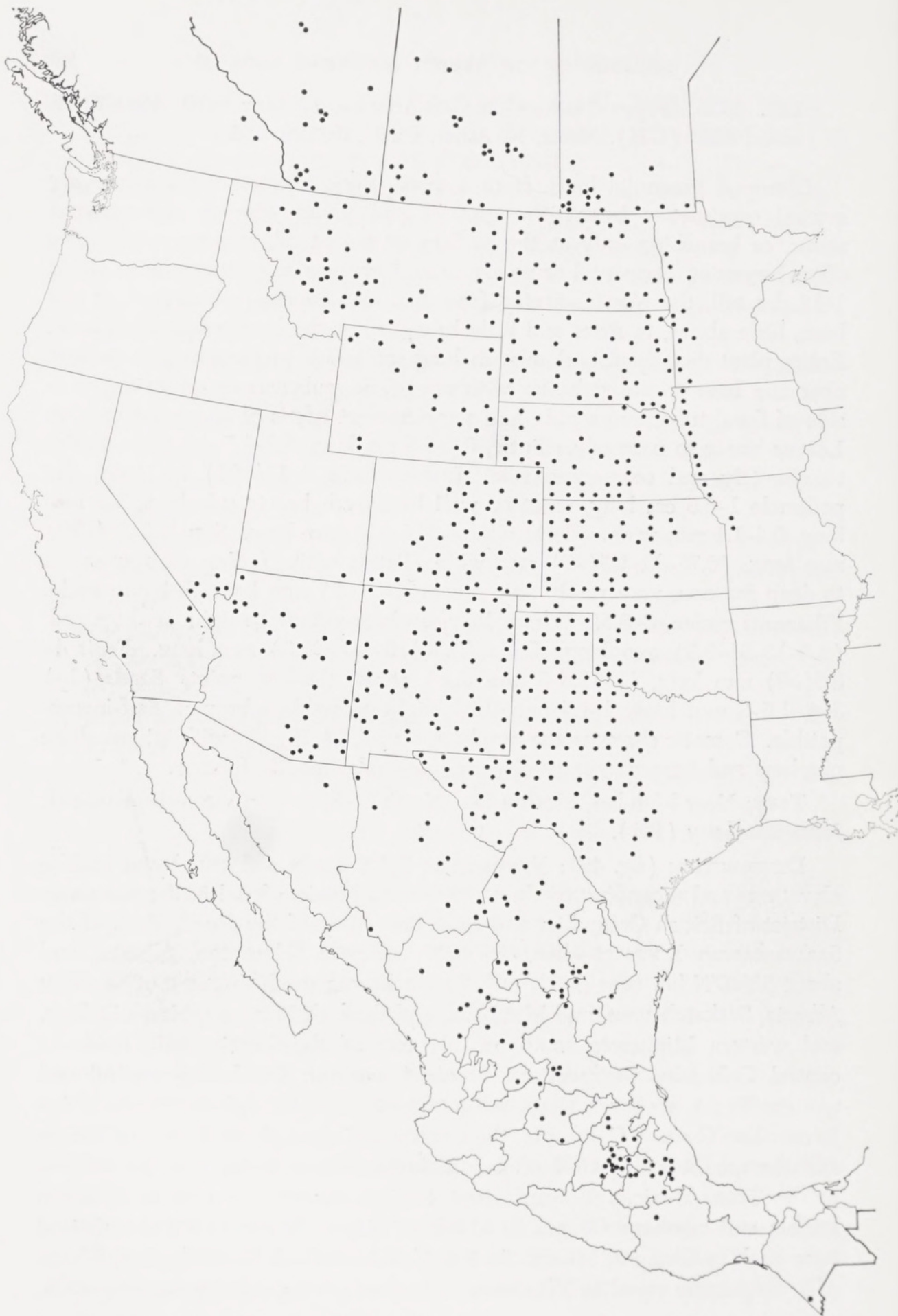


FIGURE 40. Range of *Gaura coccinea*. Localities where the plant has been collected as an adventive in eastern North America are not mapped.

coastal southern California, and in southern Ontario. Possibly native at Piute Creek, Kern County, California (6 June 1893, *N. C. Wilson*, DS, NO), but probably introduced. Flowers April to August.

REPRESENTATIVE SPECIMENS EXAMINED (from outside of the United States):

BRAZIL. RIO GRANDE DO SUL. Porto Alegre, *Reinick* in 1899 (GH).

GREAT BRITAIN. WALES. Carmathenshire: Adventive, Pembrey Burrows, *Hollis* in 1935 (K).

MEXICO. AGUASCALIENTES. Aguascalientes, *Kuntze* 23484 (NY). CHIAPAS. Escuintla, *Matuda* 676 (MEXU, MICH, US). CHIHUAHUA. Santa Eulalia, pass between Velardeña and Cristo mines, ca. 28°37'N, 105°53'W, *Hewitt* 294 (GH); near Charco, *Johnston* 8134 (GH); mountains w of Chihuahua, *LeSueur* 805 (F, NO, SMU, TEX); foothills of the Sierra Madre near Colonia Juárez, *Nelson* 6336 (GH, US); end of Sierra del Diablo, *Stewart* 1943c (GH); 7 mi s of junction of Casas Grandes Hwy. on Mexico Hwy. 45, *Straw & Forman* 1842 (MICH, RSA); Mpio. de Janos, 4800 ft, *White* 2572 (GH, MEXU, MINN); 12 mi s of Camargo, 400 ft, *White* 2229 (GH, MICH). COAHUILA. Saltillo, 1600 m, *Arsène & Adola* 6346 (US); Parras, *Kenoyer & Crum* in 1948 (A); Viesca, 3725 ft, *Fisher* 44108 (GH, MO, NSC, NY, SMU); Arteaga Road, *Kenoyer & Crum* 2659 (A, MICH); 10 mi e of Arteaga (ca. 20 mi e of Saltillo), *Straw & Forman* 1349 (MICH, RSA); 6 mi n of La Ventura on road to Saltillo, *Johnston* 7645 (GH); Múzquiz, *Marsh* 2119 (F, GH); Monclova, *Marsh* 1704 (TEX); Sierra de Santa Rosa, s of Múzquiz, *Marsh* 2272 (GH, TEX); 13 mi s of Saltillo, *McGregor* 16713 (DS, KANU); 6 mi w of San Pedro, *Munz* 15040 (GH, MO, POM); end of road from T. Armendaiz N. into the Sierra del Pino, *Johnston & Mueller* 690 (GY); Sierra de las Cruces, *Johnston & Mueller* 231 (GH); 9 km s of Parras on Sierra Negra, *Stanford et al.* 240 (GH, ILL, DS, MEXU, MO, NY); Fraile, 59 km s of Saltillo, *Stanford et al.* 251 (DS, GH, ILL, MEXU, MO, NY); 11 km ne of Jimulco, 2100 m, *Stanford et al.* 20 (DS, GH, MO, NY); 15 km w of Concepción de Oro, *Stanford et al.* 537 (DS, GH, MO, NY); 25 km s of Piedras Negras, *Rinehart* 216 (OKL); Carneros Pass, *Pringle* 3105 (BR, CM, COCO, F, G, GH, LE, MICH, MEXU, MO, MSC, ND, NY, RSA, US); Cañon del Indio Felipe, Sierra Hechiceros, *Stewart* 19 (GH); n of La Ventura, 6000 ft, *Shreve & Tinkhorn* 9610 (GH); Paila, Km 570, 1200 m, *Aguirre & Reko* 42 (NY); 8 km ne of Santa Elena, *Stewart* 1122 (GH); n slope of Sierra Planchada, 5 mi w of El Oro, *White* 1998 (MEXU, MICH); 60 mi w of Cuatro Ciénegas, *White* 1955 (DS, GH, MICH). DURANGO. Chupaderos n of Durango, *Pennell* 18181 (MEXU, PH, US); near Yerbánis, *Shreve* 9148 (GH); 11 mi n of La Zarca, *Waterfall* 12541 (GH, MICH, OKLA, US); 34–38 mi ne of Durango, *Waterfall* 13359 (IKLA, SMU); 0.5 mi w of El Pino, ca. 10 mi w of Durango, *Waterfall & Wallis* 13359 (IA, OKLA); 1 mi s of La Zarca, *Wiens* 3524 (COLO). GUANAJUATO. Acámbaro, *Duges* 303 (GH); San Miguel Allende, *Kenoyer* 1913 (GH); León, *Matuda* M19057 (F); Irapuato, *Woodruff* 144 (NY). HIDALGO. Vicinity of Zimapán, *Kenoyer* 1058 (GH); Tulancingo, Cuauhtepic, *Moore* 1601 (BH); near Tequixquiac, *Rose & Painter* 6636 (GH, US); near El Salto, *Rose & Painter* 8031 (US); Hacienda Palmar near Pachuca, *Rose & Painter* 8820 (NY, US). JALISCO. Near Km 31 sw of Ojuelos on road to Aguascalientes, above Presa de Valerio, *McVaugh* 16891 (MICH, US); 1.5 mi s of Ojuelos, *Winetraub & Roller* 33 (MICH). MEXICO. Alrededores de Atlahutenco, Mpio. de Ecatepec Morelos, 2250 m, *Cruz* 508 (DS, MICH, TEX); Teotihuacán, 2200 m, *Fröderstrom & Hultén* 1198 (NY); Los Reyes, on road to Puebla, *Langman* 2470 (PH); near Texcoco, *Mac-*



*Daniels* 577 (BY); Tlamanalco, 7000 ft, *Munz* 15051 (GH, MO, POM); field above Jacoboys, D.F., *Pringle* 10397 (COLO, DAO, DUKE, F, GH, IA, LL, KANU, MIN, MICH, MSC, OKLA, SMU, TEX, US); Lomas de Chapultepec, D. F., *Barkley & Rowell* 7452 (FLAS, MICH, TEX); Vera Cruz, 8300 ft, near Guadalupe Victoria, *Weaver* 881 (TAES, US). NUEVO LEÓN. Near Cerro Grande, ca. 3 mi sw of Ascención, 7000–8000 ft, *Straw & Forman* 1400 (MEXU, RSA); 67 km nw of San Roberto on Hwy. 57, ca. 1800 m, *Roe & Mori* 50 (WISC); Sabinas Hidalgo, *Potts in* 1941 (OKL); 38 mi se of Saltillo, *Waterfall* 16615 (OKL, OKLA, RSA, SMU). OAXACA. Ca. 6 mi s of Tamazulapán, *Straw & Gregory* 1038 (GH, MICH, MEXU, RSA). PUEBLA. Rancho Posada, 2194 m, vicinity of Puebla, *Arsène* 95 (US); Cholula, *Deam* 77 (GH, MO); Tehuacán, *J. N. & J. S. Rose* 9960 (GH, US); near Tepeaca, ca. 7000 ft, *W. E. & M. S. Manning* 53900 (FLAS, GH, TEX); 45 mi e of Puebla, 6600 ft, *W. E. & M. S. Manning* 53708 (GH); Acatzingo, 7500 ft, *Munz* 15068 (GH, MO); Hwy. from Tehuacan to Orizaba just above Azumbilla, 1500–1800 m, *Smith et al.* 3959 (F, GH, NY, US). SAN LUIS POTOSÍ. 16 mi e of San Luis Potosí, *Breedlove* 14364A (DS); 13 mi nw of San Luis Potosí, *Breedlove* 15471 (DS); Charcas, *Lundell* 5137 (MICH, NY, US). SONORA. 23.5 mi ne of Bocoachic on road to Esqueda, 4480 ft, *Wiggins* 11742 (DAO, DS, TEX, US). TAMAULIPAS. Between Marcela and Hermosa, *Stanford et al.* 2662 (DS, GH, MO, NY, RSA). TLAXCALA. Hwy. to Veracruz ca. 9 km e of México, *Lambert* 41–23 (PENN, PH); Km. 185 on road from Huamantla to El Carmen, *Sohns* 624 (US); 10 mi n of San Martín Texmelucán, *Sohns* 659 (US). VERACRUZ. Mt. Orizaba, 4000 ft, *Seaton* 266 (GH); Maltrata, *Matuda* 1219 (MEXU, MICH); Jalapa, *Coulter* 164 (GH). ZACATECAS. 32 mi nw of San Luis Potosí, *Breedlove* 15476 (DS); Pedernalillo, near Guadalupe, *Dressler* 306 (MO); Fresnillo, *Knobloch* 1030 (MICH, MSC); near Concepción del Oro, *Palmer* 318 (GH, NY, US); 22 mi n of Zacatecas, *Straw & Forman* 1493 (GH, MEXU, RSA); 2 mi se of Sombrereto, *Waterfall* 13804A (OKLA, IA).

*Gaura coccinea* is commonly known in Mexico as “linda tarde” or “hierba de golpe” and in Texas as “wild honeysuckle.” There appears to be nothing to be gained by ascribing this species to “Nutt. ex Pursh,” as Nuttall is not mentioned either by Pursh or in the Fraser Catalogue of 1813, even though we now know that Nuttall was the author of this anonymous catalogue (cf., Reveal, *Rhodora* 70: 25–54. 1968). Pursh clearly based his species upon the Bradbury specimen cited above, and not on any Nuttall specimen; indeed he remarks that the habit of his plant differs from that indicated (by a sign) in the Fraser Catalogue, where the name is, in any case, a *nomen nudum*. Pursh did include in his protologue a reference to the Catalogue. We are indebted to J. E. Dandy for his remarks on this matter.

As attested by its rather complex synonymy, *Gaura coccinea* is a variable species. Over much of its wide range, it is relatively uniform, with the plants low, usually 2–5 dm tall, branching mostly at and below ground and not much above, and often forming large colonies partly by means of vegetative reproduction. The inflorescence in such plants is usually less than 5 cm long. Plants from southern Nevada and northwestern Arizona are



taller but usually do not differ in habit, although they occasionally branch more than usual above. Such plants represent one end of a very gradual cline which begins in north-central Arizona.

From west and central Texas north into the panhandle and southern Oklahoma, the plants are taller, usually 5–10 dm tall, unbranched or with a very few branches from the base, but well branched above, and occur in clumps, spreading very little by rhizomes. The more numerous branches are long, with the central leader generally more than 5 cm long and longer than that of the widespread race at a comparable stage of growth. There is a very gradual transition from this race to the more widespread one, with many populations and individual plants impossible to assign to one or the other. Under the circumstances, it does not appear desirable to reflect these differences in the formal taxonomy.

Chromosomally, *Gaura coccinea* is very complex, with diploid ( $n = 7$ ), tetraploid ( $n = 14$ ), hexaploid ( $n = 21$ ), and octoploid ( $n = 28$ ) populations. The most extreme expression of the "Texas" race is found in the diploids, which are confined to Trans-Pecos Texas and adjacent New Mexico, and are relatively uniform morphologically. In general, the diploids have the smallest flowers found in the species, although the ranges of measurements of flower parts overlap broadly. Tetraploids and hexaploids found in adjacent regions are in general intermediate in their characteristics between the diploids and the more widespread expression of the species. The transitions are often not gradual. For example, in the area of the Davis Mountains in west Texas, populations of hexaploids growing within a few miles of one another may represent one or the other extreme or various intermediates. Around Carrizozo in south-central New Mexico the same sort of mixture of distinctive populations is found among the tetraploids. On the other hand, north of the central Texas panhandle and south of the Rio Grande (the sampling is relatively poor in Mexico), the populations seem relatively uniform and to change gradually over vast areas.

The octoploids occur locally as populations in predominantly tetraploid areas. They were presumably derived from tetraploid plants directly. Both tetraploids and hexaploids occur widely in the central and southern parts of the range of the species, and are, like the octoploids, indistinguishable morphologically except occasionally on a very local basis. Neither pollen size nor pore number is useful in distinguishing chromosomal races in *Gaura coccinea*.

The consistent occurrence of autopolyploid pairing in all polyploids of this species indicates a lack of chromosomal differentiation. The simplest explanation for the observed pairing would seem to be an initial stabilization of a diploid race of plants similar to those occurring in west Texas and a



tetraploid race with the characteristics of populations found in the central and northern parts of the species area. There is no reason to postulate an allotetraploid origin for the latter; indeed, the consistent autotetraploid association of its chromosomes and the presence of but one diploid in the complex militate against such an hypothesis. Nor can it confidently be asserted that the tetraploid originated from the diploid; cytogenetic evidence would be equally consistent with the opposite point of view (cf., Raven and Thomson, Amer. Naturalist 98: 251, 252. 1964), and there appears to be no logical basis for distinguishing between these two theories. The restriction of the diploid to an area where many related diploid species occur, however, lends credence to the idea that it may be ancestral rather than derived.

Given the initial presence of these two races, it is a simple matter to visualize the development of the pattern seen at present. The origin of the tetraploids from diploids and of octoploids from tetraploids would be consistent with the geographical patterns observed and the lack of morphological differentiation. The opposite processes may also have taken place occasionally. With the sort of chromosomal equivalence that prevails in *Gaura coccinea*, hexaploids can originate directly from the functioning of unreduced tetraploid gamete, from tetraploid-octoploid hybridization, or in the conventional way. Similarly, tetraploids can probably be derived in one step from hexaploid-diploid crosses. The proliferation of polyploid races and the subsequent hybridization within and doubtless also between chromosomal levels is attested by the pattern displayed from this complex species and the impossibility of finding morphological discontinuities in it. In our survey of approximately 300 wild plants, approximately 5 apparent interploid hybrids were encountered (Raven and Gregory, Brittonia 24: 71-86. 1972).

## SECTION V. STIPOGAURA

*Gaura* sect. *Stipogaura* Raven & Gregory, sect. nov.

Herbae perennes confertae vel rhizomatosae, caulibus strigulosis vel glandulosis, saepe etiam villosis. Inflorescentiae erectae. Flores valde zygomorphi, vespertini. Fructorum corpus ovoideum, lateribus concavibus, longe abrupteque stipitatum.

Clumped or rhizomatous perennial herbs, the stems strigulose or glandular, and usually villous also. Inflorescence erect. Flowers strongly zygomorphic, the stamens in the lower quarter or half or well distributed; flowers opening near sunset and withering early the next morning. Fruit reflexing at maturity, with the body ovoid, winged along the angles, the



sides concave with the upper half of each concavity forming a shallow trough, abruptly narrowed into a long stipe. Self-incompatible. Gametic chromosome numbers,  $n = 7, 14$ .

TYPE SPECIES: *Gaura villosa* Torr.

DISTRIBUTION: Sandy and rocky slopes and flats from southeasternmost Colorado and Texas south to eastern Durango, Coahuila, Nuevo León, and western Tamaulipas, Mexico.

The five species of section *Stipoguara* are closely related to one another and present an interesting pattern of relationship. Three—*Gaura calcicola*, *G. mckelveyae*, and *G. filipes*—are medium-sized to small clumped diploids. They replace one another geographically, with *G. calcicola* on rocky slopes at moderate elevations in west Texas and southward into Mexico, *G. mckelveyae* on sandy plains at low elevations in and near the Rio Grande valley, and *G. filipes* in the southeastern United States. *Gaura sinuata*, an aggressively rhizomatous weedy tetraploid, was very probably derived following hybridization between *G. calcicola* (or the common ancestor of *G. calcicola* and *G. filipes*, which are extremely similar morphologically) and *G. mckelveyae*. It is somewhat intermediate ecologically and has spread rather widely as a weed of cultivated fields. The fifth species, *Gaura villosa*, is a large, handsome plant of the dunes and sandy flats in south and west Texas and adjacent states, apparently separated from the others by its extreme ecological specialization. It is listed first in the section not because woodiness is thought to be primitive, a dubious proposition, but rather because it is thought to have been a rather early offshoot of the common ancestor of the other species.

6. *Gaura villosa* Torr., Ann. Lyceum Nat. Hist. New York 2: 200. 1827.  
Munz, Bull. Torrey Bot. Club 65: 213. 1938; N. Amer. Fl. II. 5: 192.  
1965.

Clumped woody perennial of dunes and sandy flats, from a deep, twisted, woody rootstock; stems sending up several branches near ground level and branching again where the inflorescences originate to form at maturity a full, leafy plant with long inflorescences rising above; stems 6–18 dm tall. Plants densely villous with hairs 2–3 mm long all over below the inflorescence, sometimes more sparsely so, and with a dense under-story of strigulose or glandular hairs; inflorescence strigulose, glandular-pubescent, or hirtellous; leaves densely covered with loose, strigose pubescence, rarely with a few glandular hairs below. Leaves oblanceolate to very narrowly elliptic or linear, 0.5–8 cm long, 0.15–2 cm wide, subentire or shallowly sinuate-dentate, occasionally markedly so, often undulate, acuminate at the tip, sessile. Inflorescence generally well branched, 20–127 cm



41



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FIGURES 41-46. Flowers of the species of *Gaura* sect. *Stipogaura*. Fig. 41. *G. villosa* subsp. *villosa*.—Fig. 42. *G. villosa* subsp. *parksii*.—Fig. 43. *G. calcicola*.—Fig. 44. *G. filipes*.—Fig. 45. *G. mckelveyae*.—Fig. 46. *G. sinuata*.



long; bracts narrowly lanceolate to narrowly ovate, 1-6(-10) mm long, 0.75-1.5 mm wide. Flowers with stamens in the lower quarter. Floral tube 1.5-5 mm long. Sepals 6-14 mm long, 1-2.5 mm wide. Petals 7-13 mm long, 4-6 mm wide. Filaments 4.5-11 mm long; anthers 2-4.5 mm long. Style 9-18.5 mm long. Body of the fruit 9-19 mm long, 1-3.5 mm thick, the stipe 2-10 mm long. Seeds (1-)2-4, 2-3(-4) mm long, 0.75-1.25 mm thick, yellowish to light brown or rarely reddish brown. Self-incompatible. Gametic chromosome number,  $n = 7$ .

TYPE: Along the upper Canadian River, in Hartley, Oldham, or Potter Co., Texas, 4-9 August 1820, *Edwin James* (NY).

DISTRIBUTION (fig. 38): Dunes and sandy flats, Rio Grande Plain of south Texas; High Plains and Rolling Plains of northwestern Texas, eastern New Mexico, southeasternmost Colorado, southwestern Kansas (one station in Ellis Co.), and the western half of Oklahoma; locally naturalized in New Jersey.

The two subspecies recognized in *Gaura villosa* have a disjunct distribution but are so closely similar that it seems best to emphasize these similarities by maintaining them within a single species.

6a. *Gaura villosa* subsp. *villosa*. Figs. 6, 41.

*Gaura cinerea* Wooton & Standl., Contr. U. S. Natl. Herb. 16: 152. 1913.

Type: 20 mi s of Roswell, 1080 m, Chaves Co., New Mexico, August 1900, *F. S. & E. S. Earle* 533 (US 382592. Isotype, NY).

*Gaura villosa* Torr. var. *typica* Munz, Bull. Torrey Bot. Club 65: 214. 1938.

*Gaura villosa* Torr. var. *arenicola* Munz, Bull. Torrey Bot. Club 65: 215. 1938. Type: 5 mi ne of Portales, on sand dunes near U.S. Hwy. 70, Roosevelt Co., New Mexico, 14 June 1930, *G. J. Goodman & C. L. Hitchcock* 1124 (POM 171881. Isotypes, MICH, NY). Munz, N. Amer. Fl. II. 5: 192. 1965.

Plants with an understory of either strigulose or glandular hairs, the corresponding kind covering the ovaries, outside of the floral tube, and sepals more densely; branches of the inflorescence either glabrous or sparsely glandular-pubescent; leaves rarely with a few glandular hairs beneath. Leaves narrowly lanceolate to very narrowly elliptic or linear, occasionally narrowly elliptic to lanceolate or even narrowly oblanceolate toward the base of the plant, subentire or shallowly sinuate-dentate, occasionally markedly so. Inflorescence whiplash-like, comparatively stout. Floral tube 2-5 mm long. Petals 8.5-13 mm long. Filaments 5-11 mm long; anthers 2.5-4.5 mm long. Style 10-18.5 mm long. Body of the fruit 9-18 mm long,



2–3.5 mm wide, the stipe 2–8 mm long. Self-incompatible. Gametic chromosome number,  $n = 7$ .

DISTRIBUTION (fig. 38): Sand dunes and sandy flats, High Plains and Rolling Plains of northwestern Texas, eastern New Mexico, southeasternmost Colorado, southwestern Kansas (one station farther north, in Ellis County), and the western half of Oklahoma; locally naturalized in New Jersey.

#### REPRESENTATIVE SPECIMENS EXAMINED:

UNITED STATES. COLORADO. Baca Co.: 23 mi s of Walsh, *Stephens & Brooks* 21792 (DS, KANU); s bank of Cimarron River at se corner of county, *Weber* 5142 (COCO, COLO, DAO, DS, GH, KANU, NSC, OKL, RSA, SMU, TAES, TEX, US). KANSAS. Barber Co.: 3 mi s of Medicine Lodge, *Horr & Franklin* in 1940 (KANU). Clark Co.: 10 mi s of Ashland, *Rydberg & Imler* 749 (KANU, NY). Comanche Co.: Coldwater, *Rydberg & Imler* 678 (NY). Ellis Co.: Hays, *Bondy* in 1937 (OKL, UMO). Kiowa Co.: 5 mi n of Greensburg, *McGregor* 10634 (KANU). Meade Co.: 2 mi w of Meade Co. State Park, *Horr* 3668 (KANU). Morton Co.: 9 mi n of Elkhart, *McGregor* 5105 (KANU). Pratt Co.: Turkey Creek, *Norris* 193 (MO). Seward Co.: 20 mi ne of Liberal, *Rydberg & Imler* 852 (KANU, NY). Stevens Co.: *Hitchcock* in 1897 (POM). NEW JERSEY. Cape May Co.: S of New England Road, Cold Spring, *Brown* in 1921 (PENN), in 1922 (PH). NEW MEXICO. Chaves Co.: 30 mi s of Roswell, *F. S. & E. S. Earle* 533 (MIN, MO, NCU). Colfax Co.: W of Willow Bar, *Fendler* 213 (MO). Curry Co.: 9 mi s of Broadview, *Stephens & Brooks* 25624 (DS, KANU). De Baca Co.: Fort Sumner, *Shinners* 20924 (SMU). Guadalupe Co.: Santa Rosa, *Cooley* 3 (OKLA). Lea Co.: 3.3 mi e-ne of Hobbs, *Shinners* 20071 (SMU). Quay Co.: 3 mi s of Sand Springs, *Wagenknecht* in 1957 (KANU). Roosevelt Co.: 5 mi ne of Portales, *Goodman & Hitchcock* 1124 (GH, MIN, POM). OKLAHOMA. Alfalfa Co.: 1 mi nw of Gonot Salt Plains Dam, *Waterfall* 7834 (OKL). Beaver Co.: 2 mi e of Headquarters, *Hindman* 216 (NCU, OKLA). Blaine Co.: 3 mi s, 1.5 mi w of Watonga, *Cox* in 1954 (OKLA). Caddo Co.: E of Bridgeport, *Munz* 13576 (POM). Cimarron Co.: S of Walsh, *Weber* 5210 (COLO, NSC). Cleveland Co.: 6 mi nw of Norman, *Bruner* in 1924 (MIN). Comanche Co.: Wichita Mts., *Marcy's Expedition*. Cotton Co.: 4 mi s of Randletter, *Waterfall* 7283 (OKL, OKLA). Custer Co.: 1/4 mi s, 2 mi e of Weatherford, *Waterfall* 2238 (OKL, OKLA). Dewey Co.: Near Canton, *Stevens* 871 (DS, GH, ILL, MO, MIN, OKL, OKLA). Ellis Co.: Pack Saddle Bridge, Canadian River valley, *Goodman* 2591 (ISC, MO, OKL, POM). Grady Co.: 3/4 mi e of Juttle, *Pearce* 690 (OKL). Grant Co.: 20 mi w of Medford, *Waterfall* 7366 (OKL, OKLA). Greer Co.: 1 mi e of Magnum, *Waterfall* 7309 (OKL, OKLA). Harmon Co.: 1.7 mi w of Vinson, *Waterfall* 7767 (OKL). Harper Co.: 4 mi s of Rosstown, *A. & R. A. Nelson & Goodman* 5319 (OKL, TEX). Jackson Co.: 3 mi w of Altus, *Hopkins* 1010 (OKL). Jefferson Co.: S of Terral, *Goodman* 7204 (OKL). Kingfisher Co.: 2 mi se of Dover, *Byers* 71 (OKLA). Kiowa Co.: 8 mi w of Snyder, *Waterfall* 13101 (OKLA). Logan Co.: Near Guthrie, *Stevens* 3262 1/2 (GH). Murray Co.: Davis, Arbuckle Mts., *Emig* 746 (CM). Payne Co.: 3 mi w of Stillwater, 5.5 mi s, *Byler* 141 (OKLA). Roger Mills Co.: *Engleman* 1624 (OKL). Texas Co.: Goodwell, *Butler* 119 (OKLA). Woods Co.: Salt Fork River near Alva, *Stevens* 2876 (ILL, MIN, OKLA, POM). Woodward Co.: Fort Supply, *Potter* in 1882 (GH). TEXAS. Bailey Co.: 1.5 mi s of



Muleshoe, *Cory* 27499 (TAES). Baylor Co.: Seymour, *Reverchon* in 1879 (F, GH, NY). Briscoe Co.: 3 mi s of Quitaque, *Whitehouse* 10010 (MICH, NY, SMU). Carson Co.: 3 mi w of Skellytown, *Stephens* 17341 (DS, KANU). Collingsworth Co.: 5.5 mi n of Wellington, *Parks & Cory* 16140 (TAES). Crane Co.: 9 1/3 mi n of Crane, *Cory* 37642 (TAES, TEX). Crosby Co.: 5 mi e of Crosbyton, *Baker* 53 (OKLA). Dickens Co.: 1 mi w, 2 mi n of Dickens, *Rowell* 10292 (DS, RSA). Dallam Co.: Just n of Dalhart, *York & Rodgers* 221 (TEX, SMU, TTC). Donley Co.: 11.8 mi nw of Clarendon, *Shinners* 15213 (SMU). Ector Co.: 14 mi e of Monahans, *Raven & Gregory* 19235 (DS). Gaines Co.: Stateline, *Tharp & Grimbredde* 51-1013 (COLO, KANU, MIN, PENN, TAES, TEX). Garza Co.: 12 mi n of Post, *McNabb* 150 (OKLA). Gray Co.: 3 mi e of McLean, *Munz & Gregory* 23512 (RSA). Hall Co.: Estelline, *Reverchon* 3847 (MO). Hardeman Co.: Quanah, *Tharp* 4486 (TEX). Hartley Co.: 5.4 mi sw of Middlewater, *Parks & Cory* 16317 (POM, TAES). Hemphill Co.: Canadian, *Bondy* in 1938 (CU, DUKE, WVA). Hutchinson Co.: 10 mi e, 1 mi s of Pringle, *Cutter* 67 (KANU, MIN). Kent Co.: 2.9 mi sw of Jayton, *Shinners* 30046 (SMU). Lipscomb Co.: *Howell* 42 (US). Loving Co.: Mentone to Wink, *Warnock* 10722 (LL, SMU). Lubbock Co.: 16 mi e of Lubbock, *Adams* 94 (OKLA). Martin Co.: 1.5 mi ne of Stanton, *Parks & Cory* 13878 (TAES). Mitchell Co.: 5 mi nw of Loraine, *Pohl* 4324 (SMU). Motley Co.: N of Matador, *Parks & Cory* 16045 (TAES). Ochiltree Co.: 12 mi se of Perryton, 5 mi e of highway, *Wallis* 4860 (OKLA, SMU). Oldham Co.: 20 mi n of Adrian, *Rowell* 8012 (OKLA, TEX, TTC). Parmer Co.: 1 mi e of Bovina, *Hicks* in 1940 (GH). Potter Co.: N of Amarillo, *Brenkle* 48175 (DAO). Randall Co.: Palo Duro Canyon, *Palmer* 14067 (MO, WISC). Roberts Co.: 27 mi s of Perryton, *Wallis* 7170 (OKLA, TEX). Taylor Co.: 10 mi sw of Tuscola, *Mahler* 1321 (OKLA). Terry Co.: Wellman, *Tharp* in 1941 (GH, TEX). Ward Co.: 1 mi e of Monahans, *Munz* 23408 (DAO, RSA). Wheller Co.: 5 mi e of Tela, *Fogg* 18790 (PENN). Wichita Co.: Red River above Burkburnett, *Tharp* 574 (NY). Winkler Co.: 8 mi ne of Kermit, *Irving* 91 (IPN, SMU).

