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A History and Annotated Account of the Benthic Marine Algae of Taiwan

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ABSTRACT

Lewis, Jane E., and James N. Norris. A History and Annotated Account of the Benthic Marine Algae of Taiwan. *Smithsonian Contributions to the Marine Sciences,* number 29, 38 pages, 1 figure, 1987.—Records of the benthic marine algae of the Island of Taiwan and neighboring islands have been organized in a floristic listing. All publications with citations of benthic marine green algae (Chlorophyta), brown algae (Phaeophyta), and red algae (Rhodophyta) in Taiwan are systematically arranged under the currently accepted nomenclature for each species. The annotated list includes names of almost 600 taxa, of which 476 are recognized today. In comparing the three major groups, the red algae predominate with 55% of the reported species, the green algae comprise 24%, and the browns 21%. *Laurencia brongniartii* J. Agardh is herein reported for Taiwan for the first time.

The history of modern marine phycology in the Taiwan region is reviewed. Three periods of phycological research are recognized: the western (1866–1905); Japanese (1895–1945); and Chinese (1950–present). Western phycologists have apparently overlooked the large body of Japanese studies, which included references and records of Taiwan algae.

By bringing together in one place all previous records of the Taiwanese marine flora, it is our expectation that this work will serve as a basis for further phycological investigations in the western Pacific region.

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A History and Annotated Account of the Benthic Marine Algae of Taiwan

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Introduction

Historical Review

The history of recognizing, naming, and using marine algae in China extends far back into the early Chinese literature. Although of uncertain antiquity, the specific mention of marine algae goes back at least to the publication of the *Er Ya** or *Literary Expositor* (Tseng and Chang, 1961), a dictionary that dates to the 3rd century B.C. (Needham, 1970). Application of Latin binomials to the Taiwan marine flora, however, began only in the late 19th century (Martens, 1866). After a period of European collections and reports, a period of extensive Japanese studies during the early to mid-20th century followed. The third, or current, period is one in which the activities of Chinese investigators predominate.

The first report of benthic Taiwan algae that followed Linnean taxonomy appeared in Georg von Martens' *Die Tange* (1866), based on the botanical explorations from the German expedition to East Asia, 1860 to 1862. During this voyage von Martens' son Eduard, chief zoologist for the expedition, collected marine and freshwater algae from Java, the Philippines, Singapore, Taiwan, Hong Kong, and other East Asian areas. In this work, the elder von Martens reported seven marine species from "Tamsui" (Danshui), a northeast Taiwan seaport, including three marine algal species, *Ulva lactuca* f. *lapathifolia, Grateloupia filicina* f. *filiformis,* and *Caulacanthus ustulatus* var. *fastigiatus,* not again recorded from Taiwan.

During a second German expedition to East Asia (1886–1888) Dr. Warburg made phycological collections that were later published by Heydrich (1894) and De Toni (1895, 1905). This expedition covered the East Indian Ocean, the Mollucca Islands, China, Java, the southern Japanese islands, and a brief stop at Taiwan. Taiwan collection locations were noted as Jilong (a northeast seaport), south Taiwan, the east coast and "Long-kiau" on the south coast.

Among Warburg's Taiwanese algal collection, Heydrich identified 43 taxa, consisting of 24 red (Rhodophyta), 12 brown (Phaeophyta), and 7 green (Chlorophyta) species. In continued studies of the algae from this expedition, De Toni (1895) reported 36 taxa from Taiwan and in 1905 another two species. As a result of these early European investigators, over 60 marine benthic algae were reported for the Taiwan region, including many new to science.

The history of the exploration of Taiwan marine algae, as with other sciences and indeed all aspects of life, was greatly shaped during the 50-year period, beginning in 1895, of Japanese political dominance in Taiwan. Voluminous studies on the Japanese flora and fauna, then including Taiwan, were undertaken. It was during this time that exploration of the Taiwan marine flora was most intensive, dominated by the work of K. Okamura (e.g., 1900–1902, 1907–1942) and his student, Y. Yamada (1930–1944).

The first publication of this period, "New or Little Known Algae From Japan" (Okamura, 1895), included two new records of species from Taiwan. Many publications specifically addressed the Taiwan flora (Okamura, 1915b, 1931, 1935b; Oshima, 1915; Ariga, 1919, 1920, 1921; Horikawa, 1919; Yamada 1925a, 1925b, 1936a; Yamada and Tanaka, 1934; Tokida, 1941), but most references to the Taiwan flora were included as distributional notes or collection sites within general Japanese floristic works (Okamura, 1930, 1936; Yamada, 1928, 1934). Three important series con-

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* Throughout this text, Chinese place names and words not enclosed in quotation marks are spelled according to the Pin Yin romanization system.

taining numerous, but scattered, references to Taiwan algae are *Illustrations of the Marine Algae of Japan* (Okamura, 1900–1902) and *Icones of Japanese Algae* (Okamura, 1907, 1909, 1913, 1915a, 1921, 1923, 1932, 1934b, 1935a, 1937, 1942); Yamada's "Notes on Some Japanese Algae" (1930, 1931a, 1932b, 1933, 1935, 1936b, 1941, 1944b); and Yendo's "Notes on Algae New to Japan" (1909, 1914, 1915, 1916a, 1916b, 1918).

From an early time the Japanese were interested in floristic comparisons, sometimes speculating on the reasons for disjunct species distributions or factors that might cause adjacent areas to have divergent floras (Ariga, 1920, 1921; Okamura, 1915b, 1919). One of the first comparative phytogeographic studies of the western Pacific region (Yamada, 1926) included Taiwan as one of its eight floristic areas. Of the 42 taxa compared in the region, 16 were present in Taiwan.

Japanese monographs included new or additional records of taxa for Taiwan. Among these were studies of the Corallinaceae (Segawa, 1941; Yendo, 1902) and the Florideophyceae (Tanaka, 1944), and the genera *Gelidium* and *Pterocladia* (Okamura, 1934a), *Galaxaura* (Tanaka, 1935, 1936), *Hypnea* (Tanaka, 1941), *Laurencia* (Yamada, 1931b, 1936c), *Liagora* (Yamada, 1938a), *Porphyra* (Ueda, 1932), and *Sargassum* (Yamada, 1942).

Many of the papers written specifically on Taiwan's marine flora are in Japanese. Ariga (1919) describes a 14-day collecting trip and lists 43 taxa collected. Horikawa's (1919) "Marine Algae of Taiwan" reports 20 red, 10 brown, and 15 green species, based on determinations by Okamura of specimens that had been collected by Horikawa, Nagasawa, Maki, and their students at locales around Taiwan, including Danshui and Jilong in the north, Elanbi (Olanpi) in the south, Xiao Liuqiu (Shao Liou Chou) and Lan Yu, and the Penghu (= Pescadores) Islands. In another study a year later, Ariga (1920) reported 69 taxa for the Penghu Islands and compared them with his records from "Amoy," a small island off Fujian (= Fukien) Province, southeast China coast. Although only about 135 km of the shallow Taiwan Strait separate the two sites, the floras were found to be drastically different in composition. Even when the same species occurred in both places they often exhibited marked morphological or seasonal differences. It was speculated that tidal fluctuation or substrate type may have effected these differences. In determining species names, Ariga (1919, 1920) relied heavily on the papers of Yendo and Okamura.

The papers of Ariga (1919, 1920) and Horikawa (1919) were subsequently overlooked by later authors, perhaps due in part to having been written in Japanese. Both 1919 papers use the Latin scientific names and authors of the species followed by Japanese names. Ariga, in his subsequent paper (1920), uses these Japanese names almost exclusively. Few cases are known in other languages where common names apply solely to a single species. In the course of our research, however, these Japanese names were found to be a special case because they are not common names but a Japanese version of the scientific name (Lai Chuen-fu, personal communication). When Latin binomials were introduced to Japan, the Japanese erected equivalent Japanese scientific names, one for each taxon, which were different from the Japanese common names. Because the Japanese names are listed with their Latin binomials in Okamura's flora (1936), it has been possible to translate Ariga's names into the binomial form for inclusion in the current listing.

Yamada's studies on the Chlorophyceae (1925a) and the Phaeophyceae (1925b) of Taiwan, representing his undergraduate thesis at Tokyo University under K. Okamura, are frequently cited in later publications. Most of the specimens of these papers were collected by Yamada during a short spring collecting trip to the north and south coasts of Taiwan and to the Penghu Islands, with a few additional specimens provided by T. Aoki, then a government official in Taiwan.

Economic considerations have also contributed to identification of Taiwan's marine flora. Some papers were devoted to the agarophytes in Taiwan at a time when the Japanese seaweed industry was flourishing (Okamura, 1915b, 1935b; Oshima, 1915). Taiwan's east coast was thought to possibly have a richer agarophyte flora than north Taiwan or any other coast in Japan. However, due to the presence of unfriendly aborigines (Okamura, 1915b), this hypothesis was not investigated until much later, and was found to be incorrect (Fan, 1951).

