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Taxonomic Studies on the Tribe Senecioneae of Eastern Asia

II. Enumeration of the Species of Eastern Asia

by

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ABSTRACT This is the second part of the taxonomical revision of the Tribe Senecioneae in Eastern Asia. The species are enumerated under fourteen genera in which the infrageneric taxa are arranged in natural system. Considering the data obtained by the chromosome studies, some emendations are made concerning to some sections.

Enumeration

An attempt is made to enumerate all the species of Tribe Senecioneae known in Eastern Asia. Owing to the availability of materials, the Siberian and Central Asiatic species are excluded but the Himalayan species are included. Thus, the area treated in this studies coincides mostly with the Sino-Japanese region.

In order to clarify the relationships among our genera from the standpoints of chromosome studies, the chromosome accounts are cited not only the species concerned but those outside of our region. Although the living materials are indispensable to examine the chromosomes, it is very difficult to observe the chromosomes of the plants in the foreign countries. Thus, it is necessary to make further studies especially on the Himalayan and Chinese species.

The morphological investigations are made by herbarium specimens and partly by living materials. The specimens examined in this studies are kept in the herbaria listed below. The indication of those herbaria is in accordance with the general use.

KYO Herbarium of Kyoto University, Kyoto.
MAK Makino Herbarium of Tokyo Metropolitan University, Tokyo.
TAI Herbarium of the National Taiwan University, Taipei, Taiwan.
TI Herbarium of Tokyo University, Tokyo.
TNS The National Science Museum, Tokyo.

Grateful acknowledgement is made here to the directors and curators of

these herbaria.

The following revisions are much important to investigate all the taxa under consideration, though comprehensive contributions have been published since those literatures.

HOOKER, J. D. *Flora of British India*, III (1881)
HANDEL-MAZZETTI Symboleae Sinicae, VII (1936)
KITAMURA, S. Compositae Japonicae, III (1942)

To simplify this revision, the synonymies cited in the above revisions are not repeated here, except in the case some amendments are necessary. SHIU-YING HU is publishing 'The Compositae of China' which comprises all the species described from China.

The distribution maps are made from the localities of the specimens kept in the herbaria cited above. Specimens quoated in the revision of KITAMURA's Compositae Japonicae are here not listed up except for the problematical materials, but the specimens collected from China and the Himalayas are fully cited for each species.

Tribe **Senecioneae**

Tribe **Senecioneae** CASS. in Journ. Phys. 88:196 (1819) Type : *Senecio* L. ; KITAM. Comp. Jap. III:155 (1942) incl. syn. ; KIRPITCHENIKOV, Fl. URSS, XXVI: 638 (1961).

Three subtribes, Liabinae, Senecioninae and Othonninae, have been arranged by HOFFMAN in Tribe Senecioneae. Subtribe Senecioninae is distinguished from subtribes Liabinae and Othonninae by the features of involucral scales. According to the HOFFMAN's limitation on these subtribes, our genera are well referred to subtribe Senecioninae. Subtribes Liabinae and Othonninae do not occur in our region.

Subtribe **Senecioninae**

Subtribe **Senecioninae** HOFFM. in ENGLER u. PRANTL Pfl.-fam. IV-5 : 286 (1894) Type : *Senecio* L. ; KITAM. Comp. Jap. III : 159 (1942) excl. syn. Subtribe Othonninae ; KIRPITCHENIKOV, Fl. URSS, XXVI: 638 (1961).

Plants monoecious except *Petasites*, which is dioecious, perennial or rarely annual, herbs or rarely shrubs. Leaves alternate, except opposite in *Arnica*, usually revolute but involute in *Farfugium*. Inflorescences solitary, corymbose or racemose. Involucral scales 1-seriate or 2-seriate and equal or subequal. Receptacles flat or slightly convex, usually naked. Heads with 3 to many florets, heterogamous radiate, hermaphrodite discoid or rarely homogamous discoid. Disk florets tubular or campanulate, 4-5 lobed at the apex, hermaphrodite and ray florets ligulate or filiform, female. Anther bases obtuse or tailed. Cells of the upper part of filament same or different in size. Style branches clavate, subulate or truncate, with hairs or papilla. Achenes with

fine hairy pappus, glabrous or hairy, terete or rarely angular, cylindric, linear oblong, usually tapered off at both ends, entire except with short beak in *Miricacalia*. Cotyledons usually two and lanceolate, but one and orbiculate in *Syneilesis*.

Distribution : about 60 genera are ranging over nearly the whole world, but 14 genera occur in our region. Five genera are known endemic to Asia.

Key to the Genera

A. Leaves coming after the flowers ; hermaphrodite flowers sterile. .....B.
A. Leaves coming before the flowers ; hermaphrodite flowers fertile. .....C.
B. Plants monoecious. .....Genus **Tussilago**.
B. Plants dioecious. ..... Genus **Petasites**.
C. Leaves opposite. .....Genus **Arnica**.
C. Leaves alternate. ..... D.
D. Involucral scales herbaceous; style branches clavate. ..... Genus **Doronicum**.
D. Involucral scales not herbaceous ; style branches subulate or truncate. .....E.
E. Style branches subulate, covered with papilla for their entire length. .....F.
E. Style branches truncate, covered with thicked hairs at their apex or for their entire length. ..... I.
F. Vaginate sheath not developed ; heads discoid. .....Genus **Gynura**.
F. Vaginate sheaths developed; heads radiate or discoid. ..... G.
G. Leaves involute ; vaginate sheaths shortly developed. .....Genus **Farfugium**.
G. Leaves revolute ; vaginate sheaths well developed. .....H.
H. Heads many or rarely single, erect. ..... Genus **Ligularia**.
H. Heads single or rarely many, cernuous. ..... Genus **Cremanthodium**.
I. Styles covered with a ring of hairs at apex. ..... J.
I. Styles covered with thickened hairs for their entire length of branches. ... L.
J. Heads mostly with bracteoles, radiate or rarely disciform. ..... K.
J. Heads without bracteoles, discoid. .....Genus **Emilia**.
K. Mostly herbs or undershrubs ; corolla pale-yellow or rarely orange-red ; ligulate florets present or rarely absent. ..... Genus **Senecio**.
K. Shrubs ; corolla pale-rosy-purple ; ligulate florets absent. ....Genus **Dendrocacalia**.
L. Cotyledon single. ..... Genus **Syneilesis**.
L. Cotyledon not single. ..... M.
M. Achenes with short beak. ..... Genus **Miricacalia**.
M. Achenes without beak. ..... Genus **Cacalia**.

Genus **Tussilago**

Tussilago was described by LINNAEUS together with some species now belonging to *Petasites*. After DE CANDOLLE'S treatment, as a monotypic genus, the circumscription of *Tussilago* has been followed by later investigators.

Tussilago L. Gen. Pl. n. 856 (1754) pro parte, Type : *T. farfara;* DC. Prod. V : 208 (1836) ; BENTH. in BENTH. et HOOK. f. Gen. Pl. II : 438 (1873 -76) ; CLARKE, Comp. Ind. 166 (1876) ; HOOK. f. Fl. Brit. Ind. III : 330 (1881) ; HOFFM. in ENGLER u. PRANTL Pfl.-fam. IV-5: 289 (1889) ; KIRPITCHENIKOV, Fl. URSS, XXVI: 641 (1961).

Plants monoecious, scapigerous and perennial, with creeping rhizomes. Radical leaves with white, wooly hairs beneath, orbiculate, cordate, angled or toothed. Scapiform stems with many small scale-like leaves. Inflorescence solitary. Heads of many florets, radiate. Ray florets with filiform ligules, in several rows, female and fertile. Disk florets hermaphrodite, sterile and tubiform. Pappus of female achenes soft, snow white, ca. 1 cm in length and of hermaphrodite ones scanty or lacking. Anther bases entire or subauriculed. Cells of the upper part of filament same in size. Styles of disk florets entire and obtuse, with short papilla for their entire length of stigma.

Tussilago farfara L. Sp. Pl. II : 865 (1753) Type from Europe ; DC. Prod. VI:208 (1837) ; CLARKE, Comp. Ind. 166 (1876) ; HOOK. f. Fl. Brit. Ind. III : 330 (1881) ; KIRPITCHENIKOV, Fl. URSS, XXVI: 641 (1961).

Chromosome number : n=30 (HAGERUP 1941). 2n=60 (LANGLET 1936 ; LÖVE & L. 1956; GADELLA & K. 1966).

SIBERIA Tomsk : *S. L. Sergievskaja* (KYO) ; *G. P. Knith & R. A. Kandasova* (TNS). CHINA Prov. Kansu : Lanchow, unknown collector (TI). NEPAL Marshandi river, *S. Nakao* (KYO) ; Kagbeni-Charka, *S. Nakao* (KYO) ; Kehe Lumgpa, *S. Nakao* (KYO) ; Pisan-Chame, *T. Fujimura 179* (KYO).

Widely distributed in temperate or subarctic region of Eurasia and north Africa, naturalized in north America ; on open slope of mountains.

References of Chromosome numbers

GADELLA, T. W. J. & K. KLIPHUIS, 1966. Chromosome numbers of flowering plants in the Netherlands II. *Proceedings Konikl. Nederl. Akademie Van Wetenschappen-Amsterdam. Seires C.* 69 (5) : 541-556.

HAGERUP, O. 1941. Nordiske Kromosom-Tal. 1. *Bot. Tidsk.* 45 : 385-395.

LANGLET, O. 1936. Några Bidrag Till Kannedomen on Kromosomtalen Inon Nymphaeaceae, Ranunculaceae, Polemoniaceae och Compositae. *Svensk Bot. Tidskr.* 30 : 288-294.

LÖVE, A. & D. LÖVE, 1956. Cytotaxonomical conspectus of Icelandic flora. *Acta Hort. Gotob.* 20 : 65-290.

Genus **Petasites**

This genus has not yet been clearly circumscribed. Setting a weight on the form of marginal florets of pistilate head, CASSINI (1825) distinguished the genus *Nardosmia* from *Petasites.* In 1850, GRENIER and GODRON treated *Nardosmia* as a section of *Petasites.* Since that time, *Petasites* has been

treated by the investigators in various ways.

In his revision of Japanese Compositae ; KITAMURA treated *Nardosmia* as a section of *Petasites*. In Flora URSS XXVI (1961), KUPRIANOVA gave generic status to *Nardosmia*. According to her, *Nardosmia* is characterized by its geographical distribution in addition to the characters pointed out by CASSINI. *Nardosmia* comprises the arctic and alpine species, while *Petasites* the species which do not transgress the timber-line but occur only in temperate zone. Thorv. SORENSEN and H. CHRISTIANSEN, however, emphasized that the distinction between *Nardosmia* and *Petasites* could be maintained neither on a morphological nor geographic-ecological basis at the generic level.

The shape of corolla seems to be useful to diagnose the species in this genus. But there are, to some extent, intermediate forms between the ligulate and disk florets among the species of *Petasites* as pointed out by Thorv. SORENSEN and H. CHRISTIANSEN. This feature can, therefore, not be recognized as being of systematic value at the generic level. *P. japonicus* which was referred to *Nardosmia* by KUPRIANOVA, occurs not in alpine but only in montane region in Japan. Thus, *Nardosmia* may better be considered as a section of *Petasites* as treated by GRENIER and GODRON and others.

Petasites MILL. Gard. Dict. ed. 4, III : PE (1754) Type: *P. major;* KITAM. Comp. Jap. III : 160 (1942) ; HARA, Enum. Sperm. Jap. III : 235 (1952) ; KUPRIANOVA, Fl. URSS, XXVI: 642 (1961) ; OHWI, Fl. Jap. Eng. ed. 877 (1965).

Nardosmia CASS. in Dict. Sci. Nat. 34 : 186 (1825) Type : *N. denticulata ;* KUPRIANOVA, Fl. URSS, XXVI : 645 (1961).

Perennial, scapigerous and dioecious herbs with white pubescent or white wooly hairs, and creeping rhizomes. Radical leaves large, and cordate, reniform, hastate or rarely palmate. Leaves of scapiform stems are small and scale-like usually with parallel-like veins, but sometimes with small laminas at the top of the scale-like leaves. Inflorescences corymbose or racemose, or rarely solitary. Heads of many florets discoid or radiate. Florets of pistilate heads fertile and filiform, and florets of staminate heads sterile and tubiform. Anther bases entire or obtuse. Cells of the upper part of filament same in size. Styles of pistilate florets shortly branched, obtuse or rarely acute, with short papilla for their entire length of the branches. Styles of staminate florets clavate at the apex conical and shortly divided, just below the apex annulate. Achenes cylindric, linear, terete, glabrous, with fine snow white pappus.

In the following list are shown the somatic number of chromosomes reported by various investigators for some species except *P. japonicus*.

Sect. *Nardosmia*

Petasites fragrans	52	MAUDE 1940
〃	ca. 60	SORENSEN & C. 1964
P. frigidus	60	FLOVIK 1940
P. palmatus	ca. 60	SORENSEN & C. 1964
P. sagittatus	ca. 60	〃
〃	60	LANGLET 1936

P. spurius	60	LANGLET 1936
Sect. *Petasites*		
Petasites albus	60	SCHEERER 1939
P. hybridus	60	GADELLA & K. 1966; LANGLET 1936; Löve & L. 1956.
〃 (under *P. officinalis*)	60	LANGLET 1936
P. niveus	60	〃
P. paradoxus	ca. 60	SORENSEN & C. 1964
P. warrenii	60	LANGLET 1936

In their 'Contribution to the chromosome cytology of *Petasites*', Thorv. SORENSEN and H. CHRISTIANSEN note that the number of 2n=52 chromosomes in *P. fragrans* is apparently erroneous and may be due to the marked tendency of the chromosomes to stick together.

Key to the Sections

A. Inflorescence corymbose or solitary; heads smallish, with ligulate florets. ..... Sect. **Nardosmia**.

A. Inflorescence racemose; heads somewhat large, without or rarely with small ligulate florets. ..... Sect. **Petasites**.

Sect. **Nardosmia** (CASS.) GREN. & GODRON, Fl. France, II: 90 (1850); KITAM. Comp. Jap. III: 161 (1942). ——*Nardosmia* CASS. l. c.

Among ten species known in this section, only one occurs in our region.

Petasites saxatilis (TRUCZ.) KOMAROV, Fl. Mansh. 684 (1907); KITAM. Comp. Jap. III: 161 (1942). ——*Nardosmia saxatilis* TRUCZ. Catal. Baikal. n. 579 (1838), in Bull. Soc. Nat. Mosc. 19 (2): 138 (1846), Fl. Baic. Dah. III: 4 (1856) Type from Baykal, Siberia; KUPRIANOVA, Fl. URSS, XXVI: 647 (1961).

