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## THE *GALIUM ACUTUM* AND *G. ASPERIFOLIUM* SPECIES COMPLEXES IN THE EASTERN HIMALAYA

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Critical discussions are presented concerning two species complexes within *Galium* L. (Rubiaceae), the *G. acutum* Edgew. and *G. asperifolium* Wall. groups, with special reference to the E Himalayas. In the *G. acutum* group, two new species, *G. megacyttarion* R.R. Mill *sp. nov.* and *G. rebae* R.R. Mill *sp. nov.*, are described and *G. himalayense* Klotzsch & Garcke is reduced to a variety of *G. acutum*, necessitating a new combination. Within the *G. asperifolium* group, *G. craticulatum* R.R. Mill *sp. nov.* is described, and *G. asperifolium* and *G. sikkimense* Gand. regarded as distinct species. The typification of several epithets (*G. blinii* Lév., *G. bodinieri* Lév., *G. cavaleriei* Lév., *G. comari* Lév. & Vaniot, and *G. esquirolii* Lév.), which all antedate *G. sikkimense*, is discussed. Only *G. cavaleriei* poses a potential threat but it is here maintained separate from *G. sikkimense*. Brief notes on *G. asperifolium* *sensu stricto* and supposedly allied plants of south India (*G. asperifolium* var. *pilosissimum* Cufod.) are given.

*Keywords.* *Galium*, new combination, new species, Rubiaceae, typification.

### INTRODUCTION

The bedstraws (*Galium* L., Rubiaceae) of the East Himalayan region have received little critical study. Some species occurring in the area were covered by Cufodontis (1940) in his treatment of Chinese *Galium* but there is no modern revision specifically dealing with the E Himalayan members of the genus. About twelve species of *Galium* occur in the *Flora of Bhutan* area. Most are readily identified. Two complexes, however, pose considerable taxonomic problems; these are the groups containing *G. acutum* Edgew. and *G. asperifolium* Wall.

### THE *G. ACUTUM* GROUP

*G. acutum* Edgew. has, in most recent literature, been considered to have a distribution extending from Kashmir to Bhutan, as well as southern Tibet (see Hara in Hara & Williams, 1979). Recently, Nazimuddin & Ehrendorfer (1987) described three new species of *Galium* from Pakistan, two of which (*G. subfalcatum* Nazim. & Ehrend. and *G. campylotrichum* Nazim. & Ehrend.) were considered allied to *G. acutum* (which also occurs in Pakistan: Nazimuddin & Qaiser, 1989) and the other (*G. tetraphyllum* Nazim. & Ehrend.) to *G. asperifolium* Wall.

Most Floras and other works include in the synonymy of *G. acutum*, *G. himalayense* Klotzsch & Garcke. This was described on the basis of a specimen collected by

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Werner Hoffmeister, somewhere in the western Himalaya between Naini Tal (Uttar Pradesh, India) and Schipke (Tibet), during the Prinz Waldemar von Preussen expedition of 1845–46. The type of *G. acutum* Edgew. was collected on Badhrinath (Edgeworth, 1851). Badhrinath is a peak (7139m) of the central Himalayas in Garhwal District of Uttar Pradesh (Meyer et al., 1908, 16: 179). The distance between the type localities of these two taxa is only about 170km. The actual type of *G. acutum* has not been seen, but a gathering by Colonel Madden from the same mountain at 10,000ft is represented at E and K. Both examples are of a very densely mat-forming plant, typical of *G. acutum* sensu stricto and agreeing with the type description; they can be regarded as topotypes.

Material of the *G. acutum* complex from both the E and W Himalayas has been examined. The following conclusions have been reached.

#### *G. acutum* and *G. himalayense*

These two taxa are normally considered synonymous (see, for example, Hara in Hara & Williams, 1979). Klotzsch & Garcke (1862), in discussing their new species, stated that its style was shorter than the stamens ('Das Längenverhältniss der zweispaltigen Griffel zu den Staubgefässen, welche bei der vorliegenden Art [*G. himalayense*] länger als die Griffel sind, solle bei der erwähnten [*G. acutum*] umgekehrt sind'), while the reverse was true for *G. acutum* (a fact confirmed by a reading of Edgeworth's protologue: 'stylo bifido ramis divaricatis staminibus longiore . . .'). Klotzsch & Garcke moreover provided an excellent illustration with analyses of *G. himalayense*, in which the two divergent styles are shown to be free almost to their base, and the corolla lobes to be ovate, acute but lacking an apiculus.

Careful examination of the available material shows that it divides up into four groups. Two of these are new taxa, described as species later in this paper (one corresponding to Bhattacharjee's unpublished *G. acutum* 'subsp. *bhutanense*', the other a new species extending sporadically from Uttar Pradesh to Bhutan). The other two groups correspond respectively to *G. acutum* sensu stricto and *G. himalayense*. Both of these, on the evidence of specimens seen, appear to be virtually restricted to the NW Himalayas as none precisely matching either of them have been seen from Sikkim, Darjeeling or Bhutan. However, a specimen of *G. acutum* has been seen from E Nepal (Koshi Zone, Sankhuwa Sabha Distr., Sedua–Mane Gaun–Jaljare–Tashigaon, 12 vii 1988, by path in open place, flowers pale green, *M. Suzuki et al.* 8820382 (E)), which appears to be the easternmost known locality of the typical state of the species. Furthermore, an anomalous specimen from Sikkim (Yakla, 10,000ft, *Clarke* 9822, BM) is tentatively referred to *G. acutum* (see p. 199).

*G. acutum* sensu stricto and *G. himalayense* can be separated by the characters in Table 1.

Although the two taxa can be separated, they are undoubtedly very closely related. Species rank does not seem appropriate for *G. himalayense*, which is here reduced

TABLE 1. The characters which separate *Galium acutum* and *G. himalayense*.

	<i>G. acutum</i>	<i>G. himalayense</i>
Style	united to near middle, then diverging into 2 stigmatic arms; style + stigmatic arms subequalling stamens	2 stigmatic arms united only at base, divergent from just above base; style + stigmatic arms shorter than stamens
Corolla lobes	apiculus 0.15–0.3mm l:b ratio (1.9–)2.3–4	apiculus 0.1mm or less, lobes often merely acute l:b ratio 1.4–2.3(–2.75)
Corolla diameter	2.3–3.5mm	1.2–2.3mm
Leaf apiculus*	(0.2–)0.25–0.45mm	0.15–0.2mm

(\*of leaves on main stems, *not* side branches.)

to a variety of *G. acutum*. Varietal rather than subspecific rank has been chosen since the two entities appear to be more or less sympatric.

***Galium acutum* Edgew. var. *himalayense* (Klotzsch & Garcke) R.R. Mill, *comb. et stat. nov.***

Basionym: *Galium himalayense* Klotzsch & Garcke, Bot. Ergebn. Reise Prinzen Waldemar von Preussen 88, t. 27 (1862). Type not designated; based on a specimen collected by Werner Hoffmeister in the Himalaya ('Dr Hoffmeister sammelte diese Art im Himalaya'). Hoffmeister's original collection was kept at B; it, including the types, is presumed to have been destroyed in 1943 (see Pilger, 1953). Until it has been established whether an isotype exists elsewhere, no neotype is chosen. Alternatively, Klotzsch & Garcke's excellent illustration with analyses could be selected as lectotype (together with a supporting epitype: Art. 9.7 of ICBN: Greuter et al., 1994) if no isotype exists. However, it is considered premature to formally make such innovations here.

