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A Revision of Ryukyu Rutaceae-Aurantioideae¹⁾
Revisio Aurantiacearum X

By

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The Asiatic continent is inhabited with 22 genera of RUTACEAE-AURANTIOIDEAE of which Sino-Japanese members are limited to only 11 genera, namely, *Micromelum*, *Clausena*, *Glycosmis*, *Murraya*, *Luvunga*, *Paramignya*, *Atalantia*, *Severinia*, *Citrus*, *Fortunella*, and *Poncirus*. *Micromelum* never goes east of Hainan, Tonkin and adjacent South China, whereas *Clausena* and *Severinia* reach into Formosa. *Clausena Lansium* Skeels, however, was once reported found in gardens of Rhykyu²⁾ but it apparently does not exist there now. Both *Luvunga* and *Paramignya* never extend further from Hainan-Tonkin region, and *Atalantia* was recorded only in Tonkin and Kwangtung. *Glycosmis* and *Murraya* remain within Ryukyu Archipelago and do not extend into Japan proper. Both *Fortunella* and *Poncirus* are native to interior China, but the former is represented by *F. polyandra* Tanaka in Swatow, Hainan and Peninsular Malaya. *Citrus* makes its gene centre in Eastern Himalaya³⁾ and only a limited group occurs wild in China and Japan territory. The only native *Citrus* species in Japan are *Citrus Tachibana* Tanaka and *Citrus Junos* Sieb. ex Tanaka, but the latter flourishes in Yangze region as far west as Indian frontier. The *Tachibana* has been reported from Amami Oshima and eastwards to Shizuoka Prefecture, reappearing in the central hill ranges of Formosa. A related species was reported by Hayata in Formosan lowlands which was named by him as *Citrus depressa*.⁴⁾ This was later identified by the author to be conspecific to the *Shiikwâshâ* of the Ryukyus and Amami Oshima. A number of *Citrus* occur in this region, as in other regions. Yuichirô Tanaka described *Citrus Oto* and *C.*

- 1) Contribution No. 4, from Tanaka Institute of Citriculture and Horticultural Science, College of Agriculture, the University of Osaka Prefecture, Sakai-shi, Osaka, Japan.
- 2) Go, Keishi: "Shitsumon Honzô" Appendix, fol. 8, 1788, in which a sterile branch was illustrated.
- 3) Tanaka, Tyôzaburô: On the centre of origin of the citrus fruits, in Stud. Citrolog. 4 (2) 175-205, 1931.
- 4) Hayata, Bunzô: Icones Plantarum Formosanarum, vol. 8, p. 16, 1919.

Tarogayo from the Ryukyus,⁵⁾ but several others came across by the author during a field trip from Dec. 17, 1956 to Jan. 19, 1957. From this incidence, it seemed to be advisable to complete the record of Citrus and Citrus relatives so far found in the Ryukyus, which will serve as a basis of future consideration as to the industrial development of citriculture of this territory.

Glycosmis citrifolia Lindl. *in* Trans. Hort. Soc. London, 6: 72, 1826: Tanaka *in* Ligan Sci. Journ. 7: 346, 1929; *in* Journ. Bot. 68: 56, 1830; *in* Med. Rijks Herb., Leiden, 69: 3, 1931: Swingle *in* Batchelor, Cit. Indus. 1: 157, 1943.

=*G. pentaphylla* auct. (*non Limonia pentaphylla* Retz.) Ito et Matsum. *in* Journ. Sci. Imp. Univ. Tokyo 12: 358, 1900: Sonohara, Tawada et Amano, Fl. Okinaw. 84, 1952: Takamine, Fl. Yaeyam. 55, 1952: Tawada *in* Test. Rept. Forest. Exp. Sta. 2: 66, 1954. (*Vide* Tanaka, *in* Bot. Not. 1928: 156.)

=*G. cochinchinensis* auct. (*non* Pierre) Sakaguchi, Gen. Ind. Fl. Okinaw. 50, 1924.

Nom. Jap.—Hanashinbôgi.

Hab.—Common throughout the Ryukyus.

Murraya paniculata Jack *in* Malay. Misc. 1: 31, 1820: Sonohara et al., l.c. 84, 1952: Takamine, l.c. 55, 1952: Tawada, l.c. 66, 1954: Walker, Imp. Tr. Ryukyu Isl. 147, 1954.

=*Chalcas paniculata* Linn. Mant. Pl. 68, 1767: Tanaka *in* Journ. Soc. Trop. Agric. (Taiwan) 1: 24, 1929; *in* Journ. Bot. 68: 229, 1930 (with note)

=*Murraya exotica* Linn. Mant. Alt. Pl. 563, 1774: Ito et Matsum. l.c. 359, 1900: Sakaguchi, l.c. 50, 1924.

Nom. Jap.—Gekkitsu.

Hab.—Common throughout the Ryukyus.

Poncirus trifoliata Rafin. Sylva Tell. 143, 1838: Swingle *in* Sargent, Pl. Wils. 2: 149, 1916: Sanohara et al. 84, 1952.

Nom. Jap.—Karatachi, Kikoku.

Hab.—Cultivated in Tôbaru Farm, Izumi, Motobu-cho.

Note.—*Citrus* spp. introduced from Japan proper is on its roots without exception. Its value as a rookstock plant in Ryukyus is doubtful, though it is believed to be most congenial to the Satsuma orange (*Citrus Unshiu* Marc.) and widely adapted in the Gulf States of the United States.

Citrus Medica Linn. Sp. Pl. 782, 1753: Tanaka, Sp. Prob. *in* Citrus, 113, 1954.

Nom. Jap.—Musan Ô-marubushukan.

Hab.—Ishigaki: Cultivated in Barabidô (Tomikawa's orchard); *in* Kaado (several homesteads); semi-wild *in* an abandoned orchard at Funazoko, north of Tomino.

5) Tanaka, Yuichirô: Iconograph of Japanese Citrus Fruits, vol. 2, 1946; *see* pp. 420, 422.

Note.—This is a large-fruited acidless citron, once called *Citrus Medica* Linn. subsp. *Madhkankur* Bonavia ex Engl., now believed unnecessary to separate it from the type species, the Turunj type of gigantic citron.⁶⁾ The origin is uncertain but Mr. Tomikawa remarked that it had come from South Sea region. The common small-fruited citron, called “Bushukan” or “Maru-bushukan” (quoted in Sonohara et al., Takamine, etc.), which was not encountered during the trip, belongs to *Citrus limonimedica* Lush., widely cultivated in China and Japan.

Citrus Limon Burm. f. Fl. Ind. 173, 1768: Tanaka in Bult. Sci. Kjušu Imp. Univ. 1: 59, 1925: Sonohara et al., l.c. 82, 1952: Takamine, l.c. 51, 1952: Walker, Imp. Tr. 137, 1954.

Nom. Jap. & Amer.—Lemon.

Hab.—Cultivated in Tôbaru Farm without variety name. Tree grew very poorly due to the lack of knowledge that the lemon requires a large amount of fertilizers and does not like wet soil and severe wind.

Note: The Kusaii Lime, *Citrus Limonia* Osbeck, seems to have been successfully introduced from Hawaii into Izumi Sub-station of Nago Agricultural Research & Demonstration Station.

Citrus grandis Osbeck Dagb. Ostind. Resa, 98, 1757: Tanaka in Hort. Stud. Okitsu, 33: 3, 1937: Swingle in Webber & Batchelor, Cit. Ind. 1: 417, 1943: Walker, l.c. 136, 1954.

=*C. maxima* Merr. Interpr. Rumph. Herb. Amb. 296, 1917: Sonohara et al., l.c. 82, 1952: Takamine, l.c. 51, 1952: Sonohara, Useful Tr. & Shrubs, 39, 1952.

=*C. Aurantium* Linn. subsp. *Decumana* Bonavia ex Engl. Nat. Pffam. 3 (4) 193, 1896: Ito et Matsum. l.c., 362, 1900.

Nom. Jap.—Zabon, Jabon, Buntan, Uchimurasaki. Nom. Amer.—Shaddock, Pummelo.

Hab.—Cultivated in Tôbaru Farm and Nago Agr. Res. & Dem. Station and elsewhere in Okinawa, and Tokuyama's shaddock farm at Funazoko, near Onoda, Ishigaki city.

Note: No fruit was seen in Okinawa, where Matô-Peiyu and Matô-buntan⁷⁾ are recorded to be successful at Nago Station. Tokuyama's seedling plants represent “Toyu” of Formosa, having somewhat obconic outline and pink flesh in fruits, which were not too good in quality. A good illustration of this type of the shaddock is given in “Shitsumon Honzô”, Appendix fol. 9, 1788, mentioning that the seed of this pink-fleshed one was introduced by boat from Chekiang Province, China.

