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New Species of *Peliosanthes* and *Tupistra* (Asparagaceae) from Eastern Indochina

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ABSTRACT: Five new species of *Peliosanthes* (*P. argenteostriata*, *P. grandiflora*, *P. nivea*, *P. nutans, P. retroflexa*) and one species of *Tupistra* (*T. theana*) of Asparagaceae (Convallariaceae s.str.) family discovered recently in eastern Indochina (Vietnam and Laos) during extensive field work are described and illustrated. All described species are local endemics with very restricted geographical range. Data for each described species comprise standard citation of type specimens, description, list of paratypes, proposed species epithet etymology, data on ecology and distribution, as well as short taxonomic remarks.

KEY WORDS: Asparagaceae (Convallariaceae s.str.), eastern Indochina, new species, *Peliosanthes*, plant taxonomy, *Tupistra*.

INTRODUCTION

Southeastern mainland Asia, particularly areas of southern China and eastern Indochina, are well known as important center of species diversity of such more or less related genera of Asparagaceae Juss. (Convallariaceae Horan.), as *Aspidistara* Ker Gawl., *Liriope* Herb., *Ophiopogon* Ker Gawl., *Peliosanthes* Andrews and *Tupistra* Ker Gawl. (including *Campylandra* Baker). Last two genera comprise in Chinese territory 6 and 20 species respectively (Chen Xinqi, Tamura, 2000; Liang Songyun, Tamura, 2000a, b; Tanaka, 2010b.). Meanwhile, these genera actually were not studied in neighboring regions of the Indochinese peninsula until recently. First taxonomic treatment in classic "Flore Generale de l'Indo-Chine" (Lecomte, Humbert, 1908-1937) for Indochina (which included Thailand, Laos, Cambodia and Vietnam) mentioned only 7 species for both genera tentatively recorded in this vast territory (Rodriguez, 1934; Gagnepain, 1934). Later formal compilations on Vietnamese flora uncritically repeated these data in a number of editions using no new data or new collections for the study (Ho Pham Hoang, 2000; Nguyen Thi Do, 2005). Some additional data were obtained during later, rather sporadic works, which described 3 species of *Peliosanthes* and 1 species of *Tupistra* from Laos and Vietnam (Tanaka, 1999, 2004, 2010c; Averyanov, 2011). Excellent, but still very preliminary assessment of Laotian flora recorded 1 species of *Tupistra* and 5 species of *Peliosanthes* based mainly on old data available in antique literature (Newman et al., 2007). Here may also be mentioned publication of Jessop, who proposed combining all earlier recognized southeast Asian *Peliosanthes* taxa into a single, very variable species - *P. teta* Andrews (Jessop, 1976). This curious point of view was not supported by further morphological studies, as well as obtained molecular data (Yamashita, Vogel, Tamura, 2002). Now most taxonomists mainly ignore it. At the same time there exist no doubt that flora of eastern Indochina (mainly Vietnam and eastern Laos) like flora of southern China is very rich in local, geographically very restricted, and taxonomically clearly distinct endemics. Recent field explorations completely confirm this supposition.

Five new species of *Peliosanthes* (*P. argenteostriata*, *P. grandiflora*, *P. nivea*, *P. nutans, P. retroflexa*) and one species of *Tupistra* (*T. theana*) discovered recently in eastern Indochina during extensive field explorations are described and illustrated below. Described taxa are listed below in alphabetical order. Data for each species comprise standard citation of type specimens, list of paratypes, description, species epithet etymology, data on ecology and distribution, as well as short taxonomic remarks.

Peliosanthes argenteostriata Aver. et N. Tanaka, ***sp. nov.*** Figs. 1 & 2a, b.

Described from central Vietnam ("Quang Binh prov., Minh Hoa distr., Thuong Hoa Municipality, about 1-1.5 km to SW of Ban On village, Ca Xach mountain around point 17°39'20"N, 105°57'42"E (Phong Nha - Ke Bang national park). Primary closed evergreen broad-leaved gnarled stunted forest along

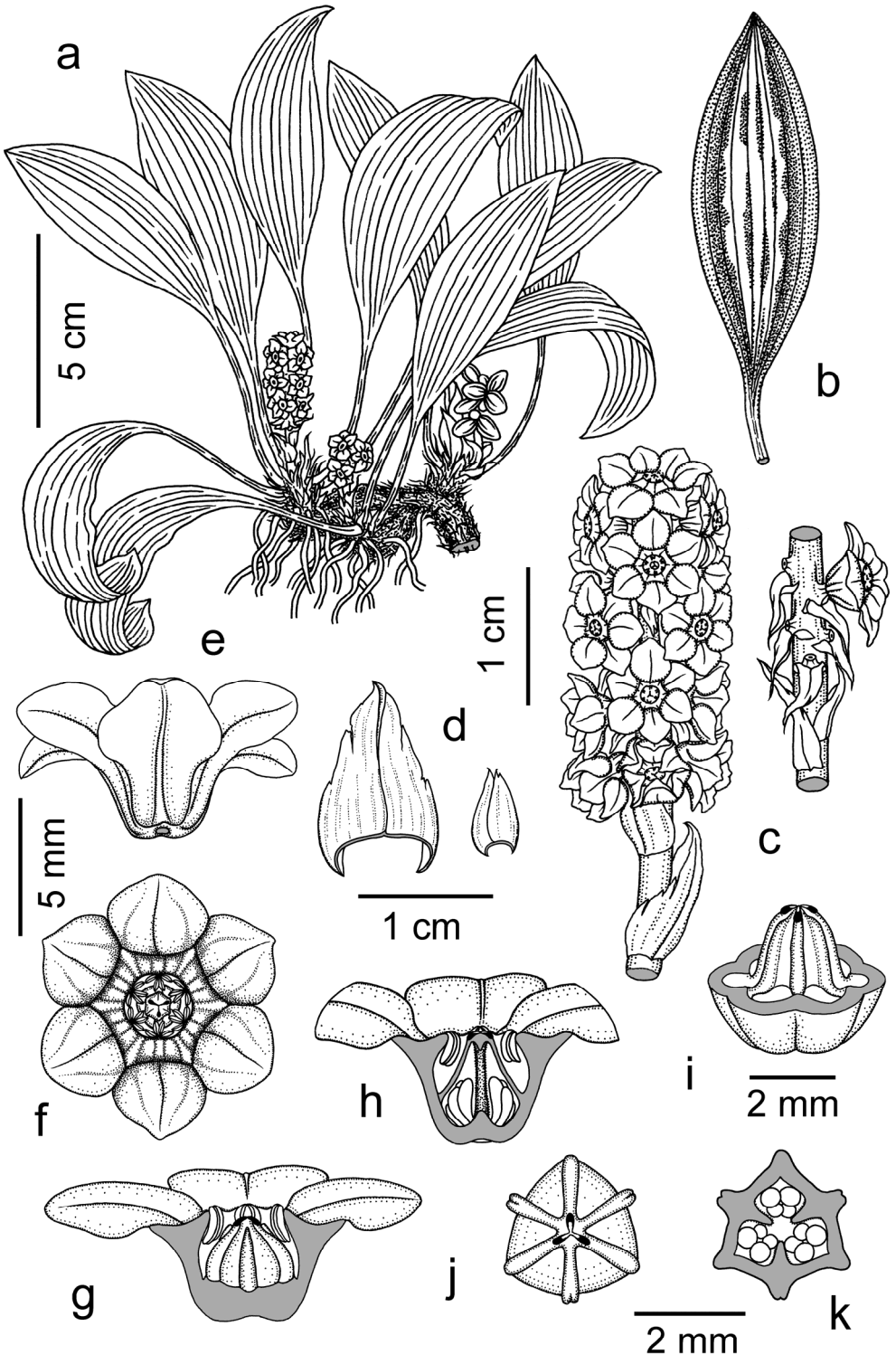

Fig. 1. ***Peliosanthes argenteostriata*** **Aver. et N. Tanaka. a: flowering and fruiting plant. b: character of leaf coloration. c: intact inflorescence and portion of inflorescence with flowers removed except one. d: sterile and floral bracts. e: opening flower, side view. f: open flower, frontal view. g, h: sagittal section of open flower with intact ovary and sagittal section of ovary. i: ovary, side view on flower base with perianth removed. j: ovary, view from above. k: cross section of ovary in middle part (all drawn from the type -** ***HAL 5975*** **by L. Averyanov).**