*Gaura villosa* var. *arenicola* Munz was separated by virtue of the glandular, not strigulose, pubescence in the inflorescences. Similar differences in pubescence are common in many species of Onagraceae, and, by themselves, are insufficient for taxonomic recognition.

**6b. *Gaura villosa* subsp. *parksii* (Munz) Raven & Gregory, comb. nov.**  
Figs. 7, 42.

*Gaura villosa* Torr. var. *parksii* Munz, Bull. Torrey Bot. Club 65: 215. 1938. Munz, N. Amer. Fl. II. 5: 192. 1965.

Plants with an understory of hispidulous pubescence which also covers the ovaries, outside of the floral tube, and sepals more densely; branches of the inflorescence glabrous; glandular pubescence absent. Leaves narrowly oblanceolate or oblanceolate to narrowly elliptic, shallowly sinuate-dentate. Inflorescence delicate, well branched. Floral tube 1.5-4 mm long. Petals 7-12 mm long. Filaments 4.5-9 mm long; anthers 2-3.5 mm long. Style 9-16 mm long. Body of the fruit 11-19 mm long, 1-2 mm wide, the



stripe 5–10 mm long. Self-incompatible. Gametic chromosome number,  $n = 7$ .

TYPE: Open sandy places, Terrell Hill, near Kaicaster, Wilson Co., Texas, 24 June 1935, P. A. Munz 13334 (POM 212450. Isotypes, GH, POM, US).

DISTRIBUTION (fig. 38): Flats and hills of red sand, local, Rio Grande Plain of south Texas.

SPECIMENS EXAMINED:

UNITED STATES. TEXAS. Atascosa Co.: Poteet, Parks R1282 (MO, SMU). Bexar Co.: 17 mi s of San Antonio, Metz 656 (NY). Dimmit Co.: 3/4 mi se of Carrizo Springs, Parks & Cory 29407 (POM, TAES); e of Carrizo Springs, Jones in 1931 (BM, POM). Frio Co.: Near Pearsall, Penfound in 1936 (NO). Guadalupe Co.: C. 10 mi s of Seguin, Webster & Rowell 7087 (IPN). Jim Hogg Co.: 5 mi ne of Hebbronville, Garcia 93 (OKLA). Maverick Co.: 31 mi e of Eagle Pass, Gregory 282 (RSA). Medina Co.: 3 mi s of Devine, Correll 15210 (LL); 2 3/4 mi sw of Devine, Parks & Cory 12737 (POM, TAES); 2 mi sw of Devine, Turner et al. 3419 (OKLA, TEX); Devine, Tharp in 1931 (TEX). Wilson Co.: Kaicaster School, Parks & Cory 15106 (TAES); Bexar Co. and western Wilson Co., Burr 194 (KANU). Zapata Co.: San Ygnacio, Tharp 3622 (TEX, US). Zavala Co.: Stony plains of the Nueces, Wright in 1848 (GH).

7. *Gaura calcicola* Raven & Gregory, sp. nov. Figs. 8, 43.

*Gaura sinuata sensu* Munz, Bull. Torrey Bot. Club 65: 218. 1938, *pro parte*; *sensu* Munz, N. Amer. Fl. II. 5: 194. 1965, *pro parte*.

Herba perennis basi sublignosi multiramosaque ramis numerosis erectis pauciramosis 0.2–1.5 m alta sparse stigulosa. Folia linearia vel anguste oblanceolata, 1–12 cm longa, 0.1–1 cm lata, basalia lyrata vel oblanceolata conspicue petiolata, superiora subsessilia. Inflorescentia 14–112 cm longa, virgata, bracteis lanceolatis vel ovatis, 1–3 mm longis, 0.5–1 mm latis. Flores zygomorphi, vespertini. Tubus floris 3–9 mm longus, intus lanatus. Sepala 6–12 mm longa, 1–2 mm lata. Petala 7–10.5 mm longa, 3–6.5 mm lata. Filamenta 3–7 mm longa; antherae 2.5–5 mm longae. Stylus 9.5–19 mm longus, basin versus lanatus. Fructus clavatus, parte crassiore 7–12 mm longo, 1.5–2.5 mm crasso, stipite 2–5 mm longo; semina (2–)3–4(–5), 1.5–2.5 mm longa, 0.75–1.25 mm lata, obovoidea, straminea vel pallide castanea. Numerus chromosomaticus gameticus,  $n = 7$ .

Clumped perennial herb, from a heavy, twisted, woody rootstock; stems branching below and just above the surface of the ground to form at maturity a clumped leafy plant from which long, wand-like inflorescences arise; stems also branching in a whorl within the leafy portion below the inflorescences, 2–15 dm tall. Plants subglabrous or with more or less dense, erect hairs 1.5–2 mm long in leafy portion, in either case the plants also



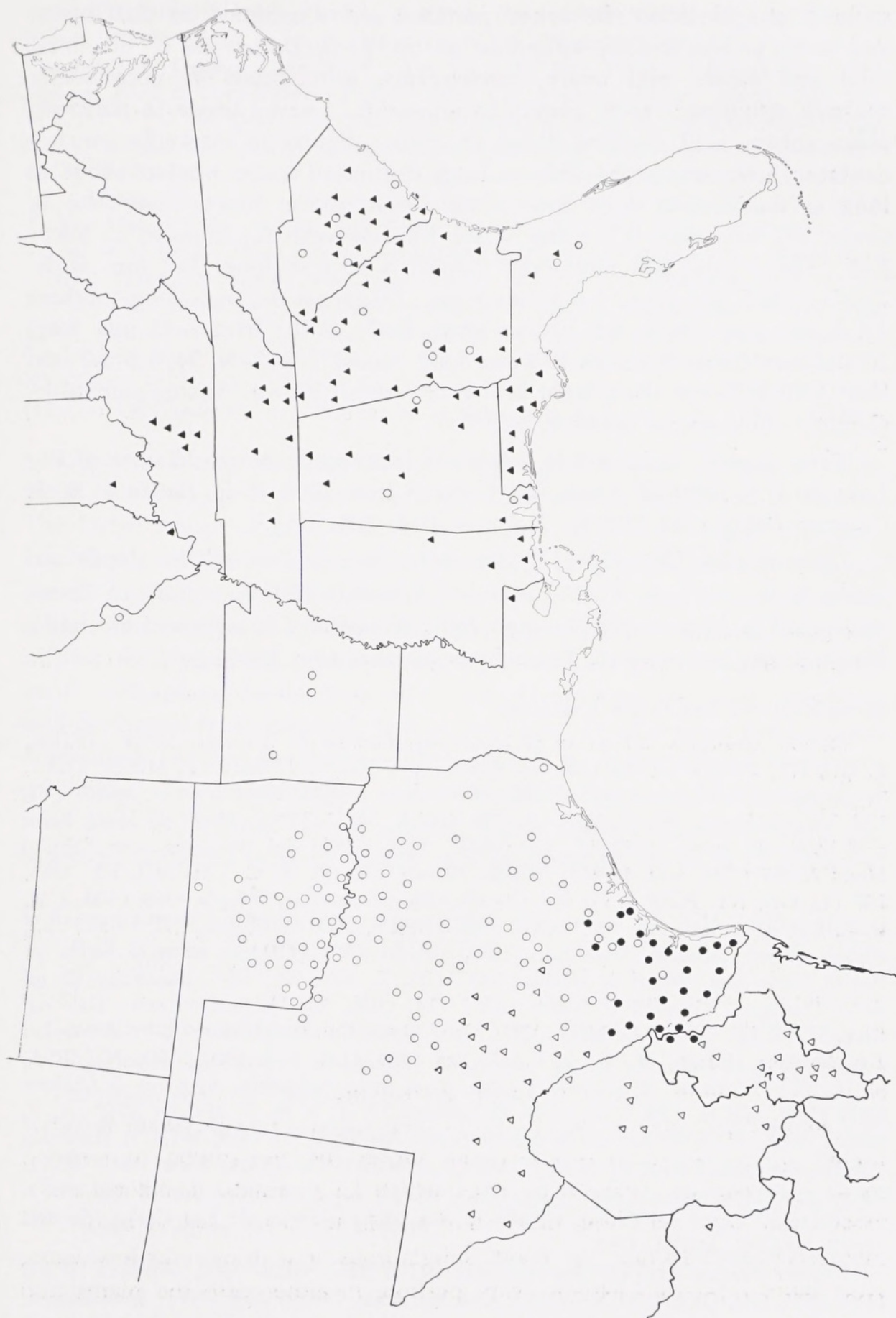


FIGURE 47. Ranges of species of *Gaura* sect. *Stipogaura*. *Gaura calcicola* (open triangles), *G. filipes* (filled triangles), *G. mckelveyae* (dots), and *G. sinuata* (circles). Stations where *G. sinuata* is naturalized beyond this area are not shown.



sparsely strigulose on the lower portions and sometimes on the leaves, and more or less heavily strigulose on the pedicels, outside of the floral tube and sepals, and ovary; inflorescence subglabrous or occasionally sparsely strigulose, rarely glandular-pubescent. Leaves linear to narrowly oblanceolate, 1–12 cm long, 0.1–1 cm wide, slightly to markedly sinuate-dentate. Inflorescence 14–112 cm long, the naked lower portion about as long as the portion with flowers and fruits above; bracts lanceolate to ovate, 1–3 mm long, 0.5–1 mm wide. Flowers with the stamens in lower half. Floral tube 3–9 mm long. Sepals 6–12 mm long, 1–2 mm wide. Petals 7–10.5 mm long, 2–6.5 mm wide. Filaments 3–7 mm long; anthers 2.5–5 mm long. Style 9.5–19 mm long. Body of the fruit 7–12 mm long, 1.5–2.5 mm thick, the stipe 2–5 mm long. Seeds (2–)3–4(–5), 1.5–2.5 mm long, 0.75–1.25 mm thick, light brown or reddish brown. Self-incompatible. Gametic chromosome number,  $n = 7$ .

TYPE: Limey, rocky soil in a fairly rich mesquite range, 15 mi e of Big Lake on U.S. Hwy. 67, Irion Co., Texas, 3 June 1964, *P. H. Raven & D. P. Gregory 19242* (DS 574029. Isotypes, BM, GH, US).

DISTRIBUTION (fig. 47): Dry limestone, gypsum, or caliche slopes and banks in the southern Trans-Pecos and Edwards Plateau regions of Texas, southward in Mexico into the mountains of eastern Durango and Coahuila, Nuevo León, and western Tamaulipas; northeastern Durango.

#### REPRESENTATIVE SPECIMENS EXAMINED:

MEXICO. COAHUILA. 23 mi se of Monterrey, *Barkley & Warnock 14849* (DUKE, F, GH, NY, TEX, US); Ojo Caliente, *Barkley & Gutiérrez 17M114* (F, MICH, TEX); 39 mi nw of Múzquiz, *Gould 11156* (DS); near Saltillo, *Hinton et al. 16637* (FI, GH, US); Múzquiz, *Marsh 2131* (F, GH, OKLA, SMU, TEX); Sierra de Santa Rosa, s of Múzquiz, *Marsh 1229* (F, GH, SMU, TEX); Palo del Diamante near Saltillo, *Munz 15026* (GH, MO, POM); Saltillo, *Palmer 131* (C, F, G, GH, MO, NY, US), 233 (C, GH, NY, POM, US); Rio Grande valley near Díaz, *Pringle 8320* (BM, CM, F, G, GH, IPN, ISC, LE, M, MEXU, MICH, MIN, MO, MSC, ND, PH, POM, US); 40 km nw of Hacienda de la Encantada, *Stewart 1621* (GH); e slope of Sierra de Puerto Santa Ana, *Wynd & Mueller 249* (GH, K, MO, NY, US). DURANGO. 95 mi ne of Durango, *Waterfall & Wallis 13221* (IA, OKL, SMU). NUEVO LEÓN. Galeana, *Chase 7722* (F, GH, ILL, MO, NCU, NY); Mpio. Galeana, *Chase 7647* (F); 5 km s of Sabinas Hidalgo, *T. C. & E. M. Fry 2401* (DS, GH, IND, MO, NY, RSA, SMU, US); 11 mi ne of Sabinas Hidalgo, 5 mi se of Vallecillos, *John ton & Graham 4608* (IPN, MICH, TEX); 15 mi sw of Galeana, *C. H. & M. T. Mueller 1040* (A, F, MICH, TEX, NY); 67 km nw of San Roberto, *Roe et al. 51* (DS, WISC); Hacienda Pablillo, Galeana, *Taylor 23* (DS, F, MEXU, MICH, MO, OKLA, RSA, SMU, TEX); 35 mi s of Monterrey, *White 1635* (GH, MICH); La Escondida, *Roybal 276* (US). TAMAULIPAS. Cerro del Chino, vicinity of San Miguel, Sierra de San Carlos, *Bartlett 10717* (MEXU, MICH, US).

UNITED STATES. TEXAS. Brewster Co.: Hess Hill, Glass Mts., *Warnock W303* (DS, FSU, GH, OKLA, TEX, WVA); s of Marathon, *Steiger 586* (NY); Pena Blanca,



Sperry T852 (US); Haley Ranch, *Parks & Cory* 9275 (TAES); Reagan Canyon, *Cory* 2148 (POM); 4 mi w of Alpine, Davis Mts. *Warnock* 5962 (LL, SMU, TEX). Crockett Co.: Ozona, *Jones* 25876 (BM, CU, DS, MO, POM). Edwards Co.: Rock Springs, *Reed & Cory* 33847 (TAES). Irion Co.: Mertzon, *Palmer* 12415 (BM, GH, MO, NY, US). Jeff Davis Co.: 3 mi n of Fort Davis, *Munz & Gregory* 23383 (DAO, RSA). Kendall Co.: Spanish Pass, *Clemens* (BH, MIN, POM). Kerr Co.: Kerrville, *Heller* 1692 (BM, C, CU, F, GH, ILL, ISC, LE, MICH, MIN, MSC, NY, PH, POM, US). Kinney Co.: 4 mi ne of Bracketville, *Strouther* 267 (COLO, DS, IPN, SMU, TEX). Maverick Co.: 13 mi n of Eagle Pass, *Gould* 11310 (DS). McCulloch Co.: 4.5 mi se of Brady, *Munz & Gregory* 23430 (DAO, RSA). Menard Co.: *Beede* 7116 (IND). Pecos Co.: Tunis Creek, *Tharp* 43-737 (F, MO, NY, OKL, PH, POM, TEX). Presidio Co.: 18 mi sw of Marfa, *Hinckley* 3525 (RSA). Sterling Co.: *Tharp* 3620 (TEX, US). Terrell Co.: 13 mi s of Sheffield, *Webster* 417 (TEX). Tom Green Co.: San Angelo, *Brady in* 1899 (TEX); 7 2/3 mi s of Christoval, *Cory* 50571 (DS, GH, NY, SMU, TEX, US). Uvalde Co.: 16 mi n of Uvalde, *T. & L. Mosquin* 5620 (DAO). Val Verde Co.: 13 3/4 mi ne of Comstock, *Parks & Cory* 31693 (TAES).

*Gaura calcicola* has heretofore been grouped with *G. sinuata*, a tetraploid ( $n=14$ ) species that is strongly rhizomatous and lower in stature. The large clumps of *G. calcicola*, with their numerous virgate branches, are often a conspicuous feature of limestone-covered hillsides in western Texas; hence the specific epithet. In contrast, *G. sinuata*, a noxious weed, often forms patches of considerable size, spreading by means of rhizomes. In bud, the tips of the inflorescences in *G. calcicola* are very slender, with small, well-spaced buds; those of *G. sinuata* are truncate, with numerous well-developed buds crowded right at the apex. Despite these fundamental differences, the two species are often difficult to distinguish as herbarium specimens. *Gaura mckelveyae* is likewise similar, but may be distinguished from both by its more deeply divided leaves and conspicuous villous pubescence; scattered villous pubescence does, however, occur in *G. calcicola*.

8. ***Gaura filipes*** Spach, *Nouv. Ann. Mus. Mist. Nat.* 4: 379. 1835. Munz. *Bull. Torrey Bot. Club* 65: 216. 1938. *N. Amer. Fl.* II. 5: 193. 1965. Figs. 9, 44.

*Gaura michauxii* Spach, *Nouv. Ann. Mus. Paris* 4: 379. 1835. Type: Cherokee Territory (= eastern Tennessee or an adjacent state), *Palisot de Beauvois* (G. Photographs, DS, POM).

*Gaura filipes* Spach  $\beta$  *major* Torr. & Gray, *Fl. N. Amer.* 1: 517. 1840. Lectotype: Barrens of Kentucky (prairies in w part of the state), 1840, C. W. Short (NY. Isotype, PH). Munz, *Bull. Torrey Bot. Club* 65: 217. 1938; *N. Amer. Fl.* 5: 193. 1965.

*Gaura filipes* Spach var. *typica* Munz, *Bull. Torrey Bot. Club* 65: 216. 1938.



Clumped perennial herb, from a heavy, twisted, woody rootstock; stems branching below and just above the surface of the ground to form at maturity a clumped leafy plant from which long, wand-like inflorescences arise; stems also branching in a whorl within the leafy portion below the inflorescence, 6–15(–20) dm tall. Plants densely strigulose on ovary, outside of floral tube, and sepals, sometimes also strigulose on the branches of the inflorescence and the stems, but usually the lower inflorescence glabrous; in some plants the leafy portion densely covered with erect hairs 1–2 mm long, in others strigulose with the very base of the inflorescence glandular-pubescent; leaves in plants with the leafy portion with long, erect hairs strigulose, especially along the veins and margins; leaves in plants with the stems of the leafy portion strigulose subglabrous. Leaves linear or narrowly lanceolate to narrowly oblanceolate, 1–9 cm long, 0.1–1.3 cm wide, slightly to coarsely sinuate-dentate. Inflorescence 50–115 cm long, often well branched; bracts linear, 1–2 mm long, 0.2–0.5 mm wide. Flowers with stamens well distributed around their diameter. Floral tube 2.5–6 mm long. Sepals 5–12.5 mm long, 1–2.1 mm wide. Petals 5–10 mm long, 1.6–4.5 mm wide. Filaments 3–8.5 mm long; anthers 1.4–4 mm long. Styles 8.5–19 mm long. Body of the fruit 5–10 mm long, 1.5–2 mm thick, the stipe 0.5–4.5 mm long. Seeds 1–2, 1.5–3.5 mm long, 1–1.5 mm thick, yellowish to reddish brown. Self-incompatible. Gametic chromosome number,  $n = 7$ .

LECTOTYPE: Jacksonville, near present-day Sheridan, Washington Parish, Louisiana, autumn 1832, *Thomas Drummond* (P. Isolectotypes, CAMB, G, GH, K); Munz, Bull. Torrey Bot. Club 65: 216. 1938, who incorrectly assumes that Drummond's "Jacksonville" was in Florida, as does McKelvey (*Botanical Exploration of the Trans-Mississippi West 1790–1850*, p. 494, 1955).

DISTRIBUTION (fig. 47): Sandy hills and flats, often in open woods, southernmost Illinois and southern Indiana to South Carolina, northern Florida, southeastern Mississippi, and Washington Parish, Louisiana. In Florida, we have seen no collections from east of the Ochlockonee River (near Tallahassee) made since 1895. A specimen said to have been collected at Tampa Bay by Asa Gray in 1840 (NY) is probably mis-labelled, as the species is otherwise unknown from south of Alachua County. Flowers August to October.

#### REPRESENTATIVE SPECIMENS EXAMINED:

UNITED STATES. ALABAMA. Baldwin Co.: 2 mi e of Foley, *Godfrey* 65958 (DS, FSU). Barbour Co.: Spring Hill, *Grave* 1043 (MO). Bibb Co.: 6.5 mi e-ne of Centerville, *Jones* 1673 (NCU). Blount Co.: Banks of Mulberry River, *Eggert* in 1898 (MO). Clay Co.: *Earle* 997 (NY). Henry Co.: Near Headland, *Wiegand* &



*Manning* 2165 (CU). Lawrence Co.: Decatur, *Smith in 1884* (NY, US). Lee Co.: Auburn, *Earle & Baker in 1898* (F). Madison Co.: Near Huntsville, *Canby* 48 (MO, US). Mobile Co.: Mobile, *Mohr in 1878* (GH, NY, PH). Pike Co.: Springhill, *Mohr in 1886* (US). Shelby Co.: Calera, *Everts in 1878* (CINC, NY). FLORIDA. Alachua Co.: *Hitchcock* 672 (F). Bay Co.: Vicinity of Youngstown, *Godfrey* 69327 (FSU). Calhoun Co.: Dead Lakes, *Godfrey* 64611 (DS, FSU). Columbia Co.: Lake City, *Nash* 2498 (PH, US). Gadsden Co.: River Junction, *Curtiss* 6003 (CU, DS, F, FLAS, GH, G, GA, ILL, ISC, KANU, LE, MIN, MO, NCU, PAC, PH, US); Aspalaga, *Biltmore Herb. (Curtis)* 3929c (C, GH, MIN, NY, US). Jackson Co.: 2 mi n of Sneads, *Godfrey* 67509a (DS, FSU). Okaloosa Co.: C. 8.5 mi ne of Niceville, *Ward* 5975 (DS, FLAS). Santa Rosa Co.: 4 mi n of Milton, *Davis* 090362-5 (LAF). Walton Co.: N of De Funiak Springs, *West & Arnold in 1954* (US). Washington Co.: S of Chipley, *Hood* 2860 (FLAS). GEORGIA. Baker Co.: 2 mi sw of Newton, *Godfrey* 67492 (DS, FSU). Barlow Co.: 6.1 mi e 56° of Adairsville, *Duncan* 13171 (GA, GH, MO, SMU, US). Brantley Co.: 10 mi s-se of Waycross, *Kuns* 93 (WISC). Catoosa Co.: 1.4 mi e 18° of Fort Oglethorpe, *Harris & Duncan* 13022 (GH, NSC, US). Chattahoochee Co.: E from Columbus, *Donnell Smith in 1883* (NY). Clarke Co.: Athens, *Miller & Maguire* 1055 (BH, CU). Cobb Co.: Archean, *Wilson* 34 (GH, MO, NY, US). Emanuel Co.: 9 mi e of Adrian, *Wilson* 2911 (FSU, GA, IA, NSC). Floyd Co.: Rome, *Chapman* (MO, US). Grady Co.: 5 mi e of Climax, *Cronquist* 5471 (GA, NY). Gwinette Co.: Yellow River, *Eggert in 1897* (CM, MO, NY, US). Habersham Co.: Currahee Mt., *Small in 1894* (F, MICH, MIN, MO, MSC, NY, PH). Jasper Co.: Monticello, *Porter* 5 (PH). Jefferson Co.: Galhura, *Hopkins* 25 (NY). Liberty Co.: 4 mi sw of Hinesville, *Wiegand & Manning* 2164 (CU). McDuffie Co.: 6 mi ne of Thomson, *Duncan* 10650 (GA, MO). Richmond Co.: Augusta, *Cuthbert in 1897* (FLAS). Screven Co.: Southeasternmost part, *Eyles* 7553 (GA). Stephens Co.: 1 mi n-nw of summit of Currahee Mt., *Duncan* 11774 (FLAS, GA, IA, IND, ISC, MO, SMU, TENN). Sumter Co.: Ca. 2 mi s of Leslie, *Duncan* 7841 (GA). Thomas Co.: Thomasville, *Harrison in 1904* (GH). Toombs Co.: 7.5 mi e 39° s of Lyons, *Hardin & Duncan* 14514 (GA). Tromp Co.: 3 mi ne of Hogansville, *Wiegand & Manning* 2166 (GH). ILLINOIS. Hardin Co.: Saline Creek, *W. D. in 1916* (Ill.) INDIANA. Pt. Commerce, 1846, *A. Wood* (NY). Daviess Co.: 4 mi n of Washington, *Deam* 47902 (GH, IND, US); 1.5 mi sw of Plainville, *Kriebel* 5804 (GH, NCU, SMU). KENTUCKY. Barren Co.: Diamond Cavern, *Braun* 3639 (Braun herb.); e of Glasgow Junction, *O. E. & G. K. Jennings* (CM). Edmondson Co.: Mammoth Cave Park National Forest, *Ahles* 7550 (ILL). Hart Co.: Munfordville, *Rhoades in 1925* (WISC). Nelson Co.: Balltown, *Braun* 3212 (Braun herb.). Pulaski Co.: Alpine, *McFarland & James* 28 (BH, F, GA, IND, MIN, MO, NY, PENN, PH, SMU, TENN, WVA). Wayne Co.: N of Monticello, *Braun* 1030 (Braun herb.). LOUISIANA. Washington Parish: Ca. 5 mi w of Venado, *Thieret* 32676 (DS). MISSISSIPPI. Forrest Co.: Hattiesburg, *Jones* 3557 (FSU). Harrison Co.: Long Beach, *Joor in 1891* (MO). Jackson Co.: Ocean Springs, *Tracy in 1889* (MSC). Lauderdale Co.: Meridian, *Schuchert in 1896* (US). SOUTH CAROLINA. Aiken Co.: 4.3 mi s of Montmorenci, *Ahles & Crutchford* 55578 (NCU). Allendale Co.: 1.6 mi nw of Fairfax, *Ahles & Bell* 15887 (NCU). Bamberg Co.: 0.2 mi n of junction of County Hwy. 27 and State Hwy. 64, *Ahles* 37647 (CM, NCU). Beaufort Co.: 0.5 mi sw of New River Crossing, *Raven* 18707a (DS). Calhoun Co.: Junction of County Hwy. 157 with County Hwy. 72, *Ahles* 35341 (NCU, SMU). Colleton Co.: Junction of County Hwy. 35 with State Hwy. 61, *Ahles & Bell* 17936



(GH, NCY). Dorchester Co.: 1 mi w-sw of Reevesville, *Ahles & Leisner* 31924 (NCU). Edgefield Co.: 1.2 mi sw of Trenton, *Radford* 30158 GA, NCU). Jasper Co.: 3 mi e of Grahamville, *Ahles & Bell* 18072 (NCU). Kershaw Co.: Junction Hwys. 602 and 12, *Duke* 2973 (NCU). Lexington Co.: 25 mi w of Columbia, *Munz* 13359 (POM). Oconee Co.: Hwy. 123 at Tugaloo River, *Freeman* 58507 (NCU). Orangeburg Co.: 2.3 mi sw of Orangeburg, *Leisner & Ahles* 31806 (DAO, NCU). Richland Co.: Columbia, *Crawford in* 1890 (F, GH). Saluda Co.: 2 mi s of Ridge Spring, *Radford* 30424 (FSU, NCU). Sumter Co.: 2.5 mi w of Pinewood, *Radford* 29682 (NCU). Williamsburg Co.: 3.5 mi sw of Mouson, *Radford* 31248 (NCU). TENNESSEE. Bledsoe Co.: Mountain e of Pikeville, *Harger* 7721 (TENN). Bradley Co.: Chattanooga, *Engelmann in* 1876 (MO). Decatur Co.: *Ames in* 1855 (MICH). Franklin Co.: Cowan, *Biltmore Herb.* 3929a (GH, NY). Hamilton Co.: Lookout Mt., *Biltmore Herb.* 3929b (GH, NY, US). Lewis Co.: Hohenwald, *King* 414 (US). Loudon Co.: *Sharp et al.* 1948-8 (TENN). Monroe Co.: 1.5 mi n of Vernon, *Raven* 20449 (DS). Rhea Co.: Waldens Ridge, *Shanks et al.* 8908 (RSA, TENN). Rutherford Co.: 6 mi e-se of Murfreesboro, *DeSelm* 718 (TENN). White Co.: Caney Fork near Webbs Camp, *Sharp et al.* 5030 (KY, TENN).