6) Tanaka, T.: Spec. Prob. in Citrus, p. 55, 1954.

7) Swingle and Tanaka in Bailey, Standard Cyclopedia of Horticulture, 2858, 1914.

Citrus Hassaku Hort. ex Tanaka in Ishii, Cycl. Hort. 1: 532, 1944: Yuichirô Tanaka, Icon. Jap. Cit. Fr. 2: 312, 1948.

Nom. Jap.—Hassaku.

Hab.—Nago Agricultural Research and Demonstration Station.

Note: Introduced from Japan proper into the Nago station, where it has been fruited. (Fruit specimens are preserved in solution and exhibited at the station office.)

Citrus Natsudaidai Hayata Icon. Pl. Formos. 8: 29, 1919: Tanaka in Mem. Tanaka Cit. Exp. Sta. 1: 26, 1927: Sonohara et al., l.c. 82, 1952: Takamine, l.c. 51, 1952: Sonohara, Usef. Tr. 39, 1952: Walker, l.c. 138, 1954.

Nom. Jap.—Natsu-daidai, Natsu-mikan (sic.)

Hab.—Okinawa: Tôbaru Farm, Izumi, Motobu-cho, cult.

Note: Plant seems to do well under Okinawa conditions, bearing rather heavily. The fruits were large-sized but were slightly crystallized inside, perhaps due to the unbalance of the amount of foliage and crop.

Citrus sulcata Hort. ex Takahashi, Citrus, 86, 1931: Tanaka, Sp. Prob. in Citrus, 122, 1954: Sonohara et al., l.c. 83, 1952.

Nom. Jap.—Sanbô-mikan.

Hab.—Okinawa: Tôbaru Farm, Izumi, Motobu-cho, cult.

Note: Fruits were large-sized, with pulp of excellent eating quality.

Citrus iriomotensis n. sp.

Branchlets inermis, old shoots somewhat terete; leaves broadly oval, large-sized, unusually broad in abnormally large-sized leaf without narrowing at the apex, about 11–12 cm. in length, lamina 8.7–9.9 × 6.3–7.3 cm., coarsely crenate on the margin, petiole 2.3–2.8 cm. with a wing variable in size, often as broad as 1.3 cm. across and obtriangular in shape, or not wider than .5 cm., or still narrower to form a mere fringed margin, always ending with linear base; medium-sized leaves somewhat resembling those of *Citrus Aurantium*. Fruits (still growing, immature example) obovate-subglobose more or less resuming obconical outline, apex flat, roughened, base narrowed, both lacking radial grooves, surface even, yellow, oil cell dotting minute, not dense, forming needle-pluck concavity, girth measuring about 12 cm. and weighing about 23 g. (scabby and not normal). Transverse section of fruit scented with musky aroma, rind adherent, solid, tightly attached, about 2 mm. thick, with pure white albedo and fairly dense green oil cell layer in which oil cells are arranged irregularly, mostly crowded on the periphery though some are seated deeply: Central

column small, filled, fiber strands circinnate; segments 9-10, mostly uniform in shape and size, outer end more or less rounded, inner end chisel-pointed; carpel wall adherent, thin, strong, translucent: Pulp still pale greenish, transparent, resembling that of the lime in appearance, acid but not intensely so, vesicle arrangement rather obscure, pararell, never reticulate at the outer part; individual vesicles elongated, fusoid, apex filiform, shiny, soft, hyaline, thin-walled, perishable. Seeds not very small, regularly broad-obovate or ellipsoid, compressed, smooth, rounded or obtusely pointed at the apex, very shortly beaked or wedged at the base, often curved downward, creamy or greenish; testa thin, tegmen light-colored, containing creamy or greenish mono-embryo.

Flowers appear to be fairly large, judged from the size of the calyx on fruit, which is fairly large in comparison with the size of the fruit, rather tall, having thick body part and very shallowly lobed margin, more or less pentagonal in the whole outline.

The general characters make it logical to place the plant into ARCHICITRUS-AURANTIUM-MEDIOGLOBOSA, but such a member has never been recorded from anywhere else, worth naming it as a new species. Fruit characters are rather apart from the sour orange group (ARCHICITRUS-AURANTIUM-AURANTIOIDES-RACEMOSA), since the fruit is tight-skinned, and having strongly adherent segments, mildly acid pulp lacking bitterness, and very regular lime-like pallid pulp vesicles. It may be more fitted to be classed into ARCHICITRUS-AURANTIUM-AURANTIOIDES-CONTRACTA if the inflorescence could be found very much contracted. The single member of this group, *Citrus canaliculata*, has similar broad leaf, tight-skinned fruit with acid pulp of fine pararell vesiculation, and smooth seed containing white or green embryos. As mature fruit was not available, its proper belonging will require further investigations.

Nom. Iriomot.—Fusara.

Hab.—Iriomote Isl. Found in the homestead of Suekichi Urauchi at Hoshidachi: Leg. Yô Ôyama, Dec. 27, 1956.

Note: With a colored illustration, a species of *Citrus* is described in "Shitsumon Honzô" Appendix fol. 4, 1788, under the name "Shi", commonly applied to *Poncirus trifoliata*, mentioning that it is "a tree resembling Kitsu (Tachibana) and leaves are large like Tô (sour orange) and the stem bears thorn; in spring, white flowers appear, and after the bloom fruits are borne, which ripen yellow in winter and are acid and bitter, becoming edible during July and August (in luna calender)" . . . The picture gives a flowering shoot and a fruiting branch, drawn rather schematically not true to nature. The present species will be nearest to it, if such a plant was really in existence

somewhere in the Ryukyus and was not a mixed reproduction of several species that the author of this book had been keeping them in mind.

Citrus Aurantium Linn. Sp. Pl. 782, 1753: Swingle, in Sargent, Pl. Wils. 2: 147, 1916: Sonohara et al., Fl. Okinaw. 81, 1952: Takimine, Fl. Yaeyama. 51, 1952: Sonohara, Useful Tr. 36, 1952: Walker, Imp. Tr. 133, 1954.

=*C. Aurantium* Linn. subsp. *amara* Engl., in Engl. et Prantl, Nat. Pffam. 3 (4) 198, 1897: Ito et Matsum., l.c. 361, 1900.

Nom. Okinaw.—In-kunibu. Nom. Jap.—Daidai, Kabusu-daidai. Nom. Amer.—Sour orange.

Hab.—Okinawa: Nûha, Ôgimi-son, cult.; Nakijin-son, cult. Ishigaki: Urazoko, north of Tomino, in an abandoned orchard, cult. Iriomote: locality unknown (fruit sold in Ishigaki city.)

Note: The form commonly cultivated represents the Kabusu-daidai with normal calyx. The "Za-daidai" with swollen calyx has never been met with, whereas it is not uncommon in east Formosan gardens. Apparently, the present species has been known in the Ryukyus for a long period with possible origin introduced from Japan proper, since it is not a common plant in subtropic coastal China.

Citrus Rokugatsu Hort. ex Yuichirô Tanaka, Icon. Jap. Cit. Fr. 2: 386, 1948: Tanaka, Sp. Prob. in Citrus, 124, 1954.

Nom. Okinaw.—Hâbuchâ (at Ôgimi), Hâbuchii or Gômagayâ (at Nûha, in Ôgimi). Nom. Jap.—Rokugatsu-mikan.

Hab.—Okinawa: Ôgimi-son, leg. T. Maeda, Dec. 21, 1956. Cultivated, but said to occur escaped from gardens.

Note: Yuichirô Tanaka states that it occurs cultivated in Amami Oshima and Konejime in Kagoshima Prefecture. The author once collected it from a garden in Miyazaki Prefecture. Its origin is uncertain but the Japanese plants are unquestionably of introduced origin either from Amami Oshima or Okinawa. It is not a palatable citrus but is slightly sweeter than the next. Its swollen calyx reminds that of the Za-daidai, but the leaves lack petiole wing and the fruit is strongly areolate at the apex, from which most of the Ryukyu names has been derived.

Citrus yanbaruensis n. sp.