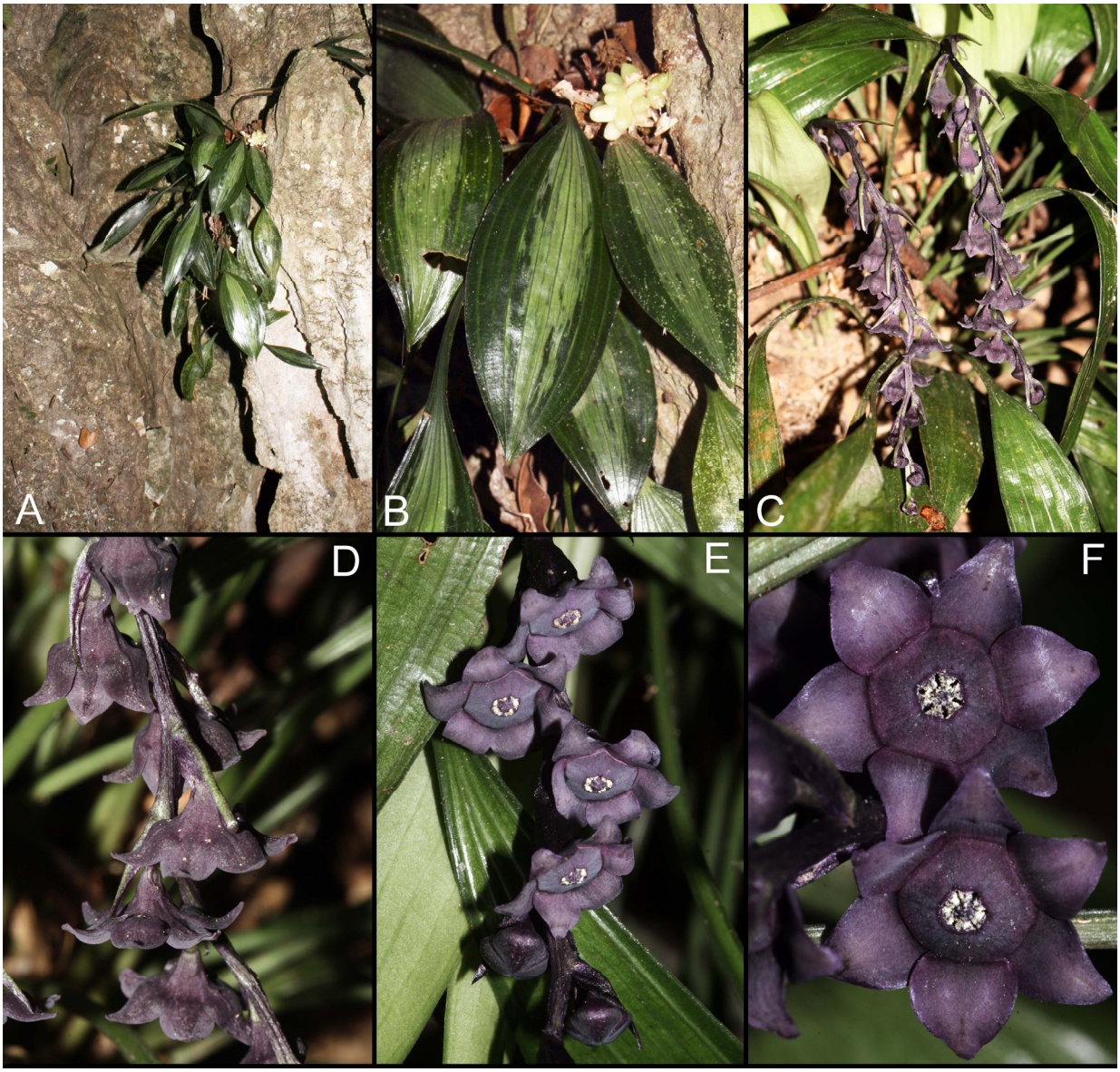

Fig. 2. *Peliosanthes argenteostriata* Aver. et N. Tanaka. a, b: fruiting plant in typical habitat (*CPC 3824*). *P. nutans* Aver. et N. Tanaka. c-f: flowering plant in natural habitat, inflorescence and flowers (type specimen - *CPC 3538*). All photos by L. Averyanov.

rocky ridge composed of solid marble-like highly eroded crystalline limestone at elevation 600-800 m a.s.l. Terrestrial and lithophytic herb on very steep rocky slope").

Type: ("20 January 2005, *L.Averyanov, P.K.Loc, P.V.The et al., HAL 5975*") - CPC Herbarium (holotype), HN, LE, MO (isotypes).

Terrestrial or lithophytic perennial herb with plagiotropic, creeping, often branching rhizome 2-5 (8) cm long, 0.5-1 cm in diam., covered with numerous irregularly imbricate, cuneate, papyraceous, whitish scales, bearing many rigid, rather fleshy roots. Stem ascending or erect, abbreviate, to 2 cm tall, covered with numerous, loose whitish herbaceous scales. Leaves petiolate; petiole rigid, usually strongly curved or suberect, 3-6 (8) cm long; leaf blade narrowly to broadly elliptic, 7-10 (12) cm long, 2-4.5 cm wide, leathery, glabrous, glossy and dark green with wide silvery-whitish longitudinal median stripe adaxially, light green to whitish-green abaxially, acute, secondary transverse veinlets not visible or very indistinct, almost perpendicular to 5-9 (11) prominent longitudinal veins. Inflorescence hysteranthous, many-flowered dense spadix-like raceme, 3-4 cm tall; peduncle light green,

erect, herbaceous, 1-1.5 cm long, 2-3 mm in diam., with (1) 2-4, loose, broadly triangular, acute, incised, papyraceous, whitish sterile bracts, 0.7-1.2 (1.4) cm long, (4) 6-10 mm wide; rachis 1-2.5 (3) cm long, bearing (4) 6-20 (30) flowers. Floral bracts whitish, papyraceous, triangular-ovate to triangular-cordate, acute and often cucullate at apex, often downward (retrorsely) recurved, usually incised, 5-8 mm long, 3-5 (6) mm wide. Flowers entirely greenish to dull light violet, solitary, subsessile, on small knob-like, conic pedicel erected on thick straight rachis, widely opening, broadly campanulate, (8) 9-11 mm across. Perianth segments subsimilar, almost triangular to broadly ovate, (3) 3.5-4 (4.5) mm long and broad, rounded at apex, with prominent midvein. Corona compressed, lens-shaped to nearly flat, indistinctly ribbed, less than 1 mm tall, hexagonal, 4.5-5 mm in diam., apical opening indistinctly hexagonal to almost regularly circular, 2-2.5 mm in diam. Anthers 6, introrse, oblong, 0.6-0.8 mm long, sessile. Ovary half-inferior, free apical part conical to broadly conical, 1.5-2 mm tall, about 2 mm across at base, with 6 subequal prominent longitudinal ridges, unilocular, with basal placentation, separated into 3 chambers by 3 longitudinal parietal, finely papillose ridges, each chamber adaxially open, containing 4 ovules; stigma sessile, 3-lobed, with small, narrowly obovate, radially spreading, finely papillose lobes, 0.2-0.3 mm long. Seeds ovoid, 8-10 (12) mm long, when young light green to nearly white, when ripe glossy blue, with fleshy juicy testa.

