

STUDIES IN ARACEAE III:  
NEW SPECIES OF *ANTHURIUM* FROM CENTRAL AMERICA

Thomas B. Croat\*

A revision of the genus *Anthurium* is nearing completion for Mexico and Central America. The genus consists of more than 600 species with greatest diversity in the northern Andes in Ecuador and Colombia. In Central America *Anthurium* is most diverse in Panama and Costa Rica. There are approximately 130 species in Panama and 70 species in Costa Rica. Species diversity seems to drop off markedly north of Costa Rica with probably no more than 37 species known from all of Central America north of Costa Rica. Mexico is only slightly more diverse with approximately 43 species.

This paper will describe 10 new species from Central America. The terminology and usage of the descriptions in this paper are mostly defined in "Standardization of *Anthurium* Descriptions" (Croat and Bunting, 1979). Colors referenced here are taken from the color chart by Berlin & Kay (1969). This color chart, available from the University of California Press, is a reproduction of the Munsell Color Array of 40 hues, at maximum saturation, with eight degrees of brightness. The Berlin & Kay color chart, as it is referred to here, represents 40 hues in the vertical columns and 8 degrees of brightness in the horizontal rows and the latter count from 2 at the bottom to 9 at the top. Colors are arranged in 10 basic clusters, subdivided into 4 different hues per cluster, ranging from red through yellow, green, blue, purple and finally red-purple. The four subdivisions for each color cluster are numbered 2.5, 5, 7.5 and 10. These numbers are repeated for each of the 10 basic color clusters. The colors from the B & K color chart are read by first reporting the color, then the brightness (rows numbered from the bottom starting with 2), followed by the hue subdivision (columns numbered from the left starting with 2.5). For example, the third color in the 5th row in the red area would be called Red 5/7.5. The second color in the 8th row column would be called Red 8/5, etc. I have preceded the color references by B & K to indicate that this color chart is being used.

Since some confusion has resulted from the description of flower spirals, additional comments are added here. Flowers are arranged in several spirals (usually 4-8 spirals); the number of spirals depends on the size of the flowers, and the size of the spadix. The number of revolutions the spirals make depends on the length of the spadix and the angle of the spiral, but usually the spiral is visible several times from any angle of view.

References made to the flower size, refer only to the apex of the flower (which is the only part visible), and the length of the flower refers to its dimensions in the direction of the axis of the spadix, while the width of the flower refers to its dimensions perpendicular to the axis. The actual length of the tepal is not easily measured and is not given in the descriptions. Any reference to the margin or sides of the tepals refers to the outline of the apex of the flower. Since the flower apex is usually square or rhombic, the description of the sides, i.e., whether straight, sigmoid or jaggedly sigmoid, may refer to the sides which parallel the spiral or to the sides which lie perpendicular to the spiral.

All references to life zones in this paper refer to those of the Holdridge Life Zone system (Holdridge et al., 1971) and are based on life zone maps of respective Central American countries prepared by Holdridge (1959) for El Salvador, or Tosi (1971) for Panama.

\* Missouri Botanical Garden, Box 299, St. Louis, MO 63166, USA  
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Although more details can be obtained from a paper on flowering behavior of *Anthurium* (Croat, 1980), mention should be made here of descriptions, especially with regard to the development of stigmatic droplets and the progressive development of stamens. All observations reported here are based on the study of cultivated material and references to the degree of accumulation of stigmatic fluid might be inaccurate in the absence of pollinators to remove it. Nevertheless, these observations show that important taxonomic characters are exhibited by the timing and amount of stigmatic fluid and particularly by the developmental sequence of the stamens. They are therefore recorded here as part of the description of the species.

*Anthurium cerrocampanense* Croat, sp. nov.

(Figures 1, 5)

TYPE: Panama: Panama: middle slopes of Cerro Campana, ca. 1 mi from Interamerican Hwy., alt. ca. 600 m, *Croat 35944* (Holotype: MO 2388983; Isotypes: R, K, PMA, SEL, US; live plant at MO).

Planta terrestris, petiolus triangularis, anguste alatus, 14-50 cm longus; lamina ovata, cordata, (13)20-40(55) cm longa, 13.5-35(40) cm lata. Inflorescentia erecta; pedunculus 14-30 cm longus, 1-2 costatus; spatha viridis, oblongo-lanceolata; spadix sessilis, viridis anthesis initio, lutescens, 5-14.5 cm longus, 6-12 mm diam. Baccae purpureo-violaceae.

Usually terrestrial and deeply rooted, rarely epiphytic, 30-100 cm tall; caudex short, 2-2.5 cm diam., internodes short; leaf scars to 2.5 cm wide; cataphylls persisting intact, subcoriaceous, 5-9 cm long, sharply ribbed throughout, acute at apex (the acumen apiculate), drying brown (B&K Yellow 4/2.5). Prophyll to ca. 2.5 cm long. Leaves usually 4 or 5; petioles 14-50 cm long, 5-9 mm wide, 3-sided, pale green, the corners sharply winged (or the abaxial side sharply 2-ribbed), the wings thin, erect, 2-4 mm high, straight, or sometimes wavy; geniculum 1.5-2 cm long, shaped like the petiole with the wings minutely and conspicuously undulate; blades ovate to broadly ovate, mostly held at nearly right angles to petioles, subcoriaceous, gradually to abruptly short-acuminate at apex (the acumen minutely apiculate, deeply cordate at base, (13)20-40(55) cm long, (13.5)15-35(40) cm wide, broadest at or just below the middle, the upper surface semi-glossy, medium-dark green, the lower surface much paler, matte or semi-glossy; midrib paler than surface obtusely raised above, diminishing and sunken at apex, sharply raised below, higher than broad at base; basal veins 4-6(7) pairs, up to 4 of them coalesced 1-2.5 cm, raised in valleys on upper surface; the posterior rib more or less straight, naked or not; primary lateral veins 6-10 per side, departing the midrib at 30-50° angle, straight, then arcuate-ascending to the collective vein, weakly raised in valleys above, prominent below, interprimary veins few, prominulous above, tertiary veins obscure above, darker than surface and flat below, submarginal collective vein arising from the basal veins, loop-connected, mostly 3-17 mm from margin. Inflorescence erect, shorter than leaves; peduncle 14-30 cm long, 5-8 mm diam., subterete, sharply 1(2)-ribbed abaxially below middle, 3/4-1¼ as long as petioles; spathe light green to yellowish-green (B&K Yellow 7/10) streaked dark green or purple at anthesis, spreading to reflexed, inserted at ca. 45° angle on peduncle, held at 90-180° angle from peduncle, becoming curled and sometimes withered, oblong-lanceolate, (3)10-14 cm long, (1)2-3 cm wide ca. 1 cm above the peduncle, gradually acuminate at apex (the acumen hooked), rounded to

obtuse at base, sometimes decurrent onto peduncle; spadix sessile, yellow (B&K Yellow 9/7.5), (2.6)5-14.5 cm long, (4)6-12 mm diam. near base, with a strong perfume-like scent when stigmas have droplets and when anthers are fresh, the principal spiral right-handed, with 8 flowers visible from any angle in each right-hand spiral and ca. 5 flowers visible in the left-hand spiral; flowers rhombic or weakly 4-lobed, 3.1-3.8 mm long, 2.8-3.5 mm wide, the edges nearly straight on sides paralleling the flower spirals, usually jaggedly sigmoid at alternate edge, sometimes jaggedly sigmoid on both edges; tepals glossy, smooth, sometimes with minute droplets; the inner margin more or less straight; pistils darker green than tepals, glossy, the stigma oblong, ca. 0.6 mm long, forming very small droplets from a scarcely open slit, the droplets enlarging for ca. 10 days, then the stigma becoming brushlike with slightly exserted white papillae, drying ca. 2 or 3 days before first anther emerges; stamens emerging more or less rapidly from the base or scattered throughout spadix, exserted in part above the tepals, soon retracting, withdrawing most of the anther beneath the tepals, the pollen deposited at edge of tepal, the anthers ephemeral, 0.3-0.6 mm long, 0.6-0.8 mm wide, the thecae oblong-ellipsoid, scarce or not divaricate, the tissue breaking apart at apex as soon as the anther emerges; pollen orange (B&K Yellow-Red 7/10), deposited in flat ribbons, ca. 1 mm long. Fruits obovoid, ca. 6.5 mm long and 5 mm diam., purple-violet in apical 1/4-1/3, white at base; seeds 1 or 2, 4-4.3 mm long, 2.7-3.7 mm wide, 1.7-2.4 mm thick, pale brown, densely punctate, weakly compressed, emarginate at apex, rounded to obtuse at base.

The species is known only from the vicinity of the Isthmus of Panama in premontane wet and tropical wet forest life zones at 500-1000 m. It is most abundant west of the Canal Zone.

The species can be recognized by its cordate blade, sharply 3-sided winged petioles, terrestrial habit, the green to golden-yellow spadix which exudes pollen in ribbons and by the violet-purple fruits. It is apparently not closely related to any known species and its subgeneric affinities are not known.

The species flowers during the dry season and early rainy season. The name of the species refers to the type locality on Cerro Campana.

PANAMA: Coclé: Above El Valle de Antón, *Allen 341* (MO, NY); *Alston & Allen 1845* (MO); *Croat 37365* (MO); *Kennedy et al. 3195* (MO); *Porter et al. 4634* (MO); *Woodson & Schery 194* (F, MO); El Potroso, summit of Mt. Mist forest, *Folsom 1551* (MO); area surrounding Rivera sawmill, 7 km N. of El Copé, 650-850 m, *Folsom 6205; 7084* (MO); *Hammel 2381; 2625* (MO); 7 km N of Llano Grande, 1700 ft, *Hammel 1957* (MO); Panamá: Cerro Campana, *Allen 2433* (US); *Croat 12077, 12134, 17163, 25207, 35994* (TYPE) (MO); *D'Arcy 11122* (MO); *Kennedy 235, 1163* (F); *Kennedy et al. 2059* (MO); *Liesner 629* (MO); *Luteyn 1002* (DUKE); *Porter et al. 4255, 4950* (MO); *Sheffer 272* (UH); Peaks of Cerro Trinidad, *Kirkbride & Duke 1654* (MO); Road from El Llano to Cartí-Tupile, 200-500 m, *Croat 22854* (MO).

