

Pharmacognostical Studies on the *Clematis* Plants and Related Crude Drugs (II)¹⁾
On the Botanical Origin of "Wei-ling-xian" (威靈仙)
from Taiwan and Liang-guang²⁾

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"Weilingxian" (威靈仙) is the crude drug used in Chinese medicine, and is derived mainly from the underground part of the *Clematis* plant of Ranunculaceae. In this paper, "Weilingxian" from Taiwan and south districts of continental China, *i.e.* Guang-dong (廣東) and Guang-xie (廣西), are investigated. The botanical origin of "Weilingxian" from these districts has been regarded as *Clematis chinensis* OSBECK. From the comparative anatomical studies of the roots in the crude drug and *Clematis chinensis*, it was made clear that "Weilingxian" from Taiwan was derived from the underground part with short stems of *Clematis chinensis*. However, the anatomical characteristics of the "Weilingxian" from south districts of continental China were not confirmable to those of *C. chinensis* from Taiwan and the southwest of Japan. The botanical origin of this crude drug might be another unknown species or one variation of *C. chinensis*.

Keywords—Weilingxian; Chinese medicine; *Clematis chinensis*; origin; anatomical study; Ranunculaceae

In the previous paper¹⁾, the anatomical characteristics of the roots of *Clematis terniflora* DC. var. *robusta* (CARR.) TAMURA, which was the original plant of "Ireisen" (威靈仙) from Japan, and two similar species of Ranunculaceae were described precisely. In this paper, the botanical origin of "Weilingxian" from Taiwan and south districts of continental China are investigated.

The botanical origin of "Weilingxian" from these areas had been assumed to be *Clematis chinensis* OSBECK.³⁾ However, there has no confirmation on it. Recently, an anatomical study on the roots of some *Clematis* plants from continental China was reported to determine the botanical origins of "Weilingxian" from China.⁴⁾ But we found many doubtful statements in the paper. There was no authenticity because of insufficiency of experimental materials.

Most of "Weilingxian" from Taiwan consist of fibrous roots. Though the roots of the crude drug which we got were slightly larger than those of *Clematis terniflora* var. *robusta*, the outlines of the roots were quite similar to each other. Therefore, the botanical origin of "Weilingxian" from Taiwan was considered to be *Clematis* plant.

In Taiwan, more than 20 species of *Clematis* plants grow wildy.⁵⁾ From our researches on the shapes of their roots, it was made clear that only two species, *i.e.* *Clematis chinensis* and *C. garanbiensis* HAYATA,⁶⁾ had fibrous roots, and the rest and some woody or larger roots. In view of these facts, the botanical origin of "Weilingxian" from Taiwan was considered to be *C. chinensis* or *C. garanbiensis*.

To clarify the botanical origin of "Weilingxian" from Taiwan, comparative anatomical studies on the crude drug and roots of above two species were made. Since *Clematis chinensis* is growing wild also in Japan, the species from Japan were also included in the experimental materials. Moreover, "Weilingxian" from Liang-guang (兩廣, means both Guang-dong 廣東 and Guang-xie 廣西) of China, which had been regarded as the root of *C. chinensis* as described above, was investigated.

On the other hand, through our market researches, it was made clear that another "Weilingxian," which had some large roots, was available in central Taiwan. The plant origin of this crude drug will be reported in the other paper.

Materials⁷⁾

***Clematis chinensis* OSBECK from Taiwan:** Ping-tung pref.; between Wu-tai (霧台) and A-li (阿里), 74001, Dec. 13, 1974. Heng-cshun (恆春), 76100, Aug. 13, 1976. San-ti-men (山地門), 76085, 76087, Aug. 7, 1976. Kao-hsing pref.; tao-yuan (桃園), 76145, Aug. 16, 1976. Hua-lien pref.; Shan-chan (山巖), 76138–76140, 76144, Aug. 16, 1976. Chia-i pref.; Mei-shan (梅山), 77058, Aug. 16, 1977.

***Clematis chinensis* from Japan:** Okinawa pref.; Kurimashima (來間島), Miyako-gun, 6629–6644, Aug. 17, 1975. Mae-hama (前浜), Miyako-gun, 6650, Aug. 19, 1975.

