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Chromosome numbers in some cacti of western North America. IV.¹

Donald J. Pinkava and Bruce D. Parfitt²

Department of Botany and Microbiology, Arizona State University, Tempe, Arizona 85287

PINKAVA, D. J., and B. D. PARFITT (Dept. Bot. and Microbiol., Arizona State Univ., Tempe, 85287). Chromosome numbers in some cacti of western North America. IV. Bull. Torrey Bot. Club 109: 121-128. 1982.—Documented meiotic and mitotic chromosome numbers are reported for 51 taxa in 41 species of 10 genera of Cactaceae of southwestern United States and northern Mexico. Included are first counts for 21 taxa belonging to 18 species plus one interspecific triploid hybrid (*Opuntia kleiniae* × *O. leptocaulis*); and new counts for 4 previously reported species.

Key words: Cactaceae; chromosome numbers; United States; Mexico.

This is the fourth in a series of studies done in an attempt to understand the evolutionary and taxonomic problems in the Cactaceae. Diploid and polyploid taxa were observed, all consistent with the base number, $x = 11$. Thus far in this series polyploidy occurs in 26 of 45 taxa (57.8%) of the Opuntioideae (including 4 taxa represented by both diploid and polyploid individuals) and in 8 of 50 taxa (16.0%) of the Cactoideae.

Materials and methods. Flower buds were collected in developmental series from plants growing in native habitats or in cultivation. Buds were killed and fixed in chloroform, ethanol and glacial acetic acid (6:3:1 v/v), transferred to 70% ethanol and refrigerated. Anthers were squashed in acetocarmine and mounted in Hoyer's medium (Beeks 1955). The mitotic count (*O. martiniana*) was obtained from root tips, fixed, stained and mounted according to Parfitt (1979). Voucher specimens are deposited in

ASU. Nomenclature largely follows that of Benson (1969a, b, c), Britton and Rose (1919-1923), and Bravo-Hollis (1978).

Results and discussion. Chromosome counts (Table 1) were made from 73 individuals belonging to 50 taxa in 41 species of 10 genera. Counts for 22 taxa are first published reports. Newly counted in our series are 35 taxa (Figs. 1-35), including one interspecific hybrid discussed below and two counts different from those we had reported for the species *O. bigelovii* (Pinkava and McLeod 1971) and *O. whipplei* (Pinkava *et al.* 1973). Of this group, the following eleven previously published counts are in agreement with our findings: *Opuntia cholla* (Yuasa *et al.* 1973), *O. imbricata* var. *imbricata* (Bowden 1945; Conde 1975; Katagiri 1953; Weedon & Powell 1978; Yuasa *et al.* 1973), *O. kleiniae* var. *kleiniae* (Fischer in Benson 1969b; Weedon & Powell 1978; Yuasa *et al.* 1973), *O. lindheimeri* var. *linguiformis* (Weedon & Powell 1978; Yuasa *et al.* 1973), *O. streptacantha* (Yuasa *et al.* 1973), *O. violacea* var. *castetteri* (Weedon & Powell 1978), *Echinocereus pectinatus* var. *pectinatus* (Ross 1981), *E. triglochidiatus* var. *neomexicanus* (Weedon & Powell 1978), *Mammillaria brandegeei* (Remski 1954), *M. gummifera* vars. *applanata* (Beard 1937; Remski 1954; Stockwell 1935; Weedon & Powell 1978), and *meiacantha* (Weedon & Powell 1978). Individuals of *Opuntia streptacantha* are also reported as diploids (Yuasa *et al.* 1973). Counts at variance with our findings are: $2n = 44$ for

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Table 1. Chromosome counts of certain cacti of western North America