*Anthurium circinatum* Croat, sp. nov.

(Figures 2, 6)

TYPE: Panama: Chiriquí: Above San Félix along mining road, 18-27 miles off the Pan-American Hwy., alt. 1200-1500 m, *Croat 33102* (Holotype: MO 2389002; Isotypes: F, K, PMA, SEL, US; live plant at MO).



Figure 1. *Anthurium cerrocampanense* (Croat 12134)  $\times$  0.71. Figure 2. *A. circinatum* (Croat 37329)  $\times$  0.45. Figure 3. *A. coclense* (Croat 37373)  $\times$  0.21. Figure 4. *A. coclense* (Croat 34144)  $\times$  0.11.

Planta epiphytica aut terrestris; caudex usque ad 30 cm longus; cataphyllum 3-5 cm longum, findens in fibras, persistens; petiolus 6-29 cm longus; lamina anguste ovato-oblonga, basi rotundata aut acuta, 14-43 cm longa in pagina inferiore dense et minute punctata. Inflorescentia effusa aut pendula, foliis brevior; pedunculus 7-34 cm longus; spatha viridis pallide tincta purpureo, lineari-lanceolata; spadix in stipite brevi, ferrugineus, circinatus. Baccae subglobosae, rubrae, ca. 8 mm longae.

Epiphytic or terrestrial; stems to 30 cm long, ca. 1.5 cm diam.; internodes short; leaf scars ca. 8 mm wide; roots few, descending, ca. 3 mm diam.; cataphylls medium thick, 3-5 cm long, acuminate, drying light brown (B&K Yellow 5/5), dilacerating into stiff brown fibers, persisting in the existing leaf axils and a few of the leafless axils. Leaves usually 3-11, spreading; petioles 6-29 cm long, 2-5 mm diam., terete or weakly canaliculate, green, minutely speckled; geniculum 6-11 mm long, paler and thicker than petiole, shaped like the petiole; blades narrowly ovate-oblong or elliptic-oblong to linear-oblong, coriaceous, sometimes arched along the midrib, downturned and acuminate at apex, rounded to acute at base, 14-43 cm long, 2-10 cm wide, broadest near the middle, the margin straight and flat; upper surface matte, dark green; lower surface paler, glossy to semiglossy, minutely and densely punctate; midrib above narrowly and prominently raised almost to the apex, then abruptly sunken, paler than surface, below flat or prominulous and paler; primary lateral veins 12-20 per side, departing midrib at ca. 45° angle, only slightly visible above and below, more or less straight to the collective vein, drying barely visible above, prominulous below; all lesser veins obscure above and below; submarginal collective vein arising from the base, mostly 2-3 mm from the margin, the margin rolled under to nearly flat. Inflorescences spreading or erect-spreading, shorter or longer than the leaves; peduncle 7-34 cm long, 1-3 mm diam, flexible, about as long as petioles; spathe chartaceous, pale green tinged purplish, spreading and often twisted, inserted at ca. 10° angle on peduncle, directed at ca. 90° angle from peduncle, oblong-lanceolate, 2.5-7 cm long, 6-10 mm wide, broadest at the base, short-acuminate at apex (the acumen hooked), rounded to subcordate at base, the margins turned under, meeting on peduncle at ca. 180° angle; stipe 5-20 mm long adaxially, 4-19 mm long abaxially, ca. 2 mm diam., green, sometimes tinged reddish; spadix rust-brown (B&K Yellow-Red 4/5), usually twisted like a corkscrew, 4.5-23.7 cm long, 2-5 mm diam. midway, 2-4 mm diam. near apex; flowers rhombic to 4-lobed, ca. 2.3 mm long, ca. 2.2 mm wide, the principal spiral usually left-handed with 3-7 flowers visible, 5-16 flowers visible in right-hand spiral, the sides adjacent, the spirals straight, the sides perpendicular to the spirals jaggedly sigmoid; tepals glossy, smooth, the lateral tepals ca. 0.7 mm wide, the inner margin slightly convex; pistils green with many purplish dots, glossy, protruding before fruits develop, the stigma linear, ca. 0.3 mm long; lateral stamens emerging more or less rapidly and irregularly from base to apex before alternate stamens have emerged to middle, the stamens held at the edge of the pistil in a tight circle, the anthers yellow, ca. 0.3 mm long and 0.5 mm wide, the thecae ellipsoid, scarcely divaricate; pollen yellow, fading to white. Infructescence more or less pendent, the spathe deciduous, the spadix 15-25 cm long; fruits globose to depressed-globose, red, ca. 8 mm long.

The species is known only in Chiriquí Province of Panama in lower montane rain forest at elevations from 1200-1700 m.

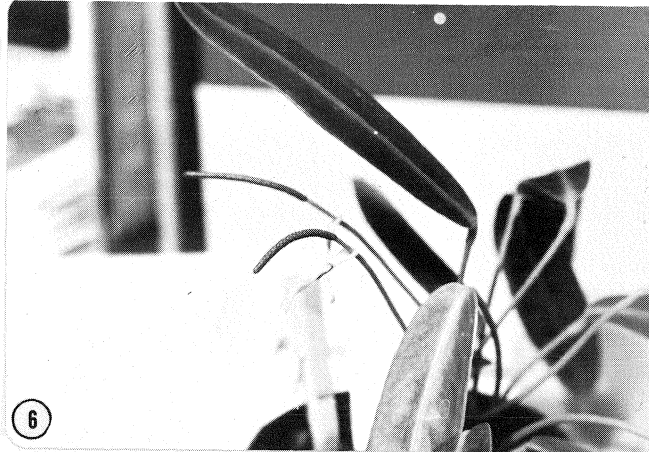


Figure 5. *A. cerrocampanense* (Croat 12134)  $\times 0.18$ . Figure 6. *A. circinatum* (Croat 37329)  $\times 0.35$ . Figure 7. *A. dwyeri* (Croat 34301)  $\times 0.35$ . Figure 8. *A. dwyeri* (Croat 27135)  $\times 0.25$ .

The species is distinguished by its oblong-lanceolate leaves with the midrib beneath scarcely or not at all raised, the spadix twisted like a corkscrew with the spathe drying and falling early and by the round, red fruits.

The species is probably best placed in section *Porphyrochitonium* Schott. It is perhaps closest to *A. louisii* Croat & Baker which differs in having leaf blades ovate to broadly ovate with petioles more than 1.5 times longer than blades. The blades of *A. circinatum* are almost oblong and the petioles are only 1/2 to 3/4 as long as the blades. The species name is derived from the coiled appearance of the spadix.

The species is also similar to *A. wendlingeri*, but that species differs by its much larger size, the veins of the lower blade surface raised, pale greenish-white flowers with anthers only weakly exerted and orange fruits, which are oblong and flattened at the apex with a minute depression. *A. circinatum* has the reddish spadix with prominently exerted stamens and has red, depressed-globose fruits.

PANAMA: Chiriquí: Above San Félix along road 18-27 miles off Pan-Am Hwy, 1200-1500 m, *Croat 33102* (MO); Cerro Colorado, 1200-1500 m, *Croat 33270* (MO), 1690 m, *Croat 37151* (MO), *Folsom 4705* (MO), Bocas Road, 1500 m, *Folsom & Collins 1773* (MO), 1390 m, *Sullivan 398* (MO); north of San Félix, *Mori & Kallunki 5872, 5990* (MO).

*Anthurium coclense* Croat, sp. nov.

(Figures 3, 4)

TYPE: Panama: Coclé: La Mesa north of El Valle de Antón, ca. 2 km west of Cerro Pilón; on slopes of steep hill, disturbed virgin forest, elev. 860-900 m, July 21, 1976, *Croat 37373* (Holotype: MO 2395383; Isotypes: F, K, PMA, SEL, US; live plant at MO).

Planta epiphytica aut terrestris, caudex elongatus, 30-75 cm longus; lamina oblongo-oblancoolata aut elliptica aut ovato-elliptica, basi obtusa aut anguste rotunda aut subcordata, (18)28-51 cm longa, (3)10-26 cm lata. Inflorescentia erecto-effusa, foliis brevior; pedunculus 3-35(50) cm longus, subquadrangularis; spatha viridis, interdum tincta purpureo, anguste lanceolata aut ovato-oblonga; spadix sessilis aut subsessilis, viridis, 2-10.5 cm longus, basi 3-7 mm diam; pollen flavum, albescens. Baccae purpureae.

Usually epiphytic, frequently terrestrial, weakly rooted, 0.5-1.5 m tall; caudex elongate, 30-75 cm long, 6-25 mm diam., dark olive-green, semiglossy, minutely fissured, turning grayish-green; internodes 1-5 cm long; leaf scars about as broad as the stem; roots few at each node, scaly; cataphylls moderately thin, 6-15 cm long, apiculate at apex, drying yellowish (B&K Yellow 9/2.5), remaining intact or dilacerating, soon deciduous. Leaves usually 2-7, petioles (3)5-57 cm long, 4-9 mm diam., terete to oval in cross-section, flattened to bluntly canaliculate near apex; geniculum 1.5-4 cm long, thicker than and shaped like the petiole with sharper edges; blades oblong-oblancoolate to elliptic or ovate-elliptic, moderately thin, gradually long-acuminate at apex to abruptly acuminate (the acumen flat, acicular at apex, sometimes downturned), obtuse to narrowly rounded or weakly cordate at base, (18)28-51 cm long, (3)10-26 cm wide, broadest above the middle, the larger blades sometimes noticeably inequilateral with one side to 3 cm narrower than the other; upper surface semiglossy; lower surface paler, semiglossy; midrib obtuse at base above, becoming more acute and diminishing and sunken at apex, paler than surface, sharply raised below, paler than surface; primary lateral veins 6-16 per side, departing midrib at 40-50° angle, straight to arcu-