***Clematis garanbiensis* HAYATA:** Ping-tung pref., Che-cheng (車城), 76098, 76101, Aug. 12, 1976.

“Weilingxian” from Taiwan was collected from following places: Lung-sheng Chinese drug store (隆盛藥材行), Ch’ao-cho, Ping-tung pref., Aug., 1976, Aug., 1977, March, 1979; Cheng-hsing Chinese drug store (振興藥行), Chia-i, Chia-i pref., Jan., 1977; Cho Chin Ch’uan (卓錦泉), herbal collector, Hua-lien, Hua-lien pref., Jan., 1976; Su Chun Hsing (蘇春雄), herbal collector, Che-cheng, Ping-tung pref., Aug., 1976; Zu I Chin (朱乙久), herbal collector, San-ti-men, Ping-tung pref., Aug., 1977; Li Kuo San (李國三), herbal collector, Kao-hsing, Kao-hsing pref., Aug., 1976.

“Weilingxian” from Liang-guang (兩廣)⁸⁾ was collected from the following stores: Wing-tai-hong (永大行), Hong-kong, 1977; Tochimoto tenkaido (栃本天海堂), Osaka, Japan, 1975.

Experimental

***Clematis chinensis* OSBECK**

Botanical characteristics: The species was placed in sect. *Flammula*, subsect. *Rectae*, ser. *Chinenses* of genus *Clematis*.⁹⁾ The plant is an evergreen vine. The leaf and calyx change into black in color when dried. Achene is fusiform in shape, and the margins scarcely elevates, and is pilose.

Macroscopical characteristics of the root (Fig. 1-A): One rhizome has 10 to 100 fibrous roots, but occasionally find more. The root is somewhat fusiform, 30–70 cm in length, 2–5 mm in diameter, normally 2–4 mm. The surface of fresh root is smooth, and yellowish brown, and changes into grayish brown when dried. But, some roots scarcely change color even in dry state. Dry roots are easily broken, and shows grayish white or yellowish white color. The root has no special odor or taste.

Microscopical characteristics of the roots (Figs. 1, 2): Anatomical characteristics are fundamentally similar to those of *Clematis terniflora* DC. var. *robusta* (CARR.) TAMURA described in the previous paper.¹¹⁾ The root at d.p.=50 mm (transverse section at a distance of 50 mm from the proximal end) measures 1,650–5,000 μm , and at d.p.=5 mm, 1,200–4,700 μm in diameter. Fusiform ratio¹⁰⁾ ranges 0.93–1.83 on each root, and 1.06–1.57 in the average from one stock. In the root at d.p.=50 mm, the stele measures 260–2,700 μm in diameter, the percentage of the stele in the root by diameter is 12.8–54.8%. The outermost layer is epidermis (Fig. 2-A), occasionally exodermis. Epidermal cells measure 40–65 μm in diameter, outer cell walls measure 3–8 μm in thickness. Exodermal cells measure 50–80 μm in diameter. The cortex consists of parenchyma cells arranged in 12–23 layers. The increase of the cell layers¹¹⁾ ranges 1–10 in individual, 4.0–5.7 in average from one stock. The cortical parenchyma cells measure 70–170 μm in diameter, 130–330 μm in length. The endodermal ring consists of 40–120 cells at d.p.=50 mm, and the observational numerals are surely more than 47 in the roots having diameters of over 2,000 μm . In large old roots, sclerenchyma cell and fiber frequently reveal in the pericyclic and phloem areas (Fig. 2-C₁). The shape of xylem is the same as that of *C. terniflora* var. *robusta* (Fig. 1, B–K). The vessels (Fig. 2-D_{4,5}) measure 40–155 μm in diameter, 120–650 μm in length. Starch grains, simple one measure up to 22 μm , and complex one up to 30 μm in diameter.

***Clematis garanbiensis* HAYATA (doubtful specimen)⁶⁾**

Botanical characteristics: The plant is similar to *C. chinensis*. But, the leaf and calyx change into somewhat brown when dried, and never to black.

