

ARCHIATRIPLEX, A NEW CHENOPODIACEOUS
GENUS FROM CHINAGE-LIN CHU¹

A new genus of Chenopodiaceae (*Archiatrilex*) and its sole species (*A. nanpinensis*, from northern Sichuan Province, China) are described. The genus is characterized by unisexual flowers, foliaceous bracts subtending the carpellate flowers, and annular embryos; it therefore belongs in tribe Atripliceae. Its relationships and morphology are discussed, and a key to the genera of this tribe is given.

In 1974, as I was finishing the manuscript of the Chenopodiaceae for the *Flora Reipublicae Popularis Sinicae* (Kung & Tsien, 1979), my attention was drawn to an unidentified fragmentary specimen (*K. T. Fu 2166*) in the herbarium of the Institute of Botany, Academia Sinica, Beijing. Its surprising floral morphology—unisexual flowers with the staminate ones fasciculate in terminal, interrupted spikes and the carpellate ones below—suggested that the plant could be placed in the tribe Atripliceae C. Meyer, but in floral and inflorescence morphology it matched no genus in the tribe. Although I located another specimen of the same taxon in the herbarium (*T. P. Wang 7967*), it was also fragmentary.

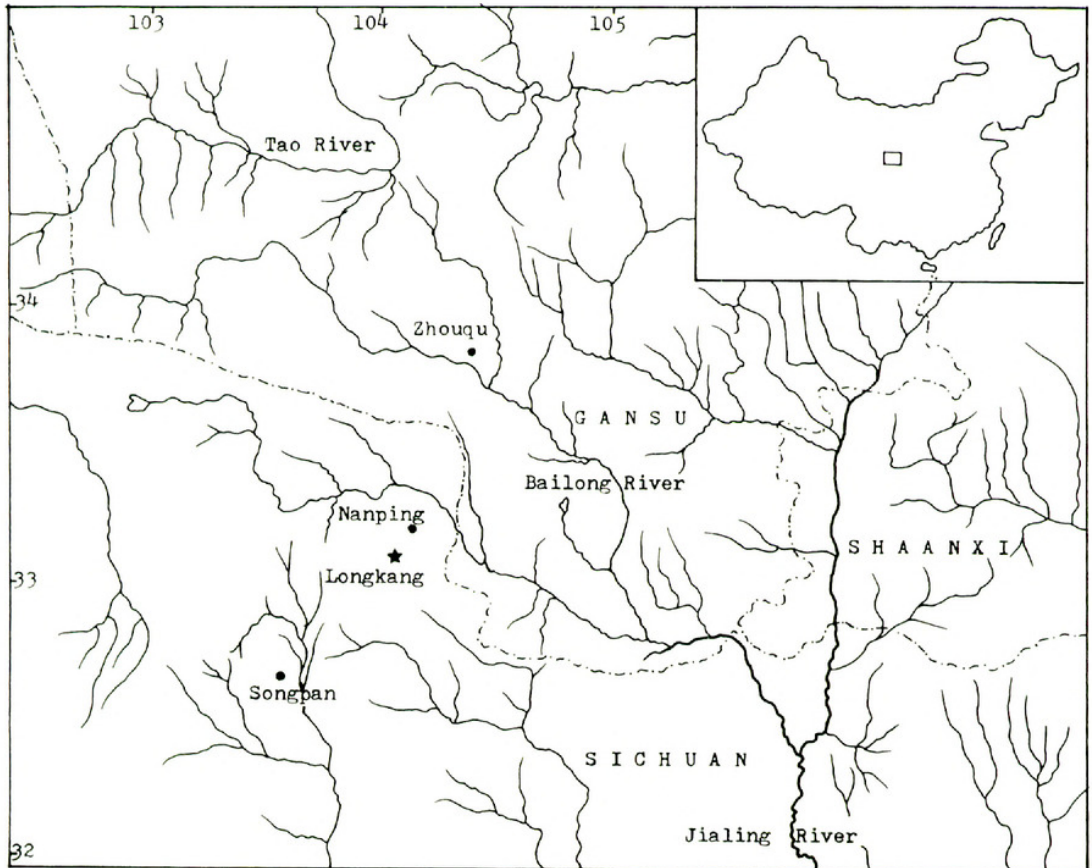
In 1980 I had the opportunity to visit Nanping, on the northern flank of the Tsinling mountain range in Sichuan Province (MAP 1), where both of the specimens had been collected. While there, I was fortunate to re-locate the population and was able to re-collect more complete specimens and make field observations. Study of the ample material gathered at that time has shown that the plant is a new species that also comprises a new genus. I propose the new genus and species below, followed by a discussion of its relationships and morphology.

