A NEW SPECIES OF ISOPYRUM ENDEMIC TO THE QUEEN CHARLOTTE ISLANDS OF BRITISH COLUMBIA AND ITS RELATION TO OTHER SPECIES IN THE GENUS[1]

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In 1957, a party composed of D. B. O. Savile and the authors carried out a botanical survey of the Queen Charlotte Islands from late May until the latter part of August. During the course of the survey, several collections of a new taxon belonging to the genus *Isopyrum* were made in the Queen Charlotte Ranges. This paper is devoted to the description of this new species and its relation to other members of the genus.

Four species of *Isopyrum* are presently recognized in North America. Three are found in western United States and their distributions include southern Washington, Oregon, and California. The fourth species, *I. biternatum,* is restricted to eastern United States and Canada. The new species, *I. savilei,* is completely disjunct from these four taxa and is found only in a small area of the Queen Charlotte Islands.

Isopyrum savilei is the fourth endemic to be described from this region as a result of the 1957 survey, the others being: *Saxifraga taylori* (Calder and Savile, 1959), *Saxifraga punctata* ssp. *carlottae* (Calder and Savile, 1960), and *Ligusticum calderi* (Mathias and Constance, 1959). Another distinct endemic, *Senecio newcombei,* was previously described by E. L. Greene in 1897 from a collection made by C. F. Newcombe during a survey of the Queen Charlotte Islands in the same year. In addition to these endemic taxa, there still remain a few undescribed entities in our collection from the alpine and subalpine areas in the Queen Charlotte Ranges. Although the endemics are few in number, the degree of endemism is high for such a small flora. The phytogeographic significance of this endemism will be fully discussed in a forthcoming treatment of the flora of the Queen Charlotte Islands.

We would like to express our appreciation to the curators of the following herbaria for the loan of specimens or the opportunity to examine material in their respective institutions: University of California, Berkeley; University of Oregon; Peck Herbarium, Willamette University; University of Washington; Washington State University; University of Wyoming; New York Botanical Garden; and Gray Herbarium, Harvard University. We would like to express our appreciation to the artist, Miss C. Mentges for the excellent illustrations, to B. Boivin for the Latin diagnosis, and to C. Crompton for technical assistance.

It is a pleasure to name this species after our close friend and colleague, D. B. O. Savile, who has collected widely in the Pacific Northwest and

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whose suggestions and stimulating discussions have provided a greater insight into the botanical problems of this region.

Key to the North American Species of Isopyrum

Tepals 3.5–6.0 mm long, veins few and prominent; filaments flat, narrowly triangular; follicles stipitate. Oregon and northern California.....*I. stipitatum*
Tepals 7.0–17.0 mm long, veins many and inconspicuous; filaments filiform, clavellate to clavate; follicles sessile.
Leaflets puberulent beneath; flowers in a cyme. Southern Washington and northern Oregon.....*I. hallii*
Leaflets glabrous beneath; flowers solitary.
Roots never tuber-like; lobes of leaflets with a shallow glandular notch at apices; tepals usually 12.0–16.0 mm long. Queen Charlotte Islands.....*I. savilei*
Roots often tuber-like; lobes of leaflets glandular apiculate at apices; tepals usually 7.0–10.5 mm long.
Tuber-like roots, fasciculate; follicles 10.0–12.0 mm long; styles recurved, 1.0 mm long or less. Central and southern California.....*I. occidentale*
Tuber-like roots never fasciculate; follicles 5.0–6.5 mm long; styles straight, *ca.* 1.5 mm long. Eastern North America.....*I. biternatum*

Isopyrum savilei Calder and Taylor, sp. nov. Perenne, erectum, glabrum, valde rhixomatiforme (10.5)–15.0–31.0–(36.0) cm; folia inferne glaucina, bi-ternatisecta; flores solitarii, terminales vel axillare; tepala 5, alba, decidua (9.8)–12.6–15.0–(16.8) mm long; (6.9)–8.2–10.2–(11.2) mm lat.; stamina 40–60, filamentis filiformis, clavatis, 5.0–8.0 mm long; carpellis sessilibus, 2–8; folliculi dense aggregati, arcuati, 11.0–15.0 mm long; semina 2–8, laevigata, ovoidea, apiculata cum raphid, 2.0–2.3 mm long.