OPUNTIOIDEAE

- Opuntia acanthocarpa* Engelm. & Bigelow var. *major* (Engelm. & Bigelow) L. Benson
 $n = 11$ ARIZONA: Pinal Co.: ca. 2 mi SW of Boyce Thompson Southwestern Arboretum, *Pinkava 13820, Pinkava & McGill*.
- Opuntia aurea* Baxter
 $n = 33$ ARIZONA: Mohave Co.: 4.1 mi NNE of Cane Beds via Rosy Canyon, *Parfitt 2870, 2971*.
 UTAH: Washington Co.: 11.2 mi N of Kanab, *Parfitt 2863, 2864, 2865*.
- * *Opuntia basilaris* Engelm. & Bigelow var. *woodburyi* Earle
 $n = 44$ UTAH: Washington Co.: Warner Valley, 2.7 mi W of Fort Pierce, *Parfitt 2868* (Fig. 1).
- ! *Opuntia bigelovii* Engelm. var. *bigelovii*
 $3n = 11_{III}$ CALIFORNIA: San Diego Co.: Hwy S-2, 25.9 mi SSE of jctn Hwy 78, *Parfitt 2777, Pinkava, Keil & McLeod* (Fig. 2).
- Opuntia chlorotica* Engelm. & Bigelow
 $n = 11$ ARIZONA: Mohave Co.: 1 mi NW of Peacock Rd. on old Hwy 93, *Parfitt 2546*.
- Opuntia cholla* Weber
 $n = 11$ MEXICO: Baja California Norte: 5.5 mi E, then 4.5 mi NE of Rosario, *Pinkava 8791 & McGill* (Fig. 3); 4.8 mi E of Rosario, *Pinkava 11159, McGill, Hensel & MacIntyre* (counted by T. Hensel); 3.9 mi SE of Progreso, then 2.4 mi S toward Santa Catarina, *Pinkava 9117, Nash & McGill*.
- Opuntia curvospina* Griffiths
 $n = 22$ ARIZONA: Mohave Co.: old Hwy 93, 0.4 mi SE of Peacock Mt. Rd., *Butterwick 5003, Parfitt & Hillyard*; west bajada of Cerbat Mts., *Parfitt 2541 & G. Brown*.
- Opuntia echinocarpa* Engelm. & Bigelow var. *echinocarpa*
 $n = 11$ CALIFORNIA: San Diego Co.: S of Clark Dry Lake, Hwy S-22, *Parfitt 2756, Pinkava, Keil & McLeod* (gold-spined form); Hwy 78, E of Anza-Borrego State Park, *Parfitt 2741C, Pinkava, Keil & McLeod*.
- * *Opuntia erinacea* Engelm. & Bigelow var. *utahensis* (Engelm.) L. Benson
 $n = 44$ ARIZONA: Coconino Co.: House Rock Valley, N. of Rock Canyon, *Parfitt 2859, 2862*.
 ARIZONA: Mohave Co.: 6.7 mi S of Hwy 389 on Mt. Trumbull Rd., *G. Brown 660 & Parfitt*; 4.2 mi SW of Wolf Hole along BLM 64, *G. Brown 851 & Parfitt*; 0.65 mi NW of Bulrush Canyon, road to Pipe Springs, *Parfitt 2873, 2874, 2876* (Fig. 4).
- Opuntia erinacea* Engelm. & Bigelow var. *erinacea*
 $n = 22$ ARIZONA: Mohave Co.: saddle, head of Lime Kiln Canyon, *G. Brown 287 & Parfitt*.
- * *Opuntia fulgida* Engelm. var. *mammillata* (Schott) Coulter
 $n = 11$ ARIZONA: Pinal Co.: ca. 2 mi SW of Boyce Thompson Southwestern Arboretum, *Pinkava 13821* (Fig. 5), *13825, Pinkava & McGill*.
- Opuntia imbricata* (Haworth) DeCandolle var. *imbricata*
 $n = 11$ MEXICO: Durango: 5.1 mi S of El Refugio, 21 air mi SW of Torreón, *Pinkava 13862, Lehto, Parfitt & Reeves* (Fig. 6).
 MEXICO: Zacatecas: Rte 54, 3.5 mi SW of San Rafael, *Pinkava 13509, McGill, Reeves & Nash*; Rte 54, 12.1 mi N of turnoff to Concepción del Oro, *Pinkava 13482, McGill, Reeves & Nash* (? intermediate to *O. tunicata* (Lehmann) Link & Otto).
- Opuntia kleiniae* DeCandolle var. *kleiniae*
 $n = 22$ MEXICO: Durango: 5.1 mi S of El Refugio, 21 air miles SW of Torreón, *Pinkava 13865, Lehto, Parfitt & Reeves* (Fig. 7).
- * *Opuntia kleiniae* DC. var. *kleiniae* × *Opuntia leptocaulis* DeCandolle
 $3n = 33$ MEXICO: San Luis Potosí: just E of Huizache Junction, *Pinkava 13530A, McGill, Reeves & Nash* (Fig. 8).
- * *Opuntia lindheimeri* Engelm. var. *cuija* (Griffiths & Hare) L. Benson
 $n = 11$ MEXICO: Zacatecas: Rte 54, 3.5 mi SE of San Rafael, *Pinkava 13510, McGill, Reeves & Nash* (Fig. 9).
- Opuntia lindheimeri* Engelm. var. *linguiformis* (Griffiths) L. Benson
 $n = 33$ ARIZONA: Maricopa Co.: cultivated NW of Tenth and Maple Sts., Tempe, *Parfitt 2147 & Clark* (Fig. 10).
- * *Opuntia martiniana* (L. Benson) Parfitt
 $n = 22$ ARIZONA: Mohave Co.: Hualapai Mt. Rd., 1.8 mi S of Rte I-40, *Parfitt 2838* (Fig. 11).
 $2n = 44$ ARIZONA: Mohave Co.: 0.1 mi S of Hwy 93 on Peacock Mt. Rd., *Parfitt 2701 & Pinkava* (root tip).