The characters used by Munz (Bull. Torrey Bot. Club 65: 216, 217. 1938) to divide *Gaura filipes* into two varieties vary within populations and are not geographically correlated; furthermore, as pointed out by E. Lucy Braun (Annotated Catalogue of the Spermatophytes of Kentucky 99, 100. 1943), flower size varies considerably from year to year.

**9. *Gaura mckelveyae* (Munz) Raven & Gregory, comb. nov. Figs. 10, 45.**

*Gaura villosa* Torr. var. *mckelveyi* Munz, Bull. Torrey Bot. Club 65: 214. 1938; N. Amer. Fl. II. 5: 192. 1965.

Clumped perennial herb, from a twisted, woody rootstock; stems branching below or just above the surface of the ground; stems well branched, 2–6 dm tall. Stems more or less densely covered with long, erect hairs 2–3.5 mm long, also strigulose; leaves, sepals, ovary, and outside of floral tube strigulose; inflorescence glabrous or often with glandular pubescence from the base of the peduncle upward for 2–3 cm or more, very rarely with a few long or strigulose hairs. Leaves exceptionally variable in size and margins, elliptic to more commonly narrowly oblanceolate, 1–6.5 cm long, 0.1–1.5 cm wide, deeply sinuate-dentate or less markedly so, often undulate, the basal ones up to 17 cm long and 2 cm wide. Inflorescence 10–75 cm long, well branched; bracts lanceolate to narrowly ovate, 1–5 mm long, 0.5–1 mm wide. Flowers with stamens in the lower half. Floral tube 2–3.5 mm long. Sepals 6–12 mm long, 1–2 mm wide. Petals 7–10.5 mm long, 2–5.5 mm wide. Filaments 5–9 mm long, lanate at the very base; anthers 2–4 mm long. Style 9–16 mm long. Body of the fruit 8–19 mm long, 1.5–2 mm thick, the stipe 3–9 mm long. Seeds (1–)2–4, 2–3 mm long, ca. 1 mm



thick, yellowish to reddish brown. Self-incompatible. Gametic chromosome number,  $n = 7$ .

TYPE: Near Mathis, San Patricio Co., Texas, 5 April 1931, *Susan Delano McKelvey 1718* (GH. Isotype, POM).

DISTRIBUTION (fig. 47): Sandy flats, sand hills, and waste places in the Rio Grande Plain of south Texas, northwesternmost Tamaulipas, and adjacent Nuevo León. Flowers, March to June.

#### REPRESENTATIVE SPECIMENS EXAMINED:

MEXICO. NUEVO LEÓN. 50 mi s of Laredo on Hwy. 85, *Hess & Hall 640* (OKL); 7 mi ne of Vallecillo, *Rodríguez 60* (SMU, TAES). TAMAULIPAS. Nuevo Laredo, *Arizmendi 68* (DS, LL); 24 km s of Nuevo Laredo, *Domínguez & McCart 8291* (TEX); 50 km s of Nuevo Laredo on Hwy. 85, *Domínguez & McCart 8234* (COLO, DS, MSC).

UNITED STATES. TEXAS. Aransas Co.: 4.6 mi ne of Rockport, *McCart 5576* (DS, SMU). Bee Co.: 4 mi se of Normanna, *Cory 54120* (GA, LL, SMU). Brooks Co.: 15 mi e of Hebbronville, *Chávez et al. 54* (SMU). Cameron Co.: National Wildlife Refuge, *Traverse 1128* (F, SMU, US). De Witt Co.: Cuero, *Howell 323* (US). Dimmit Co.: Carrizo Spring, *Cuellar 41* (LL). Duval Co.: San Diego, *Croft in 1885* (MICH, NY). Hidalgo Co.: Near San Manuel, *C. L. & A. A. Lundell 10834* (MICH, POM, SMU). Jim Hogg Co.: 5 mi ne of Hebbronville, *Gutiérrez García 93* (SMU, TEX). Jim Wells Co.: 5.5 mi e of Alice, *Shinners 24109* (SMU). Karnes Co.: 5 mi se of Choate, *Johnson 1554* (RSA, SMU). Kennedy Co.: Sand hills below Sarito, *Tharp in 1928* (TEX). Kleberg Co.: Santa Gertrudis Division of King Ranch, *Johnston 53224.19* (LL, MSC, SMU, TEX); Kingville, *Tracy 9275* (CU, DUKE, F, G, GH, MIN, MO, MSC, NY, PENN, TAES, TEX, US, WISC). La Salle Co.: Encinal, *Barrera 13* (DS, DUKE, SMU, TEX); 5 mi ne of Encinal, *Canter 70* (IKLA, SMU, TAES, TEX). Nueces Co.: Corpus Christi, *Tracy 9273* (F, G, GH, MIN, MO, MSC, NY, TAES, TEX, US). Refugio Co.: *Benke 5401* (F, POM). San Patricio Co.: Welder Wildlife Foundation n of Sinton, *Traverse 1202* (F, MO, SMU, TEX, US). Starr Co.: 3 mi w of Sullivan City, *C. L. & A. A. Lundell 9889* (LL, MICH, POM, US). Webb Co.: 6 mi n of Bruni, *Chaves et al. 32* (LL, OKLA, TTC); 13 mi n of Webb, *Correll 20752* (LL); Laredo, *Dickey 134* (OKLA). Willacy Co.: Redfish Bay, *C. L. & A. A. Lundell 8769* (DS, GH, LL, MICH, NY, POM, SMU). Zapata Co.: 4 mi e of Zapata, *Araiza 52* (COLO, DS, DUKE, NCU, SMU); 6 mi s of San Ignacio, *García 15* (DS, DUKE, SMU).

A better understanding of this entity has made it necessary to accord it specific rank. It is coordinate in status with the other diploid species of section *Stipogaura*.

10. *Gaura sinuata* Nutt. ex Ser., in DC., Prod. 3: 44. 1828. Munz, Bull. Torrey Bot. Club 65: 218. 1938, *pro parte*; Munz, N. Amer. Fl. II. 5: 194. 1965, *pro parte*. Figs. 11, 46.

Aggressively rhizomatous perennial herb, forming extensive mats with well branched stems 2–6 dm tall. Plants subglabrous or sparsely pubescent,



the stems strigulose and with long spreading hairs; ovary, outside of floral tube, and sepals strigulose, the leaves densely strigulose in relatively hairy plants. Leaves linear to narrowly oblanceolate, 1–11 cm long, 0.1–2 cm wide, sparsely sinuate-dentate, rarely subentire, often undulate. Inflorescence 10–102 cm long, simple or branched; bracts lanceolate to narrowly ovate, 1–5 mm long, 0.5–2 mm wide. Flowers with stamens in lower half. Floral tube 2.5–5 mm long. Sepals 7–14 mm long, 1.25–2.5 mm wide. Petals 7–14.5 mm long, 3–7 mm wide. Filaments 5–11 mm long, lanate at the very base; anthers 3–5 mm long. Style 12–18.5 mm long. Body of the fruit 8–15 mm long, 1.5–3.5 mm thick, the stipe 2–8 mm long. Seeds (1–)2–4, 2–3 mm long, 1–1.5 mm thick, light to reddish brown. Self-incompatible. Gametic chromosome number,  $n = 14$ .

TYPE: Near the Red River, in what is now southeastern Oklahoma, 16 May to 21 June 1819, *Thomas Nuttall* (G-DC. Isotypes, BM, CAMP, K, PH).

DISTRIBUTION (fig. 47): Flats and washes in light sandy loam, central and southern Oklahoma and southward in the Rolling Plains of Texas, whence eastward and southward throughout the eastern half of the State below the Edwards Plateau, but especially common in the Blackland Prairies and probably introduced following agricultural clearing in the East Texas Timberlands and on the Rio Grande Plain; conceivably native in Franklin County, Arkansas, but widely introduced elsewhere in the light agricultural soils of Alabama, Arkansas, California, Florida, Georgia, Missouri (Muehlenbach, *Ann. Missouri Bot. Gard.* 56: 168. 1969), New York (House, *N. Y. State Mus. Bull.* 254: 57–59. 1924), Italy, and South Africa. A noxious weed, but fortunately limited by its self-incompatibility. The species was probably originally native to the prairies and rolling plains of south-central Oklahoma and central and north-central Texas.

#### REPRESENTATIVE SPECIMENS EXAMINED:

ITALY. Viareggio, 15 Oct. 1961, *Montelucci 8034* (FI), "copiosamente naturalizzata su tutte le dune della località . . . dune alte presso le lame elevate."

SOUTH AFRICA. CAPE PROVINCE. Port Elizabeth District: Van Sladens Pass, 500 ft, 4 Jan. 1936, *Theron 1837* (M), "a small patch of 5 square yards, spreading by rhizomes . . . no mature fruit seen," 1 Dec. 1965, *Wells 3192* (G, M).

UNITED STATES. ALABAMA. Lee Co.: Auburn, *Jones 614* (NCU). Baldwin Co.: Ft. Morgan fortifications, *Iltis et al. 21478* (DS). Tuscaloosa Co.: University Campus, *Harper 3192* (GH, MO, NY, PH, US, WISC). ARKANSAS. Franklin Co.: Valley of the Arkansas River s of Ozark, ca. 500 ft elevation, *Moore 410105* (F, WISC). Lonoke, Co.: Rock Island Railroad right-of-way, near ballast, P.O. Carlisle, *Demaree 55604* (DS). Pulaski Co.: Along railway embankment, near Little Rock, *Palmer 30332* (MO, UMO). CALIFORNIA. Alameda Co.: From an infestation on fallow land a few mi ne of Livermore, *Bellue in 1949* (RSA). Fresno Co.: Fresno, *Quibell in 1960* (RSA). Kern Co.: Tehachapi Mts., *Hutchinson 3609* (DS). Los Angeles Co.: Galleano



Orchard near Walnut, *Johnson in 1939* (POM). Riverside Co.: Near Temecula, *Rowntree in 1937* (TEX). Sacramento Co.: 8.5 mi ne of Sacramento, *Fuller 2413* (DS, RSA, US). San Bernardino Co.: Below Mill Creek Power Station on road to Yucaipa, *Craig et al. 325* (POM, US). San Diego Co.: Near Ramona, *Roos 513* (RSA). San Mateo Co.: Junction of Los Trancos and San Francisquito creeks, *Abrams 13687* (DS, NY, POM). Santa Barbara Co.: E of Carpenteria, *Pollard in 1957* (CAS, DAO, MIN, TEX). Ventura Co.: 1.5 mi ne of Somis, *Johnson in 1940* (POM). FLORIDA. Alachua Co.: Gainesville, *Beckner 1246* (DS, FLAS). Marion Co.: McIntosh, 1936, *Gist 112* (US). GEORGIA. Dougherty Co.: 4 mi s of Albany, *Thorne 3199* (CU, GA, GH, IA). Greene Co.: 1.5 mi n of Greensboro, *Pyron & McVaugh 1647* (GA). Jackson Co.: 2.7 mi se of Jefferson, *Duncan 18550* (GA, KY, LAF, NCU, NSC, SMU). Macon Co.: 4 mi s of Reynolds, *Pyron & McVaugh 2807* (GA). Schley Co.: Ellaville, *Sargent 7431* (GA, NSC). MISSOURI. St. Louis Co.: Baden Freight Yard, *Muhlenbach 2760* (DS). OKLAHOMA. Atoka Co.: 15 mi s of Atoka, *Hopkins & Nelson 1133* (MO, IKL, RSA). Blaine Co.: 8 mi sw of Okeene, *Cutter in 1951* (OKL). Bryan Co.: Vicinity of Durant, *Blain 108* (US). Cleveland Co.: Norman, *Crabb 96* (PENN). Custer Co.: 6 mi sw of Butler, *Mericle 1628* (OKL). Grady Co.: Chickasha Prairie, *McGuire in 1921* (OKL). Harmon Co.: 2.6 mi e of Gould, *Shinners 31403* (SMU). Hughes Co.: 6 mi e of Holdenville, *Hopkins 1621* (BH, IND, OKL, OKLA, POM). Jefferson Co.: Ringling, *Pryor 258* (OKL). Kay Co.: Blackwell, *Byler 327* (OKLA). Kiowa Co.: N of Snyder, *Eggert in 1903* (MIN). Marshall Co.: 1.5 mi e of Lebanon, *Goodman 6500* (OKL, OKLA, RSA). Murray Co.: 8 mi n of Springs, *Cory 59093* (OKLA, SMU). Oklahoma Co.: Oklahoma City, *Waterfall 2801* (OKLA). Payne Co.: 914 mi w, 1.8 mi n of Stillwater, *Mueller 1901* (OKLA). Pittsburgh Co.: 7 mi w of McAlester, *Hopkins 1635* (OKL, POM). Tillman Co.: 4 mi n Gandfield, *Stephens 20353* (DS, KANU). Washita Co.: 3 1/3 mi s of Rocky, *Waterfall 2019* (GH, OKL). SOUTH CAROLINA. Charleston Co.: Navy Yards, *Robinson 196* (GH). Edgefield Co.: 2.5 mi s of Trenton, *Radford 22559* (DAO, FSU, GA, GH, NCU, USF, VDB). Lexington Co.: Leesville, *Radford 27169* (NCU). Richland Co.: Ridgewood, near Columbia, *Philson in 1936* (GA, NCU). Union Co.: 4 mi n of Union, *Freeman 56146* (NCU). TEXAS. Anderson Co.: Palestine, *Tharp 863* (US). Bexar Co.: Bandera Road, *Schulz 303* (US). Borden Co.: 19 mi nw of Gail, *Parks & Cory 30112* (TAES). Brazos Co.: College Station, *Reeves 819* (POM). Cameron Co.: Gunnery Range Unit at Stover Point, *Traverse 1128* (MO, TEX). Childress Co.: C.H.S. School, *Biology Class 15* (TEX). Collin Co.: 3.7 mi e of Farmersville, *Shinners 14317* (SMU). Colorado Co.: *Perkins & Hall 2464* (CU). Coleman Co.: 1 mi se of Santa Anna, *Shinners 26394* (SMU). Cooke Co.: 7.5 mi n of Gainesville, *Shinners 12433* (SMU). Duval Co.: San Diego, *Croft in 1886* (NY). Erath Co.: Dublin, *Maxwell 46* (F). Fayette Co.: Muldoon area, *Ripple 51-588* (TEX). Frio Co.: *Wolcott & Barkley 16T257* (ILL, RSA, TEX). Garza Co.: 1 mi s, 1 mi w of Post, *Rowell 10164* (OKLA). Goliad Co.: Goliad, *Williams 35* (PH, TEX). Gonzales Co.: 3/4 mi w of Monthalia, *Parks & Cory 5912* (POM, TAES). Hays Co.: 5 mi w of San Marcos, *Gregory 418* (RSA). Jack Co.: 2 mi w of Jacksboro, *Whitehouse 15305* (MICH, SMU). Jackson Co.: Edna, *Drushel 2435* (ILL, MO). Lamar Co.: Paris, *McMullen in 1927* (TEX). Lampasas Co.: 5 mi s of Evant, *Mayler 1239* (OKLA). La Salle Co.: Carrizo Spring to Cotulla, ——— in 1898 (TEX). Mitchell Co.: 3 mi n-nw of Colorado City, *Pohl 5020* (PENN, SMU). Montgomery Co.: Near Harmons Creek, *Dixon 448* (F, GH, NY, WISC). Nacogdoches Co.: Nacogdoches, *Banks 3180* (DS). Navarro Co.: 8 mi se of Corsicana, *Shinners 14427* (SMU).



Orange Co.: Curtis School, *Wild Wood Club* 8 (TEX). Parker Co.: 8 mi se of Weatherford, *Timmons in 1939* (SMU). Rains Co.: 2.5 mi nw of Point, *Shinners 14342* (SMU). San Patricio Co.: 3 mi n of Sinton, *Williges 328* (TEX). Shackleford Co.: 5 mi w of Albany, *McCoy 3762* (DAO, NCU, OKL, USL). Tarrant Co.: Fort Worth, *A. Ruth 37* (GH, MIN, US). Taylor Co.: Near Abilene, *Tolstead 7183* (ILL, OKLA, SMU). Uvalde Co.: Utopia, *Kincaid & Johnston 54638* (TEX). Victoria Co.: Victoria, *Eggert in 1900* (MIN). Waller Co.: Hempstead, *Hall 214* (F, GH, ILL, MO). Wichita Co.: Division Lake, *Parks & Cory 13221* (TAES). Williamson Co.: Near Taylor, *Innes 844* (GH). Wise Co.: 4.1 mi nw of Bridgeport, *Hennen 558* (SMU).

## SECTION VI. XENOGAURA

*Gaura* sect. *Xenogaura* Raven & Gregory, sect. nov.

Herba perennis rhizomatosa, caulibus strigulosis interdum etiam villosis. Inflorescentiae subnutantes. Flores valde zygomorphi, vespertini. Fructus 4-angulatus, parte superiore crassiore pyramidalis basi turgida, demum acutissime constricta, parte basali tereti.

Rhizomatous perennial herb, the stems strigulose and sometimes also villous. Inflorescence slightly nodding at the tip. Flowers strongly zygomorphic, the stamens in the lower quarter of the flower; flowers opening near sunset and withering the next morning. Fruit not reflexing, 4-angled, with 4 distinct ridges and 4 furrows alternating at the top of the pyramidal upper half, the base of the pyramidal portion distinctly bulging, then immediately and sharply constricted, the basal portion terete and about a quarter of the diameter of the swollen base of the upper portion. Self-incompatible. Gametic chromosome number,  $n = 14$ .

TYPE SPECIES: *Gaura drummondii* (Spach) T. & G.

The single species of this section, *Gaura drummondii*, is consistently tetraploid. Its morphological characteristics and geographical and ecological intermediacy suggest strongly that it is of polyploid derivation between *G. coccinea* and a species of section *Stipogaura* somewhat resembling *G. mckelveyae*. Because it is impossible to confirm this hypothesis at present, we have given the section a name based on the Greek word ξένος, stranger, indicating the uncertain origin of the species concerned.

11. *Gaura drummondii* (Spach) T. & G., Fl. N. Amer. 1: 519. 1838. Figs. 12, 36.

*Schizocarya drummondii* Spach, Nouv. Ann. Mus. Hist. Nat. 4: 382. 1835. Type: Austin, Travis Co., Texas. 1833–1834, *Thomas Drummond III*. 36 (G. Isotypes, BM, CAMB, GH, K, NY, P).

*Schizocarya crispa* Spach, Nouv. Ann. Mus. Paris 4: 384. 1835. Type:



Matamoros, Tamaulipas, Mexico, April 1831, *J. L. Berlandier* 2313 (G. Isotypes, BM, K, P).

*Gaura hispida* Benth., Pl. Hartw. 288. 1840. Type: In fields near León, Guanajuato, June 1837, *Thomas Hartweg* 1603 (K. Isotypes, BM, CAMB, G).

*Gaura crispa* (Spach) D. Dietr., Syn. Pl. 2: 1298. 1840.

*Guara roemeriana* Scheele, Linnaea 21: 579. 1848. Type: New Braunfels, Comal Co., Texas, 1846, *Ferdinand Roemer* (B, destroyed. Isotypes, CAS, MO).

*Gaura odorata sensu* Munz, Bull. Torrey Bot. Club 65: 219. 1938; N. Amer. Fl. II. 5: 194. 1965; non Sessé ex Lag. 1816.

Perennial herb from extremely aggressive horizontal rhizomes of about the same diameter as the lower stem, the plants spreading to form large patches; stems 2–6(–12) dm tall, sometimes strict with a single unbranched main stem but usually somewhat decumbent with several branches from the base and usually much rather irregular branching above also. Entire plant strigulose, the pubescence often denser on the ovary, outside of the floral tube, and sepals, and the main stems sometimes with an admixture of long, villous pubescence. Leaves narrowly lanceolate to elliptic, 0.5–7.5 (–9.5) cm long, 0.1–2.2 cm wide, subentire to shallowly sinuate-dentate. Inflorescence 14–36 cm long, the peduncle 3–10 cm long, sometimes branched; bracts narrowly lanceolate, 2–8 mm long, 0.8–2 mm wide. Floral tube 4–14 mm long. Sepals 7–11(–14) mm long, 0.75–2 mm wide. Petals fading reddish, 6–10 mm long, 2.5–5 mm wide. Filaments 4–8.5 mm long; anthers 3–6 mm long. Style 12–26 mm long. Fruit 4-angled, with 4 distinct ridges and 4 furrows alternating at the top of the pyramidal upper half, the base of the pyramidal portion distinctly bulging, then immediately and sharply constricted, the basal portion terete and about one fourth the diameter of the swollen base of the upper portion, 7–13 mm long, 3–5 mm thick at the thickest point. Seeds (2–)3–4(–8), 2–2.5 mm long, 1–1.25 mm thick, reddish brown. Self-incompatible. Gametic chromosome number,  $n = 14$ .

TYPE: Austin, Travis Co., Texas, 1833–1834, *Thomas Drummond* III. 36. (G. Isotypes, BM, CAMB, GH, K, NY, P).

DISTRIBUTION (fig. 48): Sandy loam at middle and lower elevations, and spreading to become a weed of light agricultural soils, from central Texas south through the Rio Grande Plain to eastern Coahuila, Nuevo León, and Tamaulipas, then southward to southeastern Durango, southern San Luis Potosí, Guanajuato, Querétaro, and Hidalgo, Mexico; absent in the Trans-Mexican Volcanic Belt, but reappearing in southernmost Puebla and





FIGURE 48. Range of *Gaura drummondii* (*G. odorata* of many authors). Station in Georgia, where it is introduced, is not shown.



abundant in and around the Valley of Oaxaca. Occasional as a weed of cultivated fields in coastal southern California, and collected once in Santa Cruz County, California; locally established (persistent from 1923 to 1948, at least) on Jekyll Island, Glynn County, Georgia and in Sevier County, Arkansas (in 1937).

#### REPRESENTATIVE SPECIMENS EXAMINED:

MEXICO. COAHUILA. Saltillo, *Palmer* 23 (C, F, G, GH, MICH, MO, NY, US); between La Varqueria and San Juan, 30 mi w of Saltillo, *Wislizenius* 299 (MO); Sierra de la Gloria, se of Monclova, *Marsh* 1916 (GH, SMU, TEX); Múzquiz, *Marsh* 111 (TEX); Monclova, *White* 1717 (MICH). DURANGO. Durango and vicinity, *Palmer* 94 (C, G, GH, MO, NY, US); 71 mi ne of Durango, *Waterfall & Wallis* 13349 (OKLA, RSA). GUANAJUATO. 33 mi s of San Luis Potosí on road to Querétaro, *Jackson* 7008 (DS); 34 mi n of Querétaro, *Waterfall* 16554 (OKL, OKLA, RSA, SMU). HIDALGO. Between Actopan and Ixmiquilpan on highway to Laredo, *Gilly & Camp* 6 (MICH, MSC); near El Salto, *Rose & Painter* 7101 (US); Ixmiquilpan, *Rose et al.* 9079 (GH, US); near Tula, *Rose et al.* 8323 (US). MICHOACAN. Vicinity of Morelia, *Arsene* 5891 (ILL, LE, MO, MY, US). NUEVO LEON. 10 mi se of Las Tortillas, *García & García* 64 (DS, FSU, DUKE, NCU, SMU, TEX); 15 mi n of Monterrey, *Villanueva* 57 (OKLA, TEX, TTC); Montemorelos, *Kelley* 17 (TEX); Obispaño, *Roybal* 34 (US). OAXACA. 5 mi ne of Oaxaca on road to Ixtlán de Juárez, 6500 ft, *Breedlove* 12208 (DS); San Felipe del Agua, 1750 m, *Conzatti* 573 (GH); Nochitlán, 2000 m, *Conzatti in* 1882 (F); Monte Albán, *Langman* 3461 (PH); near Oaxaca, 5500 ft, *Pringle* 6715 (BR, CM, F, G, GH, IPN, ISC, LE, MEXU, MIN, MO, MSC, ND, NMC, NY, P, PH, US, W); Huitzo, *J. N. & J. S. Rose* 11364 (GH, NY, US); Etla, *Seler* 83 (GH, US); 1 mi e of El Tule, *Webster et al.* 17M426 (MICH, TEX). PUEBLA. San Luis Tultitlanapa, *Purpus* 3387 (BM, F, GH, MO, NY, US). QUERETARO. Querétaro, *Arsène* 10527 (F, MO, US); 11 mi ne of San Juan del Río, *Waterfall & Wallis* 13937 (F, IA, OKL, OKLA, SMU). SAN LUIS POTOSI. Gauscama, Minas de San Rafael, *Purpus* 5383 (BM, F, GH, MO, NY, US); Tenería, 3 km sw of San Luis Potosí, *Rzedowski* 3332 (IPN). TAMAULIPAS. 24 km s of Nuevo Laredo, *Domínguez & McCart* 8214 (SMU, TEX); Soto la María, *Viereck* 1124 (US); vicinity of Victoria, *Palmer* 152 (F, GH, MY, US).

UNITED STATES. ARKANSAS. Sevier Co.: Horatio, *Brinkley* 96 (F). CALIFORNIA. Los Angeles Co.: Puente, *Johnson in* 1939 (POM); Avalon, Santa Catalina Island, *Thorne* 36478 (DS, RSA). Orange Co.: 1 mi n of Placentia, *Johnson in* 1940 (POM). Santa Barbara Co.: Goleta Point, *Raven* 14045 (DS). Santa Cruz Co.: Ca. 2 mi n of Soquel, *Fuller* 5197 (DS, RSA). San Diego Co.: Fletcher Hills, *Gander* 8787 (POM, RSA). Ventura Co.: Meiners Oaks, *Pollard in* 1946 (CAS, COLO, RSA). GEORGIA. Glynn Co.: Jekyll Island, *McAtee in* 1923 (US), *Thorne & Muenscher* 8905 (in 1948) (CU). TEXAS. Archer Co.: 2 mi w of Archer City, *Shinners* 18559 (SMU). Austin Co.: Industry, *Wurzlów in* 1894 (ILL). Bastrop Co.: Bastrop, *Duval in* 1928 (US). Bee Co.: 5 mi ne of Beeville, *Rios & Cavazos* 198 (LL). Bell Co.: Near Temple, *Wolf* 3555 (F, TAES). Bexar Co.: San Antonio, *Heller* 1590 (CU, F, GH, MICH, MIN, MSC, MO, NY, PH, US). Brazos Co.: *Lindheimer in* 1843 (MO). Brown Co.: Brownwood, *Ewing* 47 (SMU, TEX). Burnet Co.: 13 mi w of Burnet, *Jones* 8 (LL). Calhoun Co.: La Feria, *Cannon in* 1926 (MICH). Cherokee Co.: Old Frankston Crossing, *Stripling* (FSU). Comal Co.: New Braunfels, *Lindheimer*



in 1848 (MIN, SMU). Crockett Co.: Ozona, *Parks & Cory* 29669 (TAES). Dallas Co.: Oak Cliff, *Mervin* in 1953 (SMU, TEX). Dewitt Co.: Cuero, *Howell* 296 (US). Dimmit Co.: 5 mi se of Catarina, *C. & V. C. Flores* 171 (SMU, TAES, TEX). Duval Co.: San Diego, *Croft* in 1886 (NY). Erath Co.: Dublin, *Maxwell* 28 (F). Fayette Co.: Muldoon area, *Ripple* 51-589 (TEX). Frio Co.: Dilley, *Drews* 7 (TEX). Gillespie Co.: 30 mi s of Mason, *Munz & Gregory* 23433 (RSA). Guadalupe Co.: Seguin, *Gregory* 286 (RSA). Harris Co.: N of Harrisburg, *Eggert* in 1899 (MIN, MO). Hay Co.: 3 mi s of Dripping Springs, *Knodel & Warnock* 46511 (SMU). Hidalgo Co.: Los Ebanos, *Runyon* 1582 (POM). Hood Co.: Center Mills, *Blackwell* 49 (SMU). Jim Hogg Co.: 2 mi ne of Hebbbronville, *Saenz* 92 (OKLA, TEX). Kendall Co.: 1.1 mi n of Boerne, *Raven & Gregory* 19343 (DS). Kimble Co.: 8 mi s of Junction, *E. R. & E. M. Bognusch* 4719 (POM). Kleberg Co.: Kingsville, *Sinclair G-16* (GH, TEX). La Salle Co.: 5 mi n of Encinal, *Cabrera* 91 (TEX). Live Oak Co.: 5 mi sw of George West, *Rios & Cavazos* 214 (LL, SMU). McCulloch Co.: Brady, *Henderson* 62-267 (FSU). McLennan Co.: Speegleville, *Smith* 1103 (TEX). Menard Co.: 10.3 mi n of Menard, *Raven & Gregory* 19267 (DS). Milam Co.: Ben Arnold, *Shinners* 16662 (SMU). Nueces Co.: Corpus Christi, *Orcutt* 5936 (MO). San Patricio Co.: 1 mi nw of Mathis, *Raven & Gregory* 19384 (DS). Shackelford Co.: Griffen State Park, *Rohrbaugh* 475 (COLO, OKL). Starr Co.: 4 mi e of Rio Grande City, *Navarro* 96 (DS). Tarrant Co.: Fort Worth, *Ruth* 276 (US). Tom Green Co.: San Angelo, *Tharp* 44184 (ISC, TEX). Travis Co.: Austin, *Hall* 213 (F, GH, MO, NY, PH, POM, US). Uvalde Co.: Sabinal, *Palmer* 10101 (DS, MIN, PH, US). Val Verde Co.: San Felipe Creek near Del Rio, *Correll* 14943 (LL, US). Webb Co.: 6 mi s of Laredo, *Cisneros* 16 (DS, FSU, NCU). Willacy Co.: 1 mi n of Sebastian, *Runyon* 2509 (POM). Williamson Co.: Georgetown, *Bodin* 158 (US). Wilson Co.: Floresville, *Metz* in 1931 (US). Zapata Co.: 6 mi s of San Ignacio, *García* 16 (DUKE, FSU, NCU, SMU).