Paratypes: VIETNAM, Quang Binh prov., Minh Hoa distr., Dan Hoa municipality, Bai Dinh village, around point 17°45’29’’N 105°46’14’’E, 17 April 2008, *L.Averyanov, P.K.Loc, N.T.Vinh et al., HAL 11614* (HN, LE); Central Laos, Vientiane prov., Vang Vieng distr., Na Khun village, around point 18°52’28”N 102°24’21”E, 21 January 2009, *O.Souliya, N.T.Hiep, L.Averyanov et al., LA-VN 69* & *LA-VN 89* (CPC Herbarium, LE); Quang Binh prov., Minh Hoa distr., Dan Hoa municipality, Bai Dinh village around point 17°45’28”N 105°46’14”E, 4 February 2009, *L.Averyanov, P.K.Loc, N.T.Vinh et al., HAL 12209* (HN, LE); Quang Binh prov., Minh Hoa distr., Hoa Tien municipality, La Van village, around point 17°51’45”N 105°49’45”E, 30 April 2011, *L.Averyanov, P.K.Loc, N.Q.Hieu et al., CPC 2582* (CPC Herbarium, LE); Quang Binh prov., Minh Hoa distr., Thuong Hoa municipality, environs of Mo O O O village, around point 17°39’21.7”N 105°54’59.5”E, 27 July 2011, *N.T.Hiep, L.Averyanov, N.S.Khang et al., CPC 3824* (CPC Herbarium, LE); Quang Binh prov., Minh Hoa distr., Thuong Hoa municipality., Ban On village, Hang Kho mountain, around point 17°40'21"N, 105°57'59"E, 29 July 2011, *P.K.Loc, N.Tap, N.Q.Hieu et al., CPC 5242* (CPC Herbarium, LE); Quang Binh prov., Minh Hoa distr., Thuong Hoa municipality, around point 17°41’14.3”N 105°53’28.9”E, 6 August 2011, *N.T.Hiep, L.Averyanov, N.S.Khang et al., CPC 4085a* (LE).

Etymology: The specific epithet reflects the characteristic coloration of a leaf blade bearing a distinct wide longitudinal median silvery-whitish stripe on a dark green background.

Ecology: Primary and secondary evergreen broad-leaved lowland forests on rocky solid highly eroded limestone at elevations 150-600(800) m a.s.l. Terrestrial and lithophytic herb growing usually at middle part of slopes in shady places, often among rocks or in cliff crevices. Flowers in January - April, fruits in August - October (February). Locally common (LR).

Distribution: Central Vietnam (Quang Binh province), central Laos (Vientiane province, Vang Vieng district). Endemic to southern part of North Indochinese floristic province.

Notes: The described plant is distinguishable from all other congeners by its dwarf habit, dark green leathery leaf blade with broad whitish median stripe and invisible or hardly visible transverse veinlets, very short dense inflorescence and large broad sterile bracts. This new species occurs in limestone areas of central Vietnam and Laos where it inhabits steep rocky slopes of remnant mountains and mesas composed of karstic, highly eroded, solid, crystalline, marble-like limestone. Commonly its populations are represented by sporadic samples, which are sporadically found on upper part of mountain slopes and on shady limestone cliffs. Rigid, dark green, often curved leaves with a broad silvery-whitish median stripe provide plants with very remarkable and distinguishable appearance. Plants with uniformly green leaves are rarely found. Their proportion in populations is much less than 1%. The discovered plant is very easy to cultivate and may be used as a miniature shade-tolerant ornamental plant with attractive dark green glossy leaves decorated with a contrasting silvery-whitish median stripe.

Peliosanthes grandiflora Aver. et N. Tanaka, ***sp. nov.***-
P. yunnanensis auct. non F.T. Wang et Tang: Aver., Taiwania 56, 2: 143, figs. 1 & 2. 2011.

Described from northern Vietnam (“Lai Chau prov., Phong Tho distr., Sin Suoi Ho municipality, Sa Ma Pho village, around point 22°33’21’’N 103°34’29’’E. Secondary evergreen broad-leaved wet closed forest with bamboo on very steep mountain slopes and along ridges composed predominantly of weathered granite at elev. about 1900-2050 m a.s.l. Terrestrial herb on shady rocky slope. Flowers light dull yellowish. Fruits blue, juicy. Locally very common”).

Type: ("14 Dec. 2006, *N.T.Hiep, L.Averyanov, P.K.Loc, P.V.The, N.T.Vinh, HAL 10767*") - CPC Herbarium (holotype), LE (isotype).

Terrestrial perennial herbs with short plagiotropic or inclined rhizomes to 4-8 cm long, about 0.5 cm in diam., with many rigid semi-woody wiry roots. Stem erect, 1.5-3 cm tall, covered with loose broad papyraceous scales. Leaves erect, petiolate; petiole rigid, 25-30 cm long; leaf blade elliptic, 15-25 cm long, 3.5-6 cm wide, glabrous, apex distinctly attenuate, secondary transverse veinlets subperpendicular to many longitudinal veins. Inflorescence a raceme, 5-15 cm tall; peduncle erect or ascending, rigid, 3-6 cm long, 2-3 mm in diam., naked or with 1 greenish, scarious, subsubulate or narrowly deltoid-lanceolate, sterile bract, 6-12 mm long, 2-4 mm wide; rachis 3-9 cm long bearing 5-15 flowers. Floral bracts green to light greenish, scarious, cuneate to narrowly triangular, 5-8 mm long, 2-3 mm wide. Flowers solitary, articulated with short green pedicel 2-3 mm long, dull pale yellow, widely opening or slightly campanulate, 2-2.5 cm across. Sepals (outer perianth segments) almost triangular, 5-6 mm long, 6-7 mm wide at base; apex obtuse and finely irregularly denticulate. Petals (inner perianth segments) orbicular, as long as sepals, 5-6 mm wide, almost rounded at apex. Corona compressed, lens-shaped, 3-4 mm tall, 11-13 mm in diam., apical opening 6-dentate, 3-4 mm in diam. Anthers 6, introrse, oblong, about 3 mm long, subsessile, with filaments less than 0.5 mm long. Ovary superior, broadly conical, 3-4 m tall, 6-7 mm across at base, 3-partite, with 1 locule in each part, each locule with 2 chambers, each containing 2 ovules; style short, conical, less than 2 mm tall, stigma 3-lobed, with small lobes. Seeds ovoid, drupe-like, 1.4-1.8 cm long, glossy, seed coat blue, juicy.