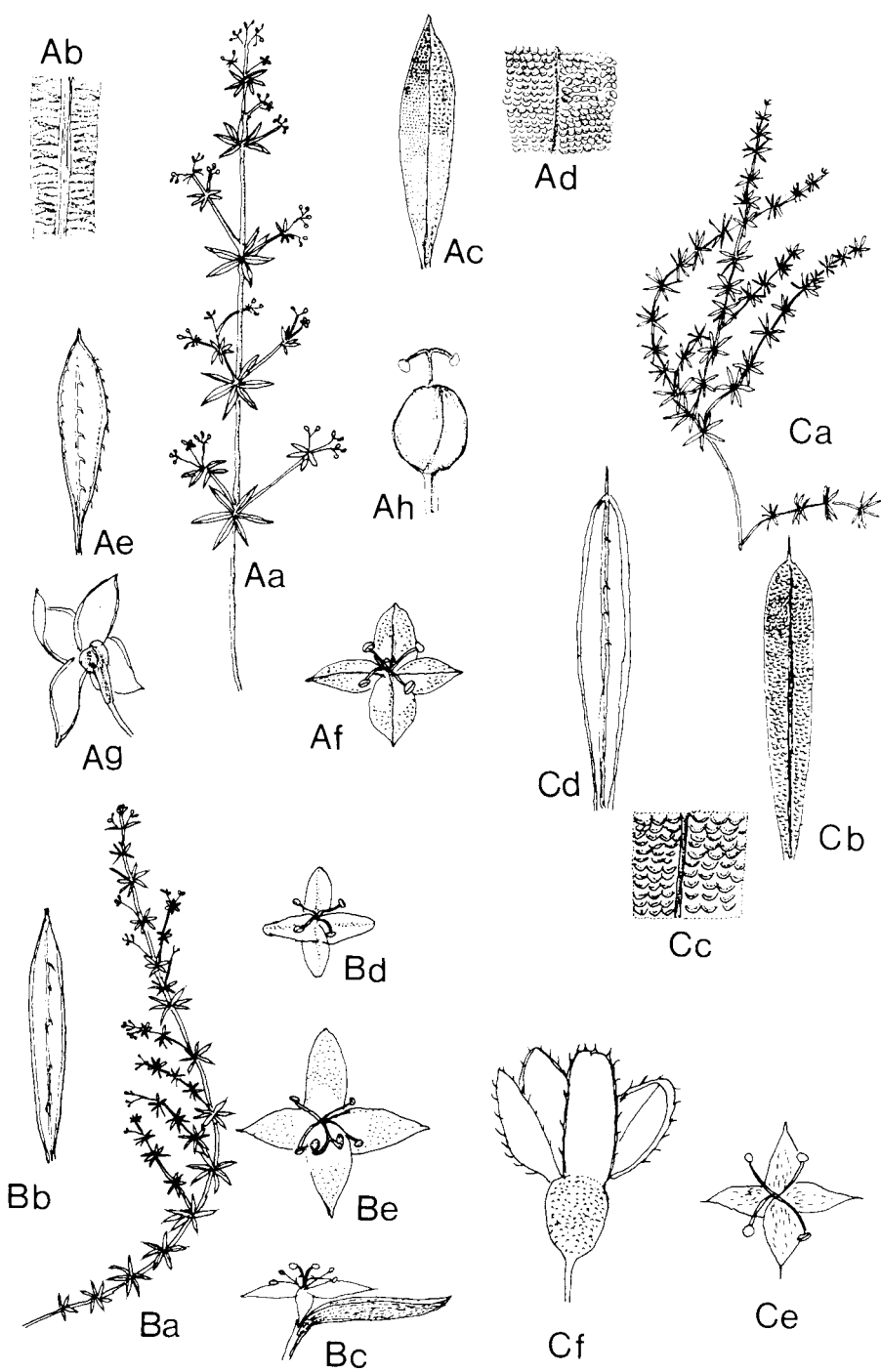
*Additional specimens examined.* INDIA. Parbati Valley, Kulu Distr., Punjab, occasional around boulder bases in grassed scree, 12,500ft, 7 vii 1952, *J. de V. Graaff* (*T. Schelpe* 3477) (BM); Mussoorie, *Bacon* 113 (BM).

In its corolla lobes with very short apiculus, or none at all, *G. acutum* var. *himalayense* resembles *G. megacyttarion* R.R. Mill (described below), but can be readily distinguished from that species by its very small cells of the upper leaf surface epidermis.

***Galium rebae* R.R. Mill, *sp. nov.* Fig. 1B.**

Syn.: [*Galium acutum* Edgew. subsp. *bhutanense* R. Bhattacharjee in sched., 1986, unpublished *nomen nudum*.]

A *G. acuto* Edgew. floribus in cymulis (2–)3–5(–6)-floris dispositis (haud solitariis),



foliis paulo longioribus (5–10mm, non 2.2–6mm), lobis corollae saepissime in sicco rubro-purpureis apiculo nullo vel brevioribus recedit.

Straggling,  $\pm$  prostrate perennial. Stems 13–40cm or more, weak, glabrous, unarmed, 0.5–1.05mm diam.; internodes on main stems 7.2–32mm, on side branches 1.6–8.2mm. Leaves in whorls of 6, herbaceous, narrowly lanceolate, linear-lanceolate or the uppermost narrowly ovate-oblongate; those of main branches (4.6–)5.2–10.2  $\times$  (0.5–)0.6–1.4mm, c.(5–)6–10(–11.5)  $\times$  as long as broad, those of side branches slightly smaller, 2.4–5.2(–6.2)  $\times$  0.4–0.7(–0.9)mm, (3.9–)4.0–7.8(–8.9)  $\times$  as long as broad; apex acute, terminating in a short arista (0.15–0.5mm on leaves of main stems, 0.07–0.20mm on leaves of side branches); base shortly attenuate; surfaces glabrous, midrib on lower leaf surface glabrous or (especially on main branches) occasionally with one or two indistinct ‘scabridities’ or up to 7 very slender prickles, but never with stout aculeae. Inflorescences axillary, cymose, each of (2–)3–5(–6) flowers; peduncle 1.5–3.5(–4.2)mm, shorter than, equalling, or longer than the subtending leaf which is 1.0–6.5(–7.2)mm long; pedicels 0.1–3.2mm, unequal at a given dichotomy, the shorter pedicel shorter than its subtending leaf, the longer one either shorter than or slightly longer than the same leaf. Corolla normally reddish-purple, crimson or pinkish-purple (very occasionally white), (1.65–)1.95–3.2(–3.6)mm diam.; lobes ovate, 0.8–1.5(–1.7)  $\times$  (0.4–)0.5–0.9(–1.0)mm, (1.3–)1.4–2.3(–2.5)  $\times$  as long as broad, terminating in a short (occasionally absent) apiculus (0–)0.1–0.2(–0.25)mm, papillose along central vein and towards tip adaxially and  $\pm$  evenly papillose abaxially. Stamens shorter than corolla lobes; filaments 0.2–0.55mm; anthers 0.15–0.2  $\times$  0.1–0.15(–0.2)mm, pale yellow or yellowish-orange. Style united for c.0.3mm, bifid at tip, the arms blackish, c.0.15–0.25mm; stigmas globose, c.0.07–0.1mm diam., blackish. Mericarps (immature) c.0.7  $\times$  0.5mm, blackish, finely verruculose, without hooks.

Type: Bhutan, forested valley above Motithang, Thimphu, 27°29'N 89°36'E, damp bank in *Abies/Juniperus* forest, flowers dark crimson, 3320m, 19 vii 1979, A.J.C. Grierson & D.G. Long 2741 (holo. E; also selected by Bhattacharjee as holotype of the unpublished name *G. acutum* subsp. *bhutanense* — see discussion below).

*Distribution and ecology.* Nepal, China (Xizang: Chumbi valley), India (Sikkim), Bhutan. Evergreen oak forest, *Abies/Juniperus* forest, alpine meadows and on exposed rocks; 2000–3700(–3960)m.

FIG. 1 (facing page). A. *Galium craticulatum*: Aa, habit,  $\times \frac{2}{3}$ ; Ab, stem wings,  $\times 27$ ; Ac, leaf upper surface,  $\times 2$ ; Ad, detail of upper surface cells,  $\times 33$ ; Ae, leaf lower surface,  $\times 2$ ; Af, flower viewed from above,  $\times 6.5$ ; Ag, flower viewed from below,  $\times 6.5$ ; Ah, ovary and style,  $\times 6.5$ . B. *G. rebae*: Ba, habit,  $\times 0.5$ ; Bb, leaf lower surface,  $\times 4$ ; Bc, flower and bract,  $\times 6.5$ ; Bd, Be flowers,  $\times 6.5$ ; a–d from Grierson & Long 2741, e from Stainton, Sykes & Williams 3249. C. *G. megaclytaron*: Ca, habit,  $\times \frac{2}{3}$ ; Cb, leaf upper surface,  $\times 6.5$ ; Cc, detail of upper surface cells,  $\times 33$ ; Cd, leaf lower surface,  $\times 6.5$ ; Ce, flower viewed from above,  $\times 6.5$ ; Cf, flower and ovary,  $\times 13$ .

*Additional specimens examined.* NEPAL. Near Seng Khola, among exposed rocks, 12,000ft, 25 vi 1954, *Stainton, Sykes & Williams* 3249 (E); Lete (S of Tukucha), Kali Gandaki, on gravel slope, 10,000ft, 9 vii 1954, *Stainton, Sykes & Williams* 1653 (E); *ibid.*, 9 vii 1954, *Stainton, Sykes & Williams* 1654 (flowers white; BM, E; BM sheet det. Bhattacharjee 1986 as *G. acutum* subsp. *bhutanense*); Yambuk, grassy hills, 20 xi [year not stated], *J.D. Hooker* (K, mounted together with *G. sikkimense* bearing a printed 'Sikkim 6-12,000ft' label; the handwritten ticket indicating the Nepal locality is at the top right corner of the sheet, above the specimen of *G. rebae*). Koshi Zone, Sankhuwa Sabha Distr., Sedua (1590m)–Mane Gaun (1740m)–Jaljare (1800m)–Tashi Gaun (Tashigaon) (2160m), on the bank beside a stream, 2010m, 12 vii 1988, *M. Suzuki et al.* 8880390 (BM); Shewaden, 2600m, 29 vi 1972, *H. Kanai et al.* 720893 (BM).