Leaves ovate-oblong, obtuse at both ends, not thick, lamina 12×5.5 cm. in a large member, petiole 1.5 cm. long, linear, the whole shape somewhat like those of *Citrus depressa*, especially in small members, but distinctly longer and larger in large members; crenation on the margin almost indistinct. Fruits medium-sized, tall depressed-globose, regular in outline, generally wrinkled on the surface, smoother in

small ones but never becoming entirely smooth, always compact and heavy, weighing 120 g. in average, apex deeply concave, corrugated and radially grooved, base abruptly concave with comparatively large calyx, the lobes of which being short and acutely pointed, color greenish-ochraceous turning partly to light orange, surface waxy but not glazed, with oil cells inconspicuous in outline but finely pitted. Transverse section of fruit has a lasting acidic, citral-like aroma distinct from that of *Citrus nobilis*; rind thick, about 6 mm., oil cells very dense, crowded, pallisade-like, oblong to oblong-obovate, often heaped in an irregular arrangement, altogether deep ochraceous in color continuous to thick, dense, light ochraceous albedo which is detachable from the pulp ball without difficulty; central column about 13 mm. across, rather large, pithy, with circinnate fiber strands becoming nearly free from the pith in fascicles at the basal portion; segments ca 10, outer end inflated, inner end obtuse, wall rather thick and separable: Pulp soft, juicy, light yellow, very acid, vesicle arrangement rather coarse, pararell, slightly netted at the outer end, individual vesicles adherent, also cling to seed, mostly plump fusoid, more or less tapering toward blunt-tipped not sharp-pointed apex, base rather obtuse, very thin walled, wet, easily perishable greenish yellow, not much standing on carpel wall: Seeds fairly abundant, somewhat resembling those of *Citrus nobilis*, large sized, oblong-obovate, pointed or apiculate at the apex, long tailed at the base, more or less plump at the middle, brownish, surface shallowly striated, testa not very thin, tegmen bright chestnut colored, reddish purple at chalaza end, containing green mono- or bi-embryos.

The shape of the fruit, its size, rind characters, segment wall, and pulp vesicles resemble those of *Citrus Rokugatsu*, but this species lacks apical areola, is provided with larger open central column, long seeds with deeper colored integument inside, and normal, not carnose, calyx.

The leaf approaches to that of MATACITRUS-ACRUMEN, but fruit characters indicate that it is closely related to *Citrus Rokugatsu*, belonging to ARCHICITRUS-AURANTIUM-AURANTIOIDES-RACEMOSA.

Nom. Okinaw.—Yûkunibu.

Hab.—Okinawa: Ôgimi-son, leg. T. Meada, Dec. 21, 1956, cultivated.

Note: The origin of this Citrus is unknown, but possibly of chance seedling origin, being rarely planted in homesteads. A protection is needed since many trees are being cut down as the fruit is unsuitable to be marketed due to its high acidity. The Nago Station reports that the seedlings of the Yûkunibu make rather weak

growth as a rootstock plant, but no comment is given after they have been worked other Citrus on to it.⁸⁾

Citrus sinensis Osbeck Dagb. Ostind. Resa, 41, 1757, nomen; Reise Ostind. China, 250, 1765: Swingle in Sargent, Pl. Wils. 2: 148, 1816: Sonohara et al., l.c. 82, 1952: Tanaka Sp. Prob. in Cit. 124, 1954.

Nom. Jap.—Amadaidai. Nom. Amer.—Sweet orange.

Hab.—Okinawa: Tōbaru Farm, Izumi, Motobu-cho, cult.

Note: The sweet orange proper is only represented by the Valencia orange, introduced from Japan proper. This variety seems to behave just as poor as in the Mainland of Japan, bearing comparatively small fruits of rather poor quality. Known Florida early or midseason varieties, such as Parson Brown and Pineapple, are most desirable to be introduced and tried out in various parts of Ryukyu Islands.

Citrus sinensis Osbeck var. **brasiliensis** Tanaka in Bult. Sci. Kjušu Imp. Univ. 2: 89, 1926: Sonohara et al., l.c. 82, 1952.

Nom. Jap. & Amer.—Washington Navel Orange.

Hab.—Okinawa: Tōbaru Farm, Izumi, Motobu-cho. Ishigali Isl.: Funazoko, north of Inoda (Tokuyama's orchard). Cultivated.

Note: The fruit produced at the Tōbaru Farm was excellent, much superior to average California products if the productivity and longevity of the plant is not taken into consideration. It requires to follow the result of planting now under trial at RYCOM nursery, the scions of which had been sent by the author from Osaka.

Citrus Tankan Hayata Icon. Pl. Formos. 8: 26, 1919: Tanaka in Journ. Hered. 20: 39, 1929: Sonohara et al., l.c. 83, 1952.

Nom. Jap. & Formos.—Tankan.

Hab.—Okinawa: Tōbaru Farm, Izumi, Motobu-cho, cult. Ishigaki Isl.: Tomikawa's Farm in Barabidō, & Takeshima's orchard near Kaado, cult.

Note: Introduced either from Japan proper or from Formosa, all producing excellent fruits, though not highly productive under the prevailing circumstances. The species seems to be better adapted than the Ponkan, *Citrus reticulata*, to which it is comparable in value and in similar climatic requirements. It is not recommended to be planted on dry uplands as adequate soil moisture is always needed for successful production.

Citrus Tamurana Hort. ex Tanaka in Mem. Tanaka Cit. Exp. Sta. 1: 54, 1927, in nota; in Ishii, Cycl. Hort. 1: 41, 1930; in Spec. Prob. in Cit. 126, 1954: Sonohara

8) Annual Report, Central Agric. Res. & Demonst. Sta. for 1954, p. 319.

et al. l.c. 83, 1952.

Nom. Jap.—Hyûga Natsu-mikan, New Summer Orange.

Hab.—Okinawa: Tôbaru Farm, Izumi, Motobu-cho, cult.

Note: The quality of fruit was only fair perhaps being picked too early. It is a late maturing citrus supplying soft, refreshing pulp of good quality.

Citrus luteo-turgida n. sp.

Leaves comparatively large exceeding 10 cm. in length, lamina oval to ovate-elliptic, 10×5.5 cm., apex obtuse or slightly acuminate or emarginate, base obtuse or at times slightly narrowed, tendency to become attenuate, rarely rounded (in Misato specimen); petiole rather long, often reaching to 2 cm., wing narrow, sometimes reaching to 5 mm. wide, but generally narrower, often merely fringed, the leaf texture not thick and veinlets fine. Fruit nearly globose, fairly large in size, weighing from 230 to 270 g., diameter often exceeding 9 cm. with a height of 8 cm., apex quite rounded, almost not sinuous at the stylar end, areola none, base shallowly concave naturally without grooves, surface turgid, greenish to light yellow, smooth, with distinct dotting of medium-sized rather irregularly distributed oil cells, which are interspaced by minute ones, almost lacking around the stylar point. Transverse section of the fruit lacks a distinct aroma but more or less reminding that of *Citrus Ujukitsu*, rind thin, uniformly 3.5–5.5 mm. in thickness, albendo white, imbedded fiber indistinct, oil cells round, slightly graded but not greatly varying in size, largest about 2 mm. high, pale yellow; segments 8–10, rather uniform, outer end pararell to the outline, almost not rounded at the corner, inner end narrowed, terminating with rather acute ends, side wall rather thick, adherent together, being not readily detachable; central column small or very small, with soft white pith and circinate fiber strands; pulp very juicy, light yellow, very acid, later becoming mild and increasing sugar to a certain degree, not unpleasantly without bitterness; vesicle arrangement pararell, netting inconspicuous, individual vesicles rather large, fusoid, tapering and sharp pointed at the apex, thin walled, easily broken, hyaline, some forked at the end, terete, often long stalked, little standing on side wall. Seeds large, obovate-oblong, very slimy, slightly narrowed at the apex or roundish, simply wedged at the base, surface longitudinally grooved, light-colored and slightly brownish drying white, testa brownish, and dirty purplish at the chalaza end, containing pale green polyembryos.

The fruit characters agree with the general characteristics of ARCHICITRUS-AURANTIUM-OSMOCITRIOIDES, resembling *Citrus*

Tamura, but differing in quite globose fruit outline, rounded apex without areola, not narrowed fruit base, and deeper colored inside of integument. Plant grows rather tall and looks to be fairly vigorous worth trying as a rootstock plant.

Nom. Okinaw.—Dêdê (at Nakijin), Fûsû (at Misato).

Hab.—Okinawa: Nakijin-son, cultivated at Sôhachi Matsuda's frontyard, Nakasone section; at the backyard of Nabe Uchima, Shoshi section; at the frontyard of Hakuan Uema (several trees), Sakiyama section; materials collected on Dec. 22, 1956: Misato-son, Ikebaru section, at Seian Yonamine, leaves collected on Jan. 10, 1957.

Note: The specimens were all cultivated materials and are hard to tell whether this is an indigen or a cultigen. It must be a product of chance seedling at Central Okinawa from where northern individuals must have been propagated.

Citrus nobilis Lour. Fl. Cochinch. 466, 1790: Swingle in Sargent, Pl. Wils. 2: 142, 1916: Tanaka, Spec. Prob. in Cit. 13, 72, & 128, 1954: Sonohara et al., l.c. 82, 1952: Sonohara, Useful Tr. 38, 1952: Walker, Imp. Tr. 139, 1954.