Table 1. (continued)

- ! *Opuntia moelleri* Berger
 n = 11 MEXICO: Coahuila: Rte 30, ca. 18 mi S of Cuatro Ciénegas Basin, at El Hundido, *Pinkava 13662, McGill, Reeves & Nash* (Fig. 12).
- Opuntia phaeacantha* Engelm. var. *discata* (Griffiths) L. Benson & Walkington
 n = 33 ARIZONA: Pima Co.: Waterman Mts., SE of Silverbell, *Parfitt 2789*.
- Opuntia phaeacantha* Engelm. var. *major* Engelm.
 n = 33 ARIZONA: Mohave Co.: Jump Canyon, T37N, R13W, S18, G. Brown 828 & Parfitt; Hualapai Mt. Rd., 1.8 mi S of Rte I-40, *Parfitt 2837* (both intermediate to var. *discata*).
- * *Opuntia phaeacantha* Engelm. aff. var. *nigricans* Engelm.
 n = 33 MEXICO: Coahuila: Sierra de la Madera, slopes between Canyons Agua and Hacienda, NW of Cuatro Ciénegas, *Pinkava 13658, 13659* (Fig. 13) *McGill, Reeves & Nash*.
- Opuntia phaeacantha* Engelm. var. *phaeacantha*
 n = 33 ARIZONA: Coconino Co.: Rte 89A, Scenic Overlook atop Oak Creek Canyon, *Pinkava 13826, Lehto, Parfitt & Hodgson* (reddish pink perianth form).
- ! *Opuntia prolifera* Engelm.
 n = 11 CALIFORNIA: Orange Co.: El Modeno, hill E of Chapman, *McLeod 449 & Pinkava* (Fig. 14).
- Opuntia spinosior* (Engelm.) Toumey
 n = 11 MEXICO: Chihuahua: Rte 10, 2.4 mi E of Buenaventura, *Pinkava 13222, McGill, Reeves & Nash*; Santa Cruz Microondas Sta., Rte 45, ca. 84 mi S of Chihuahua City, *Pinkava 13377, McGill, Reeves & Nash* (both intermediate to *O. imbricata*).
- Opuntia streptacantha* Lemaire
 n = 44 MEXICO: San Luis Potosí: Rte 49, 8 mi E of jctn Rte 45, near Zacatecas boundary, *Pinkava 9624, McGill & R. C. Brown* (Fig. 15).
 MEXICO: Zacatecas: Rte 49, ca. 22 mi E of Zacatecas City, *Pinkava 13512, McGill, Reeves & Nash*.
- Opuntia violacea* Engelm. var. *castetteri* L. Benson
 n = 11 MEXICO: Durango: ca. 2 mi NW of jctn Rte 45 and Rio Nazas, *R. K. Brown 286, Anderson & Albert* (Fig. 16).
- ! *Opuntia whipplei* Engelm. var. *whipplei*
 n = 22 ARIZONA: Mohave Co.: 0.2 mi N of Rte I-40 on Peacock Mt. Rd., *Parfitt 2547* (Fig. 17).