CHINA (XIZANG). Chumbi, 9 vii 1913, *Cooper* 205 (BM, E).

INDIA (SIKKIM). Lachung Valley, 7000ft, 29 vii 1892, *Gammie* 321 (E); Lachen woods, 9–12,000ft, *J.D. Hooker* s.n. (K); West Distr., Rathong Chu valley between Prek Chhu and Mintok Khola, 27°24'N 88°12'E, path sides in evergreen oak forest, 2350m, 27 vii 1992, *Long, McBeath, Noltie & Watson* ESIK 773 (E); regio temp., 9000–13,000ft, *J.D. Hooker* s.n. (BM); Gangtok, 1600m, 13 vi 1960, *H. Hara & M. Togashi* 7527 (K, as *G. acutum*); Chamnago, in meadow, 12,000–13,000ft, 19 vii 1913, *Cooper* 281 (BM, E).

BHUTAN. Fujudin [Phajudin, Thimphu], 10,000ft, 6 viii 1914, *Cooper* 2688 (E).

R. Bhattacharjee (in sched., E & K, 1986) determined several specimens of the *G. acutum* group from Nepal, Sikkim and Bhutan as the new taxon '*G. acutum* Edgew. subsp. *bhutanense* R. Bhattacharjee'. However, although eight years have elapsed, this subspecies has still not been validly published. There being no published description, it is not known what characters Bhattacharjee chose to use in separating her new taxon from the rest of *G. acutum*. However, comparison of material named by her as *G. acutum* subsp. *bhutanense*, and other matching material, with material of *G. acutum* (including var. *himalayense*) from the NW Himalayas reveals a range of differences, as shown in Table 2.

The number of differential characters suggests that species rank, rather than subspecies, is more appropriate for 'subsp. *bhutanense*'. Although the epithet *bhutanense* is available at species rank in *Galium*, it has not been used for the new species because its range extends quite far beyond Bhutan. Instead, I have chosen, with pleasure, to dedicate the new species to the person who originally recognized its distinctiveness, Dr Reba Bhattacharjee of Calcutta, whom I knew when she did her Ph.D. studies on *Stachys* at the University of Edinburgh in the 1970s. As type specimen I have chosen the same sheet as Bhattacharjee selected as 'type' of her unpublished name.

The three *Stainton et al.* specimens from W Nepal, which are very disjunct from the rest of the species, have slightly larger corollas and much longer filaments than the plants from Bhutan, Sikkim and S Xizang. Their status deserves further investigation and they have not been catered for in the key to species. It is clear that at the Lete site, both red- and white-flowered variants occur as there are no other differences between *Stainton et al.* 1653 and 1654; this is the only instance where plants apparently belonging to *G. rebae* but having a flower colour other than reddish or pinkish-purple have been collected. Although the colour when fresh of typical *G.*

TABLE 2. Differences between *Galium acutum* and *G. rebae* [*G.a.* 'subsp. *bhutanense*'].

	<i>G. acutum</i> (NW Himalaya)	<i>G. rebae</i> [ <i>G.a.</i> 'subsp. <i>bhutanense</i> ']
Flowers per inflorescence	1 (very rarely 2)	(2-)3-5(-6)
Leaf length (main branch)	2.2-5mm, mean of 10 leaves from any one specimen always < 5mm	5-10mm, mean of 10 leaves from any one specimen always > 5mm
Flower colour	always white or greenish-white	almost always reddish-crimson
Upper surface of corolla lobes	densely and minutely papillose all over	puberulent along central vein and towards apex
Lower surface of corolla lobes	papillose	± papillose
Corolla lobes: l:b ratio (mean of 10)	2.4-3.0 (var. <i>acutum</i> ) 1.9-2.0 (var. <i>himalayense</i> )	2.1-2.3
Filament length	0.3-0.7mm	0.2-0.45(-0.55)mm
Corolla lobe apiculus length	0.15-0.3mm (var. <i>acutum</i> ) 0.0-0.1mm (var. <i>himalayense</i> )	0.0-0.2(-0.25)mm

*rebae* has been described variously as reddish-purple, crimson, pale purple or pink, when dry the flowers always appear dark reddish-purple.

A specimen from Sikkim (Yakla, 10,000ft, *Clarke* 9822, BM) somewhat resembles *G. rebae* but differs from it in its solitary flowers, broader main-stem leaves (3.5-5.7 × as long as broad, not typically 5.9-10 × as long as broad) with slightly shorter arista, apparently whitish corollas (drying brown, without obvious purple coloration) with narrower lobes (2.8-3.3 × as long as broad, not typically 1.4-2.4 × as long as broad) which are densely puberulent beneath, and strongly recurved stigmatic lobes. It is not considered conspecific with *G. rebae* although it falls within the geographic distribution of the latter. It is tentatively treated as belonging to *G. acutum*, but it is anomalous in that species also (see above), not only morphologically but on account of occurring so far east of the main range of *G. acutum*. It may need separate taxonomic status but more material of it needs to be collected before its status can be properly assessed.

*A new species of Galium from NW Himalaya to Bhutan*

After the exclusion from '*G. acutum*' sensu stricto of var. *himalayense* and *G. rebae*, there remains a residual fourth entity which also cannot be accommodated within *G. acutum*. It differs from *G. acutum* in having much larger cells of the upper leaf surface (easily visible under a hand lens of ×20 or a dissecting microscope; those

of both varieties of *G. acutum*, and of *G. rebae*, can scarcely be seen at the same magnification). This taxon is described below as the new species *G. megacyttarion* R.R. Mill; the specific epithet alludes to the large epidermal cells on the upper leaf surface (from Greek, *mega*, large; *cyttaros*, cell).

***Galium megacyttarion* R.R. Mill, sp. nov. Fig. 1C.**

Affinis *G. acuto* Edgew. sed cellulis epidermidis paginae superioris foliorum multo majoribus (sub lente  $\times 20$  facile visis), foliis caulium principalium et ramulorum lateralium majoribus apiculo longiore (in eis caulium principalium 0.35–0.7mm, non 0.2–0.35(–0.5)mm), lobis corollae magis ovatis apiculo nullo vel brevissimo (ut in *G. acuto* var. *himalayensi* sed non in varietate typica), lobis corollae in facie superiore solum papillois (numquam puberulentis), inferne glabris, margine evidenter crassiusculis, mericarpiis longioribus magis ovoideis recedit.

Weak, straggling, prostrate herb, probably perennial, but not forming dense mats as in *G. acutum*; plant drying blackish-green or occasionally fresh green. *Stems* 6–40cm or more, glabrous, unarmed at least below, occasionally with a few aculeae on angles in uppermost part, very strongly 4-sided, the angles raised but not winged; nodes with a few short, backward-pointing,  $\pm$  straight aculeae; internodes on main stems 6.5–33mm, on side branches 1.2–7.3mm. *Leaves* on main stems always in whorls of 6 (side branches sometimes with whorls of 4), herbaceous, narrowly elliptic or narrowly oblanceolate, those of main stems (4–)5–10.5(–12.2)  $\times$  0.4–1.9mm and 4.2–12.1(–25.0)  $\times$  as long as broad, those of side branches 1.8–5.2  $\times$  0.4–1.1mm and 4.0–9.5  $\times$  as long as broad; apex cuspidate or apiculate, the apiculus (0.35–)0.4–0.65(–0.75)mm on leaves of main stems, (0.15–)0.2–0.45mm on leaves of side branches; base slightly narrowed but  $\pm$  truncate; upper surface glossy and glabrous, with conspicuous, large epidermal cells (easily seen under a  $\times 20$  lens); lower surface glabrous on lamina (including revolute margin) but with 0–6 curved, white-hyaline aculeae 0.05–0.2mm on midrib. *Flowers* usually solitary and axillary, rarely in 3-flowered cymes; *pedicels* 0.2–1.5mm at anthesis, 0.25–1  $\times$  subtending leaf (never longer than it), slightly lengthening in fruit and then up to 3.5mm. *Corolla* white or greenish-white, or sometimes (at least when dry) pale pink, (1.5–)1.8–2.7mm diam., rotate; lobes broadly ovate-elliptic to rectangular-elliptic, (0.55–)0.65–1.3  $\times$  (0.25–)0.3–0.7mm, usually 1.33–2.20  $\times$  as long as broad, glabrous on lower surface, hairy (not papillose) on upper side especially towards base, with strongly thickened, undulate-revolute margins. *Stamens* shorter than corolla lobes; filaments 0.25–0.55(–0.65)mm (usually 0.25–0.4mm); *anthers* shortly ellipsoid, pale brown when dry and  $\pm$  same colour as corolla, 0.1–0.2(–0.25)  $\times$  0.06–0.12(–0.15)mm. *Style* with a lower undivided portion 0.15–0.3mm, apically bifid, the 2 stigmatic arms 0.1–0.2mm; *stigmas* blackish, globose, 0.05–0.1mm diameter. *Mericarps* 0.7–1.1  $\times$  0.5–0.7mm, ovoid-subglobose, dark greyish-brown or blackish-brown, glabrous, papillose-verruculate (more coarsely so than in *G. acutum*).