Archiatrilex G. L. Chu, gen. nov.

Proximum Microgynoecio J. D. Hooker sed in floribus femineis basi et in stipitibus bractearum insertis, perianthio evoluta, et staminibus differtibus, dissimilis.

Monoecious herbs. Leaves opposite or alternate, petiolate, complanate, slightly succulent, serrate, with unicellular inflated trichomes. Flowers unisexual. Staminate flowers in interrupted spikes at apexes of branchlets, lacking bracts; perianth 5-parted, segments membranaceous, slightly succulent on back near apex, lacking nerves; stamens 5, inserted on disc. Carpellate flowers under

¹Institute of Botany, Northwest Teachers' College, Lanzhou, Gansu, People's Republic of China.



MAP 1. *Archiatriplex* area, showing major river-system involving tributaries of Huanghe and Changjiang rivers, and 4 towns on border of Sichuan and Gansu provinces, with ★ indicating type locality of *A. nanpinensis*.

staminate inflorescences, attached to base and petiole of bracts; bracts foliaceous, short-petiolate or nearly sessile, smaller than leaves; perianth 3- or 4-parted, the segments with longitudinal midrib, slightly enlarged in fruit; ovary obovoid, smooth, with 2 stigmas, style inconspicuous. Utricle slightly compressed, papillate; pericarp membranaceous, adnate to seed. Seeds laterally compressed, lenticular, testa crustaceous; embryo annular, perisperm copious.

TYPE SPECIES: *Archiatriplex nanpinensis* G. L. Chu.

***Archiatriplex nanpinensis* G. L. Chu, sp. nov.**

FIGURE 1.

Herbae annuales, usque ad 1.2 m altae; caulis erectus vel ascendens, ramosus, leviter tetragonus, striatus; rami ascendens ramosi, ramulis 1–5 cm longis, saepe gracilibus. Folia late ovata vel triangulari-hastata, 2–10 cm longa, latitudine longitudinem fere aequante, supra viridia, subtus pallide viridia, apice breviter acuminata, basi cordata, margine irregulariter laxe dentata; petiolus tenuis, 0.5–8 cm longus. Inflorescentiae masculinae graciles, interdum ramis brevibus praeditae; flores masculini multi in glomerulis dispositi; segmenta perianthii obovata vel oblanceolata, circa 1 mm longa, basi tantum connata, prope apicem leviter succulenta, apice paulo cucullata; stamina 5, filamentis filiformibus,



FIGURE 1. *Archiatriplex nanpinensis*: a, flowering shoot, $\times 0.5$, showing opposite leaves on lower nodes and alternate leaves on upper ones, terminal staminate inflorescences, and carpellate inflorescences with foliaceous bracts; b, carpellate flower, $\times 10$, showing 5 perianth lobes and 5 stamens; c, foliaceous bract subtending fascicle of carpellate flowers, $\times 2$; d, utricle, $\times 7.5$, showing tuberculate surface of pericarp; e, seed, lateral view, $\times 7.5$, showing position of radicle and hilum; f, seed, longitudinal section, $\times 7.5$, showing testa, curved embryo with radicle, 2 cotyledons, and central endosperm. (a-c drawn by Xia Quan.)