CACTOIDEAE

- * *Stenocereus* aff. *griseus* (Haworth) Buxbaum (*Cereus* g. Haworth; *Lemaireocereus* g. (Haworth) Britton & Rose)
 n = 11 MEXICO: Tamaulipas: Rte 101, 1.7 mi NNE of jctn Rte 80, SW of Tula, *Pinkava 9675, McGill & R. C. Brown* (Fig. 18).
- Stenocereus thurberi* (Engelm.) Buxbaum (*Cereus* t. Engelm.; *Lemaireocereus* t. (Engelm.) Britton & Rose var. *thurberi*)
 n = 11 MEXICO: Sonora: Rte 15, ca. 5 mi N of Navajoa, *Pinkava 12929*.
- * *Echinocereus cinerascens* (DeCandolle) Rümpler in Förster
 n = 11 MEXICO: San Luis Potosí: Rte 49, 6 mi ESE of Salinas turnoff, *Pinkava 13518, McGill, Reeves & Nash* (Fig. 19).
- * *Echinocereus engelmannii* (Parry) Lemaire var. *variegatus* (Engelm.) Engelm. ex Rümpler
 n = 22 ARIZONA: Mohave Co.: Rte 66, ca. 12 mi NE of Kingman, *Pinkava 12046 & Reeves*; Chico Mine Rd., 0.8 mi E of jctn Rte 93, *Pinkava 11972 & Reeves* (Fig. 20).
- * *Echinocereus fasciculatus* (Engelm.) L. Benson var. *bonkeriae* (Thornber & Bonker) L. Benson
 n = 22 ARIZONA: Pima Co.: 6.8 mi E of Coronado Nat'l. Forest, Tanque Verde Rd. extension, *Pinkava 10960, Lehto & Hensel* (Fig. 21).
- * *Echinocereus fasciculatus* (Engelm.) L. Benson var. *fasciculatus*
 n = 22 ARIZONA: Pima Co.: 6.2 mi E of Topawa, *Pinkava 10776, Lehto, R. C. Brown & Nash* (Fig. 22).
- Echinocereus pectinatus* (Scheidweiler) Engelm. var. *pectinatus*
 n = 11 MEXICO: Coahuila: ca. 11 mi W of jctn Cuatro Ciénegas—Ocampo road and Dolores Rd., *Pinkava 10492* (Fig. 23).
- Echinocereus triglochidiatus* Engelm. in Wislizenus var. *neomexicanus* (Standley) Standley ex W. T. Marshall (*E. polyacanthus* Engelm. in Wislizenus)
 n = 22 MEXICO: Chihuahua: 1 mi from Basaseachic Falls, *Pinkava 13307, McGill, Reeves & Nash* (Fig. 24).

Table 1. (continued)