Type: India, Uttar Pradesh: Jaunsar, Mundali, Kharamba peak, a small herb with whorled leaves, 10,000ft, 23 ix 1936, *M.B. Raizada* 7326 (holo. E, iso. E).

*Distribution and ecology*: India (Uttar Pradesh, Sikkim), Nepal, China (S Xizang), Bhutan. Mixed forest etc.; 1800–3100(–3600?)m.

*Additional specimens examined*. INDIA. Uttar Pradesh: Mussoorie, Camel's Back Road, 6500ft, ix 1914, *A. Anderson* s.n. (E); *ibid.*, Sunny View, c.6000ft, 8 ix 1935, *Raizada* 5515 (E).  
E NEPAL. Redak (2400m)–Chhurchathanga (3600m), 9 viii 1977, *H. Ohashi*, *H. Kanai*, *H. Ohba* & *Y. Tateishi* 772184 (E).

CHINA (S XIZANG). Chumbi & Phari, Gumboteen, 2000ft from Chumbi [sic], 18 vii 1878, *Dunghoo* s.n. (E).

INDIA (SIKKIM). Domang, 10,040ft, 10 viii 1943, *J. Pradhan* s.n. (K).

BHUTAN. No details [field book missing]. *Cooper* 1505 (E). Thimphu Distr.: valley above Motithang, 27°29'N 89°36'E, side of footpath in *Pinus/Picea/Quercus* forest, 2600m, 8 ix 1984, *Sinclair & Long* 4905 (E: epidermal cells on upper leaf surface smaller than other specimens).

The relatively few specimens seen of this species are widely scattered in the Himalayas from Uttar Pradesh eastwards to Bhutan. Some of them, especially *Raizada* 5515, are rather variable in characters such as leaf length and length: breadth ratio. Nevertheless, all of them (except *Sinclair & Long* 4905 which is somewhat transitional to *G. acutum* but is included here) are readily distinguished from the rest of *G. acutum* by their much larger upper leaf surface epidermal cells. The type gathering was originally named as *G. asperifolium*; on one sheet (Sheet I) a later hand has pencilled, '*G. ? acutum* Wall.'. The sheet labelled in pencil 'Sheet I' is designated the holotype. Both it and the E isotype (annotated in pencil, 'Sheet II') comprise five mounted specimens, all belonging to the same taxon.

*Key to the G. acutum group in the E Himalaya*

1. Cells of upper leaf surface large, readily visible under × 20 lens \_\_\_\_\_  
\_\_\_\_\_ **G. megacyttarion**
- + Cells of upper leaf surface very small, scarcely or not readily visible under × 20 lens \_\_\_\_\_ 2
2. Flowers reddish, in (2–)3–5(–6)-flowered cymes, upper surface of lobes puberulent along central vein and towards apex only; leaves on main branches 5–10mm \_\_\_\_\_ **G. rebae**
- + Flowers whitish or greenish, solitary (very rarely in 2-flowered cymes), upper surface of lobes densely and minutely papillose all over; leaves on main branches 2.2–5mm \_\_\_\_\_ **G. acutum**

THE *G. ASPERIFOLIUM* GROUP

Three E Himalayan species are recognized here within the *G. asperifolium* group: *G. asperifolium* Wall., *G. sikkimense* Gand. (both with whitish or greenish-white corollas), and a distinctive new species with dark crimson corollas, described below as *G. craticulatum*.

***Galium craticulatum* R.R. Mill, sp. nov. Fig. 1A.**

Affinis *G. asperifolium* Wall. et *G. sikkimensis* Gand., sed ab amobus corollis atrokermesinis recedit; a *G. asperifolium* etiam caulibus glaberrimis (haud crispato-pilosulis vel aculeatis) recedit; a *G. sikkimensis* basibus foliorum perfecte sessilibus (non in petiololum brevissimum anguste attenuatis), cellulis epidermidis adaxialis foliorum majusculis, corollae lobis longioribus plerumque etiam latioribus (semper plus quam 0.7mm latis) distinguitur. A *G. blinii* Lév. (quod etiam flores violaceos habet) marginibus foliorum multo minus dense aculeatis, foliis ramulis lateralibus minoribus, cymis plerumque 7–13-floris (non 1- vel 3-floris), corollis majoribus (2.25–2.8mm, non 1.6–2mm diam.) filamentis multo longioribus valde recedit.

Prostrate, very floriferous herb, branched in distal part of stem, the branches erect or suberect. *Stems* slender (0.5–0.8mm diam.), completely glabrous and unarmed, glossy and shining, brownish, broadly winged; wings up to 0.6mm wide, green, (in sicco) with a lattice-like pattern of parallel darker green veins (especially on peduncles and pedicels); *internodes* of main stems 30–46mm, of side branches 5.2–13mm. *Leaves* all in whorls of 6, herbaceous, narrowly oblanceolate, slightly unequal in any given whorl, those on main stems (6–)7–10.5 × (1.2–)1.4–2.3mm, those of side branches (2.3–)3.0–4.5(–5.0) × 0.5–1.1mm; apex shortly acuminate, ending in a short, fragile apiculus (0.1–0.13(–0.4)mm long on leaves of main stems, 0.0–0.3(–0.5)mm on those of side branches); base attenuate; upper surface completely glabrous, the epidermal cells conspicuous; lower surface slightly paler green, glabrous on lamina but the midrib, at least of leaves on main stems, sparsely aculeate, the aculeae 3–10 per leaf and 0.2–0.3mm, scattered ± evenly along midrib (on main stem leaves), (0–)1(–5) and 0.1–0.2mm, proximal or median (on side-branch leaves); margins revolute, those of main-stem leaves aculeate (aculeae (11–)14–23, 2–3 per mm, 0.1–0.25mm and more slender than those of the midrib), those of side-branch leaves less revolute or ± flat, unarmed or with up to 2 very short aculeae c.0.05mm. *Inflorescence* a narrowly cylindrical panicle of numerous, shortly pedunculate cymes; cymes mostly 7–13-flowered but some fewer-flowered (2–5 flowers) cymes also present; first-order peduncles 4–7.5mm, 1.5–1.6 × subtending leaf; second-order peduncles 2.3–3.5mm, 0.8–1.3 × subtending leaf; non-primary pedicels 0.2–1.3mm, primary ones 0.3–1.8mm, all  $\frac{1}{6}$ – $\frac{1}{2}$  × subtending leaf, winged, glabrous. *Corolla* 2.25–2.8mm diam.; lobes normally 4 (very rarely 5), dark crimson on upper side, paler and greenish-purple beneath, ovate, 1.0–1.3 × 0.65–1.0mm, papillose all over above but especially on central vein and towards margins, glabrous beneath, their acute apex ending in a very short mucro 0.02–0.1mm (not a long cusp). *Filaments* white, 0.4–0.55(–0.7)mm, c.  $\frac{1}{3}$  × corolla lobes and as long as the broadest part of the corolla lobes; *anthers* pale orange-yellow, 0.15–0.22 × 0.07–0.1(–0.15)mm, shortly oblong-ellipsoid. *Style* whitish at anthesis, turning reddish-brown later, with a lower unbranched portion 0.15–0.3mm, bifid at apex into 2 widely divergent but erecto-patent stigmatic arms 0.15–0.25mm which finally (post-anthesis) decurve; *stigmas* black throughout all phases of stylar development, globose, 0.05–0.1mm

diameter. *Ovary*: obovoid to subglobose, 0.3–0.4mm, greenish, very minutely verruculose (appearing almost smooth) and unarmed. *Mature mericarps* not seen.

Type: Bhutan, Chenkaphug, E of Thimphu, 27°28'N 89°43'E, grassy bank in cleared conifer forest, prostrate herb, flowers dark crimson, 3000m, 20 vii 1979, A.J.C. Grierson & D.G. Long 2800 (holo. E).

*Distribution and ecology*: Endemic to Bhutan; known as yet only from the type. Coniferous forest; c.3000m.