Macroscopical characteristics of the root: They were the same as those of *C. chinensis* OSBECK.

Microscopical characteristics of the root: At d.p.=5 mm and 50 mm, the roots measure 1,200–2,400 μm , 1,900–3,500 μm in diameter respectively. The fusiform ratio is 1.35–1.64. At d.p.=50 mm, steles measure 400–1,700 μm in diameter, the percentage of the stele in the root ranges 20.3–47.7%. Epidermal cells measure 40–55 μm in diameter, and outer cell wall measuring 5–8 μm in thickness. Cortical parenchyma cells measure 100–220 μm in diameter, arranged in 14–19 layers at d.p.=50 mm. The increase of the cortical cell layers ranges 2–6. The endodermal ring, at d.p.=50 mm, consists of 62–100 cells. In the areas of pericycle and phloem, mechanical tissues reveal in high frequency. The vessels measure 50–100 μm in diameter. Most of starch grains are complex type, the simple grains measure 10–13 μm , the complex grains 15–29 μm in diameter in the middle of the cortex.

These characteristics are similar to those of *C. chinensis* to some extent.

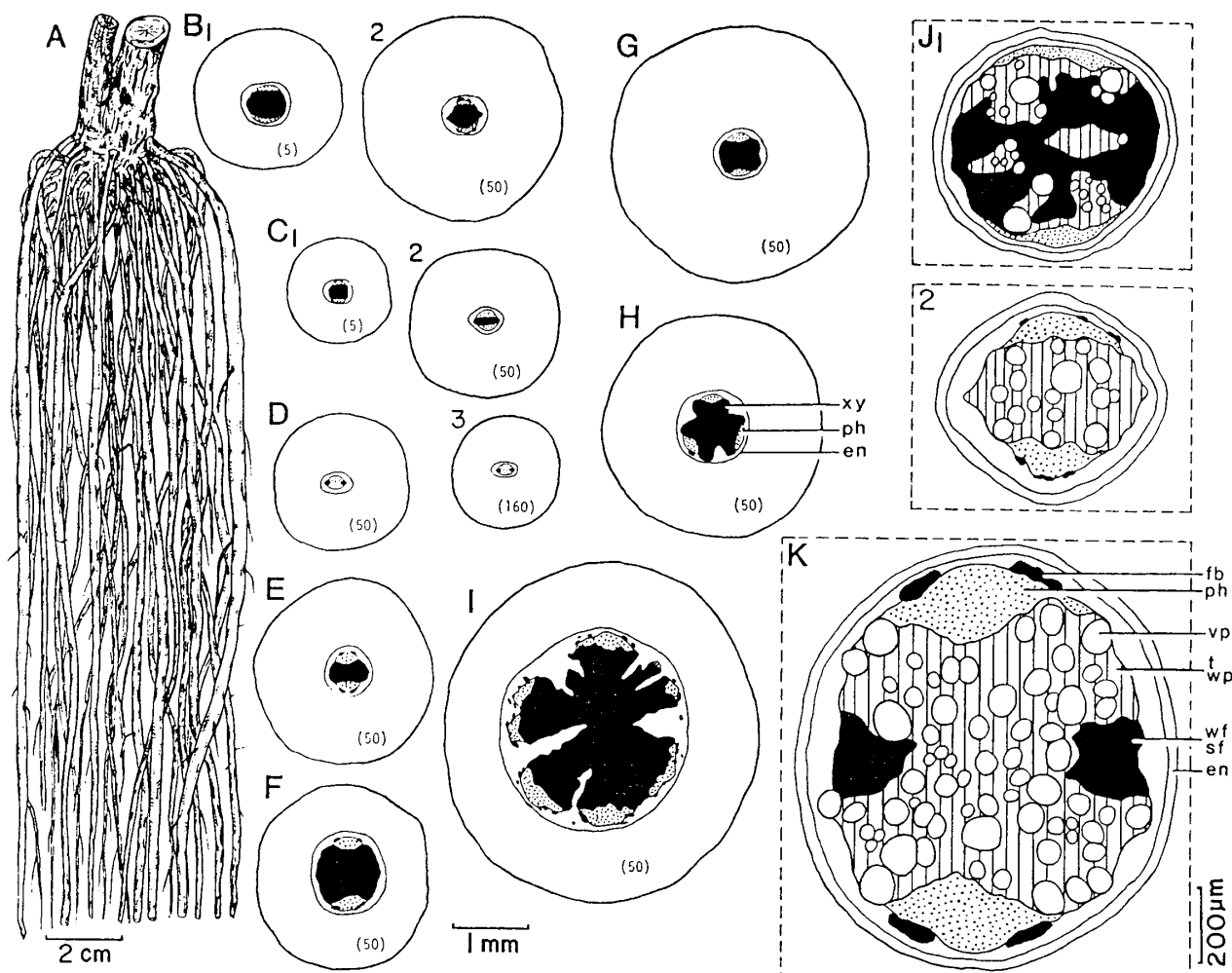


Fig. 1. *Clematis chinensis* OSBECK

A: A sketch of the "Weilingxian" from Taiwan derived from this species. B-I: Variations of the transverse sections of the roots. J-K: Variations of the steles at d.p. = 50 mm (The parenthesized numeral shows the distance from the proximal end of the root).

"Weilingxian" from Taiwan

Macroscopical characteristics: The crude drug consists of large rhizomes having fibrous roots and one or two stems. The stem measures 5–10 mm in diameter, 5–30 cm in length. The roots are somewhat fusiform in outline. The surface is smooth, yellowish or grayish brown in color. The crude drug has a slight odor.