planis, segmentis perianthii fere aequilongis, antheris late oblongis vel late ovatis, circa 0.3 mm longis. Flores feminei 4–7 simul in glomerulo, basim bractaeae inserti; bractaeae ovatae vel cordatae, 4–20 mm longae, margine integrae vel serratae; segmenta perianthii basi fructificationis lineari-elliptica vel obovata, 0.7–1 mm longa, basi tantum connata, patentia, margine integra vel leviter lacerata; stigmata circa 0.2 mm longa. Utriculus oblique ovatus, tuberculatus. Semen rubiginosum vel nigrum, nitidum, circa 1–1.5 mm diam.

Annual herbs to 1.2 m tall; stems erect or ascending, ramified, slightly tetragonal, striate, the branches ascending, ramified, with the branchlets 1–5 cm long, usually gracile. Leaves with petiole 0.5–8 cm long; blade broad-ovate or triangular-hastate, 2–10 cm long and nearly as wide, short-acuminate at apex, cordate at base, irregularly coarsely dentate at margin, dark green above, light green below. Staminate inflorescences slender, sometimes short-branched; flowers several in glomerules; perianth segments obovate or oblanceolate, ca. 1 mm long, connate at base, slightly succulent and somewhat cucullate near apex; stamens 5, the filament filiform, complanate, nearly as long as perianth segments, the anther broad-oblong or broad-ovate, ca. 0.3 mm long. Carpellate flowers 4 to 7 per glomerule, inserted at base and petiole of bracts; bracts ovate or cordate, 4–20 mm long, entire or serrate; perianth segments in fruit linear-elliptic or obovate, 0.7–1 mm long, connate at base, patent, entire or slightly lacerate; stigmas ca. 0.2 mm long. Utricles oblique-ovate, the pericarp membranaceous, papillate. Seeds red-brown or black, ca. 1–1.5 mm in diameter.

TYPE. People's Republic of China, Sichuan Province, Nanping, Longkang, 2100 m alt., at edge of bush-wood, 30 September 1980, *G. L. Chu 80040* (holotype, herbarium of the Institute of Botany, NW Teachers' College, Gansu; isotype, A).

ADDITIONAL SPECIMENS EXAMINED. **People's Republic of China.** SICHUAN PROVINCE: Nanping, Longkang, 2100 m alt., *K. T. Fu 2166* (PE), *T. P. Wang 7967* (PE); on banks of terraced farm, *G. L. Chu 80041, 80073, 80086* (all at Herb. NW Teachers' College, Gansu).

MORPHOLOGICAL OBSERVATIONS

SEEDLINGS. Approximately 25 seeds were taken from unfumigated isotypes and were sown on 28 May 1982. Germination was first observed on 2 June and proved to be epigeal. On the eighth day after germination, the first pair of photosynthetic leaves appeared; the cotyledons were then ovate-elliptic, $4\text{--}6 \times 1\text{--}1.5$ mm, and light green above and purplish beneath. At the first eight nodes the photosynthetic leaves were opposite, but at the ninth node only one emerged, and thenceforth the leaves were alternate.

POLLEN. Pollen of *Archiatriplex nanpinensis* was taken from fresh material and prepared for examination with a scanning electron microscope. The tuberculate, punctate ectexine of the spherical, polyporate grains corresponds to the general pattern of chenopodiaceous pollen. The grains are ca. $26\text{ }\mu\text{m}$ in diameter and have approximately 60 circular apertures scattered on the tuberculate and finely punctate surface (FIGURE 2a). Each aperture is ca. $2\text{ }\mu\text{m}$ in diameter, with six