ate-ascending to collective vein, sunken or weakly raised in valleys above, raised below; interprimary veins few, mostly continuous to the collective vein, sunken above, raised below; submarginal collective vein arising from one of the lowermost primary lateral veins, sometimes higher, mostly 3-10(20) mm from margin. Inflorescence spreading-erect, much shorter than leaves; peduncle 3-35(50) cm long, 2.5-5 mm diam., subquadrangular, striate, flat to rounded adaxially, the ridges closer and more prominent abaxially, the peduncles 1/4-1/2 as long as petioles; spathe subcoriaceous, green (both spathe and peduncle sometimes heavily tinged with purple) (B&K Green 7/2.5 to Yellow-green 5/5) at anthesis, usually reflexed, twisted, inserted at 45° angle on peduncle, narrowly lanceolate to ovate-oblong, 1.5-7 cm long, 0.9-2.5 cm wide, broadest slightly below the middle, abruptly acuminate at apex, rounded at base, meeting on the peduncle at ca. 170° angle; stipe to 5 mm long abaxially; spadix green to dark green (B&K Yellow-green 5/7.5 to Green 5/5) at anthesis, 2-10.5 cm long, 3-7 mm diam. at base, 2-6 mm diam. near apex, held at ca. 135° angle from peduncle; flowers irregularly and jaggedly 4-lobed, 2-2.4 mm long, 2.4-2.8 mm wide, the principal spiral right- or left-handed, ca. 10 flowers visible in the principal spiral and ca. 7 flowers visible in the alternate spiral, the sides jaggedly sigmoid; tepals semi-glossy, minutely papillate, darker along the outer margins, weakly punctate or epunctate, with scattered droplets, the lateral tepals 1-1.3 mm wide, the inner margins turned up against the pistil, the outer margin 3- or 4-sided; pistil emergent ca. 0.5 mm before anthesis, the stigma round, minutely brush-like, with a minute droplet briefly apparent several days before first stamens emerge; stamens emerging one at a time in a scattered pattern beginning near the base, exerted 0.7-0.8 mm above the tepals, the filaments fleshy, transparent, the exposed part longer than the anther, narrowly acute; anthers held erect, 0.4-0.5 mm long, 0.4-0.6 mm wide, pale yellow, widely spaced; thecae scarcely divaricate, oblong-elliptic, opening flat; pollen pale yellow (B&K Yellow 9/5) fading white. Infructescence spreading, the spathe persisting, to 8 cm long, the spadix to 15 cm long and 2 cm wide; fruits ovoid, acute at apex, reddish becoming dark purple-violet, to 7.5 mm long and 5 mm wide; mesocarp mealy (?); seeds 2, ovoid-ellipsoid, brown (B&K Yellow 4/2.5), weakly flattened, 3.2-3.8 mm long, 2.2-2.5 mm wide, 1.3-1.5 mm thick.

The species is known only from west central Panama at elevations of 500-1100 m in regions of tropical wet and premontane rain forest.

It is recognized by its erect, elongate caudex, the oblong blades broadest above the middle and usually narrowly rounded or subcordate at the base, the short inflorescence with quadrangular or striate peduncles and greenish, oblong spadix with pale yellow to whitish pollen. It is seemingly unrelated to any other species in Central America and no South American relatives are known. The name of the species refers to the type locality in Panama's Coclé Province.

PANAMA: Coclé: La Mesa above El Valle de Antón: *Croat 13434, 25363, 37373*, (MO); *Kennedy & Dressler 1743* (MO); *Kennedy et al. 3185* (MO); *Luteyn 1147, 1239, 4080* (DUKE); *Luteyn & Kennedy 1642, 1647* (DUKE, MO); *Sullivan 447* (MO); *Wilbur et al. 15657* (DUKE); Cerro Gaital Caracará, 2700-3200 feet, *Dwyer & Correa 8894* (SCZ), Cerro Pilón, 5 km NE of El Valle, 800-1045 m, *Mori 6584* (MO); *Porter et al. 4373* (MO); north of El Copé, *Folsom & Jaslon 2678* (MO); *Hammel 3467, 3518* (MO); *Folsom 3121* (MO); area between La Junta and Limón, 5 hrs walk N of Alto Calva-



rio 800-1000 m, *Folsom 5874* (MO); Atlantic slope along Río San Juan, 1200 feet, *Hammel 3461* (MO); Colón: Río Guanache, lower part, *Foster 2773* (F); Panamá: El Llano-Cartí road, *Folsom et al. 1452* (MO); *Folsom & Skog 2460* (MO); *Nee & Dressler 9386* (MO); area surrounding Rancho Chorro, 400-700 m, *Folsom et al. 6745* (MO); Veraguas: along banks of first river on road between Escuela Agrícola Alto de Piedra and Río Calovebora, 500 m, *Croat & Folsom 34144* (MO).

*Anthurium dwyeri* Croat, sp. nov.

TYPE: Panama: Colón: Santa Rita Ridge, along trail at end of road to Río Indio, beginning 10.6 km from the Transisthmian Hwy., alt. ca. 380 m, *Croat 34301* (Holotype: MO 2399063; Isotypes: K, SEL, US; live plant at MO).

Planta epiphytica; petiolus 4-19 cm longus, 5-9 mm latus, triangularis; lamina oblongo-elliptica, in pagina inferiore conspicue punctata, basi acuta, 24-40 cm longa, 6-11 cm lata. Inflorescentia erecta, foliis brevior aut longior; pedunculus 6-44 cm longus, triangularis; spatha viridis, interdum purpureo tincta, basi decurrens; spadix pallide viridis, 7.5-16.5 cm longus, basi 8-13 cm diam. Baccae ex lavindulo albae, apicibus planatis, ca. 7 mm longae.

Epiphyte; internodes short; leaf scars obscured by dense roots and persistent cataphyll fibers; roots numerous, 2-5 mm thick; cataphylls moderately thin, 5-7 cm long, acuminate at apex, quickly turning reddish-brown, dilacerating into subpersistent fibers. Leaves usually 8-14, spreading; petioles 4-19 cm long, 5-9 mm wide, green with pale specks, stiff, almost triangular, sharply acute abaxially, broadly and sharply canaliculate with a faint medial rib; geniculum 1-2 cm long, paler than petiole; blades oblong-elliptic, coriaceous, slightly arched along the midrib, acute to abruptly short-acuminate at apex (the acumen minutely apiculate), acute at base, 24-40 cm long, 6-11 cm wide, broadest near the middle or slightly above, the margin flat or broadly undulate; upper surface glossy, lower surface semiglossy, with moderately dense, dark punctations; midrib convexly raised above, narrowing and diminishing towards apex, sharply acute below, usually with a distinct, erect rib; primary lateral veins 20-35 per side, departing midrib at ca. 60° angle, slightly sunken above, obscure below, more or less straight to the collective vein; submarginal collective vein arising from the base, mostly straight and 5-6 mm from margin, slightly sunken above, obscure below. Inflorescence erect-spreading, shorter to longer than the leaves; peduncle 6-44 cm long, 1-8 mm wide, sharply triangular, the sharpest margin continuous with the decurrent edges of spathe, flexible to stiff; spathe coriaceous, yellow-green, sometimes tinged purplish (B&K Yellow-green 7/10) at anthesis, inserted at 70° angle on peduncle, spreading, lanceolate-elliptic to broadly lanceolate or oblong-elliptic, 3-11 cm long, 2.2-4.1 cm wide, broadest near point of insertion, short-acuminate at apex (the acumen hooked), acute and slightly inequilateral at base, decurrent 5-15 mm, meeting on peduncle at 60-90° angle; the stipe 1-3 mm long abaxially, 6-9 mm diam., darker green than peduncle; spadix pale green (B&K yellow-green 7/10) at anthesis, 7.5-16.5 cm long, 8-13 mm diam. near base, 5-9 mm diam. near apex; flowers square or rhombic to weakly 4-lobed, 3-4.1 mm long, 2.5-3.9 mm wide, the principal spiral right- or left-handed, ca. 6 flowers visible in the principal spiral and ca. 5 flowers visible in the alternate spiral, the sides straight to shallowly sigmoid;

tepals green, semiglossy, the lateral tepals 2-2.2 mm wide; pistil weakly emergent at anthesis, pale green, the stigma oblong, with a minute droplet just before pollen is visible, the droplets remaining after pollen appears; stamens never fully exerted, squeezing minute amounts of pollen out between tepals and pistil, the pollen held at edge of droplet; pollen white. Inflorescence spreading to pendent, the spathe much shorter than the spadix, spreading; the spadix 12-24 cm long, to 2.5 cm diam.; fruits subglobose, flattened at apex, pale lavender-white, ca. 7 mm long, 6-7 mm wide, 4-5 mm thick, with a whitish circular area ca. 2 mm wide around the stigma; seeds 6, narrowly ovoid, white, ca. 2 mm long.

In rare cases inflorescences are found which appear to lack stigmatic droplets and which have anthers exerted, lying flat against pistil before opening. Both types of inflorescences were found on the same plant at the same time in the greenhouse at MO.

The species is known from Panama and Colombia (Chocó) at elevations of 350-1150 m in tropical wet and premontane rain forest.

*Anthurium dwyeri* is distinguished by its coriaceous, oblong-elliptic blades which are punctate below, by its sharply triangular petioles, its stout triangular peduncle, pale green spadix and its usually unexposed anthers which ooze pollen from beneath the tepals. It is also unusual because of its pale, lavender-white, subglobose fruits which are flattened at the apex. The species has no known close relatives. It is placed in section *Porphyrochitonium*.

*Anthurium dwyeri* is named in honor of Dr. John D. Dwyer, noted botanist at St. Louis University, who has done considerable botanical exploration in Panama and Central America.

PANAMA: Coclé: La Mesa, 900 m, *Folsom 5634* (MO); Along Río San Juan below its junction with Río Tife, 400 m, *Hammel 3400* (MO); Mountains beyond La Pintada, 400-600 m, *Hunter & Allen 576* (MO); Colón: Santa Rita Ridge Road, *Croat 34301* (MO); *Gentry 6102* (MO); *Gentry et al. 8869* (MO); *Wilbur et al. 15069* (DUKE); South approach to Cerro Bruja from Río Escandoloso, 800 m, *Hammel 3192* (MO); Darién: Primary forest along headwaters of Río Tuquesa, *Croat 27135* (MO); Panamá: Cerro Jefe, *Dwyer & Gentry 10268* (MO); *Gomez-Pompa 3057* (MEXU); 2 miles south of Goofy Lake, *Dwyer & Stimson 8063* (MO); El Llano-Cartí Road, *Croat 25090, 34770* (MO); *Gentry et al. 8882* (MO); *Liesner 1166* (MO); *Tyson 7351* (MO); COLOMBIA: Chocó: Serranía del Darién west of Unguia on Panama border, 1150 m, *Gentry et al. 17039* (MO).