Of the specimens preserved in our herbaria, the plants have only pistilate heads. All of the florets in head are filiform and ligulate, the ligules being small, about 1.5 mm in length. In the other species of this section, the marginal florets are ligulate but the others tubulate. On the contrary, in the present species, at least the materials examined, the marginal florets in head are the same with the other ones.

The present species distributes in southeastern Siberia, Manchuria and northern Korea; on moist slope in forest.

Sect. **Petasites**. ——Sect. *Eupetasites* GREN. & GODRON, Fl. France, II: 88 (1850); KITAM. Comp. Jap. III: 161 (1942).

More than fifteen species are known. Six species are reported in our region, but the other three in the further pages have not been actually investigated in detail.

Key to the Species

A. Leaves palmately lobed. ..... **P. tatewakianus**.

A. Leaves not palmately lobed, angled or toothed. ..... B.
B. Adult leaves persistent in winter. ..... C.
B. Adult leaves not persistent in winter. ..... D.
C. Leaves and petioles with crispate hairs. ..... **P. petelotii.**
C. Leaves and petioles without crispate hairs. ..... **P. formosanus.**
D. Corolla entire or slightly 5 lobed. ..... **P. japonicus.**
D. Corolla deeply 5 lobed. ..... E.
E. Leaves with crispate hairs beneath. ..... **P. himalaicus.**
E. Leaves glabrous or with woolly hairs beneath. ..... **P. tricholobus.**

Petasites tatewakianus KITAM. in Acta Phytotax. Geobot. 9 : 64 (1940), Comp. Jap. III : 164 (1942) incl. syn. Type : SAGHALIN Totoigawa, Chirie-gun, *M. Tatewaki & Y. Takahashi 22594* (Holotype in KYO).

This species distributes in Saghalin and southeastern Siberia.

Petasites petelotii (MERR.) KITAM. in Acta Phytotax. Geobot. 22: 20 (1966). —— *Ligularia petelotii* MERR. in Journ. Arnold. Arb. 21 : 389 (1940) Type from Tonkin.

VIETNAM Tonkin : Chapa, *Tsukin* (TI).

This species has a close affinity to *P. himalaicus*, and is known only from Tonkin.

Petasites formosanus KITAM. in Acta Phytotax. Geobot. 2 : 177 (1933), Comp. Jap. III : 162 (1942) incl. syn. Type: TAIWAN Prov. Tainan: Mt. Arisan, Nimanpe, *S. Kitamura* (Holotype in KYO).

Endemic to Taiwan ; ranging on mountainous regions.

Petasites japonicus (SIEB. et ZUCC.) MAXIM. Award 34th Denidovian Prize, 212 (1866); KITAM. Comp. Jap. III : 162 (1942) ; HARA, Enum. Sperm. Jap. II : 236 (1952); OHWI, Fl. Jap. Eng. ed. 877 (1965). —— *Nardosmia japonica* SIEB. et Zucc. Fl. Jap. 181 (1843), in Abh. Akad. Muench. IV-3 : 181 (1846) Type from Japan.

The present species is divided by KITAMURA into two subspecies : subspp. *japonicus* and *giganteus*. Subsp. *giganteus* is distinguished by the robust inflorescence and larger leaves.

Subsp. **japonicus**

Tussilago petasites THUNB. Fl. Jap. 314 (1784), non L.

Nardosmia japonica SIEB. et ZUCC. 1. c.

Petasites albus A. GRAY in PERRY Exped. II : 314 (1857), non GAERTN.

Petasites liukiuensis KITAM. in Acta Phytotax. Geobot. 2 : 178 (1933).

This subspecies is known from Ryukyu, Kyushu, Shikoku, Honshu and southern Korea, and occurs in rather moist places in mountainous regions.

Chromosome number : 2n = 58 (IMAZU & F. 1962 ; KOYAMA 1966). 2n=60 (LANGLET 1936 under *Tussilago japonicus*). 2n = 87 (IMAZU & F. 1962). 2n = 84-87, 87+3 (SORENSEN & C. 1964).

Subsp. **giganteus** (FR. SCHMIDT ex TRAUTV.) KITAM. Comp. Jap. III: 164 (1942) incl. syn. ; HARA, Enum. Sperm. Jap. II : 236 (1952). —— *Petasites*

giganteus FR. SCHMIDT ex TRAUTV. in Act. Hort. Petrop. VIII : 433 (1883) Type from Saghalin, non FUSS (1866).

This subspecies distributes in northern Honshu, Hokkaido, Kuriles and Saghalin.

Chromosome number : 2n = 58 (IMAZU & F. 1962).

Some cultivars of this species are known in Japan. The somatic number of 87 chromosomes in such cultivars as Aichiwasebuki, Mizubuki and Akitaaobuki was reported by IMAZU and FUJISHITA. In their report on the chromosome numbers of *P. japonicus*, they suggested that cultivars of butterbur might be derived from triploid wild plants.

Petasites himalaicus KITAM. in Acta Phytotax. Geobot. 15 : 108 (1954) Type : NEPAL Pisan, *S. Nakao* (Holotype in KYO ; Isotype in TNS).

Nardosmia himalaica (KITAM.) KUPRIANOVA, Fl. URSS, XXVI : 653 (1961). NEPAL Pisan, *S. Nakao* (KYO ; TNS).

Chromosome number: 2n = 60 (KOYAMA unpublished).

Petasites tricholobus FRANCH. Fl. Davidian. I : 172 (1884) Type from Mongol.

CHINA Prov. Hupeh, *A. Henry 1248* (TI). Prov. Shansi, *M. Tatewaki 1070* (TI).

The present species has a close affinity to *Petasites formosanus*.

The following Chinese species are described from our region as distinct species, but further study is necessary to give the specific discrimination to each species.

Petasites mairei LÉV. in Bull. Géogr. Bot. 25 : 15 (1915) Type from Yunnan Province.

Petasites vaniotii LÉV. in Bull. Géogr. Bot. 25:15 (1915) Type from Yunnan Province.

Petasites versipilus HAND.-MZT. in Anz. Akad. Wiss. Wien, Math.-Nat. 57: 289 (1920) Type from Szechuan Province.

References of Chromosome numbers

FLOVIK, K. 1940. Chromosome numbers and polyploidy within the flora of Spitzbergen. *Hereditas*, 26: 430-440.

GADELLA, T. W. J. & K. KLIPHUIS, 1966. Chromosome numbers of flowering plants in the Netherlands II. *Proceedings Koninkl. Nederl. Akademie Van Wetenschappen-Amsterdam. Seires C.* 69 (5) : 541-556.

IMAZU, T. & N. FUJISHITA, 1962. Morphological, ecological and cytological studies on cultivated and wild butterbur, *Petasites japonicus* IV. On the chromosome numbers. *Journ. Jap. Soc. Horticult. Sci.* 31: 293-302.

KOYAMA, H. 1966. Chromosome numbers in some species of Compositae. *Acta Phytotax. Geobot.* 22 : 80.

LANGLET, O. 1936. Några Bidrag Till Kannedomen on Kromosomtalen Inon Nymphaeaceae, Ranunculaceae, Polemoniaceae och Compositae. *Svensk. Bot. Tidskr.* 30: 288-294.

Löve, Á. & D. Löve, 1956. Cytotaxonomical conspectus of Icelandic Flora. *Acta Hort. Gotob.* 20 : 65-290.

Maude, P. F. 1940. Chromosome numbers in some British Plants. *New Phytol.* 39 : 17-32.

Scheerer, H. 1939. Chromosomenzahlen aus der Schleswig-Holsteinischen Flora 1. *Planta*, 29 : 636-642.

Sorensen, T. & H. Christiansen, 1964. Contribution to the chromosome cytology of *Petasites*. *Bot. Tidssk.* 59 : 311-314.

Genus **Arnica**

Having the opposite leaves and the large radiate heads, *Arnica* is distinct among our genera. Maguire enumerated 32 species in *Arnica*, when he revised this genus in the 'Monograph of *Arnica*', and listed up a Japanese species, *Arnica mallatopus*, in the list of doubtful and rejected names and species. *Arnica mallatopus* was originally described by Franchet and Savatier under their new genus *Mallatopus* from Japan. According to these authors, *Mallatopus* is characterized by having the discoid heads, differing from *Eupatorium*, *Mikania* and *Gynura*. In 1897, Makino reduced *Mallatopus* to *Arnica*, because any other features of *Mallatopus* could not be generically discriminative from those of *Arnica*. Kitamura arrived at the same conclusion as that of Makino, when he studied the Japanese composite plants and mentioned that there were nine species of the discoid *Arnicas* in North America.

In this paper, *Mallatopus* is arranged in *Arnica* as treated by the Japanese investigators, and here the difference between *Arnica* and *Mallatopus* is considered at the infrageneric level.

In his monograph of *Arnica*, Maguire divided *Arnica* into five subgenera, which are well recognizable for the present writer. *Arnica mallatopus* differs from these subgenera in some taxonomic features, i. e. yellow anthers, discoid heads, and involucral scales having callose tip and lacking long stipitate gland. Subgen. *Andropurpurea* seems to be most related to *A. mallatopus*, but differs from *A. mallatopus* in colour of anthers, which is considered as an important diagnostic character in these groups, and in having radiate heads. Thus, *A. mallatopus* may better be treated as a separate subdivision of *Arnica*.

As shown in the following list, the chromosome numbers are reported by various investigators for some species of *Arnica*.

Species	n	2n	Investigator
Subgen. *Arctica*			
Arnica alpina	19		Löve 1967
	30		Afzelius 1936
		56	Flovik 1940 ; Löve & L. 1948
		57	Hedberg 1967
		76	Böcher & L. 1950 ; Hedberg 1967
A. louiseana		ca. 67	Ornduff *et al.* 1967

A. fulgens	19		ORNDUFF *et al.* ; LÖVE 1967
A. sororia	19		〃 ; 〃
Subgen. *Austromontana*			
A. latifolia	19		ORNDUFF *et al.* 1963 ; LÖVE 1967
		ca. 76	ORNDUFF *et al.* 1967
		112	LÖVE & L. 1964
A. cernua	19		LÖVE 1967
A. cordifolia	38	ca. 76, ca. 90+6, ca. 95+4	ORNDUFF *et al.* 1967
	ca. 38		LÖVE 1967
A. parviflora	19		ORNDUFF *et al.* 1963, '67 ; LÖVE 1967
	ca. 36–38		ORNDUFF *et al.* 1963
A. discoidea	38		〃
A. spathulata	19		ORNDUFF *et al.* 1967
	ca. 38		LÖVE 1967
A. venosa	19		〃
A. viscosa	19		〃
Subgen. *Chamissonis*			
A. chamissonis	ca. 53–54		ORNDUFF *et al.* 1963
		38, ca. 57+1	ORNDUFF *et al.* 1967
		ca. 57	LÖVE 1967
A. amplexicaulis	19		ORNDUFF *et al.* 1967 ; LÖVE 1967
	ca. 33–34		ORNDUFF *et al.* 1963
	ca. 38		LÖVE 1967
A. lanceolata		76	LÖVE & L. 1964
A. mollis	38	ca. 38, ca. 74, 76, ca. 76	ORNDUFF *et al.* 1967
A. parryi	ca. 36		ORNDUFF *et al.* 1963
		ca. 76, ca. 97	ORNDUFF *et al.* 1967
A. longifolia		10	BATTAGLIA 1952
		76	ORNDUFF *et al.* 1967
Subgen. *Montana*			
A. acaulis	19		〃
A. montana	ca. 18		AFZELIUS 1924
	19		FAVARGER 1953 ; LÖVE 1967
		38	BÖCHER & L. 1955
Subgen. *Andropurpurea*			
A. unalaschensis		38	ARANO 1963
A. sachalinensis	19		LÖVE 1967
**** *A. mallatopus*		18	MATSUURA & S. 1935
		38	KOYAMA unpublished

MAGUIRE gave the status of subgenus for these infrageneric groups. Comparing with the features in the allied genera, the diagnostic features by which each subgenus is characterized seems to the present writer to have values only

at the sectional level. In addition, these infrageneric taxa have the same basic chromosome number. In this paper, however, I prefer to cite them at subgeneric rank to avoid the new combinations.

Arnica L. Gen. Pl. ed. V : 376 (1754) pro parte, Type : *A. montana ;* KITAM. Comp. Jap. III : 166 (1942) incl. syn. ; MAGUIRE in Brittonia, IV-3 : 405 (1943) ; HARA, Enum. Sperm. Jap. II : 113 (1952) ; ELEN, Fl. URSS, XXVI : 655 (1961) ; OHWI, Fl. Jap. Eng. ed. 878 (1965).

Rhizomatous, perennial herbs with the leaves usually opposite or the upper alternate. Inflorescence cymose, of several to many heads or solitary, usually erect, not cernuous as in *Cremanthodium.* Heads of many florets, discoid or radiate. Involucral scales hairy herbaceous, biseriate but alternately arranged. Ray florets with elongate ligules, in one row, female and fertile. Ligules pale-yellow to deep-orange. Disk florets hermaphrodite, fertile and tubular. Anther bases obtuse or subauriculed. Cells of the upper part of filaments same in size. Style branches of disk florets linear and truncate at apex. Achenes with snow-white to tawny pappus, cylindric, tapered at both ends, glabrous, hirsute or glandular.

About 40 species occur in the boreal and montane regions of the northern hemisphere. Two subgenera represented by three species are known in our area and are distinguished by the following keys.

A. Heads radiate, anther purple. ..... Subgen. **Andropurpurea**.
A. Heads discoid, anther yellow. ..... Subgen. **Mallatopus**.

Subgen. **Andropurpurea** MAGUIRE in Brittonia, VI-3 : 486 (1943) ; ELEN, Fl. URSS, XXVI : 665 (1961)

Three species are known, but two of them occur in our area. They are distinguished by the following characters.

A. Cauline leaves(3)-4-5 pairs, inflorescence usually solitary. ...**A. unalascensis**.
A. Cauline leaves 10-20 pairs, inflorescence of several heads, cymose. .....
..... **A. sachalinensis**.

Arnica unalascensis LESS. in Linnaea, 6: 238 (1831) Type from Romanzof, Alaska ; KITAM. Comp. Jap. III: 167 (1942) ; MAGUIRE in Brittonia, VI-3 : 489 (1943) ; HARA, Enum. Sperm. Jap. II : 114 (1952) ; ELEN, Fl. URSS, XXVI : 666 (1961) ; OHWI, Fl. Jap. Eng. ed. 878 (1965).

Distribution : Central Honshu, Hokkaido, Kuriles, Kamtschatka and the Aleutian Islands ; growing on alpine areas in Central Japan, but in lower coastal areas in northern regions.

Two varieties are recognizable in this species, but they occur just in the same areas.

Var. **unalascensis**

Corolla tubes glabrous or slightly pubescent.

