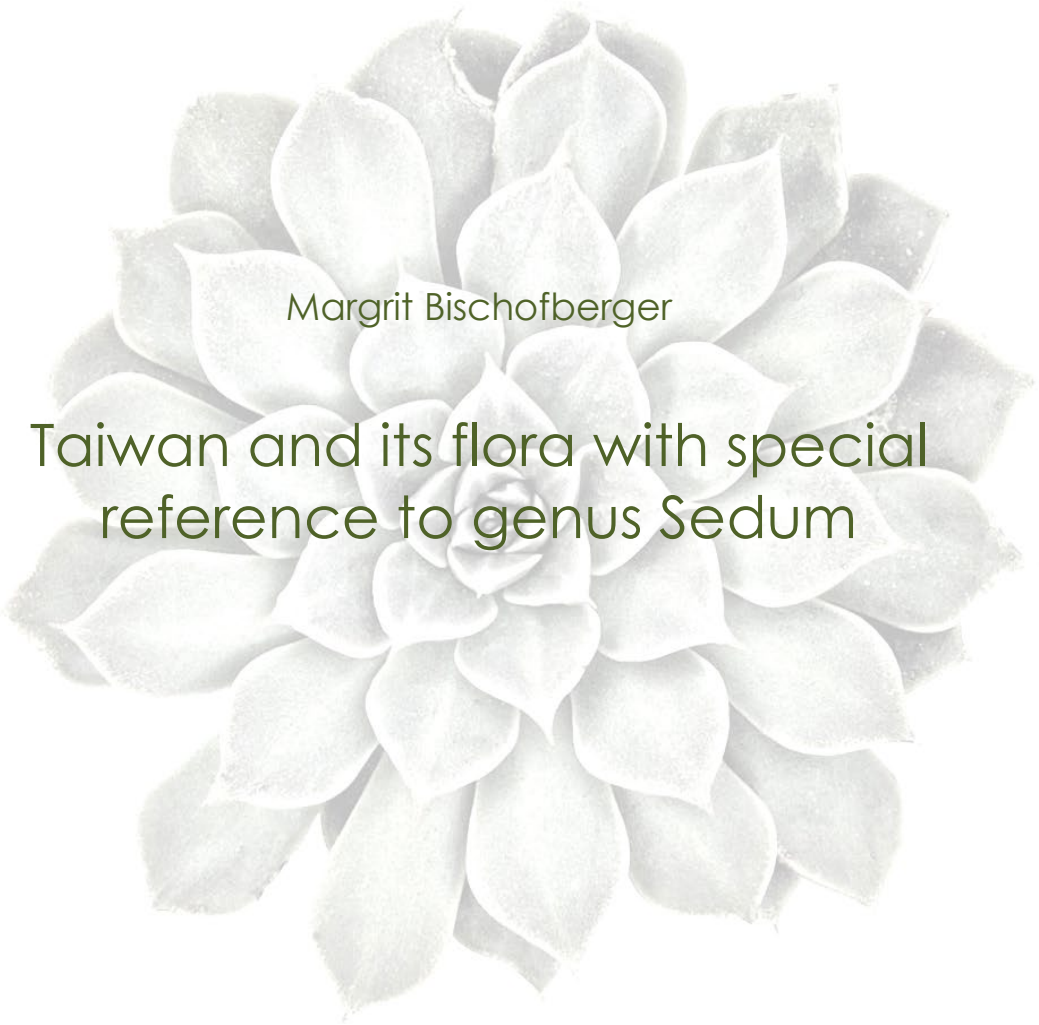
CRASSULACEA

NO. 9 1. NOVEMBER 2024

Miscellaneous notes and observations of the International Crassulaceae Network



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Published by
International Crassulaceae Network - Switzerland
ISSN 2296-1666

Impressum

Publisher International Crassulaceae Network

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Taiwan and its flora with special reference to genus *Sedum*

Margrit Bischofberger

Taiwan, officially the Republic of China (ROC), until after World War II known as Formosa, is a mountainous island in the west Pacific Ocean. It is lying directly under the Tropic of Cancer. It is situated east of the Fujian province in south-eastern China, separated from the latter by the Strait of Taiwan, which at its widest point is ca 220 km broad and only ca 100 m deep. It lies

about 700 miles south of Kyushu, the southernmost large island of Japan and only 80 miles from the most northern island in the Philippines.

With an area of about 36'000 km2 it is a rather small island. The eastern two thirds consist of many rugged ca 80 km broad mountain ranges extending parallel to the east coast with over 200 peaks more than 3000 m high. With almost 4000 m asl Mt. Yu Shan - in the past called Mt. Morrison – is the highest of these peaks. The western third is a plain crisscrossed by chains of hills. The mountains of the Central Range consist of hard rock, extremely steep slopes and deep gorges that make them almost impenetrable. The East Coast Mountain Range however mainly consists of sandstone and shale. (Fig. 1)

Fig. 1 – Relief map of Taiwan

While the south of the island has a tropical climate with almost no seasons, the climate in the north is subtropical with remarkable differences between the seasons. For the longest time of its history the western plains were covered in tropical rainforest which were first cleared in the 17th and 18th century by Chinese immigrants and converted in farmland. The mountains are still largely covered with different types of forest, with alpine plants on the highest peaks. A recent paper by Takuro Ito et al. described Taiwan's climate and flora as follows : "Taiwan has a warm climate characterized by high annual rainfall averaging 2500 mm, owing to its location between

two warm sea currents. Its environment is highly diverse and features many types of vegetation at different altitudes, from the lowlands to alpine regions. The species richness of vascular plants of Taiwan is very high : more than 4000 species are present, and the density of species is comparable to that of Hawaii. The level of endemism in plants is 25%, similar to that of the Galapagos." And regarding genus Sedum they wrote: "Taiwan has the highest levels of endemism for Sedum in East Asia, featuring many species with clear morphological and ecological differences. Sedum species occur in various physical environments, e.g. alpine scree, arid rocky slope, forest floors, mossy rocks, tree trunks in cloud forests, coastal rocks, and exposed limestone , principally at elevations over 1500 m. These environments differ greatly in their levels of light, humidity, and temperature, as well as in their soil properties, salinity and other characteristics."

I History

The island came into existence ca 9 million years ago as a result of the collision of the Eurasian Plate with the Philippine Sea Plate. The tectonic boundary of these two plates is running from north to south of the island and is still active, producing 15'000 – 18'000 earthquakes per year. During the last ice period 110'000 – 10'000 years ago, sea level was temporarily more than 100 m below its present level so that the Strait of Taiwan formed a land bridge between the mainland and the island. Archaeological findings prove that Taiwan was inhabited already 20'000 – 30'000 years ago. Taiwanese indigenous peoples – also called Formosans - are Austronesians, connected in various ways with other Austronesian peoples throughout many parts of east and southeast Asia. They spoke ca 26 different languages, but what they all had in common was that head-hunting and cannibalism were part of their way of life which is why they are often referred to in travel reports as the "savage aborigines".

There is evidence of Chinese farmers on Taiwan ca 5000 years ago. However information about contacts between China and Taiwan during the 1st millennium of our era is scarce; it is said that during the Chinese Sui dynasty (581-618) expeditions were sent to a place called "Liuqiu", most likely identical with Taiwan. And it is known that during the Chinese Yuan dynasty (1271 – 1368) Han-Chinese visited Taiwan and traded with Taiwanese inhabitants. The first written account on Taiwan is by Wang Dayuan and dates from 1349. He described the western part as a mountainous land with huge trees and fertile fields and noted that the inhabitants only had rafts, no boats, traded

Fig. 2 - Sulphur Springs near Tam-suy

with gold, beans, sulphur (Fig. 2) and deer hide, produced a liquor by fermenting sugarcane juice and were cannibals. The eastern part with extensive mountains was inhabited by different people who did no farming and produced no goods.

In the early 16th century Chinese from Fujian province settled in the SW of Taiwan, cultivated the land and traded with the aborigines as well as with Japan. In 1542 Portuguese ships passed by the east coast of the island, the sailors were impressed by the dense thriving forests covering the steep mountain slopes and noted its name on their maps as "Ilha Formosa" (beautiful island). However, by seafarers the "beautiful island" was feared above all: the east coast with its steep cliffs and the absence of harbours was almost inaccessible and also in the south and the north of the island, ships that tried to land were usually shipwrecked. Their crews, if they managed to save themselves on land, in most cases were killed without hesitation.

While the Portuguese had no interest in establishing a base in Taiwan, because they already had a staging post in Macao from where they could trade with China, this was quite different with Japan : In 1609 it sent an exploratory mission to the island and in 1616 seriously wanted to conquer it. A fleet of 13 vessels sailed to the island but never arrived there because it fell victim to a typhoon. Likewise interested were also the Dutch, more precise the Dutch East India Company : Because it was unable to gain a foothold in China itself, it at least tried to do so on Formosa. It was determined to establish a trade and military base from where it hoped to initiate trade with China ; in 1624 it started to build Fort Zeelandia (Fig. 3) on a small islet off the SW coast of Taiwan and later the smaller Fort Provintia on the adjacent Taiwanese mainland. The aborigines inhabiting the western lowlands were not amused by the Dutch presence and it was not before 1635 that the Dutch garrison of the forts succeeded in suppressing the rebellion of the surrounding villages.

Fig. 3 – The Dutch Fort Zeelandia

Regarding trade : Apart from the possibility that Taiwan could at best be used as an intermediary for trade with China, Taiwan itself was interesting particularly because large herds of deer wandered around the plain : their tough skins were in great demand by the Japanese and their nutritious meat was prized by the Chinese. Sugar cane was native in Taiwan, but the aborigines were not able to produce sugar. Therefore the Dutch encouraged the immigration of

mainland Chinese who had mastered sugar production. During the 38 years of Dutch presence in Taiwan 50'000 – 60'000 Chinese became sugar, rice and tea planters on the island. This led to a significant economic upswing. The Spaniards were also interested in Taiwan and established a fort in the north of the island, much to the displeasure of the Dutch, who eventually succeeded in driving them out again. The presence of the Dutch however was of relatively short duration.