*Anthurium luteynii* Croat, sp. nov.

(Figures 11-13, 25)

TYPE: Panama: Veraguas: Río Primero Braso, 2.5 km beyond Escuela Agrícola Alto de Piedra, beyond Santa Fé, elev. 700-750 m, *Croat 25521* (Holotype: MO; Isotypes: CAS, F, K, PMA, SEL, US; live plant at MO).

Planta epiphytica aut terrestris; cataphyllum coriaceum, 10-23 cm longum, in sicco brunneum pallide, in reticulum fibrarum findens; petiolus 9-45 cm longus, trapezoideus, abaxile tricostatus, canaliculatus; lamina elliptico-oblonga, basi acuta, 50-125 cm longa, 9-23 cm lata. Inflorescentia effusa, foliis brevior; pedunculus 49-85 cm longus, viridis aut purpureus; spatha atropurpurea, coriacea, supra spadicem arcuata, lanceolata aut oblongo-lanceolata; spadix purpureus, sessilis, 7-17 cm longus, basi 0.8-2.8 cm diam., apice 0.5-1.7 cm diam. Baccae ovoidae, 10-15 mm longae, aurantiaceae.

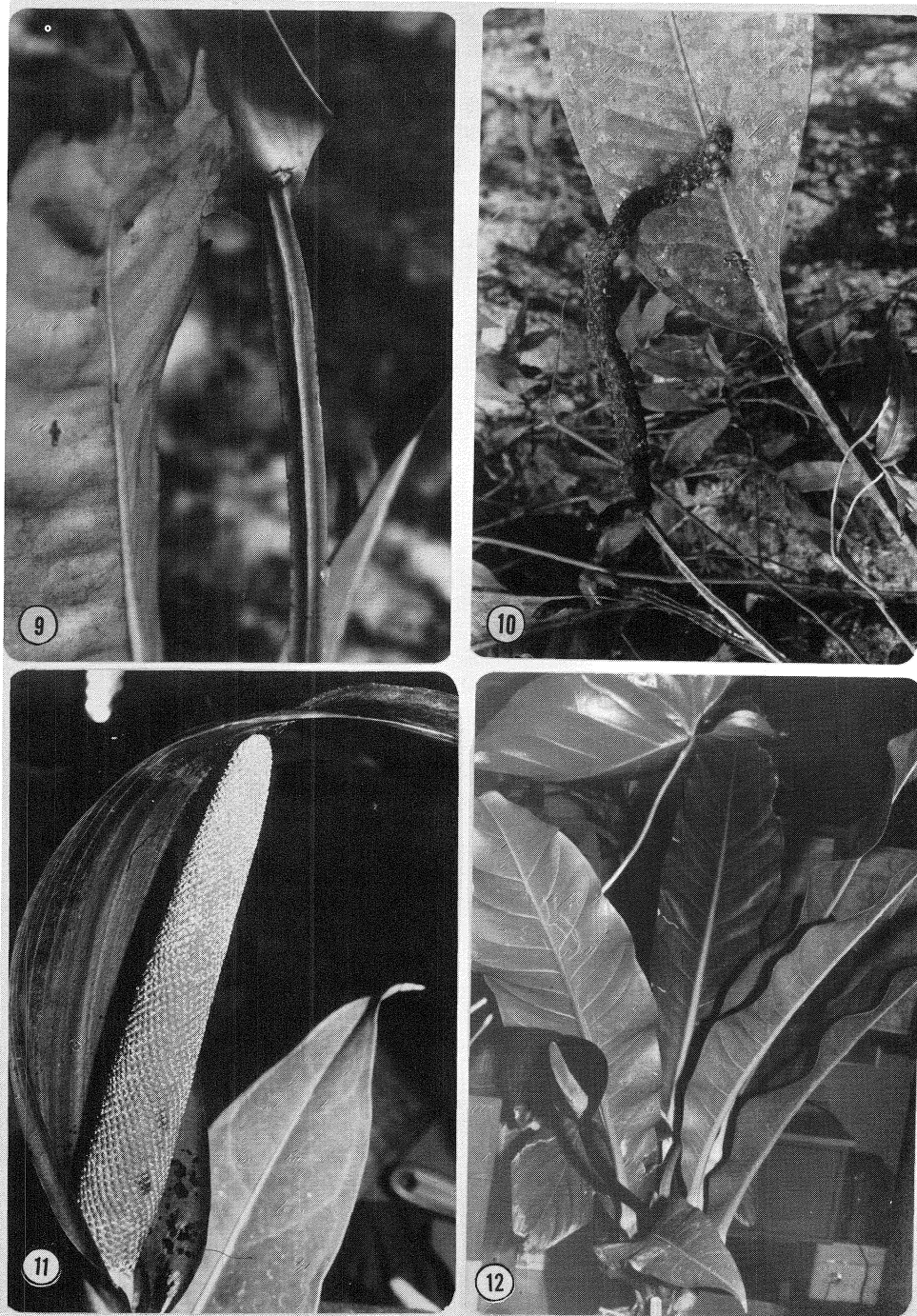


Figure 9. *A. dwyeri* (Croat 34301)  $\times 0.71$ . Figure 10. *A. dwyeri* (Croat 27135)  $\times 0.5$ .  
Figures 11 and 12. *A. luteynii* (Croat 25521)  $\times 0.6$  and  $0.11$  respectively.

Rosulate epiphyte or terrestrial in deep humus; internodes short; roots woody, brown, descending; cataphylls coriaceous, 10-23 cm long, minutely apiculate and inequilateral at apex, drying tan (B&K Yellow-red 9/2.5), the apex remaining intact as reticulate fibers, subpersistent. Leaves usually 7-9, held nearly erect; petioles 9-45 cm long, 1.5-2.5 cm wide, sharply canaliculate, more or less trapezoidal in cross-section, the abaxial surface 3-ribbed, the ribs continuing onto geniculum and lower third of midrib; geniculum 1-2 cm long, much thicker than petiole; blades elliptic-oblong to oblong-oblongate, coriaceous, gradually to abruptly acuminate at apex (the acumen downturned, blunt), acute with upturned edges at base, 50-125 cm long, 9-23 cm wide, broadest near middle; upper and lower surfaces matte to semiglossy; midrib flat near base above, convexly raised at middle, becoming acutely raised and then diminishing at apex, sharply raised below, 3-ribbed in basal third; primary lateral veins 10-25 per side, departing midrib at ca. 60° angle, prominent in valleys above, raised below, slightly arcuate-ascending, loop-connected except at base; interprimary veins sunken above, flat or slightly raised below; submarginal collective vein arising from lower fourth to upper third of blade, sunken or obscure, 3-10 mm from margin, flat above, raised below. Inflorescence erect-spreading and slightly arching, equal to or half as long as leaves, held slightly to side of central leaf cluster; peduncle 49-85 cm long, 1.3-1.7 cm diam., much longer than the petiole, green to violet-purple, with a prominent, rounded rib adaxially, a more prominent rib abaxially, and several smaller vertical lines visible at base, the ribs sometimes twisted; spathe coriaceous, dark purple (B&K Red-purple 2/7.5-2/10), cucullate, inserted at ca. 60° angle on peduncle, narrowly ovate to oblong-lanceolate, 9-33.5 cm long, 2-11 cm wide, broadest ca. 1/3 from the base, acuminate to caudate-acuminate at apex (the acumen 3-4 cm long, sometimes curled down toward spadix), cupped around base of spadix, decurrent ca. 5 mm onto peduncle and joining rib of peduncle, the margins of the spathe joining the peduncle 0.3-1 cm apart, not meeting; spadix violet-purple (B&K Red 2/2.5), 7-17 cm long, 0.8-2.8 cm diam. near base, 0.5-1.7 cm diam. near apex; flowers rhombic to slightly 4-lobed, 2-3.6 mm long, 1.8-3 mm wide, the sides straight to jaggedly sigmoid, the principal spiral right- or left-handed with ca. 15 flowers visible in the principal spiral and ca. 15 flowers visible in the alternate spiral; tepals matte to semiglossy, minutely punctate, covered with a dust-like waxy bloom (at least when dry), the lateral tepals 1.2-1.5 mm wide, the inner margin flat against pistil, turned up when dry; pistils exerted ca. 0.5 mm when anthers are emerging, green at base, purplish-brown at apex, the stigma ca. 1 mm long, producing copious stigmatic droplets for 3-4 weeks before stamens emerge; stamens opening irregularly throughout spadix, the lateral anthers opened throughout before first pairs of alternate anthers appear, the anthers cream-colored, ellipsoid, 0.4-0.5 mm long, 0.6-1 mm wide, opening with pollen exposed as they emerge; thecae weakly rounded, slightly divaricate; pollen white. Infructescence erect or spreading, the spathe cucullate, the spadix 20-25 cm long, to 4 cm wide; fruits oblong-ellipsoid, pointed at apex, orange, 10-15 mm long, 6-8 mm diam.; the pericarp thick, opaque in apical half, translucent in lower half with a few sclereids near the middle; mesocarp pulpy; seeds 2, oblong, tan, weakly beaked at both ends, 6-6.5 mm long, 2-2.7 mm diam., slightly flattened, ca. 2 mm thick.

The species is known only from Panama on both slopes in tropical wet and premontane rain forest life zones at elevations of 600-900 m.



Figure 13. *A. luteynii* (Croat 27169)  $\times 0.18$ . Figure 14. *A. purpureospathum* (Croat 38214)  $\times 0.07$ . Figures 15 and 16. *A. purpureospathum* (Croat 33139b)  $\times 0.35$  and  $0.9$  respectively.

*Anthurium luteynii* is characterized by coriaceous, more or less narrowly oblanceolate leaves, and somewhat trapezoidal petiole which is prominently 3-ribbed abaxially and sharply canaliculate adaxially. Other diagnostic features include the stout, semi-erect inflorescences with broad, often cucullate, purplish spathes and violet-purple spadices and long, sharply pointed, orange fruits.