Paratypes: VIETNAM, Lao Cai, *sine coll. 8483,* 21 January 1975 (LE); Vinh Phu, Tam Dao, *L.Averyanov et al., LX-VN 3967* (HN, LE).

Etymology: The specific epithet refers large flowers, which are distinctly larger than those of other species of the genus.

Ecology: Primary and secondary evergreen broad-leaved humid shady forest (sometimes with bamboo) on silicate soils at elevation 500-2200 m a.s.l. Flowers in November - December, fruits in December - January. Not common (LR).

Distribution: Vietnam (Lai Chau, Lao Cai and Vinh Phuc provinces).

Notes: The description and illustration of this plant recognized here as a new species was published earlier (Averyanov, 2011). Further detailed comparative studies led us to regard the Vietnamese plant as an independent species. Our plant differs from *Peliosanthes yunnanensis* in having large, fleshy, rigid, ochreous or olive-yellowish flowers and rather short, stout inflorescence.

Peliosanthes nivea Aver. et N. Tanaka, ***sp. nov.***
Figs. 3 & 4.

Described from central Vietnam ("Quang Tri prov., Huong Hoa distr., Huong Viet municipality around point 16°51'06"N 106°34'38"E. Partially destroyed primary broad-leaved evergreen forest on very steep rocky slopes of remnant hills composed of solid highly eroded crystalline limestone at elev. about 600-700 m a.s.l. Terrestrial and lithophytic herb on shady rocky slope and on cliffs").

Type: ("8 May 2011*, L.Averyanov, P.K.Loc, N.Q.Hieu, P.V.The, N.T.Vinh, CPC 2953*") - CPC Herbarium (holotype), LE (isotype).

Terrestrial or lithophytic perennial herb with short ascending to erect rhizome 1-2 (3) cm long, with many rigid rather fleshy roots. Stem erect, abbreviate, to 1 cm tall, covered with loose, broad, irregularly imbricate, white herbaceous (papyraceous when dry) scales. Leaves petiolate; petiole rigid, straight or curved, 6-12 (14) cm long; leaf blade elliptic, 9-12 cm long, 2.5-3.5 (4) cm wide, glabrous, glossy, acute to obtuse, secondary transverse veinlets indistinct, subperpendicular to 5-10 (12) prominent longitudinal veins. Inflorescence hysteranthous, several-flowered raceme, 4-6 cm tall; peduncle pure white, erect, herbaceous, 2-3 (3.5) cm long, 1.5-2 mm in diam., with 1-3 (4) herbaceous, subsubulate or narrowly deltoid, pure white sterile bracts, 5-10 mm long, 1.5-3 mm wide; rachis pure white, 1.5-2 cm long bearing 4-8 (12) flowers. Floral bracts pure white, herbaceous, cuneate or narrowly triangular, 3-8 mm long, 2-3 mm wide. Flowers solitary, articulated with short pure white pedicel 1-1.5 mm long, not widely opening, campanulate, 14-15 mm across (with artificially flattened perianth segments). Outer and inner perianth segments subsimilar, almost triangular to broadly ovate, 3.5-4 mm long, 5-5.5 mm wide at base, obtuse, pure white outside, dark dirty violet inside. Corona compressed, discoid to lens-shaped, 2-2.5 mm tall, 5.5-6 mm in diam., apical opening indistinctly hexagonal to almost regularly circular, 4-5 mm in diam. Anthers 6, introrse, oblong, about 0.8 mm long, sessile. Ovary superior, shortly cylindrical, about 2 mm tall and wide, with 6 prominent longitudinal ridges, unilocular, with basal placentation, separated into 3 chambers by 3 longitudinal parietal ridges touching with their edges; each chamber adaxially open, containing (2) 4-6 (8) ovules; stigma sessile, indistinctly 3-lobed, with small,

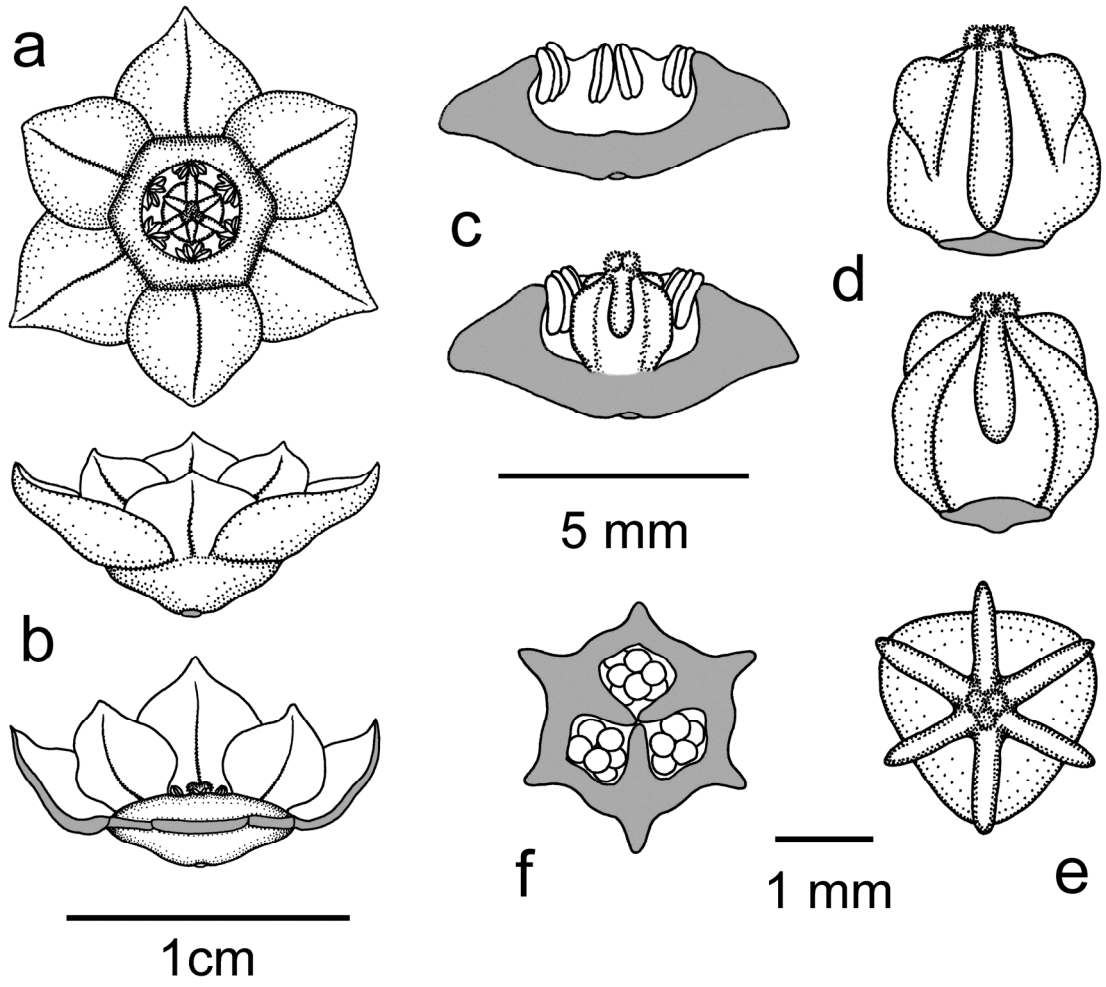

Fig. 3. ***Peliosanthes nivea*** **Aver. et N. Tanaka. a: open flower, frontal view. b: open flowers in side view, intact flower and flower with perianth segments partially removed. c: sagittal section of corona and flower base, with ovary and with ovary removed. d: ovary, side views. e: ovary, view from above. f: cross section of ovary at middle part (all drawn from the type -** ***CPC 2953*** **by L. Averyanov).**

half-rounded shortly papillose lobes. Fruits unknown.