Several papers discuss Taiwan algae used as foods. The island of Lan Yu (also called Kôtôsho, Botel Tobago, or Orchid Island) has attracted much attention because of its aboriginal population, unique biology, and its close proximity (61 km) to the island of Taiwan. An issue of the *Bulletin of the Biogeographical Society of Japan* (1931, vol. 2, no. 2) was devoted to the anthropology and biology of Lan Yu, with Okamura (1931:95–122) reporting 92 taxa of benthic algae from collections made by S. Segawa during one summer month in 1930. Only about one-third of these algae (Okamura, 1931) were also known to be on both Taiwan and Lan Yu. The Lan Yu flora was considered to be Indo-Pacific in nature, whereas no specific comments were made on the affinities of the Taiwan Island marine flora. Of the many algae presumably eaten by the "Yami" tribe on Lan Yu, Okamura listed 12 (*Carpopeltis formosana, Laurencia* sp., *Acanthophora orientalis, Halymenia durvillaei* var. *formosa, Hypnea seticulosa?, Nemalion pulvinatum, Chondria armata*, and *Dermonema dichotoma*), also giving a Japanese transliteration of their traditional Yami names. Subsequently, Tokida (1939) published an almost identical list of algae eaten by the "Ami" people on Taiwan with the same common names.

An identification book with photographs of Japanese seaweeds published during this period (Higashi, 1934) in-

cluded 12 records of Taiwan taxa. With the high scholarly level characteristic of the Japanese picturebook genre, specific names are generally considered accurate. Because these books contain records of Taiwan algae often not previously published, it is believed that distributional citations were based on Japanese herbarium material.

The Japanese flora *Nippon Kaiso-shi* (Okamura, 1936) contains numerous reports of algal species in Taiwan. This is an invaluable reference for the identification of benthic marine algae throughout the northwestern Pacific region.

In addition to the extensive Japanese publications of the period 1895–1945, some Chinese and western papers also included accounts of the Taiwan marine flora. A.D. Cotton (1915) reported nine taxa from Taiwan. Specimens of *Sargassum* were verified by K. Yendo, who visited the Royal Botanic Garden, Kew, while the paper was in preparation.

The lack of scientific communication between the East and West is perhaps characterized by J. Tilden's (1929) comments in "The Marine and Freshwater Algae of China." Although Professor Tilden claims to record "all species previously noted by investigators" for the algae of China, her account of Chinese phycological history only cites one non-western reference, a short paper by Okamura (1913) on "Chinese Edible *Nostoc*." She clearly agrees with Cotton (1915) that "Formosa [now known as Taiwan] . . . though belonging to Japan, must geographically be included with China." Though aware of Martens' (1866) account of algae, Tilden considered his determinations to be unreliable, and her account of the Taiwan marine flora was limited to only the nine taxa Cotton (1915) had reported.

Apparently unaware of the Japanese literature of 1895–1928, Tilden listed only 92 species of marine algae from the entire Chinese region, as "all that has been done in the study of Chinese algae." If the Japanese literature (e.g., Okamura, 1909–1926) and other accounts of European expeditions had been included, she would have found over 350 published records of more than 200 species for Taiwan alone by 1928. It is easy today to see the inaccuracy of Tilden's assessment; however, her conclusions were understandable considering the barriers of language, culture, and communication at that time.

Professor C.K. Tseng, as a young botany instructor from Fujian Province, made extensive collections in the 1930's throughout China. In studies of marine Chlorophyceae from Hainan Island (1936), Chinese Chaetangiaceae (1941b), Hong Kong *Polysiphonia* (1944), and "New and Unrecorded Marine Algae of Hong Kong" (1945), Tseng included several Taiwan collections, many of them new records.

The first publication by Chinese marine botanists on Taiwan after the Japanese occupation came from the Taiwan Fisheries Research Institute. Y.F. Shen and K.C. Fan (1950) compiled much of the earlier literature and studied their own collections as well as specimens from the herbarium at the National Taiwan University made from Kôtôsho by Y. Yamamoto, which resulted in a list of 62 green, 50 brown, and 142 red taxa. Locations were given as "Taiwan," "Kôtôsho" (Lan Yu), "Kasyoto" (Lu Dao) and the "Pescadores" (Penghu Islands).

Fan (1951) described eight species and two forms of the economic genera *Gelidium* and *Pterocladia* from Taiwan, with English translations of Dr. Okamura's (1935) four new taxa. *Gelidium* and *Pterocladia* were found to be restricted to the north and northeast part of the island. The distributions of the various species were compared and found to belong to two distributional groups (a disjunct north-south distribution), but Fan concluded that "[the] chief factors that delimit the mutual exclusion of these species are at present uncertain."

A list of edible marine algae (Fan, 1952) from Taiwan included 30 taxa used by Taiwan aborigines as well as those with a long Chinese tradition, with brief descriptions and localities of the algae, preparation methods, and a table of their Chinese and aboriginal names. Many species were noted to be commonly occuring only in the spring, though no reason was suggested.

Since 1960, Y.M. Chiang (now a professor at Taiwan National University), has been a major investigator of the Taiwan marine algae. Studies on floristics (Chiang, 1960, 1962a,b, 1973a,b), taxonomy (Chiang, 1981; Chiang and Chen, 1982; Yang and Chiang, 1982), reproduction (Chen and Chiang, 1982; Chiang, 1969, 1970, 1971, 1972; Chiang and Chen, 1982), and aquaculture (Chiang, 1981, 1982; Chiang and Chou, 1980; Liaw and Chiang, 1979; Nelson et al., 1983) have been the focus of his phycological contributions.

Professor Chiang began phycological publications (as a student of Y.F. Shen, Botany Department, National Taiwan University) with his two-part "Marine Algae of Northern Taiwan," the blue-green, brown, and green algae (1960), and the red algae (1962a). Included in these works were information on collection locations, habitat notes and seasonality of the major algae, identification keys, and taxonomic summaries of each of the 96 species.

After a field trip of a few days to Penghu, Chiang (1962b) recorded 26 species and noted the fragmentary nature of earlier Japanese records in the Penghu Islands. Dr. Chiang began working on Taiwan's phytogeographic affinities with "Notes on Marine Algae of Taiwan" (1973a), which included north-south distributional observations and new records of six green, six brown, and nine red algae for Taiwan and its offshore islands. "Studies on the Marine Flora of Southern Taiwan" (1973b) reported on the algae at four southern localities and compared them with the north, finding that "some northern species do not occur in the southern waters. On the contrary, there are quite many species which occur in southern Taiwan but not in the northern regions." The southern flora was also considered

to be more depauperate than the northern and unique within Taiwan in having typically tropical elements, such as *Bornetella* and *Neomeris*. The water temperatures, warmer and less variable throughout the year in the south, were suggested to be partially responsible for this difference. Because Okinawa, located slightly to the north and east of Taiwan, shares tropical genera with southern Taiwan, Chiang also suggested that the Kuroshio (or Japanese) Current is likely to be a major factor in distribution.

A later series of papers focus on aspects of morphology and reproduction (Chiang and Chou, 1980; Chen, Chiang, and Chiang, 1981; Chen and Chiang, 1982; Chiang, 1982; Chiang and Chen, 1983) and vegetative reproduction in a brown alga (Chiang and Chou, 1980). These papers provide taxonomic information, some of which is new for the Taiwan flora, and others that substantiate previous records. Taxonomic studies on *Sargassum* (Chou and Chiang, 1981), *Liagora* (Chiang and Chen, 1982), and *Gracilaria* (Yang and Chiang, 1982) provide additional listings with distribution, morphology and seasonality information.

Aquaculture in Taiwan is a well-developed business principally of shellfish and fin fish, and in the last 10 years the culture of marine algae (Chueh and Chen, 1982), especially *Gracilaria* (Chen, 1976; Shang, 1976; Michanek, 1978; Ryther, 1979; Tseng, 1981a,b; Chiang, 1981; Doty, 1983), and *Porphyra* (Chiang, 1982), has received more attention from both growers and taxonomists. Of the numerous publications on seaweed culture, those providing records of native species in Taiwan were most appropriate for inclusion in this listing.

In a review of *Gracilaria* culture in Taiwan, Chiang (1981) and Hansen et al. (1981) provided taxonomic information on the three native species cultured (*G. edulis, G. gigas,* and *G. verrucosa*) and the techniques employed. The seaweed aquaculture program, centered in the southwest of Taiwan, began in 1961, and by 1979 about 12,000 tons of the dry seaweed were being harvested, predominately for the domestic agar industry, and about 120 tons of fresh seaweed went as feed to abalone farms.

Gracilaria is the major source of agar-agar, along with some *Gelidium*. Reports on seasonal variation of agar quality and quantity produced in Taiwan (Yang, 1982; Yang et al., 1981) provide records on the native agarophyte flora, and a comparison of agar from species in Taiwan and Micronesia (Nelson et al., 1983) provides information on Taiwan sites of natural populations.

In contrast to *Gracilaria, Porphyra* culture has been small-scale and irregular. Cultivation of local species in the Penghu Islands began in 1968, but studies on the life history of the local species were not initiated until 1975 (Chiang, 1982), when the "*Conchocelis*-stage" of *Porphyra* and monospore formation were investigated. This study and two on *Conchocelis* culture (Chiang and Chou, 1980; Liaw and Chiang, 1979) also provide taxonomic information on native Taiwan taxa.

Alginates, a family of chemicals used in food preparation and with a wide variety of industrial uses, which conventionally are extracted from cold-water kelps, may become an industry in Taiwan, using a tropical brown alga. Research has been conducted (Liu, 1982) on improving the quality of alginates from *Sargassum duplicatum*, a species growing naturally along the shoreline of the southern tip of Taiwan.