Fleeing the Manchurian conquest of the Chinese Ming dynasty (1368-1644), Ming loyalists under the pirate Zheng Cheng-gong, or Koxinga, in 1662 defeated and expelled the Dutch from Taiwan and established a kingdom which in turn was defeated in 1683 by the Qing dynasty who took control of the island's western and northern coastal areas, making Taiwan first a prefecture under the administration of the Fujian province in 1684 and in 1885 a province of the Quing Empire. During its more than 200 years rule Chinese settlements spread over the entire western plains, and the population on the island grew to over 2 million people. The Qing regime came to an end when the Chinese unexpectedly lost the first Sino-Japanese war of 1894-95. Japan waged this war against China to put an end to its influence in Korea. In the treaty of Shimonoseki China was forced to cede Taiwan to Japan. Though Taiwan nominally had belonged to China for more than 2 centuries, the Chinese of the island had never felt part of the Qing dynasty and were shocked that China used them as a war pledge and that they were to become a Japanese colony. The opposition on the island was extremely violent, troops and residents fought against Japan for more than 5 months and local rebellions and partisan attacks continued for more than 10 years in the course of which more than 20'000 people were killed and 200'000 – 300'000 inhabitants fled. The aboriginal population was expropriated and pushed back in the forested mountainous areas, their resistance lasted until the 1930s. Chinese farmers faced the choice to either sell and leave their estate or to take Japanese citizenship. On the other hand the Japanese government did everything to make immigration to Taiwan appear favourable to the Japanese with the result that in the 1940s ca 350'000 Japanese were living on the island. With Japan's defeat in 1945, the Japanese occupation of Taiwan ended and the majority of the Japanese left the island.

II Botany

Collectors

Before China had to cede Taiwan to Japan, only European and American naturalists had been studying its flora and fauna, collecting plant and animal specimens which they sent home (with one exception : The Japanese botanist Manjirô Kurita (1833?-1900) is reported to have collected 1874 in the south of Taiwan). Most of them had previously collected in China. Among them are some famous names :

Robert Fortune (1813-1880), a very skilled Scottish gardener, superintendent of the hothouse department of the Royal Horticultural Society at Chiswick, was appointed 1843 by the Society as its collector in China to "collect seeds and plants of an ornamental or useful kind". He was so successful that after his return he was commissioned by the British East India Company 1848 to return to China, entrusted with the task of breaking the Chinese monopoly of tea production by unveiling the closely guarded secrets of tea-making. (This had become possible because after its defeat in the 1st Opium War China had been forced to grant foreigners somewhat easier access to the interior of the country.) Fortune succeeded in gaining knowledge of the

traditional techniques of tea-making and in collecting seeds, and in 1851 sailed for Calcutta bringing along 2000 tea plants, 17'000 seedlings and six expert Chinese tea makers. In 1852 the Company sent him again to China to collect more seeds and plants. In 1860 he left England for his forth journey in the course of which he also visited Japan and Taiwan where he only collected plants on the seashore.

Robert Swinhoe (1836-1877), born in Calcutta and educated in England (Fig. 4), joined the ministry of foreign affairs as interpreter and arrived in Hong Kong 1854. A year later he was transferred to the old seaport Amoy which traded actively with Taiwan. Like China, also Taiwan at the time was off-limits to all foreigners, moreover it was infamous for its head-hunting aborigines and the anti-foreign Chinese population. Nevertheless in 1856 Swinhoe visited the NW coast of the island. Persistent rumours of 2 survivors of a shipwreck in 1847 prompted the British authorities to order HMS Inflexible to investigate in 1858 with Swinhoe accompanying it as interpreter. The circumnavigation and also some overland excursions however were in vain.

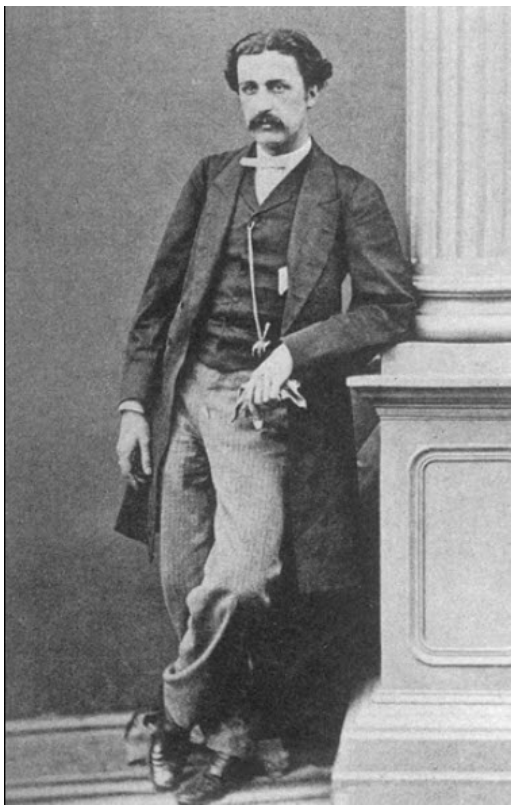


Fig. 4 - Robert Swinhoe

In the treaty of Peking (1860), following the defeat of the Chinese Qing government in the 2. Opium War, the latter had to open six new ports, one of them in Taiwan. Due to its knowledge of the island, Swinhoe was appointed Vice-Consul to Taiwan and on 2 July 1861 arrived at Taiwan-fu, the prefectural capital (today Tainan). In November 1861 he removed the vice-consulate to Tamsui, in the north of the island. In 1865 he was promoted full consul. He returned to Amoy 1866. Swinhoe was the first person who systematically collected animal and plant specimens in Taiwan. He named more than 1000 species of animals of all kinds and of plants, thus documenting the biodiversity of the island, and published scientific descriptions. His focus was rather the fauna but he also collected plants for Kew and for Henry Fletcher Hance, at the time British vice-consul at Huangpu (then Whampoa).

Charles Wilford was assistant at the Herbarium of the Royal Botanic Gardens, Kew, (d. 1893). Wilford's mission was to collect plants, first in Hong Kong, then in Taiwan, Korea and later also in Japan. In the NE of Taiwan he collected, among others what later was identified by N.E. Brown as *S. formosanum* (nr 523). He also participated in the British naval vessel H.M.S. *Inflexible's* circumnavigation of the island of Taiwan in 1858. Most of his specimens are at Kew.

Richard Oldham (1837-1864), a gardener, was also sent out as a botanical collector by the Royal Botanic Gardens, Kew to China and Japan, sort of successor to Wilford. In 1864 he, too, visited Taiwan as guest of Swinhoe, the British consul. He collected in the north and northwest of the island, and sent specimens back to Kew, among them also what later was identified by N.E. Brown as *S. formosanum*, this time collected in Tamsui (nr 255). He sent ca 13'000

specimens to Kew, duplicates of which are at the Muséum national d' Histoire naturelle, Paris, and at the Botanic Gardens of St. Petersburg.

Reverend **William Campell** (1841-1921), a Scottish Presbyterian missionary to Formosa, collected together with the two American professors Harrington and Steere mainly in central Taiwan. His specimens are at the British Museum, duplicates at Kew. The latter,

Joseph Beal Steere (1842-1940), son of an Irish quaker, a naturalist and explorer, Collector in Natural History for the State Museum of Michigan, US, spent six months on the island.

William Hancock (1847-1914) was an northern Irish botanist and customs officer in China. He travelled widely and was collecting also in Taiwan 1881-1882 from where he sent specimens to the Botanic Gardens of St. Petersburg and to Kew.

Thomas Watters (c. 1840-1904), also an Irishman, in fact the greatest authority on Buddhism of his time, was Acting British Consul in China. He first came to Taiwan in 1866 and assisted Robert Swinhoe, later procuring bird and other specimens for him when the latter had left Taiwan. During 1881-1883 he, too, collected plants for Henry Fletscher Hance and for Kew, mainly in Tamsui and Keelung. He was also one of the collectors who worked for Augustine Henry.

Charles Ford (1844-1927), a British gardener and forester, was Superintendent of the Botanical and Afforestation Department, Hongkong. He spent a short time in the north of Taiwan and collected at Tamsui and on rocks and cliffs near Keelung where in June 1884 he found and sent to Kew what N.E.Brown in the same year described and published as *S. formosanum*.

Fig. 5 – Dr Augustine Henry

And last but not least **Dr Augustine Henry** (1857-1930) (see SSN 136: 4-6, 2020), an Irish medical doctor, plantsman and sinologist (Fig. 5), entered the Chinese Maritime Customs in 1881 as medical officer. In 1891 he became an official of the Customs Department and was sent to Taiwan in 1892 where he collected extensively until 1895, mainly in the south of the island, also engaging native helpers. He sent more than 158'000 specimens to Kew and determined them after his return to the United Kingdom. In 1896 he published in Japan *A list of plants from Formosa*, including all plants collected by Europeans and Americans since 1854. This was the first systematic documentation of Taiwan's indigenous flora. However he emphasised again and again that his list was by no means complete because of "how deficient is our knowledge of the plants of the mountainous region ..... the mountainous half of the island is practically unexplored and many more species remain to be discovered. In fact, I estimate that only half the plants of the island are now known". The list contains only

plants occurring up to 1000 m asl, because in view of the "savage aborigines" inhabiting the higher regions and practising head hunting, collecting there was not advisable ! Nevertheless 1328 native plants were listed "consisting of 1182 flowering plants, 131 fern and 15 fern-allies". Regarding *Crassulaceae* Henry noted :

"346. *Kalanchoe gracilis*, Hance. South-west, Takow ; Swinhoe, Gregory, Playfair, Henry.
347. *Sedum formosanum*, N.E. Br. Tamsui : Oldham. On rocks near the sea, Kelung : Ford.
348. *Sedum sp*. South Cape : Henry 345.
349. *Sedum sp*. Takow : Henry 1.186."
The collections of all these plantsmen, stored in European herbaria, were studied by Hance, Maximowicz, Hemsley and many other botanists. Henry was the latest European botanist who extensively studied the island. After the colonisation of the island by Japan, it was Japanese botanists who began to work there.

Japanese colonisation

When the Japanese annexed Taiwan, their knowledge of the island was very rudimentary, due to only few Japanese ever having visited it. What they knew about Taiwan they had taken from the travelogues of the above mentioned plant collectors and from reports of missionaries who, as just explained, with very few exceptions had never ventured into areas above 1000 m in order to avoid the risk of falling into the hands of the head-hunting savage aborigines, but had restricted themselves to the western hills and plains. While the Chinese never had been interested in ruling the areas where the aborigines lived – and that was the greater part of Taiwan – the Japanese were decided to subjugate the whole of Taiwan, particularly also the unknown large mountainous regions, famous – among others - for their timber wealth, immense forests of camphor trees covering the flanks of the snow-capped mountains and wells of petroleum. So for the new colonial power botanical research was of primary importance. However the state of botany in Japan left a lot to be desired. This was due to a more than 200 years long isolation during which European nations were no longer allowed to trade with Japan. The only exception were the Dutch who however were also not permitted to enter Japan but had to stay in a trading post on a small artificial island off the coast near Nagasaki. Moreover Japanese were not allowed to leave the country or to return from overseas. The aim was to prevent western ideas and ideals from reaching Japan. The isolation was so effective that by the end of this period (1868) Japan had actually lagged far behind the West regarding the level of sciences and technology. This backlog should now be made up as quickly as possible : hundreds of western experts were invited to visit Japan and share their knowledge and young Japanese were encouraged to study abroad.