A delicate upright perennial, glabrous throughout, strongly rhizomaous (10.5)–15.0–31.0–(36.0) cm high; leaves glaucous beneath, twice ternately compound, leaflets strongly 2–3-lobed, lobules entire to 3-lobed, with shallow glandular notches at apices, basal leaves usually one, cauline 1–several; flowers solitary, terminal or axillary; tepals 5, white, occasionally tinged pink at apex, readily deciduous, (9.8)–12.6–15.0–(16.8) mm long, (6.9)–8.2–10.2–(11.2) mm wide; stamens usually 40–60, filaments filiform, clavate, 5.0–8.0 mm long; carpels sessile, 2–8; fruit a head of upright to strongly arcuate follicles, follicles 11.0–15.0 mm. long with recurved beaks; seeds 2–8, essentially smooth, ovoid, prominently apiculate with distinct raphe, 2.0–2.3 mm long.

Type: 20 miles south of Moresby Logging Camp near an alpine lake, Moresby Island, Queen Charlotte Islands, British Columbia, *Calder* et al. *23055* (DAO).

Graham Island: Empire Anchorage, Athlow Bay, *Calder* & *Savile 21464*; head of McClinton Bay, Masset Inlet, *Calder* et al. *21578*; east side of Shields Bay, Rennell Sound, *Calder* & *Taylor 23294*; mountain north of Mt. Stapleton, Shields Bay, Rennell Sound. *Calder* & *Taylor 23375*. Moresby Island: Mt. de la Touche, Fairfax Inlet, Tasu Sound, *Calder* & *Taylor 23566*; mountain at west end of Mosquito Lake, *Calder* & *Taylor 23721*; 20 miles south of Moresby Logging Camp near an alpine lake, *Foster* & *Joslin 56* (UBC); Tasu Inlet, June 26, 1961, *Foster* & *Bigg* (UBC).

Isopyrum savilei is restricted to the Queen Charlotte Ranges at high elevations except on the west coast where subalpine conditions extend