=*Citrus Aurantium* Linn. subsp. *sinensis* (non Engl.) sec. Ito et Matsum. Journ. Coll. Sci. Imp. Univ. Tokyo 12: 198, 1900.

Nom. Okinaw.—Tô-kunibu, Haneji-mikan. Nom. Jap.—Kunenbo.

Hab.—Okinawa: Ôgimi-son, leg. T. Meada, Dec. 21, 1956 (cult.); Tamagusuku-son, Oyakebaru section, in garden of Ryôshô Ishihara (potted plant), Jan. 12, 1957.

Note: The fruit from Ôgimi was beautifully polished, smooth, large-sized example weighing 310 g., quite distinct from the King variety which has thick warty rind, never can be found in Sino-Japanese territory. To a big surprise, two fruits picked from Mr. Ishihara's tree were entirely seedless and seemed to be a constant character of this clone. If it is, the clone must be propagated since the quality of pulp was far excellent and was much superior to good Satsumas besides seedlessness. It deserves to receive a clonal name "Mukaku Kunenbo", and Mr. Ishihara remarked that he had obtained a budwood of this strain from a neglected wayside tree found in Central Okinawa.

Citrus Unshiu Marc. in Isv. Soch. Obl. Sukh. Sel. Opyt. Stant. 2: 5, 1921; Tanaka in Int. Rev. Sci. Pract. Agr., n.s. 1: 32, 1923; in Mem. Tanaka Cit. Exp. Sta. 1: 28, 1927: Sonohara et al., l.c. 83, 1952: Takamine, Fl. Yaeyam. 55, 1952: Sonohara, Useful Tr. 39, 1952.

Nom. Jap.—Unshû-mikan. Nom. Amer.—Satsuma orange.

Hab.—Okinawa: Izumi, Motobu-cho, cultivated in Tôbaru Farm, Ogidô's orchard, etc. Ishigaki Isl.: Yaeyama Agr. Res. & Dem. Station, Tomikawa's farm, etc., cult.

Note: None of the Satsuma orchards in Ryukyus seemed well cared with precise knowledge of raising it and no fruits were met with except the imported fruits from Japan proper due to their early maturity. Reference as to the successful introduction of the clones of the Wase Satsuma (var. *praecox*) was not available, but the commercial planting of this variety, especially of Miyagawa Wase of high adaptability, seems to be very desirable, since early maturing fruit of citrus is in great demand at the period during late September and early October, in which it surely reaches to maturity.

Citrus Keraji Hort. ex Tanaka in Stud. Citrol. 7:74, 1935, nomen; in Spec. Prob. in Cit. 76 & 130, 1954: Yuichirô Tanaka, Icon. Jap. Cit. Fr. 2: 414, 1948.

Nom. Jap.—Keraji. Nom. Okinaw.—Unzoki (at Kijoka).

Hab.—Okinawa: Ôgimi-son, Kijoka section, leg. T. Maeda, Dec. 21, 1956.

Note: The Okinawa material has leaf scarcely attenuate at apex, and the fruit is smoother. The fruit outline was regularly depressed-globose, sometimes fairly oblate, and the rind was slightly loosened, but never becoming puffy. In the fruit samples received of Arita Fruit Station, Wakayama Agr. Exp. Sta., the rind was completely free from the pulp ball, and the seeds were long-tailed at the base. Complete identity of all other characters makes it impossible to separate the Unzoki from Keraji of Amami Oshima and elsewhere. The origin of the Ryukyu plants is quite obscure, but from the proximity of two regions, it must be the case of early introduction either from Amami Oshima or from Kikai Islands, where it was originated.

Citrus Keraji var. **Kabuchii** Hort., status novus.

=*Citrus Keraji* forma *Kabuchii* Y. Tanaka, Icon. Jap. Cit. Fr. 2: 417, 1928.

=*Citrus* sp. Sonohara, Useful Tr. 39, 1952.

Nom. Okinaw.—Kabuchii.

Hab.—Commonly planted in Okinawa, Miyako and Yaeyama.

Note: The leaf is comparatively thick as in the type, but the leaf base is not safely roundish, rather having a tendency to become attenuate, and at least the lowermost veinlets curve in (decurent) to the midrib with very sharp angle. The fruits of Kabuchii is taller, often obconical, and the areola being composed of several series of concave fovea, occasionally becoming quite obsolete. The number of segments is fewer, and the seeds are more elongated toward the base with a longer tail. These points cannot be regarded as to be basically specific, but are distinct enough to separate one from the other as fairly good botanical varieties, possibly backed up by geographical discontinuity. Hence, the Kabuchii is here regarded as a

variety, instead of a forma of *Citrus Keraji*. At least in Okinawa, the difference between the Kabuchii and Unzoki is fairly great, making them impossible to handle as a single species. The Kabuchii is again distinct from its relatives, *Citrus Oto* and *Citrus Tarogayo*, as is discussed in later paragraphs.

***Citrus inflato-rugosa* Hort. nov.**

Leaves rather large and thick, normal one oval or elliptic, medium-sized, lamina measuring 8.9×4.0 cm. (petiole 0.9 cm. long), but in a broad one lamina was 9.1×5.2 cm. (petiole 1.1 cm. long), while in a narrow one it was 9.2×4.5 cm. (petiole 1.1 cm. long) and in smaller ones oval members were predominating though shorter ones still present; leaf apex generally broad-obtuse around the emargination, base generally being acute, petiole naked. Fruit oblate, medium-sized, attaining to 6.4 cm. in diam., averaging 6 cm. across, average height 3.8 cm., deep yellow, very conspicuously wrinkled by fine corrugation, connected closely to the longitudinal discontinuous furrows sharply sunken in zigzag way, apex gradually broad concave, finally sinuous at the stylar end, areola lacking, base deeply concave, sharp furrows radiating from the stem end, oil cell dots graded, acutely foveolate, very rough but glazed; calyx medium-sized, somewhat irregularly cut in triangular lobes. Transverse section of the fruit faintly scented, rind thick, rather stiff, about 2.5 mm. thick, inflated and free from the pulp ball, only connected by free fiber strands running through the hollow space, oil cells crowded, distinct, graded and heaped, generally oblong, often sunk deep reaching to the inside of the albedo; central column wide open, about 2 cm. across, fiber strands free almost lacking white pith; segments 9-12, much lunate, short in cross section, well inflated, outer end quite round, inner end obtuse, almost free from each other, carpel wall rather thick; pulp deep colored, yellow, juicy, subacid, edible though not sweet enough, melting but not hyaline, reticulation coarse, few and broad, netting not clear looking as one mass; pulp vesicles few, mostly short and plump, ovate, apex acute or obtuse, usually not tapering, often lying down, thin walled and perishable, stalk short, little standing on the side wall. Seeds many, large-sized, short obovate, fairly plump, slightly striated, apex quite rounded, base short beaked or wedged, testa comparatively thick, tegmen light chestnut colored, chalaza part deep purple, containing green mono-embryo.

Such an inflated tough-rinded fruit is only met with in the *Keraji* cultivated in Japan, as mentioned before, but it is not corrugate-surfaced as this, central column not being so wide open, and the apex of seeds is more pointed having lighter colored inner seed coat.

This lacks petiole wing, but the lamina has broadly obtuse apex and narrowed base. Both have quite similar pulp characters suggesting that this belongs to the group METACITRUS-MICROACRUMEN-ANISODORA but not conspecific with *Citrus Keraji* from points stated as above. The Unzoki, considered as identical with the Keraji, has much less lunate segments wider in breadth, with longer pulp vesicles. There is a room, however, to question whether this would be a tetraploid form of certain known species with modifications of morphological characters on that account. This problem will be settled through careful cytological examination and well-planned progeny tests.

Nom. Okinaw.—Kâ-fukurû, Garagara (a homonym of *C. Tachibana*; see later discussion).

Hab.—Okinawa: Oku section in Kunigami-son, at the homestead of Mr. Shigeru Miyagi, collected on Jan. 16, 1957 (type).

Note: This species is remarked by Mr. Miyagi as a seedling origin, the seed of which was brought from Shimajiri-son. Later communication from Mr. T. Amano confirmed that the same species is widely cultivated around the community of Kuniyoshi section in Takamine-son in former Shimajiri county, where it is called "Garagara", as pulp ball rattles when the fruit is shaken. Such a "rattling" citrus was reported by Bonavia⁹⁾ under the name "Sungtara of Lahore". This curious fruit of citrus was intimately studied by the author when he called its habitat in India years ago, bringing a conclusion that it was mere a variety of *Citrus reticulata*, the standard Suntara of India which is identical with our Ponkan.¹⁰⁾ From this incidence, non-corrugated mother type of the present species is thinkable to exist or had been existed, from which the present form was derived. The severe corrugation of the rind is mere a varietal character on one hand, as in the case of *Citrus Reshni* Hort. ex Tanaka var. *canaliculata*¹¹⁾, but is definitely a hybrid character on the other hand, in so-called "MacArthur Orange", originated at the close proximity of *Citrus Unshiu* and *C. Aurantium* in an island of Inland-sea region of Japan, quoted as a sole example of a natural hybrid whose parents (these two spp.) are tenable.¹²⁾ It is hard to tell how this peculiar character gave rise in the present species as

9) Bonavia, E. Cultivated oranges and lemons of India and Ceylon, "Atlas", 1890, PL. CIX, reproduced in Tanaka, Spec. Prob. in Citrus, 1954, p. 15, fig. 2.