In the absence of mature fruit, *Gaura drummondii* can be separated only with great difficulty from *G. coccinea*. Although *G. drummondii* generally occurs at lower elevations and in somewhat more fertile soil, the two species do occur together and appear to hybridize rather freely when they do. Nevertheless, they are strikingly different in fruit and modally also in habit (*Gaura drummondii* is strongly rhizomatous) and maintain their distinctiveness over very wide areas.

It is unfortunate that the name *Gaura odorata*, applied to this species for more than 30 years, must now be abandoned in favor of the name that was generally associated with it earlier, as for example by Rothrock (Proc. Amer. Acad. Arts 6: 353. 1864-1865). No authentic material of *G. odorata* seems to have survived in the herbarium at Madrid, but Dr. Munz examined a specimen at Geneva, labeled "G. odorata Lag., Hort. reg ("veg.") Matrit 1814? Reuter (Boissier)," comparing it with *Bourgeau* 38 from the Valley of Mexico. *Bourgeau* 38 is *G. coccinea*, which is extremely common in and about Mexico City, where *G. drummondii* is unknown. Lagasca tells us that Martín de Sessé y Lagasta brought him the seeds of his *G. odorata* when he returned from Mexico City to Madrid in 1804. It is well



known that Sessé made no extensive trips during his last year or two in Mexico City, and *G. drummondii* does not occur around the city, the closest station being some 80 km to the north near Pachuca. Although Sessé, Mociño, Castillo, and Maldonado collected *G. coccinea* several times and illustrated it twice, they are not known ever to have collected *G. drummondii*. Although circumstantial in part, the evidence appears overwhelming that *G. odorata* is in fact a synonym of *G. coccinea*, and that the name has been misapplied to *G. drummondii* in recent years.

## SECTION VII. GAURA

*Gaura* sect. *Eugaura* Munz, Bull. Torrey Bot. Club 65: 106. 1938.

Annual, biennial, or perennial herbs, the stems villous, glandular, or strigulose. Inflorescence erect. Flowers strongly zygomorphic, the stamens in the lower quarter or third; flowers opening near sunset and withering the next morning, or opening near sunrise and withering in the afternoon. Fruit not reflexing, narrowly ellipsoid or ellipsoid, sharply 4-angled, with fairly deep furrows alternating with the angles for 2–3 mm from the apex, ribbed from base of furrow to base of the fruit. Self-incompatible or self-compatible. Gametic chromosome number,  $n = 7$ ; one species (*G. biennis*) a complex structural heterozygote.

TYPE SPECIES: *Gaura biennis* L.

DISTRIBUTION: Nearly throughout in eastern half of the United States, but rarer northward, and barely entering southernmost Canada, in more or less open sandy places, with one species (*G. lindheimeri*) in black prairie soil.

With six species, section *Gaura* is the largest in the genus. Of these, *G. longiflora* and its recent derivative *G. demareei* are self-incompatible, as is the morning-opening *G. lindheimeri*. The self-compatible, complex structural heterozygote *G. biennis* has doubtless been derived from northern populations of *G. longiflora*, and has become the only species of the genus throughout most of the northeastern United States. Somewhat more distantly related are the self compatible *G. neomexicana*, obviously a relict restricted to its present three disjunct areas in Colorado and New Mexico by the elimination of summer rainfall over much of the western United States; and the essentially autogamous *G. angustifolia*, the most common and often only species of the genus in the Coastal Plain of the southeastern United States.

12. *Gaura lindheimeri* Engelm. & Gray, Bost. J. Nat. Hist. 5: 217. 1845. Munz, Bull. Torrey Bot. Club 65: 115. 1938; N. Amer. Fl. II. 5: 187. 1965. Figs. 13, 49.





FIGURES 49-55. Flowers of the species of *Gaura* sect. *Gaura*. Fig. 49. *G. lindheimeri*.—Fig. 50. *G. angustifolia*.—Fig. 51. *G. neomexicana* subsp. *neomexicana*.—Fig. 52. *G. longiflora*.—Fig. 53. *G. biennis*.—Fig. 54. *G. demareei*.



*Gaura filiformis* Small var. *munzii* Cory, Rhodora 39: 420. 1937. Type: About 6.5 mi n of High Island, Chambers Co., Texas, 17 September 1936, V. L. Cory 20179 (GH). Munz, Bull. Torrey Bot. Club 65: 120. 1938; N. Amer. Fl. II. 5: 187. 1965.

Robust clumped perennial herb, usually branching copiously from a heavy underground crown, the stems erect or more often arching outward from the crown to form a full, clumped plant 5–15 dm tall. Entire plants villous, somewhat more densely so below, the trichomes mostly 1–2 mm long, subappressed on the densely pubescent leaves, or the plants more rarely subglabrous; inflorescence with a more or less dense admixture of glandular trichomes less than 1 mm long. Leaves very narrowly elliptic (to occasionally narrowly oblanceolate), 0.5–9 cm long, 0.1–1.3 mm wide, coarsely and remotely serrate, occasionally subsinuate so, diminishing in size upward. Inflorescence well branched or simple, 10–80 cm long; bracts narrowly to broadly elliptic, 4–11 mm long, 1.5–6 mm wide. Flowers opening near sunrise. Floral tube 4–9 mm long, densely lanate in the upper two-thirds or half within. Sepals 8.5–17 mm long, 1–2 mm wide. Petals white, fading to light or deep pink, 10.5–15 mm long, 5–10 mm wide. Filaments 7.5–12 mm long; anthers usually dull red, 3.5–4.5 mm long. Style 16–26.5 mm long, lanate near the base. Fruit 6–9 mm long, 2–3.5 mm thick. Seeds 1–4, 2–3 mm long, 1–1.5 mm thick, yellowish to light brown. Self-incompatible. Gametic chromosome number,  $n = 7$ .

TYPE: Prairies from Houston to the Brazos, Harris and Fort Bend counties, Texas, April to May 1843, *Ferdinand Jakob Lindheimer* I.61 (MO. Isotypes, BM, CAMB, GH, LE, P, PH, US, W).

DISTRIBUTION (fig. 55): Black prairie soil in the coastal prairie of southeastern Texas and southwestern Louisiana; Tangipahoa Parish, Louisiana. Flowers April–July.

#### REPRESENTATIVE SPECIMENS EXAMINED:

UNITED STATES. LOUISIANA. Acadia Parish: 3 mi w of Raye, *Thieret* 22847 (DS, LAF). Allen Parish: Road from Kernan to Kinder, *Crockett* 8643 (LL). Beauregard Parish: Near Longville, *Cooley & Brass* 4075 (GH, USF). Calcasieu Parish: 1 mi e of Lake Charles, *D. S. & H. D. Correll* 9636 (DUKE, F, GH, NY). Jefferson Davis Parish: Jennings, *Palmer* 7612 (MO, NY, US); *Munz* 13340 (F, G, NY, POM). Lafayette Parish: Without other data (NY). St. Mary Parish: Near Centerville, *Munz* 1588 (POM). Tangipahoa Parish: Hammond, *Cocks in* 1903 (NO); 1 mi n of Ponchatoula, *Wilson* 1070 (FSU). Vermillion Parish: 3.5 mi sw of Kaplan, *Thieret & Tuselier* 19787 (DS, LAF). TEXAS. Brazoria Co.: 2.2 mi n of Alvin, *Shinners* 24398 (SMU). Brazos Co.: 8–10 mi s of College Station, *Reeves* 1846 (POM). Chambers Co.: 14.5 mi nw of White Ranch, *Cory* 22459 (POM). Fort Bend Co.: Arcola, *Raven* 20363 (DS). Galveston Co.: Kemah, *Fisher in* 1937 (C, OKLA, US). Hardin Co.: 2.6 mi e of Camp Jackson, *Parks & Cory* 19762 (TAES). Harris Co.:





FIGURE 55. Ranges of some species of *Gaura* sect. *Gaura*. *Gaura lindheimeri* (circles), *G. angustifolia* (open diamonds), *G. neomexicana* subsp. *neomexicana* (filled diamonds), *G. demareei* (dots), *G. neomexicana* subsp. *coloradensis* (filled triangles), *G. biennis* (open triangles). Outline of range of *G. longiflora*, the remaining species of the section, indicated by the dotted line.

5 mi n Houston, *Correll* 14161 (LL, SMU); Sheldon prairie, *Reverchon* 3842 (GH, MIN, MO, POM, US). Jasper Co.: 6 mi s of Buna, *Correll et al.* 22302 (LL). Jefferson Co.: 6 mi e of Port Arthur, *Cory* 50820 (SMU). Liberty Co.: 3 mi e of Liberty, *Munz* 13342 (BH, G, GH, POM). Orange Co.: 10 mi e of Beaumont, *Munz & Gregory* 23460 (RSA). Victoria Co.: McFadden Beach, *Tharp* in 1937 (TEX). Wharton Co.: 35 mi w of East Bernard, *Raven* 20362 (DS).

In addition to these presumably native localities, *Gaura lindheimeri* has been popular in private and public gardens since it was introduced into cultivation in the mid-1840's. It is cultivated throughout the temperate regions of the world but not, as far as we know, ever truly spontaneous outside of Texas and Louisiana. The following are a few cultivated specimens to indicate something of the range:

ARGENTINA. Mendoza, *Jorgenson* 172 (C). AUSTRALIA. NEW SOUTH WALES. Camden, "Spontaneous," *McBarron* 10365 (NSW); Hazelbrook, 2200 ft, *Constable* in 1949 (NSW). CANADA. Ontario, 3 mi se of Thomas, *James* 2018 (DAO). CHINA. CHEKIANG (UC). ENGLAND. Cambridge, *Leabitt* in 1898 (MO). GERMANY. Stadt-



garten, München, *Mayer in 1896* (MICH). ITALY. Botanical Gardens, Firenze, *in 1857* (FI). MEXICO. COAHUILA, near Saltillo, *Nicolás in 1910* (BR, G, GH, K, LE, NY, P); Remate, near Monterrey, Nuevo León, *Arsène in 1911* (NY, P). PUEBLA, vicinity of Puebla, *Nicolás* (G). SWEDEN. Kolmar, *Anderson in 1929* (DS, OKL, SMU). UNITED STATES. CALIFORNIA. Berkeley, University of California Botanic Garden, *E. B. Babcock in 1903* (UC, US); IOWA. Marshalltown, *Harmon in 1929* (ISC); NEW JERSEY. Passaic, *Rusby in 1877* (MICH).

There seems no reason to regard the collections from Mexico as being from native populations, since the areas are completely out of line with those within the native range of the species ecologically and there are no undoubtedly spontaneous collections of *Gaura lindheimeri* from Mexico. The type material of *G. filiformis* var. *munzii* is typical *G. lindheimeri*. Hybridization between *G. lindheimeri* and *G. longiflora* is discussed under the latter species.

13. *Gaura angustifolia* Michx., Fl., Bor.-Amer. 1: 226. 1803. Munz, Bull. Torrey Bot. Club 65: 116. 1938; N. Amer. Fl. II. 5: 187. 1965. Figs. 14, 15, 50.

*Gaura fruticosa* Jacq., Coll. 1: 142, pl. 181. 1786; non *G. fruticosa* Löfl., Iter Hisp. 248. 1758. Type: Cultivated in the garden at Schönbrunn Palace in Vienna from seeds collected by Boos and Bredemeyer in the vicinity of Charleston, South Carolina, June–September 1785, N. Jacquin.

*Gaura simulans* Small, Bull. New York Bot. Gard. 3: 432. 1905. Type: In pinelands near the unfinished railroad grade, between Coconut Grove and Cutler, Dade Co., Florida, 31 October to 4 November 1903, J. K. Small & J. J. Carter 766 (NY. Isotypes, F, GH, MIN).

*Gaura eatonii* Small, Fl. S. E. U. S. ed. 2, 1353, 1375. 1913. Type: Sandy beach, Punta Rassa, Lee Co., Florida, 4 March 1905, A. A. Eaton 1289 (NY).

*Gaura angustifolia* Michx. var. *typica* Munz, Bull. Torrey Bot. Club 65: 117. 1938.

*Gaura angustifolia* Michx. var. *strigosa* Munz, Bull. Torrey Bot. Club 65: 118. 1938. Type: Dry sandy soil, vicinity of Eustis, Lake Co., Florida, 16–31 July 1894, G. V. Nash 1464 (NY. Isotypes, BY, CU, DAO, F, G, GH, LE, MICH, MIN, MO, MSC, PH, US). Munz, N. Amer. Fl. II. 5: 188. 1965.

*Gaura angustifolia* Michx. var. *simulans* (Small) Munz, Bull. Torrey Bot. Club 65: 118. 1938; N. Amer. Fl. II. 5: 188. 1965.

*Gaura angustifolia* Michx. var. *eatonii* (Small) Munz, Bull. Torrey Bot. Club 65: 118. 1938; N. Amer. Fl. II. 5: 188. 1965.



Annual herb, occasionally persisting through mild winters in the southern parts of its range, from a taproot; stem usually single, but occasionally with several from the base, unbranched to branched near the base or above, 6–18 dm tall. Plants subglabrous, strigulose, or hirtellous, or with a mixture of strigulose and hirtellous pubescence. Leaves narrowly lanceolate to narrowly oblanceolate, often red-blotched, 0.8–13 cm long, 0.1–1.25 cm wide, slightly to markedly sinuate-dentate. Inflorescence simple or fairly well branched, 10–70 cm long; bracts lanceolate, 2–3.5 mm long, 0.75–1 mm wide. Flowers 4-merous or 3-merous, often both types mixed on a single plant, opening near sunset. Floral tube 3–8 mm long. Sepals 2.5–8 mm long, 0.5–1.5 mm wide. Petals 4.5–8 mm long, 0.5–1.5 mm wide. Petals 4.5–8 mm long, 1–3 mm wide. Filaments 2.5–6 mm long; anthers 0.5–2 mm long, shedding pollen directly on the stigma at anthesis. Style 7.5–19 mm long. Fruit 5–9 mm long, 2–3 mm thick. Seeds 2–4, 1.5–2.25 mm long, ca. 1 mm thick, yellowish to light brown. Self-compatible and largely autogamous. Gametic chromosome number,  $n = 7$ .

TYPE: Vicinity of Charleston, South Carolina, 1787–1802, *André Michaux* (P. Isotype, F).

DISTRIBUTION (fig. 55): Sand hills and sandy flats, dunes and waste places, on the Coastal Plain from Cape Hatteras, North Carolina to and throughout Florida. Flowers chiefly May to August, but sporadically in all months, particularly in southern Florida.

#### REPRESENTATIVE SPECIMENS EXAMINED:

UNITED STATES. FLORIDA. Alachua Co.: Millhopper Reserve, nw of Gainesville, *Wiggins* 19675 (DS, FLAS, USF). Bay Co.: 15 mi s of Round Lake Common, *T. & L. Mosquin* 5868 (DAO). Bradford Co.: 6 mi e of Lake Butler, *Godfrey* 63899 (DS, FSU). Brevard Co.: Cape Canaveral, *Burgess* 654 (F, NY). Broward Co.: Pompano Beach area, *Lakela* 28294 (FLAS, RSA, USF). Calhoun Co.: 8 mi n of Wewahitchka, *Ford* 3325 (FLAS). Charlotte Co.: Chadwick Beach, *Deam* 57722 (F, IND). Citrus Co.: 5 mi s of Homosassa, *Kral* 7760 (FLAS, FSU, GA, GH, USF). Clay Co.: 9 mi s of Green Cover Springs, *Rosbach* 2106 (FLAS, WVA). Collier Co.: Marco Island, *Ward* 5387 (DS, FLAS). Columbia Co.: 7.8 mi w of Baker Co. line on U.S. Hwy. 90, *Ward* 4800 (DS, FLAS). Dade Co.: Miami, *Garber in* 1877 (F, FLAS, GH, NY, PAC, PH, US). De Soto Co.: 14 mi e of Arcadia, *Adams* 136 (GA, GH, NCU, NSC, USF). Dixie Co.: 5 mi s of Cross City, *Murrill in* 1940 (FLAS). Duval Co.: Near Jacksonville, *Curtis* 895 (F, FLAS, GA, IA, LE, MO, NMC, PENN, PH, US). Flagler Co.: 10 mi e of county line on Hwy. 28, *West & Arnold in* 1940 (FLAS). Franklin Co.: 3 mi sw of Panacea, *Kral* 4688 (FSU, GH, LAF, SMU). Glades Co.: 10 mi n of Lakeport, *Will in* 1960 (FLAS). Hamilton Co.: 2.7 mi w of Jasper, *Godfrey* 63687 (DS, FSU). Hardee Co.: *Cooley et al.* 6107 (FSU, GA, GH, NY, USF). Hendry Co.: S of Labelle, *Lakela* 26935 (USF). Hernando Co.: Brooksville, *Murrill in* 1939 (FLAS). Highlands Co.: 8 mi w of Childs, *Deam* 61188 (IND). Hillsborough Co.: N of Gibsonton, *Lakela* 25183 (DS,



FLAS, GH, NCU, SMU, USF, VDB). Indian River Co.: Near Fellsmere, *Small et al.* 1113 (GH, NY, US). Jefferson Co.: *Hitchcock* 670 (F, MO). Lafayette Co.: 2.7 mi sw of Mayo, *Ward* 4485 (FLAS). Lee Co.: W of Buckingham, *Moldenke* 1008 (DUKE, MIN, MO, NY, PENN, US). Leon Co.: Near Tallahassee, *Godfrey* 53488 (DUKE, FSU, GH, NY). Levy Co.: 5 mi s of Williston, *Kral* 4855 (FSU, SMU). Liberty Co.: *Sargent in* 1950 (KANU, MIN, OKL, WVA). Madison Co.: 6.8 mi e of Greenville, *Raven* 18633 (DS). Manatee Co.: Bradenton, Longboat Key, *Long & Lakela* 27581 (DS, FLAS, OKLA, USF). Marion Co.: Ocala National Forest, 1.5 mi e of Juniper Springs Road, *Mather M-296* (USF). Martin Co.: 2 mi s of Stuart, *West in* 1944 (FLAS). Monroe Co.: Big Pine Key, *Killip* 43200 (FLAS, MICH, NO, MSC, NY). Nassau Co.: Yulee, *Raven* 18699 (DS). Okaloosa Co.: 2.7 mi e of Destin Bridge, *Raven* 18592 (DS). Okeechobee Co.: Zigzaggy, *Demaree* 50228 (DS, NO). Orange Co.: N of Winter Park, *Bright* 3676 (CM). Osceola Co.: Road to Gables Golf Course, *Singeltary in* 1938 (DUKE, MSC). Palm Beach Co.: Near Palm Beach, *von Reis* 201 (MICH, US). Pasco Co.: 10 mi n of Hillsborough Co. line, *Wiggins* 19595 (DS, FLAS, USF). Pinellas Co.: Mullet Key, *Lakela* 27625 (DS, USF). Polk Co.: 10 mi e of Lake Wales, *Demaree* 49442 (DS, SMU). Putnam Co.: 3.6 mi nw of Pomona Park, *T. & L. Mosquin* 5911 (DAO). St. Johns Co.: San Sebastian River, *Godfrey* 63965 (DS, FSU). St. Lucie Co.: Fort Pierce, *Burgess* 735 (F, NY). Santa Rosa Co.: Santa Rosa Island, *Mohr in* 1872 (US). Sarasota Co.: Longboat Key, *Lakela & Laker* 28698 (DS, FSU). Seminole Co.: *Cooley et al.* 7422 (USF). Sumter Co.: 4 mi s of Bushnell, *Kral* 6847 (FLAS, FSU, GA, GH, USF). Suwannee Co.: 5 mi w of O'Brien, *West & Arnold in* 1946 (FLAS). Union Co.: Lake Butler, *Godfrey* 63859 (DS, FSU). Volusia Co.: 6 mi e of Geneva, *Kral* 5170 (FSU, GH, SMU). Walton Co.: 16 mi e of Destin, *Dress & Read* 7656 (BH). GEORGIA. Camden Co.: 10 mi w of Kingsland, *Gregory* 540 (DS). Chatham Co.: Tybee Island, *Duncan* 21178 (GA, KY, LAF, TENN). Decatur Co.: Near Hutchinsons Ferry, *Thorne* 4746 (CU, IA). Glynn Co.: 10 mi n of Brunswick, *Munz & Gregory* 23490 (RSA). Lanier Co.: 4.9 mi e of Lakeland, *Kral* 24257 (FSU). McIntosh Co.: Sapelo Island, *Duncan* 20164 (DUKE, F, GA, GH, ISC, NCU, SMU, TEX, US, USF). Seminole Co.: 3 mi e of Donaldsonville, *Thorne* 4430 (CU, GA). Ware Co.: Waycross Airport, *Kuns* 279 (WISC). Wayne Co.: 2 mi n of Jessup, *Fitzgerald* 72 (GA). NORTH CAROLINA. Beaufort Co.: Near Bayview, *Correll* 1653 (DUKE). Brunswick Co.: Southport, *Wells in* 1949 (NSC). Cartaret Co.: Shackelford Banks, *Anderson* 359 (DUKE, FSU, SMU). Craven Co.: Havelock Radford 37495 (NCU). Dare Co.: Buxton, *Pence* 45091 (CM, KY, LAF, NCU). Hyde Co.: Swan Quarter, *Radford & Stewart* 797 (NCU). Jones Co.: Maysville, Radford 37229 (NCU). New Hanover Co.: 0.5 mi n of bridge into Wrightsville Bridge, *Gregory* 527 (DS). Onslow Co.: 4.8 mi w-sw of Haw, *Ahles & Haesloop* 28203 (KANU, NCU). Pamlico Co.: Front of Bay River, *L. F. & F. R. Randolph* 856 (BH, CU, GH). Pender Co.: *Ahles & Haesloop* 27988 (FLAS, NCU, SMU). SOUTH CAROLINA. Beaufort Co.: Beaufort, *Churchill in* 1917 (GH, MIN, MO). Berkeley Co.: 10 mi nw of Charleston, *Godfrey & Tryon* 712 (F, GH, MO, MY, POM, US). Charleston Co.: Sullivans Island, *Gibbs in* 1856 (NY). Colleton Co.: 14 mi e of Walterboro, *Wiegand & Manning* 2160 (CU, GH). Georgetown Co.: 3 mi n of Litchfield Beach, *Gregory* 532 (DS). Hampton Co.: 1.7 mi se of Early Branch, *Bell & Ahles* 15719 (GA, NCU). Horry Co.: Myrtle Beach, *Buker in* 1954 (CM). Jasper Co.: 3 mi ne of Coosawhatchie, *Ahles & Bell* 15687 (NCU, USF).



The four varieties into which *Gaura angustifolia* was divided by Munz (1938) differ in the character of the pubescence in the inflorescence only. Although they are weakly correlated geographically, there are numerous intermediates between them. The pattern of variation in this species is not extraordinary for such a strictly autogamous taxon, and does not appear to warrant taxonomic subdivision. *Gaura angustifolia* was collected once as a weed on ballast in the Navy Yard at Philadelphia (*Parker*, PH), curiously enough on 30 September 1865; one may wonder how it became established at Philadelphia during the Civil War in view of its known range.

14. *Gaura neomexicana* Wooton, Bull. Torrey Bot. Club 25: 307. 1898.  
Munz, Bull. Torrey Bot. Club 65: 113. 1938; N. Amer. Fl. II. 5: 186.  
1965.

Biennial herb sending up several stems from the top of a fleshy, carrot-like taproot; stems erect, 5–12.5 dm tall, unbranched to moderately branched. Pubescence villous, glandular, or strigulose. Leaves subglabrous or strigulose, very narrowly elliptic, 2–13 cm long, 1–4 cm wide, subentire to repand-denticulate, those of the rosette to 33 cm long. Sepals 9.5–15 mm long, 1.5–2.5 mm wide. Petals 7–13.5 mm long, 4–8 mm wide. Filaments 6.5–9 mm long; anthers 2.5–4 mm long. Style 19–28 mm long. Fruit 6–11 mm long, 2–5 mm thick. Seeds 2–4, 2–3 mm long, 1–1.5 mm thick, yellowish to light brown. Self-compatible. Gametic chromosome number,  $n.=7$ .

TYPE: White Mts., 6500 ft elevation, Lincoln Co., New Mexico, 26 July 1897, *E. O. Wooton* 204 (US. Isotypes, G, LE, MIN, MO, ND, NY, P).

DISTRIBUTION (fig. 55): Heavy sod in mountain meadows and openings, very local: southern Larimer County, Wyoming, and adjacent Weld County, Colorado; near Fort Collins, Larimer County, Colorado (probably extinct); western foothills of San Juan Mountains, Archuleta County, Colorado, and Rio Arriba County, New Mexico, and perhaps also near Durango, La Plata County, Colorado; Sierra Blanca and Sacramento Mountains in Lincoln and Otero counties, south-central New Mexico. Flowers July to September.

In view of the remarkably disjunct range, the differences between the northernmost and two southern populations of this species appear to warrant taxonomic recognition.

- 14a. *Gaura neomexicana* subsp. *neomexicana*. Figs. 16, 51.

*Gaura neomexicana* Wooton var. *typica* Munz, Bull. Torrey Bot. Club 65: 114. 1938.

Stems with both villous and strigulose pubescence, the inflorescences occasionally with a few long hairs. Sepals 11–15 mm long, 1.6–2.5 mm wide.



Petals 10.8–13.5 mm long, 5–8 mm wide. Style 22–28 mm long. Fruit 8.5–11 mm long, 4.5 mm thick. Self-compatible. Gametic chromosome number,  $n = 7$ .

DISTRIBUTION (fig. 56): Mountain meadows in openings in coniferous forest, western foothills of the San Juan Mountains in Archuleta County, Colorado, and Rio Arriba County, New Mexico; Sierra Blanca and Sacramento Mountains in Lincoln and Otero counties, south-central New Mexico. Collected once at Durango, La Plata County, Colorado, but the locality needs to be confirmed.

REPRESENTATIVE SPECIMENS EXAMINED:

UNITED STATES. COLORADO. Archuleta Co.: Pagosa Springs, *Baker* 490 (BM, G, GH, M, MO, ND, NY, POM, US), *Bethel* in 1917 (COCO); 18 mi s of Pagosa Springs, *Penland* 4656 (COCO, COLO); Piedra, *Baker* 491 (MO, ND, NO, NY, POM, US). La Plata Co.: Durango, *Livingston* in 1936 (COCO). NEW MEXICO. Otero Co.: Apache Indian Reservation, Sacramento Mts., *Huber* in 1932 (PH); James Canyon, Sacramento Mts., *Wootton* in 1899 (US); vicinity of Cloudcroft, *Wootton* in 1899 (COLO, DS, GH, ILL, NY, POM, US); High Rolls, *Young* in 1916 (TEX); Tularosa Creek, 3 mi s of Mescalero Agency, *Wolf* 2768 (BH, DS, GH, POM, RSA); 2.8 mi w of Cloudcroft, *Harms* 1833 (KANU, SMU). Rio Arriba Co.: Vicinity of Chama, *Standley* 6783 (NY, US).

The populations in southern Colorado have much less villous pubescence than those in the White Mountains of New Mexico, thus in some sense being transitional to the more northerly subsp. *coloradensis*.

14b. *Gaura neomexicana* subsp. *coloradensis* (Rydb.) Raven & Gregory, comb. nov. Fig. 17.

*Gaura coloradensis* Rydb., Bull. Torrey Bot. Club 31: 572. 1904.

*Gaura neomexicana* Wootton var. *coloradensis* (Rydb.) Munz, Bull. Torrey Bot. Club 65: 114. 1938; N. Amer. Fl. II. 5: 186. 1965.

Stems strigulose, the inflorescences with glandular pubescence only. Sepals 9.5–13 mm long, 1.5–2 mm wide. Style 19–25 mm long. Fruit 6–8.5 mm long, 2–3 mm thick. Self-compatible. Gametic chromosome number,  $n = 7$ .