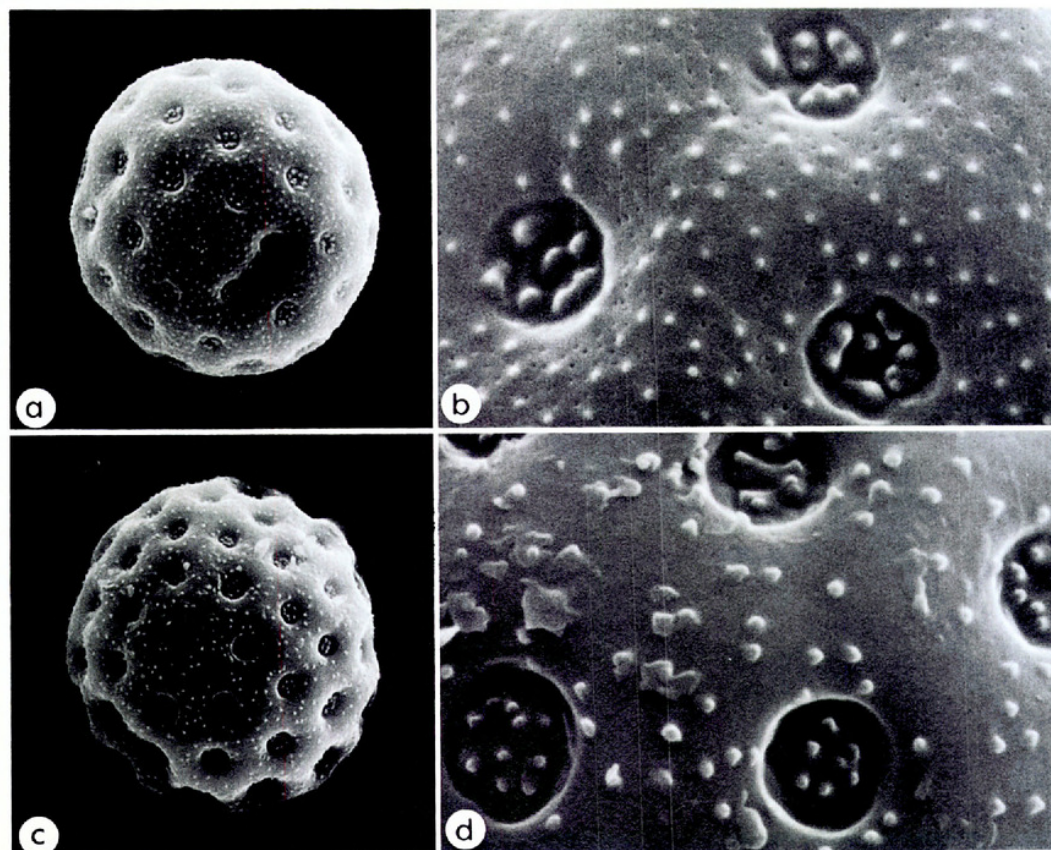


FIGURE 2. Scanning electron micrographs of pollen grains: a, b, *Archiatriplex nanpinensis*, showing numerous circular apertures, and tuberculate and punctate ectexine; c, d, *Microgynoecium tibeticum*, showing more numerous and larger apertures and smooth ectexine (a, c, $\times 1240$; b, d, $\times 6200$).

to nine free or coalescent tubercles (FIGURE 2b). Compared with the pollen of *Microgynoecium tibeticum* Hooker f. (FIGURE 2c, d), the grains of *A. nanpinensis* have fewer apertures but more tubercles.

CYTOLOGICAL OBSERVATIONS

Very young buds of staminate flowers from greenhouse-grown plants of *Archiatriplex nanpinensis* were fixed in Carnoy's solution, and pollen mother cells were stained and prepared in the normal manner for microscopic observation. It was determined that the species is a diploid with $2n = 18$. At meiosis bivalent pairing is regular (see FIGURE 3).