Japanese botanists

In 1877 the University of Tokyo was founded. A chair of Botany was established and **Ryokichi Yatabe** (1851-1899) was appointed the first professor of Botany. In 1871, at the age of 20, Yatabe had moved to the United States of America as an official of the Ministry of Foreign Affairs, but as his true purpose had rather been the pursuit of knowledge he had sought admission to Cornell University and had become its first Japanese student. From 1871-1876 he had studied various subjects, including botany (also at Harvard University). Back in Japan 1877 he was offered the newly created Chair of Botany. He became also the director of the botanical gardens and later a founding member of the Botanical Society of Japan.

Fig. 6 - Jinzo Matsumura

His successor at the Imperial University of Tokyo was **Jinzo Matsumura** (1856-1928). In 1883 he was employed as assistant professor of Botany under Ryokichi Yatabe and afterwards went to Germany to study botany at the universities of Würzburg and Heidelberg (1886-1888). Back home, after the suspension of Ryokichi Yatabe, he became the second professor of Botany. (Fig. 6) He was personally deeply interested in the Taiwanese flora and ensured that, between 1896 and 1900, commissioned by the University, three teams were sent to Taiwan for botanical survey, consisting of the botanists C. Owatari, K. Miyake and Tomitaro Makino (1862-1957), for whom *Sedum makinoi* is named. Their collections were immediately studied by Matsumura, obviously the driving force behind the botanical exploration of Taiwan.

Already in 1905 the new Government of Formosa for its part had begun to send out expeditions to investigate the natural products of Taiwan. The first to be mentioned is **Yasusada Tashiro** (1856-1926). He was born in Kagoshima, Japan. In 1884 he was ordered by the Ministry of Agriculture and Commerce to visit the International Horticultural Expedition at St. Petersburg. There he studied botany and before returning to Japan he also studied in Belgium, Germany and France. From 1895 – 1910 he worked for the Government of Formosa and conducted research concerning the utilisation of Taiwan's natural resources visiting several regions of the island and collecting specimens which he also sent to Matsumura.

However during the first years of the Japanese occupation of Taiwan no great progress was made regarding the study of its botany : Research was confined to the lowlands because it was almost impossible to get into the mountains which were still ruled by the head-hunting indigenous people. In 1904 the Government decided that henceforth the botanical survey should be extended to the whole island. Military campaigns were launched to suppress the resistance of the aborigines, and gradually the Japanese succeeded in controlling the mountains so that it was possible for researchers to penetrate into hitherto unknown higher regions. On behalf of the Government several excursions were carried out in 1905 and 1906. The botanist **Takiya Kawakami** (1871-1915), who was also working for Matsumura's Department of Botany at the University of Tokyo, was employed. Together with several assistants **(**S. Nagasawa, G. Nakahara and U.Mori) he investigated for the first time Mt. Morrison, the highest peak of the island, and also some other mountains of the Central Mountain Range. They brought back a wealth of new plants. In 1910 Kawakami published a *List of plants of Formosa*, recording 2368 species – 2199 native and 170 introduced – an enormous increase compared with Henry's publication. The plants mentioned in this list were collected either by botanists hired for this purpose by the Government of Formosa or by independent botanists.

Fig. 7 - Prof. Bunzo Hayata

The most important botanist regarding the flora of Taiwan is **Bunzo Hayata** (1874-1934) (Fig. 7). He had been interested in botany from an early age. His first botanical trip to Taiwan was in the summer of 1900, before he began to study botany at the Imperial University of Tokyo, as a student of Prof. Dr. J. Matsumura. In May 1905 he was employed by the Government of Taiwan to identify and classify the specimens which the Government's botanists had assembled in the course of the survey of useful plants on the island in the ten years since Taiwan had become a colony of Japan. And as it was obvious that since the publication of Augustine Henry's *List of plants from Formosa* in 1896 many new plants had been discovered, in 1906 Matsumura and Hayata considered it necessary to issue a new and more complete list, the ***Enumeratio plantarum in insula Formosa***, still comprising however only the flora of the low altitudes. Concerning *Crassulaceae* the new list indicated *Bryophyllum calycinum* Salisb., collected by T. Makino et al. in the N and NW of Taiwan several times*, Kalanchoe gracilis* Hance (cited from Henry)*, K. spathulata* DC, collected by T. Makino at Keelung and Shintiku, and *Sedum formosanum*, collected by K. Miyake, 1899 on the island of Kotosho, and by U. Faurie "in rupibus Kelung" 1903 (nr 183).

When, as mentioned above, botanical excursions to Mt. Morrison and other peaks in that part of Taiwan had been carried out and provided a wealth of new material, Hayata considered it necessary to supplement the *Enumeratio* with a publication on this mountainous region (although the larger part of the island was still unknown) : In 1908 appeared his ***Flora Montana Formosae*** which includes the First Description of *S. morrisonense*, collected by S. Nagasawa,

Nov. 1905 (nr 566) "ad summam montis Morrison, ad 13094 ped. alt." and mentions another *Sedum* species and a *Kalanchoe*, both from Mt. Morrison, collected by T. Kawakami and U. Mori Oct. 1906 at ca 2'000 m asl., however not identifiable.

Not surprisingly the flora of Formosa is closely related to the floras of Japan and of China. The herbarium at Tokyo included nearly all Japanese plants, so Hayata could easily find out which of the newly found Taiwanese plants corresponded to plants occurring in Japan and had already been identified and classified. Regarding the Chinese flora, the situation was different : The Japanese herbarium at Tokyo held only very few specimens of Chinese plants. But of course it was equally important to know which of the newly found Taiwanese plants had already been gathered – possibly long ago – by European plant hunters in China and subsequently been described and named by European botanists. Therefore in 1910 Hayata decided to go to Europe to visit the relevant herbaria, first of all Kew, where he wanted to study the Chinese herbaria, then Paris, where he wanted to check the Chinese collections **Adrien René Franchet** (1834-1900) had worked on, i.e. *Plantae Davidianae ex Sinarum Imperio* and *Plantae Delavayanae*, afterwards Berlin-Dahlem and last St. Petersburg where the collections of the chief botanist at the Botanic Gardens **Carl Maximowicz** (1827-1891) were stored (the latter had collected in the region of the Amur and Ussuri rivers, in Manchuria and Japan), in order to compare the specimens with the newly collected material he carried with him. The result : His assumption was confirmed - many of his new plants were species that had not yet been described. And that his trip to Europe was a success is reflected in the two books he published 1911, immediately after his return: ***Materials for a Flora of Formosa*** and the first of ten volumes of ***Icones plantarum formosanarum***. In the 2. vol., published 1912 (p. 11-13) Hayata listed the following *Crassulaceae : Bryophyllum calycinum* Salisb*., Kalanchoe gracilis* Hance*, K. spathulata* DC*, Sedum formosanum* N.E.Br. – all already indicated in Matsumara & Hayata's *Enumeratio plantarum formosanarum* - and published the description of *S. morrisonense* Hayata.

In 1912 Hayata undertook two extensive botanical excursions in Taiwan which had a decisive influence on the conception of the following volumes of the *Icones plantarum formosanarum* the final part of which appeared 1921.

In vol 3, issued 1913 (p. 110-112), the descriptions of the following *Sedum* species are published : *S. erythrospermum* Hayata, *S. microsepalum* Hayata, *S. subcapitatum* Hayata, *S. obtuso-lineare* Hayata and *S. sasakii* Hayata. And mentioned is *S. drymarioides* Hance, coll. by U. Faurie, 1903 at an unknown locality. In vol. 6 (1916) the description of *S. uraiense* Hayata is published. In vol 8 (1919) Hayata's description of *Kalanchoe takeoi* - now in the synonymy of *K. ceratophylla* - was published.

Fig. 8 - Urbain Faurie

In 1922 Hayata became the third Professor of Systematic Botany at the Imperial University of Tokyo, succeeding Jingo Matsumura. The aforementioned publications and journal articles by Hayata on Formosa's flora attracted the interest of European botanists. They were eager to participate in the study of the Taiwanese flora and urged the French missionary **Urbain Faurie** (1847-1915) (Fig. 8) to collect plants for them. Faurie was a catholic priest from the Missions Étrangère de Paris (Paris Foreign Missions Society) who after his ordination in 1873 had been sent to Japan. During his missionary journeys through the islands he tirelessly collected plants and amassed a collection of several hundred thousand specimens, at the same time selling plants to the great herbariums of Europe, the United States and Japan in order to raise money for his missionary works, i.e. for building churches. Faurie already knew Taiwan from a visit he had paid to the island in 1901. He did not mind leaving Japan and moved to Taiwan in 1913 where he stayed until his death in 1915, incessantly collecting and preparing specimens. Hayata, who was his friend, attested him an incredible assiduity. He wrote: "He travelled in all seasons. He would climb any mountain however difficult, if he thought it botanically interesting. Quite alone, with his pressplates and very simple provisions on his back, he would travel and work for many days in the mountains, sleeping at night perhaps in a tree or under a crag. ... His love of plants became ever more intense, and in his advanced years, he devoted himself entirely to making collections .... In all parts of Formosa, except where the presence of dangerous savages prevented, he travelled, traversing pathless peaks and precipitous valleys."

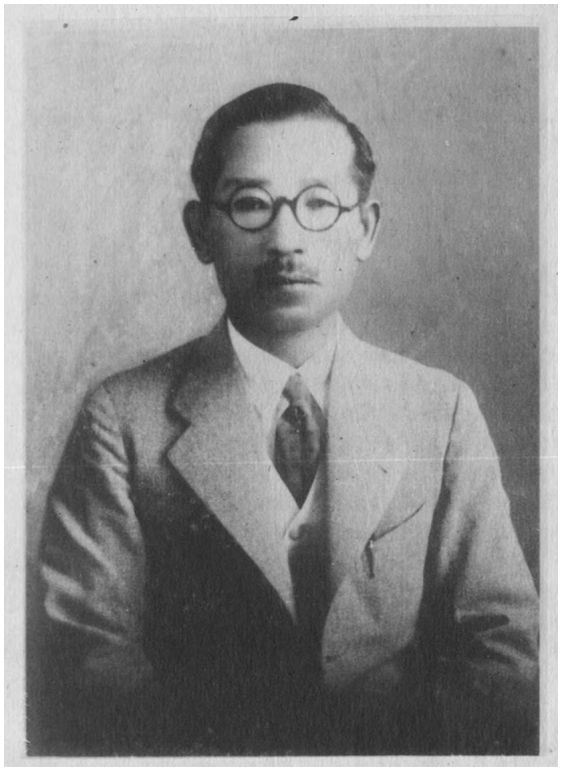


Fig. 9 - Yoshimatsu Yamamoto

After his promotion to Professor of the Department of Botany and assumption of the Director of the Botanical Garden Hayata had to give up his work on the Taiwanese flora. He had described over 1600 different plants, the majority of them from Taiwan where he had been botanising more than ten times. Bunzo Hayata is considered the founding father of the study of the flora of Taiwan.