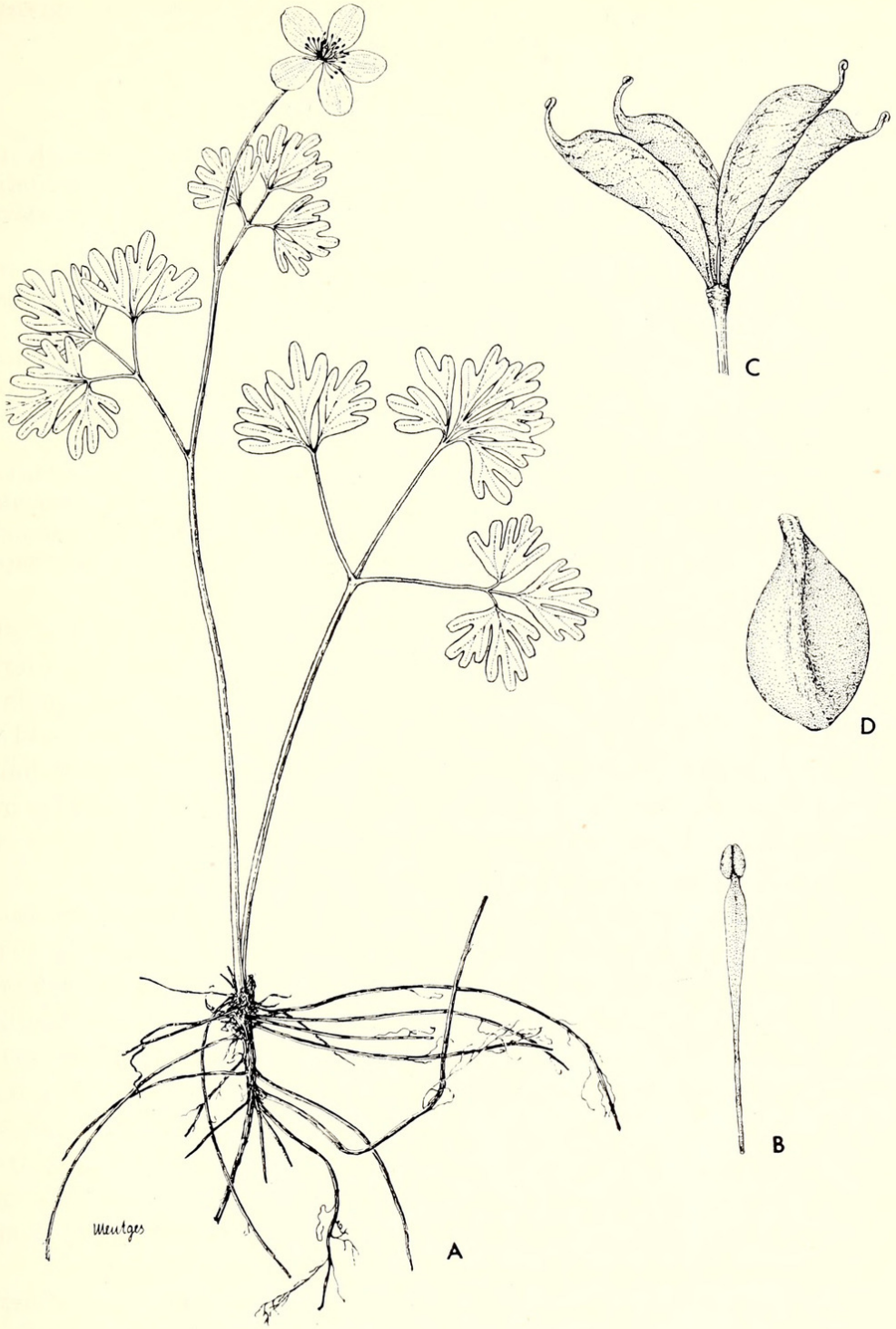

FIG. 1. *Isopyrum savilei*: A, habit, × ½; B, stamen, × 5; C, fruit, × 2; D, seed, × 10.

down to sea level. It is a species usually found in moist, shady, rock runnels or in cliff crevices, but it occasionally extends onto talus slopes where suitable habitats exist. It is associated with many species, but is frequently found with *Lloydia serotina, Saxifraga mertensiana, Anemone narcissiflora* (*s.l.*), *Romanzoffia sitchensis, Heuchera glabra,* and *Pingui-*