TYPE: Fort Collins, Larimer Co., Colorado, 8 July 1895, *J. H. Cowen* (NY. Isotype, GH).

DISTRIBUTION (fig. 56): Mountain meadows, in heavy soil, southern Laramie County, Wyoming, and northern Weld County, Colorado; once near Fort Collins, Larimer County, Colorado, but apparently now extinct there (not collected since 1897).



## SPECIMENS EXAMINED:

UNITED STATES. COLORADO. Larimer Co.: Meadows east of college, Fort Collins, *Crandall* 1308 (ISC, NY); Fort Collins, *Cowen* in 1895 (US); e of Poudre, *Cowen* 1632 (COCO); 30 mi n of Fort Collins, 6200 ft, *Harrington* in 1944 (COCO). Weld Co.: 3.2 mi s of Wyoming line on U.S. Hwy. 87, *Porter* 9690 (DS, MSC, RSA). WYOMING. Laramie Co.: Pine Bluffs, *Bodin* in 1889 (MIN).

15. *Gaura longiflora* Spach, Nouv. Ann. Mus. Hist. Nat. 4: 380. 1835. Figs. 18, 19, 53.

*Gaura biennis* L. var. *pitcheri* T. & G., Fl. N. Amer. 1: 517. 1840. Type: Red River, presumably near the site of Fort Towson, Chocktaw Co., Oklahoma, 1831–1834, *Zina Pitcher* (NY). Munz, Bull. Torrey Bot. Club 65: 113. 1938; *pro parte*; N. Amer. Fl. II 5: 185. 1965; *pro parte*.

*Gaura filiformis* Small, Bull. Torrey Bot. Club 25: 617. 1898. Type: Near Texarkana, Miller Co., Arkansas, 23 August 1898, A. A. & E. G. Heller 4138 (NY. Isotypes, CU, F, G, GH, ISC, LE, MO, NY, P, PH, US). Munz, Bull. Torrey Bot. Club 65: 118. 1938; N. Amer. Fl. II. 5: 188. 1938.

*Gaura filiformis* Small var. *kearneyi* Munz, Bull. Torrey Bot. Club 65: 119. 1938. Type: Along railroad track, Starkville, Oktibbeha Co., Mississippi, 28 Sept. 1896, T. H. Kearney, Jr. (NY).

*Gaura biennis sensu* Munz, Bull. Torrey Bot. Club 65: 111. 1938; N. Amer. Fl. II. 5: 185. 1965; *et auct. mult., pro parte*.

Robust winter annual or perhaps occasionally biennial from a fleshy taproot; stems usually well branched above the base, 5–40 dm tall. Stems and leaves more or less densely strigulose with an admixture of glandular or villous pubescence in northern populations; inflorescence densely strigulose, hirtellous, or glandular, the latter two hair types often intermixed. Leaves usually narrowly elliptic, 1.5–13 cm long, 0.2–2.75 cm wide, subentire or shallowly undulate-denticulate, often left in short axillary fascicles after main leaves have dropped; rosette leaves (withered by time of flowering) up to 40 cm long and to 3 cm or more wide, often highly irregular in outline. Inflorescence well branched; bracts lanceolate or ovate, 1–6 mm long, 0.5–2 mm wide. Flowers opening near sunset. Floral tube 4–13.5(–15) mm long. Sepals 7–18 mm long, 1–2.3 mm wide. Petals 6.5–15 mm long, 2.5–7 mm wide. Filaments 5–13 mm long; anthers 1.5–5 mm long. Style 12–33.5 mm long. Fruit 4.5–7 mm long, 1.5–2.5 mm thick. Seeds 2–4, 1.25–3 mm long, 0.75–1.25 mm thick, yellowish to reddish brown. Self-incompatible. Gametic chromosome number,  $n = 7$ .

TYPE: Jacksonville, near present-day Sheridan, Washington Parish, Louisiana, autumn 1832, *Thomas Drummond* (F. Isotypes, GH, K, P).



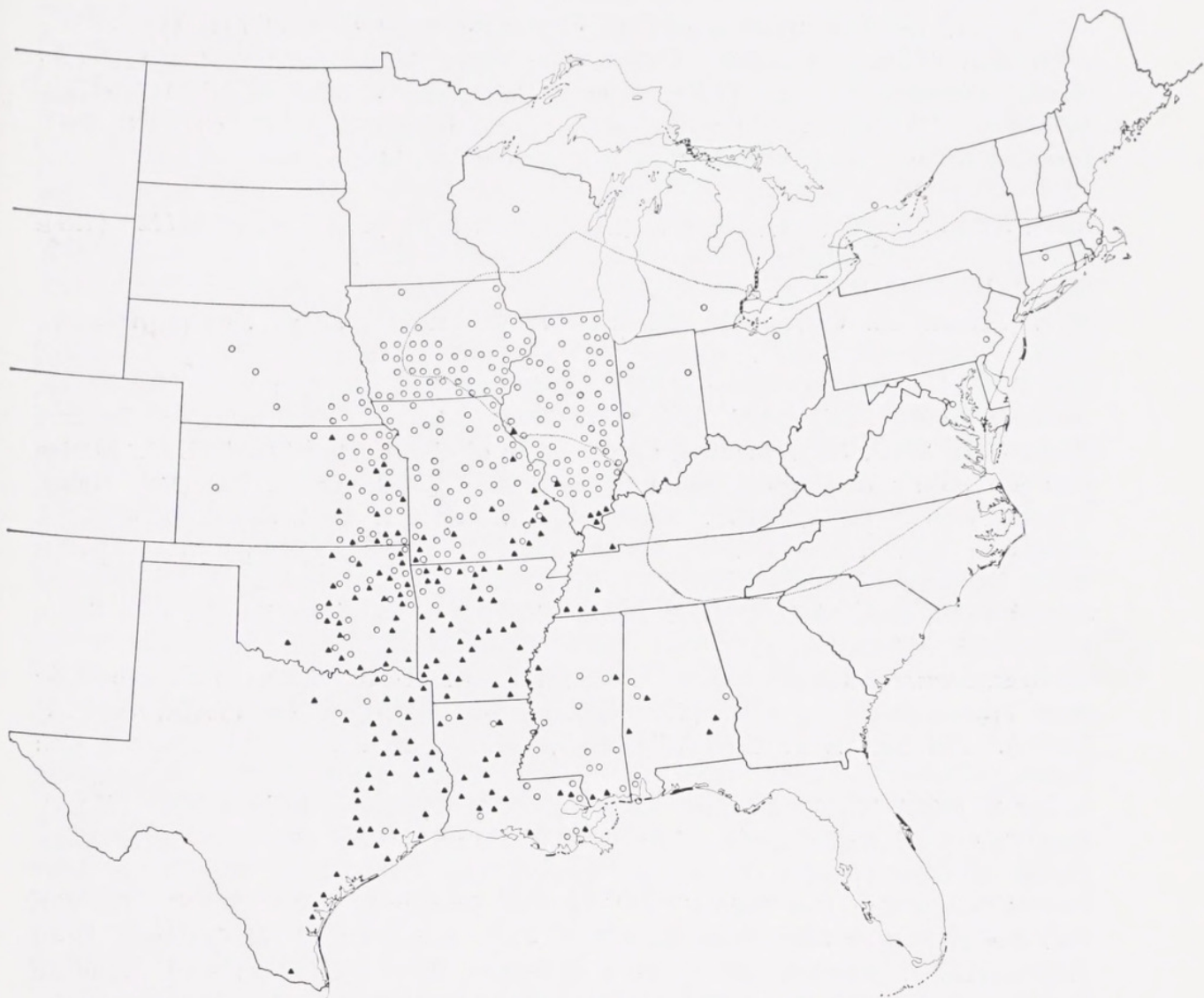


FIGURE 56. Range of *Gaura longiflora* (*G. filiformis*). Plants with strigulose pubescence on the sepals are indicated by solid triangles, those with glandular pubescence by circles.

The type locality of this species has generally (and erroneously) been considered to have been Jacksonville, Florida, one factor in its having been relegated to the synonymy of *G. angustifolia*.

DISTRIBUTION (fig. 56): Open grassland and waste places, often along roadsides and railway embankments, southeastern Nebraska, Iowa, Illinois, and western and northern Indiana south to eastern and southern Texas, Louisiana, Mississippi, and Alabama; rare and scattered in Colorado, central and western Nebraska, western Kansas, Minnesota, Wisconsin, Michigan, and Ohio, with one station each in southern Ontario, Massachusetts, Connecticut, Pennsylvania, and Maryland. Probably introduced at most stations outside of its main area of distribution. Flowers July to October.



## REPRESENTATIVE SPECIMENS EXAMINED:

CANADA. ONTARIO. Scarborough Twp., Ontario, *Scott in 1905* (DAO).

UNITED STATES. ALABAMA. Bullock Co.: Flora, 3929g (MIN). Choctaw Co.: Cocoa, *Schuchert in 1896* (NY). Greene Co.: 1 mi n of Forkland, *Whitehouse 24360\** (SMU). Hale Co.: 1 mi nw of Rosemary, *Harper 3253* (BY, GH, MO, PH). Lee Co.: Auburn, *Earle & Baker\** (ILL). Mobile Co.: Monroe Park, Mobile, *Drushel 2577\** (ILL, MO); 11.5 mi s of Mobile, *Shinners 12579\** (SMU); 0.6 mi n of Dog River, *Raven 22110\** (DS); South Dog River at State Hwy. 163, *Raven 22112\** (DS). Pickens Co.: Pickensville, *Demaree 51291\** (DS, SMU). Pike Co.: Spring Hill, *Graves 1043a* (MIN). ARKANSAS. Arkansas Co.: Nady P.O., *Demaree 21657* (MO, NY). Benton Co.: Claytonville, *Demaree 4678\** (SMU); Siloan Springs, *Demaree 22389* (MO, POM, SMU). Bradley Co.: *Demaree 24639* (MO, SMU). Craighead Co.: P. O. Jonesboro, *Demaree 26552\** (RSA, SMU). Drew Co.: Lone Pine Prairie, *Demaree 21592* (ISC, MIN, NY, OKL, OKLA, SMU). Faulkner Co.: *Demaree 10966* (GH, SMU, US). Madison Co.: 2 mi w of Clifty, *Hoff 210-4* (DS). Marion Co.: 4.5 mi sw of Flippin, *Raven 20559* (DS); Jimmie Creek, P.O. Bull Shoals, *Demaree 30172\** (RSA, SMU). Newton Co.: 1.4 mi n of Print, *Raven 20574* (DS). Pope Co.: P.O. Hector, *Demaree 19898* (MO, NY, SMU). Pulaski Co.: Arkansas River, *Demaree 8741* (CM, IND, NY, US). Randolph Co.: Noland P. O., *Demaree 31403\** (ISC, RSA, SMU, UMO). Searcy Co.: 4.8 mi se of Marion Co. line, *Raven 20560* (DS). Sebastian Co.: Fort Smith, *Raven 20430* (DS). Stone Co.: P. O. Optimus, *Demaree 29929\** (KANU, ISC, MIN, RSA, SMU, TEX). Washington Co.: Near Fayetteville, *Isely 4782* (ISC, OKLA); Mt. Sequoyah, Fayetteville, *Beck 4\** (OKL). Yell Co.: N of Centerville, *Raven 20572* (DS). COLORADO. Douglas Co.: Sedalia, *Ginter in 1942* (COCO). CONNECTICUT. Hartford Co.: Southington, *Bissell in 1906\** (GH). ILLINOIS. Bond Co.: E of Smithbow, *Evers 14334\** (ILLS). Cass Co.: N of Bluff Springs, *Evers 21362\** (ILLS). Clay Co.: 3 mi e of Flora, *Boewe in 1938* (ILLS). Coles Co.: Lincoln Log Cabin State Park, *Voigt 959\** (MIN). Cook Co.: Des Plaines River, Leyden, *Bennett in 1956\** (ILLS). De Witt Co.: Nw of Farmer City, *Evers 31664\** (ILLS). Edgar Co.: N of Chrisman, *Evers 7425\** (ILLS). Franklin Co.: 2 mi s of Sesser, *Evers 52327\** (ILLS). Hamilton Co.: 1 mi e of Piopolis, *Evers 13144\** (ILLS). Henderson Co.: Near Oquawka, *Patterson\** (ND). Iroquois Co.: 1 mi w of Woodworth, *Evers 6321\** (ILLS). Jersey Co.: 2 mi se of Jerseyville, *Boewe in 1944\** (ILLS). Kankakee Co.: *Lansing & Sherff 14\** (GH, MIN, PENN). Lawrence Co.: 8 mi w of Lawrenceville, *Henderson 62-1070\** (FSU). Logan Co.: 1 mi e of Burton View, *Evers 5858\** (ILLS). Marion Co.: Nw of Kinmundy, *Evers 81476\** (DS). McHenry Co.: Rattray Hill near Algonquin, *Nason in 1913\** (F). Peoria Co.: 3 mi e of Edwards, *Bates 2665\** (DS). Pike Co.: Nw corner of C. F. Gurhrie's peach orchard, *Campbell & Alexopoulos 4404* (ILLS). Pope Co.: Ramsey Branch, *Hopkins 1017* (SIU). Rock Island Co.: W of Andalusia, *Evers 31926\** (ILLS). St. Clare Co.: East St. Louis, *Eggert in 1896* (MIN). Sangamon Co.: 2 mi se of Springfield, *Winterringer 22375\** (DS). Tazewell Co.: E of Tremont, *Evers 31763\** (ILLS). Washington Co.: 2 mi n of New Minden, *Boewe in 1946\** (ILLS). Winnebago Co.: Rockford, *Fuller 3048\** (GH). INDIANA. Jasper Co.: Remington, *Barnes 18* (GH); 3 mi n, 5 mi w of Remington, *Deam 42089* (IND). Newton Co.: 5 mi nw of Goodland, *Deam 57322* (IND). Vermillion Co.: 1 mi n of Rileysburg, *Deam 51339* (IND). Wells Co.: W of Murray Bridge along river, *Deam 480* (US). IOWA. Allamakee Co.: Yellow River,

\* Specimens with glandular pubescence on the buds; all others were entirely strigulose.



*Pammel* in 1927\* (PH). Appanoose Co.: E of Moravia, *Shimek* in 1923\* (IA). Black Hawk Co.: Bennington Township, *Burk* 729\* (ILL). Calhoun Co.: Carroll, *Pammel* 23\* (CINC, FLAS, GH, MO, NY). Clinton Co.: Clinton, *Blake* 53\* (ISC). Crawford Co.: *Butler* in 1928\* (ISC). Davis Co.: 0.5 mi w of Bloomfield, *Davidson* 3715\* (IA, SMU, US). Des Moines Co.: *Davidson* 3245\* (IA, TEX). Dubuque Co.: *Anderson* in 1900\* (IA). Emmet Co.: *Wolden* in 1925\* (ISC). Fremont Co.: Hamburg, *Shimek* in 1898\* (IA). Hardin Co.: Near Cave in Rock, *Bailey & Swayne* 1668 (ISC). Greene Co.: *Cratty* in 1924\* (ISC). Lee Co.: Skunk River Valley, *Bartsch* in 1895\* (IA). Louisa Co.: 3/4 mi e of Wapello, *Davidson* 6\* (IA, ISC, SMU). Poweshiek Co.: 8 mi w of Grinnell, *Russell* 85556\* (IA, TENN). Ringgold Co.: 2 mi sw of Tingley, *Fay* 4494\* (IA). Shelby Co.: Se of Harlan, *Shimek* in 1913\* (ISC). Warren Co.: Indianola, *Pammel* in 1913\* (ISC). Webster Co.: *Olsson* in 1903\* (ISC). KANSAS. Butler Co.: 4.5 mi s of Leon, *Stevens* 6618 (KANU). Chase Co.: 4 mi s of Matfield Green, *Stephens* 8706\* (KANU). Chautauqua Co.: 1 mi w of Wauneta, *Raven* 20590\* (DS); Niotaze, *Raven* 20587 (DS). Cherokee Co.: Riverton Dam, *Wagenknecht* 2075\* (KANU); 5 mi e of Baxter Springs, *McGregor* 3795 (KANU). Cowley Co.: Junction of Hwy. 166 with Hwy. 15, *Raven* 20590\* (DS). Dickinson Co.: 3 mi ne of Detroit, *Hoover* 1239\* (PAC). Doniphan Co.: *Agrelius* in 1918\* (KANU). Douglas Co.: 4 mi sw of Clinton, *McGregor* 12634 (US). Jefferson Co.: 2 mi n of Oskaloosa, *Horr* 4222\* (KANU, NY, US). Linn Co.: 1 mi s of Parker, *Richardson & Robertson* 1036 (KANU, SMU). Montgomery Co.: 5.4 mi w of Hwy. 169 on Hwy. 166, *Raven* 20586\* (DS). Morris Co.: *Horr* in 1930 (KANU), 4 mi e of Council Grove, *McGregor* 14154\* (KANU). Nemaha Co.: 3.3 mi w of Wetmore, *Stephens* 9449\* (KANU). Neosha Co.: *Horr* in 1929 (KANU). Republic Co.: 2 mi s and 0.5 mi w of Munden, *Morley* 943\* (SMU). Scott Co.: *Scott, Thompson* in 1936\* (KANU). Shawnee Co.: 2.5 mi ne of Topeka, *Volle* 444 (KANU). Washington Co.: 1 mi n and 3 mi w of Washington, *Horr* 4636 (KANU). Woodson Co.: 1 mi sw of Yates Center, *Lathrop* 1366 (MIN, NY); *Lathrop* 1469\* (RSA). KENTUCKY. Calloway Co.: *Spann* in 1932 (KANU). LOUISIANA. Acadia Parish: 1.5 mi w of Midland, *Raven* 22093 (DS). Beauregard Parish: 2 mi e of De Ridder, *Ewan* 20060 (DS). Boissier Parish: 7 mi n of Plain Dealing, *Penn* 951\* (NO). Caddo Parish: 6 mi n of Springridge, *Raven* 20383 (DS). East Baton Rouge Parish: *Brown* 7204\* (GH). Evangeline Parish: 5 mi e of Beaver, *Ewan* 20019 (DS). Grant Parish: 4.5 mi n of Dry Prong, *Shinners* 24941 (SMU). Jefferson Davis Parish: Turn to Jennings off Interstate 10, *Raven* 22092 (DS). Lafourche Parish: 7 mi s of Leeville, *Thieret* 25272\* (DS). La Salle Parish: 1.5 mi e-se of Tullos, *Shinners* 24730 (SMU). Ouachita Parish: 7 mi w of Monroe, *Kral* 8148 (FSU, LAF); banks of Bartholomew Bayou, P.O. Bastrop, *Demaree* 14128\* (DS, GH, NY, OKLA, POM, SMU). St. Landry Parish: U.S. Hwy. 190 4.6 mi w of State Hwy. 741, *Raven* 22098 (DS). St. Mary Parish: Franklin, *Langlois* in 1884 (PENN). St. Tammany Parish: Mandeville, *Cooks* in 1902 (NO); Slidell, *Raven* 22106\* (DS); point s of Slidell at Lake Pontchartrain, *Raven* 22117\* (DS). Tangipahoa Parish: Hammond, *Cooks* in 1903 (NO). Vernon Parish: 1.3 mi n of Rosepine, *Shinners* 21593 (SMU). Washington Parish: Choctaw Trail, 3816 mi s of Pine, *Ewan* 19453\* (DS; glandular and with some long hairs on the sepals). Webster Parish: 2 mi s of Doyline, *Thieret* 24344 (DS). West Feliciana Parish: Catalpa, *Pennell* 4297\* (PENN). MARYLAND. Prince Georges Co.: Patuxent Wildlife Research Center, *Hotchkiss* in 1964\* (DS). MASSACHUSETTS. Plymouth Co.: Wareham, *Hunnewell* 4912\* (NEBS). MICHIGAN. Jackson Co.: 7 mi s of Jackson, *Raven* 20508\* (DS).



Monroe Co.: Pointe Mouillee State Game Area, mouth of Huron River, *McDonald* 5351\* (MSC). MINNESOTA: Without definite locality, *Young* in 1925 (CM). MISSISSIPPI: Adams Co.: 6 mi e of Natchez, *Gillis* 5971 (MSC). Bolivar Co.: Shelton, *Rhoades* in 1931 (GH). Clarke Co.: 3.2 mi s-sw of Pachuta, *Shinners* 27569 (SMU). Covington Co.: 1 mi nw of Covington, *Oosting* 1964\* (DUKE). Forest Co.: 11 mi s of Hattiesburg, *Ray* in 1958\* (USF). Hancock Co.: 7.5 mi s of Kiln, *Jones* 9498 (DS); Magnolia Ridge, *Diener* 436\* (ILL); Bay St. Louis, *Demaree* 32986\* (DUKE, LAF, RSA, SMU, VDB); 4 mi s of Santa Rosa, *Sargeant* 8330\* (OKLA, SMU, WISC). Harrison Co.: Tracys Point, *MacFarlane & Goertz* in 1905 (PENN). Hinds Co.: Riverside Park, *Dunaway* in 1962 (BY). Jackson Co.: Ocean Springs, *Pollard* 1021\* (CU, F, MIN, ND, NY), *Seymour* in 1891\* (DUKE, FSU, GH, IA, ILL, K, KANU, MIN, MSC, NCU, SMU, UMO, USF, WISC); Biloxi, *Tracy* 5071\* CM, CU, DAO, F, GH, KANU, MICH, MO, MSC, NCU, PENN, TAES). Jeff Davis Co.: Near Carson, *Jones* 9867\* (DS). Jefferson Co.: *McDougall* 1080\* (US). Lamar Co.: 5 mi sw of Hattiesburg, *Ray* 5954\* (GA, GH, NCU, NY, USF). Leake or Madison Co.: *McDougall* 1421\* (US). Lowndes Co.: P.O. Columbus, *Demaree* 51280 (DS, KY, SMU). Montgomery Co.: P.O. Duck Hill, *Demaree* 31318\* (KANU, OKL, RSA, SMU). Oktibbeha Co.: Agricultural College, *Pollard* 1320 (MIN, NO, NY, US). Smith/Scott County line: Road between Marathon Lake and Otho, *Jones* 2407 (FSU, GA, NCU). Warren Co.: Near Vicksburg, *Schallert* 13126\* (SMU). Wayne Co.: Chickawawhay River ca. 4 mi nw of Waynesboro, *Jones* 9665\* (DS). MISSOURI: Atchison Co.: 6 mi ne of Watson, *Steyermark* 4451\* (F). Barton Co.: 2 mi ne of Milford, *Palmer* 53119\* (UMO). Boone Co.: Hallsville, *Daniels* in 1897\* (UMO). Camden Co.: Zebra, *Zirkle & Drouet* in 1928\* (UMO). Carter Co.: 2 mi w of Van Buren, *Munz* 13589\* (POM). Cass Co.: Near Pleasant Hill, *Palmer* 43804\* (MO). Clarke Co.: 2 mi w of Alexandria, *Drones* 1788\* (GH, UMO). Davies Co.: 5 mi sw of Gullatin, *Evers* 68081\* (ILLS). Greene Co.: 8 mi w of Springfield, *Munz* 13553\* (BY, F, NY); e of Fellows, *Redfearn* 3789 (LAF). Jasper Co.: Carthage, *Palmer* 3147\* (MIN); Prosperity, *Palmer* 15798 (UMO). Jefferson Co.: 2 mi w of Hunter Ford, *Steyermark* 345 (MIN); Hillsbow, — in 1885\* (MIN). Lafayette Co.: Wellington, *Bush* 11519\* (UMO). Lawrence Co.: 4 mi w of Chesapeake, *Raven* 20580\* (DS). Lincoln Co.: Whiteside, *Davis* 139 (MIN); near Whiteside, *Davis* 6031\* (MIN, MO). Madison Co.: Hwy. 67 at Wayne Co. line, *Raven* 20533\* (DS); Mine La Motte, *Monell* in 1890 (MO). Marion Co.: Hannibal, *Davis* 6146\* (MIN, MO). McDonald Co.: McNatt, *Palmer* 60875 (UMO); Butler Creek, Noel, *Palmer* 4223\* (US). Oregon Co.: Just n of Gregg, *Raven* 20552 (DS). Ozark Co.: Near top of "Bald Jesse," near Gainesville, *Palmer* 33-59\* (MO, USF). Phelps Co.: Little Piney River, Yancey Mills, *Rickett* in 1927\* (UMO); Rolla, *Coe* in 1903 (GH). Reynolds Co.: Route M near Walker Branch School, *Shacklette* 6760\* (MICH). St. Genevieve Co.: Bloomsdale, *Kellogg* 1897 (MO). Shannon Co.: 9 mi w of Birch Tree, *Munz* 13549 (POM). Stone Co.: 0.8 mi w of Taney Co. line on Hwy. 65, *Raven* 20577\* (DS). Taney Co.: *Spencer* 135 (UMO). Wayne Co.: Piedmont, *Raven* 20546 (DS). NEBRASKA: Cass Co.: Weeping Water, *Williams*\* (US). Caster Co.: Broken Bow, *Webber* in 1889\* (NY). Douglas Co.: Omaha, *Eastman* in 1915\* (ILL). Gage Co.: Beatrice, *Washburn* in 1899\* (US). Jefferson Co.: 1 1/4 mi s of Hevley, *Rohrbaugh* 155\* (OKL, TEX). Kearny Co.: Minden, *Rydberg* 546\* (NY). Lancaster Co.: Near Lincoln, *Mulford* in 1892\* (MIN). Nemaha Co.: Nemaha, *Winter* in 1933\* (US). Otoe Co.: 5 mi s, 1 mi e of Syracuse, *Stephens* 17610\* (DS, KANU). Saline Co.: Crete, *Dreisbach* 6038\* (PH). Sioux Co.: *Winter* in



1931\* (CU). Thomas Co.: Middle Loup River near Seneca, *Rydberg in 1893\** (US). OHIO. Lorrain Co.: 2 mi nw of Oberlin, *Cooperrider 8047\** (KENT). OKLAHOMA. Adair Co.: 3 mi w of Stilwell, *Stephens 28027* (DS, KANU); 25.3 mi ne of Tahlequahon, *Wallis 2667\** (OKLA). Bryan Co.: 0.5 mi e of Bokchito, *Stephens 27575* (DS, KANU). Cherokee Co.: 3 mi ne of Fort Gibson, *Wallis 8417\** (KANU, NCU, VDB). Cleveland Co.: Little River, Norman, *Brewer 215\** (ISC). Comanche Co.: Wichita Mts. Wildlife Refuge, *McMurry 1274* (OKL). Delaware Co.: 15 mi s of Jay, *Stephens 28137* (DS, KANU); Flint, *Wallis 1878\** (OKLA). Haskell Co.: 6 mi w, 1 mi s of Kinta, *Stephens 27888* (DS, KANU). Kay Co.: 9 mi ne of Newkirk, *Byler 337* (OKLA). McCurtain Co.: 10 mi n of Broken Bow, *Stephens 27701* (DS KANU). Murray Co.: Back of Cowper Canyon, Conglomerate, Arbuckle Mts., *Hopkins & Nelson 705\** (DS, F, MO, OKLA, SMU). Oklahoma Co.: 4.5 mi e of Arcadia, *Waterfall 1779\** (GH, OKL, PH). Osage Co.: 1 mi w, 5 mi n of Burbank, *Stephens 27038* (DS, KANU); 10 mi w of Pawhusta, *Price 69\** (OKLA). Ottawa Co.: Near Miami, *Stevens 2254\** (DS, GH, ILL, MIN, SMU). Payne Co.: 4 mi e of Stillwater, *Fry 49\** (PH, POM, TEX). Seminole Co.: 6 mi se of Wowoka, *Smith 114\** (OKL). Sequoyah Co.: 1 1/4 mi se of Gore, *Wallis 8332\** (FSU, KANU, OKL, VDB). Tulsa Co.: 5 mi n of Tulsa, *Scully 510\** (POM). PENNSYLVANIA. Montgomery Co.: Roslyn, *Redles in 1920\** (PH; 92 percent stainable pollen). TENNESSEE. Fayette Co.: S of Lakeland, *Goolsby et al. 6677* (TENN). Hardeman Co.: 1 mi e of Grand Junction, *Rogers 40035* (TENN). Madison Co.: *Bain in 1892* (US). Shelby Co.: 0.5 mi n of Shelby, *Gregory 558* (DS). TEXAS. Anderson Co.: Slocum, *Hoff 378* (DS). Angelina Co.: 7 mi w of Lufkin, *Cory 10633* (POM). Aransas Co.: N shores of Capano Bay, *Johnston 53224.21* (MIN, OKLA, SMU, TEX). Austin Co.: 2.4 mi w of Belleville, *Cory 17711* (POM). Bowie Co.: 5.3 mi n of Corley, *Raven 20395* (DS). Brazoria Co.: 2.4 mi w of Alvin, *Raven 20366* (DS). Brazos Co.: College Station, *Parks in 1946* (RSA, TAES). Chambers Co.: 6.5 mi n of High Island, *Raven & Gregory 19420* (DS). Cherokee Co.: 4.6 mi e of Summerfield, *Shinners 19075* (SMU). Colorado Co.: 10.5 mi e of Alleyton, *Cory 19505* (POM). Dallas Co.: White Rock Lake, *Longnecker 89* (some glandular pubescence; LL, MICH, NY, SMU, TEX). Fort Bend Co.: Richmond, *Palmer 6655* (CU, F, MIN, POM, US). Galveston Co.: Evergreen Ranch, *Joar in 1884* (MIN). Hardin Co.: Near Village Creek, *Watson H-10* (LL). Harris Co.: Houston, *Fisher 47046\** (SMU), *Traverse 217* (F, GH, SMU). Henderson Co.: 3 mi ne of Frankston, *Hoff 385* (DS). Hidalgo Co.: Donna, *Parke 2942* (F). Hopkins Co.: Midland, *Tharp 2435* (US). Houston Co.: 6 mi w of Crockett, *Gregory 573* (DS). Hunt Co.: 6 mi sw of Commerce, *Turner 1677\** (DAO, SMU). Lamar Co.: 3.7 mi s of Paris, *Shinners 16328\** (SMU). Leon Co.: Centerville, *Gregory 574* (DS). Madison Co.: Trinity Bottom, *Tabenhaus 2639* (TAES, US). Morris Co.: 10 mi s of Daingerfield, *Cory 25741* (POM). Nacogdoches Co.: Nacogdoches, *Francis & Warnick in 1950* (SMU). Newton Co.: 2 mi s of Newton, *Cory 10906* (POM, TAES). San Augustine Co.: 3 mi n of San Augustine, *Gregory 569* (DS). Shelby Co.: Timpson, *Crausby in 1944* (TEX). Smith Co.: Amigo, *Moore 1025* (BH, GH). Upshur Co.: Ore City, *Shinners 16267* (SMU, TAES); 10 mi s of Daingerfield, *Parks & Cory 25741\** (TAES). Van Zandt Co.: 15 mi n of Edgewood, *Whitehouse 16443* (GA, MICH, SMU, US). Victoria Co.: Mission Valley, *Schott in 1851* (NY). Waller Co.: Waller, *Whitehouse in 1936* (TEX). Washington Co.: *Brackett in 1939* (GH, TEX). Wise Co.: *Ferris & Duncan 3324* (DS, NY). WISCONSIN. Taylor Co.: Rib Lake, *Goessl in 1915\** (WISC).