His successor was **Yoshimatsu Yamamoto** (1893-1947) (Fig. 9). He had been his first student in the

Department of Botany. He graduated in 1923 and became Hayata's assistant from 1923-1928, afterwards assistant professor at Taihoku University of Taiwan. From 1933-1934 he studied in the United States and in England. From 1945-1947 he was ordinary professor of Botany at the National Taiwan University. Regarding the flora of Taiwan : most important are his 5 volumes of ***Supplementa iconum plantarum formosanarum*** (1925 – 1932) with descriptions of species newly discovered since 1922, thus providing a supplement to Hayata's *Icones plantarum formosanarum*. Vol. 2 (1926) includes the descriptions of the following *Crassulaceae* species : *S. actinocarpum* Yamamoto, *S. arisanense* Yamamoto , *S. brachyrhinchum* Yamamoto, *S. nokoense* Yamamoto, *S. parvisepalum* Yamamoto, *S. sekiteiense* Yamamoto and *Kalanchoe tashiroi* Yamamoto. (The latter was collected by Y. Tashiro on Kotosho, a small volcanic island off the southeastern coast of Taiwan. It is similar to *K. spathulata* but the shape of its leaves is different.) Also listed are : *Sedum alfredii* Hance, ***S. drymarioides Hance***, *S. formosanum* and *S. japonicum*.

After World War II

The majority of the *Sedum* species mentioned so far was described by Japanese botanists, the last one being *S. cryptomerioides* Bart. & Yamam. published 1932 – in total 14 species. After Japan's surrender 1945 China re-annected Taiwan. Most of Taiwan's ca 300'000 Japanese residents were expelled. Taiwan was placed under martial law and military concerns had priority. So it is no surprise that it was not until 1975 that the first volume of a ***Flora of Taiwan*** was edited. Regarding *Crassulaceae* (vol. 3 1977) the responsible authors Tang-Shui Liu and Nian-June Chung indicated 1 species of genus *Bryophyllum* (*B. pinnatum*), 4 species of genus *Kalanchoe (K. garambiensis, K. gracilis, K. spathulata* and *K. tashiroi)* and 14 species of genus *Sedum* – all taxa described by Hayata and Yamamoto and additionally some previously published ones - inexplicably without ever mentioning the type:

S. actinocarpum Yamam.*,*
S. alfredii Hance (incl*. S. formosanum* N.E.Br.)*,*
S. drymarioides Hance (incl*. S. uraiense* Hayata)*,*
S. erythrospermum Hayata (incl*. S. arisanense* Yamam. and *S. brachyrhinchum* Yamam.*),*
S. japonicum Sieb. ex Miq.
S. lineare Thunb*.* (incl*. S. obtuso-lineare* Hayata*),*
S. microsepalum Hayata (incl*. S. parvisepalum* Yamam.),
S. morrisonensis Hayata (incl*. S. cryptomerioides* Bart. & Yamam.),
S. nokoense Yamam.*,*
S. sekiteiense Yamam.*,*
S. subcapitatum Hayata*,*
S. triangulosepalum Liu & Chung*,*
S. truncatistigmum Liu & Chung and
S. uniflorum Hook. & Arn. (incl. *S. sasakii* Hayata)*.*

Already in 1993 the 3. volume - including *Crassulaceae* - of the 2. edition was published, with Liu and Chung again responsible for genera *Kalanchoe, Bryophyllum* and *Hylotelephium*, and - newly - Wei-Shin Tang and Tseng-Chieng Huang for genus *Sedum*. While *Bryophyllum pinnatum*

and *Kalanchoe garambiensis, K. gracilis* and *K. spathulata* are cited in the same way as in the 1. ed., *K. tashiroi* is treated as an "uncertain species". And *S. subcapitatum* Hayata is now listed as *Hylotelephium subcapitatum* (Hayata) Ohba. As far as genus *Sedum* is concerned, the new treatment differs considerably from that of the 1. ed. :

S. actinocarpum Yamam.
S. bulbiferum Makino
S. cryptomerioides Bart. & Yamam.
S. drymarioides Hance (incl. *S. uraiense* Hayata)
S. erythrospermum Hayata (incl. *S. arisanense* Yamam. and *S. brachyrhinchum* Yamam.)
S. formosanum N.E. Br.
S. mexicanum Britt. (incl. *S. obtuso-lineare* Hayata)
S. microsepalum Hayata (incl. *S. triangulosepalum* Liu & Chung and *S. truncatistigmum* Liu & Chung)
S. morrisonense Hayata
S. nokoense Yamam. (incl. *S. taiwanianum* Ying)
S. parvisepalum Yamam.
S. sekiteiense Yamam.
S. stellariifolium Franch.
S. uniflorum Hook. & Arn. (incl. *S. sasakii* Hayata)

(S. alfredii is omitted because according to Ohba (1984) "the specimens cited by Yamamoto are not identical with the type of *S. alfredii* at all".)

The only new species is *S. taiwanianum* Ying, 1986. Since that time 4 new descriptions have been produced : *S. tarokoense* Lin & Wang, 2013 and S. *nanshanchunense* Ying, 2021, beyond dispute two distinct species, and *S. kwanwuense* Lin, Wang & Lu, 2019, and *S. taiwanalpinum* Lin, Wang & Lu, 2019 – two species which may at best be regarded as varieties of already published ones or possibly rather as synonyms.

Fig. 10 – Taiwan Counties

Currently accepted Taiwanese Sedum species and their synonyms

(All illustrations copied from the 2. ed. of *Flora of Taiwan*, 1993.)

1. ***Sedum actinocarpum*** Yamam., 1926

Description :

An annual, fleshy, glabrous species.

Stems 10-18 cm high, slender, erect, simple, di- or trichotomously branched upwards.

Leaves alternate, rarely opposite, spatulate, apex rounded-obtuse, base obtuse, 8-27 x 4-11 mm, entire.

Flowers 5-merous, yellow, in cymes, sessile.

Sepals unequal, 2.5-4.5 x 2-3 mm, spatulate, oblanceolate.

Petals elongate-oblong or lanceolate, 4 x 1.5 mm, apex acuminate.

Flowering and fruiting time February – May

Pl. 8. Sedum actinocarpum Yamamoto (CRASSULACEAE)

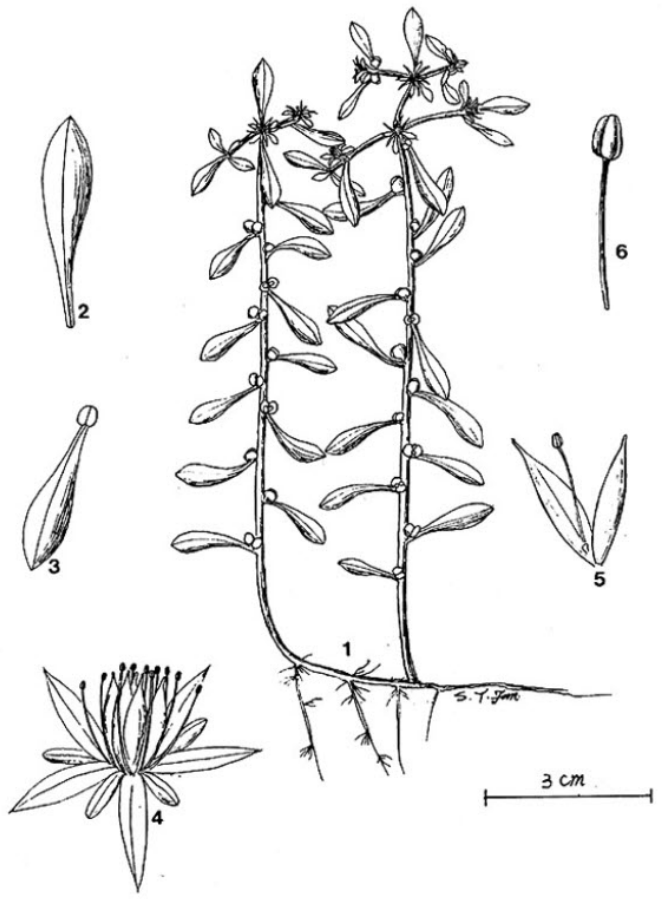
1. habit; 2. leaves; 3. flower; 4a. immature stamen; 4b. mature stamen; 5. petal and stamens; 6. follicle; 7. seed.

The type was collected by Hayata in 1917 in prov. Taihoku (in the past consisting of modern-day Keelung, New Taipei City, Taipei and Yilan County), U. Faurie found it in the same region in 1914. Occurring at altitudes 200 – 2500 m, in Taipei, Kaohsiung, Taitung, Hualien and Yilan County and in Keelung City, mainly on the E and NE sides of the central chain of mountains; endemic to Taiwan.

S. actinocarpum is closely related to *S. erythrospermum*, the latter however is occurring on higher elevations of the central chain of mountains. Whether an occurrence on different altitudes justifies the classification as two distinct species is debateable.

2. *Sedum bulbiferum* Makino 1891

Description :
A fleshy biennial or perennial with axillary **bulbils** consisting of 1-3 pairs of small, fleshy, scale-like leaves.
Stems erect or ascending, often branched from the base.
Leaves alternate, but opposite at the stem base, ovate-spatulate to spatulate-oblanceolate, spurred, 4-20 x 2-10 mm, apex obtuse, sometimes mamillate towards the tip.
Flowers 5-merous, yellow, in 20 cm tall cymes with 1-3 often forked cincinni, subsessile.
Sepals unequal, 2-6 mm long, basally free, shortly spurred, broadly lanceolate to oblanceolate, mamillate.
Petals lanceolate, shortly and narrowly mucronate, 3.5-5 mm long.
Flowering April – June, normally no seeds, reproduction by the axillary bulbils.



Pl. 9. Sedum bulbiferum Makino (CRASSULACEAE)

1. habit; 2. leaf; 3. leaf with a bud; 4. flower; 5. portion of flower; 6. stamens.