Green algae are also a part of Taiwan's aquaculture industry. Liu (1982) mentions use of *Chlorella*. Included in a report on chemical analysis and utilization of *Monostroma* (Wu, 1982) is information on the two native species and their distribution.

The study of biological activity and natural-product chemistry (e.g., Norris and Fenical, 1985) is a recent research interest in Taiwan. For example, in a recent paper, "Pharmacological Properties of Some Taiwan Seaweeds" (Su et al., 1982), 30 species from Taiwan were screened for antimicrobial activity.

Geographic and Oceanographic Features

The area encompassed in this study includes the main island of Taiwan and a few of its 14 associated islands as well as the 64 islands of the Pescadores Archipelago (Figure 1). The islands most commonly referred to in the phycological literature are those of Taiwan (= Formosa) (21°53′–25°18′N, 120°1′–122°0′E), Orchid Island (= Kôtôsho or Lan Yu) (22°0′–22°5′N, 121°36′–121°30′E), Green Island (= Kasyoto or Lu Dao) (22°38′–22°41′N, 121°28′–121°30′E) and the Pescadores (= Penghu Islands) (23°11′–23°46′N, 119°18′–119°42′E). The most frequented collecting sites on the Island of Taiwan have been Olanpi at the southern tip, "Tai Dung" on the east coast, and the general area of the northern tip. Bisected by the Tropic of Cancer, the Island of Taiwan is considered both tropical and subtropical. Geologically it is a continental island with a mostly sedimentary origin, and it has a coastline of roughly 1600 km.

Oceanographic conditions around the island vary in topography, temperature, and currents. The Taiwan Strait is shallow (60 m average depth) and turbid, extending westward from Taiwan some 140 to 200 nautical miles to the southeast coast of mainland China. Within the Strait, the Penghu Islands are some 40 km from Taiwan. Tidal currents around these islands reach almost 6 knots in places (USDD Nautical Map #94060). In the East China Sea northeast of Taiwan is the Ryukyu Island chain, beyond which are the main islands of Japan. To the south the Bashi Channel separates Taiwan and the Philippines. The east coast, often precipitous, marks the eastern edge of the continental shelf. The sharp drop-off continues some 4000 m below sea level, reaching the floor of the Philippine Basin. Along the southeast coast are areas of upwelling, with colder, nutrient-rich waters.

Many benthic marine algae are found growing in the

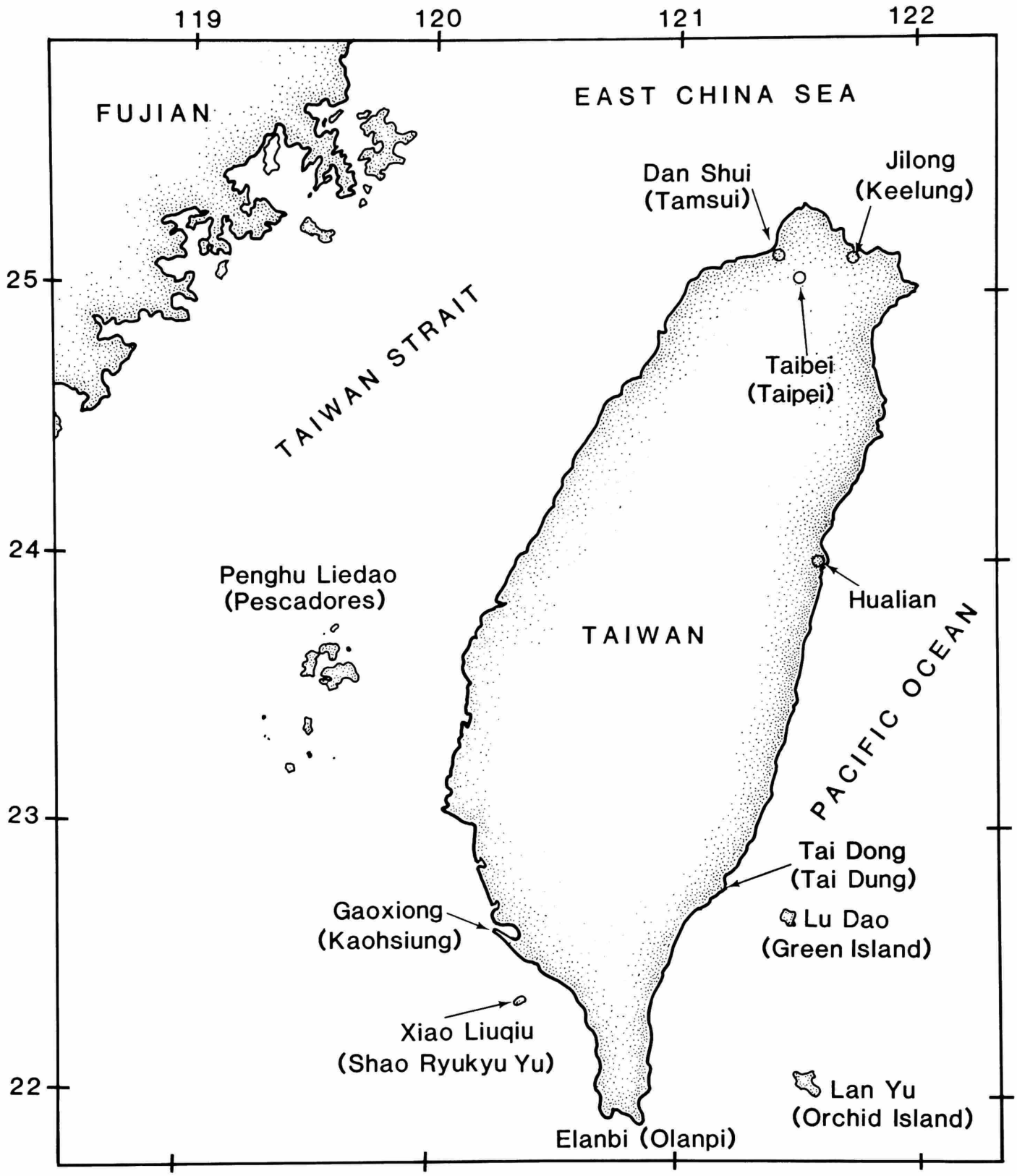

FIGURE 1.—Map of Taiwan, showing islands and locales most commonly referred to in the phycological literature.

nearshore coastal waters. Shoreline conditions in Taiwan vary from sandy to rocky shores with murky water in the north, to coral reefs with clear swift water in the south. To the east are precipitous cliffs and rough waters with deep-ocean upwellings along the coast and, in contrast, level, calm expanses of intertidal mud and sand flats along the western shoreline.

The two main currents affecting Taiwan are the Kuroshio (or Japanese) Current and the Taiwan coastal current. The Kuroshio Current brings water of high temperature and salinity up from the Philippines and the equatorial region toward southern Taiwan where it branches. The stable, main branch runs past the east coast of Taiwan at an average velocity of 30 to 40 nautical miles per day toward Japan (USDD Nautical Map #94010). A smaller branch, subject to seasonal variability, veers west through the Taiwan Strait.

Flowing south along the China mainland coastal region, the Taiwan coastal current carries colder water from north to south, and is strong in summer and weak in winter. Two smaller seasonal currents, the northeast monsoon current and the southwest seasonal current, result from an interaction between the two major currents and the prevailing winds.

Discussion

While compiling the records of Taiwan algae from the numerous publications, efforts were made to find the correct name as well as the valid date and place of publication for each of the taxa in the annotated list. Unfortunately, phycologists do not have a modern source for specific names such as *Index Kewensis* (Jackson et al., 1893 to date; see Stafleu and Cowan, 1979:397–398, for complete listing) for phanerogams, or *Index Filicum* (Christensen, 1905, 1906; see Stafleu and Cowan, 1976:501–501, for complete listing) for ferns. Our effort has shown how great the need is for such an index of algal species names, such as has recently been done for the generic names of fossil and living plants (Farr et al., 1979). In the absence of such a reference, we found the earlier works of De Toni (1895–1924) and Dawson (1962) helpful.

The Taiwan algae project was undertaken recognizing that a single bibliographic source on the Taiwan marine flora would facilitate identification of the algae and their distribution and would encourage further research within the region. It was evident that the existing literature was widely dispersed and not adequately referenced in most phycological bibliographies. It became necessary to carefully research the east Asiatic algal literature, particularly from Japan and China, and the whole Pacific region, in order to locate information on Taiwan algae. Work on this compilation commenced while the first author was employed at the Fisheries Biology Laboratory, Institute of Zoology, Academia Sinica, Taiwan. Additional extensive searches were necessary to locate original publications to establish proper citation of the binomial and to subsequently determine the current taxonomic and systematic status of each taxon. For this work, the E. Yale Dawson Phycological Library and Department of Botany libraries of the National Museum of Natural History, Smithsonian Institution, were invaluable.

The annotated list stands as a compilation of reports of attached, benthic marine taxa occurring naturally in the region of Taiwan. Efforts were taken to locate all relevant literature, and although it is possible that additional reports can be found, the present work represents the most comprehensive compilation available for the region. It must be emphasized that records are taken from published papers and that the accuracy of these identifications has not been confirmed by herbarium investigations; reported names of taxa are simply noted and arranged systematically following current convention. Verification of the determinations awaits future investigation. Some indication of accuracy may, however, be gained from the frequency and dates of the reports for any given taxon. For example, the three taxa reported by Martens (1866) that have not again been recorded may be considered in need of verification. Nevertheless, it is felt that the present list reasonably reflects the general composition of the Taiwan marine flora.