Microscopical characteristics of the root: The anatomical characteristics of "Weilingxian" from Taiwan corresponded well to those of *C. chinensis* OSBECK.

"Weilixian" from Liang-guang (Fig. 3)

Macroscopical characteristics: The crude drug consists of small rhizome bearing from 10 to 50 roots (A). The rhizome is massive or somewhat rod shaped, measuring 4–8 mm in diameter, and sometimes remains short stems measuring 3–5 mm in diameter. The roots are fusiform more or less in shape, with 1–2 mm in diameter near rhizome, and 1.5–3 mm at d.p. = 50 mm. The roots are broken off from the rhizome, and remaining 5–15 cm in length. The surface of the root is smooth, grayish to yellowish brown. The root can be broken easily, and the broken surface shows grayish to yellowish white. The crude drug has a slight odor, and has no taste. •

Microscopical characteristics of the root (Fig. 3, B–G): It is fundamentally similar to that of *C. chinensis*. The root is 1,300–3,200 μm at d.p. = 5 mm, and 2,300–4,300 μm in diameter at d.p. = 50 mm. The fusiform ratio ranges 1.27–2.31 in individual, 1.52–1.80 in average per stock. The stele, at d.p. = 50 mm, is 340–2,350 μm in diameter, and the percentage of the stele in the root ranges 13.3–54.7%, normally 13–25%. The epidermal cells measure 40–50 μm in diameter, and outer cell wall is 3–7 μm in thickness (G_1). The cortex consists of 16–23 layers of parenchyma cells with diameters of 90–200 μm , and length of 150–360 μm . The increase of cortical cell layers ranges 2–10, and 5.5–7.8 in average per stock. The endodermal ring consists of 44–90 cells. Mechanical tissue in the pericycle and phloem appears less frequent than the case of *C. chinensis*. The vessels measure 50–130 μm in dia-