Though initially confused with *A. seibertii* Croat & Baker because of its orange, pointed fruits and its coriaceous, persistent, intact cataphylls, the species is not believed to be closely related to that species or to any other known species. *A. seibertii* differs principally in having thinner, strap-shaped leaves which always have the collective vein arising from the near the base and in having a narrowly tapered, much paler violet-purple spadix.

*Anthurium luteynii* is possibly best placed in the section *Pachyneurium* but may either have free ending veins typical of that section or a distinct collective vein arising from the base. The species is named in honor of James Luteyn, one of the first collectors of the species.

PANAMA: Coclé: Vicinity of La Mesa, above El Valle de Antón, *Allen 2694* (F); *Croat 37416* (MO); *Luteyn 3162* (DUKE, MO); *Luteyn 3163* (DUKE); Darién: Along headwaters of Río Tuquesa in vicinity of gold mining camp of Tyler Kitteridge, *Croat 27120, 27156, 27169* (MO); Veraguas: Above Santa Fé, vicinity of Escuela Agrícola Alto de Piedra, alt. 735 m, *Croat & Folsom 33993* (MO); *Mori & Kallunki 4751* (MO).

***Anthurium purpureospathum* Croat, sp. nov.** (Figures 14-16, 27)

TYPE: Panama: Bocas del Toro: Station Milla 7.5 on Changuinola-Almirante Railroad, less than 100 m above sea level, along slender ridge to WW II communications facility, ca. 2 km NW of ruins of U. S. Army military barracks, *Croat 38094* (Holotype: MO 2388335; Isotypes: CAS, F, K, MO, PMA, SEL, US; live plant at MO).

Planta epiphytica aut terrestris; petiolus 12-31 cm longus, quadrangularis, in pagina abaxiali tricostatus; lamina oblongo-oblanceolata, coriacea, 27-74 cm longa, 7.5-40 cm lata, basi obtusa aut acuta aut attenuata. Inflorescentia erecta; pedunculus 3-38 cm longus; spatha purpurata; spadix sessilis, purpuratus, 5-22 cm longus. Baccae 1 cm longae, aurantiacae, maturae emergentes.

Epiphytic or terrestrial at higher elevations; caudex hidden by roots; roots dense, 3-4 mm diam., descending; cataphylls coriaceous, 7-14 cm long, acuminate at apex, reddish, drying dark tan (B&K Yellow 5/2.5), subpersistent, remaining intact as reticulate fibers. Prophylls ca. 6 cm long, drying brown and dilacerating. Leaves usually 4-6, erect to spreading; petioles 12-31 cm long, 4-10 mm diam., more or less quadrangular, flat to broadly and sharply canaliculate, usually prominently 3-ribbed abaxially, densely speckled with pale green; geniculum 1-2.5 cm long, thicker and paler than petiole; blades oblong-oblanceolate to oblong-elliptic, coriaceous, acuminate at apex (the acumen minutely inrolled), obtuse to acute or attenuate at base, 27-74 cm long, 7.5-40 cm wide, broadest at or above the middle, the margin flat to undulate; upper surface matte to semiglossy, medium to dark green, lower surface paler, glossy to semiglossy; midrib acutely raised above, diminishing at apex, paler than surface, acutely raised below; primary lateral veins (6)11-14 per side, departing midrib at 45(60)° angle, raised in valleys above, raised

below, arcuate ascending, loop-connected in upper half; interprimary veins flat or prominulous above, prominulous below; secondary veins flat above and below; submarginal collective vein arising from the primary lateral veins near the middle, 4-8(13) mm from the margin, sunken above, raised below; antimarginal collective vein paler than upper surface. Inflorescence erect; peduncles 3-38 cm long, 0.8-2 cm diam., more or less stiff, purplish or green, subterete, equal to or as long as petioles; spathe medium thickness, purple to purplish with green mottling especially near base at center or green mottled with purple (B&K Red-Purple 2/5) at anthesis, spreading then reflexed, the apex recurved, held at 90° angle from peduncle, the spathe oblong to narrowly ovate, 4.5-17.5 cm long, 1.5-4 cm wide, broadest just above the base, cuspidate at apex, obtuse to rounded at base, decurrent ca. 2 mm, the margins somewhat downturned, meeting on peduncle at 100-180° angle; spadix sessile, violet-purple (B&K Purple 2/7.5), (4)5-22 cm long, 1-2.5 cm diam. at base, 4-8 mm diam. at apex; flowers rhombic to weakly 4-lobed, 2-2.3 mm long, 2.5-3 mm wide, the principal spiral right- or-left handed, ca. 14 flowers visible in the principal spiral and ca. 7 flowers visible in the alternate spiral, the sides gradually to jaggedly sigmoid; tepals matte, with small scattered droplets; lateral tepals 1.4-1.6 mm wide, the inner margin flat against pistil; pistils slightly raised, purple (as spadix) becoming green and finally orange, the stigma linear, ca. 5 mm long, with droplets for 4-10 days, drying with exserted papillae 4-6 days before first anther emerges; stamens exserted ca. 1 mm, emerging in a slow progression from the base, the lowermost flowers with their full complement before the middle flowers have any stamens exserted, held in a tight circle, the thecae often contiguous; filaments 0.2-1 mm long, flattened, transparent, tapered to anther, retracting to hold anther at edge of tepals; anthers ca. 0.7 mm long and wide; thecae ellipsoid, usually held closely parallel; pollen golden-yellow (B&K Yellow 8/2.5), drying white. Infructescence erect to spreading, the spathe drying, usually persisting; the spadix 9-19 cm long, to 4 cm diam.; fruits narrowly ovoid, acute at apex with a round, minute, mammilliform style, orange, red-orange to red (B&K Red 6/7.5), to 10 mm long, the mesocarp pasty, clear, sweet; seeds 1 or 2, ca. 4 mm long and 2 mm wide, pale greenish-yellow.

The species is endemic to Panama and occurs principally from near sea level to 200 m in Bocas del Toro Province in wetter parts of tropical moist forest and premontane wet forest. A population on Cerro Colorado in tropical wet or premontane rain forest at 1200-1500 m appears to differ in no way from the populations at lower elevations except that it has thicker leaves and a consistently terrestrial habit. The terrestrial habit is not unusual for populations at higher elevations where a greater accumulation of debris exists and where the steeper slopes provide better drainage. The species should be expected at medium elevations as well.

*Anthurium purpureospathum* is distinguished by its rosulate habit, more or less oblanceolate leaf blades, almost quadrangular petioles often 3-ribbed abaxially, generally short peduncles, usually violet-purple reflexed spathe, usually short violet-purple spadix, early emergent pistils and long, sharply pointed, orange to red-orange fruits.

The species is certainly placed in the section *Pachyneurium*, though the leaves sometimes have a collective vein arising from below the middle. It is closely related to no other known species.

PANAMA: Bocas del Toro: Hill above Milla 7.5, *Croat & Porter 16416* (MO); Vicinity of Ojo del Agua, *Croat 38179, 38180, 38214* (MO); South of Changuinola, *Lazor & Tyson 2661* (MO); Chiriquicito, 5 miles south along Río Guarumo, *Lewis et al. 1985* (MO, NY); Isla Colón, *Wedel 125* (MO); Careering Cay, *Wedel 569* (GH, MO); Water Valley, *Wedel 708* (MO); *Wedel 774* (GH, MO); Shepherd Island, *Wedel 2721* (GH, MO); Río Cricamola between Finca St. Louis & Konkintoe, *Woodson, Allen & Seibert 1889* (MO, NY); Chiriquí: Above San Felix, 1200-1500 m, *Croat 33139, 33257* (MO); Cerro Colorado-Bocas Road, *Folsom 1835* (MO).

***Anthurium rotundistigmatum* Croat, sp. nov.** (Figures 17-20)

TYPE: Panama: Darién: Serranía de Pirré, along ascent above Cana Gold Mine between Río Cana and Río Escucha Ruido; elev. 600-1000 m; premontane rain forest (Holdridge Life Zone Map), *Croat 37745* (Holotype: MO 2465320; Isotypes: F, K, PMA, SEL, US; live plant at MO).

Planta epiphytica; caudex 15-30 cm longus; cataphyllum 5-10 cm longum, brunnescens; petiolus 22-40 cm longus, canaliculatus; lamina ovato-triangularis, cordata, 23-56 cm longa, 17-30 cm lata. Inflorescentia effusa, foliis multibrevior; pedunculus 8-13.5 cm longus, teres; spatha pallide viridis, purpureo tinctorum, basi rotundata; spadix subsessilis, atropurpureus, 10-17 cm longus, basi 7-11 mm diam. Baccae rubrae.