S. bulbiferum was described by **Tomitaro Makino** (1862-1957) as early as 1891 from plants in Japan, i.e. before the annexion of Taiwan by Japan. Makino was a self-taught botanist. His botanical career began when he met Ryokichi Yatabe, professor of Botany at the university of Tokyo, who permitted him to use the research facilities of the university for his studies. He

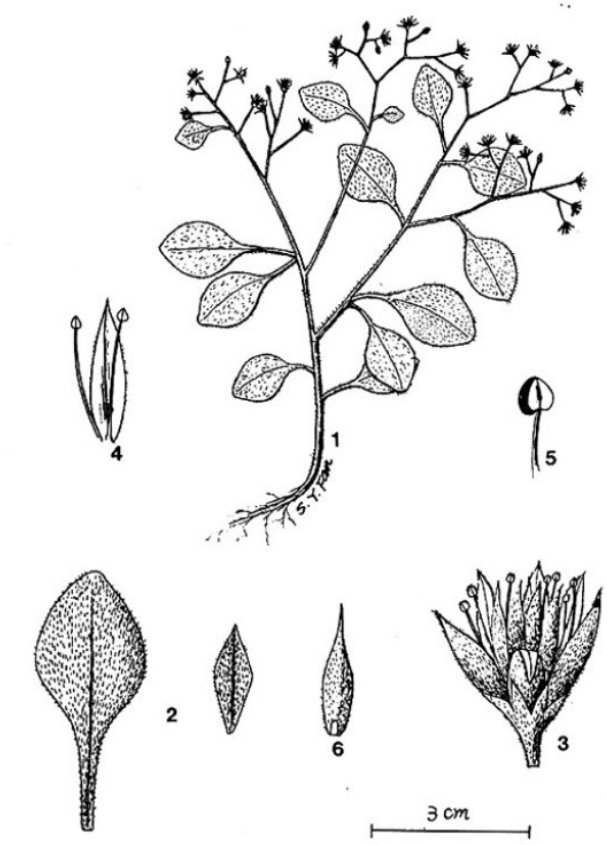
founded *The Botanical Magazine* and the *Journal of Japanese Botany* and published multi-volume works on the flora of Japan, most skilfully illustrated by himself. He is revered to this day as the Father of Japanese Botany.

S. bulbiferum is also reported from SE China and Korea. In Taiwan it is naturalized in Chitou, Nantou County. It is growing in shaded places in lowlands, from near sea level to 1000 m asl.

Fröderström treated *S. bulbiferum* as a variety of *S. alfredii* because – apart from the bulbils – it agrees in all important features with the latter.

3. *Sedum drymarioides* Hance, 1865

Description :
A glandular-pubescent annual or biennial species.
Stems creeping at base, then erect, to 20 cm tall.
Leaves opposite or verticillate, broadly ovate, 1.5-2 x 1.3-1.5 mm, obtuse, abruptly cuneate at base, with 5-8 mm long petioles.
Flowers 5-merous, white, flowering branches ascending, to 25 cm, much branched, pedicels 2-5 mm.
Sepals densely hairy outside, glabrous inside, oblong-triangular, 1.5 x 0.7 mm, apex obtuse.
Petals lanceolate, 3-3.5 x 0.7-1 mm, apex acuminate.
Flowering and fruiting April – May.



Pl. 11. Sedum drymarioides Hance (CRASSULACEAE)

1. habit; 2. leaves; 3. flower; 4. petal and stamens; 5. stamen; 6. pistil with a gland.

S. drymarioides was described from a plant collected by T. Sampson, June 1865, in the province Kwantung (Guangdong) in southern China, growing in damp clefts and hollows of isolated limestone rocks; it is widespread in southern and western China and it is also occurring in Japan. Regarding Taiwan : The specimens Yamamoto indicated were collected by E. Matsuda in "mont. Nokozan, prov. Taichu", Aug 1919 and also in "mont. Niitaka" in the same province. According to the *Flora of Taiwan* (1993) it is occurring only in Wulai, Taipei County and is rather rare.

S. uraiense Hayata, collected by U. Faurie, April 1914 "in petrosis rara" (nr 810) in Urai (also Taipei County), was published in 1916 and is considered synonymous with *S. drymarioides* Hance, differing – according to Hayata – from the latter only in having much longer petals.

4. *Sedum erythrospermum* Hayata, 1913

incl. *S. arisanense* Yamam. 1926 / incl. *S. brachyrhinchum* Yamam. 1926 and possibly also *S. taiwanalpinum* Lin, Wang & Lu 2019

Description :

An annual, fleshy, glabrous species.

Stems 6 – 8 cm high, branched from the base.

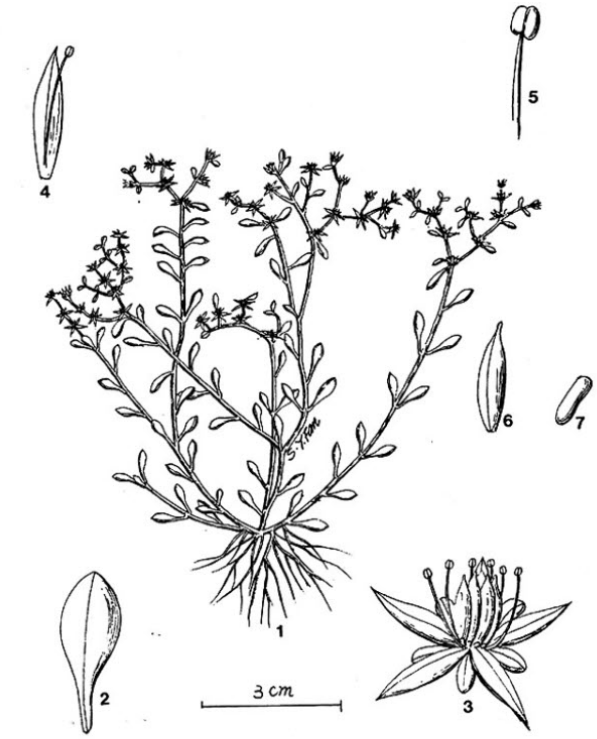
Leaves verticillate or opposite, obovate-spatulate, rounded – obtuse at apex, elongate-obtuse at base, 7-12 x 3-6 mm, entire.

Flowers 5-merous, yellow, in dichotomously divaricate cymes, sessile.

Sepals unequal 2 x 0.5 mm, oblanceolate to spatulate.

Petals lanceolate, 3.5 x 2 mm, apex acute.

Flowering and fruiting time July – October.



Pl. 12. Sedum erythrospermum Hayata (CRASSULACEAE)

1. habit; 2. leaf; 3. flower; 4. petal and stamen; 5. stamen; 6. pistil; 7. seed.

The type was collected by U. Mori (s.n.) on Mt. Morrison (today Yu-shan). Occurring on mountains at 2500 – 3500 m in Hsinchu, Taichung, Nantou, Chiayi, Pingtung, Hualien and Yilan County, endemic to Taiwan. *S. erythrospermum* is closely related to *S. actinocarpum*, growing however on higher elevations than the latter. Whether the occurrence on different altitudes justifies the classification of two distinct species is debatable.

S. arisanense Yamam. was collected "in mont. Arisan, ad 2500 m, prov. Tainan" by U. Faurie (nr 555), June 1914; ***S. brachyrhinchum*** Yamam. was collected in "Montibus centralibus" by U. Mori, Dec. 1908.

S. taiwanalpinum Lin, Wang & Lu, 2019, is stated to be resembling *S. brachyrhinchum* Yamam. and may therefore also belong in the synonymy of *S. erythrospermum*.

A form with alternate leaves, trichotomously branching cymes and 4-merous flowers, occurring on the Luzon Island, Philippines, was described by Ohba in 1977 as **ssp. *australis*.**

https://www.crassulaceae.ch/de/artikel?akID=182&aaID=2&aiID=E&aID=5864

5. Sedum formosanum *N.E. Br., 1885*

Description :

Annual to biennial, fleshy, glabrous.

Stems erect, rather stout, 10-15 cm high, branching di- or trichotomously from near the base, densely leafy.

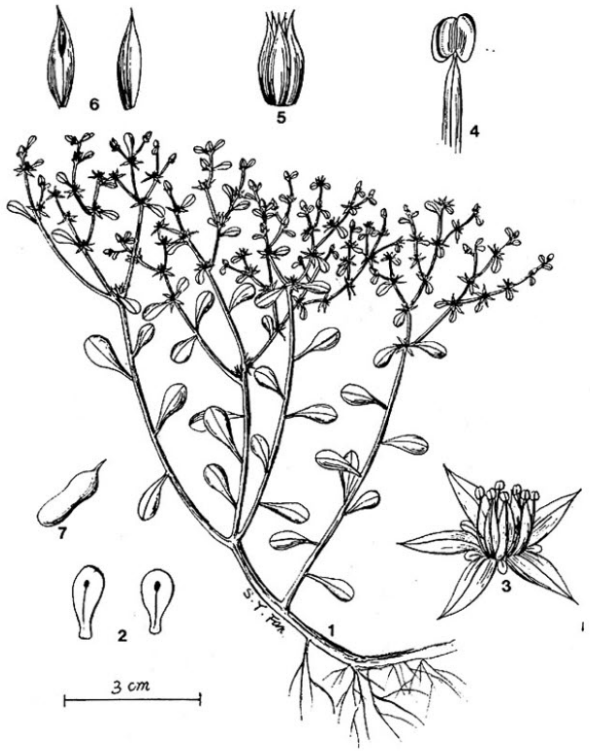
Leaves alternate, spatulate to obovate, 10-15 x 8-12 mm, broadly rounded at apex, obtuse to cuneate at base.

Flowers, 5-merous, yellow, in large many-flowered cymes, sessile.

Sepals unequal, linear-lanceolate, 2-3 mm long, apex obtuse.

Petals lanceolate, acuminate, 6-7 mm long.

Flowering and fruiting time April – June.



Pl. 13. Sedum formosanum N. E. Br. (CRASSULACEAE)

1. habit; 2. leaves; 3. flower; 4. stamen; 5. pistil; 6. follicles; 7. seed.

As mentioned above, *S. formosanum* was first collected by Charles Wilford in northeast Taiwan in 1858 and 6 years later by Richard Oldham in Tamsui in northwest Taiwan. However it was described only much later, in 1885, by Nicholas Edward Brown, when a plant flowered in the Succulent House at Kew, originating from a third collection by Charles Ford in 1884 on rocks and cliffs near the sea at Keelung, i.e. again in the northeast of the island. Brown considered it useful for outdoor effect what may have been the reason for publishing his description in the Gardeners' Chronicle.
Occurring on seashore on the bases of coastal cliffs, in crevices of coral rocks and along river beds in Taipei, Yilan, Pingtung and Taitung County and in Keelung City; it is not hardy. It is also present in Japan, the Korean archipelago and the Philippines.
S. formosanum is similar to *S. alfredii* (Fröderström called it "an adapted beach form of *S. alfredii*" and Fu & Pu (1984) even included it in *S. alfredii*) by having also spatulate leaves and yellow flowers, but is distinguished by erect carpels and large, loose inflorescences. It is one of the few east Asian *Sedum* species branching trichotomously (or dichotomously).
Ito et al. (2020) described a ssp. of *S. formosanum* from the Miyako-jima island, Japan, as *S. formosanum* ssp*. miyakojimense*. Whether the rank of ssp. is justified is not beyond doubt.