In the autumn of 1832, while on a trip from Covington, Louisiana to Columbia, Mississippi, Thomas Drummond gathered the specimens that were to become the type material of *Gaura filipes* Spach and *G. longiflora* Spach in the vicinity of Jacksonville, Louisiana. This town no longer exists but was located near present-day Sheridan, in Washington Parish. Curiously, the locality has been confused in the present century with Jacksonville, Florida (e.g., by Munz, Amer. J. Bot. 65: 117. 1938), and *Gaura longiflora* regarded as a synonym of *G. angustifolia* Michx., a species not known from west of Santa Rosa County, Florida. Even though Rothrock used the name *G. longiflora* correctly in his monograph of the Gaurineae in 1864 (Proc. Amer. Acad. Arts 6: 347–354), the much later name *G. filiformis* Small has generally been associated with this species since 1900.

As partly documented by the map (fig. 56), *Gaura longiflora* exhibits a complex pattern of morphological features over a wide geographical area. From northern Arkansas and eastern Oklahoma northward, populations of this species usually consist of plants that have glandular pubescence on the inflorescence, whereas most southern ones consist of plants in which the pubescence is strigulose. In addition, northern plants tend to be more coarsely branched and lower (often about 1–1.5 m tall), southern ones to be virgate and often over 2 m tall. Nevertheless, these differences are recombined over a very broad zone of intergradation, and exceptions to these geographical trends are numerous. For several years we intended to separate the two series of populations as subspecies, but this no longer seems desirable in view of the overall pattern of variation.

The northern populations of *Gaura longiflora* were grouped by Munz (Bull. Torrey Bot. Club 65: 105–122, 211–228. 1938) with *G. biennis*, a self-compatible complex structural heterozygote that was probably derived from similar populations of the self-incompatible *G. longiflora*, in which bivalents or small rings of chromosomes are formed at meiotic metaphase I. In *G. longiflora*, the pollen is usually more than 80 percent stainable, whereas in *G. biennis*, as is the case in most other complex structural heterozygotes in Onagraceae, the pollen is only about 50 percent stainable (usually 35–65 percent). The chromosomal complex that is not transmitted through the pollen is eliminated in this way.

In many areas, *Gaura longiflora* and *G. biennis* can be separated by the long, villous pubescence on the main stems of the latter. Where their ranges overlap broadly in Illinois and Iowa, and to a lesser extent eastward (where *G. longiflora* becomes rare), the situation is more complex, and phenotypic characteristics (except for pollen fertility) do not always provide a reliable guide to the identity of a particular plant. These two species share the same pollinators (mostly medium-sized to small moths),



bloom at the same time of year, and can be hybridized readily in the experimental garden to produce an  $F_1$  generation that ranges from 30–90 percent pollen fertility. Undoubtedly they also hybridize where they come together in the field.

*Gaura longiflora* is a species of light prairie soils; its derivative *G. biennis* occurs mainly in openings in the eastern deciduous woodland. With the advent of European man, the habitats of both have been profoundly disturbed, and they have spread along roadsides to occur in vacant lots and other waste places. Their populations are very probably much larger and more extensive now than they were in the past. Their presumed hybridization, as well as the broad zone of overlap that was a necessary prerequisite for this hybridization, are probably phenomena of the last 150 years. Although considerable modification of the populations of the two species by introgressive hybridization seems to be going on at present, it still appears best to reflect the profound genetic discontinuity between them by recognizing them as distinct species.

In the southern portion of its range, *Gaura longiflora* forms hybrids with a much more distinct species, *G. lindheimeri*. In eastern Texas and the Gulf States, as we have noted above, most populations of *G. longiflora* have appressed, strigulose pubescence on the inflorescences. *Gaura lindheimeri*, a handsome species with long, spreading hairs on the inflorescences and large flowers that open in the morning, is restricted to black clay prairie soils in a relatively small area of southeastern Texas and southwestern Louisiana, with disjunct stations in Tangipahoa Parish of eastern Louisiana. *Gaura longiflora* occurs in the same area, but grows in light, sandy soils as it does throughout its range. It has very probably entered the area of distribution of *G. lindheimeri* to a large extent along roadside banks and in other habitats that have resulted from disturbance by man.

At some localities, the two species coexist without hybridizing. For example, in the low prairie along U.S. Highway 90, 1.5 miles west of Midland, Acadia Parish, Louisiana, in 1967, *Gaura lindheimeri* was abundant, whereas *G. longiflora* was represented by scattered plants along the roadside and canalside diggings. No hybrids were observed. At other localities, hybrids were uncommon. For example, obvious  $F_1$  individuals were seen in mixed populations as follows: 0.6 mi w of Manvel, Brazoria Co., Texas, in 1965, *Raven* 20371 (one plant with many of both parents, at the edge of a rich, boggy pasture; pollen stainability 39 percent); edge of pine woods along U.S. Highway 59, 4.8 mi s of Humble, Harris Co., Texas, 1965, *Raven* 20375 (two hybrids, with many plants of the parental species; one had 1 chain of 4, 1 chain of 6, and 2 pairs, with a pollen stainability of 55 percent; the other had 68 percent); large field at east limits



of Arcola, Fort Bend Co., Texas, 1965, *Raven* 20365. In the last locality, there seemed to be about one hybrid individual per 10,000 of the parents. These were easily seen owing to their combination of the height of *G. longiflora*, nearly 2 m, with the basal, virgate branching pattern of *G. lindheimeri*. One of them had a chain of 10 chromosomes and 2 ring bivalents, with a pollen stainability of 63 percent; another had a chain of 14 chromosomes, with a pollen stainability of 40 percent; and a third had a pollen stainability of 37 percent. The species could easily be hybridized in the experimental garden, with about 75 percent capsule set, and their hybrids had a cytology compatible with that reported above and a fertility that ranged from 13–76 percent (40–70 percent in most hybrid individuals).

In addition to their gross ecology, there are at least two other factors tending to restrict hybridization between these two species. *Gaura lindheimeri* blooms earlier, from May to early July, for the most part, whereas *Gaura longiflora* blooms from July to late summer. Thus their period of overlap is restricted. In addition, and in line with their different daily times of bloom, they are pollinated by different insects: medium-sized to small moths in *G. longiflora*, bees in *G. lindheimeri*. Although bees occasionally visit the withered flowers of *G. longiflora* the morning after they have first opened (and may then carry pollen from one of these species to the other), the moths probably never visit flowers of *G. lindheimeri*.

Despite these barriers, populations are also encountered which seem to consist largely or entirely of hybrids. For instance, 2.5 mi n of Talisheek, St. Tammany Parish, Louisiana, in 1967, an extremely variable population (*Raven* 22105) was encountered that appeared referable to *G. longiflora*, but with individual plants having variable amounts of the long spreading pubescence of *G. lindheimeri*. Even more direct evidence of past hybridization is provided by a series of populations that occur in eastern Louisiana and southern Alabama which resemble *G. longiflora* but have large flowers that open *in the morning*. Populations of this nature were studied in southern Mobile County, Alabama, where they are the only representatives of the genus *Gaura*: abundant along edge of salt marsh near Cedar Point, 2 mi s of turn to Bayou la Batre on State Hwy. 163, *Raven* 22116; 4 mi s, *Raven* 22115; *Hildebrand* 65 (TEX); Dauphin Island, *Deramus* D.1074 (DS); State Hwy. 163 at South Deer River, *Raven* 22112. They likewise occur in Orleans Parish, Louisiana, where they may have had an independent origin: Ft. Pike at the Rigolets, along U.S. Hwy. 90 *Ewan* 22182 (DS); edge of marsh among tall grasses and *Baccharis*, between Rigolets and mouth of Pearl River, 7 mi s of junction of State Hwy. 433 on U.S. Hwy. 90, Chef Menteur Hwy., *Ewan* 22170 (DS), *Lemaire* 957 (NO), *Raven*. 22107. The pollen stainability of three individuals from the last-



mentioned locality was studied, with the following results: 99 percent, 44 percent, and 74 percent. Some of the individuals resembled one or the other parent closely, and there was considerable variability. Similar plants were once collected "on shell islands near the Gulf, Plaquemines Parish," Louisiana, Aug. 1879, *Langlois* 97 (R, NY, PENN), and were confused by Munz (Bull. Torrey Bot. Club 65: 217. 1938) with *G. filipes*. Another collection is from Jefferson Parish, Louisiana, *Langlois* in 1884 (M).

Certain collections from Texas, from populations that we have not studied in the field, are morphologically similar and may also represent morning-opening plants of the derivation just discussed. Examples are: TEXAS. Aransas Co.: Goose Island, shell beach, *Whitehouse* 18302 (NY). Galveston Co.: Near Galveston, *Perkins & Hall* 2458 (POM). Harris Co.: Morgans Point, *Cory* 8140 (POM). Nueces Co.: Corpus Christi, *Pickenpaugh* in 1936 (POM). San Patricio Co.: Ransom Island, *Parks* 21272 (POM).

It might be argued that this series of large-flowered, relatively glabrous, morning-opening plants ought to be recognized as a distinct species, and we considered this possibility for several years. The chief reasons that we decided not to adopt this course of action were 1). populations of this nature may well have originated more than once along the Gulf Coast, and further study might well reveal significant differences between them; 2. even locally, the situation is extremely dynamic and the populations are highly variable, a condition that does not lend itself well to formal classification; 3. as indicated by the discussion above, plants of this nature are very difficult to identify except from living plants, and it is therefore impossible at this point to give an accurate idea of their distribution in nature; 4. they are connected with typical populations of *G. longiflora* by a series of intermediate populations without any abrupt morphological gaps. For example, a population that was growing along the borders of the salt marsh south of Slidell, St. Tammany Parish, Louisiana, in 1967 (*Raven* 22117), was similar in aspect and pubescence to the population we studied between Rigolets and the mouth of the Pearl River, farther east, but consisted of plants in which the petals were only 10–12 mm long (11–17 mm in the Rigolets population) and the flowers opened in the evening. Along the highway 0.6 mi n of Dog River, Mobile Co., Alabama, at the margins of the woods, we studied a population (*Raven* 22110) in which the petals were 11–16 mm long, but were not able to determine whether the flowers opened in the morning, as in the more glabrous plants found along the borders of the salt marshes farther south, or in the evening.

As may be seen from the map (fig. 56), a number of the populations in the southern part of the range of *G. longiflora* consist of plants that have



glandular pubescence (and rarely also longer hairs) in their inflorescences. In many cases, these plants, which are similar to those just discussed from Dog River, Alabama, have probably resulted from introgression of *Gaura lindheimeri* into *G. longiflora*. They were treated by Munz (Bull. Torrey Bot. Club 65: 18–120. 1938) as *G. filiformis* Small var. *kearneyi* Munz. They occur considerably beyond the present range of *G. lindheimeri*, but it is likely, in view of the pattern reported here and considering the isolated stations for *G. lindheimeri* in eastern Louisiana, that that species once had a wider range, perhaps accompanied by a greater ecological amplitude.

16. *Gaura biennis* L., Sp. Pl. 347. 1753. Munz, Bull. Torrey Bot. Club 65: 111. 1938; N. Amer. Fl. II. 5: 185. 1965; *pro parte*. Figs. 20, 53.

Similar to *G. longiflora* in all except the following characteristics: plants up to 18 dm tall; stems conspicuously and densely villous, rarely short-villous, the leaves short-villous along the veins and margins; inflorescence villous, also densely glandular pubescent; plants entirely lacking strigulose pubescence; bracts of inflorescence 1–2.25 mm long, 0.5–1 mm wide; floral tube 6–12.5 mm long; sepals 8–13 mm long, 1–2 mm wide; petals 6.5–12 mm long, 2–6 mm wide; filaments 5–10 mm long; anthers 2–4 mm long; pollen fertility ca. 50 percent; style 13.5 mm long; fruit 5–9 mm long, 2–3 mm thick; seeds 3–6, 2–2.5 mm long, 1–1.25 mm thick, light to reddish brown. Self-compatible, often self-pollinating. Gametic chromosome number,  $n = 7$  (ring of 14 at meiotic metaphase I).

LECTOTYPE: Cultivated in Uppsala, Sweden, prior to 1751, from seeds from eastern Pennsylvania collected by Peter Kalm, 1748–1750, *C. Linnaeus* (LINN 485.1). Linnaeus' reference to "Virginia" in his protologue concerns his reference to Plukenet, who was discussing some member of *Oenothera* subgenus *Oenothera*.

DISTRIBUTION (fig. 55): Clearings in woodland and waste places, eastern Iowa, southeasternmost Minnesota, southern Wisconsin, southern Michigan, southernmost Ontario, southern New York, and Massachusetts, south to Virginia, western North Carolina, central and eastern Tennessee, and Illinois. Flowers July to September.

#### REPRESENTATIVE SPECIMENS EXAMINED:

CANADA. ONTARIO. Essex Co.: Windsor, *McCrae* 7845 (NMC); Amsterburgh, *Macoun* 44459 (CM, GH, NMC); Leamington district, *Eroh* in 1924 (DAO). Lincoln Co.: Queenston, *Scott* 20506 (NMC). Welland Co.: Fort Erie, *Sharp* 4 (DAO); Erie Beach, Bertie Twp., *Miller* in 1954 (DAO).

UNITED STATES. CONNECTICUT. Fairfield Co.: Oxford, *Harger & Weatherby* 2287 (NSC). Hartford Co.: Bristol, *Bishop* in 1897 (GH). New Haven Co.: Eaton



(GH, POM). DELAWARE. New Castle Co.: Holly Oak, near Wilmington, *Canby in 1878* (LE, NY). DISTRICT OF COLUMBIA. Washington, *Ward in 1882* (GH). ILLINOIS. Adams Co.: S of Burton, *Evers 89613* (ILLS). Carroll Co.: Palisades State Park, *Hartley 9931* (IA). Champaign Co.: Sangamon River near Mahomet, *Jones 12717* (GH, ILL). Cook Co.: Chicago, *Greenman in 1876* (MO). Dupage Co.: Naperville, *Umbach in 1897* (MIN). Grundy Co.: 1.5 mi s of Morris, *Evers 6647* (ILLS). Hancock Co.: Augusta, *Mead* (GH). Jo Davies Co.: W of Galena, *Weber 1953* (COLO). Kane Co.: Vicinity of Elgin, *Gronemann 101* (F). Kankakee Co.: 7 mi nw of Kankakee, *Sherff 1625* (MIN). La Salle Co.: Utica, *Clemens in 1909* (POM). Marshall Co.: S of Jacon, *Evers 6232* (ILLS). McHenry Co.: Algonquin, *Nason in 1878* (ILLS). Menard Co.: *Hall in 1861* (NY). Ogle Co.: *Cratty in 1877* (ISC). Peoria Co.: Near Tubercular Santarium, *Chase 13011* (DAO, NY, OKL). Platt Co.: Deland, *Seymour in 1889* (DUKE). Richmond Co.: 3.5 mi n of Olney, *Scherer 449* (ILL). Rock Island Co.: N of Reynolds, *Evers 6988* (ILLS). St. Clair Co.: *Eggert in 1877* (MO). Sangamon Co.: 0.5 mi e of Curran, *Winterringer 22374* (DS). Tazewell Co., Near East Peoria, *Chase 3286* (BH, ILL, MIN, PAC, PH, POM). Vermillion Co.: Between Oakwood and Collison, *Jones 13045* (SMU). Whiteside Co.: 3 mi w of Garden Plain, *Evers 6893* (ILLS). Will Co.: Romeo, *Umbach 1991* MICH). Winnebago Co.: *Bebb in 1858* (PH). INDIANA. Adams Co.: 2 mi nw of Decatur, *Deam 5315* (IND). Fayette Co.: 1 mi s of Connersville, *Buser 1643* (ILL). Franklin Co.: 1/8 mi n of Brookville, *Deam in 1903* (IND). Grant Co.: 1/4 mi nw of Matthews, *Deam 49439* (IND). Harrison Co.: State Forest, *Friesner 19579* (DAO, FLAS, KANU, KY). Howard Co.: 4 mi n of Kokomo, *Ek 42* (US). Knox Co.: 3 mi sw of Vincennes, *Deam 29302* (IND). Lake Co.: Dyer, *Peattie 2026* (F). Marion Co.: Indianapolis, *Friesner 7892* (DUKE, PENN, POM, SMU, TENN, TEX, WVA). Perry Co.: 2 mi s of Oriole, *Deam 47991* (IND). Ripley Co.: About 3 mi ne of Morris, *Deam 58094* (IND). Steuben Co.: Near Lake James, *Blatchley in 1902* (IND). Tippecanoe Co.: 3 mi nw of Westpoint, *Deam 54407* (IND). Vermillion Co.: About 0.5 mi e of Dana, *Deam 54372* (WVA). White Co.: 2 mi e of Seafeld, *Deam 15225* (IND). IOWA. Allamakee Co.: Yellow River, *Pammel in 1927* (ISC, OKLA). Benton Co.: Vinton, *Davis 6* (US). Clinton Co.: Elk River Township, *Cooperrider 2708* (MIN). Dallas Co.: Union Township, *Van Bruggen 906* (SMU). Guthrie Co.: 4 mi n of Panora, *Hayden 3633* (ISC). Jackson Co.: Union Township, *Cooperrider 2610* (IA). Johnson Co.: S of Iowa City, *Shimek in 1915* (ISC). Jones Co.: Clay Township, *Brown in 1948* (ISC). Lee Co.: Skunk River Valley, *Bartsch in 1894* (ISC). Linn Co.: Cedar Rapids, *Buchanan in 1902* (ISC). Makaska Co.: 3 mi nw of Fremont, *Rohrbaugh 99* (COLO, TEX). Muscatine Co.: 8 mi nw of Muscatine, *Shimek in 1925* (SMU, USF). Poweshiek Co.: Grinnell, *Jones* (POM). Scott Co.: *Parry* (ISC). Van Buren Co.: 4 mi e of Willets, *Shimek in 1932* (ISC). Washington Co.: 3 mi s of Wellman Fine Creek, *Wagenknecht 1239* (SMU). Webster Co.: Fort Dodge, *Somes in 1906* (ISC). KENTUCKY. Anderson Co.: Floodplain of Gilbert Creek, *Wharton 9387* (KY). Bullitt Co.: Wilson Creek Road, *Gunn 841* (KY). Clark Co.: 3 mi s of Indian Fields, *Wharton 5104* (KY, USF). Fayette Co.: Lexington, *Short* (KY). Grayson Co.: Leitchfield, *Rose in 1895* (US). Jefferson Co.: Jennings Lane, *Gunn 2265* (KY). Jessamine Co.: Wilmore, *Anderson 585* (GH, IA). Mercer Co.: Burgin, *Kind 232* (F). Nelson Co.: Agnes (IA). Robertson Co.: Blue Licks State Park, *Smith 1748* (KY). Woodford Co.: Near Hifner Road, *Wharton 8660* (KY). MARYLAND. Alleghany Co.: Wills Creek, *Shreve & Jones 995* (US). Anne Arundel Co.: Near Portland, *Otis in 1916* (PH). Baltimore Co.: Powhatan,



*Plett* 866 (GH). Cecil Co.: Porters Bridge, Octararo Creek, *Long* 28503 (GH, PH). Frederick Co.: Emmitsburgh, *Aikin* (PH). Harford Co.: Shores Landing, *Leeds* 2056 (PH). Montgomery Co.: Great Potomac Falls, *Schott* in 1858 (F). Washington Co.: Potomac River near Hancock, *Rose* in 1910 (US). MASSACHUSETTS. Berkshire Co.: *Hoffman* in 1940 (NEBC). Bristol Co.: *Ware* 4163 (NEBC). Middlesex Co.: *Morong* in 1886 (NY). Plymouth Co.: *Knowlton* in 1925 (NEBC, USF). Suffolk Co.: *Nepomset*, *Knowlton* in 1935 (IND, NEBC). MICHIGAN. Berrien Co.: Benton Harbor, *E.B.M.* in 1891 (F). Houghton Co.: W.W.C. (MICH). Kent Co.: Plaster Creek s of Grand Rapids, *Skul* in 1895 (MSC, NMC). Monroe Co.: Pointe Mouillee State Game Area, *McDonald* 5487 (MSC). Oakland Co.: Oakwood, *Sutton* in 1914 (MICH). Wayne Co.: West Detroit, *Chandler* in 1941 (MSC). MINNESOTA. Houston Co.: Jefferson, *Wheeler* 574 (MIN). NEW JERSEY. Burlington Co.: Bordentown, *Long* 17797 (PH). Camden Co.: Camden, *Boice* in 1888 (PH). Hunterdon Co.: Near Stanton Station, *Benner* 6873 (PH). Mercer Co.: Princeton, *Peters* in 1885 (NY). Middlesex Co.: Along Raritan Road, *McKenzie* 2863 (IND, MO, US). Morris Co.: Whippany, *Moldenke* 21675 (OKLA, SMU). Passaic Co.: Vicinity of Clifton, *Nash* in 1891 (MO). Warren Co.: 1 1/4 mi nw of Broadway, *Schaeffer* 29978 (PH). NEW YORK. Albany Co.: N end of Van Schaick Island, *Burnham* in 1911 (GH). Bronx Co.: Van Cortland Park, *Monachino* 655 (NY). Broome Co.: Front Street swamp, *Millspaugh* in 1886 (F). Cattaraugus Co.: Near Irving, *Smith* in 1944 (MO). Chemung Co.: Ashland, *Lucy* 728 (NY). Erie Co.: Buffalo, *Clinton* (MICH). Herkimer Co.: Bank of Mohawk River at Little Falls, *Burnham* in 1905 (GH). Madison Co.: Vicinity of Hamilton, *Longworthy* 51 (CU). Niagara Co.: Goat Island, *Johnson* in 1927 (US). Rensselaer Co.: Troy, *Hall* in 1828-1834 (F). Rockland Co.: Nyack, *Ahles* 842/48 (ILL). Schenectady Co.: Bank of Mohawk River, *Foxworthy* in 1902 (CU, NY). Schuyler Co.: Watkins Glen, *Schuster* A-6923 (DUKE). Seneca Co.: Seneca Lake, *Sartwell* (NY). Steuben Co.: 1 mi n of Bath, *Clausen & Trapido* 2706 (BH, CU). Tioga Co.: *Millspaugh* 189 (F). Tompkins Co.: Renwick Park, *Eames & MacDaniels* 4634 (CU, GH, IND). Tompkins Co.: Ithaca, *Munz* 767 (POM). Yates Co.: Dundee, *Wright* (POM). NORTH CAROLINA. Alleghany Co.: 0.9 mi n of Twin Oaks, *Radford* 38403 (NCU). Cherokee Co.: 2 mi e of Murphy, *Radford* 17479 (GH, NCU). Davidson Co.: Yadkin River bottom land, near Yadkin College, *Totten* in 1926 (NCU). Haywood Co.: 0.5 mi s of Sunburst, *Ahles & Duke* 46679 (COLO, MIN, NCU, RSA). Jackson Co.: Near Tuckaseegee, *Godfrey* 52025 (GA, NSC, PH, TENN). Macon Co.: Cartoogechaye, *Johnson* 894 (F). Mitchell Co.: 2.3 mi ne of Hunt Dale, *Ahles & Duke* 47237 (NCU). Person Co.: 2 mi e of Woodsdale, *Bell* 14647 (KY, NCU). Rockingham Co.: Spray, *De Chalmot* (US). Surry Co.: Yadkin River near Elkin, *Radford* 18379 (FSU, GA, NCU, USF). Swain Co.: Cherokee, *Munz* 13522 (POM). OHIO. Coshocton Co.: Near Coshocton, *Moldenke* 13378 (CM, NSC, OKLA, VDB). Cuyahoga Co.: Cleveland, *Ashcroft* in 1897 (MO). Erie Co.: Vermillion River e of Birmingham, *Cooperrider* 7966 (KENT). Franklin Co.: Reynoldsburg, *Raven* 18733 (DS). Green Co.: Yellow Springs, *Demaree* 11541 (MIN, MO, NY, OSU, SMU, US). Hocking Co.: Laurelville, *Demaree* 11592 (DS, MU, SMU). Lucas Co.: Toledo, *Young* in 1884 (NY). Muskingum Co.: 3 mi s of Adamsville, *Buker* in 1957 (CM). Pickaway Co.: Pickaway Township, *Cooperrider et al.* 9415 (DS). Richland Co.: Mansfield, *Wilkinson* 3425 (F, ISC, MICH, MIN, MSC). Ross Co.: 2 mi sw of Kingston, *Cooperrider et al.* 9396 (DS, KENT). Wayne Co.: Wooster, *Duvel* 833 (NY). PENNSYLVANIA. Allegheny Co.: Harmarville, *Van Dersal* 557 (NY). Bedford Co.:



Bedford Springs, *Berkheimer* 1363 (PENN). Bucks Co.: 2 mi above Yardley, *Meredith* in 1923 (GH). Center Co.: 2 mi w of Spring Mills, *Wahl* 339 (FLAS, ISC, GH, PAC, PENN). Columbia Co.: Bersick, *Small* in 1889 (F). Delaware Co.: Tenni, *Pennell* in 1906 (PH). Greene Co.: Monongahela River near Marion, *Bright* 7651 (MIN). Juniata Co.: Open banks above Juniata River, *Fogg* 15546 (GH, PENN). Lehigh Co.: 1 mi n of Lowhill, *Schaffer* 32317 (PH). Mercer Co.: Sharon, *Aschman* in 1886 (PH). Montgomery Co.: Perkiomen Creek, *Long* in 1908 (GH). Perry Co.: 5 mi s of Liverpool, *Munz* 13408 (POM). Pike Co.: 2.5 mi ne of Milford, *Fogg* 19229 (PENN). Union Co.: 0.5 mi se of Millmont, *Westerfield* in 1949 (PAC). Westmoreland Co.: Ligonier, *Gress* 766 (PENN). TENNESSEE. Blount Co.: Little Tennessee River above Chilhowee Dam, *Sharp & Veloira* 21000 (TENN). Campbell Co.: Near Chaska, *McFarland* 4863 (IND, POM). Carter Co.: Elizabethton, *Wiegand & Manning* 2162 (CU, GH). Cheatham Co.: Craggie Hope, *Svenson* 328 (GH). Coffee Co.: Between Manchester and Tullahoma, *Woodruff* in 1941 (TENN). Hamblen Co.: Morristown, *Smith* in 1880 (US). Hancock Co.: Clinch River bank near Narrows, Kyles Ford, *Sharp* 3074 (IND, TENN). Knox Co.: Knoxville, *Ruth* 2782 (NY). Loudon Co.: Clinch River at corner of county, *Hatcher* 29803 (GA, TENN). Roane Co.: White Oak Lake, *Nease* in 1950 (TENN, US). Rutherford Co.: N of Lavergne, *Eggert* in 1897 (MO). Sevier Co.: Near Sevierville, *Rugel* in 1842 (DAO, RSA). White Co.: Caney Fork near Webbs Camp, below Grand Falls Dam, *Sharp et al.* 5030 (KY, TENN). VIRGINIA. Augusta Co.: Near Augusta Springs, *Steele* in 1908 (US). Bath Co.: Hot Springs Valley, *Steele & Wheeler* in 1907 (US). Bedford Co.: Blue Ridge Parkway, *Freer* 1844 (GH). Charlotte Co.: 2.1 mi s of Harrisburg, *Ahles & James* 61658 (NCU). Fairfax Co.: Great Falls of the Potomac, *Ball* 263 (ISC). Fauquier Co.: W slope of Bull Run Mts., *Allard* 5462 (GH). Frederick Co.: Middletown, *Hunnerwell* 11338 (GH). Giles Co.: Near Newport, *Thorne* 17847 (FSU). Grayson Co.: 3.8 mi sw of Elk Creek, *Ahles & Tucker* 60286 (NCU). Halifax Co.: Just n of Halifax, *Ahles & James* 60561 (NCU). Henrico Co.: Three Shopt Road, *Canada* 2074 (GH). Isle of Wight Co.: W of old Fort Baykin, James River, *Fernald & Long* 13709 (GH). Loudoun Co.: 1.3 mi nw of junction of U.S. Hwy. 15 with Co. Route 672, *Ahles & James* 61316 (NCU). Madison Co.: 4 mi se of Marksville, *Fosberg* 36118 (GH, US). Montgomery Co.: 2 mi nw Blacksburg, *Kral* 11468 (USF). Orange Co.: Gordonsville, *Blanchard* in 1890 (MO). Page Co.: Luray, *Heritage* in 1887 (PENN). Pittsylvania Co.: Staunton River on County Route 668, *Ahles & James* 62470 (NCU). Prince Edward Co.: Appomattox River at Farmville, *Ahles & James* 62937 (NCU). Prince George Co.: City Point, *Fernald & Long* 11094 (GH). Prince William Co.: E slope of Bull Run Mts., *Allard* 8171 (GH). Roanoke Co.: *Wood* 5308 (GH, PENN, PH). Rockbridge Co.: Near Lexington, *Churchill* in 1924 (GH). Rockingham Co.: Mt. Crawford, *Heller & Halback* in 1893 (CU, DAO, DS, F, GH, MO, PENN, PH). Smyth Co.: Marion, *Small* in 1892 (MO). Surry Co.: Claremont, *Fernald & Long* 13708 (GH, US). Warren Co.: Front Royal, Oldfield, *Sargent* in 1949 (NY). Washington Co.: Wallace Switch, *Small* in 1892 (NY). WEST VIRGINIA. Brooke Co.: 3 mi above Bethany, *Bartholomew* B1937-15 (WVA). Jefferson Co.: Charleston, *Harper* in 1894 (POM). Marshall Co.: Near Majorsville, *Bartholomew* 85 (WVA). McDowell Co.: Red Chesnut Mt., *Music* in 1961 (WVA). Mercer Co.: Shawnee Lake, *Core* 1860 (DS, WVA). Mineral Co.: Burlington, *Core* 3333 (NY, WVA). Monongalia Co.: Valley Crossing, Morgantown and Kingwood Railroad, *Sheldon* in 1918 (CM). Morgan Co.: Near Berkeley Springs, *Alexander et al.* in 1933 (NY). Randolph Co.: Above



Huttonsville, *Greenman* 167 (GH). Tyler Co.: Davenport, *Barkley* 957 (MO). Wirt Co.: 1 mi e of Elizabeth, *Bartholomew* in 1933 (WVA). WISCONSIN. Dane Co.: Mazomanie to Sauk City, *Greene* in 1948 (WISC). Grant Co.: Opposite Dubuque, Iowa, *Fassett* 13338 (WISC). Green Co.: 8 mi w of New Glarus, *Shinners & Catenhusen* 4608 (WISC). Iowa Co.: 1.5 mi e of Arena, *Mason* 1371 (WISC). Lafayette Co.: *Wagner* in 1959 (WISC). Milwaukee Co.: Milwaukee, *Shinners & Stearns* 4131 (GH, WISC). Outagamie Co.: Binghampton Bog, *Melchert* in 1957 (WISC). Rock Co.: Beloit, *Shinners* 4642 (WISC). Walworth Co.: *Wadmond* 2605 (WISC).