The Annotated List

There are 476 taxonomic entries in this list, systematically arranged following Abbott and Hollenberg (1976) for the red algae, and Lobban and Wynne (1981) for the brown and green algae. Below family level, genera and species within each genus are listed alphabetically. Each entry consists of (1) the currently accepted taxon name, with its author(s), and date and page of valid publication, and (2) an alphabetical list of the investigators who have reported the taxon present in the Taiwan region.

Orthographic errors in publication of taxa were found to have occurred nine times in this list (M.J. Lai and D.H. Nicolson, personal communication). These were simply corrected, with the original spelling in single quotations following "Recommendation 50F.1" of the *International Code of Botanical Nomenclature* (Voss et al., 1983).

In some cases there are additional names within the entry. In reporting a taxon from Taiwan, authors sometimes used names that have since been considered taxonomic or nomenclatural synonyms, or have been re-determined by later investigators. In all cases, the actual names used by the authors for their algal records from Taiwan are retained in this list. However, when those names differ from the currently accepted ones, they are included in the alphabetical list of references to the taxon. It is hoped that by preserving the original names, the concepts held by the authors will be

indicated and later taxonomic and nomenclatural changes will be more easily integrated into this list.

Conclusion

The marine flora of this region appears to have tropical, subtropical, and temperate elements. Many authors have commented on the diversity of floral elements within this region (e.g., Ariga, Chiang, Horikawa, Okamura) and have speculated on the possible causes. As noted earlier, water quality and substrate vary greatly in the region, no doubt affecting floral elements. Southern Taiwan and especially the two southeast islands Lan Yu and Lu Dao are referred to as having a tropical/subtropical flora and the north and west as having a temperate flora, judged by the abundance of brown algae and rarity of red algal elements. These correlations are deserving of further study. Indications are that a number of physical and biotic factors interact to create this diversity of floristic types exhibited in the Taiwan region.

Based on written reports from the literature, this study makes available much previously inaccessible information basic to all phycological studies of the East Asiatic region. This comprehensive list of marine algae, treated in both historical and modern systematic contexts, constitutes a basis for further systematic and ecological investigations and biogeographical comparisons among the East Asian and Pacific areas, and serves as a possible framework for a marine flora of Taiwan.

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Benthic Marine Algae from Taiwan

CHLOROPHYTA

ULOTRICHALES

Ulotrichaceae

Ulothrix flaccida (Dillwyn) Thuret in Le Jolis, 1863:56.
Taniguti, 1976.

CHAETOPHORALES

Chaetophoraceae

Endophyton ramosum Gardner, 1909:372.
Chiang, 1973a.

ULVALES

Ulvaceae

Enteromorpha clathrata (Roth) Greville, 1830:181.
Chiang, 1960; Fan, 1953a; Okamura, 1931, 1936; Shen and Fan, 1950; Tokida, 1939.

Enteromorpha clathrata var. *crinita* (Roth) Hauck, 1884:429.
As *"E. crinita":* Ariga, 1920; Chiang, 1960; Chihara, 1970; De Toni, 1895; Fan, 1953a; Heydrich, 1894; Okamura, 1936; Segawa, 1974; Shen and Fan, 1950; Tokida, 1939.

Enteromorpha compressa (Linnaeus) Greville, 1830:180.
Chiang, 1960; Fan, 1953a; Okamura, 1931, 1936; Shen and Fan, 1950; Taniguti, 1976; Tokida, 1939; Yamada, 1925a, 1926, 1950; Yoshikawa and Yoshikawa, 1977.

Enteromorpha intestinalis (Linnaeus) Link ex Nees, 1820:5.
Ariga, 1919; Chiang, 1960, 1973b; Fan, 1953a; Horikawa, 1919; Shen and Fan, 1950.

Enteromorpha linza (Linnaeus) J. Agardh, 1883:134.
Chiang, 1960, 1973b; Chiang et al., 1974. As *"Phycoseris lanceolata* var. *angusta":* Martens, 1866.

Enteromorpha prolifera (O.F. Müller) J. Agardh, 1883:129.
Chiang, 1960; Fan, 1953a; Shen and Fan, 1950; Taniguti, 1976.

Enteromorpha sp.
Chiang, 1973b.

Monostroma latissimum (Kützing) Wittrock, 1866:33.
Chiang, 1973a, 1973b; Okamura, 1935b; Rho, 1958.

Monostroma nitidum Wittrock, 1866:41.
Chiang, 1960; Fan, 1953a; Okamura, 1936; Shen and Fan, 1950; Taniguti, 1976; Yamada, 1925a, 1925b, 1934, 1950.
Ulva angusta Setchell et Gardner, 1920:283.
Chiang, 1973a; Okamura, 1935b.
Ulva conglobata Kjellman, 1897b:10.
Ariga, 1920, 1921; Chiang, 1960, 1962a; Shen and Fan, 1950; Taniguti, 1976; Tokida, 1939; Yamada, 1925a; Yoshikawa and Yoshikawa, 1977.
Ulva fasciata Delile, 1813:155.
Chiang, 1960, 1973b; Fan, 1953a; Shen and Fan, 1950; Tokida, 1939; Tseng, 1983; Yamada, 1935; Yoshikawa and Yoshikawa, 1977.
Ulva japonica (Holmes) Papenfuss, 1960:309.
As *"Letterstedtia japonica":* Chiang, 1973a; Okamura, 1935b; Taniguti, 1976.
Ulva lactuca Linnaeus, 1753:1163.
Chiang, 1960, 1973b; Fan, 1953a; Heydrich, 1894; Okamura, 1930, 1931; Shen and Fan, 1950; Su et al., 1982; Yamada, 1950; Yoshikawa and Yoshikawa, 1977.
Ulva lactuca f. *lapathifolia* (Areschoug) Hauck, 1884:437.
As *"Phycoseris lapathifolia":* Martens, 1866.
Ulva pertusa Kjellman, 1897b:4.
Ariga, 1919, 1920; Chiang, 1960, 1973b; Fan, 1953a; Horikawa, 1919; Okamura, 1921; Rho, 1958; Shen and Fan, 1950; Taniguti, 1976; Tokida, 1939, 1954; Yamada, 1925a; Yoshikawa and Yoshikawa, 1977.
Ulva reticulata Forsskål, 1775:187.
Arasaki, 1964; Ariga, 1920; Chiang, 1960, 1973b; Fan, 1953a; Okamura, 1936; Rho, 1958; Segawa, 1974; Shen and Fan, 1950; Tokida, 1939; Tseng, 1936; Yamada, 1925a.
Ulva rigida C. Agardh, 1823:410.
Ariga, 1920; Yendo, 1916b.
Ulva sp.
Chiang et al., 1974.

CLADOPHORALES

Cladophoraceae

Chaetomorpha aerea (Dillwyn) Kützing, 1849:379.
Ariga, 1921.
Chaetomorpha aerea f. *versata* Heydrich, 1894:273.
De Toni, 1895; Heydrich, 1894; Okamura, 1936; Shen and Fan, 1950.
Chaetomorpha basiretrorsa Setchell, 1926:72.
Chiang, 1960.
Chaetomorpha brachygona Harvey, 1858:87.
Chiang, 1960; Okamura, 1936; Shen and Fan, 1950; Yamada, 1925a.
Chaetomorpha crassa (C. Agardh) Kützing, 1845:204.
Ariga, 1920; Chiang, 1960, 1973b; Fan, 1953a; Okamura, 1931, 1936; Shen and Fan, 1950; Taniguti, 1976; Yamada, 1925a, 1950; Yoshikawa and Yoshikawa, 1977.
Chaetomorpha linum (O.F. Müller) Kützing, 1845:204.
Ariga, 1919; Chiang, 1960; Fan, 1953a; Horikawa, 1919; Okamura, 1936; Shen and Fan, 1950; Tokida, 1954; Yamada, 1925a, 1926, 1950; Yendo, 1916a.
Chaetomorpha spiralis Okamura, 1912:162.
Chiang, 1960, 1973b; Fan, 1953a.
Cladophora aokii Yamada, 1925a:85.
Okamura, 1936; Shen and Fan, 1950; Yamada, 1925a.
Cladophora fuliginosa Kützing, 1849:415.
Okamura, 1936; Tseng, 1983; Yamada, 1932b, 1934, 1950.
Cladophora montagnei var. *radicans* Yamada, 1925a:87.
Okamura, 1936; Shen and Fan, 1950; Yamada, 1925a.
Cladophora patentiramea (Montagne) Kützing, 1849:416.
Okamura, 1936; Shen and Fan, 1950; Tseng, 1983; Yamada, 1925a, 1950.
Cladophora pellucida (Hudson) Kützing, 1845:208.
Okamura, 1936; Shen and Fan, 1950. As *"C. prolifera":* Okamura, 1931.
Cladophora rugulosa Martens, 1866:112.
Ariga, 1920.
Cladophora scitula (Suhr) Kützing, 1849:399.
De Toni, 1895; Heydrich, 1894; Okamura, 1936; Shen and Fan, 1950.
Cladophora sibogae Reinbold, 1905:146.
Okamura, 1931, 1936; Shen and Fan, 1950; Taniguti, 1976; Yamada, 1950.
Cladophora sp.
Ariga, 1919, 1920; Fan, 1953a; Horikawa, 1919; Okamura, 1931; Shen and Fan, 1950; Tokida, 1939.