10) Under the name *Citrus chrysocarpa* Lush. (= *C. poonensis* Hort. ex Tanaka) the distribution of this valuable citrus is discussed in Journ. Ind. Bot. Soc. 16 (4) 234, 1937, q.v. Also refer, Tanaka in Trans. Nat. Hist. Soc. Forms. 22: 432, 1932.

11) Tanaka, in Stud. Citrol. 8 (1) 71-74, 1937.

12) Tanaka, Spec. Prob. in Cit. 134, 1954.

in other rough-skinned citrus like the rough lemon (*Citrus Jambhiri*), Wenchow orange (*C. suavissima*), Ôyu (Jagatara-yu, *Citrus pseudogulgul*), a number of Turunj citrons and the King orange.¹³⁾

Citrus Oto Hort. ex Yuichirô Tanaka Icon. Jap. Cit. Fr. 2: 420, 1948: Tanaka Spec. Prob. in Cit. 130, 1954.

=*Citrus* sp. Sonohara et al., l.c. 83, 1952.

Nom. Okinaw. & Jap.—Otô.

Hab.—Widely cultivated in Okinawa, Ishigaki and Iriomote.

Note: Fruit is very early maturing and not met with during this trip. It has been studied in 1952 from the material cultivated at Shizuoka Citrus Experiment Station. The fruit was about 5 cm. in diam., rather tall in depressed-globose outline, distinctly orange in color, smooth, shallow concave at the apex, providing areola composed of convex oil cells, base also not conspicuously concave almost without grooves; oil cells were very dense, rather sharply pitted, forming shallow fovea equidistantly all over the turgid surface of the rind, reminding that of the Kôji, *Citrus leiocarpa*; calyx was also somewhat hanging with apiculate lobes and deep sinus between them. These points disagree with the Kabuchii, most occasionally cultivated together. The cross section of the fruit is also different in having (1) rather tight-skinned rind with dense, not spongy albedo, (2) smaller, closed central column, with acute ends of segments. (3) not rounded corner of them at the outer end in the cross section, (4) semi-transparent, greenish, not ochraceous, pulp with vesicular arrangement more netted than to be pararell, (5) smaller seeds, etc. These disagreements are too large to regard them as belonging to the same cultigen, although both have similar pulp quality and flavor with faint aroma somewhat resembling a cardamom, and broad leaves providing distinct petiole wing. It is a well known fact that this has much thinner leaves than the Kabuchii.

Citrus Tarogayo Hort. ex Yuichirô Tanaka Icon. Jap. Cit. Fr. 2: 422, 1948: Tanaka Spec. Prob. in Cit. 130, 1954.

Nom. Okinaw.—Tarogayo, Tarugayu.

Hab.—Okinawa: Ikebaru, Misato-son, in homestead of Zôei Yonamine (leg. Eiki Shimabukuro, Jan. 10, 1957), Oyakebaru, Tamagusukuson, a potted plant of Shôryô Ishihara, Jan. 11, 1957.

13) Loureiro, in 1790, described his *Citrus nobilis* of which "fructu tuberculoso; sub-compresso" and "tuberculoso-inaequali" showing its distinct corrugation of the rind, as shown in common King orange. In this case, it is clear that the smooth form we see in Kunenbo and Tôkunibu is a later acquired character *en route* reaching to this region from farther India.

Note: A single late-bloom fruit was collected in the latter place, which was an obconical, still green, depressed-globose fruit of about 4 cm. in diam., sharply pitted with minute oil cells somewhat graded in size, and provided rudimentary radial grooves, but not areolated at the apex. Calyx was medium sized, more or less swollen and shortly cut into lobes. The cross section of the fruit was scented with mandarin aroma, having thin rind, and subglobose dense oil cells, and small central column filled with white pith and circinnate fiber strands. Segments were 8 and still tight, with not much rounded outer corner and acutely chisel-pointed inner end. Pulp was meaty, not juicy, ochraceous, subacid but edible, lacking conspicuous flavor. The vesicular arrangement was rather distinctly pararell-netted as fine as that of the Satsuma, with fusoid, slightly tapering, sometimes 2-tipped pulp vesicles. The immature seeds were rather large in size, flattened, smooth, with rounded apex and simply pointed base, containing green polyembryos. The leaf specimens of Okinawa were elliptic ovate, with rounded base and slightly narrowed but not acuminate apex, lamina measuring about 8×4.5 cm. Petioles were short, about 8 mm. long, linear, entirely lacking a developed wing. These points indicate that the present material belongs to a cultigen distinct from either Otô or Kabuchii, justifying Y. Tanaka's identification to be correct, to regard this an independent species. All of them belong to METACITRUS-MICROACRUMEN-ANISODORA, together with their earlier known type species *Citrus Keraji* (Keraji and Unzôki) and later derivative *C. inflato-rugosa*. The name Tarogayo seems to mean "to which does it belong", questioning its proper affinity to either Otô or Kabuchii.

Citrus reticulata Blanco Fl. Filip. 610, 1837: Tanaka *in* Stud. Citrol. 9: 21, 1939; Spec. Prob. in Cit. 131, 1954: Y. Tanaka, Icon. Jap. Cit. Fr. 2: 457, 1948.

=*Citrus poonensis* Hort. ex Tanaka in Int. Rev. Sci. Prac. Agr. n.s. 1: 34, 1923; *in* Mem. Tanaka Cit. Exp. Sta. 1: 29, 1927; Sonohara et al., l.c. 82, 1952: Takamine, Fl. Yaeyam. 51, 1952; Sonohara, Useful Tr. 37, 1952: Walker, Imp. Tr. 141, 1954.

Nom. Jap. & Formos.—Ponkan. Nom. Ind.—Suntara. Nom. Amer.—Swatow orange.

Hab.—Okinawa: Tôbaru Farm, Izumi, Motobu-cho, cult. Ishigaki Isl: Nakasuji, south of Tomino, Mr. Ryo's orchard, cult.

Note: The celebrated Formosa citrus,¹⁴⁾ widely cultivated in south coastal China, Formosa, India, and in some part of Japan, Philippines, Java and Ceylon. The Okinawa plants were introduced from Japan proper, while Ishigaki trees came from Formosa, both

14) Tanaka, *in* Journ. Hered. 20: 37-45, 1929.

bearing excellent fruits. The plant seems to be susceptible to defoliation trouble due to greasy spot infection, causing the fruit to solidify by direct radiation of sun. Bagging the fruit is practiced at Tōbaru farm to protect the product from the damage caused by the attack of insect and bat, but it seems to be helpless against the bat. It should not be recommended to raise it on a large scale, as the plant protection seems to be extremely difficult to obtain perfect crop marketable most profitably.

Citrus Tachibana Tanaka in Bult. Sci. Fak. Terk. Kjusu Imp. Univ. 1: 31, 1924; Spec. Prob. in Cit. 135, 1954: Sonohara et al., l.c. 82, 1952: Takamine, l.c. 51, 1952.

=*Citrus nobilis* Lour. var. *spontanea* T. Ito, in Itô et Matsum in Journ. Coll. Sci. Imp. Univ. Tokyo 12: 358, 1900: Sakaguchi, S. Gen. Ind. Fl. Okinawa. 50, 1924.

Nom. Jap.—Tachibana.

Hab.—Japan, Ryukyus!, and Formosa.