Var. **tschonoskyi** (ILJIN) KITAM. et HARA in Bot. Mag. TOKYO 52: 3 (1938) ; KITAM. Comp. Jap. III: 168 (1942) incl. syn. ; HARA, Enum. Sperm. Jap. II : 114 (1952) ; OHWI, Fl. Jap. Eng. ed. 878 (1965). —— *Arnica tschonoskyi*

ILJIN in Trav. Mus. Bot. Acad. Sci. URSS, 19 : 119 (1926) Type from Mt. Tateyama, Honshu.

Corolla tubes pubescent.

Arnica sachalinensis (REGEL) A. GRAY in Proc. Am. Acad. 19 : 55 (1884) ; KITAM. Comp. Jap. III : 169 (1942) incl. syn. ; MAGUIRE in Brittonia, VI-3 : 491 (1943) ; HARA, Enum. Sperm. Jap. II : 113 (1652) ; ELEN, Fl. URSS, XXVI : 668 (1961) ; OHWI, Fl. Jap. Eng. ed. 878 (1965). —— *Arnica chamissonis* LESS. var. *sachalinensis* REGEL in Suppl. Ind. Sachal. 151 (1864) Type from Saghalin.

The present species is known from Saghalin and Maritime Province in eastern Siberia.

Subgen. **Mallatopus** (FR. et SAV.) H. KOYAMA stat. nov. —— *Mallatopus* FR. et SAV. Enum. Pl. Jap. II : 394 (1879).

Arnica mallatopus (FR. et SAV.) MAKINO in Bot. Mag. Tokyo, 11 : 381 (1897), l. c. 15 : 94 (1901) ; KITAM. Comp. Jap. III : 166 (1942) ; HARA, Enum. Sperm. Jap. II : 113 (1952) ; OHWI, Fl. Jap. Eng. ed. 878 (1965). —— *Mallatopus japonicus* FR. et SAV. Enum. Pl. Jap. II : 394 (1879) Type from Honshu.

Endemic to Honshu, occuring in rather moist places in mountain region; one of the Japan Sea-side elements.

The present species is characterized by having discoid heads as mentioned above. The feature with many cauline leaves in this species is the same as in *A. sachalinensis*.

References of Chromosome numbers

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FLOVIK, K. 1940. Chromosome numbers and polyploidy within the flora of Spitzbergen. *Hereditas*, 26 : 430 - 440.

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Ornduff, R., Raven, P. H., Kyhos, D. W. & A. R. Kruckeberg, 1963. Chromosome numbers in Compositae III. Senecioneae. *Amer. Journ. Bot.* 50: 131 - 139.

Ornduff, R., Mosquin, T., Kyhos, D. W. & P. H. Raven, 1967. Chromosome numbers in Compositae VI. Senecioneae II. *Amer. Journ. Bot.* 54 : 205 - 213.

Genus **Doronicum**

This genus is one of the well known genera in Europe. Some species are medicinal. *Aronicum* is a genus described by Necker with a close affinity to *Doronicum*, and the former differs from the latter in having the florets all with pappus. In Genera Plantarum, Bentham treated *Aronicum* as a section of *Doronicum*. Both *Grammarthron* Cass. (1817) and *Fullartonia* DC. (1836) were also reduced by Bentham to *Doronicum*.

Doronicum L. Gen. Pl. ed. V : 377 (1754) ; Benth. in Benth. et Hook. f. Gen. Pl. II : 440 (1873) incl. syn. ; Hoffm. in Engler u. Prantl Pfl.-fam. IV-5 : 294 (1892) ; Gorschk. Fl. URSS, XXVI : 669 (1961).

Perennial herbs with alternate leaves. Radical leaves long petioled, cauline ones distant, often amplexicaul. Inflorescence corymbose. Heads large, long-peduncled, yellow and radiate. Ray florets long ligulate, female, mostly 1-seriate and fertile ; disk florets hermaphrodite, fertile, tubular and 5-lobed at apex. Involucral scales hairy, herbaceous, 1 or 2 seriate, subequal and lanceolate, acuminate at the apex. Anther bases entire or subauricled. Cells of upper part of filament same in size. Style branches of disk florets short or linear, round or truncate at the top. Achenes glabrous, of disk florets always pappose, but of ray florets often epappose.

More than 25 species are known from cool temperate Eurasia.

The present genus is divided into two sections as follows.

A. All of the florets in a head pappose : achenes slender or slightly terete. ..... Sect. **Aronicum**.

A. Ray florets epappose and disk florets pappose ; achenes terete or angled. ..... Sect. **Doronicum**.

Chromosome numbers are counted for only six species in this genus.

Species	n	2n	Investigator
Sect. *Aronicum*			
Doronicum clusii		120	Wcisło 1951
D. grandiflorum	30		Löve & S. 1964

D.	*grandiflorum*	60	FAVARGER 1949
Sect.	*Doronicum*		
D.	*austriacum*	60	WCISŁO 1951
D.	*cordatum*	60	LINDQVIST 1950
D.	*pardalianches*	60	〃
D.	*plantagineum*	ca. 120	〃

Sect. **Aronicum** (NECK.) BENTH. in BENTH. et HOOK. f. Gen. Pl. II : 440 (1873) ; GORSCHK. Fl. URSS, XXVI : 671 (1961).

About ten species are known. Following two species are reported from our area, but further study is necessary for every species.

Doronicum altaicum PALL. in Act. Acad. Petrop. 2: 271 t. 16 (1779), 6: 2 (1783) Type from Altai, Siberia ; GORSCHK. Fl. URSS, XXVI : 672 (1961) incl. syn. ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 234 (1966) incl. syn.

SIBERIA Prov. Altai : Karakol, *L. Smirnova* (KYO) ; Koksinskii, *G. Perminova & A. Botinova* (TNS). CHINA Prov. Sikang : Tapaoshan, *H. Smith 11473* (KYO).

Distribution : Tibet, China, and Siberia.

Doronicum hookeri CLARKE ex HOOK. f. Fl. Brit. Ind. III : 332 (1882) Type from Sikkim.

BHUTAN Ling-shi Dzong, *S. Nakao 415* (KYO) ; near Tong, *S. Nakao 652* (KYO) ; Sankepong, *S. Nakao 713* (KYO). EASTERN NEPAL Near Deoma, *K. Nishioka 1035* (KYO).

Endemic to Himalayas.

Sect. **Doronicum**. ——Sect. *Eudoronicum* DC. Prod. VI : 320 (1837).

Sect. *Doronicastrum* CAVILL. in Ann. Conserv. et Jard. Bot. Genéve, 13-14: 339 (1911).

Sect. *Pardalianches* TAUSCH. in Flora, 11 : 182 (1828) ; GORSCHK. Fl. URSS, XXVI : 676 (1961).

More than fifteen species are known. Two species are described from western Himalaya, but the present writer could not examine material of one species.

Doronicum falconeri CLARKE ex HOOK. f. Fl. Brit. Ind. III : 333 (1882) Type from Kashmir ; Kitam. Fl. Pl. West Pakist. 147 (1964).

KARAKORAM Skoro La, *S. Nakao* (KYO).

Endemic to western Himalaya.

Doronicum roylei DC. Prod. VI : 321 (1836) Type from Kashmir ; HOOK. f. Fl. Brit. Ind. III : 332 (1882).

Following two species are reported as central Asiatic elements.

Doronicum stenoglossum MAXIM. in Mél. Biol. 11 : 238 (1881) Type from Kansu, China ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 235 (1966) incl. syn.

CHINA Prov. Sikang : Chungo Valley, Hsintientzii, Ca. 3800m, *H. Smith 11378* (KYO).

Doronicum thibetanum CAVILL. in Ann. Conserv. Jard. Bot. Genéve 10 : 225 fig. 13 a-e (1907) Type from Tibet ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 235 (1966).

References of Chromosome numbers

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LINDQVIST, K. 1950. Some results of a cytological investigation of *Doronicum*. *Hereditas*, 36 : 94 - 102.

LÖVE, Á. & O. T. SOLBRIG, 1964. IOPB chromosome number reports II. *Taxon*, 13 (6) : 201 - 209.

WCISŁO, H. 1951. in Chromosome atlas of flowering plants edited by DARLINGTON & WYLIE (1955).

Genus **Gynura**

The present genus is confined to the tropical and subtropical regions of the Old World. More than 100 species are known, and about a half of them distribute in our area.

Gynura CASS. in Dict. Sci. Nat. 34 : 391 (1825) ; KITAM. Comp. Jap. III : 175 (1942) ; HARA, Enum. Sperm. Jap. II : 206 (1952).

Perennial and somewhat succulent herbs, or undershrubs. Leaves alternate, entire, toothed or pinnatifid. Inflorescence terminal, solitary or loosely corymbose. Heads discoid, bracteolate at base. Florets tubular, 5-lobed, yellow or purplish, hermaphrodite and fertile. Style branches linear and sublate, with papilla for their entire length. Anther bases entire or subauricled. Cells of the upper part of filament different in size. Achenes glabrous or pubescent, cylindrical, many-ribbed, with fine, white pappus.

The chromosomal accounts are given as to five species only.

Species	n	2n	Investigator
Gynura aurantiaca		20	AFZELIUS 1924
G. japonica		22	SUZUKA 1953
G. formosana		20	CHUANG *et al.* 1962
G. cusimbua	10, 20		MEHRA *et al.* 1965
G. nepalensis	10		〃

Key to the Species

A. Stem climbing. ..... **G. procumbens.**
A. Stem not climbing. ..... B.
B. Leaves radical ; heads one or two, with long peduncle. ..... C.
B. Leaves cauline or nearly radical ; heads more than two, with short or rarely long peduncle. ..... D.
C. Leaves entire or slightly dentate. ..... **G. integrifolia.**
C. Leaves dentate or rarely pinnately lobed. ..... **G. pseudo-china.**
D. Stem procumbent at the base ; leaves obovate. ..... **G. formosana.**

D. Stem erect at the base; leaves oblong or oblanceolate. ..... E.
E. Leaves nearly entire, irregularly toothed. ..... F.
E. Leaves lyrate-pinnatifid or pinnatifid. ..... G.
F. Achenes glabrous. ..... **G. elliptica.**
F. Achenes papillose between the ribs. ..... **G. cusimbua.**
G. Leaves hoary-pubescent. ..... **G. nepalensis.**
G. Leaves not hoary-pubescent. ..... **G. japonica.**

Gynura procumbens (LOUR.) MERR. Enum. Philipp. Fl. Pl. III : 618 (1923) ; CHANG in Sunyats. 3: 298 (1930) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 282 (1966). —— *Cacalia procumbens* LOUR. Fl. Cochinch. 485 (1790) Type from Vietnam.

Gynura sarmentosa DC. Prod. VI: 298 (1838).
Gynura affinis TURCZ. in Bull. Soc. Nat. Mosc. 24 (1) : 201 (1851).
Gynura scabra TURCZ. l. c.
Gynura cavaleriei LÉV. in Bull. Géogr. Bot. 24 : 284 (1914).

HAINAN Ching Mai Distr. : Tai Wong Ling and vicinity, *C. I. Lei 382* (KYO ; TI). THAILAND Pref. Nakawn Sritamarat : lower elevation of Khao Luang, *M. Tagawa et al. T. 4544* (KYO ; TNS).

Gynura integrifolia GAGNEP. in Bull. Soc. Bot. France, 68 : 120 (1921) Type from Udawn, Thailand ; KERR in CRAIB Fl. Siam. Enum. II : 288 (1936).

THAILAND Udawn : Phu Kradung, *M. Tagawa et al. T. 797, 813* (KYO ; TNS) ; ibidem, *T. Smitinand 1901* (TNS) ; ibidem, *D. Bunpheng 77* (TNS).

Gynura pseudo-china (L.) DC. Prod. VI : 299 (1838) ; GAGNEP. in LECOMTE Fl. Gén. Indo-chine, III : 511 (1924) ; HAND.-MZT. Symb. Sin. Pt. VII : 1119 (1936) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 283 (1966) ; KITAM. in HARA Fl. East. Himal. 340 (1966). —— *Senecio pseudo-china* L. Sp. Pl. 867 (1753) Type from Kwangtung, China.

Gynura bodinieri LÉV. in Bull. Géogr. Bot. 24 : 283 (1914).

HAINAN Ching Mai Distr. : Pak Shik Ling and vicinity, *C. I. Lei 313* (KYO ; TNS). EASTERN INDIA Darjeeling : Peshok, *H. Hara & T. Tuyama 5510* (TI ; KYO).

Gynura formosana KITAM. in Acta Phytotax. Geobot. 2 : 175 (1933), Comp. Jap. III : 175, Pl. VIII, fig. 1 (right) (1942) incl. syn. Type : TAIWAN Prov. Taihoku: Tamsui, *S. Kitamura* (Holotype in KYO); S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 281 (1966).

Endemic to Taiwan.

Gynura elliptica YABE et HAYATA ex HAYATA in Journ. Coll. Sci. Imp. Univ. Tokyo, 18, Art. 8 : 25, t. 2 (1904) Type : TAIWAN Isl. Kotosho, *K. Miyake* (Holotype in TI) ; KITAM. Comp. Jap. III : 177 (1942); S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 281 (1966).

Gynura cusimbua (D. DON) S. MOORE in Journ. Bot. 50 : 212 (1912); HAND.-MZT. Symb. Sin. Pt. VII : 1119 (1936) ; KITAM. in KIHARA Fau. Fl. Nepal Himal. I : 260 (1955), in HARA Fl. East. Himal. 340 (1966) ; S.-Y. HU in

Quart. Journ. Taiwan Mus. 19: 280 (1966).——*Cacalia cusimbua* D. DON, Prod. Fl. Nepal. 179 (1825) Type from Nepal.

NEPAL Sinduwa, *H. Hara et al. 6306280* (KYO ; TI) ; Dhankuta-Hilay-Murhay, *H. Hara et al. 6306281* (KYO ; TI); below Siling Tzokupa-Khebang, *H. Hara et al. 6306282* (KYO ; TI) ; Batasay-Halhale Bhanjang-Bhuspate Danra, *H. Hara et al. 6306283* (KYO ; TI) ; Siklis to BH, *T. Fujimura 121* (KYO) ; Thalung, *S. Nakao* (KYO ; TI) ; Wallung-Chung Gola to Tsoki, *K. Nishioka 1135* (KYO). EASTERN INDIA Darjeeling, *H. Hara & S. Kurosawa 6300342* (TI). BHUTAN Kya-cha Dzong-Similaca, *S. Nakao 540* (KYO). CHINA Prov. Yunnan, *A. Henry 9381 A* (TNS).

Gynura nepalensis DC. Prod. VI : 300 (1838) Type from Nepal ; HOOK. f. Fl. Brit. Ind. III : 333 (1881) ; KITAM. in KIHARA Fau. Fl. Nepal Himal. I : 260 (1955), in HARA Fl. East. Himal. 340 (1966).