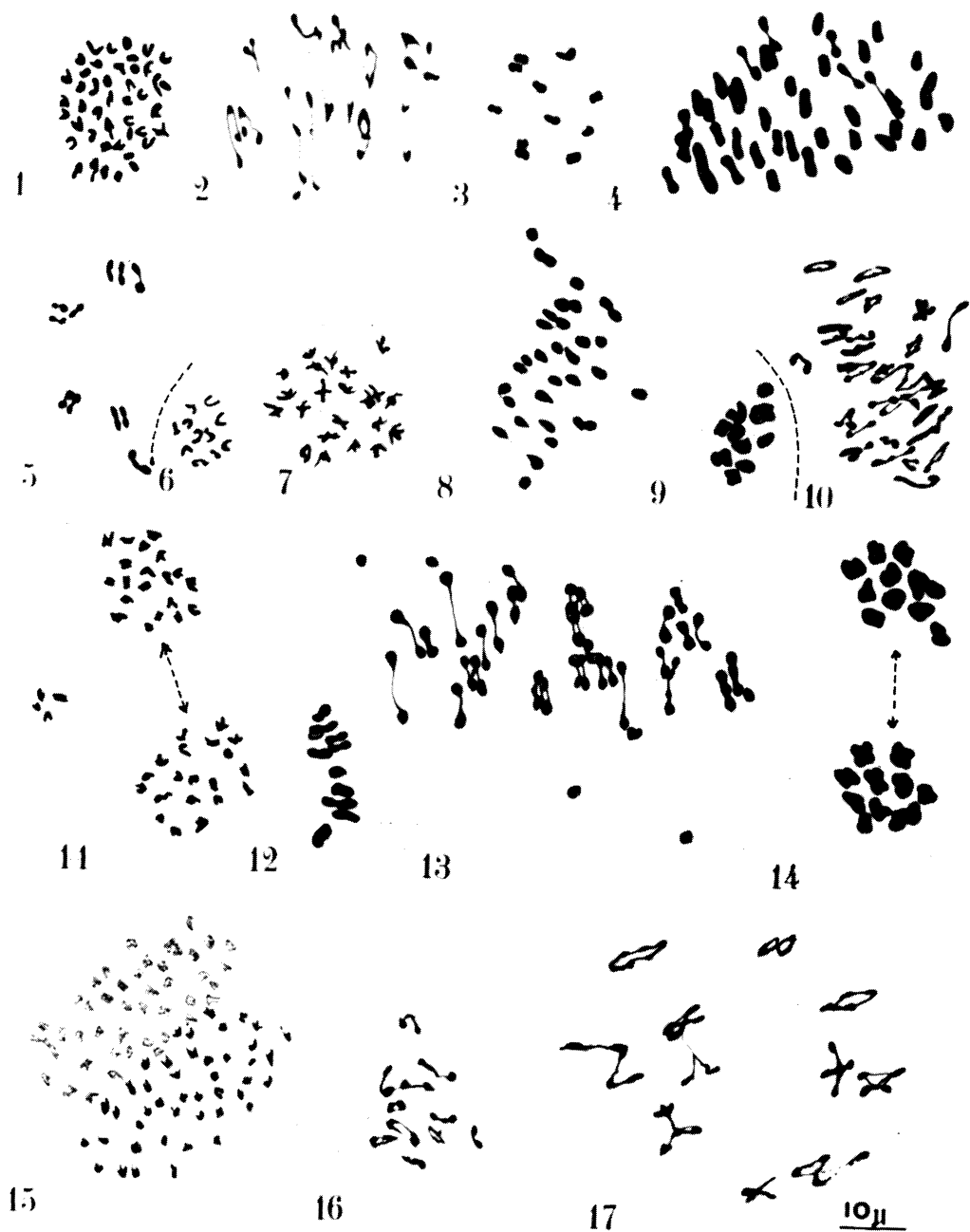
- **Echinocactus platyacanthus* Link & Otto
 n = 11 MEXICO: San Luis Potosí: just E of Huizache Junction, *Pinkava 13533, McGill, Reeves & Nash* (Fig. 25).
- Ferocactus pilosus* (Galeotti in Salm-Dyck) Werdermann (*F. pringlei* (Coulter) Britton & Rose)
 n = 11 MEXICO: Zacatecas: loop road from Concepción del Oro to Mazapil, 5.9 mi before jctn road to Noche Buena, *Pinkava 13912, Lehto, Parfitt & Reeves*.
- **Echinofossulocactus* aff. *pentacanthus* (Lemaire) Britton & Rose
 n = 11 MEXICO: San Luis Potosí: road to Balneario de Lourdes, ca. 1 mi from jctn Rte 57, *Pinkava 9629, McGill & R. C. Brown* (Fig. 26).
- Neolloydia johnsonii* (Parry) L. Benson
 n = 11 ARIZONA: Mohave Co.: 0.25 mi SW of Middle Spring, T36N, R16W, S7, *G. Brown 338 & Parfitt* (pink flower form); near Whitney Pass, *Gierisch 4147*.
- **Pediocactus paradei* B. W. Benson
 n = 11 ARIZONA: Coconino Co.: 7.5 mi E of Jacob Lake, Rte 89A, *Gierisch 4158* (Fig. 27).
- **Coryphantha clavata* (Scheidweiler) Backeberg
 n = 11 MEXICO: San Luis Potosí: Rte 49, 6 mi ESE of Salinas turnoff, *Pinkava 13521, McGill, Reeves & Nash* (Fig. 28).
- **Coryphantha salm-dyckiana* (Scheer) Britton & Rose
 n = 11 MEXICO: Chihuahua: Rte 45, ca. 10 mi S of Ciudad Camargo, *Pinkava 9256, 9258* (Fig. 29), *McGill & R. C. Brown*.
- **Coryphantha vivipara* (Nuttall) Britton & Rose var. *rosea* (Clokey) L. Benson
 n = 11 ARIZONA: Mohave Co.: jctn BLM 04 and road to Pakoon, T37N, R16W, S13, *G. Brown 298 & Parfitt* (Fig. 30).
- Mammillaria brandegeei* (Coulter) Britton & Rose
 n = 11 MEXICO: Baja California Norte: ca. 0.5 mi S of Rancho El Socorro, *Pinkava 8842 & McGill* (Fig. 31).
- Mammillaria gummifera* Engelm in Wislizenus var. *applanata* (Engelmann) L. Benson (*M. heyderi* Mühlenpfordt var. *heyderi*)
 n = 11 MEXICO: Coahuila: Cuatro Ciénegas Basin, turnoff to Poso El Churince, *Pinkava 10430A* (Fig. 32), and N tip of Sierra de San Marcos, *Pinkava 10393*.
- Mammillaria gummifera* Engelm in Wislizenus var. *meiacantha* (Engelmann) L. Benson (*M. heyderi* Mühlenpfordt var. *meicantha* (Engelmann) L. Benson)
 n = 11 MEXICO: Coahuila: 20 km W of Saltillo, *R. K. Brown 250* (Fig. 33).
- **Mammillaria muehlenpfordtii* Förster
 n = 11 MEXICO: San Luis Potosí: road to Balneario de Lourdes, ca. 1 mi from jctn Rte 57, *Pinkava 9632, McGill & R. C. Brown* (Fig. 34).