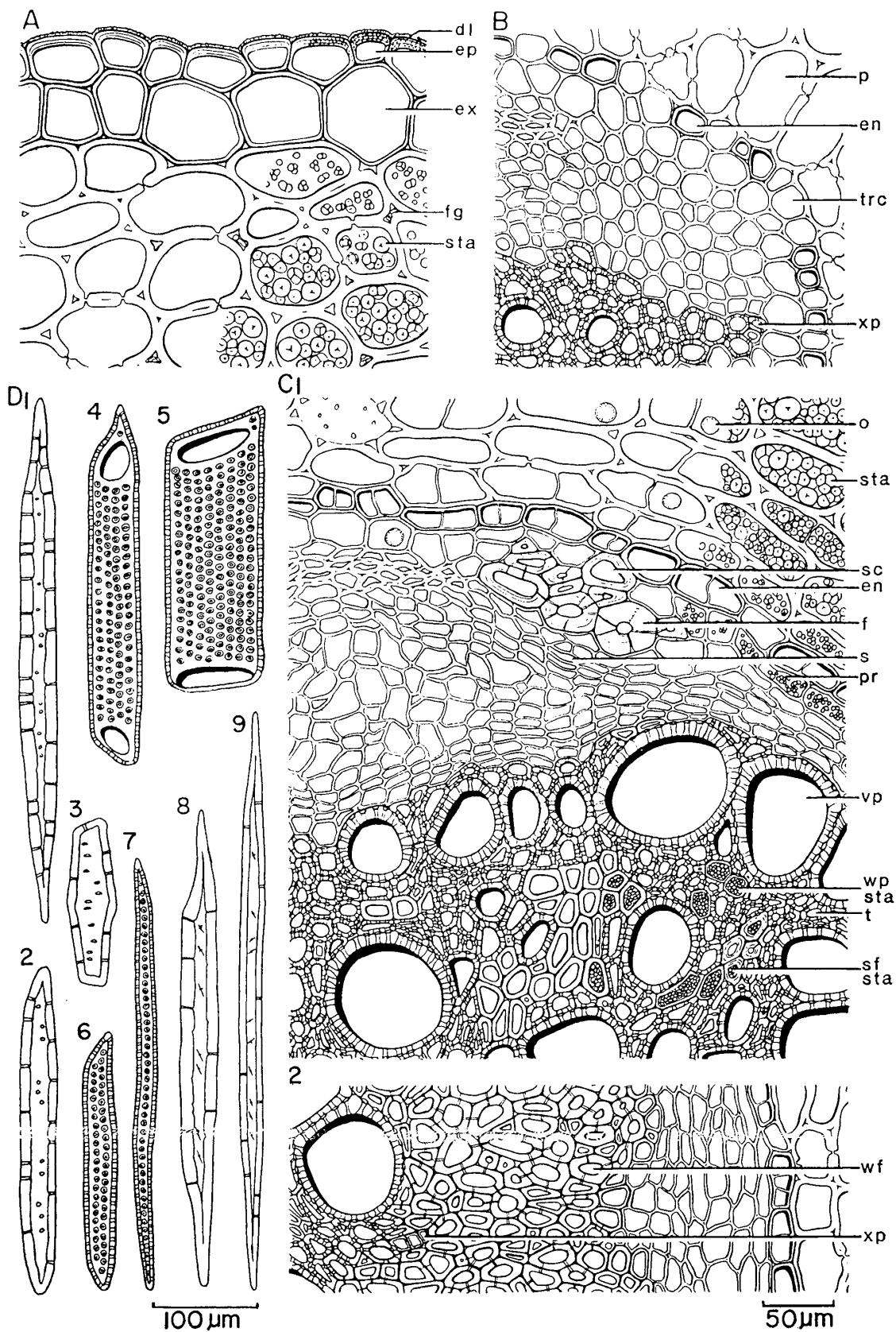


Fig. 2. *Clematis chinensis* OSBECK

A-C: Detailed drawings of the transverse section of the outer part of the root (A), a part of the stele in the young root (B), and a part of the stele in the matured root (C) at a distance of 50 mm from the proximal end. D: Isolated elements of the central cylinder, 1, 2, phloem fiber; 3, pericyclic sclerenchyma cell; 4, 5, pitted vessel; 6, 7, tracheid; 8, 9, wood fiber.