NEPAL Chepe Khola, *S. Nakao* (KYO). SIKKIM Rhenock, *H. Hara 6300210* (TI). DARJEELING Below Forest Bungalow, Takdah, *H. Hara & M. Togashi 5511* (TI).

Gynura japonica (THUNB.) JUEL in Act. Hort. Bergian, 1(3) : 86 (1891) ; KITAM. Comp. Jap. III : 176 (1942) incl. syn. ; HARA, Enum. Sperm. Jap. II : 206 (1952) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 281 (1966).——*Senecio japonicus* THUNB. Fl. Jap. 315 (1784) Type from Japan.

Var. **japonica**

The type was taken from a cultivated plant in Japan.

Var. **flava** (HAYATA) KITAM. in Acta Phytotax. Geobot. 8 : 202 (1937), Comp. Jap. III : 176 (1942) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 281 (1966).——*Gynura flava* HAYATA in Journ. Coll. Sci. Imp. Univ. Tokyo, 25: 138 (1908) Type : TAIWAN Prov. Tainan : Mt. Niitaka, *U. Mori & T. Kawakami* (Holotype in TI).

The following species have been reported from our region, but further study should be made to understand them.

Gynura auriculata CASS. Opusc. Phyt. III: 100 (1834) Type from Hainan.

Gynura barbaraefolia GAGNEP. in Bull. Soc. Bot. France, 68 : 119 (1921) Type from Tonkin.

CHINA Hongkong, *B. Hayata* (TI).

Gynura calciphila KERR in Kew Bull. 1935 : 330 (1935) Type from Chumpawn, Thailand.

Gynura colaniae MERR. in Univ. Calif. Publ. Bot. 13 : 142 (1926) Type from Tonkin.

Gynura divaricata (L.) DC. Prod. VI: 301 (1838) ; CHANG in Sunyats. 3: 298 (1937); S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 280 (1966).——*Senecio divaricatus* L. Sp. PI. 866 (1873) Type from Kwangtung, China.

Gynura longifolia KERR in Kew Bull. 1935 : 331(1935). Type from Doi Suthep.

THAILAND Doi Suthep, 1000-1100m, *H. Ogawa & K. Yoda* 212-63 (TI).

Gynura maclurei MERR. in Philipp. Journ. Sci. 21 : 355 (1922), in Lingn. Sci. Journ. 5 : 185 (1928) Type from Hainan ; CHANG in Sunyats. 3 : 299 (1937).

Gynura nitida DC. Prod. VI : 299 (1838). Type from India, mt. Dendigul. THAILAND Bannkikh-Toktoong, *B Hayata* (TI).

Gynura purpurascens DC. Prod. VI : 299 (1938) Type from Nepal.

Gynura truncata KERR in Kew Bull. 1935 : 331 (1935) Type from Korat, Thailand.

References of Chromosome numbers

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CHUAN, T.-I., CHAO, W. L., WILMA & S. C. KWAN, 1962. Chromosome numbers of the vascular plants of Taiwan I. *Taiwania*, 8 : 51 - 66.

MEHRA, P. N., GILL, B. S., MEHTA, J. K. & S. S. SIDHU, 1965. Cytological investigations on the Indian Compositae I. North-Indian taxa. *Caryologia*, 18 : 35 - 68.

SUZUKA, O. 1953. Chromosome numbers in phamaceutical plants II. *Rep. Kihara Inst. Biol. Res.* 6 : 79.

Genus **Farfugium**

The plants of this genus have been well known as the Leopard Plant from the late of 17th century. SIEBOLD & ZUCCARINI described *Ligularia kaempferi* based on the plants from Japan. J. LINDLEY proposed a new genus *Farfugium* on the basis of *Farfugium grande*, which was later reduced to *Ligularia kaempferi* by W. J. HOOKER. After then, the genus *Farfugium* has been considered as a synonym of *Ligularia*. In 1939, KITAMURA revived the genus *Farfugium* in his sense and made emendation to consider such characters as involute vernation and hirsute achenes as genetical. Recently, G. P. DE WOLF & P. D. SELL, and J. DRESS independently emphasized that it did not seem to be wise or expedient to recognize minutely segregated genera distinguished only by recondite characters——particularly when changes in name are necessary for well known species. The involute vernation is, however, a peculiar feature of *Farfugium*, completely lacking in the allied genera. In addition, this genus differs from *Ligularia* in the following characters: the radical leaves develop largely, but the cauline leaves do slightly or none, and the petiole-bases of the leaves are not truly vaginate and sheathing. Thus, *Farfugium* may be treated as a separate genus as defined by KITAMURA.

Farfugium LINDL. Gard. Chron. 1857 : 4 (1857); emend. KITAM. in Acta Phytotax. Geobot. 8: 77 (1939), Comp. Jap. III : 179 (1942) Type: *F. japonicum;* HARA, Enum. Sperm. Jap. II : 203 (1952); OHWI, Fl. Jap. Eng. ed. 879 (1965); S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 262 (1966).

Perennial herbs with radical leaves. Inflorescence corymbose. Heads of many florets, radiate. Ray florets with elongate ligules, in one row, female and fertile. Ligules yellow. Disk florets hermaphrodite, fertile and tubiform, 5-lobed at the apex. Anther bases tailed. Cells of the upper part of filament all the same in size. Style branches of disk florets linear and round

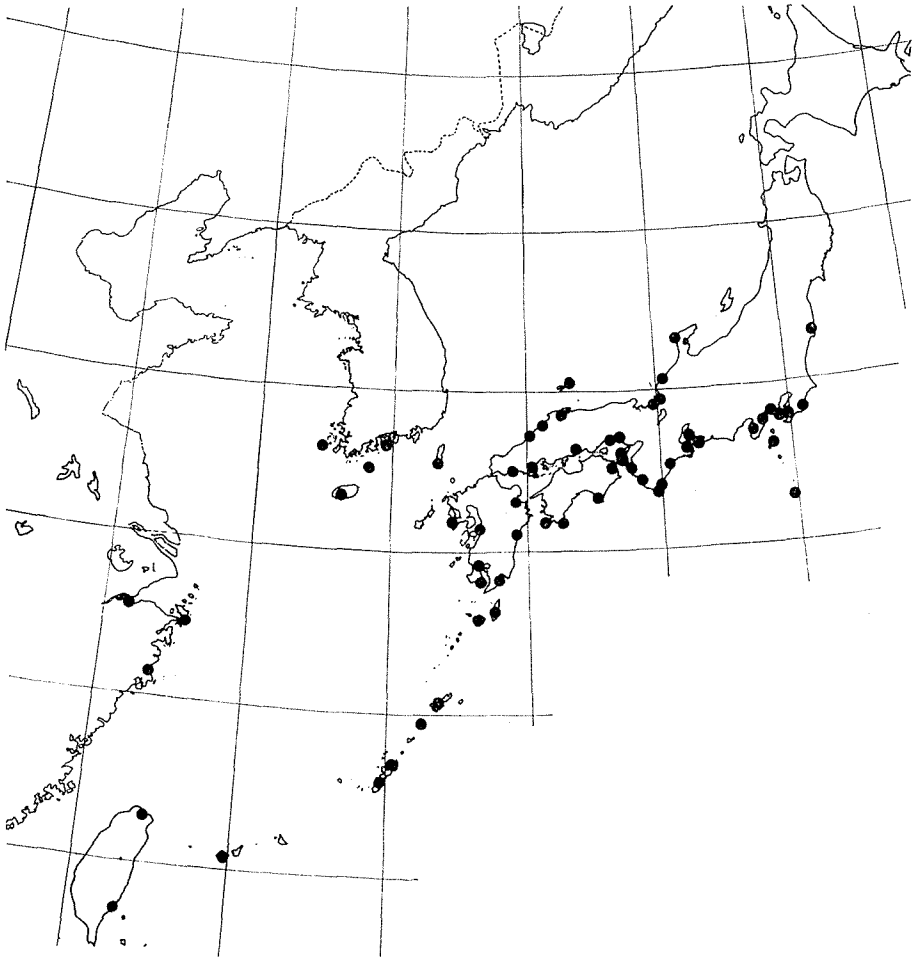

Fig. 1. Ranges of *Farfugium japonicum* var. *japonicum*; growing on the littoral cliffs.

at the apex, papillate for their entire length. Achenes with fine white pappus, cylindric or tapered at both ends, densely hirsute.

Distribution : Southeastern China, southeastern Korea, Taiwan, RYUKYU, Kyushu, Shikoku and western Honshu. Most of the plants grow on the sea side.

Two species are known from the area and are distinguished by the following key characters.

A. Leaves thin, cordate, acuminate at apex, sharply serrate. .... **F. hiberniflorum.**

A. Leaves thick, reniform or flabelliform, not sharply serrate. .... **F. japonicum.**

Farfugium hiberniflorum (MAKINO) KITAM. in Acta Phytotax. Geobot. 8 : 73, 79 (1939), Comp. Jap. III : 183 (1942) incl. syn. ; HARA, Enum. Sperm. Jap. II : 203 (1952); OHWI, Fl. Jap. Eng. ed. 879 (1965). —— *Ligularia hiberniflora* MAKINO in Bot. Mag. Tokyo, 24 : 34 (1910) Type from Miyanoura of Yakushima Island, Kagoshima Prefecture, Kyushu.

The present species is known from Yakushima Island and southern part of Tanegashima Island. Plants grow in rather moist places in mountain forest. The structure of inflorescence is the same as that of *F. japonicum*, though smaller in size than of *F. japonicum*. The serration of the leaves in this species is fairly unique and is easily distinguished from that of *F. japonicum*.

Chromosome number : 2n=60 (ARANO 1962 ; KOYAMA unpublished).

Farfugium japonicum (L. f.) KITAM. in Acta Phytotax. Geobot. 8 : 268 (1939), Comp. Jap. III : 180 (1942) incl. syn. ; HARA, Enum. Sperm. Jap. II : 203 (1952) ; OHWI, Fl. Jap. Eng. ed. 879 (1965) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 262 (1966). —— *Tussilago japonica* L. f. Mant. Pl. I : 113 (1767) Type from Japan.

Cultivated plants of this species are well known as the Leopard Plant in America and Tsuwabuki in Japan. There are several interesting cultivars. The petioles are eaten by the natives. Five wild varieties arranged by KITAMURA are well recognizable.

Var. **japonicum**

Tussilago japonica L. f. l. c.

This variety distributes widely in the warm littoral cliffs of Eastern Asia. Most interesting cultivars may have been derived from this variety.

Chromosome number : 2n=60 (ARANO 1962 ; KOYAMA unpublished).

Var. **nokozanense** (YAMAMOTO) KITAM. in Acta Phytotax. Geobot. 8 : 78 (1939), Comp. Jap. III : 182 (1942) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 263 (1966). —— *Ligularia nokozanensis* YAMAMOTO, Suppl. Icon. Pl. Formos. IV : 22 (1928) Type: TAIWAN Prov. Kareko : Mt. Noko, *E. Matsuda* (Holotype in TI).

Endemic to Taiwan, in rather high mountain areas.

Var. **luchuensis** (MASAMUNE) KITAM. Comp. Jap. III : 182 (1942) incl. syn. —— *Ligularia luchuensis* MASAMUNE in Journ. Trop. Agric. 4: 193 (1932) Type : RYUKYU Okinawa Island : Kunigami, *M. Itomitsu* (Holotype in TAI).

This variety is characterized by having the flabelliform leaves which are fairly variable.

Chromosome number : 2n=60 (KOYAMA unpublished).

Var. **giganteum** (SIEB. et ZUCC.) KITAM. in Acta Phytotax. Geobot. 8 : 78 (1939), Comp. Jap. III : 182 (1942) incl. syn. ; HARA, Enum. Sperm. Jap. II : 204 (1952); OHWI, Fl. Jap. Eng. ed. 879 (1965). —— *Ligularia gigantea* SIEB. et ZUCC. Fl. Jap. I : 79, t. 36 (1835) Type from Japan.

Known only in Kyushu. The petioles are easten as vegetable.

Var. **formosanum** (HAYATA) KITAM. in Acta Phytotax. Geobot. 8: 78 (1939), Comp. Jap. III: 182 (1942) incl. syn. ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 263 (1966). —— *Ligularia tussilaginea* var. *formosana* HAYATA, Icon. Pl. Formos. VIII : 69 (1919) Type from Taiwan.

The present variety is known from Taiwan and Hongkong, growing in fairly low mountainous area comparing with var. *nokoensis*. This variety differs from the type in having the lusterless angular leaves.

Reference of Chromosome numbers

ARANO, H. 1962. Cytological studies in subfamily Carduoideae (Compositae) of Japan VIII. The karyotype analysis in tribe Senecioneae. *Bot. Mag. Tokyo*, 75: 401 - 410.

Genus **Ligularia**

Ligularia CASS. (1816) is the conserved generic name against the earlier name, *Ligularia* DUVAL (1809). Concerning to the circumscription of *Ligularia*, various definitions have ever been given. Owing to its close relation to *Senecio*, *Ligularia* has been considered as a section of *Senecio* by the botanists with conservative conceptions. There are, indeed, intermediate forms concerning some taxonomic characters between *Ligularia* and *Senecio*. *Ligularia* is characterized by having the well developed vaginate sheath of petiole base. In addition, the achenes are glabrous throughout the genus *Ligularia*, though sometimes pubescent in *Senecio*. From these facts, *Ligularia* may be considered as a separate genus from *Senecio*. On the other hand, *Ligularia* is rather obscurely distinguished from *Cremanthodium*, though most of *Cremanthodium* have solitary and cernuous heads. On the ecological bases, however, these two genera are different from each other : *Ligularia* occurs mostly in mountain area of Asia, but *Cremanthodium* is restricted to high alpine area of central Asia. *Ligularia* seems to be well defined as a distinct genus, when *Cremanthodium* is recognized as a phylogenetic and ecological genus as pointed out by R. GOOD. As mentioned already in the former pages, *Ligularia* is distinguished from *Farfugium*, though these two have close affinity to each other.

Ligularia CASS. in Bull. Soc. Philom. 1816 : 198 (1816), in Dict. Sci. Nat. 26 : 401 (1823), non *Ligularia* DUVAL (1809) Type : *L. sibirica* ; KITAM. Comp. Jap. III : 183 (1942) incl. syn. ; HARA, Enum. Sperm. Jap. II : 226 (1952) ;

POJARK. Fl. URSS, XXVI : 788 (1961) ; OHWI, Fl. Jap. Eng. ed. 879 (1965) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 20 : 53 (1967).