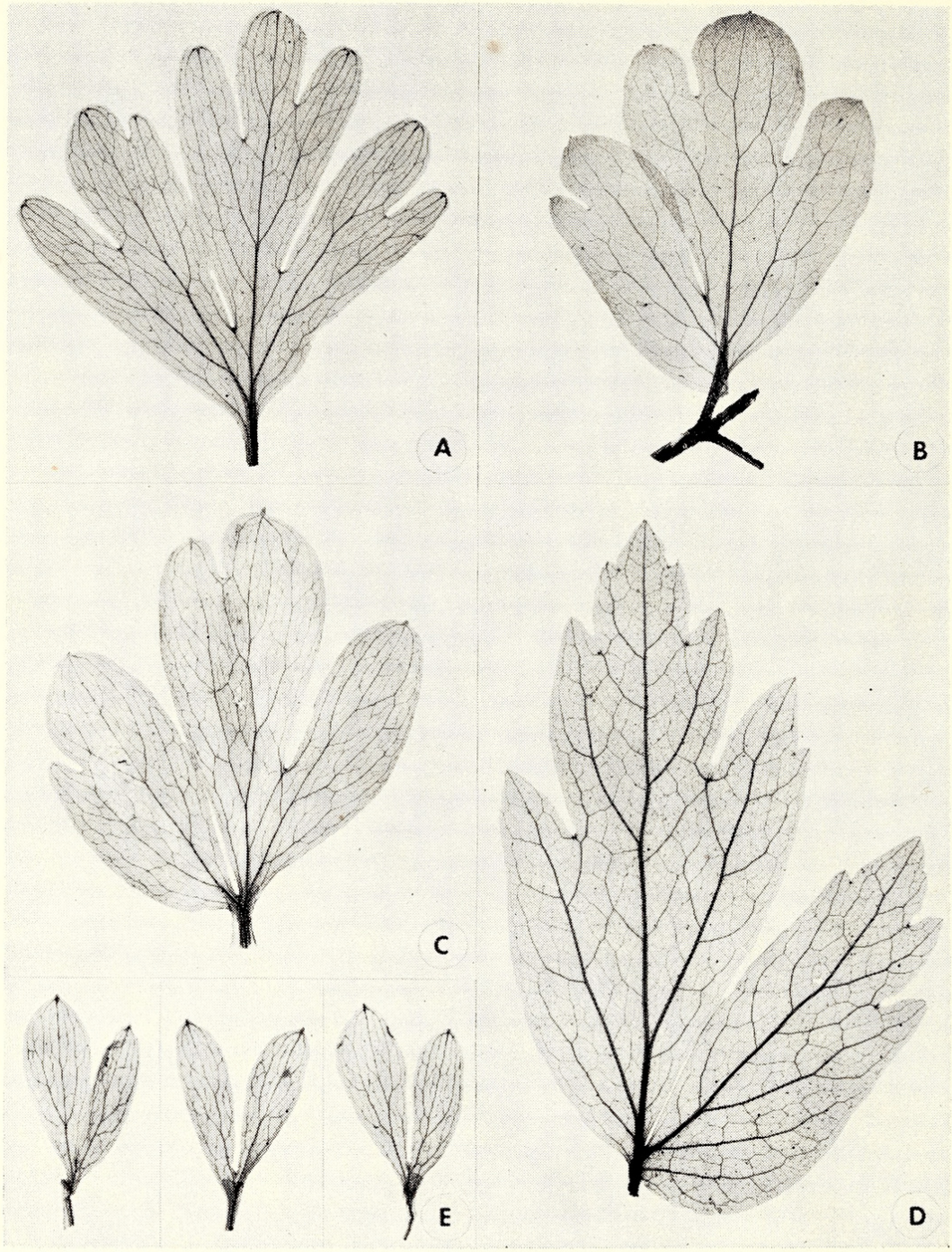

FIG. 2. Leaflets of North American species of *Isopyrum*: A, *I. savilei;* B, *I. biternatum*; *C, I. occidentale*; *D, I. hallii*; *E, I. stipitatum.* (All *ca.* × 2.)

cula vulgaris. Although noted in all alpine areas surveyed, it was never a conspicuous element of the vegetation.

A detailed comparison has been made between the five North American species, emphasizing those morphological characters which we feel are most diagnostic (table 1). We fully realize that additional characters such as the shape of the leaflets, stamen number, and follicle shape, which

have been used by other authors, could have been included. However, the number of stamens and shape of the follicle is variable and cannot be used readily to separate the species. On the other hand, leaflet characters are distinct, but difficult to describe adequately. For this reason we have included detailed morphological comparisons of actual leaves utilizing a chloral hydrate/sodium hydroxide clearing technique (fig. 2). This method of comparison of leaf types clearly shows the venation patterns, lobule apiculation (or lack of same), and the degree and types of lobing. The distribution of the four western species is shown in Figure 3.

Isopyrum savilei is strikingly distinct from the other specie of *Isopyrum* that occur in North America in several morphological characters, e.g., the strongly rhizomatous nature of the root system, the shallowly notched tips of the ultimate leaf segments, the large showy flowers, the arcuate follicles, and the essentially smooth apiculate seeds with prominent raphes (fig. 1).

The discovery of this endemic is significant as it provides further evidence of the close relationships between the North American and Japanese species. Close scrutiny of the distinctive western North American species, *Isopyrum hallii,* reveals that it possesses many similar characters to the Japanese species, *I. raddeanum,* such as: pubescence of leaves, apiculate tipped leaflets, and seed coat characters. These observations confirm those of Drummond and Hutchinson (1920. p. 154) who stated, "The remarkably close affinity of two species of this genus, *E.* [*nemion*] *Raddeanum* from Manchuria, and *E. Hallii* from Oregon, is worthy of note." Another group of Japanese species have glandular, notched tips on the ultimate leaf segments, smooth seeds, rhizomatous root systems, and usually two carpels; characters which are also found in *Isopyrum savilei.* On the other hand, *I. savilei* also shows close relationships with the American taxa with respect to lack of staminodia, clavate filaments, follicle size, and deeper lobation of leaf segments.