CORRECTIONS

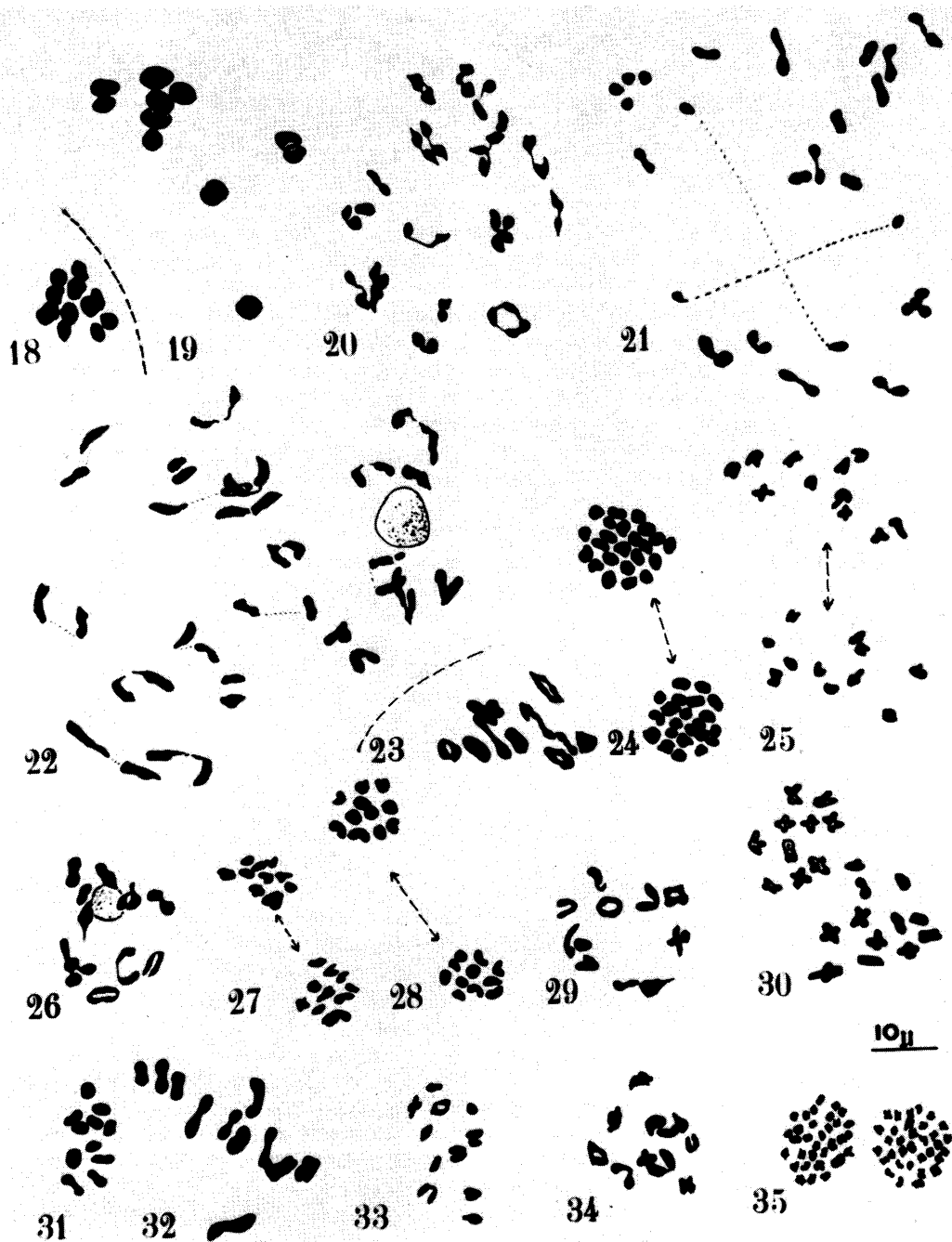
- **Opuntia phaeacantha* Engelm var. *flavispina* L. Benson
 n = 33 ARIZONA: Maricopa Co.: unpaved extension of Greenway Rd., White Tank Mts. Regional Park, *McLeod 368* (Fig. 35), 492. Originally published as *O. phaeacantha* var. *discata* approaching var. *major* (*Pinkava et al. 1973*).
- **Mammillaria wrightii* Engelm var. *wilcoxii* (Toumey ex Schumann) W. T. Marshall
 n = 11 MEXICO: Sonora: near Mababi Ranch, ca. 20 mi NW of Bacoachi, *Pinkava 6653B & McGill* (identification by A. D. Zimmerman). Originally reported as *M. wrightii* Engelm by *Pinkava and McLeod (1971)*.
- **Coryphantha varicolor* Tiegel
 n = 11 TEXAS: Presidio Co.: 1.4 mi N of Cibola Creek in Shafter, Rte 67, *Keil 7751 & McGill*. Originally reported as *C. strobiliformis* (Poselger) Orcutt by *Pinkava et al. (1973)*; considered as sub-specific to *C. strobiliformis* though not transferred according to A. D. Zimmerman (pers. comm.); treated as a variety of *C. dasycantha* (Engelmann) Orcutt by L. Benson (1969a).