Paratype: Central VIETNAM, Quang Tri prov., Huong Hoa distr., Huong Viet municipality, to N of Sa Mui pass, around point 16°51’14’’N 106°34’13’’E, 31 March 2006, *N.T.Hiep, L.Averyanov, P.K.Loc et al., HLF 5940* (CPC Herbarium, LE).

Etymology: The specific epithet relates to the pure (snow) white color of inflorescence, floral bracts and flowers.

Ecology: Primary broad-leaved evergreen lowland and submontane forests on rocky highly eroded solid marble-like limestone at elevations 500-700 m a.s.l. Terrestrial or lithophytic rosulate herbs growing commonly in middle part of very steep rocky slopes of remnant limestone hills and low mountains, usually in shady humid places. Flowers in March-May. Not common (VU).

Distribution: Central Vietnam (Quang Tri province). Endemic.

Notes: The described plant differs distinctly from other congeners in the dwarf habit and in the white short inflorescence with white floral bracts and white, not widely opening, often slightly nodding flowers. Our plant represents a strict calcium dependent endemism of remnant limestone formations of central Vietnam and is restricted to a very small, distinctly isolated area.

Peliosanthes nutans Aver. et N. Tanaka, ***sp. nov.***
Figs. 2c-f, 5.

Described from central Vietnam (“Quang Nam prov., Dai Loc distr., Dai Hong municipality, environs of Dai Hong town around point 15°49’44”N 107°57’19”E. Rich secondary closed broad-leaved evergreen forest on very

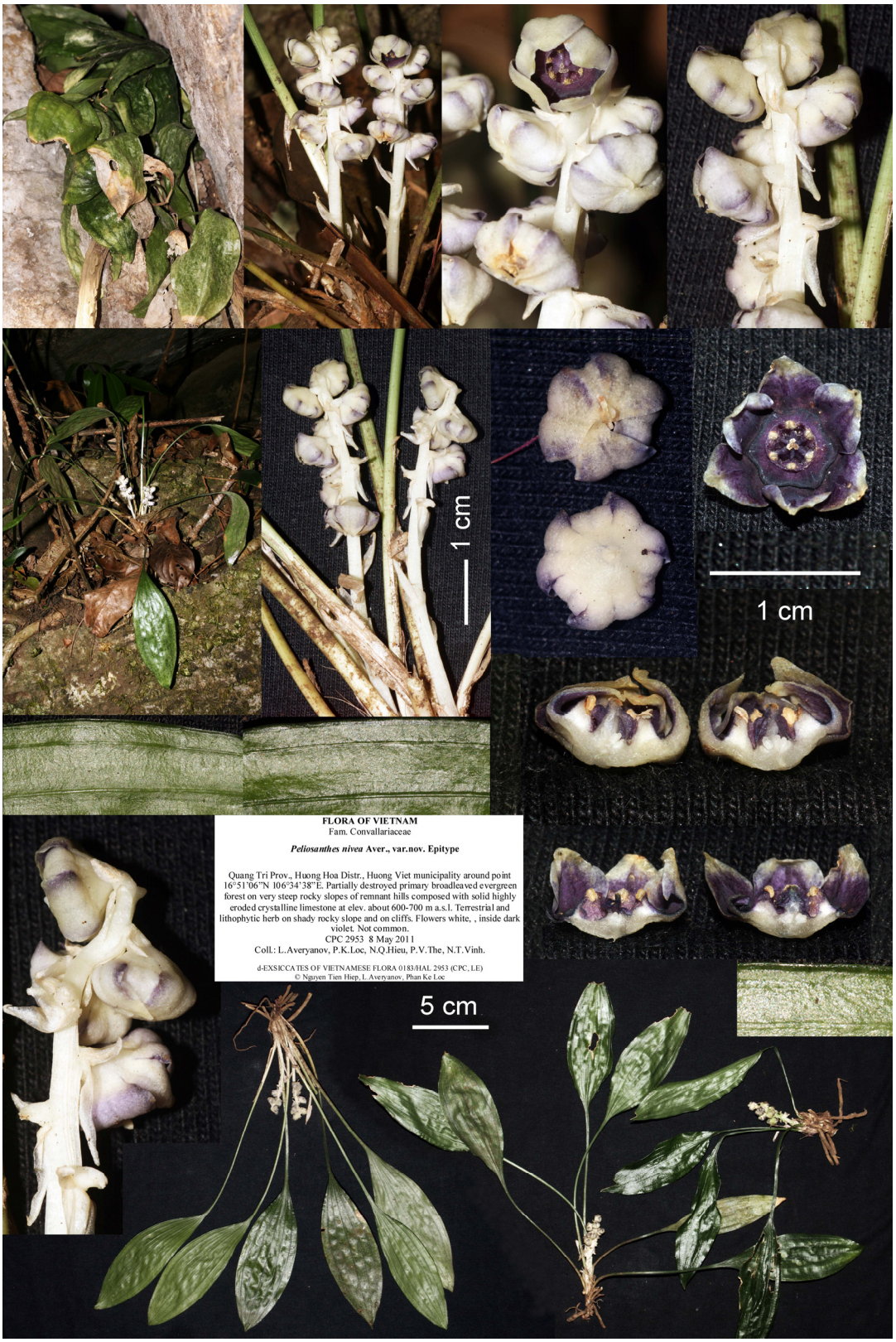

Fig. 4. *Peliosanthes nivea*. Aver. et N. Tanaka. Digital herbarium specimen: d-EXSICCATES OF VIETNAMESE FLORA *0183/HAL 2953* (all photos and design by L. Averyanov).