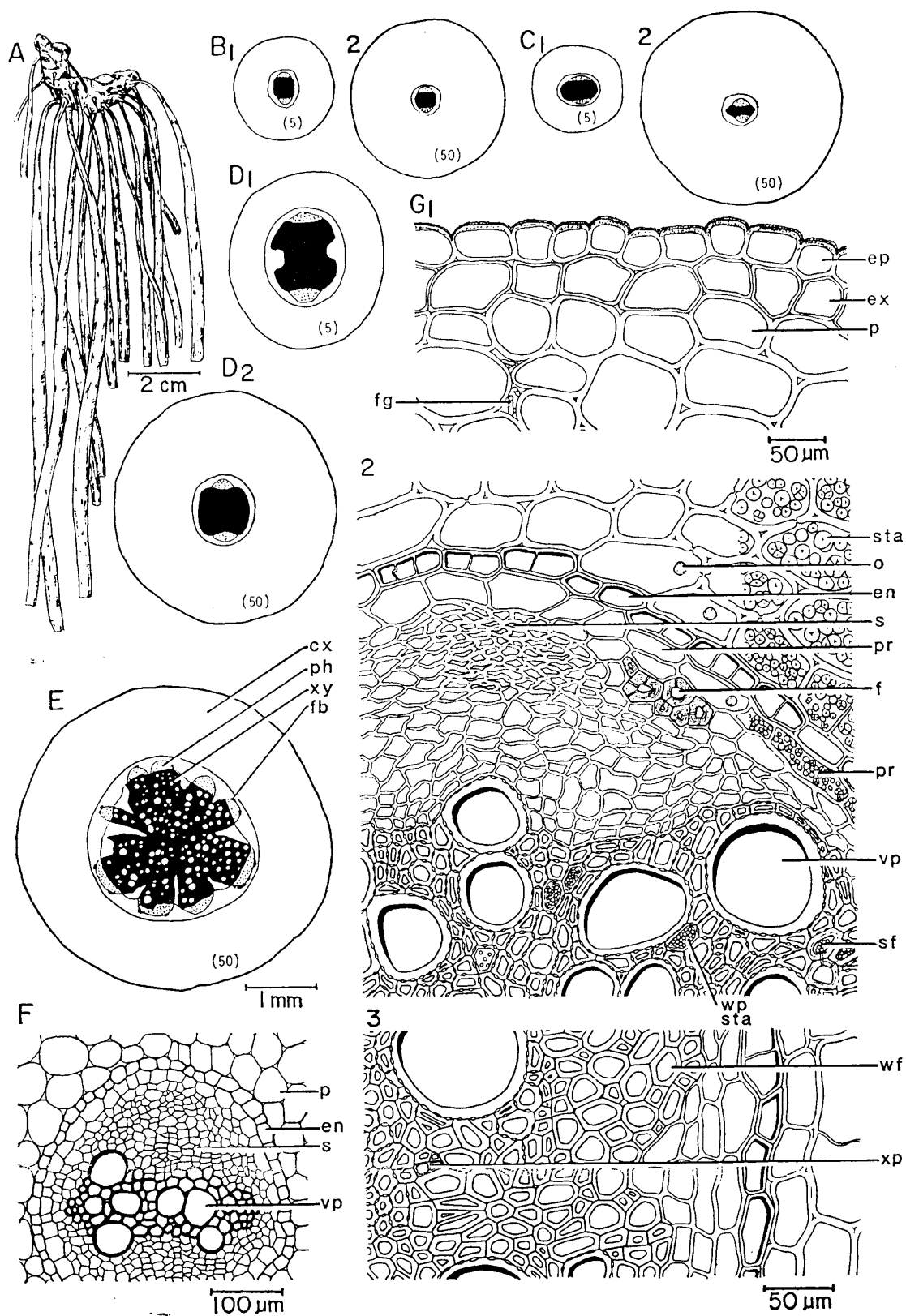


Fig. 3. "Weilingxian" from Liang-guang

A: A sketch of the crude drug; B-E: variations of the transverse sections of the roots. F-G: Detailed drawings of the transverse sections of the standard root (F) and old root (G) at a distance of 50 mm from the proximal end.

meter. The starch grains in the middle of the cortex, the simple type measures up to 25 μ m, the complex type up to 35 μ m in diameter.

Through these anatomical characteristics, the crude drug not seems to be derived from the roots of *C. chinensis* OSBECK which was examined in this study as a comparative plant.

Results and Discussion

1. The botanical origin of "Weilingxian" from Taiwan, consisting of one large rhizome with many fibrous roots and sometimes with one or two stems measuring up to 30 cm long, was *Clematis chinensis* OSBECK.