This new species was originally identified as *G. asperifolium* but it is readily distinguished from that species, even when considered in its broadest sense, by its larger, dark crimson (not whitish-yellow) corollas whose lobes end in a very short mucro instead of a long cusp. The completely glabrous stems also separate it from *G. asperifolium* sensu stricto, although *G. sikkimense* Gand., which has sometimes been subsumed in *G. asperifolium*, has the stems glabrous or almost so. *G. sikkimense* is recognized at specific rank in *Flora of Bhutan* (see below).

The epithet *craticulatum*, from Lat. *craticulus*, latticed or wattled like wicker-work, alludes to the pattern of closely packed, dark green, parallel lines, at right angles to the main axis, which can be seen (using a dissecting microscope or good hand lens) on the broad, paler green wings of the pedicels, peduncles and upper part of the stem on the holotype.

#### *The status of Galium sikkimense Gand.*

Plants of the *Galium asperifolium* complex which have been commonly referred to *G. sikkimense* Gand. (sometimes referred to as *G. asperifolium* var. *sikkimense* (Gand.) Cufod.) can have the stems either completely smooth, or aculeate. It is clear from Gandoger's type description (Gandoger, 1920: 307) that those plants with completely glabrous, non-aculeate, unwinged stems must belong to the same taxon that includes the type of *G. sikkimense*, if the glabrous and aculeate variants are to be awarded taxonomic recognition ('Glabrum pedale rectum, caules laeves graciles stricti ad angulos non scabridi nec inflati . . .'). Gandoger went on to ally *G. sikkimense* with *G. erectum* Huds., from which he differentiated it by its non-scabrid, slender stems, somewhat glaucous leaves, few-flowered leafy panicles, and the corolla lobes with a longer mucro. It is curious that Gandoger failed to mention *G. asperifolium* Wall. in his discussion. He appears to have misapplied the name *G. erectum*: *G. erectum* Huds. is applicable to a European taxon (within either *G. mollugo* L. or *G. album* Mill.: Hudson (1762, 1778) applied the name in two different senses which has resulted in subsequent confusion at both species and subspecies rank).

The name *G. sikkimense* Gand. (1920) is in fact antedated at specific rank by the names of five species based on Chinese material, all described by Lévillé (1904, 1912, 1915a, 1915b), and which have all been regarded as synonyms of *G. asperifolium* var. *sikkimense* by either Cufodontis (1940) or Lauener & Ferguson in Lauener (1972). These are *Galium comari* Lév. & Van. (Lévillé, 1904), *G. cavaleriei* Lév.

(Léveillé, 1912), *G. blinii* Lév. (Léveillé, 1915a), *G. bodinieri* Lév. (Léveillé, 1915b) and *G. esquirolii* Lév. (Léveillé, 1915a). Hara in 1971 determined the types of all these taxa, except *G. comari*, as belonging to *G. asperifolium* var. *sikkimense*. All of them threaten to take nomenclatural priority over the name *sikkimense* when that is used as species rank, therefore it has been necessary to critically examine them and assess their status (see below, a–e). A sixth name, *G. cuneatum* Lév. (Léveillé, 1917), whose status was unknown to Cufodontis (1940) but was regarded as a synonym of *G. asperifolium* var. *sikkimense* by Lauener & Ferguson (1972), is a *nomen nudum* and so can be disregarded for the purposes of priority.

(a) *G. comari* Lév.

The type of *G. comari* (China: Guizhou: Pin-fa sud-ouest, bois ombrages, 21 viii 1902, *Cavalerie* 263 (holo. E)) was not seen by Cufodontis (1940) (see Lauener & Ferguson, 1972: 107). It differs markedly from all plants seen of *G. asperifolium* var. *sikkimense* in having a very diffuse inflorescence of 3-flowered cymes, the flowers borne on long, filiform, arcuate (not  $\pm$  straight) pedicels. Lauener & Ferguson (1972) treated it as a species distinct from *G. asperifolium*, a view with which I concur.

(b) *G. blinii* Lév.

The type of *G. blinii* (China: haies-plaine et coteaux à Tong-tchouau, altier 2990m. *Galium* annuel, en touffes, un peu grim pant, fl. violette, juillet, *E.E. Maire* (holo. E, unnumbered; iso. E, numbered 694/1914; only the isotype bears flowers)) is easily separable from *G. sikkimense* by the far more numerous marginal aculeae on the leaves (35–45 per margin, in the distal  $\frac{3}{4}$  of the leaf) and by its far fewer, violet flowers. The very numerous marginal aculeae also distinguish it from the reddish-purple flowered *G. craticulatum* (which has only 11–23 aculeae per side). The latter species is also separable from *G. blinii* by its smaller leaves on the lateral branches ((2.3–)3.0–4.5(–5)mm not 4.5–6.5mm); cymes usually 7–13-flowered (not 1- or 3-flowered); larger corolla 2.25–2.8mm diam. (not 1.6–2mm diam.) and much longer filaments 0.4–0.55(–0.7)mm (not 0.15–0.25mm). Consequently, *G. blinii* is here not considered synonymous with *G. sikkimense*, or with *G. craticulatum*.

(c) *G. bodinieri* Lév.

The type of *G. bodinieri* (China: Guizhou: cueillie à Majo, Septembre 1907, couleur rouge-pourpre, *Cavalerie* 3085 (holo. E)) also has violet flowers and so is distinct from *G. sikkimense* which, like *G. asperifolium*, has yellowish flowers. In its mat-forming habit it is more like a larger version of *G. acutum* than either *G. asperifolium* or *G. sikkimense*. Other characteristic features which serve to separate *G. bodinieri* from Sikkim and E Himalayan material of *G. sikkimense* are the very broad stem wings (broader than the stem 'core' diameter) which are tessellated with darker green reticulate veins; the midrib completely glabrous adaxially and with only 1 or 2 very weak, minute aculeae abaxially; the margins of side-branch leaves completely glabrous and of main-stem leaves with 7 or fewer, weak slender prickles only; the corolla lobes with distinct, relatively large papillae on the distal margin but otherwise com-

pletely glabrous; and, most importantly, the 2 styles which are completely separate from each other (even arising a short distance apart on the top of the ovary), rather than being united in their lower half. Moreover, the styles are, especially post-anthesis, virtually straight, not strongly arcuate-reflexed apically as in *G. sikkimense*. The separate styles are more reminiscent of *G. acutum* var. *himalayense* (see above). *G. bodinieri*, consequently, is also not considered here to be conspecific with *G. sikkimense* or *G. craticulatum*.

(d) *G. esquirolii* Lév.

The type of *G. esquirolii* (China: brousse-collines de Tong-tchouen, 2990m, Galium annuel un peu grim pant, tiges courtes 0<sup>m</sup> 40, fl. jaunes, E.E. Maire (herb. Lévillé: holo. E; also a probable syntype from Yunnan with original label missing, E)) has yellow corollas and in its general morphology is very much more similar to E Himalayan *G. sikkimense* than are either *G. blinii* or *G. bodinieri*. Like the E Himalayan plants referred to as *G. sikkimense* it has yellow corollas, conspicuous prickles on the midvein beneath, and apiculate corolla lobes. Although the similarities to *G. sikkimense* are very great, the ovary is coarsely reticulate instead of verruculose or papillose; the upper surface epidermal cells are more conspicuous than in the vast majority of specimens of *G. sikkimense*; the leaves, although attenuate at the base, do not have the short 'false petiole' which is clearly evident in *G. sikkimense*; and the anthers appear pinkish or pinkish-brown, not yellow. These differences, albeit subtle and small, are sufficient to prevent me from taking up the name *G. esquirolii*, of which I have seen only a single (type) specimen, in place of *G. sikkimense* which is known to me from a large suite of specimens. The possibility that *G. sikkimense* could be regarded as a subspecies of *G. esquirolii* should be explored if, and when, more abundant material of *G. esquirolii* becomes available.

(e) *G. cavaleriei* Lév.