GENERIC RELATIONSHIPS OF ARCHIATRIPLEX

Including *Archiatriplex*, the tribe Atripliceae consists of 13 genera, of which *Atriplex* L. is the largest, with more than 100 species widely distributed in Asia, North America, Europe, Australia, and Africa. *Axyris* L. and *Ceratoides* (Tourn.) Gagnebin are represented in the floras of Eurasia and North America, while

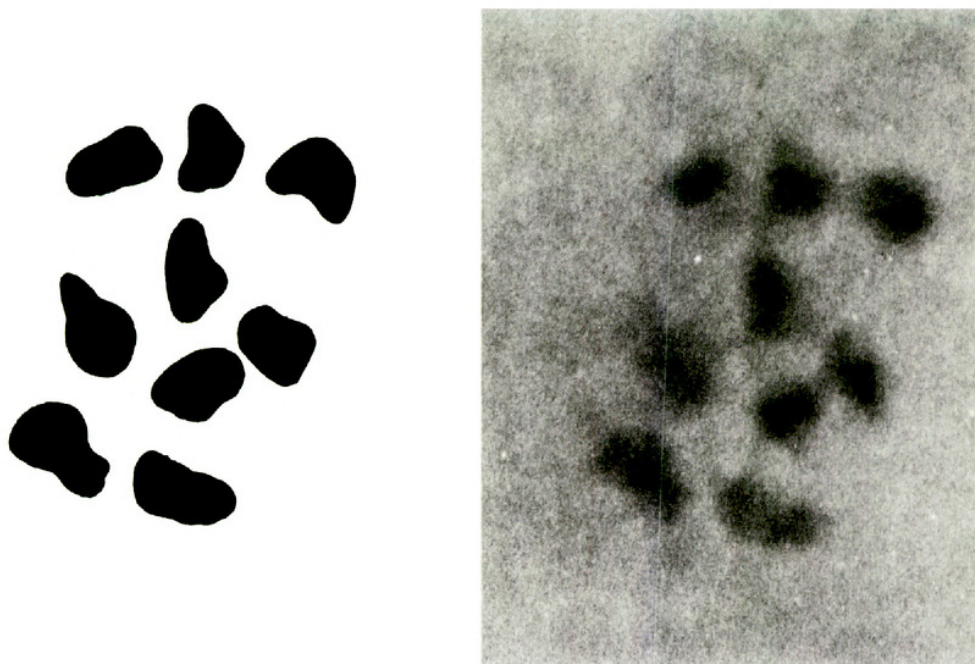
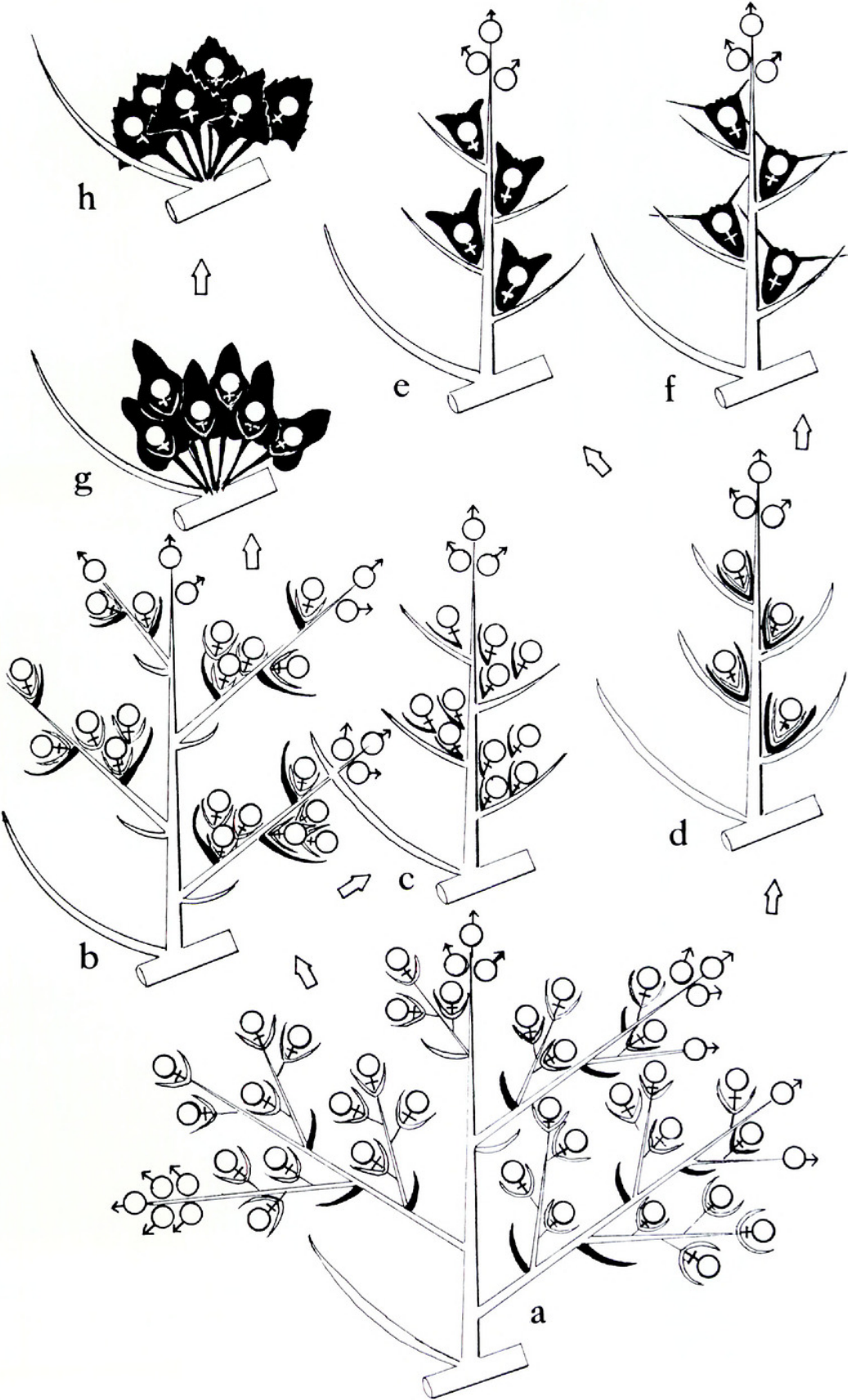