The type specimen, like all other cultivated material from Europe, has about 50 percent sterile pollen and is referable to the complex structural heterozygote. *Gaura biennis* has been in cultivation in the botanical gardens of Europe and, later, North America, since the mid-18th Century. For example, we have seen a specimen collected in the botanical garden at Leningrad in 1779, from seeds received in 1771 (LE).

**17. *Gaura demareei* Raven & Gregory, sp. nov. Figs. 21, 54.**

A *G. longiflora* differt: calibus inflorescentiis dense cinereo-strigulosis eglandulosis; bracteis 3–10 mm longis, 0.5–1.5 mm latis; floribus diurnalibus; tubo floris 4–13 mm longo; sepalis 13–20 mm longis, 1–2.5 mm latis; petalis (10–)11–17 mm longis, 4.5–8.5 mm latis; filamentis 8–17 mm longis; antheribus 3–7 mm longis; stylo 18–31 mm longo.

Similar to *G. longiflora* in all except the following characteristics: stems and inflorescences densely gray-strigulose, with no spreading or glandular hairs; bracts of inflorescence 3–10 mm long, 0.5–1.5 mm wide; flowers opening near sunrise; floral tube 4–13 mm long; sepals 13–20 mm long; 1–2.5 mm wide; petals (10–)11–17 mm long, 4.5–8.5 mm wide; filaments 8–17 mm long; anthers 3–7 mm long; style 18–31 mm long. Self-incompatible. Gametic chromosome number,  $n = 7$ .

Types 4.6 mi ne of Hot Springs on U.S. Highway 270, Garland Co., Arkansas, 3 August 1965, *P. H. Raven* 20435 (DS 574399. Isotypes, BM, GH, NY, RSA, US).

DISTRIBUTION (fig. 56): Open meadows in sandy loam, southwestern Arkansas. Flowers July to October.

SPECIMENS EXAMINED:

UNITED STATES. ARKANSAS. Chalybete Mt., *Demaree* 54824 (DS); P.O. Arkadelphia, *Demaree* 15639 (MO, NY, POM), 40476 (G, RSA, SMU). Garland Co.: Hot Springs, *Beer* in 1947 (CM); Hot Springs National Park, *Demaree* 49027 (DS), 53971A (DS); 6 mi n of Hot Springs, *Scully* 377 (POM); Crystal Springs, *Demaree* 54256 (DS), 54255 (DS); Hot Springs National Park, *Demaree* 53971A (DS); Mountain Valley P.O., *Demaree* 37652 (KANU, OKL, SMU); *Eggert* in 1896 (MO); 2.5 mi w of Hwy. 5, *Raven* 20570 (DS); Hot Springs Mts., *Runyon* 2275 (BH, US).



Hempstead Co.: Bingen, *Demaree* 54098 (DS); McNab, *Demaree* 44670 (DS); P.O. Ozan, *Demaree* 15966 (MIN, MO), 40517 (NCU, SMU); P.O. Magnet Cove, *Demaree* 17462 (SMU). Howard Co.: P.O. Nashville, *Demaree* 9858 (MO). Montgomery Co.: Caddo River, *Demaree* 9583 (US); Mt. Ida, *Demaree* 54266 (DS); South Fork of Ouachita River, *Demaree* 44872 (DS, RSA). Pike Co.: Delight, *Demaree* 54119 (DS). Saline Co.: 3.7 mi s of Paron, *Raven* 20568 (DS); 1.5 mi w of Owensville on Hwy. 5, *Raven* 20569 (DS). Sevier Co.: P.O. Ben Lomond, *Demaree* 41625 (NCU).

It is a great pleasure to name this attractive, large-flowered, morning-opening derivative of *Gaura longiflora* in honor of Dr. Delzie Demaree (1889– ), whose active botanical work in Arkansas and in other states is attested by his many collections of this local species cited above. Dr. Demaree's collections are best represented in the herbarium of Southern Methodist University, but large sets are deposited in many other institutions.

## SECTION VIII. PTEROGAURA

*Gaura* sect. *Pterogaura* Raven & Gregory, sect. nov.

Herbae annua infra inflorescentiam villosae. Inflorescentiae erectae. Flores valde zygomorphi, vespertini. Fructus ellipsoidalis vel ovoideus, late alatus.

Annual herbs, villous below the inflorescence. Inflorescence erect. Flowers strongly zygomorphic, the stamens in the lower quarter; flowers opening near sunset and withering the next morning. Fruit not deflexing, ellipsoid or ovoid, broadly winged on the 4 (or 3) angles and deeply furrowed between them, sessile or short-stipitate and with pronounced "corners" at the bottom or these absent. Self-incompatible or self-compatible. Gametic chromosome number,  $n = 7$ ; one species (*G. triangulata*) a complex structural heterozygote.

TYPE SPECIES: *Gaura suffulta* Engelm.

DISTRIBUTION: Sandy flats and waste places, or as a weed of cultivated fields, from Arizona to Guatemala, west through Oklahoma and Texas to southern Mississippi.

This highly specialized section consists of four species, one—*Gaura suffulta*—self-incompatible, another—*G. brachycarpa*—self-compatible but outcrossing. Of the remaining two highly autogamous species, *G. hexandra*, which ranges throughout Arizona, New Mexico, and western Mexico to Guatemala, is a derivative of *G. suffulta* subspecies *nealleyi*. The remaining species, *G. triangulata*, which is found mainly in north-central Texas and south-central Oklahoma, is a complex structural heterozygote probably derived from hybrids between *G. suffulta* subspecies *suffulta* and *G. brachy-*



*carpa*, between which it is intermediate in its morphological characteristics.

Some plants of all species of this section, except the self-incompatible *G. suffulta*, and most plants of *G. triangulata* have 3-merous flowers, as is often also the case in *G. angustifolia*. As discussed earlier (Raven, Contr. U.S. Natl. Herb. 37: 376–377. 1969), such a reduction in number of floral parts is apparently closely correlated with self-pollination in the family Onagraceae. As circumscribed by Munz (Bull. Torrey Bot. Club 65: 211–213. 1938; and with increasing doubts in N. Amer. Fl. II. 5: 191. 1965), *Gaura hexandra* (*G. tripetala* Cav.) included as subspecies elements here treated as *G. hexandra*, *G. brachycarpa*, and *G. triangulata* which have independently attained the 3-merous condition in connection with self-pollination.

18. *Gaura suffulta* Engelm. ex Gray, Bost. J. Nat. Hist. 6: 190. 1850.  
Munz, Bull. Torrey Bot. Club 65: 120. 1938; N. Amer. Fl. II. 5: 189.  
1965.

Annual herb from a stout taproot; stems usually well branched, 2–12 dm tall. Plants villous (with hairs 1.5–2.5 mm long) below the inflorescence, the leaves subglabrous or sparsely villous along the veins and around the margins; inflorescence glabrous or glandular-pubescent, especially on the outside of the floral tube and the sepals. Rosette leaves lyrate, 3.5–11 cm long, 0.5–2 cm wide, gradually narrowed to the petiole; cauline leaves very narrowly elliptic or linear to lanceolate, 1–9.5 cm long, 0.1–2.3 cm wide, sinuate-dentate to subentire, subsessile. Inflorescence dense in bud, unbranched to sparsely branched, 2–80 cm long; bracts lanceolate to ovate, 2.5–6.5 mm long, 1–2.5 mm wide. Floral tube 6.5–20 mm long. Sepals 11–21 mm long, 2–3 mm wide. Petals 10–15 mm long, 4–8 mm wide. Filaments 6–13 mm long; anthers 2–6 mm long. Style 16–36 mm long. Fruit with or without prominent lower corners or projections of the wings at or above the middle, 4.5–8 mm long, 2–5 mm thick, sessile or on a stipe up to 2.2 mm long. Seeds (1–)2–4(–5), 2–3(–4) mm long, 1–1.5 mm thick, yellowish to light brown. Self-incompatible. Gametic chromosome number,  $n = 7$ .

TYPE: Cedar woods, in sandy and rocky soil, New Braunfels, Comal Co., Texas, May 1847, *F. Lindheimer IV.611* (GH. Isotypes, BM, CAMB, F, LE, M, MO, NY, PH, US).

DISTRIBUTION (fig. 57): Open sandy places and washes, Tulsa and Woodward counties, Oklahoma, south to Nacogdoches, Goliad, and Cameron counties, Texas, to northern Coahuila, Mexico, northward to Bernalillo



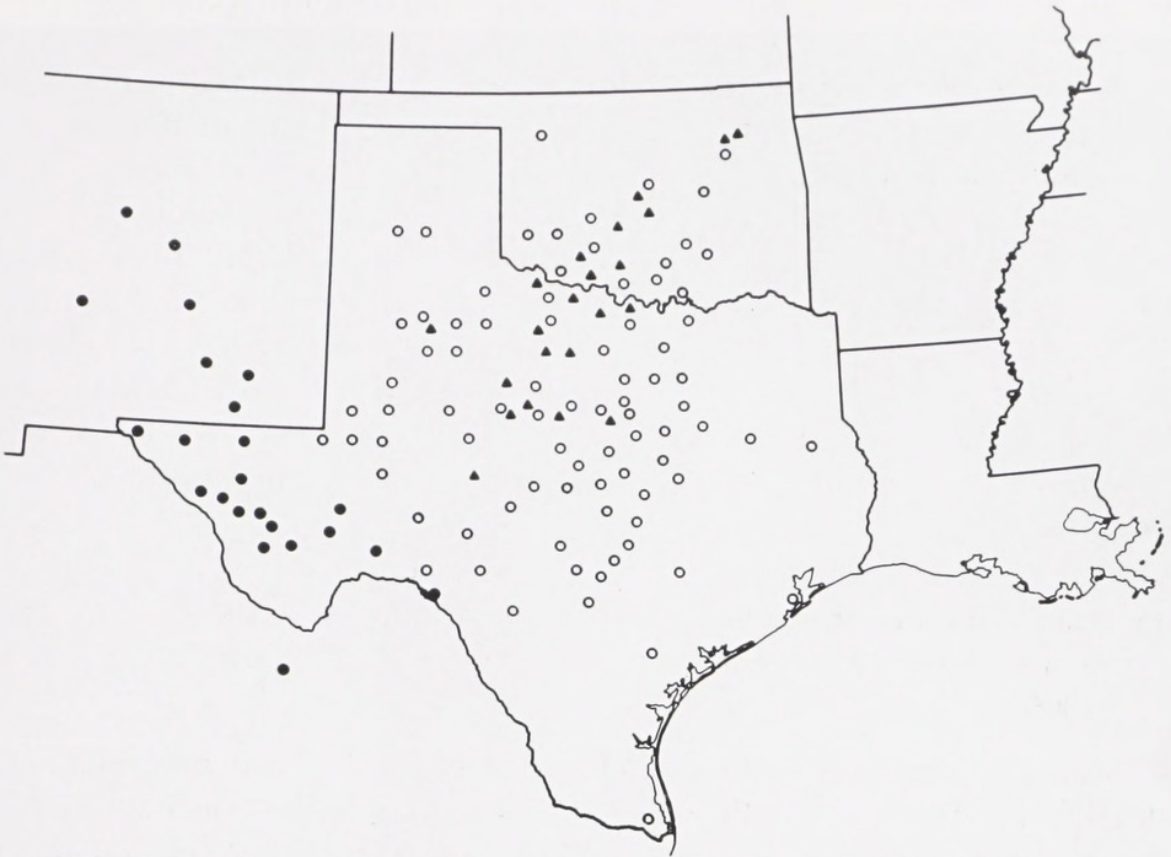


FIGURE 57. Ranges of *Gaura suffulta* subsp. *nealleyi* (dots), *G. suffulta* subsp. *suffulta* (circles), and *G. triangulata* (triangles).

and Tarrant counties, New Mexico, and the central Panhandle in Texas. Flowers April to June.

In characters of the pubescence of the inflorescence, bract size, and fruit morphology, the two subspecies of *Gaura suffulta* intergrade unevenly, with various recombinants being characteristic of different populations in the zone of contact. One such recombinant is *G. suffulta* variety *terrellensis* Munz, which has the glandular pubescence of subspecies *nealleyi* but the bracts and non-stipitate fruits of subspecies *suffulta*. The length of the floral tube appears to increase along a cline from east to west, being 12–16.5 mm in populations of New Mexico, 4.5–7.5 mm in those of eastern Texas.

18a. *Gaura suffulta* Engelm. ex Gray subsp. *nealleyi* (Coult.) Raven & Gregory, comb. nov. Figs. 23, 24, 59.

*Gaura nealleyi* Coult., Contr. U.S. Natl. Herb. 1: 38. 1890. Munz, Bull. Torrey Bot. Club 65: 121. 1938; N. Amer. Fl. II. 5: 193. 1965.

*Gaura suffulta* Engelm. ex Gray var. *terrellensis* Munz, Bull. Torrey Bot. Club 65: 121. 1928. Type: Sanderson, Terrell Co., Texas, 1 May



58



59



60



61



62



63

FIGURES 58-63. Flowers of the species of *Gaura* sect. *Pterogaura*. Fig. 58. *G. suffulta* subsp. *suffulta*.—Fig. 59. *G. suffulta* subsp. *nealleyi*.—Fig. 60. *G. hexandra* subsp. *gracilis*.—Fig. 61. *G. hexandra* subsp. *hexandra*.—Fig. 62. *G. brachycarpa*.—Fig. 63. *G. triangulata*.



1934, V. L. Cory 8469 (POM 200873. Isotype, TAES). Munz, N. Amer. Fl. II. 5: 190. 1965.

Stems usually branched from the base, 2-7(-10) dm tall. Inflorescence glandular-pubescent, especially on the outside of the floral tube and on the sepals, the ovary subglabrous. Rosette leaves 3.5-9 cm long, 0.5-1.5 cm wide; cauline leaves very narrowly elliptic or narrowly lanceolate to linear, 1.5-7 cm long, 0.1-0.6 cm wide, sinuate dentate, undulate. Inflorescence 10-50 cm long; bracts lanceolate to ovate, 2.5-3.5 mm long, 1-2.5 mm wide. Floral tube 10-20 mm long. Petals 5-8 mm wide. Filaments 8-13 mm long. Style 22-36 mm long. Fruit with more prominent lower corners than in subspecies *suffulta*, the stipe 0.2-2.2 mm long. Seeds 3-4 (-5), 2-3(-4) mm long. Self-incompatible. Gametic chromosome number,  $n = 7$ .

TYPE: Chenate Mts., Presidio Co., Texas, 1889, G. C. Nealley 545 (US 15158. Isotype, F).

DISTRIBUTION (fig. 57): Trans-Pecos Texas and northern Coahuila, Mexico, north to Bernalillo and Tarrant counties, New Mexico, in washes and other sandy places. Flowers April to June.

#### REPRESENTATIVE SPECIMENS EXAMINED:

MEXICO. COAHUILA. Cañon de Indio Felipe, Stewart 18 (GH).

UNITED STATES. NEW MEXICO. Bernalillo Co.: Above Tijeras, Barneby 2414 (US). Chaves Co.: 6 mi se of Elk, Munz & Gregory 23347 (DAO, RSA). Eddy Co.: Artesia, Gregory 306 (NY, RSA). Lincoln Co.: 15 mi e of Capitan, Hitchcock et al. 4232 (DS, MY, POM, RSA, US). Socorro Co.: Weather Station 5, Chupadera Mesa, 6500 ft, Dunn 4856 (RSA). Tarrant Co.: 8 mi se of Cedarvale, Stephens & Brooks 26008 (DS). TEXAS. Brewster Co.: 5 mi w of Alpine, Cory 53523 (DS, FSU, GH, NY, SMU); 20 mi s of Alpine, Sperry T-981 (TAES, US). Culberson Co.: Guadalupe Mts., Havard in 1881 (US); 14.5 mi s of Van Horn, Gregory 80 (RSA); 4 mi w of Kent, Parks & Cory 30875 (POM, TAES). El Paso Co.: Gueco Tanks, Whitehouse 8584 (F). Hudspeth Co.: 43 mi w of Salt Flat, Raven & Gregory 19151 (DS). Jeff Davis Co.: Limpia Canyon, Tracy 294 (BM, G, GH, MIN, MSC, PENN, TAES, WISC). Pecos Co.: 24 mi nw of Sheffield, McVaugh 8210 (DS, F, G, LL, MICH, SMU, TEX). Presidio Co.: Marfa, Hinkley 2952 (BH, TAES). Terrell Co.: Sanderson, Cory 53602 (GH, NY, RSA, SMU, TAES); 22 mi se of Dryden, Whitehouse 18604 (SMU). Val Verde Co.: Near mouth of Devils River, Correll 27130 (LL).

*Gaura suffulta* subspecies *nealleyi* has, in general, been a rather poorly understood entity. Because of the stipe present in some individuals it has been loosely associated with the members of section *Stipogaura* and not seen in proper perspective as an intergrading geographical race within the species *G. suffulta*. The many collections made in recent years have helped greatly to clarify its affinities.



**18b. *Gaura suffulta suffulta*. subsp. Figs. 22, 58.**

*Gaura suffulta* Engelm. ex Gray var. *typica* Munz, Bull. Torrey Bot. Club 65: 120. 1938.

Stems moderately well branched, but without any definite pattern, 2.5–12 dm tall. Inflorescence glabrous or rarely with a very few long hairs on the bracts. Rosette leaves 7–11 cm long, 1.5–2 cm wide; cauline leaves narrowly lanceolate to lanceolate, 1–9.5 cm long, 0.1–2.3 cm wide, sinuate-dentate to subentire, plane. Inflorescence 6–80 cm long; bracts lanceolate to narrowly ovate, 2–6.5 mm long, 1.5–2 mm wide. Floral tube 6.5–14 mm long. Petals 4–6 mm wide. Filaments 6–9 mm long. Style 16–32 mm long. Fruit without prominent lower corners but usually with projections of the wings at or above the middle, sessile, or in western populations, on a stipe up to 1 mm long. Seeds (1–)2–4, 2–2.5 mm long. Self-incompatible. Gametic chromosome number,  $n = 7$ .

DISTRIBUTION (fig. 57): Open, sandy places, common in Texas but rare in southern, eastern, and northern portions of the state and absent in the Trans-Pecos; southern Oklahoma, east to Tulsa, Okfuskee, and Coal counties, and in Woodward County.

## REPRESENTATIVE SPECIMENS EXAMINED:

UNITED STATES. OKLAHOMA. Caddo Co.: 10 mi w of Apache, *Waterfall* 11932 (OKLA). Carter Co.: 6 mi s of Turner Falls, *Hopkins* 4859 (OKLA). Coal Co.: Camp Simpson near Bromide, *Goodman* 5464 (OKL). Comanche Co.: 11 mi n of Medicine Park, *Stephens* 20336 (DS, KANU). Jefferson Co.: W of Wanrika, *Rohrbaugh* 498 (OKL). Greer Co.: Below Lake Altus, *Goodman* 4400 (OKL, OKLA). Kiowa Co.: S of Lake Altus, Granite Mts., *Waterfall* 9456 (KANU, OKLA, RSA, SMU). Marshall Co.: 4 mi n of Medill, *Goodman* 6539 (OKL, OKLA, RSA, SMU). Murray Co.: Davis, *Emig in 1917* (CM). Okfuskee Co.: 1 mi s of Paden, *Ray* 2 (OKLA). Oklahoma Co.: Oklahoma City, *Waterfall* 1938 (OKLA). Pontotoc Co.: 1/4 mi e of Ada, *McCoy* 582 (OKLA). Tillman Co.: *Shinners* 26064 (SMU). Tulsa Co.: *Clark* 339 (OKL). Woodward Co.: 5 mi ne of Woodward, *Crockett* 32 (OKL). TEXAS. Anderson Co.: Palestine, *Tharp* 864 (US). Andrews Co.: *Scudday in 1960* (LL). Armstrong Co.: Palo Duro State Park, *Parks & Cory* 13521 (TAES). Baylor Co.: 13 1/3 mi s of Seymour, *Cory* 37247 (TAES). Bell Co.: C. L. & G. York 55233 (KANU, OKL). Bexar Co.: 6.8 mi n of San Antonio, *Klein* 1719 (DS). Bosque Co.: 5 mi ne of Clifton, *Shinners* 14214 (SMU). Brown Co.: 18 mi w of Brownwood, *Atkerson* 8 (TEX). Burnet Co.: Marble Falls, *Carsiets & Studhalter* 4345 (TEX). Callahan Co.: 15 mi se of Abilene, *Henderson* 64-555 (DS). Cameron Co.: 8.4 mi w of Brownsville, *Blankinship* 6 (SMU). Coke Co.: *Smith et al.* 21640 (TAES). Comal Co.: Comanche Spring, *Lindheimer* 42 (GH). Coryell Co.: 13 mi e of Gatesville, *Jackson* 5 (LL, SMU, TEX). Cottle Co.: *Meek* 60 (TTC). Crockett Co.: Ozona, *Jones* 25878 (POM). Crosby Co.: 5 mi e of Crosbytown, *Pittman* 104 (OKLA). Dallas Co.: Prairies, *Reverchon* 4334A (MIN, NY). Dawson Co.: 15 mi w of Gail, C. L. & A. A. *Lundell* 16960 (LL). Denton Co.: 5 mi w of Denton, *Whitehouse* 15564 (SMU). Dickens Co.: 11.4 mi w of Guthrie, *Roberts* 32 (OKLA).



Eastland Co.: Rising Star, *Crossley* in 1931 (TEX, mixed with *G. triangulata*). Ector Co.: 3 mi e of Odessa, *McCracken* 53 (TTC). Edwards Co.: Yard Ranch Exper. Station, *Parks & Cory* 15264 (TAES). Ellis Co.: 4 mi n of Midlothian, *Perkins* 16 (SMU, TAES). Erath Co.: 3.5 mi s of Hico Hwy., *Hoisington* 57 (OKL). Fayette Co.: La Grange to Schulenburg, *H. L. S. & K. O. L. in 1935* (MO). Galveston Co.: 0.5 mi w of Arcadia Park, *Parks & Cory* 32087 (TAES). Garza Co.: 12 mi n of Post, *McNabb* 125 (OKLA). Gillespie Co.: 10 mi w of Frederickberg, *Barkley* 1452B (MSC, TEX). Goliad Co.: Goliad to Bexar, *Berlandier* 2578 (PH). Grayson Co.: Near Sherman, *Maples* in 1963 (VDB). Hamilton Co.: N of Edson, *Wolff* 2090 (TAES). Harp Co.: Speck Hall, *Cheaser* in 1964 (SMU). Hays Co.: San Marcos and vicinity, *Stanfield* (NY). Hill Co.: Itasca, *Smith* 27 (TEX). Hood Co.: 7.5 mi ne of Granbury, *Shinners* 11058 (SMU). Jack Co.: 4.1 mi ne of Jacksboro, *Shinners* 12349 (SMU). Kendall Co.: 2.1 mi n of Boerne, *Raven & Gregory* 19344 (DS). Kent Co.: 7 mi sw of Clairemont, *Cory* 13680 (POM). King Co.: 4 mi n of Guthrie, *Sullivan* 43 (OKLA). Lampasas Co.: 5 mi nw of Lampasas, *Shinners* 28407 (SMU). Lubbock Co.: 1 mi w of Lubbock, *Stewart* 125 (OKLA). Martin Co.: W of Tarzan, *Gregory* 300 (RSA, US). McCulloch Co.: 12.3 mi w of Brady, *Shinners* 30130 (SMU). McLennan Co.: N of Mart, *Smith* 955 (OKLA). Menard Co.: 1 mi e of Menard, *Anders* 132 (TAES). Midland Co.: 4 mi e of Midland, *Raven & Gregory* 19223 (DS). Mills Co.: 6.5 mi s of Goldthwaite, *Parks & Cory* 13030 (POM, TAES). Mitchell Co.: Lone Wolf Creek, Colorado, *Pohl* 4924 (ISC, SMU). Montague Co.: *Brooks* 13223 (POM). Nacogdoches Co.: *Powell* 27 (DS). Navarro Co.: Frost, *McCard* 2 (TEX). Parker Co.: 9.5 mi e of Weatherford, *Shinners* 10161 (SMU). Randall Co.: Palo Duro State Park, *Cory* 13522 (POM). San Saba Co.: 2.2 mi s of San Saba, *Shinners* 28339 (SMU). Shackelford Co.: 3 mi w of Albany, *Mahler* 1628 (OKLA). Somerwell Co.: 1 mi s of Glen Rose, *Shinners* 11279 (SMU). Sutton Co.: 4 mi s of Sonora, *Rohrbaugh* 382 (COLO, OKL). Tarrant Co.: 2 mi sw of Benbrooke, *Cory* 54407 (GA, KANU, LL, NSC, SMU). Taylor Co.: 1 mi e of Needle Dome, *Mahler* 3192 (SMU). Travis Co.: Austin, *Raven & Gregory* 19369 (DS). Upton Co.: Rankin, *Cory* 5136 (POM). Uvalde Co.: 14 mi n of Uvalde, *T. & L. Mosquin* 5618 (DAO). Valverde Co.: N of Del Rio, *Pilsbry* (PH). Willbarger Co.: 11.8 mi w of Electra, *Whitehouse* 9808 (SMU). Williamson Co.: 2 mi e of Georgetown, *Gregory* 288 (NY, RSA, US). Winkler Co.: 15 mi ne of Kermit, *Collins* in 1965 (TTC).

The distribution and characteristics of this entity were first clearly delineated by Mathias (Ann. Missouri Bot. Gard. 16: 399–401. 1929).

19. *Gaura hexandra* Gómez Ortega, Dec. 14. 1797. Munz, N. Amer. Fl. II. 5: 191. 1965, *pro parte*.