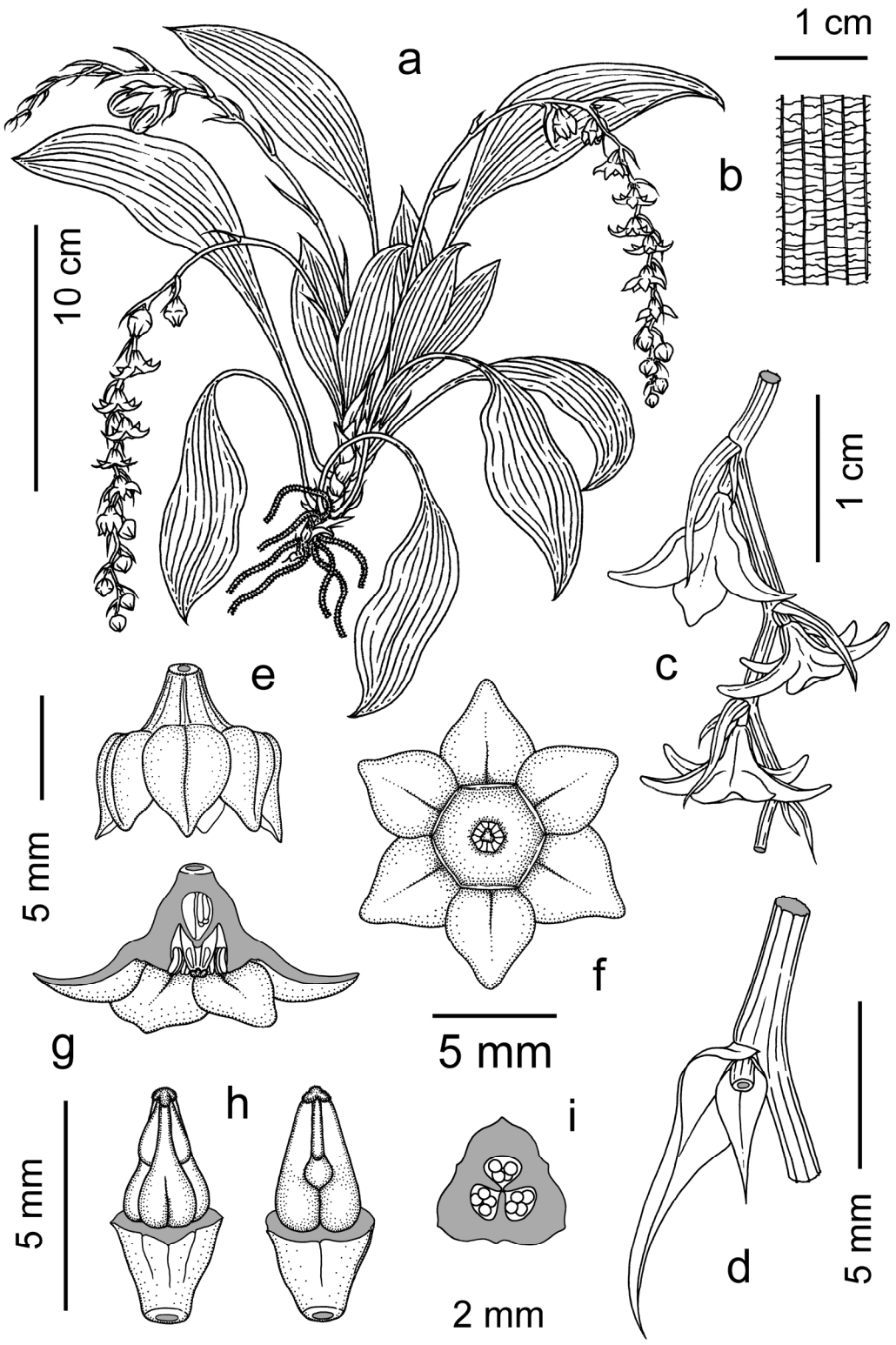

Fig. 5. *Peliosanthes nutans* Aver. et N. Tanaka. a: flowering plant. b: character of leaf venation. c: portion of flowering inflorescence. d: floral bracts at base of pedicel. e: opening flower, side view. f: open flower, frontal view. g: sagittal section of open flower. h: ovary viewed from different sides. i: cross section of ovary in upper part (all drawn from the type - *CPC 3538* by L. Averyanov).

steep rocky slopes composed of eroded sandstone along high waterfall sides at elev. about 250 m a.s.l. Terrestrial herb on very steep rocky shady slope").

Type: ("21 May 2011, *L.Averyanov, P.K.Loc, N.Q.Hieu, P.V.The, N.T.Vinh, CPC 3538*") - CPC Herbarium (holotype), LE (isotype).

Terrestrial perennial herb with short, creeping to ascending, often branching rhizome 3-5 (8) cm long, with many, rigid, semi-woody, wiry roots. Stems erect, often clustering by 2-5 on one rhizome, abbreviate, to 1 cm tall, covered with several, loose, yellowish-gray, papyraceous scales. Leaves usually strongly curved, petiolate; petiole rigid, curved, 6-8 (10) cm long; leaf blade narrowly elliptic to elliptic, 6-12 cm long, 1.5-3.5 (4) cm wide, glabrous, dark green, glossy adaxially, dull light green to whitish abaxially, attenuate to acute, secondary transverse veinlets distinct, subperpendicular to 5-10 (12) prominent longitudinal veins. Inflorescence synanthous, loosely many-flowered, secund raceme, 8-16(18) cm long; scape dark dirty violet, rigid, arching, 4-8 cm long, 1.5-2 mm in diam., naked or with 1-2, herbaceous, subulate, dull violet sterile bracts, 1-1.5 (3.5) cm long, 1-2 mm wide; rachis arching downward to pendulous, distinctly longitudinally ridged, slender, slightly zigzag-flexuose, dark violet, 5-10 (12) cm long, bearing 10-15 (18) flowers. Floral bracts 2 at base of each pedicel, inner bract twice smaller, dark dirty violet, sometime tinged with olive-green, herbaceous, cuneate to narrowly triangular, 5-15 mm long, 1-3 mm wide, outer bract as long as flowers or little longer. Flowers solitary, distinctly articulated with short antrorse violet pedicel 1-1.5 mm long, with conical basal part 2-3 mm long, widely opening, with rather recurved segments entirely dark violet to nearly black, 12-14 mm across. Outer and inner perianth segments subsimilar, almost triangular to broadly ovate, 3.5-4.5 mm long, about 4 mm wide at base, shortly attenuate and rounded at apex. Corona compressed, almost flat at apex, 4.5-5 mm across, apical opening hexagonal, 2 mm in diam. Anthers 6, introrse, oblong, about 1 mm long, sessile. Ovary half-inferior, free apical part shortly conical, 2-2.5 (3) mm tall, 1.5-2 mm across, with 6 low longitudinal ridges in upper part, unilocular, with basal placentation, separated into 3 chambers by 3 longitudinal parietal ridges touching at center with their edges, each chamber adaxially open, containing 4 ovules; stigma sessile, indistinctly 3-lobed, 0.7-0.8 mm across, with small, half-rounded papillose lobes. Seeds ovoid to narrowly ovoid, 1-1.5 cm long, glossy, blue, enveloped at base with enlarged perianth segments.

Etymology: The specific epithet refers to the drooping inflorescence, which is a unique feature of this species.

Ecology: Primary and secondary broad-leaved evergreen forests on very steep rocky slopes composed of eroded sandstone at elevations 200-400 m a.s.l. Terrestrial rosulate herb growing commonly in middle and high part of slopes, usually in shady places. Flowers in May-June. Locally common (LR).

Distribution: Central Vietnam (Quang Nam province). Endemic.

Notes: The new species differs distinctly from other congeners by its cernuous slender ridged flexuose inflorescence rachis, loosely spaced antrorse (i.e. nutant) flowers, broadly campanulate perianth with recurved segments, subulate floral bracts nearly as long as flowers, and in the leaves strongly contrasting in color between both sides. Further, our plant is characterized by remarkably dark violet or nearly black perianths. This species definitely represents strict endemism of ancient sandstone formations of central part of Vietnam with very limited distribution.

Peliosanthes retroflexa Aver. et N. Tanaka, ***sp. nov.***
Figs. 6 & 7.

Described from central Vietnam ("Quang Binh province, Minh Hoa district, Dan Hoa municipality").

Type: ("Type flowering specimen was pressed on 15 June 2011 from cultivated plants grown from seeds of fruiting specimen collected from field ("Quang Binh prov., Minh Hoa distr., Dan Hoa municipality, Giang Man Ridge (Vietnam-Laos border) near Cha Lo Vietnam-Lao border gate around point 17°41'50"N 105°45'54"E. Primary evergreen broad-leaved and coniferous (with *Dacrycarpus* and *Fokienia*) wet forest along ridge edge composed of shale and sandstone at elevation about 900-1100 m a.s.l., 8 February 2009, *L.Averyanov, P.K.Loc, N.T.Vinh, L.T.Son*, *HAL 12374*") - LE (holotype).