Note: Itô mentions that his wild variety occurs both in Amami Oshima and in Iriomote along the River Nakara-gâ. The description tells that the fruit is globose, 2.5 mm. long, 7–8 loculed, and seeds 4–6 mm. long, small and obovoid. This is an unquestionable Tachibana, as the fruit is “globose”, not oblate as in *Citrus depressa*, though he failed to mention the fruit color. It was later confirmed that both Tachibana and Shiikwâshâ occur at Yamatohama, Yamato-mura in Amami Oshima,¹⁵⁾ where Ito’s wild variety occurs, distinguishable from his var. *Tachibana*, meaning the Shiikwâshâ. It was rather an astounding finding to record that the Tachibana re-appears wild in Formosa highland between 3340 and 4000 ft.,¹⁶⁾ but no connecting link between Formosa and Amami Oshima was confirmed with actual collection of the material. Probably, Sonohara and others (1952) are the first reporters of Tachibana from Okinawa, under the name “Ishikunibu”, and Takamine also recorded it from Iriomote and Yonakuni without local name. Y. Tanaka, however, made Ishikunibu a forma of *C. depressa*, based upon a material collected by Bunshû Yamakawa, from Haneji-son, Kunigami-gun.¹⁷⁾ In fact, the author’s survey during this trip confirmed the occurrences of *C. Tachibana* in the following localities:

15) Tanaka in Bult. Sci. Kjusu Imp. Univ. 2(1) 52, 1926.

16) ———, in Stud. Citrol. 5(1) 1–20, 1932.

17) Yuichirô Tanaka, Icon. Jap. Cit. Fr. 2: 484, 1948, with a remark saying “fruit turgid, so the name Stone-like Kunibu (Ishi-kunibu). Its distribution in Okinawa is much narrower than the ordinary Shiikwâshâ. Fruit is acid and not edible...” His illustration is nothing but a straight Shiikwâshâ having a small, flat fruit with comparatively tight-skinned, much fluted rind. No doubt he described an individual of *C. depressa*, and not *C. Tachibana*.

(1) Ôgimi-son, N. Okinawa, domesticated from wild plant under the name "Garagara" (leg. T. Maeda, Dec. 21, 1956.)

(2) Asahigawa section, Yabu-son, N. Okinawa, cultivated at the homestead of Tsuneo Miyagi, under the name "Kâ-achii", not the individual of the same name identified as *C. depressa*. (leg. T. Tanaka, Jan. 9, 1957.)

(3) Ikebaru, Misato-son, C. Okinawa, cultivated at the homestead of Seian Yonamine, under the name "Mikangwâ". (leg. T. Tanaka, Jan. 10, 1957, leaf specimen only).

(4) Funazoko, near Inoda, Ishigaki Isl., near Tokuyama's shaddock orchard, wild. (leg. T. Tanaka, Dec. 26, 1956.) Locally called "Ishifunin."

(5) Urazoko, Tomino section, Ishigaki Isl., old tree, seedling, on the wayside plot, possibly reserved from wild occurrence, locally called "Yama-funibu" (leg. T. Tanaka and T. Amano, Dec. 26, 1956.)

(6) Barabidô, north of Ishigaki city, in wild jungle of Mr. Seiken Tomikawa's property, wild. (leg. Seisei Tomikawa and T. Amano, Dec. 29, 1956.)

(7) Hoshidachi, Iriomote Isl., on valley near Naani Settlement, wild (leg. Yô Oyama, Dec. 27, 1956, leaf specimen only.) Local name—"Kunganema".

(8) Shinmata, Inaba section, Iriomote Isl., leg. Kanshō Kuroshima, Jan. 5, 1957 (mailed for identification by Yaeyama Forest Service, G. R. I., without local name.) Sterile specimen with spiny stem and long leaf, possibly wild.

The characteristic feature of the Ryukyu specimens of Tachibana is a great approach to *C. depressa* in many respects, sometimes making the identification very difficult. The fruit sometimes grows large resuming depressed-globose shape instead of typical truncate-globose outline, the color of the rind also becoming deep ochraceous but never turning into reddish orange, and the number of segments slightly increasing. Tachibana's typical oblong leaves may become shortened to a degree more or less transgressing into typically elliptic ovate, broad, *depressa* leaves. Under the co-existence of both species in the same locality and propagating themselves through seedling process, such a transgression of characters can be expected, and an approach of one to the other might be quite possible. For instance, the fruit Kâ-achii of Asahigawa has 6-9 segments, rather deep-colored pulp and rather thick rind. Together with the elongated leaf blade, these fruit characters do not necessarily contradict to be the Tachibana. It is necessary, however, to study both in regular season, when the discrimination can be made more accurately than handling off-season fruits. At any rate, it seems quite appropriate to conclude that the

Tachibana is distributed quite widely throughout the Ryukyus, playing a role of a connecting link between Amami Oshima and Formosa. It is curious that the Tachibana never comes down below 2300 ft. in Formosa, while it does occur in lowland near the seashore in Okinawa, Ishigaki and Amami Oshima. Whether this may be due to the climatic difference of Ryukyu Archipelago and Formosa, is hard to tell, but the vegetational identity is acceptable as the chief cause, since the typical lauri-lignosa belt occurs in Formosa only in such an altitude where Tachibana is found, while such an area quite predominates throughout the Ryukyus even in the lowlands near the coast.¹⁸⁾

Citrus Tachibana Tanaka var. *attenuata*, n. var.

Leaves very thick, in large ones lamina measuring 7.2×3.7 cm. (petiole 0.9 cm. long,) obovate, base distinctly attenuate into wingless petiole. Fruits small, depressed-globose, mostly less than 3 cm. in diam., largest 3.9 cm. across, generally resuming rectangular shape, apex deeply concave, base naked, devoid of oil cells and not accompanying radial grooves or striations; calyx very much raised, more or less large, body part broad and concave toward the stem, rather regularly 5 lobed. In transverse section of the fruit, rind thin, detached from the pulp ball, segments all free, 6–8 in number, outer ends much rounded, acutish at base; pulp little in amount, very light colored, melting, slightly sweet and completely acidless; pulp vesicles few in number, very short and mostly sessile. Seeds large, plump, obovate, smooth, slightly compressed, adherent to the carpel wall, testa extremely thick, tegmen light colored, especially so at chalaza, containing green monoembryo.

Nom. Okinaw.—Tanibutâ.

Hab.—Okinawa: Kunigami-son, Oku section, transplanted into the homestead of Mr. Shigeru Miyagi from wild tree: Two trees in existence. (leg. S. Miyagi, Jan. 16, 1957.)

Note: Very unusual variety with entirely different leaf shape from the type. It is suspicious to be natural tetraploid individuals, requiring further investigations. The complete acidlessness of the pulp is not a rare character as is met with in acidless citron mentioned before. But, in this case, modifications in the characters of the calyx, puffy rind, and seed coat are following, apparently very unusual in nature. A solution as to the cause of such changes certainly must wait further critical investigations.

Citrus Ponki Hort. ex Tanaka in Mem. Tanaka Cit. Exp. Sta. 1: 31, 1927; Spec. Prob. in Cit. 132, 1954; Yuichirô Tanaka, Icon. Jap. Cit. Fr. 2: 460, 1948.

18) Nuttonson, M.Y. Ecological crop geography of the Ryukyu Isl. 50–51, 1952.

Nom. Formos.—Ponki.

Hab.—Ishigaki Isl.: Mr. Ryo's Nakasuji Banana Farm, in Yoshihara (leg. T. Tanaka, Dec. 26, 1956), cultivated. Introduced from Formosa.

Note: The plants remained unidentified until this visit, when a few remaining scabby fruits were collected. They were not typical, much roughened, rounded, and thicker skinned, probably due to insufficient pollination besides scab infection. They had mostly 8 and 9 segments, comparatively small central column, reticulate, rather deep-colored sweet pulp, contained in not highly lunate segments, the inner end of which being more or less acute angled in the cross section, and fairly plump seeds with deep-colored inner coat and light green polyembryos. These characters are all in agreement with the characteristics of the Ponki.

Citrus oleocarpa Hort. ex Tanaka *in* Stud. Citrol. 7: 24, 1935, & 8: 83, 1937; Spec. Prob. in Cit. 137, 1954: Yuichirô Tanaka, Icon. Jap. Cit. Fr. 2: 476, 1948.

Nom. Jap. & Foroms.—Yuhikitsu (Yu-pi-chü).

Hab.—Ishigaki Isl.: Ryo's Nakasuji Banana Farm, in Yoshihara (leg. T. Tanaka, Dec. 26, 1956), cultivated. Introduced from Formosa.

Note: The fruit of this and the next are characterized by having thinner rind, larger open central column, and more acid pulp, with certain other differences. The present species has coarser and shorter pulp vesicles and larger seeds: Pulp is mildly acid, probably becomes edible a few months later. It is not uncommon in Formosan gardens, but is very abundantly planted in Hongkong Island.

Citrus Sunki Hrt. ex Tanaka *in* Mem. Tanaka Cit. Exp. Sta. 1: 42, 1927, in obs.; *in* Ishii, Cycl. Hort. 1: 529, 1944; Spec. Prob. in Cit. 137, 1954: Yuichirô Tanaka, Icon. Jap. Cit. Fr. 2: 479, 1948.

Nom. Jap. & Formos.—Sunki.