Epiphyte; stems 15-30 cm long, 1.5-2.5 cm diam.; leaf scars 1.4-2 cm wide, roots few, ascending and descending, 2-3 mm diam.; cataphylls coriaceous, (5)9.5-10 cm long, acute and apiculate at apex (the apiculum ca. 2 mm long), green or suffused with violet-purple, turning brown on drying (B&K Red 9/10), falling, more or less intact. Prophylls ca. 4 cm long. Leaves usually 5 or 6, erect or spreading; petioles (22)18-40 cm long, 4-6 mm diam., stiff, medium green with pale speckles, sometimes tinged purplish near base, shallowly and bluntly canaliculate, rounded abaxially; sheath sometimes purplish tinged; geniculum 2-4 cm long, thicker than petiole, same color and shape as petiole; blades ovate-triangular, minutely and obscurely speckled, acuminate and down-turned at apex (the acumen minutely inrolled), deeply cordate at base, (23)26-56 cm long, 17-30 cm wide, broadest at point of attachment of petiole, the margin slightly undulate, the anterior lobe 19-45 cm long, the posterior lobes 7-18 cm long, the sinus parabolic, sometimes spatulate, rounded or obtuse at apex; upper surface matte to semiglossy, medium green, lower surface much paler, matte; midrib prominently and obtusely raised above, diminishing and sunken toward apex, prominently and convexly raised below; basal veins 5-7 pairs, up to 5 of them coalesced 2.5-3 cm, the posterior rib naked ca. half way, the outer margin rolled inward except near the point of petiole attachment; paler than surface and sunken or raised in valleys above, raised and pale below, primary lateral veins 4-8 per side, departing midrib at 40-45° angle, paler than surface, sunken above, raised and paler than surface below; arcuate-ascending; interprimary veins flat or sunken and paler above, raised and darker below; submarginal collective vein arising from near apex, 2-6 mm from margin, sunken above, raised below; antimarginal collective vein relatively conspicuous and paler than surface above, continuous throughout margin. Inflorescence spreading; peduncle 8-13.5 cm long, 3-7 mm diam., flexible, more or less stiff, shorter than petiole; spathe medium thickness, pale green heavily tinged with reddish-purple at anthesis, inserted at ca. 45° angle on peduncle, directed at 120° angle



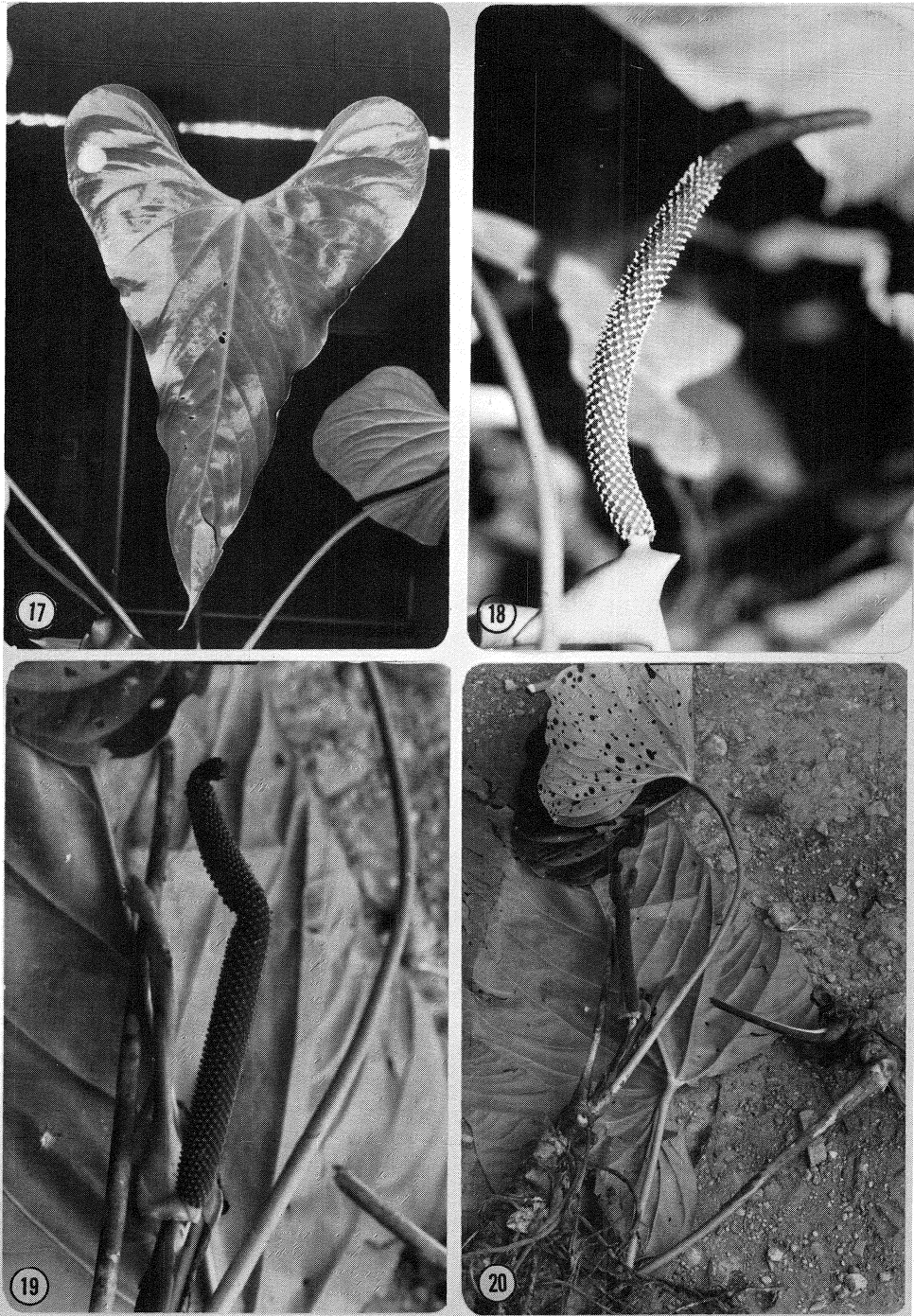
from peduncle, spreading and often twisted, oblong-oblongate, 8-12.5 cm long, 1-3.8 cm wide, broadest ca. 2 mm above the point of attachment, acuminate at apex, rounded at base, the margins upturned, forming a pocket at the base, meeting on peduncle at 140° angle; the stipe ca. 7 mm long adaxially, ca. 1 mm long abaxially, ca. 6 mm diam., green; spadix violet-purple (B&K Purple 2/2.5) at anthesis, 10-17 cm long, 7-11 mm diam. at base, 4-5 mm diam. at apex; flowers 4-lobed, 3-3.5 mm long, 2-2.5 mm wide, the sides jaggedly sigmoid; the principal spiral left-handed with 9-11 flowers visible, and 7 or 8 flowers visible in the right-hand spiral; tepals dark purple with pale punctations, minutely papillate, semiglossy, separating as stamens emerge to show deep, pale yellow cracks, the lateral tepals 1.6-1.8 mm wide, the outer margin unequally 3-sided; pistil slightly emergent at anthesis, paler than tepals (translucent white with purplish blotches), at first covered by tepals, exposed ca. 1 week before first stamens emerge, becoming prominently exerted; the stigma oblong-elliptic, white, ca. 0.5 mm long with glistening papillae, then filled with droplets 4-6 days before stamens emerge, dry when stamens open; stamens emerging from the base first or scattered throughout, then developing a full complement promptly except for the flowers in the advancing spirals, the stamens positioned at random around pistil; filaments retracting to hold pollen against pistil, transparent, ca. 0.7 mm long and 0.6 mm wide; anthers yellow, held curved over pistil before opening, ca. 0.9 mm long and 0.7-0.8 mm wide; thecae ellipsoid, not divaricate; pollen yellow fading white (B&K Yellow 9/7.5). Infructescence pendent; fruits obovoid, rounded at apex, ca. 6 mm long, 4.5 mm diam., red at apex, the exposed area around the style round and scruffy, ca. 2 mm diam.; pericarp thin, with moderately few punctiform sclereids near the apex; seeds 2, broadly ellipsoid, markedly flattened, greenish, 2.5-3 mm long, 2.2-2.5 mm wide.

The species is known for certain from tropical wet forest and premontane wet forest at elevations of 500-1000 m in Darién Province. Sterile collections from Cerro Jefe, *Croat 35924* (MO), and Cerro Tute, *Croat & Folsom 34233* (MO), are probably also this species. Another sterile collection, *Croat 34440* (MO), from tropical moist forest at less than 150 m elevation matches this species also, but is well outside the expected ecological range of the species.

The species is best characterized by its thin, ovate-triangular leaves, violet-purple spadix, and especially the markedly protruded pistils which emerge from the tepals well before the stamens emerge. Though sterile collections of *A. rotundistigmatum* can be confused with *A. ochranthum* Schott, the latter species is consistently terrestrial and has a bright yellow spadix at maturity with pollen usually oozing from submerged anthers in slender paste-like ribbons. *A. rotundistigmatum* is probably in section *Belolonchium*.

Flowering specimens have been found only during July and August. The name is derived from its characteristically large stigma.

PANAMA: Darién: La Boca de Pirré, *Bristan 1291* (US); Headwaters of Río Tuquesa, 500 m, *Croat 27130, 27142* (MO); Serranía de Pirré above Cana Gold Mine, 600-1000 m, *Croat 37745* (MO); Cerro Pirré, *Folsom 4400* (MO); Panamá: Río Maje, 50 m, *Croat 34440* (MO); Vicinity of Cerro Jefe, *Croat 35924* (MO); Veraguas: Above Santa Fé, *Croat & Folsom 34233* (MO).



Figures 17, 18, 19 and 20. *A. rotundstigmatum* (Croat 37745)  $\times$  0.18, 0.50, 0.50 and 0.15 respectively.

***Anthurium salvadorensis* Croat, sp. nov.**

(Figures 21-23)

TYPE: El Salvador; Dept. of Ahuachapán: 1.5 miles SW of Tacuba on road to San Francisco Menéndez; riverbank, Río Chokama, alt. 700 m, *Croat 42169* (Holotype: MO 2583750; Isotypes: CAS, F, ITIC, K, MO, SEL, US; live plant at MO, Pacific Tropical Botanical Garden).

Planta terrestris aut rupicola; petiolus quadrangularis, 11-22 cm longus, 4-5 costatus; lamina elliptica aut oblanceolata, basi obtusa aut subrotundata aut subauriculata, 25-50 cm longa, 8-26 cm lata. Inflorescentia effusa; pedunculus 13-45 cm longus, basi amplexans; spadix sessilis, viridis pallide, 2.5-6.5 cm longus, basi 8-12 mm diam. Baccae ignotae.