Terrestrial perennial herb with short, erect to ascending, sometimes branching rhizome 1-3 (5) cm long, with many rigid, thick, semi-woody roots. Stems erect, often clustering by 2-3 (5) on common rhizome, abbreviate, to 3 cm tall, covered with many loose, greenish to greenish-violet herbaceous imbricate scales scarious along margin, later becoming entirely light yellowish-gray and papyraceous. Leaves erect, often curved, petiolate; petiole rigid, straight or curved, (5) 8-12 (15) cm long; leaf blade elliptic, (10) 12-15 (18) cm long, (2) 2.5-5.5 (6.5) cm wide, glabrous, more or less thin, coriaceous, glossy, brightly green on both sides, shortly attenuate and acute at apex, often irregularly finely undulate along margin, secondary

Fig. 6. ***Peliosanthes retroflexa*** **Aver. et N. Tanaka. a: flowering plant grown from seed under cultivation. b: base of stem covered with sterile scales. c: leaf venation. d, e: portion of inflorescence and flowers. f: floral bracts on alcohol-fixed inflorescence rachis (*HAL 12374a*). All photos by L. Averyanov.**

transverse veinlets distinct, at acute angle near margin and almost perpendicular in median part of leaf blade to (5) 7-9 prominent longitudinal veins. Inflorescence synanthous to hysteranthous, many-flowered dense terete raceme, 8-12 (16) cm long; peduncle brightly violet, rigid, straight or slightly curved, (4) 5-6 (8) cm long, 3-3.5 (4) 2 mm in diam., with 4-6 (8), herbaceous, ovate to cuneate or narrowly triangular, attenuate, light green sterile bracts, (6) 7-10 (12) mm long, 4-6 mm wide at base; rachis straight or slightly curved, finely longitudinally ridged, thick, brightly violet, 5-7 (10) cm long, bearing many dense flowers. Floral bracts 2 at base of each pedicel, green, dark gray-brown toward apex, herbaceous, ovate to triangular, concave, attenuate; outer bracts (4) 5-9 (10) mm long, 3.5-4.5 (5) mm wide, much longer than flowers, often with strongly recurved margin at base; inner bracts twice smaller. Flowers odorless, solitary, distinctly articulated with short straight pedicel, (1) 1.5-2 mm long, with cup-like, ridged broad basal part 1.5-2 mm long, widely opening, with strongly recurved perianth segments, 4-5.5 mm across with naturally recurved segments, 8-9 (10) mm across with artificially flattened perianth segments. Perianth olive green, with more or less dark gray-brown tint at base, thick, fleshy, with membranous margin, becoming strongly recurved just after flower opening; sepals (outer perianth segments) almost equilateral-triangular (2) 2.5 (3) mm long and wide, obtuse; petals (inner segments) almost circular, slightly shorter than sepals. Corona olive-green with more or less dark gray-brown tint, compressed, almost flat, 3-4 mm across, indistinctly hexagonal to almost circular, apical

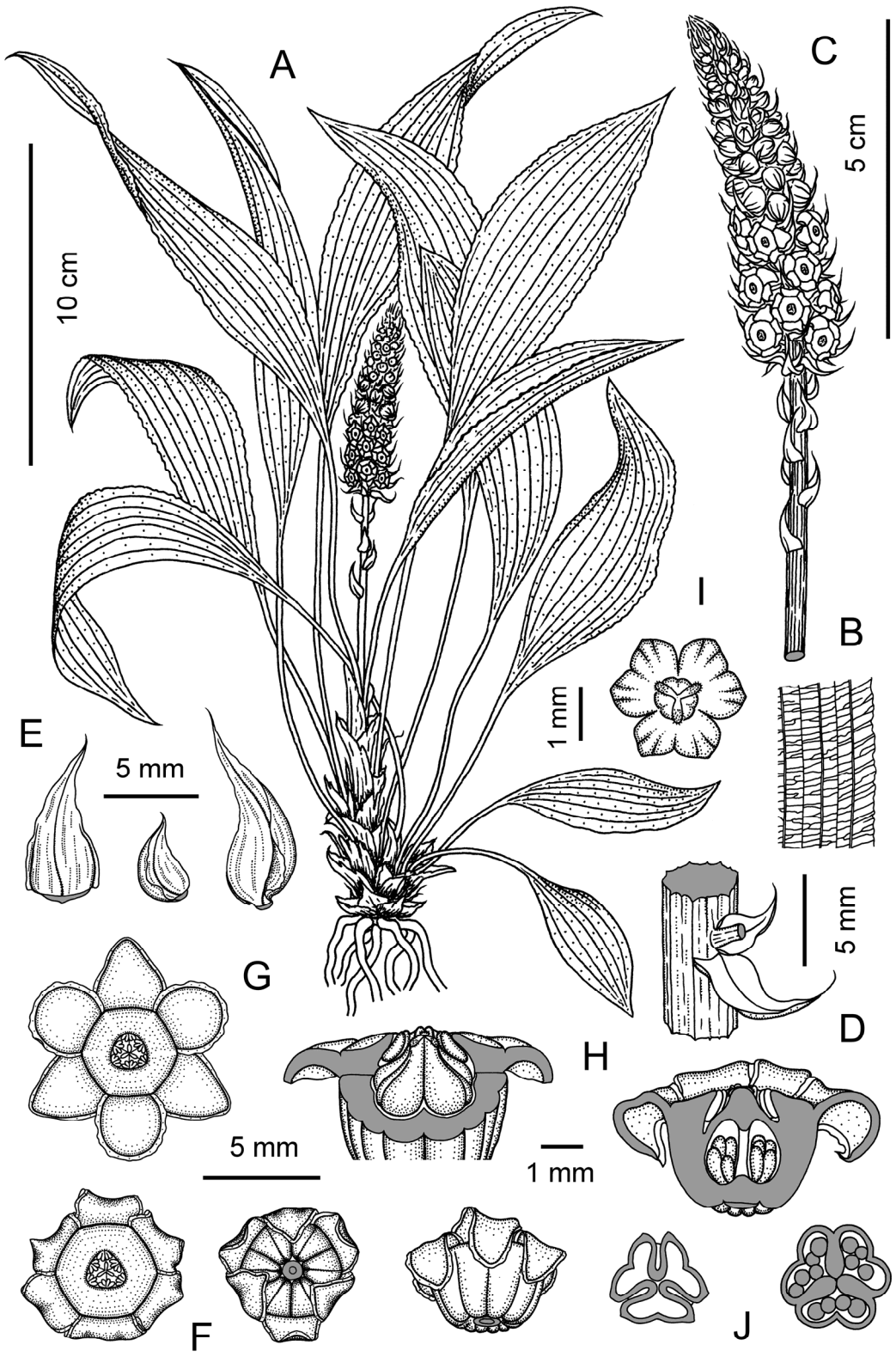

Fig. 7. *Peliosanthes retroflexa* Aver. et N. Tanaka. a: flowering plant. b: character of leaf venation. c: inflorescence. d: portion of rachis and floral bracts at base of pedicel. e: floral bracts. f: open flowers, from above, below and side. g: flower with artificially flattened perianth segments. h: sagittal and half sagittal/cross sections of open flower. i: ovary, view from above. j: cross sections of ovary in upper and middle part (all drawn from the type - *HAL 12374a* by L. Averyanov).

opening indistinctly triangular to almost circular, 1-1.2 (1.4) mm in diam. Anthers 6, introrse, oblong, about 0.8-1 mm long, sessile. Ovary half-inferior, free apical part shortly conical, 6-8 mm tall, 1.6-1.8 mm across, with 6 broad notched lobes in free upper part, unilocular, with basal placentation, separated into 3 chambers by 3 longitudinal parietal folds touching each other at center, each chamber adaxially open, containing (3) 4 (5) ovules; stigma sub-sessile, 3-lobed, 0.3-0.4 mm across, with small, oblanceolate papillose lobes. Seeds ovoid to narrowly ovoid, about 1 cm long, glossy blue.