Hab.—Ishigaki Isl.: Ryo's Banana Farm in Nakasuji, Yoshihara section, cultivated. Came rise from the rootstock of Ponkan plant, introduced from Formosa, after the top is dead.

Note: The fruit resembles the former species, but is in possession of lighter-colored rind, more acid and juicier pulp, finer pulp vesicles and smaller seeds.

Citrus depressa Hayata Icon. Pl. Formos. 8: 16, 1919: Tanaka *in* Journ. Jap. Bot. 3: 193, 1926; *in* Mem. Tanaka Cit. Exp. Sta. 1: 31, 1937; *in* Ishii, Cycl. Hort. 1: 528, 1944; Spec. Prob. in Cit. 138, 1954: Yuichirô Tanaka, Icon. Jap. Cit. Fr. 2: 481, 1948, incl. var. et forma: Sonohara et al., l.c. 81, 1952: Takamine, Fl. Yaeyam. 51, 1952: Sonohara, Useful Tr. 37, 1952: Walker, Imp. Tr. 135, 1954.

Nom. Okinaw.—Shiikwâshâ, Kuganii, Ishikunibu, etc. Nom. Jap.—Hirami lemon.

Hab.—Okinawa, Miyako and Yaeyama, wild and cultivated with seedling variations, differently called by the names Fusubutâ, Ingwâ-kunibu, Mikangwâ (pro parte), Minkan, Hiijâ-kunibu, Kâ-achii (pro parte), Kâ-bishii, Isnikunibu (partly specialized) and Kuganii (partly generalized).

Note: All forms can be termed Shiikwâshâ or Shiikwâsâ in general, following the common call name at Naha. It is called Minkan almost exclusively in Ôgimi-son, while the term Kuganii prevails in Nago, Motobu and Nakijin. It will not be necessary to create var. *Kuganii* for individuals having lighter-colored fruit with sweeter pulp, since there seems to exist no constantly yellow-skinned form within the present species. In that connection, Tachibana might have been mistaken, and moreover, no color discrimination is made in vulgar names of these variants, which are so wisely segregated out by the people giving rather distinct varietal names. Again, what they call Ishikunibu has the leaves and fruits generally smaller, but whether this is a constant clonal character or not is doubtful.

The specimens collected and identified as *C. depressa* are as follows:

(1) Mr. Sonohara's new collections:

A. Well-colored fruits, with branches: Collected around Yabu-son, Dec. 21, 1956, wild. Three fruits examined.

B. Five still yellow fruits with branches, came with the above.

C. Eight fruits with branches, color was changing into orange when examined on Jan. 17, 1957: Collected at Tsuchi section, Ôgimi-son, wild; received on Jan. 9, 1957.

D. Two fruits with branches: Collected in Katsuyama, Yabu-son, wild; received on Jan. 9, 1957.

(2) Mr. Amano's new collection, two lots, each collected in Ôgimi-son; received on Jan. 8, 1957. Two fruits each, with branches.

(3) Three fruits with branches, given by Prof. Y. Sakurai, a material brought from Nago; received at Naha on Dec. 20, 1956. Probably a cultivated material.

(4) Mr. Meada's collection, under the name "Minkan" from Ôgimi-son, Dec. 21, 1956, consisted of 18 fruits with foliage.

(5) Mr. Shinjô's collection, mostly from Asahigawa, Yabu-son; received on Jan. 8, 1957, with branches; Defoliated and defruited materials. G only came from Izumi, Motobu-cho.

A. Named "Fusubutâ", 7 fruits with medium sized leaves.

B. Named "Ingwâ-kunibu", 5 fruits with very large, broad leaves.

- C. Named "Mikangwâ", 6 fruits with small leaves.
- D. Named "Hijjâ-kunibu", 3 fruits with rather small leaves.
- E. Named "Kâ-achii", 8 fruits with medium or medium-large sized leaves, different from a tree identified to be the Tachibana, as mentioned before.
- F. Named "Ishikunibu", 10 fruits with medium or small fruits.
- G. Named "Kuganii", 7 fruits with medium or rather small leaves.

(6) The author's Asahigawa collections with Mr. Shinjô, on Jan. 9, 1957. Two lots: At the first homestead, foliage specimens were collected, which are said to represent "Ingwâ-kunibu" and "Kâ-chii", both being *C. depressa*. At the second place, Mr. Tsuneo Miyagi's homestead, the following collections were made:

- A. Named "Kâ-achii", 4 fruits with very broad leaves.
- B. Named "Fusubutâ", 3 fruits with generally broad and short leaves.
- C. Named "Ingwâ-kunibu", 4 fruits with medium-sized, broad leaves.
- D. Named "Ishikunibu", 2 lots, of 8 and 4 fruits each, all with broad leaves.

(7) Second Shinjô's collection, sterile specimens only, of "Hijjâ-kunibu", "Mikangwâ", all representing the Shiikwâshâ.

(8) Miyako Island: At Karimata, aged trees with very immature fruits and abnormally small leaves, collected on Jan. 4, 1957. (Identification rather uncertain.)

(9) Ishigaki Island: At Takeda, here and there wild in Mr. Ryo's Kaado Estate. (Identification not certain due to the lack of fruit specimens.) Leaves provide distinctly acuminate apex.

(10) Sterile specimens received as wild Citrus from Karê-san, Ishigaki Isl., consisted of 3 lots, all identical with the preceding lot of specimens.

(11) Iriomote Island: Wild in the valley near Naani Settlement north of Hoshidachi, collected under the name "Pipatzâ", with two fruits of fairly tight skin and narrow segments (9 and 11 loculed). Leaves all resembling the former lot, having acuminate apex. The specimens were collected by Mr. Yô Oyama, Forest Officer, on Dec. 27, 1956.

(12) Iriomote Island: Collection # 1, leg. Tôsuke Masha at Umuto, Inaba section, Jan. 1, 1957. Sterile specimen sent for identification from Yaeyama Forest Service, G.R.I.

Citrus madurensis Lour. Fl. Cochinch. 467, 1790: Tanaka *in* Stud. Citrol. 9: 30 & 139, 1939; Spec. Prob. in Cit. 140, 1954.

=*Citrus microcarpa* Bunge in Mem. Acad. Imp. Sci. St. Petersb. 2: 84, 1833: Tanaka, in Bull. Soc. Bot. France, 5 sér. 4: 715, 1928.

=*Citrus mitis* Blanco, Fl. Filip. 610, 1937: Swingle in Bailey, Stand Cycl. Hort. 784, 1914.

Nom. Jap.—Shikikitsu, Shikinari-kinkan, Tô-kinkan. Nom. Amer.—Calamondin.

Hab.—N. Okinawa around Nago city, leg. S. Sonohara, received on Jan. 9, 1957, locally called “Nenchû-mikan” (translated). Ishigaki Isl.: Mr. Ryo’s Nakasuji Farm, Introduced from Formosa (leg. T. Tanaka, Dec. 26, 1956); Miara estate (Historical Monument), collected on Dec. 26, 1956.

Note: This is a true *Citrus*, common in the tropics of Asia, often mistaken as a *Fortunella*. Mr. Ryo’s plants are rather young and seemed to be a recent introduction. Others may be earlier introductions from unknown sources, also names being lost. In Japan, it has been recorded only from Nagasaki, possibly brought by Chinese among whom it is very popular.

Fortunella crassifolia Swingle in Journ. Wash. Acad. Sci. 5: 172, 1915: Tanaka in Stud. Citrol. 6: 149, 1933.

=*Fortunella japonica* (non Swingle) Sonohara Useful Tr. 39, 1952.

Nom. Jap.—Neiha Kinkan. Nom. Okinaw.—Chinkan. Nom. Amer.—Meiwa Kumquat.

Hab.—Okinawa: Izumi Branch of Nago Agr. Res. & Dem. Sta., propagated from a remaining tree of Feudal Kumquat Garden at Onna from which occasional escaped trees are found in adjacent woodlands in the vicinity of the original site.

Note: The potted plant examined was neither *F. japonica* nor *F. margarita* (= *F. japonica* var. *margarita*), listed in Sonohara et al., Fl. Okinaw. 83, 1952. These two species seem to be not existing, one of which possibly based upon *Citrus madurensis* by misidentification.