Terrestrial or rupicolous; stems 2-3 cm diam., usually well rooted; roots to 1 cm thick, descending; cataphylls moderately thick, 5-8 cm long, apiculate at apex, pale green, drying light brown (B&K Yellow 5/5), persisting intact or dilacerating. Prophylls 2-5 cm long, pale green, fading tan. Leaves usually 3-6; petioles more or less quadrangular, 11-22 cm long, 6-8 mm wide and 7-9 mm thick, green with paler speckles, stiff, the sides more or less parallel, broadly rounded to slightly 3-ribbed abaxially, broadly and sharply canaliculate, sometimes with a medial rib; geniculum 1-1.5 cm long, thicker and paler than petiole, shaped like petiole; blades elliptic to oblanceolate, medium thick, gradually acuminate at apex, turned downward (the acumen ca. 1.5 cm long, minutely inrolled), obtuse to rounded and auriculate at base, 25-50 cm long, 8-26 cm wide, broadest at or above the middle, the margin undulate, slightly irregular; upper surface matte to semiglossy, medium green, lower surface paler, matte; midrib obtuse and raised above, diminishing and sunken at apex, paler than surface, convexly raised and paler below, ribbed near base; primary lateral veins 8-14 per side, departing midrib at ca. 45° angle, raised at midrib, diminishing and sunken near margin above, prominently raised below, straight to near margin, loop-connected in upper half; interprimary veins few, paler, flat above, raised below; secondary veins weakly sunken or flat above, flat below; tertiary veins flat above and below; submarginal collective vein arising from middle or above, ca. 5 mm from margin, paler and sunken above, raised below; antemarginal collective vein paler than upper surface. Inflorescences spreading; peduncle 13-45 cm long, 5-7 mm diam., stiff, faintly striate, 1-ribbed adaxially and sometimes also abaxially, longer than petioles; spathe ovate-lanceolate, coriaceous, stiff, pale green, held erect, enshrining and wrapped around base of spadix, (B&K Yellow-Green 8/10), 4.5-6.5 cm long, 2.4-2.7 cm wide, broadest just above base, narrowly acute, inserted at 10-25° angle on peduncle, the margins meeting on peduncle at 90-180° angle, then turning down for ca. 3 mm before joining peduncle; spadix sessile, pale green (B&K Green 8/5), 2.5-6.5 cm long, 8-12 mm diam. near base, 4-7 mm diam. near apex, held at a slight angle from the peduncle; flowers irregularly 4-lobed, 2-3.3 mm long, 2.5-3.6 mm wide, the sides jaggedly sigmoid, the principal spiral right- or left-handed, ca. 10 flowers visible in the principal spiral and ca. 9 flowers visible in the alternate spiral; tepals matte, densely papillate, lateral tepals 1.4-1.7 mm wide, turned up against emerging pistil; pistils weakly exerted, green; the stigma elliptic, ca. 0.4 mm long, erect and brushlike, with a small droplet apparent 2-4 days before first anthers emerge; stamens emerging rapidly in a soon complete progression from the base, one or two lateral anthers open in flowers at apex when the 3rd and 4th stamens are emerging from flowers at the base, the stamens held in a close, contiguous circle around and then over the

stigma, held at about the same height as the style; anthers pale green, 0.8-1.2 mm long, 0.7-1.3 mm wide, the thecae weakly divaricate; pollen pale yellow, soon fading white. Infructescence spreading, the spathe persisting and erect-spreading, the spadix to 9 cm long and ca. 2 cm diam.; immature fruits obovoid, 5.5 mm long, 4 mm wide, rounded at apex; pericarp moderately thick, with dense punctiform sclereids, especially in apical half; seeds 1 or 2, broadly ellipsoid, rounded on both ends, ca. 4.3 mm long and 3 mm wide, densely covered with punctiform sclereids.

*Anthurium salvadorensis* is known only from El Salvador and Guatemala at 500-800 m elevation. It was first collected by Sisto Alberto Padilla in 1922 in the Department of Ahuacapán in El Salvador. The species was later collected by Paul C. Standley in the adjacent Department of Jutiapa in Guatemala.

The species is a typical member of section *Pachyneurium* and the earlier collections were confused with *A. schlechtendalii* Kunth, to which it is related. *Anthurium salvadorensis* is distinguished by being usually a well-rooted plant with fewer, very large fleshy roots and a usually almost elliptic blade, but especially by its inflorescence which has a pale green, ovate-lanceolate spathe which is weakly convolute at the base and erect, enshrining the usually short, pale green spadix. *Anthurium schlechtendalii* differs in having usually oblanceolate blades, a coriaceous, more lanceolate, prominently reflexed, usually purplish spathe and a more elongate, purplish spadix.

The species is named for the country in which it was originally collected.

EL SALVADOR: Ahuacapán: Vicinity of El Impossible, *Bernhardt s.n.* (MO); *Croat 42092* (MO); *Croat 42169* (MO); *Padilla 296* (US); GUATEMALA: Jutiapa: Vicinity of Jutiapa, 850 m, *Standley 76313* (F, US).

*Anthurium sanctifidense* Croat, sp. nov.

(Figures 24, 26, 29, 30)

TYPE: Panama; Veraguas: 0.2 miles beyond fork in road at Escuela Agrícola Alto Piedra, above Sante Fé, ca. 750 m elev., *Croat & Folsom 33957* (Holotype: MO 2381537; Isotypes: CAS, CR, F, K, MO, NY, PMA, SEL, US; live plant at MO).

Planta terrestris; caudex elongatus; cataphyllum 10-20 cm longum, subteres; lamina late ovata, in pagina inferiore obscure punctata, basi cordata, 21-57 cm longa, 16-46 cm lata. Inflorescentia erecta; pedunculus 7-36 cm longus, 5-8 mm latus, subteres; spatha viridis pallide aut alba, ovata aut lanceolata aut oblongo-elliptica; spadix subsessilis, albus aut viridis pallide, 6.7-15 cm longus, basi 9-11 latus. Baccae purpureae.

Terrestrial, rarely epiphytic; caudex 1.5-2 cm diam., to 30 cm long or more; leaf scars often hidden by persisting cataphylls; roots stout, green to grayish; cataphylls moderately thick, 10-20 cm long, cuspidate-acuminate at apex, drying reddish-brown, persisting intact. Prophylls 4-5 cm long. Leaves usually 4 or more; petioles 33-50 cm long, 4-11 mm diam., subterete, shallowly and bluntly canaliculate; geniculum 2.5-3 cm long, slightly thicker than and shaped like petiole, sometimes greatly thickened where it meets the blade; blades broadly ovate, cordate at base, abruptly acuminate at apex (the acumen slightly twisted, downturned, flat or inrolled at tip), 21-57 cm long, 16-46 cm wide, broadest at point of petiole attachment, the margin broadly undulate, scarcely revolute; anterior lobe 16-35 cm long, the margins broadly rounded, not at all constricted at base; basal lobes 5-14 cm long, directed



Figures 21, 22 and 23. *A. salvadorens* (Croat 42169)  $\times$  0.42, 0.75 and 0.13 respectively.  
Figure 24. *A. sanctifidens* (Croat 33957)  $\times$  0.40.

basally or somewhat outward, the sinus parabolic to broadly triangular, obtuse to rounded at apex; upper surface matte to semiglossy, medium green, drying dark brown with sparse, pale, linear sclereids; lower surface moderately paler with many pale, weakly raised, round glands (not dark punctations); midrib above obtusely raised, diminished and sunken at apex, paler than surface, below obtusely raised, extending to the apex, slightly paler than surface; basal veins 5 or 6 pairs, 2 or 3 of them coalesced 1.5-3 cm, paler than surface above, raised at base, sunken near margin above, paler and raised below, the posterior rib straight to slightly curved, naked, the outer margin rolled upward; primary lateral veins 5-7 per side, departing midrib at ca. 45° angle, more or less straight to collective vein, raised or sunken above, raised below; interprimary veins few, flat above and below; secondary veins weakly raised to flat above, in part raised and in part weakly sunken below; submarginal collective vein arising from the uppermost basal vein or one of the primary lateral veins, weakly sunken above, mostly 5-7 mm from the margin, weakly raised below; antemarginal collective vein paler than surface. Inflorescences stiffly erect; peduncle 7-36 cm long, 5-8 mm diam., subterete, 1/6-1/3 as long as petioles; spathe pale green to greenish-white, medium thick, reflexed-spreading, held at 30-90° angle from peduncle, ovate to lanceolate or oblong-elliptic, 5.5-15 cm long, 2.8-3.4 cm wide, broadest just above peduncle, cuspidate-acuminate at apex (the acumen 1.5-3 cm long), obtuse to weakly subcordate at base, decurrent ca. 6 mm, the margins turned down near the base, meeting on peduncle at 90-150° angle; stipe 5-19 mm long adaxially, 2-7 mm long abaxially, green; spadix greenish white (B&K Yellow-green 9/7.5), 6.7-15 cm long, 9-11 mm diam. near base, 5-9 mm diam. near apex; flowers subrhombic to 4-lobed, 3-3.3 mm long, 3.3-3.6 mm wide, the sides jaggedly sigmoid to almost straight, the sides parallel to the spiral, straighter than those perpendicular to the spiral; the principal spiral right-handed with 7-17 flowers visible and 5-11 flowers visible in each left-hand spiral; tepals glossy, smooth, the lateral tepals 1.4-1.8 mm wide, the inner margin very broadly rounded to almost straight, turned up against pistil; pistils flat to moderately exserted, pale green to white, becoming purplish, exserted 0.3-0.7 mm (including style) at anthesis; the stigma tufted, raised, colorless, extending ca. 0.3 mm above the pistil, apparently not forming nectar droplets; stamens emerging moderately rapidly, scattered from the middle and soon progressing toward both ends, held over the pistil; the anthers creamy-white, 0.5-0.6 mm long, 0.8-0.9 mm wide, obscuring pistil when completed; the thecae narrowly ovoid, slightly divaricate; pollen white. Infructescence with spathe persistent, the spadix purplish. Fruits obovoid, ca. 8 mm long, 5.5 mm wide, rounded at apex, violet-purple, whitish toward the base; pericarp thin with moderately conspicuous linear sclereids; seeds 2, pale green (?), encased in a mucilaginous, transparent sack, to ca. 6.5 mm long, moderately flattened, oblong-ellipsoid, emarginate at apex, ca. 5 mm long and 4 mm wide.

*Anthurium sanctifidense* is known only from Panama, though it is expected to be found in the Chocó of Colombia. It is known from areas of tropical wet and premontane rain forest on both sides of the isthmus and on both sides of the Continental Divide.

The species is a member of section *Calomystrium* and is most easily confused with *A. hoffmannii* Schott. *Anthurium sanctifidense*, named for the Santa Fé region of Veraguas Province where it was first recognized as a new species, is distinguished from other section *Calomystrium* species in Panama by its frequently terrestrial habit, pale, matte lower leaf surface and by its



Figure 25. *A. luteynii* (Croat 25521)  $\times$  0.20. Figure 26. *A. sanctifidense* (Croat 33957)  $\times$  0.21. Figure 27. *A. purpureospathum* (Croat 33257)  $\times$  1.10. Figure 28. *A. vallense* (Croat 37327)  $\times$  0.11.

purplish fruits. *Anthurium hoffmannii* is probably more frequently epiphytic, has leaf blades semiglossy on the lower surface, and has red fruits.