CAULERPALES

Codiaceae

Codium adhaerens (Cabrera) C. Agardh, 1823:457.
Ariga, 1919, 1920; Chiang, 1960, 1962b; Horikawa, 1919; Okamura, 1936.
Codium arabicum Kützing, 1856:35.
Okamura, 1936; Shen and Fan, 1950; Tseng, 1983; Yamada, 1925a.
Codium contractum Kjellman, 1897b:35.
Ariga, 1920; Taniguti, 1976.
Codium cylindricum Holmes, 1896:250.
Taniguti, 1976.
Codium dichotomum (Hudson) S.F. Gray, 1821:293.
Fan, 1953a; Tokida, 1954. As *"C. tomentosum":* De Toni, 1895; Heydrich, 1894; Shen and Fan, 1950.
Codium formosanum Yamada, 1950:180.
Fan, 1953a; Yamada, 1950; Yoshikawa and Yoshikawa, 1977.
Codium fragile (Suringar) Hariot, 1889:32.
As *"C. mucronatum":* Ariga, 1919; Horikawa, 1919.

Codium intricatum Okamura, 1913:74.
Ariga, 1919, 1920; Chiang, 1962b, 1973b; Fan, 1953a; Higashi, 1934; Horikawa, 1919; Shen and Fan, 1950; Yamada, 1950.
Codium reediae Silva in Egerod, 1952:389.
Chiang, 1973a.
Codium repens (P. et H. Crouan) Vickers, 1905:56.
Fan, 1953a; Okamura, 1931, 1936; Shen and Fan, 1950; Tseng, 1983; Yamada, 1925a.
Codium tenue Kützing, 1856:33.
Fan, 1953a; Okamura, 1936; Rho, 1958; Shen and Fan, 1950; Taniguti, 1976; Yamada, 1925a.

UDOTEACEAE

Chlorodesmis caespitosa J. Agardh, 1887:49.
Chiang, 1973b; Chihara, 1975; Yoshikawa and Yoshikawa, 1977. As *"C. formosana":* Arasaki, 1964; Chihara, 1970; Okamura, 1930, 1936; Rho, 1958; Segawa, 1974; Shen and Fan, 1950; Yamada, 1925a.
Remarks: Ducker et al. (1965) and Ducker (1967) provide evidence for reducing *C. formosana* into synonomy with *C. caespitosa* (see also Fan, 1974).
Chlorodesmis comosa Bailey et Harvey in Harvey, 1858:29.
Ariga, 1920; Higashi, 1934; Okamura, 1931, 1936; Rho, 1958; Shen and Fan, 1950; Yamada, 1925a.
Halimeda cuneata Hering in Krauss, 1846:214.
Higashi, 1934; Okamura, 1930, 1936; Shen and Fan, 1950; Taniguti, 1976; Yamada, 1925a, 1950.
Halimeda discoidea Decaisne, 1842:102.
Ariga, 1920.
Halimeda incrassata var. *ovata* (J. Agardh) Barton, 1901:27.
Okamura, 1936; Yendo, 1909.
Halimeda macroloba Decaisne, 1841:118.
Chiang, 1973a, 1973b; Okamura, 1915a, 1935b, 1936.
Halimeda opuntia (Linnaeus) Lamouroux, 1812:186.
Ariga, 1920; Chiang, 1973b; Su et al., 1982; Taniguti, 1976; Yamada, 1926.
Halimeda renschii Hauck, 1886:167.
As *"H. opuntia* f. *renschii":* Ariga, 1919, 1920; Chiang, 1962b; Horikawa, 1919; Okamura, 1915a, 1931, 1936; Shen and Fan, 1950; Su et al., 1982; Yamada, 1925a, 1950.
Halimeda velasquezii W.R. Taylor, 1962:176.
As *"H. opuntia* f. *intermedia"* Chiang, 1962b.

CAULERPACEAE

Caulerpa cupressoides var. *lycopodium* f. *amicorum* (Harvey) Weber-van Bosse, 1898:337.
Ariga, 1920.
Caulerpa freycinetti var. *freycinetti* f. *lata* Weber-van Bosse, 1898:313.
Ariga, 1920; Okamura, 1936; Shen and Fan, 1950; Yoshikawa and Yoshikawa, 1977. As *"C. freycinetti* var. *typica":* Okamura, 1931.
Caulerpa racemosa (Forsskål) J. Agardh, 1873:35.
Ariga, 1919; Fan, 1953a; Horikawa, 1919; Taniguti, 1976; Tokida, 1939.
Caulerpa racemosa var. *clavifera* f. *macrophysa* (Kützing) Weber-van Bosse, 1898:361.
Ariga, 1920; Chiang, 1962b; Okamura, 1936; Rho, 1958; Segawa, 1974; Yamada, 1925a, 1926, 1950. As *"C. racemosa* var. *clavifera":* Okamura, 1913, 1931; Shen and Fan, 1950; Yamada, 1925a, 1926; Tseng, 1983.
Caulerpa racemosa var. *clavifera* f. *microphysa* (Kützing) Weber-van Bosse, 1898:361.
Okamura, 1931, 1936; Yamada, 1950.
Caulerpa racemosa var. *laetevirens* (Montagne) Weber-van Bosse, 1898:366.
Chiang, 1960, 1973b; Okamura, 1930, 1931, 1936; Segawa, 1974; Shen and Fan, 1950; Taniguti, 1976; Yamada, 1925a, 1926, 1950; Yoshikawa and Yoshikawa, 1977.
Caulerpa racemosa var. *occidentalis* (J. Agardh) Bφrgesen, 1907:379.
Yoshikawa and Yoshikawa, 1977.
Caulerpa racemosa var. *peltata* (Lamouroux) Eubank, 1946:421.
As *"C. peltata":* Chiang, 1960, 1962b; Okamura, 1931, 1932, 1936; Segawa, 1974; Shen and Fan, 1950; Tseng, 1936; Yamada, 1950.
Caulerpa racemosa var. *turbinata* (J. Agardh) Eubank, 1946:420.
As *"C. racemosa* var. *chemnitzia":* Chiang, 1960; Shen and Fan, 1950; Yamada, 1925a, 1926.
Caulerpa serrulata (Forsskål) C. Agardh, 1823:446.
Eubank, 1946; Segawa, 1974; Tseng, 1936; Chihara, 1975.
Caulerpa serrulata f. *lata* (Weber-van Bosse) Tseng 1936:178.
Tseng, 1983.
Caulerpa sertularioides (Gmelin) Howe, 1905:576.
Ariga, 1919; Chihara, 1975; Horikawa, 1919; Yamada, 1950.
Caulerpa sertularioides f. *longipes* (J. Agardh) Collins, 1909:415.
Ariga, 1920.
Caulerpa taxifolia (Vahl) C. Agardh, 1823:435.
Yamada, 1926.
Caulerpa webbiana Montagne, 1838:18.
Ariga, 1919; Horikawa, 1919.
Caulerpa webbiana f. *disticha* Weber-van Bosse, 1898:270.
Okamura, 1931, 1936; Shen and Fan, 1950.
Caulerpa webbiana f. *tomentella* (Harvey) Weber-van Bosse, 1898:270.
Ariga, 1920; Chihara, 1975; Okamura, 1931, 1936; Segawa, 1974; Shen and Fan, 1950; Tseng, 1936.

BRYOPSIDACEAE

Bryopsis harveyana J. Agardh, 1887:22.
Okamura, 1931, 1936; Shen and Fan, 1950; Tseng, 1983; Yamada, 1925a, 1950.

Bryopsis indica A. et E.S. Gepp, 1908:169.
Chiang, 1960, 1962b.

Bryopsis mucosa Lamouroux, 1809b:333.
Chiang, 1960.

Bryopsis plumosa (Hudson) C. Agardh, 1823:448.
Ariga, 1920; Chiang, 1960; De Toni, 1895; Heydrich, 1894; Okamura, 1936; Rho, 1958; Shen and Fan, 1950.

DERBESIACEAE

Derbesia lamourouxii (J. Agardh) Solier, 1847:162.
Taniguti, 1976.

SIPHONOCLADALES

SIPHONOCLADACEAE

Boergesenia forbesii (Harvey) Feldmann, 1938:584.
Chiang, 1962b, 1973b; Tseng, 1983; Yamada, 1950. As *"Valonia forbesii":* Ariga, 1919; Horikawa, 1919; Okamura, 1936; Shen and Fan, 1950; Yamada, 1925a.

VALONIACEAE

Boodlea coacta (Dickie) Murray et De Toni in Murray, 1889:245.
Yamada, 1926, 1950; Yoshikawa and Yoshikawa, 1977.

Boodlea composita (Harvey et J. Hooker) Brand, 1904:187.
Chiang, 1960, 1973b; Okamura, 1936; Shen and Fan, 1950; Tseng, 1983; Yamada 1925a, 1950.

Boodlea montagnei (Harvey ex J.E. Gray) Egerod, 1952:332.
As *"B. paradoxa":* Chiang, 1960; Okamura, 1936; Shen and Fan, 1950.