ALPHABETICAL LIST OF SPECIES OF *CITRUS*, *FORTUNELLA*
AND *PONCIRUS* FOUND IN THE RYUKYUS,
WITH THEIR SYSTEMATIC POSITIONS

<i>Citrus Aurantium</i> (Kabusu-daidai, Inkunibu, Sour orange)	I AAR
<i>C. depressa</i> (Shiikwâshâ, Minkan, Kuganii, Hiramî-lemon)	II AMCMi
<i>C. grandis</i> (Jabon, Zabon, Buntan, Uchimurasaki, Shaddock, Pummelo)	I CD
* <i>C. Hassaku</i> (Hassaku)	I CIA
* <i>C. inflato-rugosa</i> n. sp. (Kâ-fukurû)	I AMA
* <i>C. iriomotensis</i> n. sp. (Fusarâ)	II AMA
* <i>C. Keraji</i> (Keraji, Unzôki)	

var. Kabuchii n. stat. (Kabuchii)	II AMA
C. Limon (Lemon)	I CL
*C. luteo-turgida n. sp. (Dêdê, Fûsû)	I AOT
*C. madurensis (Shikikitsu, Shikinari-kinkan, Tô-kinkan, Calamondin)	II P
C. Medica (Musan-Ô-marubushukan, Acidless citron, Madhkankur)	I CC
C. Natsudaïdai (Natsu-daïdai)	I AM
C. nobilis (Kunenbo, Tô-kunibu, a variety of King)	II AE
* c. seedless (Mukaku kunenbo)	II AE
*C. oleocarpa (Yuhikitsu)	II AMCMi
C. Oto (Ôtô)	II AMA
*C. Ponki (Ponki)	II AMCMi
C. reticulata (Ponkan, Swatow orange, Suntara)	II AMCMe
C. Rokugatsu (Rokugatsu-mikan, Hâbuchâ)	I AAR
C. sinensis (Ama-daïdai, Sweet orange, Valencia orange)	I AS
var. brasiliensis (Washington Navel Orange)	I AS
*C. sulcata (Sanbô-mikan)	I AM
*C. Sunki (Sunki)	II AMCMi
C. Tachibana (Tachibana, Garagara, p.p., Kâ-achii, p.p., Mikangwâ, p.p.)	II AMCMi
* var. attenuata n. var. (Tanibutâ)	II AMCMi
C. Tamura (Hyûga-natsumikan)	I AOT
C. Tankan (Tankan)	I AS
C. Tarogayo (Tarogayo, Tarugayu)	II AMA
C. Unshiu (Unshû-mikan, Satsuma orange)	II AE
*C. yanbaruensis n. sp. (Yû-kunibu)	I AAR
* Fortunella crassifolia (Neiha-kinkan, Chinkan, Meiwa kumquat)	—
Poncirus trifoliata (Karatachi, Kikoku)	—

EXCLUDED SPECIES

Citrus deliciosa (correctly, *C. Kinokuni*, Hort. ex Tanaka, Kishû-mikan), listed in Sonohara et al., Fl. Okinaw. 81, 1952.¹⁹⁾

* (Asterisks) Species or varieties newly recorded.

ABBREVIATED TAXA EXPLAINED: I=Subgenus ARCHICITRUS, II=Subgenus METACITRUS. AAR=Aurantium-Aurantioides-Racemosa, AE=Acrumen-Euacrumen, AM=Aurantium-Medioglobosa, AMA=Acrumen-Microacrumen-Anisodora, AMCMe=Acrumen-Microacrumen-Citriodora-Megacarpa, AMCMi=ditto, Microcarpa, AOT=Aurantium-Osmocitrioides-Tenuicarpa, AS=Aurantium-Sinensioides, CC=Citrophorum-Citrioides, CD=Cephalocitrus-Decumanoides, CIA=Cephalocitrus-Intermedia-Aureocarpa, CL=Citrophorum-Limonioides, P=Pseudofortunella.

19) A few seedling plants of "Sakurajima-mikan" are planted in Nago Station. If this will come true to type, the species should be retained in the list. Wait further study for confirmation.

- Citrus erythrosa* Hort. ex Tanaka (Shushakitsu, Kobeni-mikan), Sonohara et al., l.c. 81, 1952.
Citrus glaberrima Hort. ex Tanaka (Kinukawa-mikan), Sonohara et al., l.c. 81, 1952.
Citrus paradisi Macfad. (Grapefruit), Sonohara et al., l.c. 82, 1952.
Kinkoshi (*Citrus obovoidea* Hort. ex Takahashi, Kinkôji), Sonohara et al., l.c. 83, 1952.

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琉球産芸香科柑橘亜科校訂 X (摘要)

田 中 長 三 郎*

芸香科柑橘亜科は北進と共に次第にその属数を減じ、琉球において僅にハナシンボウギ属・ゲッキツ属及び 2, 3 柑橘属の野生を見るのみであるが、他に導入によるカラタチ属及びキンカン属の栽培を見るの外、過去においてワンピ属ワンピの栽培を見た。

柑橘属においては従来野生はただ 1 種のみでシイクワシャーがそれであると認められ、他に栽培種としてオートー・タロガヨ・ケラジの 1 品種としてのカブチー・ダイダイ・ザボン・レモン・マルブシュカン・ナツダイ・クネンボ・ボンカン・タンカン・アマダイダイ・その変種の Washington navel orange・ウンシウ・ヒウガナツ・ロクガツミカンなどが報告されていた。

第一に野生柑橘たるシイクワシャーは 1926 年著者の沖縄本島実地踏査によりその台湾産ヒラミレモン *Citrus depressa* HAYATA と同種であると同定せられて以来ただ 1 種であると認められて来たが、園原・多和田・天野の 3 氏はタチバナ *Citrus Tachibana* TANAKA が混生しているのではないかという注意を喚起された。元来この両者は野外において往々鑑別困難の場合があるが、注出して観察すると立派に区別され得る場合が多く、タチバナの分布は沖縄から石垣・西表に達することが判明したのみならず、極めて判然たる 1 変種タニブター var. *attenuata* n. var. の存在をも確認し得た。ただタチバナが台湾高地に再現することは両地の気候差では説明できず樟櫛帯という共通植物帯の存在によるものであると考えるの外はない。一方シイクワシャーは実生繁殖による多少の変異はあるが、別に植物学的変種・品種と称し得るものは存在しないことを知った。

クネンボ (トクニブ) は沖縄北部の名果であるがその起原は南方から導入したもので、後鹿兒島へ渡り日本で普及するに至ったものである。従て今回無核系統の存在を発見したことは重大な意義がある。

オートーと共に多く栽培されているカブチーは確に奄美大島のケラジと同種であるが正に変種たるに値するものであるのみならず、ケラジそのものも北部沖縄にウンゾキーと称して蔵存することが判明した。タロガヨはこの両種のいずれにも属せず、独立の栽培種であり、またケラジに類するカーフルーが新種 *Citrus inflato-rugosa* n. sp. と決定した。要するにこの 1 類の柑橘は普通の蜜柑類とは別類たる「アニソドラドラ群」を形成するという自説を再確認し、これが奄美・琉球地帯に限り産する特有柑橘であることを断定し得るに至った。即ちこの地帯における柑橘属種造成の一方向を新に決定し得た。

今一つの方向は日本本土における雑柑造成の傾向とはほぼ同一であって、ダイダイに類するヨークニブ *Citrus yambaruensis* n. sp., 及びヒウガナツに類するデーデー (フースー) *Citrus luteo-turgida* n. sp. が沖縄において実現していることを発見した。また標本不完全の嫌はあるが、西表産のフサラーがサンボウミカン・ナツダイダイ等の属する中果変種類 (MEDIO-GLOBOSA) と同一類の新種であると考え *Citrus iriomotensis* n. sp. と命名記載した。しかしザボンに近似する栽培種の造成は認められなかった。

日本本土から導入された栽培種で琉球に栽培されていることを新に確認したものはハッサク及びサンボウミカンの二種で、嘗て記録されたキヌカワミカン及びキンコウジは出会わなかつ

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た。然るに台湾からはユヒキツ・ボンキ・スンキの3種が導入されており、またシキキツも来ていたが、宮古の宮良邸にも沖縄北部にもこの種の栽培が発見されたから、或は別径路の導入があったのではないかと考えられる。

マブルシュカン即ちシトロソが報告されているが、しかし中国及び日本に見る如きコマルブシュカン (*Citrus limonimedica* LUSH.) は来て居らず、別に南洋から無酸オオマルブシュカンが石垣に導入せられて居り、逸生して半野生状態にあるのを見た。

キンカンは従来マルキンカンとナガキンカンが報告されているが、共にこれを見ず、尚家御用金柑山のキンカンはネイハキンカンであると認めた。これは恐らく日本本土より来たものではなく、寧波穿山方面の主産地から直接渡来したものではなかろうか。またマルキンカンは或は新記録の上記シキキツを誤認したものではないかと考える。

なお、キシウミカンはただ名護農研にサクラジマミカンの実生樹があるのみで確認記録は尚早であり、朱砂橘即ちコベニミカンは全然その存在を認め得なかった。

本研究は琉球政府経済局の要請に基づき行ったものであり、日本文報告書は別に印刷出版される筈である。右につき多大の便宜を供せられたる当局各位に厚く謝意を表す。