Perennial herbs, with several basal leaves and a few or more cauline ones. Leaves revolute, when young. Petioles of radical leaves long, and those of cauline ones short, encircle the stem completely, with developed vaginate sheath. Inflorescence solitary, corymbose or racemose. Heads of many florets, mostly radiate, rarely discoid. Ray florets with yellow, long ligules, uniserial, female and fertile. Disk florets yellow, tubular, 5-lobed at apex, hermaphrodite and fertile. Anther base auricled. All the cells of the upper part of filament same in size. Style branches slender, with papilla throughout or hairy in their upper half. Achenes cylindric, tapered off at both ends, terete, glabrous, with white, tawny and more or less red-brown pappus.

Distribution : most of *Ligularia* are Asiatic, but *L. sibirica* has a wide geographic range and reaches as far west as France.

About 100 species have been reported from Asia, and only 8 of them are recognized from Japan. Several species, as being much attractive, are grown ornamently in America and Europe, producing a number of cultivars.

Three sections are recognized by KITAMURA in *Ligularia*. *L. leesicotal* described from Himalayas, however, is peculiar in having several cauline leaves of good development, more or less similar style branches to those of *Senecio*, and less developed vaginate sheath —— particulary of cauline leaves. This species may, therefore, better be referred to a separate section.

Following species are cytologically examined. Most of them have 60 chromosomes in diploid condition which derive from $X_b = 30$.

Species	n	2n	Investigator
Ligularia altaica		48	SOKOLOVSKAJA & S. 1938
L. angusta		58	ARANO 1964
L. dentata	30		AFZELIUS 1924
		60	ARANO 1962
L. fischeri	30		AFZELIUS 1924
		60	ARANO 1964; KOYAMA 1966
L. hodgsonii	29		AFZELIUS 1949
		58	ARANO 1964
L. japonica	30		AFZELIUS 1924
		ca. 60	ISHIKAWA 1916
L. kaialpina		58	ARANO 1962
L. macrophylla	29		AFZELIUS 1924
L. przewalskii	30		AFZELIUS 1949
L. sibirica	29–30		AFZELIUS 1924
L. stenocephala	29		KOYAMA 1962
		60	ARANO 1962
L. tangutica	30		AFZELIUS 1924
L. veitchiana	30		〃

L. wilsoniana 30 AFZELIUS 1924

The somatic number of 48 chromosomes in *L. altaica* is unique in our genus, though the chromosomal accounts are too scanty to discuss the basic number of the present genus.

Four sections are distinguished by the following characters.

A. Cauline leaves well developed with less developed vaginate sheath at the base of petioles. ..... Sect. **Erectae**.
A. Cauline leaves not so well developed, with well developed vaginate sheath at the base of petioles. ..... B.
B. Radical leaves spreading horizontally, upper surface green but pale beneath. ..... Sect. **Ligularia**.
B. Radical leaves erect, both surfaces of the leaves grey-green. ..... C.
C. Involucral scales connate. ..... Sect. **Cyathocephalum**.
C. Involucral scales free. ..... Sect. **Senecillis**.

Sect. **Erectae** H. KOYAMA sect. nov.

Folia alterna caulina 3 - 4, basi parum dilatata modeste vaginata. Lamina foliorum erectae. Inflorescentia corymbosa.

Ligularia leesicotal KITHAM. in Acta Phytotax. Geobot. 15 : 74 (1953), in KIHARA Fau. Fl. Nepal Himal. I : 263 (1955) Type : TIBET Lhasa : Mt. Pali, *E. Kawaguchi 132* (Holotype in TNS); KOYAMA in Acta Phytotax. Geobot. 22 : 75 (1966); S.-Y. HU in Quart. Journ. Taiwan Mus. 20 : 64 (1967).

NEPAL Thumje, *S. Nakao* (KYO; TNS). TIBET Mt. Pali, *E. Kawaguchi 132* (TNS) ; Mt. Tsuon-Zue, *E. Kawaguchi 33, 203* (TNS) ; Seshika-mura, *E. Kawaguchi 65* (TNS) ; Mt. Gyan-Bei, *E. Kawaguchi 198* (TNS).

Sect. **Ligularia**. —— Sect. *Euligularia* NAKAI in Bot. Mag. Tokyo, 31 : 124 (1917) ; KITAM. Comp. Jap. III : 188 (1942) incl. syn. ; KOYAMA in Acta Phytotax. Geobot. 22 : 75 (1966). —— Subgen. *Ligularia* ; POJARK. Fl. URSS, XXVI : 797 (1961).

Most of the species of this genus are referred to this section, which is subdivided into three series by the following characters.

A. Head solitary, erect. ..... Series **Monocephalae**.
A. Heads many. ..... B.
B. Inflorescence corymbose. ..... Series **Corymbosae**.
B. Inflorescence racemose. ..... Series **Ligularia**.

Series **Monocephalae** (NAKAI) KITAM. Comp. Jap. III : 189 (1942). —— *Ligularia* Sect. *Monocephala* NAKAI in Bot. Mag. Tokyo, 31 : 123 (1917).

Ligularia jamesii (HEMSL.) KOMAROV, Fl. Mansh. III : 697 (1907) ; KITAM. Comp. Jap. III : 189 (1942) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 20 : 61 (1967). —— *Senecio jamesii* HEMSL. in Journ. Linn. Soc. 23 : 453 (1888) Type from Kirin, Manchuria.

Distribution : Manchuria and northern Korea.

Series **Corymbosae** (FRANCH.) KITAM. Comp. Jap. III : 197 (1942) incl. syn., pro parte ; KOYAMA in Acta Phytotax. Geobot. 22 : 75 (1966). —— *Senecio* groupe

Ligularia B. *Eu-ligularia* 3 *Corymbosi* FRANCH. in Bull. Soc. Bot. France, 39 : 290 (1892).

The present series is characterized by having the corymbose inflorescence. In this inflorescence, flowering proceeds from the central head to the marginal heads. In *L. hodgsonii*, the inflorescence is apparently corymbose, but flowering proceeds from the marginal heads to the central ones. Therefore, *L. hodgsonii* should be treated as a member of Series *Ligularia*, though it has been referred to Series *Corymbosae*. The same treatment is made to *L. kaialpina*.

A. Heads small, 3-9 mm in width. ..... B.
A. Heads large, 16 - 28 mm in width. ..... C.
B. Ray florets 1 - 2 in a head. ..... **L. thomsoni.**
B. Ray florets 5 - 6 in a head. ..... **L. amplexicaulis.**
C. Leaves palmately lobed. ..... **L. japonica.**
C. Leaves not palmately lobed. ..... **L. dentata.**

Ligularia thomsoni (CLARKE) POJARK. in Not. Syst. Herb. Komarov, XII : 293 (1950) : KITAM. in KIHARA Fau. Fl. Nepal Himal. I : 266 (1955). —— *Senecio thomsoni* CLARKE, Comp. Ind. 205 (1876) Type from Kashmir ; HOOK. f. Fl. Brit. Ind. III : 348 (1881).

NEPAL Tolo Gompa Khola, *S. Nakao* (KYO; TNS).

Distribution : Himalayas, from Kashmir to Nepal.

Ligularia amplexicaulis WALL. ex DC. Prod. VI : 314 (1837) Type from Kashmir ; HOOK. f. Fl. Brit. Ind. III : 348 (1881) incl. syn.

BHUTAN Ling-shi Dzong, *S. Nakao 97* (KYO).

Distribution : Himalayas, from Kashmir to Bhutan.

Ligularia japonica (THUNB.) LESS. Syn. Comp. 390 (1832) ; KITAM. Comp. Jap. III : 199 (1942) incl. syn. ; HARA, Enum. Sperm. Jap. II : 228 (1952) ; OHWI, Fl. Jap. Eng. ed. 881 (1965) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 20 : 61 (1967). —— *Arnica japonica* THUNB. Fl. Jap. 319 (1784) Type from Japan, non L. f. (1781).

Distribution : southern China, North Korea, Taiwan and southern Japan ; in moist places and grassy slopes in montane areas.

Ligularia dentata (A. GRAY) HARA in Journ. Jap. Bot. 15 : 318 (1939) ; KITAM. Comp. Jap. III : 200 (1942) ; HARA, Enum. Sperm. Jap. II : 226 (1952) ; OHWI, Fl. Jap. Eng. ed. 881 (1965) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 20 : 57 (1967). —— *Erythrochaete dentata* A. GRAY, Bot. Jap. 395 (1859) Type from Japan.

Ligularia clivorum MAXIM. in Bull. Acad. Sci. St. Pétersb. 15 : 374 (1870) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 20 : 56 (1967).

Distribution : southern and central China and Japan ; rather wet places in light forest, and by stream in montane areas in central Honshu and Shikoku, but on seaside slope in northern Honshu.

Ligularia × yoshizoeana (MAKINO) KITAM. Comp. Jap. III: 201 (1942) ; HARA, Enum. Sperm. Jap. II : 229 (1952) ; OHWI, Fl. Jap. Eng. ed. 882 (1965). —— *Ligularia japonica* var. *yoshizoeana* MAKINO in Bot. Mag. Tokyo, 19 : 153

Fig. 2. Ranges of *Ligularia dentata* (★) and *L. japonica* (●) in Japan.

(1905).

The type of this species was taken from a cultivated plant in Koishikawa Botanic Garden, Tokyo. The present species is considered as a hybrid between *L. japonica* and *L. dentata*. Although the wild plant had not been collected since described, in 1954 H. KANAI collected the present species on Mt. Yobiko-dake in Pref. Shizuoka of central Honshu where both *L. japonica* and *L. dentata* occur.

HONSHU Pref. Shizuoka : Mt. Yobiko-dake in Mts. Ashitaka, *H. Kanai* (July 18, 1954) (TI).

The following species may be referred to this series, though further study is necessary to clarify the discrimination of each species.

Ligularia crassa HAND.-MZT. in ENGLER Bot. Jahr. 69 : 108 (1939) Type from SW-Szechuan, China.

Ligularia rockiana HAND.-MZT. in ENGLER Bot. Jahr. 69 : 110 (1939) Type from NW-Yunnan, China.

Ligularia macrantha (CLARKE) H. KOYAMA comb. nov. —— *Senecio macranthus* CLARKE, Comp. Ind. 205 (1876) Type from Khasi, eastern India ; HOOK. f. Fl. Brit. Ind. III : 349 (1881).

Series **Ligularia**. —— Series *Racemosae* (FRANCH.) KITAM. Comp. Jap. III : 190 (1942) incl. syn. ; KOYAMA in Acta Phytotax. Geobot. 22 : 75 (1966). —— *Senecio* groupe *Ligularia* B, *Eu-Ligularia* 1. *Racemosi* FRANCH. in Bull. Soc. Bot. France, 39 : 289 (1891).

Most of the species in this series are characterized by having racemose inflorescence, though some have thyrsoid inflorescence. In both the racemose and thyrsoid inflorescences, however, flowering proceeds from the basal head upward to the apical one.

Key to the Species

A. Pappus snow-white. ..... **L. jaluensis**.
A. Pappus cream-white or tawny. ..... B.
B. Involucres narrow less than 4 mm in width. ..... C.
B. Involucres broad more than 6 mm in width. ..... E.
C. Involucral scales 8 in a head. ..... **L. intermedia**.
C. Involucral scales 5 in a head. ..... D.
D. Heads many in number. ..... **L. stenocephala**.
D. Heads a few in number. ..... **L. kojimae**.
E. Inflorescence apparently corymbose. ..... **L. hodgsonii**.
E. Inflorescence racemose. ..... F.
F. Heads discoid. ..... **L. chekianensis**.
F. Heads radiate. ..... G.
G. Pappus equal to florets in length. ..... H.
G. Pappus shorter than florets. ..... I.

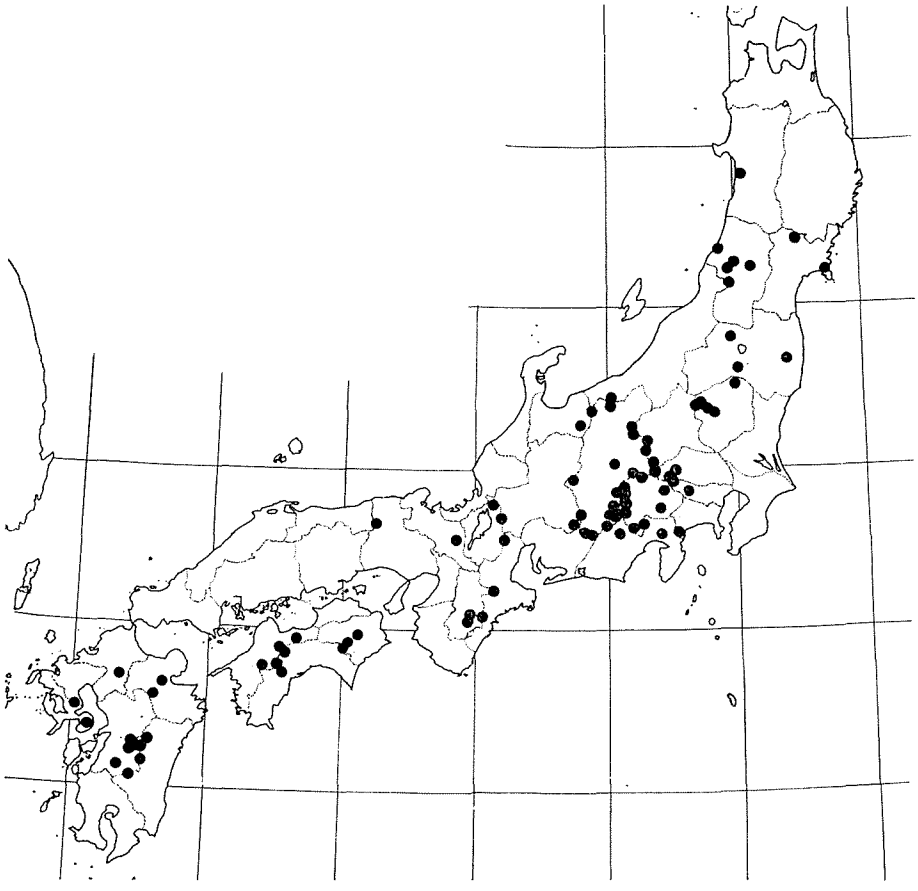

Fig. 3. Range of *Ligularia stenocephala* in Japan.

H. Leaves cordate or cordate-reniform. ..... **L. sibirica**.
H. Leaves ovate-elliptic. ..... **L. ovato-oblonga**.
I. Inflorescence racemose, involucres 8 - 14 mm in width. ..... **L. fischeri**.
I. Inflorescence apparently corymbose, involucres 6 mm in width. ...**L. kaialpina**.

Ligularia jaluensis KOMAROV in Acta Horti Petrop. 18 : 420 (1901) Type from Kirin, Manchuria ; KITAM. Comp. Jap. III : 192 (1942) incl. syn. ; POJARK. Fl. URSS, XXVI : 826 (1961) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 20 : 61 (1967).