Boodlea siamensis Reinbold, 1901:191.
Chiang, 1962b; Okamura, 1931, 1936; Shen and Fan, 1950; Yamada, 1925a.

Boodlea van-bosseae Reinbold, 1905:148, *'van Bossei'*.
Okamura, 1919, 1931, 1936; Shen and Fan, 1950. As *"B. bosseae":* Ariga, 1919; Horikawa, 1919.
Remarks: Following the examples given under Article 73.9 of the *International Code of Botanical Nomenclature* (Voss et al., 1983), "a hyphen is correctly used in an epithet after a word which could stand independently . .," we spell the species name *"van-bosseae."*

Chamaedoris orientalis Okamura et Higashi in Okamura, 1931:98.
Okamura, 1931, 1932, 1936; Shen and Fan, 1950.

Cladophoropsis herpestica (Montagne) Howe, 1914:31.
Shen and Fan, 1950.

Cladophoropsis sundanensis Reinbold, 1905:147.
Chiang, 1960; Su et al., 1982.

Cladophoropsis zollingeri (Kützing) Reinbold, 1905:147.
Chiang, 1960; Shen and Fan, 1950; Su et al., 1982; Taniguti, 1976; Tseng, 1983. As *"C. fasciculatus":* Okamura, 1930, 1931; Tseng, 1983; Yamada, 1925a.
Remarks: There has been some question as to when and where the combination *Cladophoropsis zollingeri* was validly published. Most authors (e.g., Papenfuss, 1950; Chiang, 1962a; Taniguti, 1976) have accepted *C. zollingeri* (Kützing) Bφrgesen (1905:288) as correct. According to Article 33.1 of the *International Code of Botanical Nomenclature* (Voss et al., 1983), "the combination is not validly published unless the author definitely indicates that the epithet or epithets concerned are to be used in that particular combination." Parallel to the examples, such as *Eulophus,* cited in the Code, Bφrgesen (1905) has merely stated that *"S. zollingeri"* belongs here but did not actually make the combination in *Cladophoropsis.* The earliest valid combination we are aware of is: *C. zollingeri* (Kützing) Reinbold 1905:147.

Dictyosphaeria bokotensis Yamada, 1925a:81.
Okamura, 1936; Shen and Fan, 1950; Yamada, 1925a, 1950.

Dictyosphaeria cavernosa (Forsskål) Bφrgesen, 1932:2.
Chiang, 1960, 1973b; Shen and Fan, 1950; Taniguti, 1976; Tseng, 1983. As *"D. favulosa":* Ariga, 1920; Okamura, 1930, 1931, 1936; Yamada, 1925a, 1926.

Microdictyon japonicum Setchell, 1925:107.
Chiang, 1962b; Tseng, 1983; Shen and Fan, 1950. As *"Rhipidiphyllon reticulatum":* Ariga, 1920; De Toni, 1895; Heydrich, 1894.
Remarks: Fan (1974:249–250,253–254) reviews taxonomic problems with the genus *Rhipidiphyllon* Heydrich, 1894:281. The type-locality for this genus is in east Taiwan.

Microdictyon nigrescens (Yamada) Setchell, 1925:107.
Okamura, 1936; Shen and Fan, 1950; Fan, 1974; Yamada, 1950. As *"Rhipidiphyllon nigrescens":* Yamada, 1925a.

Microdictyon okamurae Setchell, 1925:107, *'okamurai'*.
Okamura, 1931; Shen and Fan, 1950; Tseng, 1983.
Remarks: The correct spelling for the Latinization of Professor Okamura's name is *"okamurae"* and has been corrected throughout this study.

Struvea anastomosans (Harvey) Piccone et Grunow ex Piccone, 1884:20.
Ariga, 1920; Tseng, 1983.

Struvea delicatula Kützing, 1866:1.
Chiang, 1960; De Toni, 1895; Heydrich, 1894; Oka-

mura, 1930, 1931, 1936; Shen and Fan, 1950; Yamada, 1925b, 1926.

Valonia aegagropila C. Agardh, 1823:429.
Chiang, 1973b; Chihara, 1975; Shen and Fan, 1950; Tseng, 1983; Yamada, 1925a, 1950; Yoshikawa and Yoshikawa, 1977.

Valonia fastigiata Harvey in J. Agardh, 1887:101.
Okamura, 1931; Shen and Fan, 1950.

Valonia utricularis (Roth) C. Agardh, 1823:431.
Okamura, 1931, 1936; Shen and Fan, 1950; Tseng, 1983; Yamada, 1926; Yendo, 1914.

Valonia verticillata Kützing, 1849:508.
Okamura, 1930.

Valoniopsis pachynema (Martens) Bφrgesen, 1934:10.
Chiang, 1960, 1973b; Shen and Fan, 1950; Tseng, 1983; Yamada, 1950; Yoshikawa and Yoshikawa, 1977. As *"Valonia confervoides":* Ariga, 1920; Okamura, 1909, 1931, 1936; Yamada, 1925a.

ANADYOMENACEAE

Anadyomene wrightii Harvey in Gray, 1866:48.
Ariga, 1920; Chiang, 1973b; Okamura, 1936; Shen and Fan, 1950; Tseng, 1983; Yamada, 1925a, 1926, 1950.

DASYCLADALES

ACETABULARIACEAE

Acetabularia gigas Solms-Laubach, 1895:23.
Okamura, 1936; Shen and Fan, 1950; Yamada, 1925a.

Acetabularia major Martens, 1866:25.
Okamura, 1936; Shen and Fan, 1950; Yamada, 1925a.

Bornetella sphaerica (Zanardini) Solms-Laubach, 1893:92.
Chiang, 1973b.

Neomeris annulata Dickie, 1874:198.
Chiang, 1973b.

PHAEOPHYTA

ECTOCARPALES

ECTOCARPACEAE

Ectocarpus breviarticulatus J. Agardh, 1847:7.
Okamura, 1936; Segawa, 1974; Shen and Fan, 1950; Tseng, 1983; Yamada, 1925b, 1950.

Ectocarpus laurenciae Yamada, 1931a:66.
Okamura, 1936; Shen and Fan, 1950; Yamada, 1931a.

Ectocarpus spinosus Kützing, 1843:288.
Heydrich, 1894; Shen and Fan, 1950.

Ectocarpus van-bossea Setchell et Gardner in Setchell, 1924:170.
Yamada, 1950.

Ectocarpus sp.
Chiang, 1976.

Feldmannia formosana (Yamada) Itono, 1973:162.
As *"Ectocarpus formosanus":* Yamada, 1950.

Giffordia mitchelliae (Harvey) Hamel, 1939:xiv.
As *"Ectocarpus mitchelliae":* Chiang, 1960; Okamura, 1936; Shen and Fan, 1950; Tseng, 1983; Yamada, 1925b.

CHORDARIALES

CORYNOTHLAEACEAE

Leathesia difformis (Linnaeus) Areschoug, 1847:376.
Taniguti, 1976.

SPHACELARIALES

SPHACELARIACEAE

Sphacelaria furcigera var. *tenuis* Yamada, 1941:196.
Shen and Fan, 1950; Yamada, 1941.

Sphacelaria tribuloides Meneghini, 1840:2.
Chihara, 1975; De Toni, 1895; Heydrich, 1894; Okamura, 1897, 1936; Segawa, 1974; Shen and Fan, 1950; Tseng, 1983; Yamada, 1925b.

DICTYOTALES

DICTYOTACEAE

Dictyopteris delicatula Lamouroux, 1809b:332.
Yamada, 1950.

Dictyopteris repens (Okamura) Bφrgesen, 1920a:265.
Tseng, 1983; Yoshikawa and Yoshikawa, 1977. As *"Neurocarpus repens":* Okamura, 1931, 1936; Shen and Fan, 1950.

Dictyopteris undulata Holmes, 1896:251.
Tseng, 1983. As *"Haliseris undulata":* Okamura, 1907. As *"Neurocarpus undulata":* Higashi, 1934; Okamura, 1930, 1936; Shen and Fan, 1950. As *"N. undulata* f. *plana":* Chiang, 1960; Okamura, 1930, 1936.

Dictyota bartayresii Lamouroux, 1809b:331.
Okamura, 1931, 1936; Shen and Fan, 1950.

Dictyota ceylanica var. *anastomosans* Yamada, 1950:186.
Yamada, 1950; Yoshikawa and Yoshikawa, 1977.

Dictyota dichotoma (Hudson) Lamouroux, 1809a:42.
Ariga, 1919; Higashi, 1934; Horikawa, 1919; Okamura, 1930; Rho, 1958; Shen and Fan, 1950; Tokida, 1954; Yamada, 1925b.

Dictyota dilata Yamada, 1925b:252.
Okamura, 1936; Segawa, 1974; Shen and Fan, 1950; Yamada, 1925b.

Dictyota divaricata Lamouroux, 1809a:43.
Chiang, 1960; Okamura, 1930; Shen and Fan, 1950; Yamada, 1925b.

Dictyota hamifera Setchell, 1926:92.
Yamada, 1950.

Dictyota linearis (C. Agardh) Greville, 1830:xliii.
Ariga, 1919, 1920; Horikawa, 1919.

Dictyota patens J. Agardh, 1882:93.
Taniguti, 1976.
Remarks: Howe (1920) and Allender and Kraft (1983) consider this taxon to be a synonym of *D. bartayresii* Lamouroux.