6*. Sedum lineare* Thunb., 1784

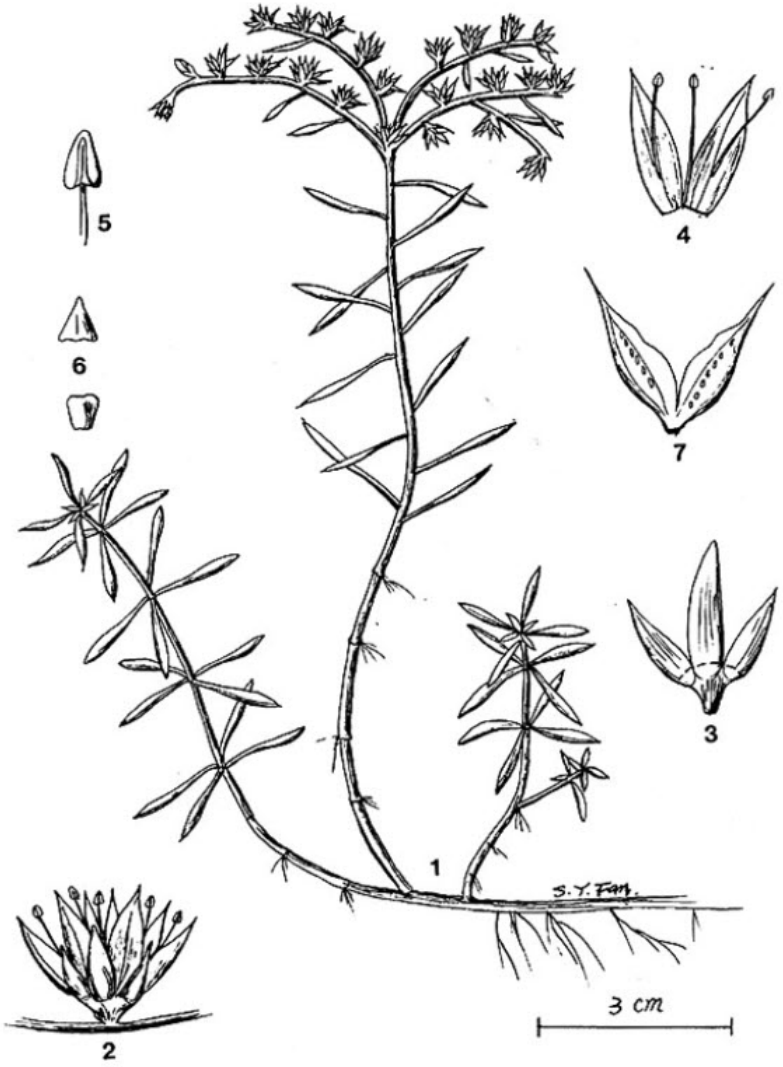
Description :
A glabrous, evergreen perennial.
Stems slender, fleshy, decumbent, branches ascending, 10-20+ cm long.
Leaves in whorls of 3 or 4, linear to linear-lanceolate, 20-25 x 2 mm, rather flat, sessile, bluntly spurred, apex subacute.
Flowers 5-merous, yellow, in few- to many-flowered, flat, 2 or 3 forked cymes, sessile.
Sepals basally free, unequal, 1.5-7 x 2 mm, linear-lanceolate, apex obtuse, standing up between the petals.
Petals 4-9 mm long, oblong, slightly narrowed at base, shortly mucronate.
Flowering and fruiting April – July.

Thunberg described *S. lineare* from a plant "crescit in regionibus Fakoniae", Japan.

Regarding the classification of *S. lineare* botanists widely disagree :
- Fröderström (1931) listed *S. subtile* and *S. zentaro-tashiroi* as synonyms of *S. lineare*.
- Ohwi (1965) considered *S. subtile* distinct from *S. lineare*.
- Fu & Fu (1984) also treated *S. subtile* and *S. lineare* as distinct species and considered *S. obtuso –lineare* Hayata as a synonym of *S. lineare*.
- Tang & Huang (1989) however considered *S. lineare* as a synonym of *S. mexicanum*.
- Fu & Ohba (2001) treated *S. obtuso-lineare* as a synonym of *S. yvesii* and *S. anhuiense* as a synonym of *S. lineare*.
- 't Hart & Bleij (2003) listed *S. obtuso-lineare* Hayata as a synonym of *S. lineare*.
Moreover even the occurrence of *S. lineare* in Japan – though described from Japanese material – does not seem to be beyond all doubt.

7. *Sedum mexicanum* Britt., 1899
incl. *S. obtuso-lineare* Hayata, 1913.

Description :
A glabrous, bright green, shiny perennial.
Stems decumbent, weak, rooting, sterile branches erect, densely leafy, 2-8 cm long.
Leaves alternate or in whorles of 3-5, spreading, linear, nearly terete, 5-20 mm long.
Flowering branches ascending, up to 20+ cm long.
Flowers 5-merous, golden-yellow, in flat-topped, 3-5-forked leafy cymes, sessile.
Sepals unequal, 3.5-5 mm long, the longest almost as long as a petal, basally free, shortly spurred, lanceolate, apex subobtuse.
Petals lanceolate, 5-6 mm long, apex subobtuse and shortly mucronate.
Flowering and fruiting May – June.



Pl. 14. Sedum mexicanum Britt. (CRASSULACEAE)

1. habit; 2. flower; 3. sepals; 4. petals and stamens; 5. stamen; 6. glands; 7. follicle.

S. mexicanum was described in 1899 by N.L. Britton from plants raised from seeds "collected by Mrs Britton on a trap dyke near the city of Mexico, November, 1896", however it has never

been found in the wild in Mexico. There is evidence that it was in cultivation at Kew long before Britton described it - wrongly named as "*S. sarmentosum*". Its origin is still unknown, and as it seems closest to certain Asian species, the name "mexicanum" is rather inappropriate. It is naturalised in Europe (France, Spain), USA (Florida), Mexico, Central America, Colombia, Japan and according to the 2. ed. of the *Flora of Taiwan* also in Taiwan.
Living plants of *S. lineare* and *S. mexicanum*, having similarly whorled leaves, can very easily be confused, and this applies even more to herbarium specimens, in the present case to the specimen Chung 265 from Shihting : in the 1. ed. of the *Flora of Taiwan* it was identified as *S. lineare* and in the 2. edition the very same specimen was cited as a proof of the existence of *S. mexicanum* in Taiwan ! In view of the fact that neither the *Flora of China* nor the *Flora of Japan* are listing *S. mexicanum,* this indication is rather doubtful. Photos on iNaturalist of so-called *S. mexicanum* in Taiwan are almost identical with photos of *S. lineare*.
https://www.inaturalist.org/observations/181499764
[Sedum obtuso-lineare Hayata, 1913

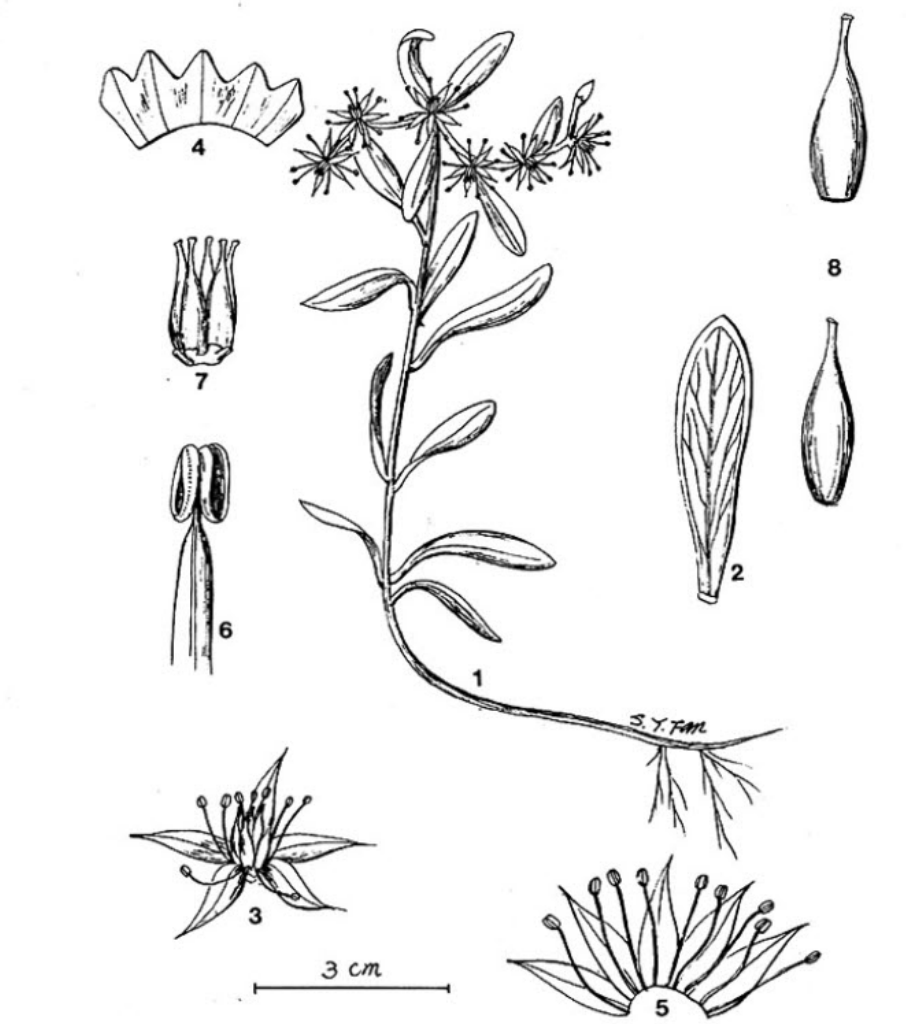
Description :
Stems erect, to 12 cm high.
Leaves irregularly alternate or ternate, 7 x 1.5 mm, apex obtuse.
Flowers 5-merous, yellow, in terminal cymes 1.5 x 3 cm.
Sepals linear-lanceolate, 4 x 1.3 mm, apex obtuse, base subpeltate.
Petals ovate-lanceolate, 4.5 x 2 mm, apex obcuneate-acute to obtuse, base narrowed.

The type was collected by S. Nagasawa, April 1910, in Fokien. (Fokien is the name of 3 small archipelagos off the coast of Fujian Province : Matsu Islands, Wuqui Islands and Kinmen Islands.)

In the 1. ed. of the *Flora of Taiwan S. obtuso-lineare* was treated as a synonym of *S. lineare*. The latter was collected in Taipei County, Tanshui and Shihting (Chung 265) while *S. obtuso-lineare* was described from plants collected in Fokien. In the 2. ed. of the *Flora of Taiwan* it was listed as a synonym of *S. mexicanum*. The latter was collected in Taipei County (Chung 265) and in Taoyuan County – again not in Fokien. In *Flora of China*, 2001, Fu & Ohba treated *S. obtuso-lineare* as a synonym of *S. yvesii*, that means according to them neither *S. lineare* nor *S. mexicanum* are occurring in Taiwan, instead it is *S. yvesii* which is growing there ! What is correct now – i.e. what really is *S. obtuso-lineare* Hayata ?]