*G. cavaleriei*, like *G. bodinieri*, was collected in the vicinity of Pin-fa, province of Guizhou (China) (Type: bois, Pin-fa, 11 8<sup>bre</sup> [October] 1905, *Cavalérie* 2541, holo. E). Being collected so late in the year, the holotype is, not unexpectedly, a poor specimen of a decrepit plant at the end of its season. However, an unusual and very characteristic feature of this specimen is that the ultimate branchlets of the partial inflorescences are extremely widely divaricate, some at  $\pm 90^\circ$  to the penultimate branch. I have not observed such widely divaricate branchlets (which are vaguely reminiscent of the branching arrangement of *Kelloggia chinensis* Franch.) in any Himalayan example of *G. sikkimense*. Although *G. cavaleriei* is in other respects superficially very similar to *G. sikkimense*, I consider that the type specimen is inadequate to pass judgment on whether the two are conspecific; the matter will not be resolved unless and until good flowering and fruiting material of *G. cavaleriei* is either present elsewhere or is re-collected from the type locality (assuming that the plant is still present). The specimen in the type folder of *G. cavaleriei* at K is a different (non-type) collection (Pin-fa, *Cavalérie* 367). There are two plants on the sheet, one of which (right-hand) has been re-determined as *G. hungei* Wall., the other

(left-hand) as *G. asperifolium* Wall. The left-hand plant, which is very leafy and floriferous quite unlike the E holotype, has much shorter internodes than Himalayan *G. sikkimense* and the midrib and margins of the leaves appear to be completely devoid of obvious aculeae, whereas these are virtually always present in Himalayan *G. sikkimense*, and the corolla lobes are very obtuse without any apiculus. The sheet is named *G. cavaleriei* Lév.; if Lévillé intended it to be conspecific with the scrappy specimen which is the holotype of the name, it cannot be considered synonymous with *G. sikkimense* although superficially similar especially in its glabrous stems.

*Cavalerie* 367 (K, left-hand) bears a strong similarity to *G. innocuum* Miq. (iso. K, from Java). This species also has completely non-aculeate leaves and stems. As well as occurring in Java and Sumatra, specimens determined as it (by C. Puff in 1975) have been seen from Khasia (*J.D. Hooker & T. Thomson*, K; Khasia, regio temp., 5000ft, *J.D. Hooker & T. Thomson*, K; Khasia, 1850, *Griffith*, K), Arunachal Pradesh (Sirhoi, in high grass and thickets in partial shelter along the ridge, 8000ft, 25 vii 1948, *Kingdon-Ward* 17861, BM), Bangladesh (East Bengal, towards Jodhath Khaal (? illegible), iv 1828, *Griffith* H.E.I.C. 3075, K); Manipur (Myang Khong, 4000ft, 20 v 1882, *Watt* 7154, K), Nagaland (Naga Hills, Benroumi, 3500ft, 18 v 1935, *Bor* 2665, K) and NE Myanmar (flank of the N'Maikha-Salwin divide, 26°25'N, 10–11,000ft, vi 1931, *Forrest* 29661 (E, det. C. Puff). It thus reaches close to the borders of the area covered by *Flora of Bhutan* and, being published much earlier, would threaten *G. sikkimense* if it were proved to be conspecific. However, it is here considered not to be synonymous, on account of the complete lack of prickles on the stems and leaves, to which Miquel's epithet *innocuum* presumably alludes.

In the meantime, therefore, the name *G. sikkimense* is retained for the glabrous or subglabrous plants of the *G. asperifolium* complex from Sikkim and Bhutan, with *G. blinii*, *G. bodinieri*, *G. cavaleriei*, *G. comari* and *G. esquirolii* being considered Chinese endemics. *G. sikkimense* differs from typical *G. asperifolium* in its stems being either completely glabrous or with only a few very tiny aculeae, rather than densely covered with crispate, inwardly curved, long aculeae. It is also considered to be specifically distinct from *G. innocuum*. A full description of *G. sikkimense* is given below.

**Galium sikkimense** Gand. in Bull. Soc. Bot. France 66: 307 (1920).

Syn.: *G. asperifolium* Wall. var. *sikkimense* (Gand.) Cufod. in Österr. Bot. Z. 89: 241 (1940). Type: Himalaya, in Sikkim ad Jakeynpyaj, alt. 12,000 ped., *Ribu & Rhomoo* 5099 (holo. LY? – n.v.; iso. B, fide Cufodontis (1940), now destroyed).

Prostrate, straggling or scrambling, clinging herb, probably perennial. *Stems* 30cm or longer, slender, straw-coloured or pale brownish, shining, completely glabrous (apart from aculeae if present), unarmed or sparsely retrorse-aculeate, unwinged or with narrow wings 0.15–0.4mm wide. *Leaves* in whorls of 6, herbaceous, narrowly oblanceolate or linear-oblanceolate, 5–20 × 0.5–4.5mm; apex rounded but gradually

or  $\pm$  abruptly passing into a short apiculus 0.1–0.5mm; base attenuate, frequently simulating a short petiole; epidermal cells on upper surface scarcely visible at  $\times 20$ ; midrib on lower surface always with a few, strongly retrorse aculeae 0.1–0.25(–0.5)mm; margins with shorter aculeae (0.1–0.3mm) or occasionally apparently none. *Inflorescence* a long,  $\pm$  narrow panicle of few-flowered, dichotomous, bracteate cymes; bracts leaf-like but smaller and more ovate. *Corolla* whitish, cream, or greenish, with typically no trace of pinkish coloration, 1.2–2.2mm diam.; lobes ovate, (0.35–)0.4–1.3  $\times$  0.2–0.7mm, primary flowers with all lobes apiculate, other flowers often with 2 or all lobes obtuse; upper surface papillose on midvein and towards margins. *Filaments* white,  $\frac{1}{3}$ – $\frac{1}{4}$   $\times$  corolla lobes; *anthers* pale yellowish, c.0.1mm. *Style branches* whitish, erecto-patent, not markedly arched downwards even in fruit; stigmas globose, dark brown or blackish. *Mericarps* 0.4–0.7mm, blackish, minutely verruculose or almost smooth, without hooks.

Variation occurs in stem indumentum, some specimens being totally glabrous and without any aculeae, others having at least some sparse, indistinct aculeae (very much more sparse and much shorter than in *G. asperifolium*). The plants with sparsely aculeate stems also appear to have slightly smaller flowers (1.0–1.9mm diam. with lobes 0.4–1.3  $\times$  0.4–0.7mm, compared with 1.8–2.2mm diam. with lobes 0.35–0.8  $\times$  0.2–0.4mm in plants with non-aculeate stems) but the differences are so weak and insubstantial that no taxonomic recognition is here given to the aculeate-stemmed variant, which, as mentioned above, must be regarded as the non-typical one in the nomenclatural sense.

The typical flower colour of *G. sikkimense* is greenish, cream or whitish with no red tint. Two specimens from Nepal (Marsiandi valley, damp retaining walls in sun and shade, 11,500ft, 10 vii 1950, *D.G. Lowndes* 1168 (E); Annapurna Himal, Seti Khola, on open slopes, 12,500ft, 3 viii 1954, *Stainton, Sykes & Williams* 6610 (E)) are described as having ‘flowers brownish pink’ or ‘flowers pink’ respectively. They both belong to the group with aculeate stems and need further study, and are not cited in the following lists of representative specimens.

*Representative specimens of G. sikkimense* (all E except where otherwise stated, with original identification and any re-determinations indicated):

*Non-aculeate variant (G. sikkimense sensu strictissimo):*

E NEPAL. Koshi Zone, Sankhuwa Sabha Distr., Bhainsi Kharka (2540m)–Danda Kharka (Dhari Kharka) (2860m)–Unshisa Kharka (3150m)–Khongma (Kauma) (3500m), 87°15'E 27°35'N–87°10'E 27°40'N, by path in *Rhododendron* forest, 15 vii 1988, *M. Suzuki et al.* 8820471, as *G. asperifolium* var. *sikkimense*; Tambur, 22 xi [year not stated], *J.D. Hooker* s.n. (K); Janakpur Zone, Ramechhap Distr., Neju (3651m)–Choarma (2760m), 86°31'E 27°44'N–86°28'E 27°41'N, in *Abies* forest, 3900m, 2 viii 1985, *H. Ohba et al.* 8530698 (BM).

INDIA (WEST BENGAL, DARJEELING DISTRICT). Darjeeling, without locality or date, *Cowan* s.n., as *G. asperifolium*; Darjeeling, Three Miles (Simkuna) (2200m)–Mungpoo (2200m), 24 ix 1977, *H. Ohashi, H. Ohba & Y. Tateishi* 775758, as *G. asperifolium* var. *sikkimense*; Changu, 12,000ft, 1 xi 1919, *Cave* s.n., as *G. sp. aff. mollugo*; Rishap, 3000ft, 1 vii 1913, *Cave* s.n., as *G. sp. aff. mollugo*; Sureil, 6000ft, 9 vii 1918, *Cave* s.n., as *G. sp. aff.*

*mollugo*; Riyang, 2000ft, 31 vii 1918, *Cave* s.n., as *G. sp. aff. mollugo*; above Sonada, 7000ft, 15 vii 1919, *Cave* s.n., as *G. sp. aff. mollugo*; Batasia, 6000ft, 7 ix 1912, *Cave* s.n., as *G. mollugo*; Sittong, 3000ft, 1 ix 1919, *Cave* s.n., as *G. sp. aff. mollugo*; Darjeeling, *J.D. Hooker* s.n. (K, several sheets, one mixed with *G. rebae*).