The North American species have been segregtated under *Enemion* (Drummond and Hutchinson, 1920) and this segregation was based on the tenuous character of carpel number and the presence or absence of petals; two morphological units which are extremely difficult to evaluate in the family Ranunculaceae. They recognized seven genera; however, only *Isopyrum* and *Enemion* are pertinent to the present discussion. *Enemion* was proposed by Rafinesque (1821) to include a group of species differing from *Isopyrum* by the absence of petals and this separation was supported by Drummond and Hutchinson. It should be emphasized that the use of the terms petals and sepals with respect to the genera in question was not supported by anatomical studies by either Rafinesque, or Drummond and Hutchinson. Indeed, the latter authors have based their segregation primarily on phyletic grounds rather than on critical evaluation of morphological characters. We believe the outer showy organs arranged in a spiral fashion are not sepals, but are best classified as tepals in accordance with modern terminology. In addition

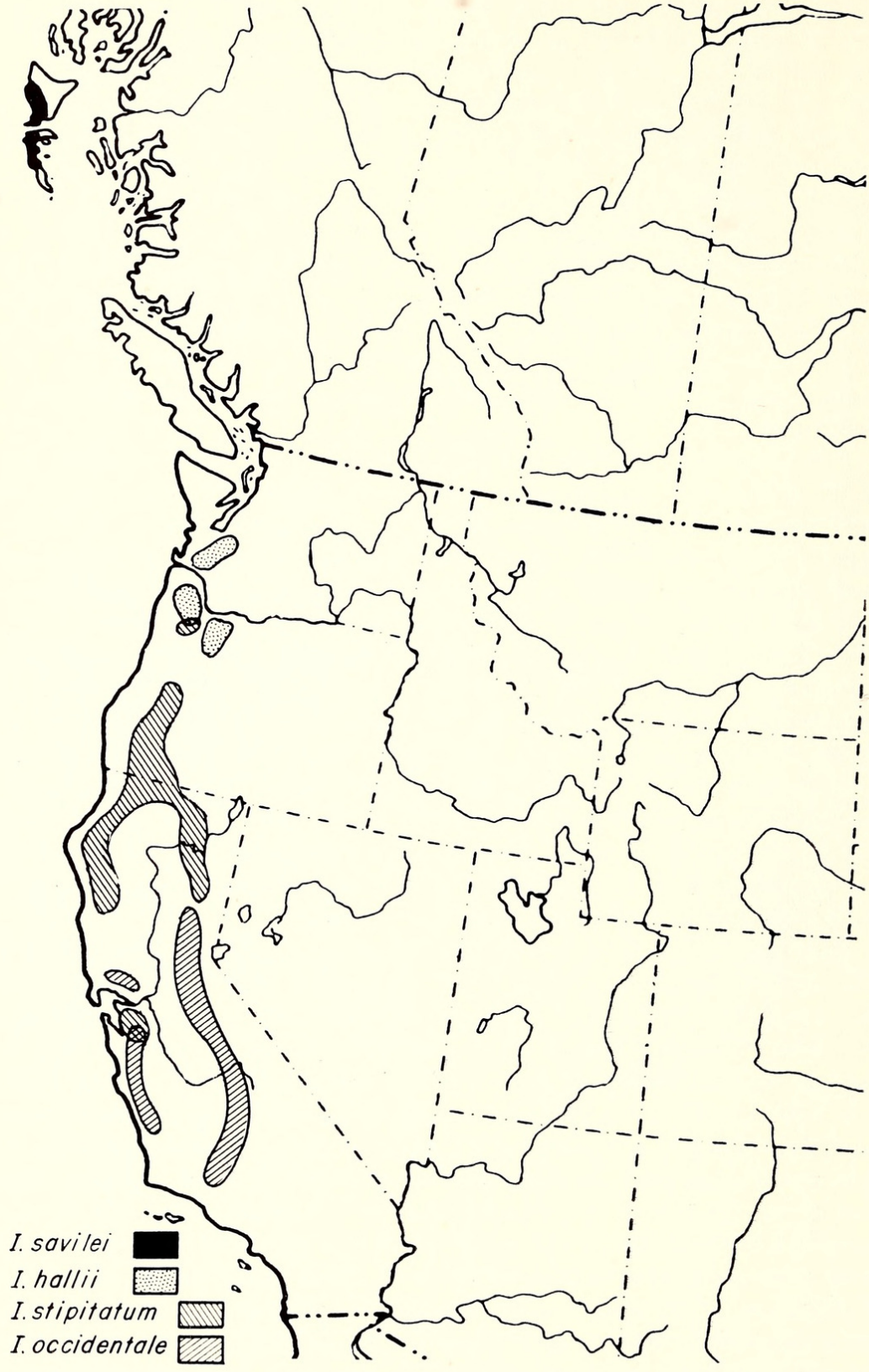

FIG. 3. The geographical distributions of western North American *Isopyrum*.