8. *S. microsepalum* Hayata, 1913
incl. *S. triangulosepalum* Liu & Chung, 1977 / incl. *S. truncatistigmum* Liu & Chung, 1977.

Description :
A glabrous perennial species.
Stems decumbent at base, rooting at nodes, suberect upwards, loosely branched above, 10-20 cm high.
Leaves sessile, alternate, oblong, 2-2.5 x 0.5 mm, apex obtuse, base cuneate, entire.
Flowers 5-merous, yellow, in loosely branched cymes, sessile.
Sepals subequal, triangular, 1.5-2 x 0.5-1.8 mm, connate to at least middle, apex obtuse.
Petals linear-lanceolate, ca 6 mm long, acuminate.
Flowering and fruiting May – July.



Pl. 15. Sedum microsepalum Hayata (CRASSULACEAE)

1. habit; 2. leaf; 3. flower; 4. calyx; 5. petals and stamens; 6. stamen; 7. pistil with glands; 8. follicles.

The type was collected on Mt. Morrison by T. Kawakami and U. Mori, Oct. 1908. Occurring on mountains at altitudes 1700 – 3000 m asl in Taipei, Nantou, Taitung and Hualien County, endemic to Taiwan.

9*. Sedum morrisonense* Hayata, 1908
incl. *S. cryptomerioides* Bart. & Yamam., 1932 and possibly also *S. kwanwuense* Lu, Lin & Wang, 2019

Description :
A dwarf, glabrous, reddish perennial.
Stems erect, 8 cm high, branched from the base.
Leaves thick, fleshy, oblong-lanceolate, closely imbricate, 6 x 1.5 mm, apex obtuse.
Flowers 5-merous, yellow, in trichotomous many-flowered cymes, small, campanulate, sessile.
Sepals unequal, thick, half as long as petals, oblong-linear, apex obtuse.
Petals 6.5 mm long, apex obtuse.
Flowering and fruiting June – September.

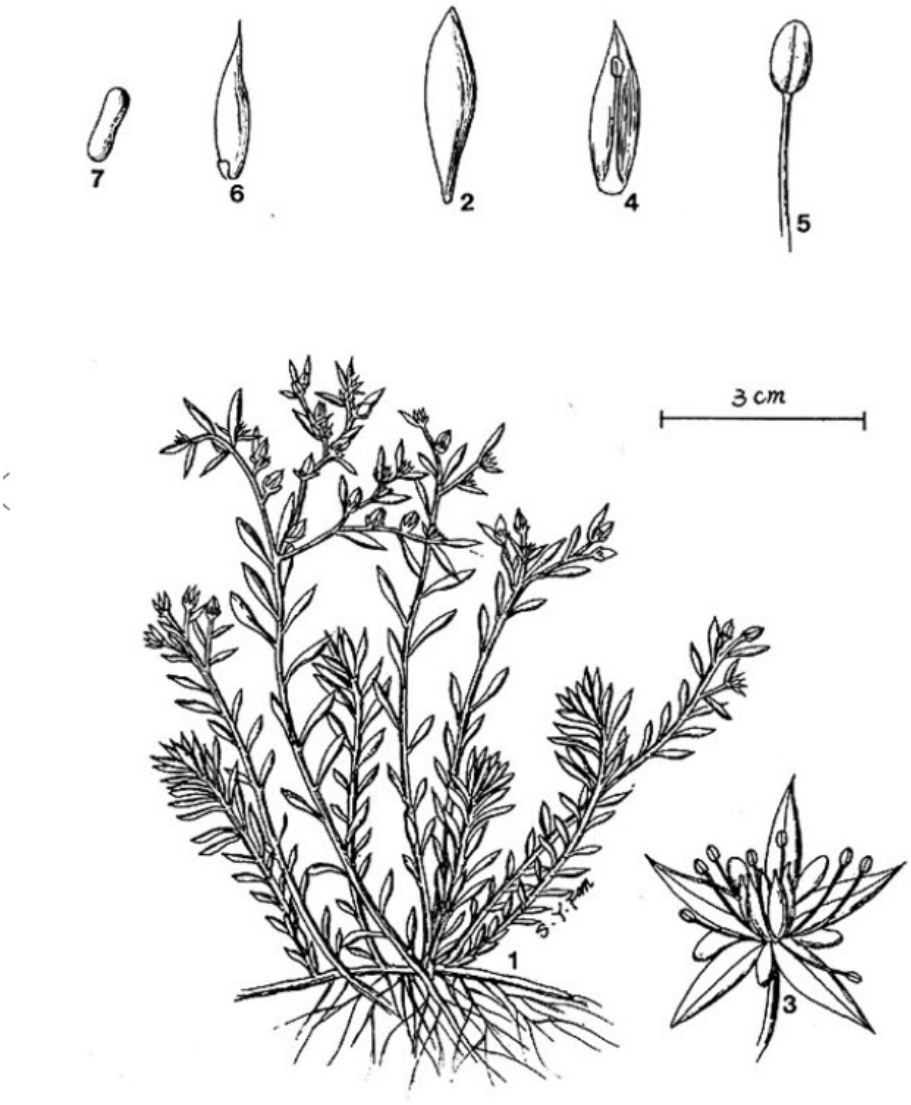
Pl. 16. Sedum morrisonense Hayata (CRASSULACEAE)

1. habit; 2. leaves; 3. flower; 4. calyx; 5. petal and stamens; 6. stamen; 7. pistil with glands; 8. seed.

The species was originally collected by S. Nagasawa, Nov. 1905, "ad summam montis Morrison, ad 13094 ped. alt." (nr 566) and again Oct. 1906 by T. Kawakami and U. Mori at the same mountain but at "12000 ped. alt" (nr 2281), moreover also by T. Kawakami and U. Mori Nov 1906 (nr 1892) "in montibus centralibus". It is clearly a high alpine species, quite widespread,

occurring above 2500 m asl. in Yilan, Hsinchu, Taichung, Nantou, Chiayi and Hualien County ; endemic to Taiwan.

According to WFO ***S. cryptomerioides*** Bart. & Yamam. is a synonym of *S. morrisonense* Hayata, differing from the latter only in larger and verticillate leaves – two rather variable features. *S. kwanwuense*, only reported from Kwanwu, Hsinchu County and Taichung City, proposed by Lin (1999) as a variety of *S. morrisonense* and published 2019 at species rank by Lu, Lin & Wang, is strongly resembling *S. cryptomerioides* and may therefore as well be placed in the synonymy of *S. morrisonense* or possibly - as suggested by Lin - as a var. of the latter.

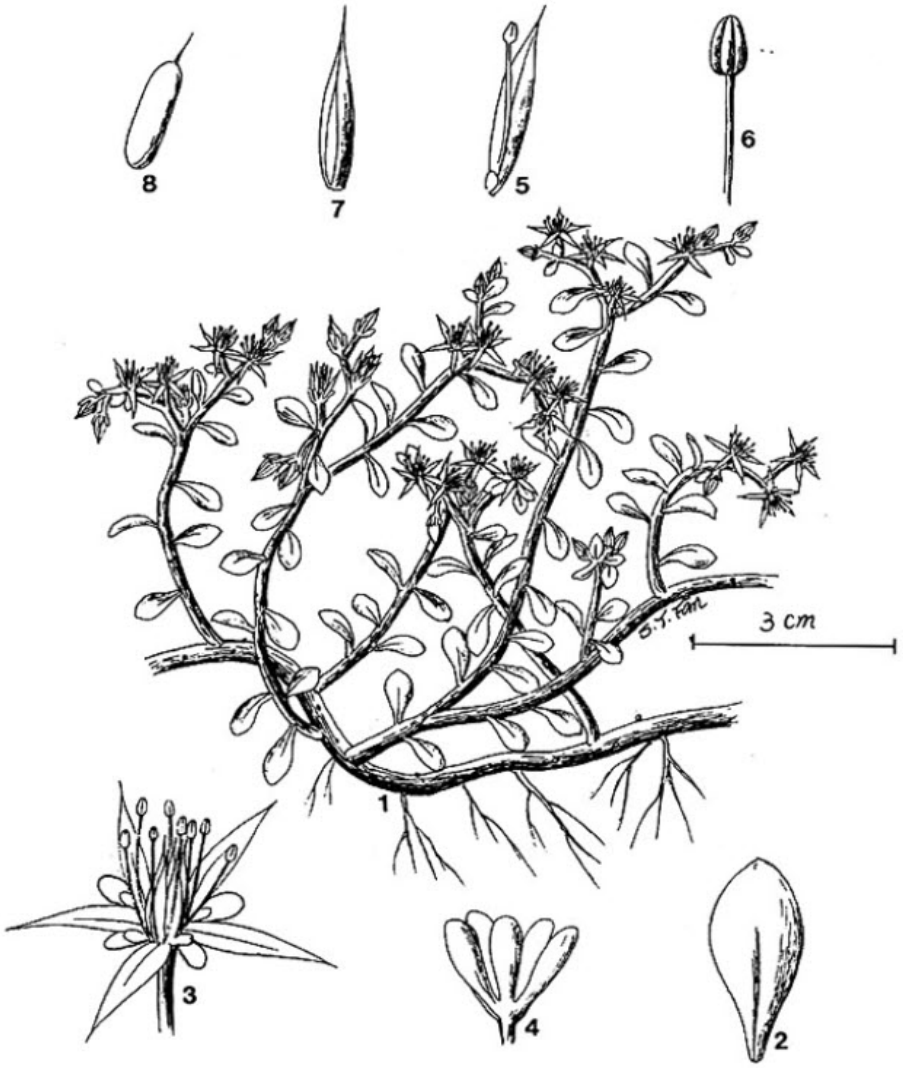


Pl. 10. Sedum cryptomerioides Bart. & Yamamoto (CRASSULACEAE)

1. habit; 2. leaf; 3. flower; 4. petal and stamen; 5. stamen; 6. pistil with a gland; 7. seed.

10. *Sedum nokoense* Yamam., 1926
incl. *S. taiwanianum* Ying, 1986

Description :
A perennial species with glandular spots.
Stems decumbent at base, rooting at nodes, branched above, 9-20 cm high.
Leaves alternate, spatulate, 6-10 x 3-5 mm, fleshy, apex obtuse, base rounded and spurred.
Flowers 5-merous, yellow, in branched cymes, sessile.
Sepals unequal, oblanceolate, subspatulate or linear-lanceolate, 3 x 1 mm, apex obtuse, base cuneate.
Petals linear-lanceolate, 5 x 1.5 mm, apex subacuminate, 1-veined.
Flowering and fruiting July – September (- November).