FIGURE 3. Chromosomes of dividing microsporocyte of *Archiatriplex nanpinensis*, $n = 9$, metaphase I (voucher specimen, G. L. Chu 80084).

Spinacia L. and *Ceratocarpus* L. are confined to Eurasia. The remaining genera are endemics, with distributions restricted to Asia (*Microgynoecium* and *Archiatriplex*), North America (*Endolepis* Torrey, *Suckleya* A. Gray, *Zuckia* Standley, and *Grayia* Hooker & Arn.), Africa (*Exomis* Fenzl ex Moq.), or Australia (*Theleophyton* (Hooker) Moq.).

Archiatriplex has close affinities to *Microgynoecium*. The two species are characterized by similar foliaceous bracts subtending the carpellate flowers, with each bract containing several flowers; the carpellate flowers of *Microgynoecium*, however, lack perianths. The other genera in the tribe differ from *Archiatriplex* in having a single carpellate flower included between two opposite and specialized bracts and (except for *Exomis* and *Endolepis*) in lacking a perianth, or in the stellate hairs covering the plant.

FIGURE 4. Inflorescences in tribe Atripliceae, showing possible evolutionary changes that led to present forms. a, hypothetical prototype with numerous branches, each with staminate flowers at distal end, carpellate at proximal (dark bracts subtending lateral branches indicate key area of evolutionary change). b, *Archiatriplex*, fascicles of 1 to 7 carpellate flowers subtended by bract (black). c, *Microgynoecium*, reduction of rachis and perianth segments. d, *Axyris*, branch of much-reduced panicle, solitary carpellate flowers with perianth subtended by 2 bracts (black). e, *Eurotia*, f, *Ceratocarpus*: bracts (black) fused, carpellate flowers lacking perianth. g, h, fascicles of solitary flowers subtended by enlarged bracts: g, *Endolepis*, carpellate flowers with perianth; h, *Atriplex*, carpellate flowers lacking perianth.