Etymology: The specific epithet reflects a characteristic reflection of perianth segments just after flower opening.

Ecology: Primary evergreen broad-leaved and coniferous humid forests on shale and sandstone at elevations 900-1100 m a.s.l. Terrestrial rosulate herb growing commonly in shady depressions and reclined slopes with rich soils. Flowers in cultivation in June-July; fruits in nature observed in January-February. Locally common (LR).

Distribution: Central Vietnam (Quang Binh province). Endemic.

Notes. This new species appears to be most closely allied to *Peliosanthes violacea* Wall. ex Baker, but differs from it in the perianth segments strongly recurved from the base and membranous in the margin, and in the broad crateriform basal part of the flower.

Tupistra theana Aver. et N. Tanaka, ***sp. nov.*** Fig. 8.

Described from central Vietnam ("Quang Binh prov., Minh Hoa distr., Hoa Tien municipality, La Van village, around point 17°51'45"N 105°49'45"E. Highly degraded primary and secondary evergreen broad-leaved forest on very steep rocky slopes of remnant limestone hills composed of highly eroded marble-like crystalline limestone at elev. 200-450 m a.s.l.").

Type: ("30 April 2011, *L.Averyanov et al., CPC 2581*") - CPC Herbarium (holotype), LE, VNM (isotypes).

Lithophytic clustering perennial herb. Rhizome short, terete, erect, suberect or ascending, branching, thick and stout, sometimes slightly woody, dense with many nodes, light yellowish-brown, 3-10 cm long, 1-2.5 cm in diam. Stem erect, very short, 1-3 cm tall, covered with leaf sheaths and partially disintegrated fibrous scales. Leaves (2) 3-5, basal, sub-distichous, equitant, distinctly petiolate; petiole straight, rigid, shallowly canaliculate, 2-4 mm in diam., 30-60 cm long; leaf blade leathery, dark green, glossy, narrowly oblanceolate to oblanceolate, acute at apex, gradually tapering to base, 40-70 (80) cm long, 3-6 cm wide. Peduncle axillary, erect, straight or slightly arching, rigid, 3-5 mm in diam., (20) 30-40 (55) cm long, naked or with 1-2 small cuneate sterile bracts at apex (below inflorescence). Inflorescence terminal, many flowered, very dense spadix, 3-5 cm long, 1-2 cm in diam. Floral bracts cucullate, nearly triangular, obtuse to acute, as long as flowers, green, often with purple-violet tint. Flowers sessile, dark dirty purple-violet, campanulate, not fully opening, 6-8 mm across, perianth 6-8 mm long, very fleshy, proximally connate for about 2/3 of the length; segments triangular to ovate, obtuse. Stamens 6; anthers light dull yellow, subsessile, adnate to perianth tube higher than stigma, dorsifixed on very short fleshy filaments less than 1 mm long, slightly incurved, without any appendages. Ovary ovoid 1-1.4 mm tall; style violet, shortly cylindrical, 1 mm tall and wide; stigma almost white with violet tint, indistinctly 3-lobed to nearly entire, head-like, roughly warty. Ripening fruits spherical, dark green, berry-like, 1-2 (3) seeded.

Paratypes: VIETNAM, Quang Binh prov., Tuyen Hoa distr., Lam Hoa municipality, Hung village, around point 17°55'41"N 105°49'43"E, 1 May 2011, *L.Averyanov et al., CPC 2616* (CPC Herbarium, LE, VNM); Quang Binh prov., Minh Hoa distr., Thuong Hoa municipality, environs of Mo O O O village, around point 17°39'31.7"N 105°54'48.2"E, 23 July 2011, *N.T.Hiep, L.Averyanov, N.S.Khang, N.Q.Vinh, CPC 3649* (CPC Herbarium, LE, VNM), 28 July 2011, *N.T.Hiep, L.Averyanov, N.S.Khang, N.Q.Vinh, CPC 3870* (CPC Herbarium, LE, VNM), around point 17°41'28"N 105°53'42.7"E, 5 August 2011, *N.T.Hiep, L.Averyanov, N.S.Khang et al., CPC 3952* (CPC Herbarium, LE, VNM), Ban On village, around point 17°40'21"N, 105°57'59"E, 27 July 2011, *P.K.Loc, N.Tap, N.Q.Hieu et al., CPC 5188* (CPC Herbarium, LE, VNM).

Etymology: The specific epithet is named after a young talent Vietnamese botanist - Mr. Pham Van The, who collected the first samples of this novelty on an inaccessible mountain cliff just on his birthday.

Ecology: Primary and secondary dry evergreen broad-leaved forests on rocky highly eroded marble-like crystalline limestone at elevations 200-700 (800) m a.s.l. Obligate lithophyte on shady vertical cliffs near to tops of mountains and on rocky tops. Flowers in April - May, fruits in July - August. Rare (EN).

Distribution: Central Vietnam (Quang Binh province: Minh Hoa and Tuyen Hoa districts). Local endemic.

Notes: This new species has a long narrowly oblanceolate leaf blade gradually tapering to a distinct petiole, a dark dirty purple-violet perianth (not greenish

Fig. 8. *Tupistra theana*. Aver. et N. Tanaka. Digital epitype: d-EXSICCATES OF VIETNAMESE FLORA *0182/HAL 2581* (all photos and design by L. Averyanov).

like that of *Rohdea*; Tanaka, 2010a), an extremely short ovary almost as thick as the style, and a comparatively broad stigma. These characters are consistent with those of *Tupistra* (Tanaka, 2010b). Our species is most closely allied to *T. laotica* N. Tanaka, which was recently described from Vientiane, Laos (Tanaka, 2010b; Tanaka, 210c), in having a very long peduncle and small flowers. It differs from the latter by the shorter spike, acute bracts, perianth segments not expanding outward, shorter pistil with a smaller stigma positioned lower than the anthers. Further, the perianth segments of this species become closed after anthesis, differing from those of *T. laotica* which appear to remain open even after anthesis.

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中南半島東部發現球子草屬 (*Peliosanthes*) 與開口箭屬 (*Tupistra*) (天門冬科) 新種

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摘要：本文報導近來中南半島東部（越南和寮國）大規模野外調查發現的五種球子草屬新種 (*P. argenteostriata*, *P. grandiflora*, *P. nivea*, *P. nutans, P. retroflexa*) 與一天門冬科開口箭屬新種（*T. theana*），並佐以手繪圖描述。上述新種皆為特有種且生長地範圍狹窄。每一新種的敘述資料包含標準的引用模式標本、描述、副模標本 (paratype) 列表、建議種名詞源、生態學及分佈數據和簡要分類備註。

關鍵詞：天門冬科、鈴蘭科、中南半島東部、新種、球子草屬、植物分類、開口箭屬。