Pl. 17. Sedum nokoense Yamamoto (CRASSULACEAE)

1. habit; 2. leaf; 3. flower; 4. sepals; 5. petal and stamen with a gland; 6. stamen; 7. follicle; 8. seed.

The type was collected by E. Matsuda "in mont. Nokozan" in the Taihoku Prefecture (in the past consisting of modern-day Keelung, New Taipei City, Taipei and Yilan County), later also found in Taipei, Hsinchu, Taichung, Nantou and Taitung County. It is occurring at altitudes of 1500 - 3500 m and is endemic to Taiwan.

11. *Sedum parvisepalum* Yamam., 1926

Description :
A glabrous, fleshy perennial.
Stems decumbent at base, rooting at nodes, erect upwards, not branched, 17-25 cm high.
Leaves alternate, oblanceolate or oblong-lanceolate, 20-25 x 0.5 mm, apex obtuse, base cuneate.
Flowers 5-merous, yellow, in cymes, sessile.
Sepals unequal, linear or linear-lanceolate, 1.5-3 x 0.5 mm, apex obtuse.
Petals linear-lanceolate, 6 x 2 mm, apex acuminate.
Flowering and fruiting August – October.

The type was collected by T. Kawakami & U. Mori "in mont. Niitaka", 6000 ft asl in 1905, later also found in mountainous regions in Yilan, Nantou, Chiayi and Taitung County from 1800 – 3000 m, it is endemic to Taiwan.
A form with narrowly obovate to oblanceolate leaves, flowering branches only to 15 cm and only 5-6.5 mm long petals, occurring on the Philippines (Luzon), was described by Ohba 1977 as *S. parvisepalum* ssp. *philippinense* :
https://www.crassulaceae.ch/de/artikel?akID=182&aaID=2&aiID=P&aID=5904

12. *Sedum sarmentosum* Bge, 1833

Description :
A glabrous, fleshy perennial.
Stems creeping, slender, rooting at nodes.
Leaves ternately whorled, sessile, oblanceolate to rhombic-ovoid, 3-3 x 0.5-1 cm, apex subacute, abruptly narrowed at base.
Flowers 5-merous, yellow, in short, few-flowered, 3-5-branched cymes, sessile.
Sepals often unequal, 3-5 mm long, lanceolate, apex obtuse.
Petals lanceolate to oblong, 5-8 mm long, apex ± long mucronate.
Flowering and fruiting May – August.

S. sarmentosum was described from a plant collected near Peking. It is widespread in China, also occurring in Japan, Korea and N Thailand, and according to Su & Lu (2014) newly naturalised on Mt. Tatun in the north of Taiwan.

13. *Sedum sasakii* Hayata, 1913
incl. *S. japonicum* ssp. *uniflorum*

Description :
A fleshy perennial species.
Stems slender, tufted, prostrate, emitting fibrous roots at base, many-branched, branches ascending, 5-7 cm high.
Leaves alternate, ovate-oblong, 3 x 2 mm, apex rounded.
Flowers 5-merous, yellow, solitary, in terminal spikes, sessile.
Sepals linear-oblong, 3 mm long, apex rounded or obtuse, base obtusely peltate.
Petals obovate-spatulate, 3.5 x 1.5 mm, apex acute.
Flowering and fruiting April – June.

Pl. 20. Sedum uniflorum Hook. & Arn. (CRASSULACEAE)

1. habit; 2. leaf; 3. flower; 4. follicles.

The type was collected by S. Sasaki, May 1912, at the coast at Denryoyosha and Shinsha. It is occurring in the northern part of Taiwan (Taipei and Yilan County and Keelung City), in Japan and the Ryukyu, especially on sandy places at the seashore.
While the 2. ed. of the *Flora of Taiwan* (1993) listed *S. sasakii* as a synonym of *S. uniflorum* Hook. & Arn., according to WFO and POWO *S. japonicum* ssp. *uniflorum* is currently in the synonymy of *S. sasakii* Hayata – exactly the other way round !

14*. Sedum sekiteiense* Yamam., 1926

Description :
A fleshy, glabrous perennial.
Stems creeping and decumbent below, suberect upward, 6-12 cm high.
Leaves alternate, on sterile branches rosulate, long-spatulate, 10-25 x 4-6 mm, apex (sub-)obtuse, attenuate-petiolate at base.
Flowers 5-merous, yellow, in cymes with 2 or 3 forked cincinni, sessile.
Sepals unequal, spatulate or linear-oblanceolate, 2.8-4 x 0.9 mm, apex obtuse, narrowly truncate at base.
Petals linear-lanceolate.
Flowering and fruiting April – June.

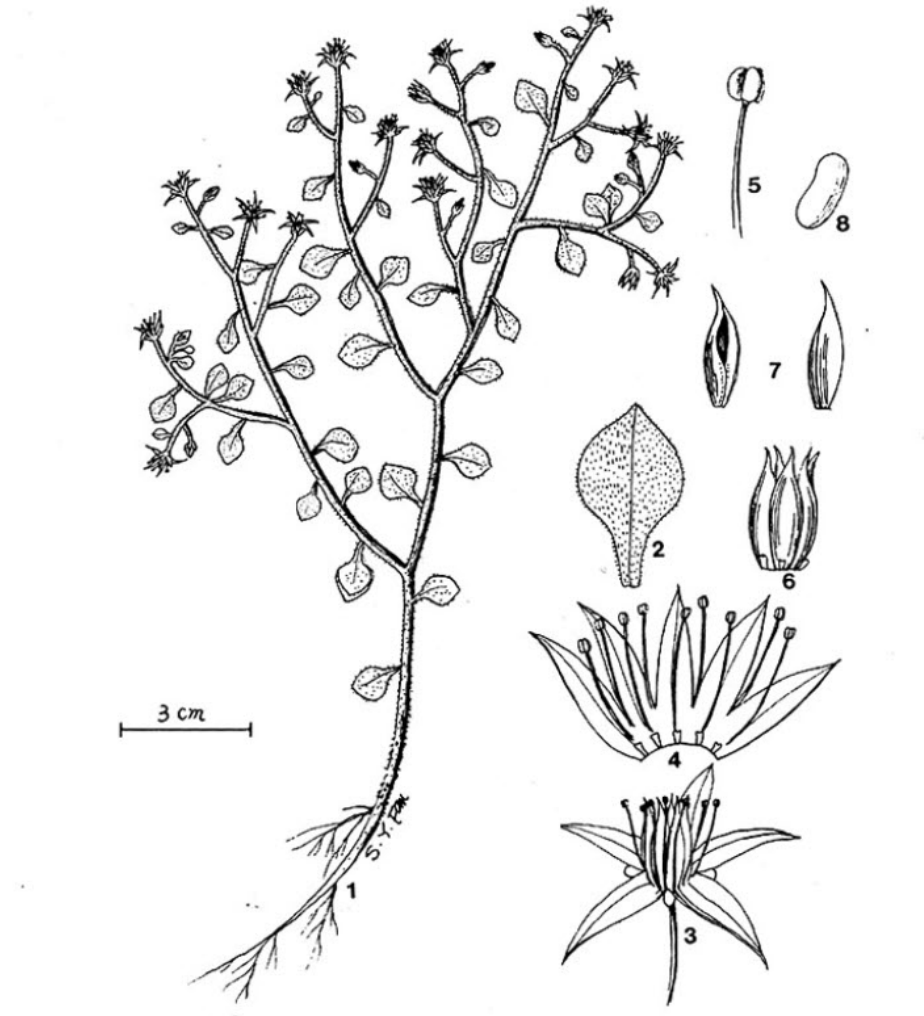
Pl. 18. Sedum sekiteiense Yamamoto (CRASSULACEAE)

1. habit; 2. leaf; 3. flower; 4. sepals; 5. petal and stamen; 6. stamen; 7. pistil with glands; 8. follicle; 9. seed.

The type was collected by Hayata 1916 at Sekitei, in Taihoku Prefecture (in the past consisting of modern-day Keelung, New Taipei City, Taipei and Yilan County). *S. sekiteiense* is restricted to mountainous areas of 200 – 1500 m in Taipei County, it is endemic to Taiwan. It is resembling *S. tricarpum* Makino from Japan, but with 4-5 carpels instead of 3-5.

15. *Sedum stellariifolium* Franch., 1883

Description :
A fleshy, glandular-pubescent annual or biennial species.
Stems erect, somewhat frutescent, 10-15 cm high.
Leaves alternate, obovate-rhombic, 7-15 x 5-10 mm, apex acute, base wide-cuneate, petioles 5-6 mm long.
Flowers 5-merous, yellow, in lax few-flowered cymes, pedicels 5-10 mm long.
Sepals broadly sessile, lanceolate to oblong, 1-2 mm long.
Petals lanceolate-oblong, 3-5 mm long.
Flowering and fruiting July - August.



Pl. 19. Sedum stellariaefolium Franch. (CRASSULACEAE)

1. habit; 2. leaf; 3. flower; 4. petals and stamens with glands; 5. stamens; 6. pistil with glands; 7. follicle; 8. seed.

S. stellariifolium was described in 1883 by the French botanist Adrien René Franchet (1834-1900), employed at the Muséum National d'Histoire Naturelle in Paris from 1881-1900, in the context of his work on the herbarium of Abbé Armand David (1826-1900). The description was made from a specimen collected near Peking (nr 404) and published in *Plantae Davidianae*. This species is native to north-central, south-central and south-east China and also to Manchuria, occurring on mountains 1500 – 2500 m, especially on shady stone slit. On Taiwan it is found growing in Nantou and Hualien County.

16*. Sedum tarokoense* Lin & Wang, 2013

Description :
Perennial fleshy herbs.
Stems thick, glabrous, usually reddish, with glandular spots, woody, 6-8 (-10) cm tall, basally decumbent, distally erect, rooting at nodes, base usually with young branches.
Leaves alternate, usually reddish, densely arranged on upper part of stem, orbicular to ellipsoid, 5-6 x 3-4 mm, 2-3 mm thick, base truncate, spurred, apex obtuse, sometimes mucronate.
Flowers 5-merous, yellow, in spicate, usually dichotomously branched cymes, usually 3 - 5 per branch, lower flowers short pedunculate, upper flowers sessile.
Sepals free, equal to subequal, oblanceolate-spatulate, 2.5-3 mm long, slightly spurred, reddish green, glabrous.
Petals oblong-lanceolate to lanceolate, 4-5 mm long, apex acute to acuminate.
Flowering and fruiting May – July.

S. tarokoense has only been found in two localities in the Taroko area of Hualien Hsien in eastern Taiwan. It is growing at exposed, sunny places on limestone scree slopes, 300 – 1200 m asl., endemic to Taiwan.

Conclusion :
While a few of the Taiwanese *Sedum* species are distinct, possibly the majority of them does not differ obviously and their definitive identification will probably only be determined once a thorough revision has taken place - a revision that is urgently needed.

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