Distribution : Manchuria and northern Korea.

Ligularia intermedia NAKAI in Bot. Mag. Tokyo, 31 : 125 (1917) Type : KOREA Prov. Kanhoku : Setsurei, *T. Nakai* (Holotype in TI) ; KITAM. Comp. Jap. III : 191 (1942) incl. syn. ; S.-Y. HU in Quart. Journ. Taiwan Mus. 20 : 61 (1967).

Distribution: China, Manchuria and northern Korea.

Ligularia stenocephala (MAXIM.) MATSUM. et KOIDZ. in Bot. Mag. Tokyo, 24 : 149 (1910) ; KITAM. Comp. Jap. III : 195 (1942) incl. syn. ; HARA, Enum. Sperm. Jap. II : 229 (1952) ; OHWI, Fl. Jap. Eng. ed. 881 (1965) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 20 : 72 (1967). —— *Senecio stenocephalus* MAXIM. in Bull. Acad. Pétersb. 14 : 218 (1871) Type from Mt. Hakone in Honshu.

Distribution : southeast China, Taiwan and Japan excluding Hokkaido ; on moist slope of montane regions.

Ligularia kojimae KITAM. in Acta Phytotax. Geobot. 3 : 135 (1934), Comp. Jap. III : 191 (1942) Type : TAIWAN Prov. Shinchiku : inter Daihasen et Tsugitaka, *K. Kojima* (Holotype in KYO) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 20 : 63 (1967).

Endemic to Taiwan ; on high mountain.

Ligularia hodgsonii HOOK. f. in CURTIS Bot. Mag. tab. 5417 (1863) Type from Hakodate, Hokkaido ; KITAM. Comp. Jap. III : 197 (1942) incl. syn. ; HARA, Enum. Sperm. Jap. II : 228 (1952) ; POJARK. Fl. URSS, XXVI: 798 (1961) ; OHWI, Fl. Jap. Eng. ed. 881 (1965) ; KOYAMA in Acta Phytotax. Geobot. 22 : 75 (1966).

In her enumeration of 'The Compositae of China', SHIU-YING HU listed up *L. hodgsonii* and its varieties. The plant collected by FARGES from Prov. Szechuan, China is also deposited in the herbarium of the National Science Museum, and is identified as *L. hodgsonii* var. *crenifera*. This plant differs from *L. hodgsonii* in the inflorescence lacking the bracteoles on their heads. As to the occurrence of *L. hodgsonii* in China, therefore, further study is required.

Ligularia chekianensis KITAM. in Journ. Jap. Bot. 21 : 53 (1947) Type : CHINA Prov. Chekiang : Mt. Hsi-tien-mu-shan, *H. Migo 185* (Holotype in KYO) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 20 : 56 (1967).

The present species has a close affinity to *L. fischeri*, though the former differs from the latter in having discoid heads.

This species is known only from Chekiang Province, China.

Ligularia sibirica (L.) CASS. in Dict. Sci. Nat. 26 : 401 (1823) ; KITAM. Comp. Jap. III : 190 (1942) pro parte ; S.-Y. Hu in Quart. Journ. Taiwan Mus. 20 : 70 (1967). —— *Othonna sibirica* L. Sp. Pl. II : 924 (1753) Type from Siberia.

The present species has a vast geographical range in Eurasia and reaches as far west as France from eastern China. Because of the high variation of this species, several varieties have been proposed by the various authors. As to the discrimination of these varieties, further study is necessary, since the materials are not enough to set up a final classification.

Ligularia ovato-oblonga (KITAM.) KITAM. in Acta Phytotax. Geobot. 10 : 174 (1941) ; S.-Y. Hu in Ouart. Journ. Taiwan Mus. 20 : 67 (1967). —— *Senecillis ovato-oblonga* KITAM. in Acta Phytotax. Geobot. 8 : 88 (1939) Type : MANCHURIA Prov. Heilungchiang : inter Teremoto et Khingan, *J. Sato 2553* (Holotype in KYO).

MANCHURIA Prov. Heilungchiang : Hsing-an Bor., Sanga, *M. Tatewaki 2798* (Hb. Hokkaido Univ.) ; inter Teremoto et Khingan, *J. Sato 2553* (KYO). Prov. Chahar : Doron, *T. Ishidoya* (KYO).

MONGOLIA Hailar, *M. Kitagawa* (TI) ; ibidem, *unknown collector TNS 76637* (TNS) ; Suburbs of Talun, *K. Chujo* (TNS).

Ligularia fischeri (LEDEB.) TURCZ. Catal. Pl. Baic. Dahur. n. 644 (1837) ; KITAM. Comp. Jap. III : 193 (1942) incl. syn. ; HARA, Enum. Sperm. Jap. II : 227 (1952) ; POJARK. Fl. URSS, XXVI : 802 (1961) ; KOYAMA in Acta Phytotax. Geobot. 22: 75 (1966) ; S.-Y. Hu in Quart. Journ. Taiwan Mus. 20 : 58 (1967). —— *Cineraria fischeri* LEDEB. Index Sem. Hort. Dorap. 17 (1820)

Ligularia splendens (LÉV. et VANT.) NAKAI in Journ. Jap. Bot. 20 : 141 (1944). —— *Senecio splendens* LÉV. et VANT. in FEDDE Repert. Sp. Nov. VIII : 139 (1910).

The conception of this species is different according to the authors, as the variability of this species has not been revised appropriately. As noted in my paper, two forms as indicated by the cellular constitution of hairs may be referred to two infraspecific taxa, though further study is necessary, particulary as to the materials from the continental Asia.

Ligularia fischeri is distinguished from *L. sibirica* by several characters, though there are some intermediate forms in every characters. The length of florets and pappi is considered as most important characters to classify them : *L. fischeri* is characterized by having the florets being longer than the pappi and *L. sibirica* by having the florets being equal to the pappi. By this indicator, the materials from Himalayas are identified with *L. fischeri*, though most botanists have referred them to *L. sibirica*.

Ligularia kaialpina KITAM. in Acta Phytotax. Geobot. 3 : 170 (1934), Comp. Jap. III : 198 (1942) Type : HONSHU Pref. Yamanashi : Mt. Jizo, Sainokawara, *S. Kitamura* (Holotype in KYO) ; HARA, Enum. Sperm. Jap. II : 229 (1952) ; KOYAMA in Acta Phytotax. Geobot. 22 : 75 (1966).

Ligularia sibirica var. *kaialpina* (KITAM.) OHWI, Fl. Jap. Eng. ed. 881 (1965).

Endemic to central Honshu ; on wet grassy slope in high mountain.

The present species is characterized by having corymbose inflorescence, though there are various inflorescences from corymbose to panicle. The species belonging to Series *Corymbosae*, the flowering is of centrifugal type. In the present species, however, the flowering is of centripetal type. In addition, the present species was considered by KITAMURA as an alpine race of *L. fischeri.* since the characters of this species are almost equal to those of *L. fischeri.* Thus, *L. kaialpina* may be best regarded as a member of Series *Ligularia.*

The following Chinese species may be referred to this Series.

Ligularia kansuensis HAND.-MZT. in ENGLER Bot. Jahr. 69: 134 (1938) Type from SW-Kansu.

Ligularia lidjiangensis HAND.-MZT. in ENGLER Bot. Jahr. 69 : 134 (1938) Type from NW-Yunnan.

Ligularia melanothyrsa HAND.-MZT. in ENGLER Bot. Jahr. 69 : 119 (1968) Type from SW-Szechuan.

Ligularia subnudicaulis HAND.-MZT. in ENGLER Bot. Jahr. 69 : 131 (July 1938) Type from NW-Yunnan.

Sect. **Cyathocephalum** (NAKAI) KITAM. Comp. Jap. III : 185 (1942). —— *Cyathocephalum* NAKAI in Bot. Mag. Tokyo, 29 : 11 (1915).

Key to the Species

A. Inflorescence apparently corymbose, pappus absent. ..... **L. biceps.**
A. Inflorescence racemose, pappus present. ..... B.
B. Inflorescence long, about 30 cm, with many heads. ..... **L. angusta.**
B. Inflorescence short, about 2 - 4 cm, with a few heads. ..... **L. schmidtii.**

Ligularia biceps KITAGAWA in Journ. Jap. Bot. 17 : 239 (1941) Type : MANCHURIA Prov. Feng-Tien : Ma-tien-ling, *S. Ito* (Holotype in TI) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 20 : 55 (1967).

The present species is known only from the type locality. In having achenes without pappus and the corymbose inflorescence, the present is unique, though it may sufficiently be included in this section.

Ligularia angusta (NAKAI) KITAM. in Acta Phytotax. Geobot. 9 : 117 (1940), Comp. Jap. III : 185 (1942) ; HARA, Enum. Sperm. Jap. II : 226 (1952) ; OHWI, Fl. Jap. Eng. ed. 887 (1965). —— *Cyathocephalum angustum* NAKAI in Bot. Mag. Tokyo, 29 : 12 (1915) Type from Honshu.

Endemic to Honshu, restricted to central Honshu.

Ligularia schmidtii (MAXIM.) MAKINO in Bot. Mag. Tokyo, 17 : 191 (1903) excl. specim. ; KITAM. Comp. Jap. III : 186 (1942) incl. syn. ; POJARK. Fl. URSS, XXVI : 850 (1961) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 20 : 70 (1967). —— *Senecillis schmidtii* MAXIM. in Bull. Acad. Sci. Pétersb. 16 : 222 (1871) Type from Manchuria.

Distribution : Manchuria, Primorskaya and Korea.

Sect. **Senecillis** KITAM. Comp. Jap. III : 187 (1942).

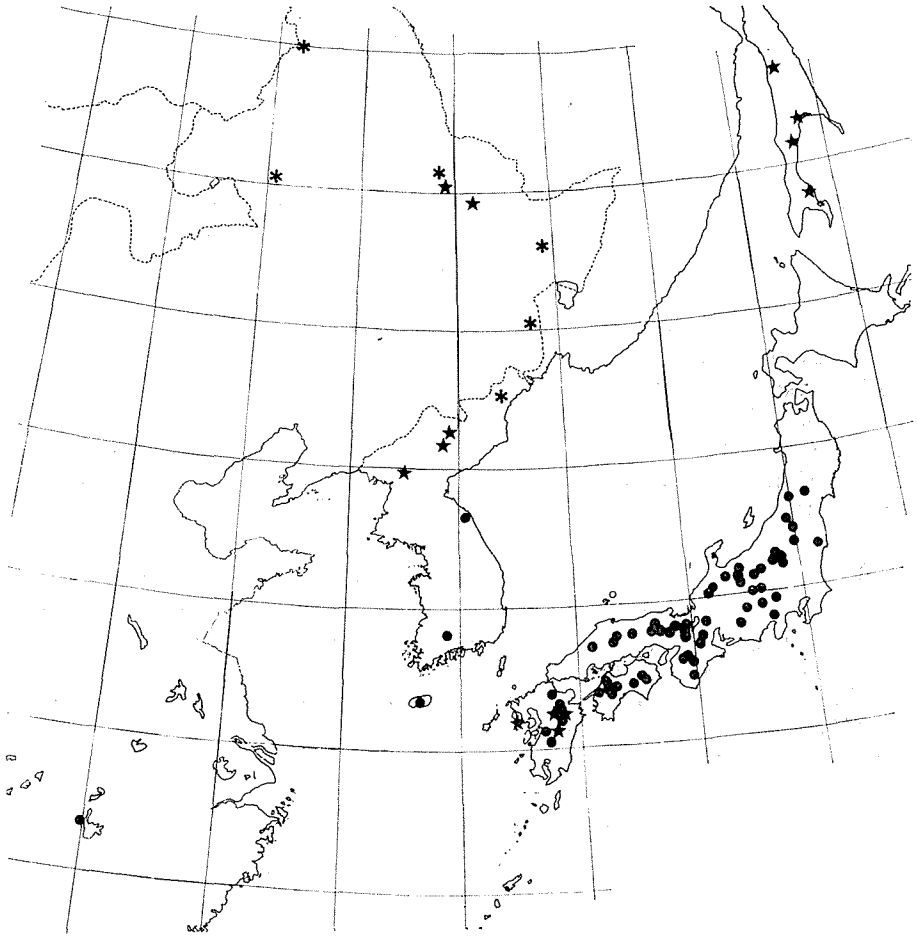

Fig. 4. Ranges of *Ligularia sibirica* (*) and *L. fischeri*: ★ is characterized by early flowering, occuring in dry place, and having hirsute hairs on the leaf beneath and the hairs on the scape with a few rows of cells; ● by late flowering, occuring in moist place, and having the arachnoid hairs on the leaf beneath and the hairs on the scape with one row of cells.

Sect. *Senecillis* (GAERT.) POJARK. Fl. URSS, XXVI : 836 (1961) pro parte, non KITAM. (1942).

About ten species are known from our area, but most of them have not yet been actually examined by the present writer.

A. Heads cernuous after blooming ; pappus 3 mm, disk floret 6 mm in length. ..... **L. fauriae.**

A. Heads erect after blooming ; pappus 7 mm, disk floret 12 mm in length. ..... **L. mongolica.**

Ligularia fauriae (FRANCH.) KOIDZ. Fl. Symbol. Or.-Asia. 47 (1930) ; KITAM. Comp. Jap. III : 187 (1942) incl. syn. ; HARA, Enum. Sperm. Jap. II : 227 (1952) incl. syn. : OHWI, Fl. Jap. Eng. ed. 887 (1965). —— *Senecio fauriei* FRANCH. in Bull. Soc. Philom. Paris, Ser. 7, 12 : 87 (1888) Type from Oginohama, Honshu, Japan.

Endemic to Honshu ; on grassy slope near seaside of northern Honshu.

Ligularia mongolica DC. Prod. VI : 315 (1837) Type from Mongolica ; POJARK. Fl. URSS, XXVI : 849 (1961) incl. syn. ; S.-Y. HU in Quart. Journ. Taiwan Mus. 20 : 66 (1967). ——*Senecio mongolicus* (DC.) SCH.-BIP. in Flora, 28 ; 50 (1845). —— *Senecillis mongolica* (DC.) KITAM. in Acta Phytotax. Geobot. 8 : 85 (1939).

MONGOLIA Inshan Ra. *K. Chou 5428* (KYO) ; Chakbar, *M. Togashi 2703* (KYO) ; Fushechuang, *T. Kanasiro 3887* (KYO) ; Chalentum, *J. Sato* (KYO ; TI; TNS) ; Palimu, *M. Tatewaki 29651* (Hb. Hokkaido Univ.) ; Halasu, *M. Tatewaki 28149* (Hb. Hokkaido Univ.). MANCHURIA Prov. Heilungchiang : Sunwu, *M. Kitagawa* (TI) ; Siaoking-an Ra, *M. Kitagawa* (TI) ; Siao-Khingan, *S. Nakao* (KYO) ; Anta, *T. Uchikawa* (TNS). Prov. Chilin : Wanfu, *M. Tatewaki 27489, 27577, 28893, 28985* (Hb. Hokkaido Univ.).