INDIA (SIKKIM). East Distr.: Gangtok, 27°20'N 88°37'E, shrubby roadside bank, 1800m, 30 vii 1992, *Long, McBeath, Noltie & Watson* ESİK 904, as *G. asperifolium*; Gangtok–Karponang road, eastern aspect in open forest glade in shade of rocks and on moss, trailing, 8000ft, 9 iii 1938, *F.H. Lister* 10 (K, poor specimen, ± sterile and very young); Sikkim, unloc. (regio. temp.), 6–12,000ft, *J.D. Hooker* s.n. (K).

INDIA (ASSAM). Khasi Hills, Shillong Peak, in thickets at the edge of the forest, 6000ft, 8 ix 1949, *Kingdon-Ward* 18841 (BM), tending towards *G. innocuum* Miq. but with shortly aculeate midrib; Tserra Rin, Khasias, 4500ft, 10 x 1867, *Clarke* 6286 (BM), tending towards *G. innocuum* (the specimen was originally named as that species by Clarke but he later deleted this and changed the determination to '*G. aspericaule* Wall.', presumably an error for *asperifolium* Wall.).

CHINA (XIZANG). Champitang to Tatung, 12,000–10,000ft, 2 viii 1938, *F. Spencer Chapman* 313 (K).

*Aculeate-stemmed plants:*

PAKISTAN. Upper Topa (Murree Hills), viii 1920, *J.H. Barbour* s.n. (BM; det. Bhattacharjee as *G. asperifolium* var. *sikkimense*).

NEPAL. C Nepal: Rolwaling Khola, Kyalche (2700m)–Dongang (2650m)–Thandingma (3200m), 1 ix 1983, *H. Ohba, M. Wakabayashi, M. Suzuki & S. Akiyama* 8351171 (E), as *G. asperifolium* var. *sikkimense*; Gandaki Zone, Kaski Distr., Ghandruk (Ghandrung) (1890m)–Bhainsi Kharka (2460m), 83°45'E 29°20'N, 2000m, 22 viii 1988, *M. Suzuki et al.* 8881185 (BM). E Nepal: Sankhuwasabha Distr., between Shidua and Tashigaon, 27°36'N 87°16'E, degraded shrubbery, 1860m, 23 ix 1991, *Long, McBeath, D.A.H. Rae & N.P. Bhattarai* EMAK 177, det. D.G. Long Dec. 1991 as *G. asperifolium*.

INDIA (SIKKIM). Sikkim, unloc., 1881, *Watt* 5532, as 'cfr. *G. spurium* L.', det. Bhattacharjee 1986 as *G. asperifolium* var. *sikkimense*; *ibid.*, unloc., 6000–12,000ft, *J.D. Hooker* (E, K).

INDIA (WEST BENGAL). Darjeeling: Rungboo, 7500ft, x 1872, *Gamble* 3805A (K); between Darjeeling and Lebong near Tibetan refugee camp, 27°02'N 88°16'E, on top of stone retaining wall, 2000m, 6 vii 1992, *Long, McBeath, Noltie & Watson* ESİK 95 (stem prickles very few, especially on thicker stems).

BHUTAN. Mongar Distr.: steep forested slopes near Namning, NW of Mongar, 27°19'N 91°02'E, gravelly roadside in wet broadleaved forest, 2500m, 5 vii 1979, *Grierson & Long* 2502. Tashigang Distr.: S slope of Yonpu La, S of Tashigang, 27°14'N 91°31'E, open cleared forest slope, 2625m, 27 vi 1979, *Grierson & Long* 2315. Bumthang Distr.: near Bumthang, grassy meadows, 9300ft, 31 vii 1949, *Ludlow, Sherriff & Hicks* 16980 (BM, E); Bumthang, in moss in bamboo forest, 11,000ft, 30 vii 1949, *Ludlow, Sherriff & Hicks* 19523 (BM). Shamgong Distr.: hillside 3km NE of Shamgong, 27°14'N 90°39'E, amongst shrubs on roadside in mixed forest, 1900m, 4 vi 1979, *Grierson & Long* 1606, det. Bhattacharjee as *G. asperifolium* var. *sikkimense*. Tongsa Distr.: Tongsa Dzong, 27°30'N 90°30'E, on terrace wall, 2300m, 24 v 1979, *Grierson & Long* 1299, det. Bhattacharjee as *G. asperifolium* (not specifically as var. *sikkimense*); Tambje, 27 viii 1914, 7000ft, *Cooper* 2608, det. Bhattacharjee as *G. asperifolium* var. *sikkimense*. Punakha Distr.: Gichha, Punakha, 7500ft, 24 viii 1914, *Cooper* 2772, det. Bhattacharjee as *G. asperifolium* var. *sikkimense*.

INDIA (ASSAM). Khasia, 4000–6000ft, *J.D. Hooker* s.n. (but see note below); Khasi Hills, Shillong, on roadside banks, also in thickets and pastures, 5000ft, 28 vii 1949, *Kingdon-Ward* 18688 (BM); Shillong, Khasiyas, 5000ft, 15 x 1887, *Clarke* 6142 (BM).



MYANMAR (BURMA). North Triangle, Hkinkum, a weed of open pasture slopes, 4000ft, 14 vii 1953, *Kingdon-Ward* 21153 (BM).

*Further observations on G. asperifolium*

Plants of *G. asperifolium* sensu stricto occur in western and C Nepal, whence the type (*Wallich* 6213A, iso. E, E-GL) was collected (*Wallich's* original determination was '*G. aparine* L.?'); the species becomes rarer in E Nepal where *G. sikkimense* tends to replace it. Other examples of *G. asperifolium* include the following (all E unless otherwise indicated):

INDIA (UTTAR PRADESH): Mussoorie, 6000ft, *James Marten* (BM).

NEPAL. Marsyandi Valley, Manang, on stony shrubby places between Braga and Manangbhot, 3500m, 12 x 1969, *T. Wraber* 36437 (BM); above Bheri, Suli Gad junction, dryish grassy slopes facing south, 9500ft, 26 vi 1952, *Polunin, Sykes & Williams* 2316 (leaves rather short, possibly because young); Mugu Karnali valley, between Gum and Lumsa, trailing down shady bank, 6500ft, 14 viii 1952, *Polunin, Sykes & Williams* 5223; NW of Gurjakhani, around shrubs on ridge, 10,500ft, 19 ix 1954, *Stainton, Sykes & Williams* 4490; N of Tukucha, Jomsom, 10,000ft, 24 vi 1954, *Stainton, Sykes & Williams* 1393; Tukucha, Kali Gandaki, open grass slopes, 11,000ft, 21 vii 1954, *Stainton, Sykes & Williams* 1939; Munigaon, SE of Jumla, on open slopes among tall herbs, 9000ft, 22 vii 1952, *Polunin, Sykes & Williams* 4847; E Nepal, Sinduwa, Dhnankuta Distr., 1100m, 24 x 1963, *H. Hara, S. Kanai & S. Kurosawa* 6300578 (BM, E: BM label differs slightly: '*Sinduwa-Chitray, . . . H. Hara, H. Kanai, S. Kurosawa & G. Murata* 6300578'); E Nepal, Janakpur Zone, Ramechhap Distr., Jiri (1860m)–Kune (1860m)–Kattike (2000m)–Those (1740m)–Shivalaya (1800m), 16 viii 1985, *M. Suzuki, N. Kurosaki & S.K. Wu* 8580862 (BM, E: stem hairs shorter, plant darker green than typical, and in appearance somewhat tending towards, but not belonging to, *G. sikkimense*); E Nepal, lower slopes [of] Dobala Danda, above Yamphudin, 27°27'N 87°56'E, open woodland, 2075m, 26 ix 1989, *KEKE* 979; E Nepal, Koshi Zone, Sankhuwa Sabha Distr., Chichila (1870m)–Kuwapani (1940m)–Sakrate (Sakurate) (1840m)–Hurhure (Fururu) (2040m)–Mude (Mure) (2040m), by path in thicket, 9 vii 1988, *M. Suzuki et al.* 8820314 (BM, E) (det. on label as var. *sikkimense* (Gand.) Cufod.; approaching *G. sikkimense* but the hairs are crispulate-adpressed, typical of *G. asperifolium*).

Many specimens of supposedly 'typical' *G. asperifolium* have also been seen from Uttar Pradesh, Himachal Pradesh and northern Pakistan. Nearly all of these have upper leaf surface epidermal cells large and clearly visible at  $\times 20$ , whereas most Nepalese plants have much less distinct epidermal cells. It may therefore be necessary to further divide *G. asperifolium* in some way to take account of this variation, as I have done in *G. acutum* by the recognition of *G. megacyttarion*. Phytogeographically, the break between plants with large and small epidermal cells approximately corresponds to a well-documented 'phytogeographical barrier' in western Nepal and it would thus not be surprising if separate recognition were needed for the plants of the *G. asperifolium* group from the NW Himalayas. Indeed, the new species *G. tetraphyllum* Nazim. & Ehrend., differing from *G. asperifolium* by its smooth stems and leaves in whorls of 4 (not 6), was recently described by Nazimuddin & Ehrendorfer (1987: 73) and further taxa may well need to be separated from this

difficult complex, as was the case when another difficult Himalayan *Galium*, *G. serpylloides* Royle ex Hook.f., was revised resulting in the description of four new species (Schönbeck-Temesy & Ehrendorfer, 1987).