PANAMA: Chiriquí: Cerro Colorado 1610-1670 m, *Croat 37100* (MO); Coclé: N of El Copé, *Croat 44567* (MO); *Folsom 1339* (MO); *Folsom & Jaslon 2692* (MO); *Folsom 3182* (MO); *Hammel 1051, 2346* (MO); Colón: without further locality, *Tyson et al. 4541* (SCZ); Darién: Vicinity of gold mining camp of Tyler Kittredge, *Croat 27285* (MO); Panamá: Altos de Río Pacora, 2500 feet, *Herrera 2327* (MO); Campo Tres 3 mi NW of Altos de Pacora, 500-800 m, *Liesner 580* (MO); *Cerro Jefe*, D'Arcy 6231 (MO); 10 mi N of Hwy 1 towards Cerro Jefe, *Luteyn 1326* (DUKE); El Llano-Cartí Road, *Busey 889* (MO); *Croat 26067, 34803* (MO); *Folsom 2585, 3489, 3490, 3491* (all MO); *Kennedy et al. 3136* (MO); *Liesner 1235* (MO); *Nee 7943* (MO); San Blas: Forest SW of Puerto Obaldía, *Croat 16819* (MO); Veraguas: Along Road between Escuela Agrícola Alto de Piedra and Calovebora, 15.6 km NW of Santa Fé, *Croat 23015A, 27598, 27698A* (MO); *Croat & Folsom 34129* (MO); *Folsom & Collins 1607, 1617* (MO); *Folsom 2983* (MO); *Hammel 4647* (MO); *Liesner 829* (MO); *Mori et al. 3803a* (MO); *Mori & Kallunki 6192* (MO); *Nee 9718* (MO).

*Anthurium vallense* Croat, sp. nov.

(Figures 28, 31, 32)

TYPE: Panama: Coclé: La Mesa, above El Valle de Antón, ca. 2 km west of Cerro Pilón on slopes of steep hill, alt. 860-900 m, disturbed virgin forest, *Croat 37327* (Holotype: MO 2395387; Isotypes: CAS, F, K, PMA, SEL, US; live plant at MO).

Planta epiphytica aut terrestris, repens; cataphyllum ad 12 cm longum, subpersistens; petiolus 7-16 cm longus, acute triangularis; lamina elliptica aut oblanceolato-elliptica, base acuta aut obtusa, 17-40 cm longa, 5-16 cm lata. Inflorescentia erecto-effusa; pedunculus 25-46 cm longus; spatha viridis pallide, oblonga aut oblongo-lanceolata; spadix sessilis, viridis aut flavus, interdum rubellus, 5-18 cm longus, basi 3-7 mm latus. Baccae ovoidae, apice acutae, rubrae, 6-10 mm longae.

Creeping epiphyte or terrestrial; stems elongate, to 60 cm long or more, ca. 1.5 cm diam.; internodes to 1.5 cm long, shorter near apex; leaf scars ca. 1 cm wide; roots long, thin, moderately dense; cataphylls to 12 cm long, green, acute and apiculate at apex, drying tan, dilacerating and persisting as a network of fibers. Prophylls ca. 3 cm long, dilacerating like cataphylls. Leaves usually 4-9, spreading; petioles 7-16 cm long, ca. 10 mm wide, triangular, sharply canaliculate, sharply 1-ribbed abaxially, medium green with dense light speckles; geniculum 1-2 cm long, scarcely thicker and paler than petiole, shaped like petiole; blades elliptic to oblanceolate-elliptic, slightly arched along the midrib, coriaceous, abruptly short- to long-acuminate at apex (the acumen minutely apiculate), acute to obtuse at base, 17-40 cm long, 5-16 cm wide, broadest near middle or above, the margin flat and smooth; upper surface glossy, medium-dark green, minutely punctate; lower surface somewhat paler, glossy, minutely and more or less densely punctate; midrib above raised, narrowly acute, diminishing toward apex, paler than surface, sharply and acutely raised below; primary lateral veins 14-18 per side, departing midrib at ca. 45° angle, sunken above, raised below, almost straight to the collective vein; interprimary veins sunken above, raised below, submarginal collective vein arising from the base, mostly ca. 5 mm from the margin, about as prominent as the primary lateral veins, sunken above, raised below; antemar-





Figures 29 and 30. *A. sanctifidense* (Croat 33957)  $\times$  0.40 and 0.10 respectively. Figure 31. *A. vallense* (Croat 27476)  $\times$  0.20. Figure 32. *A. vallense* (Croat 44751)  $\times$  0.25.

ginal collective vein paler than upper surface. Inflorescences erect-spreading, longer than the leaves; peduncle 25-46 cm long, ca. 5 mm diam., 3-7 times longer than petioles; spathe medium thickness, pale green, inserted at ca. 70° angle on peduncle, directed at 30-150° angle from peduncle, spreading-reflexed, oblong or oblong-lanceolate, 11-15 cm long, 1.5-2 cm wide, broadest near middle, acuminate at apex, obtuse at base; spadix sessile, green to yellow, sometimes reddish, 5-18 cm long, 3-7 mm diam. near base, 2-6 mm diam. at apex, held at 180° angle from peduncle; flowers rhombic, ca. 3.5 mm long, ca. 1.5 mm wide, the sides straight to slightly sigmoid; the principal spiral right- or left-handed, with 3-5 flowers visible in the principal spiral; lateral tepals ca. 1.5 mm wide, the inner margin convex; the pistil slightly raised at anthesis; the stigma ca. 0.8 mm long, oblong, brushlike, exserted; anthers (dry) ca. 3 mm long and 5 mm wide, the thecae ellipsoid, scarcely divaricate. Infructescence spreading-pendent, the spathe reflexed, sometimes missing; the spadix 11-45 cm long, 1-1.5 cm diam.; fruits ovoid, red, 6-10 mm long, prominently exserted.

*Anthurium vallense* ranges from Panama to Colombia though it is interesting to note that in Panama, it has been collected only west of the isthmus where it occurs in premontane, wet, tropical wet and premontane rain forest at elevations of 350-1200 m. In Colombia, the species may occur almost at sea level.

The species apparently flowers and fruits year round with most flowering occurring from August to January and most fruits maturing from February to August.

*Anthurium vallense* is characterized by its elliptic to oblanceolate-elliptic, punctate leaves and especially by the conspicuous network of weathered, fibrous cataphylls which persist. The species is similar to several undescribed punctate-leaved species with similar leaves and orange, truncate fruits. It is perhaps closest to *A. binervia* Croat (ined.) but is distinguished from that species by its conspicuous cataphylls and by its red fruits. It is a member of section *Porphyrochitonium*.

The name *vallense* is taken from the El Valle region of Panama (Coclé Province) in which the species was first discovered by Paul Allen while he was in Panama working for the Missouri Botanical Garden.

PANAMA: Coclé: La Mesa N of El Valle de Antón, Allen 2731 (F, MO); Croat 13426, 14376, 14289, 25409 (MO); Duke & Correa 14698 (US); Dwyer 11883 (AAU, MO); Dwyer 11910 (AAU, GH, MO); Folsom & Butcher 2794, 2839A, 2839B (MO); Folsom 3118, 3641 (MO); Folsom & Raul 5643 (MO); Gentry 5657, 7444 (MO); Kennedy & Dressler 1756 (MO); Kennedy et al. 3044 (MO); Luteyn 1148 (DUKE, MO); Luteyn 1152 (DUKE); Luteyn & Kennedy 1620 (DUKE, MO); Nee & Dwyer 9143 (MO); Nee & Hale 9628 (MO); Porter et al. 4426 (MO); Sullivan 479 (MO); Wilber et al. 15659, 15668 (DUKE); Above El Copé: Croat 44751 (MO); Folsom 1215 (MO); Folsom & Lantz 1874 (MO); Folsom 2342A (MO); Folsom & Robinson 2405 (MO); Folsom 3241 (MO); Folsom et al. 5691 (MO); Folsom & Collins 6521 (MO); Folsom 3413, 4946, 4947 (MO); Hammel 781, 996, 1024, 2360, 2399, 2400, 2542, 2624, 2637, 2638, 3523, 3524, 3556 (MO); Cerro Caracoral, Kirkbride 1114 (MO); North rim of El Valle de Antón, near Cerro Teruga, Woodson & Schery 198 (MO); 7 km N of Llano Grande on road to Coclesito, Hammel 1949 (MO); Colón: Río Guanche, ca. 2 miles upstream from bridge, Kennedy & Mori 3458 (F); Veraguas: On road between

Escuela Agrícola Alto Piedra (above Santa Fé) and Calovebora, *Croat* 23009, 23022, 23023, 27363, 27476, 27566, 27661 (MO); *D'Arcy* 10307 (MO); *Liesner* 1024 (MO); *Mori et al.* 3829, 3888, 3948 (MO); *Mori & Kallunki* 6122 (MO); *Mori* 6658, 6721 (MO); *Mori & Bolten* 7613, 7666 (MO); trail up east side of Cerro Tute, 1200 m, *Witherspoon et al.* 8874 (MO); COLOMBIA: Chocó: Tutunendo, 20 km N of Quibdó, 80 m, *Archer* 2164 (US); Estribaciones del Alto del Buey y Río Mutatá, 300-1000 m, *Ferrero & Gentry* 793 (COL); Corcovada Region, upper Río San Juan; ridge along Yeracui Valley, 200-275 m, *Killip* 35238 (US); Valle: Costa del Pacifico, Río Naya, Puerto Merizalde, *Cuatrecasas* 14102 (VALLE); Costa del Pacifico, Río Yurumanguí, Veneral, 5-50 m, *Cuatrecasas* 15759 (F, US); Río Calima (Region del Chocó), La Trojita, 5-50 m, *Cuatrecasas* 16460 (VALLE); Costa del Pacifico, Bahía de Buenaventura, Quebrada de San Joaquin, 1-10 m, *Cuatrecasas* 19931 (VALLE).

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