TABLE 1. A COMPARISON OF THE NORTH AMERICAN SPECIES OF ISOPYRUM

	I. occidentale	*I. savilei*	*I. biternatum*	*I. hallii*	*I. stipitatum*
Height	(7.0)–15.0–30.0 –(40.0) cm	(10.5)–15.0–31.0 –(36.0) cm	11.0–31.0 cm	55.0–65.0–(67.0) cm	5.5–11.0–(12.5) cm
Root system	not rhizomatous; fascicle of short, thickened, tuber-like (fusiform) roots	strongly rhizomatous; roots not thickened	weakly rhizomatous; roots sometimes tuberous, but never in fascicles	not rhizomatous; short, stout, woody rootstock	not rhizomatous; fascicle of short, thickened, tuber-like (fusiform) roots
Leaflets	lobes glandular apiculate; glabrous	lobes with a shallow glan lular notch; glabrous	lobes glandular apiculate; glabrous	lobes glandular apiculate; puberulent beneath	lobes glandular apiculate; glabrous
Inflorescence	flowers solitary	flowers solitary	flowers solitary	flowers cymose	flowers solitary
Peduncle	apex never strongly flared	apex never strongly flared	apex never strongly flared	apex never strongly flared	apex strongly flared, obconic
Tepals	white, occasionally pink 7.0–9.3–(11.3) mm long, (3.2)–3.8–5.7 mm wide; veins inconspicuous in dried material	white, (9.8)–12.6–15.0 –(16.8) mm long, (6.9)–8.2–10.2 –(11.2) mm wide; veins inconspicuous in dried material	white, 7.2–9.1–(11.2) mm long, 4.2–6.6 mm wide; veins inconspicuous in dried material	white, 7.5–9.3 mm long; 3.3–5.5 mm wide; veins inconspicuous in dried material	white, (3.5)–4.2–5.5 –(6.0) mm long, 1.5–2.2 mm wide; veins prominent in dried material
Stamens	2.2–5.5 mm long	5.0–8.0 mm long	2.7–5.2 mm long	5.1–8.2 mm long	1.9–2.8 mm long
Filaments	filiform, weakly clavate	filiform, weakly clavate	filiform, clavellate	filiform, weakly clavate	flat, membranous; narrowly triangular
Mature follicles	10.0–12.0 mm long; upright to widely divergent; sessile	11.0–15.0 mm long; upright to strongly arcuate; sessile	5.0–6.5 mm long; upright to widely divergent; sessile	4.0–7.0 mm long; upright to widely divergent; sessile	5.0–8.0 mm long; upright and appressed; stipitate
Seeds	1.7–2.0 mm long; rugulose, reniform	2.0–2.3 mm long; essentially smooth, ovoid, and prominently opiculate	2.1–2.6 mm long; smooth or slightly rugulose, ovoid, raphe prominent; minutely pubescent	2.0–2.2 mm long; rugulose, ovoid, and weakly apiculate	1.4–1.7 mm long; strongly rugose, round, and weakly apiculate

to the tepals, Drummond and Hutchinson have noted small petaloid structures in the European *I. thalictroides,* and stalked and bilobate structures in the Japanese species, *I. stolonifera* and *I. trachyspermum,* respectively. We feel they have misinterpreted these petaloid structures as petals and have subsequently placed too much stress on their value as characters for segregation of the genera. After careful examination of these structures, we have concluded they are staminodia and represent a transitional series from a sessile petaloid organ to one which is stalked bilobate. These structures are readily identifiable as staminodia and closely approximate the stamens with clavellate filaments found in several *Isopyrum* species. It should be pointed out that we have not completed a detailed ontogenetic study of these structures.

Drummond and Hutchinson considered that both *Isopyrum* and *Enemion* were derived from *Paraquilegi*a, a "primitive ancestoral" genus comprised of four species from the mountainous regions of central and southern Asia, and that they represent separate and distinct lines of divergence. We have no evidence that *Paraquilegia* does not represent the ancestoral progenitor of this complex and we do not disagree with their concept that a "natural" group exists in Japan and North America. However, we do think that the two groups, i.e., the Japanese and the North American, do not represent divergent lines of evolution, but rather that they represent overlapping stages within a single line of development. These two groups are closely related and there is no significant morphological evidence for separating them into two separate and distinct genera, hence we consider that the North American taxa belong in the genus *Isopyrum.*

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