Dictyota spinulosa Hooker et Arnott, 1838:275.
Ariga, 1920.

Dilophus okamurae Dawson, 1950:83, *'okamurai'*.
Chihara, 1970, 1975; Fan, 1953b; Segawa, 1974; Tseng, 1983. As *"D. marginatus":* Chiang, 1960; Okamura, 1936; Shen and Fan, 1950.

Dilophus radicans Okamura, 1916:7.
Chiang, 1960; Okamura, 1936; Shen and Fan, 1950.
Remarks: Fan (1953b) considers this name to be in need of synonomy since he believes *D. radicans* may be the prostrate form of *Padina commersonii* (see also Lewis et al., 1987).

Lobophora variegata (Lamouroux) Womersley, 1967:221.
Tseng, 1983. As *"Gymnosorus collaris":* Ariga, 1920. As *"Zonaria variegata":* Heydrich, 1894.

Pachydictyon coriaceum (Holmes) Okamura, 1899:39.
Ariga, 1920; Chiang, 1976; Chihara, 1970; Okamura, 1936; Rho, 1958; Shen and Fan, 1950.

Padina arborescens Holmes, 1896:251.
Higashi, 1934.

Padina australis Hauck, 1887:44.
Chiang, 1960, 1962b; Okamura, 1931, 1932, 1936; Rho, 1958; Shen and Fan, 1950; Su et al., 1982; Tseng, 1936, 1983; Yamada, 1925b, 1931a, 1950.

Padina boryana Thivy in Taylor, 1966:355.
Tseng, 1983.
Remarks: Papenfuss (1977) considered both *P. tenuis* (C. Agardh) Bory and *P. commersonii* Bory to be synonyms of *Lobophora variegata* (Lamouroux) Womersley, and recognized *P. boryana* Thivy as the name for this taxon. Tseng (1983) apparently follows this, listing *P. commersonii* as a synonym of *P. boryana,* whereas Womersley and Bailey (1970) and Allender and Kraft (1983) considered *P. commersonii* and *P. boryana* to be synonyms of *P. tenuis.*

Padina crassa Yamada, 1931a:67.
Ariga, 1920; Chiang, 1960; Yoshikawa and Yoshikawa, 1977.

Padina durvillaei Bory, 1827:591.
Ariga, 1920; Chiang, 1973a; De Toni, 1895; Heydrich, 1894; Okamura, 1935b; Shen and Fan, 1950.

Padina japonica Yamada, 1931a:69.
As *"P. pavonia":* Ariga, 1919; De Toni, 1895; Heydrich, 1894; Horikawa, 1919.

Padina minor Yamada, 1925b:251.
Chiang, 1960, 1962a, 1962b, 1973b, 1976; Chihara, 1975; Okamura, 1931, 1932, 1936; Rho, 1958; Shen and Fan, 1950; Taniguti, 1976; Tseng, 1983; Yamada, 1925b, 1931a, 1950; Yoshikawa and Yoshikawa, 1977.

Padina tenuis Bory, 1827:590.
As *"Padina commersonii":* Okamura, 1931, 1936; Shen and Fan, 1950; Yamada, 1925b, 1931a.
Remarks: See "Remarks" herein under *Padina boryana* Thivy in Taylor.

Spatoglossum pacificum Yendo, 1920:2.
Chiang, 1973a.

Zonaria coriacea Yamada, 1925b:249.
Chiang, 1960; Okamura, 1936; Shen and Fan, 1950; Yamada, 1925b.

Zonaria diesingiana J. Agardh, 1841:443.
Ariga, 1920; Chiang, 1960; Okamura, 1930; Shen and Fan, 1950; Tseng, 1983; Yamada, 1925b.

Zonaria flabellata (Okamura) Papenfuss, 1944:341.
As *"Homoeostrichus flabellatus":* Taniguti, 1976.

Zonaria harveyana (Kützing) Areschoug, 1851:26.
As *"Homoeostrichus multifidus":* Chiang, 1960; Okamura, 1936; Shen and Fan, 1950; Yamada, 1925b.

Zonaria nigrescens Sonder, 1845:50.
Heydrich, 1894; Shen and Fan, 1950.

Zonaria stipitata Tanaka et Nozawa, 1962:183.
Chiang and Chou, 1980.

Zonaria sp.
Su et al., 1982.

SCYTOSIPHONALES

ISHIGEACEAE

Ishige okamurae Yendo, 1907:154, *'okamurai'*.
Chiang, 1960, 1973b; Higashi, 1934; Okamura, 1936; Rho, 1958; Shen and Fan, 1950; Yamada, 1925b.

Ishige sinicola (Setchell et Gardner) Chihara, 1969:3.
As *"I. foliacea":* Rho, 1958; Tseng, 1936.

PUNCTARIACEAE

Petalonia fascia (O.F. Müller) Kuntze, 1898:419.
As *"Ilea fascia":* Chiang, 1960, 1976; De Toni, 1895; Rho, 1958; Shen and Fan, 1950; Tokida, 1954; Yamada, 1925b. As *"Phyllitis fascia":* Heydrich, 1894.

SCYTOSIPHONACEAE

Chnoospora implexa (Hering) J. Agardh, 1848:172.
Chiang, 1960; Okamura, 1931, 1936; Shen and Fan, 1950; Taniguti, 1976; Tokida, 1939; Tseng, 1983; Yamada, 1925b, 1950.

Chnoospora minima (Hering) Papenfuss, 1956:69.
Chiang, 1976; Segawa, 1974. As *"Chnoospora pacifica":* Okamura, 1931, 1936; Shen and Fan, 1950; Tokida, 1939; Yamada, 1950.

Colpomenia sinuosa (Mertens et Roth) Derbès et Solier in Castagne, 1851:95.
Ariga, 1919, 1920; Chiang, 1960, 1976; De Toni, 1895; Heydrich, 1894; Horikawa, 1919; Okamura, 1930; Shen and Fan, 1950; Taniguti, 1976; Tokida, 1954; Yamada, 1925b, 1950; Yoshikawa and Yoshikawa, 1977.

Endarachne binghamiae J. Agardh, 1896:27.
Ariga, 1919, 1920; Chiang, 1960, 1973b, 1976; Cotton, 1915; Fan, 1953a; Higashi, 1934; Horikawa, 1919; Okamura, 1930, 1936; Rho, 1958; Shen and Fan, 1950; Taniguti, 1976; Tilden, 1929; Tseng, 1983; Yamada, 1925b.

Hydroclathrus clathratus (Bory) Howe, 1920:590.
Chiang, 1960, 1962a, 1973b; Okamura, 1936; Rho, 1958; Shen and Fan, 1950; Taniguti, 1976; Tseng, 1983; Yamada, 1950; Yoshikawa and Yoshikawa, 1977. As *"H. cancellatus":* De Toni, 1895; Heydrich, 1894; Higashi, 1934; Okamura, 1897, 1931; Yamada, 1925b.

Rosenvingea orientalis (J. Agardh) Bǿrgesen, 1914:26.
Okamura, 1936; Shen and Fan, 1950; Tseng, 1983. As *"Hydroclathrus orientalis":* De Toni, 1895; Heydrich, 1894.

Scytosiphon lomentaria (Lyngbye) J. Agardh, 1848:126, *'lomentarium'*.
Chiang, 1973a, 1976; Okamura, 1935b, 1936; Segawa, 1974; Tokida, 1954; Yamada, 1925b, 1928. As *"S. lomentarius":* Chihara, 1970, 1975.

FUCALES

CYSTOSEIRACEAE

Cystoseira prolifera J. Agardh, 1848:215.
Chiang, 1976.

Cystoseira sp.
Nizamuddin, 1970.

Hormophysa triquetra (Linnaeus) Kützing, 1843:359.
Chiang, 1973a; Okamura, 1935b; Su et al., 1982.

SARGASSACEAE

Sargassum amabile Yamada, 1944a:1.
Shen and Fan, 1950.

Sargassum aquifolium (Turner) C. Agardh, 1820:12.
Okamura, 1931, 1936; Shen and Fan, 1950.

Sargassum baccularia (Mertens) C. Agardh, 1824:304.
Chou and Chiang, 1981.

Sargassum berberifolium J. Agardh, 1848:337.
Okamura, 1936; Shen and Fan, 1950; Yamada, 1925b.

Sargassum binderi Sonder in J. Agardh, 1848:328.
Chiang, 1976; Chou and Chiang, 1981; Okamura, 1936; Shen and Fan, 1950; Yamada, 1925b.

Sargassum carpophyllum J. Agardh, 1848:304.
Chou and Chiang, 1981; Yamada, 1942.

Sargassum coriifolium J. Agardh, 1889:86.
Okamura, 1936; Shen and Fan, 1950; Yamada, 1925b.

Sargassum coriifolium f. *duplicatum* Yamada, 1950:192.
Yamada, 1950; Yoshikawa and Yoshikawa, 1977.

Sargassum coriifolium f. *prolongatum* (Okamura) Yamada, 1950:192.
Yamada, 1950. As *"S. prolongatum":* Okamura, 1931, 1932, 1936; Shen and Fan, 1950.

Sargassum crassifolium J. Agardh, 1848:326.
Chihara, 1975; Chou and Chiang, 1981; Tseng, 1983; Yamada, 1942, 1950; Yoshikawa and Yoshikawa, 1977.