Ligularia taquetii differs from this species in having shorter involucres, though the other diagnostic characters of *L. taquetii* are almost the same with those of the present species. The difference of involucral length between those two species, however, seems to the present writer to have value only at the infraspecific level. Thus, *L. taquetii* may better be treated as a variety of the present species

Var. **taquetii** (LÉV. et VANT.) H. KOYAMA stat. nov. —— *Senecio taquetii* LÉV. et VANT. in FEDDE Repert. 8 : 139 (1910) Type: KOREA Quelpaert : in Rang Kyangi, *E. Taquet 994* (Isotype in TI). —— *Ligularia taquetii* (LÉV. et VANT.) NAKAI, Rep. Veg. Isl. Quelpaert, 90 (1914) ; KITAM. Comp. Jap. III : 188 (1942).

Endemic to Quelpaert Island.

The following Chinese species are referable to this section.

Ligularia brassicoides HAND.-MZT. in ENGLER Bot. Jahr. 69 : 118 (1939) Type from Prov. SW-Szechuan.

Ligularia muliensis HAND.-MZT. in ENGLER Bot. Jahr. 69 : 117 (1939) Type from Prov. SW-Szechuan.

Ligularia platyphylla HAND.-MZT. in ENGLER Bot. Jahr. 69 ; 119 (1939) Type from Prov. SW-Szechuan.

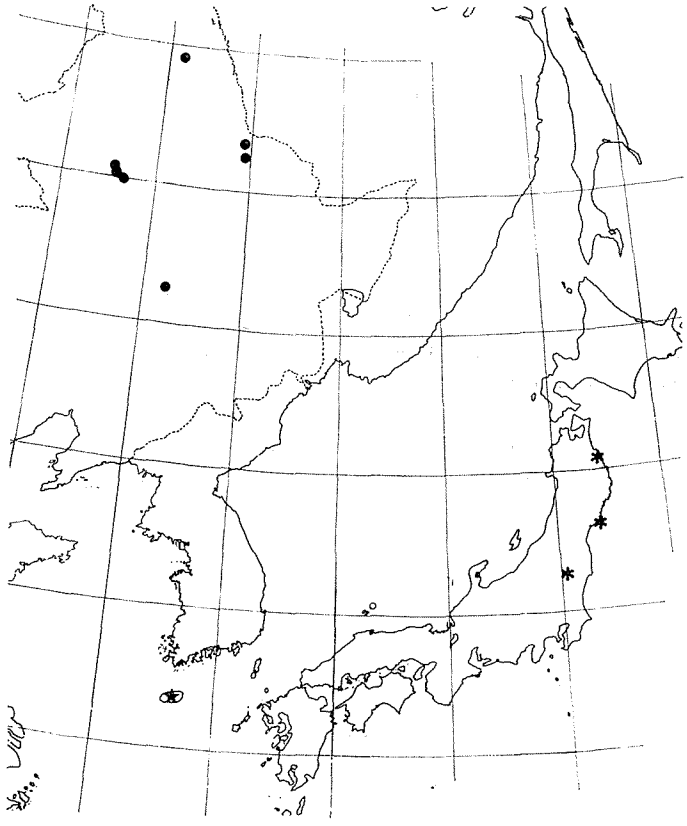

Fig. 5. Rages of *Ligularia mongolica*: var. *mongolica* (●) and var. *taquetii* (★), and *L. fauriae* (*).

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SOKOLOVSKAJA, A. & O. STRELKOVA, 1938. in Chromosome atlas of flowering plants edited by DARLINGTON & WYLIE (1955).

Genus **Cremanthodium**

Cremanthodium is a genus described by BENTHAM based on the Himalayan plants and differs from the allied genus *Ligularia* in having large, solitary and cernuous heads. The character of *Cremanthodium* is, however, fairly variable among the members of this genus. The circumscription of this genus, therefore, has been given in various ways by the investigators. In his revision of the genus *Cremanthodium*, GOOD has arrived at the conclusion that the high alpine derivatives of *Ligularia* in Asia shall remain grouped together in the phylogenetic and ecological genus *Cremanthodium*, and enumerates 48 species. After that time, several taxonomists have described new species from the Himalayas and southern China. Perhaps 60 species are known at present.

In the Flora of British India, BENTHAM referred two Indian species to American genus *Werneria*. These two were considered by GOOD as ecological forms of *Cremanthodium*, though BENTHAM noted that they might be characterized by the erect heads without outer basal bracts, and the involucral scales connated into a cup.

Most of *Cremanthodia* are well characterized by the solitary and cernuous head. In addition, it is noted by GOOD that the habits and geographic distribution of *Cremanthodium* are unique. Thus, *Cremanthodium* may better be considered as a separate genus.

As already noted in the General Part of this studies, *Cremanthodium* is restricted to central Asia and does not distribute in Japan. In order to study the relationships among the members of this genus, an attempt is made here as to the classification of intergeneric groups, though GOOD did not give any intergeneric categories in the present genus. In order to facilitate comparison between the species, the eight important features of the plants were given by GOOD. Some of them were considered as important specific characters and a few of them as being constant in form throughout the genus. According to his notes, the form of radical leaves, however, seems to be useful to subdivide the present genus. Three intergeneric groups may be arranged by the venation of the leaves in addition to the form of them. Further studies are necessary to fix the taxonomic ranks for these groups, since both the chromosomal accounts and new materials are too scanty at hand.

Cremanthodium BENTH. in HOOK. Icon. Pl. XXII : 37 (1873) Type : *C. reniforme*; BENTH. et HOOK. f. Gen. Pl. II : 439 (1873) ; HOFFM. in ENGLER u. PRANTL Pfl.-fam. IV-5 : 301 (1892) ; GOOD in Journ. Linn. Soc. Bot. 48 : 259

(1929) ; S.-Y. Hu in Quart. Journ. Taiwan Mus. 19 : 205 (1966).

Perennial scapigerous herbs. Leaves chiefly radical, cordate or reniform, lanceolate, or palmate or rarely pinnatifid, entire or toothed. Heads solitary, sometimes a few or rarely many, always cernuous, heterogamous, radiate. Ray florets 1-seriate, female, ligulate, large, yellow or pale-pink. Disk florets hermaphrodite, fertile, tubular, 5-lobed at apex. Anther bases subentire. Cells of the upper part of filament same in size. Style branches short or long, flattened, obtuse or acute. Achenes with white or reddish, slender, rough or barbellate pappus, glabrous.

Key to the Groups

A. Leaves with long petioles, reniform, cordate, with triple-ribbed or palmate venation. ..... **Group I.**
A. Leaves with short or no petioles. ..... B.
B. Leaves ovate or lanceolate, with pinnate venation. ..... **Group II.**
B. Leaves linear, with apparently parallel venation. ..... **Group III.**

Group I.

This group is characterized by having the reniform or cordate leaves with long petioles. Most of the leaves have the triple-ribbed venation and a few of them palmate one. This shape is not different from that of *Ligularia* Sect. *Ligularia*. Many species of this group is well associated with the single cernuous head. There occur, however, the plants with the inflorescences consisting of many heads among the species of this group. The difference between the plants with many heads and *Ligularia* Sect. *Ligularia*, therefore, is very difficult.

The following species may be considered as members of this group.

A. Leaves palmately lobed. ..... **C. palmatum.**
A. Leaves reniform-cordate. ..... B.
B. Heads discoid, involucral scales petaloid. ..... **C. campanulatum.**
B. Heads radiate, involucral scales not petaloid. ..... C.
C. Leaves densely tomentose beneath. ..... **C. decaisnei.**
C. Leaves glabrous or subglabrous beneath. ..... D.
D. Tube of ligules obsolete, heads large. ..... **C. reniforme.**
D. Tube of ligules present. ..... E.
E. Involucral scales brown, glandular, pubescent ; heads usually corymbose. ..... **C. cremanthodioides.**
E. Involucral scales glabrous or subglabrous ; heads not corymbose. ..... F.
F. Heads small, solitary or racemose, campanulate. ..... **C. hookeri.**
F. Heads medium to large, hemispherical, never in a close racemose. ..... G.
G. Radical leaves small, up to 4 cm in across. ..... **C. thomsoni.**
G. Radical leaves very large, more than 7 cm in across. ..... **C. retusum.**

Cremanthodium campanulatum (FRANCH.) DIELS in Notes Roy. Bot. Gard. Edin. 5 : 190 (1912) ; GOOD in Journ. Linn. Soc. Bot. 48 : 270 (1929) incl. syn. ; HAND.-MZT. Symb. Sin. VII : 1141 (1936) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 206 (1966). —— *Senecio campanulatus* FRANCH. in Bull. Soc. Bot. France, 39 : 284 (1892) Type from Prov. Yunnan.

CHINA Prov. Yunnan: *E. H. Wilson 3812* (TNS).

Cremanthodium cremanthodioides (HAND.-MZT.) GOOD in Journ. Linn. Soc. Bot. 48 : 279 (1929) ; HAND.-MZT. Symb. Sin. VII : 1142 (1936) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 207 (1966). —— *Ligularia cremanthodioides* HAND.-MZT. in Anz. Akad. Wiss. Wien, Math.-Nat. 62: 13 (1925) Type from Prov. Yunnan.

SE-TIBET Budi Tsepo La, Kongbo, *F. Ludlow, G. Sherriff & H. H. Elliot 14411* (TNS).

Distribution : Yunnan, Sikkim and Tibet.

Cremanthodium decaisnei CLARKE, Comp. Ind. 168 (1876) Type from Sikkim ; GOOD in Journ. Linn. Soc. Bot. 48 : 275 (1929) ; HAND.-MZT. in Act. Hort. Gothob. 12 : 304 (1938) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 207 (1966).

CHINA Prov. Sikang : Tapaoshan, Kangting distr., *H. Smith 11471* (KYO). TIBET Budi Tsepo La, Kongbo, *F. Ludlow, G. Sherriff & H. H. Elliot 14412* (TNS). BHUTAN Sincle La, *S. Nakao 233* (KYO). NEPAL Thaple Himal, *S. Nakao* (KYO ; TNS) ; Near Sangda, *K. Nishioka 104* (KYO) ; Tamur valley, Yangma Khola, *J. D. A. Stainton 1104* (TNS).

Distribution : southern China, Tibet, Bhutan and Nepal.

Cremanthodium hookeri CIARKE, Comp. Ind. 169 (1876) Type from Sikkim ; GOOD in Journ. Linn. Soc. Bot. 48 : 279 (1929) ; LING in Contr. Inst. Bot. Nat. Acad. Peiping, 2: 526 (1934) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 209 (1966).

CHINA Prov. Sikang : Gomba La, Kangting distr., *H. Smith 10710*-var. *atkinsoni* (KYO). Prov. NW-Yunnan : Mt. Shang-Ma-Kou, *J. F. Rock 17159* (TI). BHUTAN Tongu to Camp n. 11, *S. Nakao 702* (KYO) ; Rudo La, *F. Ludlow, G. Sherriff & J. H. Hicks 20979* (TNS) ; Rinchen Chu, *F. Ludlow, G. Sherriff & J. H. Hicks 17085* (TNS). E-NEPAL Tamur valley, Mewa Khola, Topke Gola, *J. D. A. Stainton 971* (TNS) ; Mouma to Tip top La, *K. Nishioka 699, 707, 737* (KYO).

The present species is hardly distinguished from *L. sibirica*, when the plants have racemose inflorescences.

Distribution : western China, Tibet, Nepal and Bhutan.

Cremanthodium palmatum BENTH. in HOOK. Icon. Pl. 17 : t. 1142 (1887) Type from Sikkim ; GOOD in Journ. Linn. Soc. Bot. 48 : 271 (1929) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 212 (1966).

S-TIBET Chosam, Tsari, *F. Ludlow & G. Sherriff 2040*-ssp. *rhodocephalum* (TNS). BHUTAN Ha La to Kyu La, *S. Nakao 727, 919* (KYO).

Distribution : southern China, Tibet, Bhutan and upper Burma.

Cremanthodium reniforme BENTH. in HOOK. Icon. Pl. 12 : 37, t. 1141 (1876) Type from Sikkim ; HAND.-MZT. Symb. Sin. VII : 1142 (1936) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 216 (1966).

BHUTAN Tanga to Parshong, *S. Nakao 648* (KYO). E-NEPAL near Mouma, *K Nishioka 745, 772* (KYO) ; near Deoma, *K. Nishioka 1043* (KYO) ; Arun valley, Wabak Khola, *J. D. A. Stainton 1343* (TNS) ; Mouma to Wallum Chun Gola, *K. Nishioka 1265* (KYO) ; Tangba, *L. Dhwoj 0213* (TNS).

Chromosome number : 2n= 58 (KOYAMA 1966).

Distribution : Bhutan, Sikkim and Nepal.

Cremanthodium retusum (DC.) GOOD in Journ. Linn. Soc. Bot. 48 : 278 (1929) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19: 216 (1966). —— *Ligularia retusa* DC. Prod. VI : 314 (1838) Type from Nepal —— *Senecio retusus* WALL. ex HOOK. f. Fl. Brit. Ind. III: 350 (1881) —— *Ligularia nigropilosa* KITAM. in Acta Phytotax. Geobot. 15 : 107 (1954), in KIHARA Fau. Fl. Nepal Himal. I: 265, fig. 76 (1955) syn. sec. KITAMURA.

E-NEPAL Tamur valley, Mewa Khola, Topke Gola, *J. D. A. Stainton 918* (TNS) ; Tolo Gompa Khola, 4000 m, S. Nakao (KYO).

Distribution: Tibet, Nepal, Sikkim, Assam and Yunnan.

Cremanthodium thomsoni CLARKE, Comp. Ind. 169 (1876) Type from Sikkim; GOOD in Journ. Linn. Soc. Bot. 48 : 273 (1929) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 217 (1966).

BHUTAN Chiley La, *S. Nakao 600* (KYO) ; Tanga to Parshong, *S. Nakao 648 bis* (KYO). NEPAL Tolo Gompa Khola, *S. Nakao* (KYO ; TNS). CHINA Prov. Kansu Cool ledges, high alpine limestone, *Farrer & Purdom* 212 (KYO).

Distribution : Tibet, Nepal, Sikkim, Bhutan and China.

Considering the original description of each species, the following species may be referred to the present group, thoguh none of the specimens of these species have been actually examined by the present writer.

Cremanthodium acernnum GOOD in Journ. Linn. Soc. Bot. 48 : 284 (1929) Type from Burma.

Cremanthodium atrocapitatum GOOD in Journ. Linn. Soc. Bot. 48 : 282 (1929) Type from Burma.