Annual herb from a stout taproot; stems usually well branched at the base and above, 1.5–10 dm tall. Plants villous with hairs 1–2 mm long below the inflorescence, the leaves subglabrous to more or less densely short-villous; inflorescence subglabrous, strigulose, or glandular-pubescent, or with a mixture of strigulose and glandular pubescence. Rosette leaves lyrate, 3–15 cm long, 0.5–1 cm wide, gradually narrowed to the petiole; cauline leaves linear to very narrowly elliptic or narrowly lanceolate, 1–9



cm long, 0.1–0.8 cm wide, sinuate-dentate to subentire, subsessile. Inflorescence strict to somewhat branched, 7–53 cm long; bracts narrowly lanceolate to ovate, 2–5 cm long, 1–2 mm wide. Flowers 3-merous or 4-merous. Floral tube 4.5–10 mm long. Sepals 3–12 mm long, 0.75–2 mm wide. Petals 4.5–9.5 mm long, 2–4 mm wide. Filaments 3–6 mm long; anthers 1.5–3 mm long. Style 9–18.5 mm long. Fruit ellipsoid or narrowly obovoid, narrowed at the base but not stipitate, 4.5–8 mm long, 2–4.5 mm thick. Seeds 3 or 4, 1.75–3 mm long, 1–1.25 mm thick, yellowish to reddish brown. Self-compatible and mostly autogamous. Gametic chromosome number,  $n = 7$ .

TYPE: Cultivated in the botanical garden at Madrid, and flowering



FIGURE 64. Range of *Gaura hexandra* subsp. *gracilis* (filled triangles) and *G. hexandra* subsp. *hexandra* (open triangles).



in August 1797, from seeds sent from Mexico by Martín de Sessé y Lacasta; incorrectly stated to be from Cuba.

**DISTRIBUTION** (fig. 64): Washes and other sandy places at middle elevations in the mountains, from central Arizona and southwestern New Mexico south in the Sierra Madre Occidental to the Trans-Mexican Volcanic Belt, and in Chiapas and southern Guatemala. Flowers July to October.

Mixed populations involving 3- and 4-merous plants occur in the region where the two subspecies come together in northern Mexico; very rarely 3- and 4-merous flowers are found on the same plant. Both sorts of plants are found at various localities in western Chihuahua, where subspecies *gracilis* is more common, and in Durango, where subspecies *hexandra* is more common. They are maintained by their rather strict autogamy.

**19a. *Gaura hexandra* subsp. *gracilis*** (Wooton & Standl.) Raven & Gregory, comb. nov. Figs. 25, 6.

*Gaura gracilis* Wooton & Standl., Contr. U.S. Natl. Herb. 16: 153. 1913. Munz, Bull. Torrey Bot. Club 65: 121. 1938; N. Amer. Fl. II. 5: 190. 1965.

*Gaura podocarpa* Wooton & Standl., Contr. U.S. Natl. Herb. 16: 154. 1913. Type: Bear Mt., 1500 m, near Silver City, Grant Co., New Mexico, 17 June 1903, O. B. Metcalfe 166 (US 495277. Isotypes, DS, G, GH, LE, MIN, MO, NY, POM).

*Gaura strigillosa* Wooton & Standl., Contr. U.S. Natl. Herb. 16: 154. 1913. Type: Wingfields Ranch on Ruidosa Creek, White Mts., Lincoln Co., New Mexico, 8 July 1895, E. O. Wooton (US 561073).

*Gaura brassicacea* Wooton & Standl., Contr. U.S. Natl. Herb. 16: 152. 1913. Type: Socorro, Socorro Co., New Mexico, May 1881, G. R. Vasey (US 45764).

*Gaura glandulosa* Wooton & Standl., Contr. U.S. Natl. Herb. 16: 153. 1913. Type: Reserve, Catron Co., New Mexico, 9 July 1906, E. O. Wooton (US 561072).

*Gaura gracilis* Wooton & Standl. f. *glandulosa* (Wooton & Standl.) Munz, Bull. Torrey Bot. Club 65: 122. 1938. Munz, N. Amer. Fl. II. 5: 190. 1965.

Rosette leaves persistent. Flowers 4-merous. Floral tube 6–10 mm long. Sepals 6–12 mm long, 1–2 mm wide. Petals 5.5–9.5 mm long, 2.25 mm wide. Filaments 4–6 mm long; anthers 2–3 mm long. Style 11.5–18.5 mm long. Fruit 6–8 mm long, 2–3 mm thick. Seeds 4. Self-compatible and often autogamous. Gametic chromosome number,  $n = 7$ .



TYPE: Forest Nursery, Fort Bayard, Grant Co., New Mexico, 29 August 1905, J. C. Blumer 44 (US 499693. Isotypes, GH, NY).

DISTRIBUTION (fig. 64): Sandy washes at middle elevations, from eastern Mohave County south through the mountains of central Arizona to eastern Pima County and the southwestern quarter of New Mexico, and in Mexico southward in the Sierra Madre Occidental to eastern Sonora and throughout the western halves of Chihuahua and Durango, but much rarer than subspecies *hexandra* south of central Chihuahua.

REPRESENTATIVE SPECIMENS EXAMINED:

MEXICO. CHIHUAHUA. 3 mi e of La Junta, *Freytag & Baxter* 29 (MO); mountains near Pilaes, *Hartman* 796 (F, GH, NY, PENN, US); Loreto, Río Mayo, *Gentry* 2557 (GH, MO); Memelichi, Río Mayo, *Gentry* 2741 (F, GH, MO, MEXU, US); San Juanito, *Knobloch* 5415 (F, MSC); Sierra Madre foothills, *Nelson* 6110 (GH, K, US); vicinity of Chihuahua, *Palmer* 204 (F, GH, MO, NY, US); Strawberry Creek, ne of Colonia Pacheco, *Pennell* 19195 (PH, US); El Cima, *Le Seuer* 806 (GH, IND, MEXU, MO, OKL, PH, SMU, TEX); mesas near Carretas, *Pringle* 2002 (BM, BR, CM, COCO, G, LE, MEXU, MO, MSC, NY, US); Broad Canyon, 10 mi w of Cuautemoc, *Straw & Forman* 1680 (GH, MEXU, RSA); 1 mi w of Aguaje, *Straw & Forman* 1849 (RSA); 1 mi s of Guadalupe, *Straw & Forman* 1912 (MICH, RSA); 11 mi s of Matamoros, *Ripley & Barneby* 13942 (DS); Colonia García, Sierra Madre Occidental, *Townsend & Barber* 124 (G, K, MEXU, ND, NY, P, POM, US); 7 mi s of Parral, *Waterfall* 16130 (OKL, OKLA, RSA, SMU); 40 mi nw of Chihuahua, *White* 2399 (GH, MEXU, MICH). DURANGO. Near La Providencia, *Nelson* 4982 (GH, US); Otinapa, *Palmer* 552 (US); Inde, *Reko* 5171 (US); 28 mi sw of Durango, *Waterfall & Wallis* 13410 (OKLA). SONORA. San Bernardo, along Río Curahuí, *Pennell* 19595 (PH, US); Puerto de los Aserrados, *Phillips* 405 (GH, MICH); Las Tierritas del Temblor, *White* 3442 (GH, MICH).

UNITED STATES. ARIZONA. Apache Co.: McNary, *Deaver* 1664 (RSA); 3 mi e of Alpine, *Kral* 21397 (VDB). Cochise Co.: Cave Creek Canyon, *Barkley* 14A683 (GH, MIN, NY, TEX); Mule Mts., Bisbee, *Henderson in* 1933 (TEX); Huachuca Mts., *Goodding* 250 (GH, NY). Coconino Co.: Flagstaff, *Hanson* A113 (CU, F, ILL, MO, MSC, NY, PENN, TEX); U.S. Army Navajo Ordnance Depot, *Schallert in* 1943 (F, ILL, NCU, NY, PENN). Gila Co.: Matatzal Mts., *Collom* 15 (GH, MICH, MO, NY, US); Workman Creek Canyon, *Gould* 3648 (NY, RSA). Graham Co.: San Carlos Indian Reservation, A. & R. A. *Nelson* 1835 (GH, MICH, NY, PH, SMU, US). Greenlee Co.: 37 mi n of Metcalf Range, *Hutchinson* 6866 (NO, RSA). Maricopa Co.: W of Phoenix, *Harrison* 1823 (US). Mohave Co.: S top of Blue Mt., Coronado Trail, *Ramsey* 1105 (POM). Navajo Co.: 2 mi w of McNary, *Ferris* 10102 (DS, MICH). Pima Co.: Manning Camp, *Blumer* 3378 (DS, F, GH, ISC, MIN); Santa Rita Mts., *Peebles & Harrison* 2950 (US). Pinal Co.: 7 mi w of Superior, *Gregory* 578 (DS). Santa Cruz Co.: White House Canyon, *Shreve* 7681 (F, MICH, MO). Yavapai Co.: 0.5 mi w of Prescott, *Wolf* 2340 (BH, DS, GH, POM, RSA). NEW MEXICO. Catron Co.: Beaverhead, *Eggleston* 20374 (US); Mangas Mts., 8 mi s of Horse Spring, 10 mi n of Aragon, *Weber & Salamon* 12778 (COLO). Chaves Co.: 5 mi ne of Roswell, *Palmer* 6 (F). Dona Ana Co.: Organ Mts., *Wootton & Standley in* 1906 (US). Granite Co.: 15 mi n of Silver City, ca. 7000 ft, *Hitchcock et al.* 4394 (COLO, DS). Grant Co.: Mimbres River, *Metcalf* 1033 (F, GH, MIN, MO,



NY, POM). Lincoln Co.: White Mts., Wootton 339 (ILL, MIN, MO, NY, US). Sierra Co.: Lake Valley, *Beals in 1904* (MICH). Socorro Co.: Pinos Altos Mts., *Greene* (GH, MO, NY, PH, POM); Mogollon Mts., *Rusby 137* (F, MICH, MO, NY, PENN).

This taxon is modally self-pollinating but closely similar to the self-incompatible *Gaura suffulta* subspecies *nealleyi*, from which it was certainly derived. In turn, *G. hexandra* subspecies *gracilis* seems to have given rise to subspecies *hexandra*, which ranges much farther to the south and is almost exclusively self-pollinating.

**19b. *Gaura hexandra* subsp. *hexandra*. Figs. 26, 61.**

*Gaura tripetala* Cav., Ic. 4: 66, pl. 396. 1798. Type: Flowering in the Royal Botanical Garden, Madrid, from May to August 1797, the seeds gathered along the roadside near Pachuca and San Agustín de las Cuevas, Hidalgo, Mexico, and sent to Madrid by *Louis Née* (wild gathering, F; cultivated material from Madrid, F. Fragment, GH). Munz, Bull. Torrey Bot. Club 65: 211. 1938.

*Gaura tripetala* Cav. var. *coryi sensu* Munz, Bull. Torrey Bot. Club 65: 212. 1938, *pro parte*.

*Gaura hexandra* Gómez Ortega var. *coryi sensu* Munz, N. Amer. Fl. II. 5: 191. 1956, *pro parte*.

Rosette leaves not as persistent as in subspecies *gracilis*. Flowers 3-merous. Floral tube 4.5–7.5 mm long. Sepals 3–10 mm long, 0.75–1.5 mm wide. Petals 4.5–7 mm long, 2.3 mm wide. Filaments 3–5.5 mm long; anthers 1.5–2 mm long. Style 9–14.5 mm long. Fruit 4.5–8 mm long, 2.5–4.5 mm thick. Seeds 3. Self-compatible and highly autogamous. Gametic chromosome number,  $n = 7$ .

DISTRIBUTION (fig. 64): Sandy and weedy places, and in cornfields; in Mexico from Durango south in the Sierra Madre Occidental to the Trans-Mexican Volcanic Belt, where abundant, and in Chiapas and Guatemala.

REPRESENTATIVE SPECIMENS EXAMINED:

GUATEMALA. Near Tecpán, *Goodman 3500* (F, ISC, OKL).

MEXICO. AGUASCALIENTES. Near Aguascalientes, *Rose & Painter 7786* (NY, US). CHIAPAS. Cerro San Cristóbal, *Breedlove 10245* (DS). CHIHUAHUA. 3 mi e of La Junta, *Freytag & Baxter 29* (US); 10 mi e of Madera, *Breedlove 15541* (DS); Basigochi, se of Creel, *Knobloch 480* (MSC). DURANGO. 5 mi e of El Salto, *Breedlove 15501* (DS); 3 mi ne of Otinapa, *Maysilles 7308* (MICH); Durango, *Palmer 257* (C, F, G, GH, MO, NY, US); 57 mi sw of Durango, *Waterfall & Wallis 13713* (F, IA, IKL, OKLA, SMU); 18 mi w of Santiago Papasquiaro, *Wiens 3515* (COLO, DS); San Luis del Río, 51 road mi nw of Coyotes, *Maysilles 7226* (MICH). HIDALGO. 2 mi w of Tulancingo, *Moore 2047* (BH, GH). JALISCO. 3 mi s of Mazamitla,



McVaugh 13074 (MEXU, MICH, SMU, US); near Km 27, sw of Ojuelos, 6 mi ne of Paso de la Froje, McVaugh 16902 (MICH, RSA, TEX, US). MEXICO. Comunidad Temascaltepec, Hinton 7688 (C, F, G, GH, LL, MICH, MO, NY, US); near Pyramid of Calixtlahuaca, Barkley *et al.* 664 (F, TEX); Rancho de Rosario, 10 mi n of México, D.F., Happ 153 (MO). MICHOACAN. Just n of San Juan Viejo, Beaman 4397 (DS, MSC); near Volcán Paricutín, Eggler 36 (US); Llano, Hinton 11920 (DS, F, GH, MICH, NY, POM, US); Zitacuaro, Hinton 11863 (BM, BR, DS, F, G, GH, LE, MICH, NY, POM, TEX, US); 2 mi w of Tancitaro, Leavenworth 294 (F, GH, ILL, MICH, MO, NY). MORELOS. Cuernavaca, Kenoyer A419 (F). PUEBLA. Guadalupe, Arsène 1113 (BR, US). TLAXCALA. 5 mi nw of Huamantla, Breedlove 15877 (DS). ZACATECAS. Villa Nueva, Seler 4790 (GH); 5 mi w of Sanches Román, Straw & Forman 1809 (RSA).

*Gaura hexandra* was described from plants that flowered in the Royal Botanical Garden in Madrid in 1797, and it has been in cultivation in botanical gardens ever since. Probably both it and *Gaura tripetala*, the better-known name for this species, were described from the same cultivated strain. We have seen numerous specimens collected from European gardens throughout the 19th Century.

20. *Gaura brachycarpa* Small, Fl. S.E. U.S. 848, 1335. 1903. Munz, Bull. Torrey Bot. Club 65: 211. 1938; N. Amer. Fl. II. 5: 190. 1965. Figs. 27, 62.

*Gaura tripetala* Cav. var. *coryi* Munz, Bull. Torrey Bot. Club 65: 212. 1938. Type: Dry banks, Hempstead, Waller Co., Texas, 25 April 1872, E. Hall 211 (POM 39283. Isotypes, GH, NY, US). The Mexican specimens cited are *G. hexandra* Gómez Ortega subsp. *hexandra*.

*Gaura hexandra* Gómez Ortega var. *coryi* (Munz) Munz, N. Amer. Fl. II. 5: 191. 1965. The Mexican portion of the range given rests upon specimens of *G. hexandra* Gómez Ortega subsp. *hexandra*.

Annual herb from a taproot; stems usually with several to many branches from the base, very rarely with a single stem, 1.5–6.5(–8.5) dm tall. Plants villous with hairs 1.5–2 mm long below the inflorescence, the leaves subglabrous or sparsely villous along the veins and around the margins; inflorescence subglabrous or the ovary, outside of the floral tube, and sepals strigulose. Rosette leaves lyrate, 6–9.5 cm long, 1–1.5 cm wide, gradually narrowed to a petiole; cauline leaves narrowly lanceolate to oblanceolate, 1–7 cm long, 0.1–1.6 cm wide, shallowly sinuate-denticulate to subentire. Inflorescence usually unbranched, 10–51 cm long; bracts lanceolate, 2–4 mm long, 0.5–1 mm wide. Flowers 4-merous, very rarely 3-merous. Floral tube 6.5–12 mm long. Sepals 10–15 mm long, 1.5–2 mm wide. Petals 8–12.5 mm long, 2.5–5 mm wide. Filaments 5–8 mm long; anthers 2–4 mm long.



Style 15–24 mm long. Fruit ellipsoid, with or without prominent lower “corners,” 5.5–10 mm long, 2–3 mm thick, sessile or on a stripe up to 1 mm long. Seeds 3–4, 2–2.5 mm long, 1–1.5 mm thick, yellowish to light brown. Self-compatible but mostly outcrossing. Gametic chromosome number,  $n = 7$ .

TYPE: San Diego, Duval Co., Texas, 1885–1886, *Mary B. Croft* 109 (NY).

DISTRIBUTION (fig. 65): Open sandy places, eastern Texas except for the East Texas Timberlands, and in Bryan and Love counties, Oklahoma; introduced near Tulsa, Oklahoma, and at one station each in Arkansas and Mississippi.

Flowering March to June, or occasionally longer at the southern end of its range.



FIGURE 65. Range of *G. brachycarpa*.



## REPRESENTATIVE SPECIMENS EXAMINED:

UNITED STATES. LOUISIANA. Acadia Parish: Trackway, Crowley, *Penfound* in 1936 (NO). MISSISSIPPI. Amite Co.: W of Pike Co. line on Hwy. 98, *Jones* 5345 (DS). OKLAHOMA. Bryan Co.: Vicinity of Durant, *Blain* 109 (US); 2 mi e, 1.25 mi s of Roosevelt Bridge, *J. & C. Taylor* 1578 (OKL). Love Co.: Near Marietta, *Stevens* 95 (NY). Tulsa Co.: 1.5 mi n, 2.5 mi e of State Hwy. 33, *Clark* 383 (OKLA). TEXAS. Anderson Co.: N of Palestine, *Eggert* in 1899 (MO). Aransas Co.: Rockport, *Tharp* 5599 (MICH, TEX, US). Atascosa Co.: 2.5 mi s of Campbellton, *Correll* 29233 (LL). Austin Co.: Industry, *Wurzlów* in 1891 (ILL). Bastrop Co.: Smithville, *Marrs* in 1930 (TEX). Bee Co.: *Munz & Gregory* 23448 (RSA). Bexar Co.: San Antonio, *Bebb* 2264 (OKL). Brazos Co.: College Station, *Crockett* 8488 (LL). Brooks Co.: 7 mi e of Falfurrias, *Gould & Hycka* 8114 (SMU, TEX, TTC). Burnet Co.: 10 mi w of Burnet, *Wolff & Dana* 1550 (TAES, US). Caldwell Co.: 6 mi s of Lockhart, *McCart* 6452 (SMU). Colorado Co.: 1 mi s of Eagle Lake, *Harris* in 1958 (FSU, GH, LAF). Dallas Co.: Rylie, *Kral* 761 (FSU). Delta Co.: 5 2/3 mi sw of Cooper, *Cory* 55830 (SMU, US). Denton Co.: 2 mi sw of Denton, *McCart* 1983 (ISC, SMU, TEX). DeWitt Co.: 3 mi w of Cuero, *McCart* 5992 (SMU). Dimmit Co.: Catarina, *Cory* 28062 (TAES). Duval Co.: S of Sejita, *Johnston* 5487 (SMU, TEX). Fayette Co.: Near La Grange, *Albers* 224 (NY). Fort Bend Co.: 21 mi w of Richmond, *L. N. & G. B. Upton* in 1930 (CU). Freestone Co.: 15 mi se of Fairfield, *Kral* 872 (FSU). Frio Co.: 4 mi w of Dilley, *Alvarez et al.* 8016 (FSU, OKLA, TEX). Gillespie Co.: 18 mi ne of Fredricksburg, *Raven & Gregory* 19339 (DS). Goliad Co.: N of Goliad, *Eggert* in 1900 (MIN, MO). Gonzales Co.: *McCaleb* 38 (OKLA). Grayson Co.: Denison, *Leas* in 1932 (TEX). Harris Co.: Houston, *Schneck* in 1894 (ILL). Hays Co.: 5 mi w of San Marcos, *Gregory* 420 (RSA). Hidalgo Co.: McAllen, *Fleetwood* 8067 (TEX). Hill Co.: 7 mi sw of Hillsboro, *Shinners* 14170 (SMU). Hood Co.: Granbury, *Waynles School* in 1929 (TEX). Hunt Co.: Bank of Greenville River, *Bebb* 2649 (OKL). Jim Wells Co.: 7.7 mi n of Fremont, *Shinners* 17922 (SMU). Johnson Co.: Cleburne, *Whitehouse* in 1930 (TEX). Karnes Co.: 7 3/4 mi n of Karnes City, *Shinners* 9834 (SMU). Kaufman Co.: *Gentry* 53-221 (TEX). Kleberg Co.: 2.7 mi s of Ricardo, *Shinners* 17843 (SMU). La Salle Co.: 6.5 mi w of Fowlerton, *Parks & Cory* 28534 (TAES). Leon Co.: 5.5 mi e of Marquez, *Shinners* 30983 (DS, DUKE, SMU). Limestone Co.: Near Delia, *Matthews* 145 (TTC). Llano Co.: Llano, *Bray* 320 (TEX). Mason Co.: 4 mi w-nw of Mason, *Shinners* 26295 (SMU). McLennan Co.: East Waco, *Smith* 406 (ILL, OKLA). Medina Co.: 3 mi ne of Natalia, *Raven & Gregory* 19348 (DS). Milam Co.: 3.2 mi e of Mayfield, *Shinners* 29450 (SMU, TEX). Mills Co.: 8 mi sw of Goldthwaite, *Shinners* 28320 (SMU). Navarro Co.: Dawson, *Reverchon* 3843 (MO). Nueces Co.: Corpus Christi, *Heller* 1391 (F, GH, ILL, ISC, LE, MICH, MIN, MO, MSC, NY, PH, RSA, SMU). Rains Co.: 2.5 mi nw of Point, *Shinners* 14341 (SMU). Refugio Co.: 6 mi n of Bayside, *Whitehouse* 21231 (SMU). San Patricio Co.: 4 mi n of Sinton, *Goodman* 7469 (OKL, RSA). San Saba Co.: 2.2 mi s of San Saba, *Shinners* 28342 (SMU). Tarrant Co.: Fort Worth, *Moldenke* 6968 (NY). Travis Co.: Pedernales River w of Hamilton Pool, *Webster* 74 (TEX). Uvalde Co.: W of Uvalde, *Jones* in 1931 (RSA). Van Zandt Co.: Wills Point, *Henderson* 5693 (TEX). Victoria Co.: Victoria, *Lewton* 92 (PH, US). Waller Co.: Hempstead, *Hall* in 1872 (F, GH, ILL, MO, NMC, NY, PH, POM, US). Webb Co.: Laredo, *Palmer* 11264 (GH, MO, NY, US). Wharton Co.: 1 mi e of Hungerford, *Turner* 4515 (TEX). Wichita



Co.: 12.5 mi nw of Iowa Park, *Mertins* 836 (OKLA). Willacy Co.: 4 mi s of Raymondville, *Goodman* 7475 (OKL, RSA). Wilson Co.: 1.4 mi n of Stockdale, *Shinners* 19525 (SMU). Zavala Co.: 5 mi n of La Pryor, *Serna et al.* 125 (DUKE, OKLA, SMU).

We have seen one specimen of *Gaura brachycarpa* labeled Sabinal, Mexico, 26 March 1932, *M. E. Jones* (POM). Although the species is to be expected in Mexico, its occurrence in northern Chihuahua would be inconsistent with the rest of its range. Jones collected at one place called Sabinal in this area in earlier years (cf., *Leaflet W. Bot.* 10: 222. 1965), but perhaps his 1932 locality was different; thus far we have been unable to trace it.

21. *Gaura triangulata* Buckl., *Proc. Acad. Nat. Sci. Philadelphia* 1861: 454. 1862. Figs. 28, 29, 63.

*Gaura tripetala* Cav. var. *triangulata* (Buckl.) Munz, *Bull. Torrey Bot. Club* 65: 213. 1938.

*Gaura hexandra* Gómez Ortega var. *triangulata* (Buckl.) Munz, *N. Amer. Fl. II.* 5: 191. 1965.

Slender, erect annual herb from a taproot; stems usually with several branches from the base, sometimes unbranched, 1.5–6 dm tall. Plants villous with hairs 1.5–2.5 mm long below the inflorescence, the leaves subglabrous or sparsely villous along the veins and around the margins; inflorescence glabrous or the ovary, outside of the floral tube, and sepals lightly strigulose. Leaves very narrowly elliptic to oblanceolate, 1.5–8 cm long, 0.2–1.5 cm wide, entire to very slightly sinuate-dentate, subsessile. Inflorescence dense in bud but fairly well spaced just before the flowers open, 10–37 cm long; bracts lanceolate or narrowly ovate, 2–4 mm long, 1–1.75 mm wide. Flowers 3-merous, very rarely 4-merous. Floral tube 4–5.5 mm long. Sepals 4.5–6 mm long, 0.75–1 mm wide. Petals 3.5–5 mm long, 1–2 mm wide. Filaments 2–3.5 mm long; anthers 1.5–3 mm long. Pollen about 50 percent fertile. Style 9–10 mm long. Fruit ovoid, 7–9 mm long, 3–5 mm thick, sessile. Seeds (1–)2–5, 1.5–3.5 mm long, 1–1.5 mm thick, yellowish to light brown. Autogamous. Gametic chromosome number,  $n = 7$  (ring of 14 at meiotic metaphase I).

TYPE: "Prairies, northern Texas"; i.e., near Fort Bellknap, Young Co., Texas, May, *S. B. Buckley* (PH).

DISTRIBUTION (fig. 57): Open sandy places, north-central Texas and south-central Oklahoma, with outlying stations near Tulsa, Oklahoma, and in Tom Green and Crosby counties, Texas. Flowers May and June.



## REPRESENTATIVE SPECIMENS EXAMINED:

UNITED STATES. OKLAHOMA. Cleveland Co.: 5 mi nw of Norman, *Engelmann in 1935* (ISC, MO, OKL). Comanche Co.: Near Cache, *Stevens 1325* (DS, MIN, MO, NY). Cotton Co.: 1.7 mi n of Randlett, *Shinners 25966* (SMU). Grady Co.: Chickasha, *McElreath 94* (OKL). Oklahoma Co.: Oklahoma City, *Waterfall 1938* (GH, NY, OKLA). Rogers Co.: Catoosa, *Bush 1131* (MIN, MO, ND, NY, OKL, WVA). Stephens Co.: 0.5 mi e of Comanche, *Waterfall 3649* (MO, OKL). Tulsa Co.: 15 mi e of Tulsa, *Engelmann in 1935* (OKL, POM). TEXAS. Archer Co.: 3 mi n of Olney, *McCart 834* (SMU). Baylor Co.: 8 mi e-ne of Mabelle, *Shinners 18752* (SMU). Callahan Co.: 8 mi e of Abilene, *Henderson 62-181* (DS). Clay Co.: 3 mi se of Henrietta, *Stephens 20600* (DS). Coleman Co.: 1 mi se of Santa Anna, *Shinners 26395* (ILL, SMU). Crosby Co.: 3 mi e of Crosbyton, *Graham in 1960* (TEX). Eastland Co.: Eastland, *Harris 51* (TEX). Erath Co.: 5 mi ne of Stephenville, *Shinners 11080* (SMU). Jones Co.: 6.5 mi ne of Anson, *Cory 37214* (TAES). Montague Co.: 8.5 mi w of Nocona, *Shinners 13291* (SMU). Taylor Co.: 4 mi s of Buffalo Gap, *Mahler 3166* (SMU). Throckmorton Co.: 5.4 mi n-nw of Throckmorton, *Shinners 18795* (SMU). Tom Greene Co.: 3 mi e of San Angelo, *Ragsdale* (SMU). Wichita Co.: Wichita Falls, *Shinners 18744* (SMU). Wilbarger Co.: 11.8 mi w of Electra, *Whitehorse 9808* (MICH). Young Co.: 3 mi se of Olney, *Parks & Cory 13141* (MICH, SMU).

This distinctive and rather local complex structural heterozygote consists of an extremely uniform, highly autogamous series of populations. As mentioned earlier, the species was almost certainly derived following hybridization of the self-incompatible *Gaura suffulta* subspecies *suffulta* with the self-compatible *G. brachycarpa*.

## EXCLUDED NAMES

- Gaura chinensis* Lour., Fl. Coch. 225. 1790. Definitely not *Gaura*, and probably not Onagraceae.
- Gaura*? *epilobia* Moc. & Sessé ex Ser., in DC., Prod. 3: 45. 1828 = *Oenothera rosea* L'Hér. ex Ait., Hort. Kew. ed. 1, 2: 3. 1789.
- Gaura fruticosa* Loebl., Inter Hisp. 248. 1758 = *Combretum fruticosum* (Loebl.) Stuntz, U.S. Dept. Agric. Bur. Pl. Ind. Invent. Seeds and Pl. Import. No. 31: 86. 1914; see J. Linn. Soc. Bot. 55: 117. 1953.
- Gaura*? *fruticulosa* Benth., Bot. Voy. Sulph. 15. 1844 = *Gongylocarpus fruticulosus* (Benth.) T. S. Brandege, Proc. Calif. Acad. Sci. II. 2: 158. 1889.
- Gaura heterandra* Torr., Pac. R.R. Rep. 4: 87. 1857 = *Heterogaura heterandra* (Torr.) Coville, Contr. U.S. Natl. Herb. 4: 106. 1893.
- Gaura humilis* (Juss.) D. Dietr. Linnaea 21. 580. 1848 = *Gayophytum humile* Juss., Ann. Sci. Nat. (Paris) I. 25: 18. 1832.
- Gaura linifolia* Nutt., in James, Exp. Long 2: 355. 1823 = *Stenosiphon linifolius* (Nutt.) Heynh., Nom. 2: 704. 1840.



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