*S Indian material of G. asperifolium sensu lato*

Other plants which have been treated as *G. asperifolium* occur in SW and S India, especially the Nilghiris. Some of these differ from Nepalese material in having longer, denser, stouter hairs which, except sometimes in the uppermost part of the stem, are spreading and straight, not retrorsely and inwardly crispate-curved. These plants were separated by Cufodontis (1940) as *G. asperifolium* var. *pilosissimum*, a combination which was overlooked in the recently published list of plants described from the Indian subcontinent since *Flora of British India* (Naithani, 1990) and does not seem to have been used in any recent Flora of any part of southern India. However, in my opinion Cufodontis was correct in separating these south Indian plants from typical *G. asperifolium*.

*G. asperifolium* sensu stricto was also said by Cufodontis to occur in south India including the Nilghiris; cited specimens included Meebold 9937 from 'Kalhutti Bababoodans' (label of E example: Kulhutti Bababuden berge, Maisor, 6000', Nov. 1908) and Warburg 359 and Ralph 101 from the Nilghiris (neither seen by me). The Meebold collection does have inwardly curved, retrorse hairs as in *G. asperifolium* and thus Cufodontis's view that two taxa of the *G. asperifolium* group occur in S India appears to be correct, but further study is needed to confirm whether the S Indian plants matching Nepalese *G. asperifolium* in their indumentum also match in other respects. Other examples belonging to this group include an unnumbered Watt specimen from the Nilghiri Hills (E); top of Sezoor Ghat, 1857, Drew (E); Binsur, flowers buff, 7200ft, Madden 393 (E); Tamil Nadu, along path from Kodai Kanal to Dolphine's Nose, 2300m, 22 ix 1982, J. Kluckenberg & R. Lundin 022 (K); Coonoor, Bourne s.n. (K); Neelgherries, Gordon s.n. (K); Ootacamund, 7000ft, vi 1883, Gamble 11815 (K); Ooty downs, 9 ix 1937, R.S. Vine 112 (BM); Kodaikanal, Pulneys, 20 v 1897, Bourne 36 (K, left-hand, small-leaved plant only); Bababudda, ix 1816, anon. (Rottler or Heyne?; ex Herb. Rottlerianum, named as *Galium indicum* Heyne); and Nilgerris, Perrotet 516 (BM: isosyntype of *G. asperifolium* var. *pilosissimum* but differing from the other specimens seen in having shorter, retrorse hairs c.0.3mm and thus included in the above group).

Specimens of the spreading-haired group, var. *pilosissimum* Cufod., cited by Cufodontis (1940) included Hohenacker 992, Perrottet 516 and J.D. Hooker & Thomson s.n., all from the Nilghiris and Coorg; Engler 3540 from Ootacamund; A. Sauliere 83 from Kodaikanal; and Wight 1510 p.p. & 1371 (unlocalized). As none was designated type, all the above are syntypes of Cufodontis's variety. Of them, I have seen material of Perrotet 516 (BM: localized 'Nilgerris'), Wight 1510 (K: localized 'Neelgherry, September 1848'), Wight 1371 (2 sheets E, 2 sheets E-GL, 1 sheet K, all unlocalized), and Hohenacker 992 (1 sheet BM det. Hara as isosyntype

of var. *pilosissimum*, 1 sheet E, 1 sheet K: 'in montibus Nilagiri'). A specimen (E) collected by J.D. Hooker & Thomson, mounted together with *Wight* 1371, is typical *G. asperifolium* and may well belong to a different collection to that seen by Cufodontis as it is labelled 'Himal. Bor. Occ. 5000–9000 ped. leg. T.T.' [T. Thomson]. All the collections seen, except *Perrotet* 516, agree with Cufodontis's description of var. *pilosissimum*. Of them, *Hohenacker* 992 is here designated lectotype of var. *pilosissimum*. The actual lectotype (i.e. the specimen of *Hohenacker* 992 that Cufodontis would have examined) should be at W but has not been seen by me; the BM, E and K specimens are all isolectotypes. It should be noted that, although not stated on the specimen, the collector was in fact not R.F. Hohenacker, but F. Metz; Hohenacker merely edited the set of exsiccata (see Lanjouw & Stafleu, 1957: 281 fn. and Vegter, 1976: 532). Other examples of var. *pilosissimum* which have been seen but do not represent type material include: Nilghiris, *Schmidt* s.n. (E, K); Almora, 5500ft, *Madden* s.n. (E); Nilgiris, Fairlawn Ooty, 7000ft, ix 1883, *Gamble* 12475 (K); Nilgiris, Kinnacoorie, 5200ft, 19 i 1913, *C. Fischer* s.n. (K); Nilgerris, *Perrotet* 480 (BM).

A few specimens of the *G. asperifolium* group from the Nilghiris differ from either of the above hairy-stemmed variants in having glabrous or subglabrous stems and thus resemble *G. sikkimense*, from which they differ in their more broadly obovate leaves. They require further study but only a limited number of specimens have been seen. Examples of this variant include Nilghiris, 7000ft, *Beddome* 4080 (BM); Nilgheiris, 8000ft, 23 iii 1870, *Clarke* 11202 (BM); Pulney Hills, *M.A. Evershed* s.n. (BM, with common name 'Indian Bedstraw') and some from Sri Lanka (Ragalla, 18 ix 1931, *N.D. Simpson* 8678, BM; Hakgala Peak track, 10 i 1932, *N.D. Simpson* 9092 (BM)).

#### *Conclusions regarding the G. asperifolium group*

From the specimens seen, the densely crisped species *G. asperifolium* of W and C Nepal (and further west in the NW Himalayas if the large-celled plants from there are included) appears to be replaced rather abruptly in E Nepal and Sikkim by the non-aculeate, type variant of *G. sikkimense*. The aculeate variant of *G. sikkimense* in turn appears to largely replace the non-aculeate state of this species in Bhutan, and extends eastwards to Khasia and Burma and sporadically westwards in Nepal where it appears to be much less frequent than the non-aculeate state. The *G. asperifolium* group is thus differentiated into several more or less morphologically distinct and geographically largely allopatric taxa, extending throughout much of the Indian subcontinent. The high degree of allopatry combined with the morphological differences has been used here to justify specific rank for *G. sikkimense* and *G. asperifolium*. A more detailed analysis of the whole group is desirable but is beyond the scope of the present paper. It should include a study of the relationships between the southern Indian plants presently referred to *G. asperifolium* var. *pilosissimum* and the typical state of the species occurring in Nepal. Although several authors (e.g. Subramanyam

& Nayar, 1974) have demonstrated a phytogeographical connection between the southern Indian hill ranges, especially the Nilghiri hills, and parts of Khasia (particularly the Shillong plateau), such connections have hitherto been much less clearly shown between Nepal and the Nilghiris or Western Ghats.

*Key to the G. asperifolium group in the E Himalaya*

1. Stems densely (occasionally rather sparsely) crisped-hairy with incurved, slender prickle-like hairs ..... **G. asperifolium**
- + Stems glabrous, or with sparse,  $\pm$  stout, prickles which are not arcuate inwards towards the stem axis ..... 2
2. Stems with a few short prickles, but lacking hairs; corolla whitish, greenish or cream ..... **G. sikkimense** (aculeate variants)
- + Stems completely glabrous (prickles absent); corolla colour various ..... 3
3. Flowers dark crimson, 2.25–2.8mm diameter ..... **G. craticulatum**
- + Flowers whitish, greenish or cream, 1.2–2.2mm diameter ..... **G. sikkimense** (non-aculeate variant)

#### CONCLUDING REMARKS

It is clear that further work needs to be done to clarify the taxonomy of both these difficult Himalayan groups of *Galium*. However, it is obvious from the results obtained in this preliminary revision that the pattern of variation is similar to the vicarious differentiation that was found in the *G. serpylloides* group by Schönbeck-Temesy & Ehrendorfer (1987). Taxa, either at species rank or lower, are delimited not only morphologically but also distributionally, following well-known patterns of phytogeographical vicariant differentiation which are being demonstrated in more and more widely dissimilar taxa as revision of their Himalayan members progresses. Such work is beyond the scope of the present paper, which nevertheless has attempted to give pointers towards future avenues of research.

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