2. Though "Weilingxian" from Liang-guang in continental China has been regarded as the roots of *Clematis chinensis* OSBECK, the anatomical characteristics of the crude drug did not correspond to that of *C. chinensis* from Taiwan and the southwest part of Japan. The botanical origin is supposed phytogeographically, to be *C. chinensis*. Macroscopically, however, the rhizome and stem of the crude drug are smaller in size than those of *C. chinensis* from Taiwan and southwest of Japan. In view of this condition, the plant origin seems to be another species. It is difficult to think it as a local variation of *C. chinensis*, on the bases of the differences in the anatomical characteristics, while all "Weilingxian" collected in this area are the same type. Therefore, the species from Liang-guang, which had been confirmed as *Clematis chinensis* OSBECK, may be another unknown species or a variation of *C. chinensis*. Since the root of this species has small vessels, measuring up to 130 μm in diameter even in old one, as to the diameter of vessel, the species is rather similar to *C. fujisanensis* and *C. kyushuensis* that have reported in the previous paper.¹⁾ It can be imagined that the plant has annual short and slender stem, measuring nearly 5 mm in diameter and up to 3 m in height. The anatomical characteristics of the root of *C. chinensis* and "Weilingxian" from Liang-guang are shown in TABLE I.

3. The underground parts of *C. chinensis* and *C. terniflora* var. *robusta* which is growing wild in Japan are similar to each other. When the experimental roots from one rootstock are sufficient in number, they can be distinguished anatomically from each other by comparing the diameter of vessels, fusiform ratio and so on. These anatomical characteristics, including that of "Weilingxian" from Liang-guang change continuously from of northeast species to southwest ones. Namely, from northeast, *C. terniflora* var. *robusta*, *C. chinensis* and the original species of "Weilingxian" are growing wild in that order, and southwestern species, that is the plant from Liang-guang, has smaller vessels in diameter, higher fusiform ratio and larger starch grains. Besides, as to those characteristics, *C. fujisanensis* and *C. kyushuensis*

TABLE I. Anatomical Characteristics of the Roots of *Clematis chinensis* and "Weilingxian" from Liang-guang, in the Transverse Sections at a Distance of 50 mm from the Proximal End

		<i>C. chinensis</i>	"Wei-ling-xian" from Liang-guang
Diameter of the root (μm)		1,650-5,000	2,300-4,300
Diameter of the stele (μm)		260-2,700	340-2,350
Percentage of stele in root (%)		12.8-54.8	13.3-54.7
Fusiform ratio ^{a)}	Each root	0.93-1.83	1.27-2.31
	Average from one stock	1.06-1.57	1.52-1.80
Epidermal cell	Diameter (μm)	40-65	40-50
	Thickness of outer cell wall (μm)	3-8	3-7
Cortex	Diameter of cell (μm)	70-170	90-200
	Number of cell layers	12-23	16-23
Increase of cell layers ^{b)}	Each root	1-10	2-10
	Average from one stock	4.0-5.7	5.5-7.8
Number of endodermal cell		40-120	44-90
Phloem fiber		frequent	somewhat frequent
Diameter of vessel		40-155	50-130
Size of starch grain (μm)	Simple grain	up to 22	up to 25
	Complex grain	up to 30	up to 35

^{a)} Diameter of the root at a distance of 50 mm from the proximal end, divided by that at 5 mm.

^{b)} Number of the cell layers at a distance of 50 mm from the proximal end, minus that at 5 mm.