*First report of chromosome count for this taxon.

!Chromosome counts different from that previously reported for the taxon.



Figs. 1-35. Camera lucida drawings of meiotic chromosomes of cacti. Voucher specimens are cited in Table 1. Spacing of chromosome groups adjusted in Figs. 5, 21 and 25. Fig. 1. *Opuntia basilaris* var. *woodburyi*, metaphase II ($\frac{1}{2}$ cell), $n = 44$. Fig. 2. *O. bigelovii* var. *bigelovii*, metaphase I, $3n = 11_{III}$. Fig. 3. *O. cholla*, metaphase II, $n = 11$. Fig. 4. *O. erinacea* var. *utahensis*, metaphase I, $n = 44$. Fig. 5. *O. fulgida* var. *mammillata*, metaphase I, $n = 11$. Fig. 6. *O. imbricata* var. *imbricata*, metaphase II ($\frac{1}{2}$ cell), $n = 11$. Fig. 7. *O. kleiniae* var. *kleiniae*, telophase I ($\frac{1}{2}$ cell), $n = 22$. Fig. 8. *O. kleiniae* var. *kleiniae* $\times$ *O. leptocaulis*, metaphase I, $3n = 33$. Fig. 9. *O. lindheimeri* var. *cuija*, metaphase I, $n = 11$. Fig. 10. *O. lindheimeri* var. *linguiformis*, metaphase I, $n = 33$. Fig. 11. *O. martiniana*, prophase II, $n = 22$ (irregular). Fig. 12. *O. moelleri*, metaphase I, $n = 11$. Fig. 13. *O. phaeacantha* aff. var. *nigricans*, metaphase I, $n = 33$. Fig. 14. *O. proliferata*, metaphase II, $n = 11$. Fig. 15. *O. streptacantha*, anaphase I, $n = 44$. Fig. 16. *O. violacea* var. *castetteri*, metaphase I, $n = 11$. Fig. 17. *O. whipplei* var. *whipplei*, metaphase I, $n = 22$ (multivalents). Fig. 18. *Stenocereus* aff. *griseus*, meta-