Cremanthodium bulbilliferum W. W. SMITH in Notes Roy. Bot. Gard. Edin. 12 : 200 (1920) Type from Tibet.

Cremanthodium calcicola W. W. SMITH in Notes Roy. Bot. Gard. Edin. 21 : 201 (1920) Type from Yunnan.

Cremanthodium citriflorum GOOD in Journ. Linn. Soc. Bot. 48 : 277 (1929) Type from Burma.

Cremanthodium farreri W. W. SMITH in Notes Roy. Bot. Gard. Edin. 21 : 202 (1920) Type from Burma.

Cremanthodium gracillimum W. W. SMITH in Notes Roy. Bot. Gard. Edin, 10 : 27 (1917) Type from Burma.

Cremanthodium microcephalum HAND.-MZT. in Anz. Akad. Wiss. Wien, Math.-Nat. 57: 174 (1920) Type from Yunnan.

Cremanthodium phaenicochaetum (FRANCH.) GOOD in Journ. Linn. Soc. Bot. 48 :279 (1929). —— *Senecio phaenicochaetus* FRANCH. in Bull. Soc. Bot. Fr. 39 : 295 (1892) Type from Yunnan.

Cremanthodium pulchrum GOOD in Journ. Linn. Scc. Bot. 48 : 274 (1929) Type from Burma.

Cremanthodium smithianum HAND.-MZT. in Anz. Akad. Wiss. Wien, Math.-Nat. 62 : 14 (1925) Type from Yunnan.

Cremanthodium wardii W. W. SMITH in Notes Roy. Bot. Gard. Edin. 10: 27 (1917) Type from Burma.

Group II.

This group is characterized by having hastate, ovate or lanceolate leaves of which the venation is essentially pinnate. Hastate leaves are wingless and long petioled, while most of ovate or lanceolate leaves are gradually narrowed to the base and usually sessile. In addition, the hastate leaves tend to have triple-ribbed veins. Thus, the species with hastate leaves may be considered as being intermediate between Group I and Group II.

The following species may be referred to the present group, though further study is necessary to clarify the circumscription on this group.

A. Leaves pinnately lobed. ..... **C. pinnatifidum.**
A. Leaves ovate, elliptic or lanceolate. ..... B.
B. Leaves subcordate, truncate or nearly so at the base. ..... C.
B. Leaves gradually narrowed into petioles. ..... J.
C. Leaves regularly and acutely dentate. ..... D.
C. Leaves entire or shallowly dentate. ..... F.
D. Cauline leaves not touching or overlapping each other. ..... **C. nakaoi.**
D. Cauline leaves touching or overlapping each other. ..... E.
E. Involucral scales araneose below. ..... **C. oblongatum.**
E. Involucral scales densely black-villose. ..... **C. purpureifolium.**
F. Leaves very small ; ligules very narrow, strap-shaped. ..... **C. potanini.**
F. Leaves medium size ; ligules lanceolate, long tapering. ..... G.
G. Involucral scales quite glabrous. ..... **C. pseudo-oblongatum.**
G. Involucral scales not glabrous. ..... H.
H. Involucral scales white-arachnoid. ..... **C. prattii.**
H. Involucral scales black-villose. ..... I.
I. Heads radiate. ..... **C. nepalense.**
I. Heads discoid. ..... **C. discoideum.**
J. Heads erect, a very dwarf herb. ..... **C. nanum.**
J. Heads cernuous. ..... K.
K. Leaves subglabrous or glabrous beneath. ..... **C. plantagineum.**
K. Leaves densely white-arachnoid beneath. ..... **C. humile.**

The species are alphabetically arranged.

Cremanthodium discoideum MAXIM. in Mél. Biol. 11 : 238 (1881) Type from Kansu ; GOOD in Journ. Linn. Soc. Bot. 48 : 297 (1929) ; HAND.-MZT. in Act. Hort. Gothob. 12 : 307 (1938) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 208 (1966).

CHINA Prov. Sikang : Taining, Zungkong La, *H. Smith 11927* (KYO).

Distribution : Sikkim and southwest China.

Cremanthodium humile MAXIM. in Mél. Biol. 11 : 236 (1881) Type from Kansu ; GOOD in Journ. Linn. Soc. Bot. 48 : 299 (1929) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 210 (1966).

CHINA Prov. Sikang : Tapaoshan, Kangting distr., *H. Smith 11275* (KYO). TIBET Ata Kang La, Nagong, *F. Kingdon-Ward 10581* (TNS).

Distribution : Tibet and southwestern China.

Cremanthodium nakaoi KITAM. in Acta Phytotax. Geobot. 15 : 105 (1954) Type : NEPAL Tolo Gompa Khola, *S. Nakao* (Holotype in KYO and Isotype in TNS).

Endemic to Nepal.

Cremanthodium nanum (DECNE.) W. W. SMITH in Notes Bot. Gard. Edinb. 14 : 118 (1924) ; GOOD in Journ. Linn. Soc. Bot. 48 : 300 (1929) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 211 (1966). —— *Ligularia nana* DECNE. in JACQ. Voy. Bot. 41, t. 99 (1844) Type from NW-Yunnan.

NEPAL Thaple pass, *S. Nakao* (KYO ; TNS).

Distribution : Tibet, Nepal, Sikkim and southern China.

The involucral bracts of this species connate below to form a cup. In the Flora of British India, the present species was referred to Andean genus *Werneria*. In his revision of *Cremanthodium*, GOOD considered the present species as an ecological form of *Cremanthodium* and excluded it from *Werneria*.

Cremanthodium nepalense KITAM. in Acta Phytotax. Geobot. 15 : 105 (1954) Type : NEPAL, Tsumje, Bangu Khola, *S. Nakao* (Holotype in KYO).

Endemic to Nepal.

Cremanthodium oblongatum CLARKE, Comp. Ind. 168 (1876) Type from Kunawur ; GOOD in Journ. Linn. Soc. Bot. 48 : 287 (1929) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 212 (1966).

E-NEPAL Mouma, *K. Nishioka 773* (KYO).

Distribution : Tibet, Nepal, Sikkima and western China.

Cremanthodium pinnatifidum BENTH. in HOOK. Icon. Pl. 17: t. 1142 (1887) Type from Sikkim ; GOOD in Journ. Linn. Soc. Bot. 48 : 296 (1929) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 213 (1966).

BHUTAN Ha La —— Kyu La, *S. Nakao 805* (KYO). E-NEPAL Arun-Tamur Water shed, South of Topke Gola, *J. D. A. Stainton 847* (TNS).

Distribution : southeastern Tibet, Nepal, Sikkim and Bhutan.

Cremanthodium plantagineum MAXIM. in Bull. Acad. Pétersb. 27 : 481 (1882) Type from Kansu ; GOOD in Journ. Linn. Soc. Bot. 23 : 447 (1888), l. c. 48 : 293 (1929) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 213 (1966).

CHINA Prov. Sikang : Taining —— Maoniu, Lhaja Gabu La, *H. Smith 12554* - f. *ellisii* (KYO). SE-TIBET Nam La, Kongbo, *F. Ludlow, G. Sherriff & H. H. Elliot 14477, 15395* (TNS) ; Chachima, Lotu Chu, Kongbo, *F. Ludlow, G. Sherriff & H. H. Elliot 15757* (TNS) ; Puchu Mira La, *F. Ludlow, G. Sherriff & G. Taylor 6155* (TNS) ; Tsangpo valley, Go Nyi Re, *F. Ludlow, G. Sherriff & G. Taylor 5992* (TNS). S-TIBET Migytun, Tsari, *F. Ludlow & G. Sherriff 2530* (TNS). BHUTAN Kangla Karchu La, *F. Ludlow, G. Sherriff & J. H. Hicks 17331* (TNS). NEPAL *L. Dwoj 241* (TNS).

Werneria ellisii was considered by GOOD as an ecological form of the present species.

Distribution : southwest China, Tibet and Nepal.

Cremanthodium potanini C. WINKL. in Act. Hort. Petrop. 14 : 150 (1895) Type from Kansu ; GOOD in Journ. Linn. Soc. Bot. 48 : 285 (1929) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 215 (1966).

CHINA Prov. Sikang : Tapaoshan, Kangting distr., *H. Smith 11457* (KYO).

Distribution : western China.

Cremanthodium prattii (HEMSL.) GOOD in Journ. Linn. Soc. Bot. 48 : 285 (1929) ; HAND.-MZT. in Act. Hort. Gothob. 12 : 316 (1938) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 215 (1966). —— *Senecio prattii* HEMSL. in HOOK. Icon. Pl. 25 : t. 2491 (1896) Type from SW-Szechuan.

CHINA Prov. Sikang : Kangting distr., *H. Smith 11058, 11222* (KYO).

Distribution : western China.

Cremanthodium pseudo-oblongatum GOOD in Journ. Linn. Soc. Bot. 48 : 297 (1929) Type from Tibet; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 216 (1966).

SE-TIBET Rong Chu, Tumbatse, *F. Ludlow, G. Sherriff & G. Taylor 5101* (TNS) ; Nambu La, Kongbo, *F. Ludlow, G. Sherriff & H. H. Elliot 15475* (TNS).

Distribution: Tibet and Sikkim.

Cremanthodium purpureifoium KITAM. in Acta Phytotax. Geobot. 15 : 106 (1954) Type : NEPAL Thaple Himalaya : Shiar Khola, *S. Nakao* (Holotype in KYO and Isotype in TNS).

NEPAL Shiar, *S. Nakao* (TNS; KYO) ; near Sangda. *K. Nishioka 567, 568* (KYO).

Endemic to Nepal.

The following species may be arranged as members of the present group, though further study is necessary to clarify the discrimination of each species.

Cremanthodium angustifolium W. W. SMITH in Notes Roy. Bot. Gard. Edin. 12 : 200 (1920) Type from Yunnan.

Cremanthodium arnicoides WALL. ex R. GOOD in Journ. Linn. Soc. Bot. 48 : 288 (1929) Type from S-Tibet.

Cremanthodium atroviolaceum (FRANCH.) R. GOOD in Journ. Linn. Soc. Bot. 48 : 286 (1929). —— *Senecio atroviolaceus* FRANCH. in Bull. Soc. Bot. Fr. 39 : 303 (1892) Type from Yunnan.

Cremanthodium bupleurifolium W. W. SMITH in Notes Roy. Bot. Gard. Edin. 8 : 112 (1913) Type from Yunnan.

Cremanthodium cyclaminanthum HAND.-MZT. in Anz. Akad. Wiss. Wien, Math.-Nat. 62 : 14 (1925) Type from Szechuan.

Cremanthodium delavayi (FRANCH.) DIELS ex LÉV. Cat. Pl. Yunnan, 43 (1915). —— *Senecio delavayi* FRANCH. in Bull. Soc. Bot. Fr. 39 : 286 (1892) Type from Yunnan.

Cremanthodium forrestii J. F. JEFF. in Notes Roy. Bot. Gard. Edin. 5 : 191 (1912) Type from Yunnan.

Cremanthodium gypsophilum R. GOOD in Journ. Linn. Soc. Bot. 48 : 283 (1929) Type from Yunnan.

Cremanthodium helianthum (FRANCH.) W. W. SMITH in Notes Roy. Bot. Gard. Edin. 14 : 289 (1924). —— *Senecio helianthus* FRANCH. in Bull. Soc. Bot. Fr. 39 : 286 (1892) Type from Yunnan.

Cremanthodium nobile (FRANCH.) DIELS ex LÉV. Cat. Pl. Yunnan, 43 (1915). —— *Senecio nobilis* FRANCH. in Bull. Soc. Bot. Fr. 39: 287 (1892) Type from Yunnan.

Cremanthodium plantaginifolium (FRANCH.) R. GOOD in Journ. Linn. Soc. Bot. 48 : 291 (1929). —— *Senecio plantaginifolius* FRANCH. in Bull. Soc. Philom. de Paris, ser. 8: 145 (1891) Type from Szechuan.

Cremanthodium principis (FRANCH.) R. GOOD in Journ. Linn. Soc. Bot. 48 : 283 (1929) Type from Yunnan.

Cremanthodium rumicifolium (J. R. DRUMM.) R. GOOD in Journ. Linn. Soc. Bot. 48 : 289 (1929). —— *Senecio rumicifolius* J. R. DRUMM. in Kew Bull. 1911 : 371 (1911) Type from S-Tibet.

Cremanthodium sino-oblongatum R. GOOD in Journ. Linn. Soc. Bot. 48 : 288 (1929) Type from Yunnan.

Cremanthodium stenactium DIELS ex LIMPRICHT in FEDDE Repert. Beih. 12 : 510 (1922) Type from Szechuan.

Cremanthodium suave W. W. SMITH in Notes Roy. Bot. Gard. Edin. 12: 203 (1920) Type from Szechuan.

Cremanthodium variifolium R. GOOD in Journ. Linn. Soc. Bot. 48 : 298 (1929) Type from Yunnan.

Group III.

Following two species are characterized by having linear or sublate leaves of which the venation is, at sight, parallel and racemose inflorescences. The present group, therefore, may be considered as one of the phylogenetic groups in *Cremanthodium*.

A. Leaves very narrow linear, acute, rather broader towards the tip. .... **C. lineare.**

A. Leaves linear elliptic, oblanceolate to broad lanceolate. .... **C. pleurocaule.**

Cremanthodium lineare MAXIM. in Mél. Biol. 11 : 238 (1881) Type from

Kansu ; GOOD in Journ. Linn. Soc. Bot. 48 : 291 (1929) ; HAND.-MZT. in Act. Hort. Gothob. 12 : 306 (1938) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 211 (1966).

CHINA Prov. Sikang : Taining to Taofu, Sunglingku, *H. Smith 12037, 12032* -var. *roseum* (KYO) ; Chungo valley, Hsintientzu, Kangting distr., *H. Smith 11502* (KYO).

Distribution : western China.

Cremanthodium pleurocaule (FRANCH.) GOOD in Journ. Linn. Soc. Bot. 48 : 290 (1929) ; HAND.-MZT. Symb. Sin. VII : 1144 (1936) ; S.-Y. HU in Quart. Journ. Taiwan Mus. 19 : 215 (1966). —— *Senecio pleurocaulis* FRANCH. in Journ. de Bot. 8 : 365 (1894) Type from SW-Szechuan.

CHINA Prov. Sikang : Haitzeshan, Taofu distr., *H. Smith 11358* (KYO). Prov. Yunnan : *G. Forrest 20676*-f. *uberrima* (KYO). TIBET Ta-Tsien-Lou, *J. A. Soulie 558* (TNS).

Distribution : Tibet and southwest China.

References of Chromosome numbers

KOYAMA, H. 1966. Chromosome numbers in some species of Compositae. *Acta Phytotax. Geobot.* 22 : 80.

(to be continued)

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