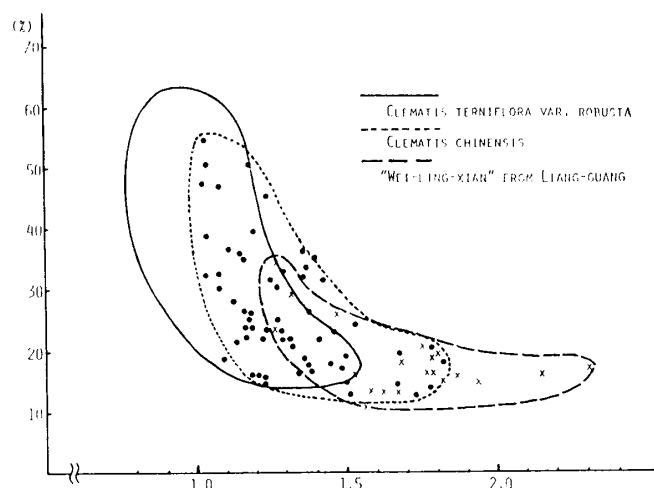


Fig. 4. Anatomical Correlation among the Three Species

The ordinate shows the percentage of the stele in the root by diameter, and the abscissa the fusiform ratio.¹⁰⁾ The individual marks of *Clematis terniflora* var. *robusta* are omitted in order not to become confusion. The figure indicated that the three species vary continuously in root anatomy by the growing range, in order from the northeast species to southwest one as *C. terniflora* var. *robusta*, *C. chinensis* and "Weilingxian" from Liang-guang. Besides, *C. fujisanensis* and *C. kyushuensis*, reported in the previous paper,¹⁾ are in the range of *C. chinensis*.

shuensis show nearly middle values in the variation range observing in the root of *C. chinensis*. The correlation among these species in the root anatomy is shown in Fig. 4.

4. *C. garanbiensis* HAYATA, which is near species to *C. terniflora* var. *robusta* (= *C. paniculata* THUNB.)¹²⁾, is similar to *C. chinensis* rather than *C. terniflora* var. *robusta* from Japan in root anatomy. This species could be separated from *C. chinensis* by its larger cortical parenchyma cells. But it is not practical to separate the both species by this factor only, because the factor is changeable. Though *C. garanbiensis* is rare and endemic to south of Taiwan, the species also may be collected as "Weilingxian."

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List of abbreviations: cx, cortex; dl, dark colored layer; en, endodermis; ep, epidermis; ex, exodermis; f, fiber; fb, fiber bundle; fg, fungy; o, oil drop; p, parenchyma; ph, phloem; pr, pericycle; s, sieb tube; sc, sclerenchyma cell; sf, substitute fiber; sta, starch grain; t, tracheid; trc, transfusion cell; vp, pitted vessel; wf, wood fiber; wp, wood parenchyma cell; px, primary xylem; xy, xylem.

References and Notes

- 1) Part I: T. Namba and M. Mikage, *Shoyakugaku Zasshi*, **37**, 307 (1983).
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- 4) J.S. Li, P.G. Xiao, Z.Q. Lou, *Acta Pharmaceutica Sinica*, **15**(5), 288 (1980).

- 5) Editorial Committee of Flora of Taiwan (ed.), "Flora of Taiwan," Vol. II, Angiospermae, Epoch Publishing, Taipei, 1976, p. 481; T. Shimizu, *Taiwania*, **18**(2), 173 (1973). It is supposed that there are some unknown species in Taiwan. Two strange species have been collected by the authors.
- 6) It is doubtful whether this species is native in Taiwan.* But, similar plant, of which the leaf and calyx change never into blackish color when dried, has been collected by the authors. In this paper, this plant is treated as *C. garanbiensis* for convenience. The species should be put in sect. *Flammula*, subsect. *Rectae*, ser. *Rectae* of the genus. *M. Tamura, *Acta Phytotax. Geobot.*, **15**(1), 17 (1953).
- 7) The experimental plants were identified by Dr. M. Tamura, Kobe University, and parts of them are stored in the specimen rooms of Toyama Medical and Pharmaceutical University and Kyoto University.
- 8) In the Hong-kong market, "Weilingxian" from Guang-dong (廣東) and Guang-xie (廣西) are used to be labeled as "from Liang-guang (兩廣產)" or "from Dong-xie (東西產)."
- 9) M. Tamura, "Systema Clematidis Asiae Orientalis," Science Report, No. 4, Osaka Univ., Osaka, 1955, p. 54.
- 10) Diameter of the root at d.p. = 50 mm divided by that of at 5 mm.
- 11) The number of cell layers at d.p. = 50 mm minus that at 5 mm.
- 12) B. Hayata, "Icones Plantarum Formosanarum" IX, Bureau of Forestry, Government of Formosa, Taihoku, 1920, p. 1.