KEY TO THE GENERA OF THE ATRIPLICEAE

1. Plant glabrous, or covered with simple or ramified inflated hairs.
 2. Carpellate flowers with perianth.
 3. Carpellate flowers subtended by single foliaceous bract, axil of each bract usually with several flowers. *Archiatriplex*.
 3. Carpellate flowers each subtended by 2 opposite, separate bracts, these not foliaceous.
 4. Radicle oriented downward; perianth with 5 segments; bracts succulent. *Exomis*.
 4. Radicle oriented upward; perianth with 3 or 4 segments; bracts not succulent. *Endolepis*.
 2. Carpellate flowers lacking perianth.
 5. Stigmas 2; plants monoecious, rarely dioecious.
 6. Carpellate flowers subtended by single foliaceous bract, axil of each bract usually with several flowers. *Microgynoecium*.
 6. Carpellate flowers each subtended by 2 opposite bracts, these partially or totally fused.
 7. Seeds oriented vertically in fruit.
 8. Bracts of carpellate flowers inflated, saclike; inflated hairs indurated into cubic crystals. *Theleophyton*.
 8. Bracts of carpellate flowers compressed; inflated hairs scurfy when dry.
 9. Inflated hairs not ramified; radicle oriented upward, rarely downward.
 10. Bracts of carpellate flowers bilobed at apex. . . . *Suckleya*.
 10. Bracts of carpellate flowers entire or serrate, not bilobed. *Atriplex*.
 9. Inflated hairs ramified; radicle oriented downward. . . . *Grayia*.
 7. Seeds oriented horizontally in fruit. *Zuckia*.
 5. Stigmas 4 or 5; plants dioecious. *Spinacia*.
 1. Plant covered with stellate hairs.
 11. Carpellate flowers with evident perianth, each subtended by 2 separate, foliaceous bracts. *Axyris*.
 11. Carpellate flowers lacking perianth, each subtended by 2 opposite bracts, these partially or totally fused.
 12. Shrubs or subshrubs; bracts of carpellate flowers fused below middle, forming tube furnished with 4 fascicles of villose hairs. *Ceratoides*.
 12. Annual herbs; bracts of carpellate flowers fused their entire length, furnished with acicular appendage on both sides near apex. *Ceratocarpus*.

Compared with the other genera in tribe Atripliceae, the most distinctive primitive character of *Archiatriplex* is its large, loose panicles (FIGURE 4b). Such an inflorescence probably developed from a prototype with flowers protected by a perianth, the staminate flowers located at the distal end of the branches and the carpellate ones below (FIGURE 4a). Evolutionary change from the *Archiatriplex* type of inflorescence led to fasciculate carpellate flowers lacking a perianth and to a reduction in the length of the rachis and in the number of flowers, leaving small bracts as in *Microgynoecium* (FIGURE 4c). It seems that also through reduction of the rachis, the fasciculate *Endolepis*- and *Atriplex*-type inflorescences (FIGURE 4g, h) evolved from the *Archiatriplex* type. In the *Endolepis* type of inflorescence, the flowers have a perianth, while in the *Atriplex* type they do not. Another trend in the inflorescence can be traced

from the prototype: through reduction in flower number and rachis length and by fusion of the bracts, the *Axyris* type of inflorescence (FIGURE 4d) resulted. Here, two bracts subtend a single carpellate flower with a segmented perianth. Further evolutionary changes led to the *Eurotia* and the *Ceratocarpus* types (FIGURE 4e, f). In these the carpellate flowers lack a perianth, and the subtending bracts have become highly specialized and fused.

From the above interpretation, it is clear that the discovery of *Archiatrilex* provides a better understanding of the evolutionary changes in tribe Atripliceae.

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