phase I, $n = 11$. Fig. 19. *Echinocereus cinerascens*, metaphase I, $n = 11$. Fig. 20. *E. engelmannii* var. *variegatus*, metaphase I, $n = 22$. Fig. 21. *E. fasciculatus* var. *bonkeriae*, metaphase I, $n = 22$. Fig. 22. *E. fasciculatus* var. *fasciculatus*, diakinesis, $n = 22$. Fig. 23. *E. pectinatus* var. *pectinatus*, metaphase I, $n = 11$. Fig. 24. *E. triglochidiatus* var. *neomexicanus*, metaphase II, $n = 22$. Fig. 25. *Echinocactus platyacanthus*, telophase I, $n = 11$. Fig. 26. *Echinofossulocactus* aff. *pentacanthus*, diakinesis, $n = 11$. Fig. 27. *Pediocactus paradinei*, metaphase II, $n = 11$. Fig. 28. *Coryphantha clavata*, metaphase II, $n = 11$. Fig. 29. *C. salm-dyckiana*, diakinesis, $n = 11$. Fig. 30. *C. vivipara* var. *rosea*, telophase I, $n = 11$. Fig. 31. *Mammillaria brandegeei*, metaphase I, $n = 11$. Fig. 32. *M. gummifera* var. *applanata*, metaphase I, $n = 11$. Fig. 33. *M. gummifera* var. *meiacantha*, diakinesis, $n = 11$. Fig. 34. *M. muehlenpfordtii*, diakinesis, $n = 11$. Fig. 35. *Opuntia phaeacantha* var. *flavispina*, metaphase II, $n = 33$.

O. moelleri; and $3n = 33$ for *O. prolifera* (Yuasa *et al.* 1973).

As with the triploid specimen of *Opuntia basilaris* var. *treleasei* reported earlier (Pinkava *et al.* 1977), the triploid *O. bigelovii* var. *bigelovii* specimen (Parfitt *et al.* 2777) does not differ significantly from its diploid counterpart except in size, suggesting autotriploidy, believed to be formed from the union of reduced (n) and unreduced ($2n$) gametes. Remski (1954) observed tetraploid and diploid cells in root tips of two *Mammillaria* spp. and postulated that autopolyploids might arise by mitotic abnormalities producing a polyploid shoot. Ross (1981) found a tetraploid microspocyte among diploid ones in *Pereskia diazromeroana*. Either mechanism could account for $2n$ gametes in basically diploid populations. Putative auto- and alloautotriploids involving *Opuntia fulgida* and *O. spinosior* are currently being investigated (Pinkava & McGill 1979).

A natural hybrid (Pinkava *et al.* 13530A) found in San Luis Potosi, presumably *O. kleiniae* var. *kleiniae* $\times$ *O. leptocaulis*, shows intermediate morphology approaching, slightly, the larger flowers, fruits and stem diameter of *O. kleiniae* and the partly red and proliferating fruits of *O. leptocaulis*. Thus far both putative parents are known only as tetraploids in the Chihuahuan Desert (Fischer 1962; Pinkava *et al.* 1973) but diploid forms of each are known from the Sonoran Desert and further work may uncover diploid specimens of either or both putative parents in the Chihuahuan Desert. Fischer (1962) reports a similar cultivated hybrid of this presumed parentage, (presumably originating from near the Davis Mountains, Texas), as $3n = 33$. He also counted three triploid individuals (*Fischer Texas A, C, G*) and two tetraploid individuals (*Fischer Texas E, F*) of *O. kleiniae* var. *kleiniae* from a population 8 miles south of Kent, Texas, at 4600 feet elevation, but admits that "it seems likely the other plants of *O. kleiniae* which have a chromosome number of 33 are also hybrids of the same parentage as the hybrid discussed above." Anthony (1956) describes in detail an uncounted hybrid between these same putative parents from a population at

Musquiz Creek, Jeff Davis County, Texas. She reports that in "most respects, these hybrid plants resemble *O. kleiniae* more closely than *O. leptocaulis*", suggesting to us that the *O. kleiniae* parent may have contributed the $2n$ gamete.

Opuntia martiniana was recently studied by Parfitt (1980) who has shown it to have a unique style shape (tapering downward) and a tetraploid chromosome number which distinguishes it from *O. littoralis* (Englem.) Cockerell, warranting a change in its status to the species level. Although partly sympatric with the tetraploid *O. curvospina*, *O. martiniana* may be separated from it by style shape, other morphological characters and meiotic behavior (Parfitt 1980). *Opuntia martiniana* shows laggards (Fig. 11) but lacks other aberrations such as an inversion bridge with fragment (Pinkava *et al.* 1973, Fig. 4) and quadrivalent formation found in *O. curvospina*.

Reported in the four-parted series thus far are chromosome counts for 255 specimens of cacti belonging to 113 taxa in 78 species (plus one interspecific and one intergeneric hybrids) of which 91 were new counts when reported, 7 differing from previously published accounts.

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