Sargassum crispifolium Yamada, 1931a:72.
Chiang, 1960, 1962b.

Sargassum cristaefolium C. Agardh, 1820:13.
Ariga, 1920; Chiang, 1976; Chou and Chiang, 1981; Cotton, 1915; Okamura, 1931, 1935b, 1936; Shen and Fan, 1950; Tilden, 1929. As *"S. biserrula":* De Toni, 1895; Heydrich, 1894.

Sargassum duplicatum J. Agardh, 1889:90.
Ariga, 1921; Chiang, 1976; Chou and Chiang, 1981; Liu, 1982; Okamura, 1936; Shen and Fan, 1950; Taniguti, 1976; Yamada, 1925b.

Sargassum echinocarpum J. Agardh, 1848:327.
Yamada, 1950.

Sargassum fulvellum (Turner) C. Agardh, 1820:34.
Ariga, 1920.

Sargassum glaucescens J. Agardh, 1848:306.
Chiang, 1973a; Chou and Chiang, 1981; Okamura, 1935b.

Sargassum hemiphyllum (Turner) C. Agardh, 1820:39.
Ariga, 1920; Chiang, 1976; Chou and Chiang, 1981; Tilden, 1929; Tseng et al., 1985.

Sargassum henslowianum C. Agardh in J. Agardh, 1848:315.
Chou and Chiang, 1981.

Sargassum heterocystum Montagne, 1842:250.
Chou and Chiang, 1981.

Sargassum horneri (Turner) C. Agardh, 1820:38.
Ariga, 1919; Chiang, 1960; Chou and Chiang, 1981; Horikawa, 1919; Okamura, 1936; Rho, 1958; Shen and Fan, 1950; Tokida, 1954; Tseng et al., 1962, 1985; Yamada, 1925b.

Sargassum ilicifolium (Turner) C. Agardh, 1820:11.
Ariga, 1920; Chou and Chiang, 1981; Okamura, 1936; Shen and Fan, 1950; Tseng, 1983; Yamada, 1925b.

Sargassum ilicifolium var. *conduplicatum* Grunow in Weber-van Bosse, 1913a:160.
Yamada, 1942.

Sargassum kasyotense Yamada, 1942:553.
Shen and Fan, 1950; Yamada, 1942.
Sargassum kuetzingii Setchell, 1931:249.
Chou and Chiang, 1981.
Sargassum kushimotense Yendo, 1905:157.
Chou and Chiang, 1981.
Sargassum muriocystum J. Agardh, 1848:314.
Ariga, 1920; De Toni, 1895; Okamura, 1895, 1936; Shen and Fan, 1950.
Sargassum plagiophyllum C. Agardh, 1824:309.
Yamada, 1942.
Sargassum polycystum C. Agardh, 1824:304.
Ariga, 1920; Chou and Chiang, 1981; Okamura, 1931, 1936; Shen and Fan, 1950, Su et al., 1982; Tseng, 1983; Yamada, 1942, 1950; Yoshikawa and Yoshikawa, 1977. As *"S. microphyllum":* Chiang, 1976; Yamada, 1925b.
Sargassum rostratum J. Agardh, 1896:55.
Chou and Chiang, 1981; Okamura, 1936; Shen and Fan, 1950; Tseng et al., 1985.
Sargassum sandei Reinbold in Weber-van Bosse, 1913a:158.
Chiang, 1960, 1976; Chou and Chiang, 1981; Okamura, 1936; Segawa, 1974; Yamada, 1925b; Yoshikawa and Yoshikawa, 1977.
Sargassum sandei f. *heterophyllum* Yamada, 1950:192.
Yamada, 1950.
Sargassum serratifolium C. Agardh, 1820:16.
Chiang, 1973a.
Sargassum siliquosum J. Agardh, 1848:316.
Chiang, 1976; Chou and Chiang, 1981; Okamura, 1931, 1936; Rho, 1958; Shen and Fan, 1950; Yamada, 1925b, 1942.
Sargassum swartzii (Turner) C. Agardh, 1820:11.
Yamada, 1942.
Sargassum telephifolium (Turner) C. Agardh in J. Agardh, 1889:107.
Okamura, 1931, 1936; Shen and Fan, 1950.
Sargassum tenuifolium Yamada, 1942:505.
Yamada, 1942.
Sargassum vulgare C. Agardh, 1820:3.
Ariga, 1919; Horikawa, 1919.
Sargassum sp.
Chiang, 1962b, 1976; Chiang et al., 1974; Chou and Chiang, 1981; Su et al., 1982.
Turbinaria conoides (J. Agardh) Kützing, 1860:24.
Chiang, 1973b; Okamura, 1931, 1936; Shen and Fan, 1950; Tseng, 1983.
Turbinaria filamentosa Yamada, 1925b:243.
Chiang, 1960, 1976; Fan, 1974; Shen and Fan, 1950; Yamada, 1925b. As *"T. filiformis":* Okamura, 1936; Yoshikawa and Yoshikawa, 1977.
Remarks: Fan (1974:252, 254) suggests that the characteristic of this species (i.e., elongate filiform receptacle) may not reflect a species difference, but rather reflect an ecological or physiological state.
Turbinaria ornata (Turner) J. Agardh, 1848:266.
Chiang, 1960, 1962b, 1976; De Toni, 1895; Okamura, 1895, 1931, 1936; Shen and Fan, 1950; Su et al., 1982; Yamada, 1925b, 1950.
Turbinaria trialata (J. Agardh) Kützing, 1860:24.
Chiang, 1962b; Yamada, 1950.
Turbinaria sp.
Ariga, 1919; Horikawa, 1919.

RHODOPHYTA

GONIOTRICHALES

Goniotrichaceae

Chroodactylon ornatum (C. Agardh) Basson, 1979:67.
As *"Asterocytis ornata":* Shen and Fan, 1950; Tanaka, 1944, 1952. As *"Asterocytis ornata* f. *simplex":* Shen and Fan, 1950; Tanaka, 1944, 1952. As *"Asterocytis ramosa* f. *simplex":* Tanaka, 1944.
Stylonema alsidii (Zanardini) Drew, 1956:72.
As *"Goniotrichum alsidii":* Tanaka, 1952.
Remarks: See Wynne (1985) for discussion of use of the generic name *Stylonema* Reinsche, and Drew and Ross (1965) on use of some generic names in the Bangiophycidae.

BANGIALES

Erythropeltidaceae

Erythrotrichia biseriata Tanaka, 1944:86.
Shen and Fan, 1950; Tanaka, 1944, 1951, 1952.
Erythrotrichia carnea f. *tenuis* Tanaka, 1944:92.
Shen and Fan, 1950; Tanaka, 1944.

Bangiaceae

Bangia atropurpurea (Roth) C. Agardh, 1824:76.
Ariga, 1920. As *"B. fuscopurpurea":* Chiang, 1962a, 1973b; Fan, 1953a; Okamura, 1936; Rho, 1958; Sheath and Cole, 1984; Shen and Fan, 1950; Tanaka, 1950, 1952; Taniguti, 1976; Tokida, 1954.
Bangia yamadae Tanaka, 1944:84, *'yamadai'*.
Shen and Fan, 1950; Tanaka, 1944, 1950, 1952.
Bangia sp.
Chiang, 1973b.
Porphyra angusta Okamura et Ueda in Ueda, 1932:28.
Liaw and Chiang, 1979; Wang and Chiang, 1977.
Porphyra crispata Kjellman, 1897a:15.
Ariga, 1920; Chiang, 1962a; Chihara, 1975; Dawson, 1954c; Fan, 1953a; Okamura, 1931, 1936; Shen and Fan, 1950; Tanaka, 1952; Taniguti, 1976; Wang and Chiang, 1977; Ueda, 1932.

Porphyra dentata Kjellman, 1897a:13.
Wang and Chiang, 1977.
Porphyra suborbiculata Kjellman, 1897a:10.
Okamura, 1930, 1936; Wang and Chiang, 1977.
Porphyra sp.
Wang and Chiang, 1977.

NEMALIALES

Remarks: For discussion on the correct spelling of the name of this order see Nicolson and Norris, 1983.

ACROCHAETIACEAE

Liagorophila endophytica Yamada, 1944b:16.
Fan, 1974; Shen and Fan, 1950; Yamada, 1944b. As *"Liagora orientalis":* Yamada, 1938a.

DERMONEMATACEAE

Dermonema frappieri (Montagne et Millardet) Bφrgesen, 1942:42.
Chiang, 1969, 1971, 1973b; Chihara, 1975; Segawa, 1974; Tseng, 1983.
Dermonema gracile Martens ex Weber-van Bosse, 1921:204.
Fan, 1953a; Okamura, 1931, 1936; Shen and Fan, 1950; Tokida, 1939; Tseng, 1945. As *"D. dichotomum":* Ariga, 1920; Chen and Chiang, 1982; De Toni, 1895; Fan, 1974; Heydrich, 1894.
Dermonema pulvinata (Grunow in Holmes) Fan, 1962:337.
Chen and Chiang, 1982; Chihara, 1975; Fan, 1953a; Tseng, 1983; Umezaki, 1972. As *"Nemalion pulvinatum":* Chiang, 1962a; Chihara, 1970; Okamura, 1931, 1936; Rho, 1958; Segawa, 1974; Shen and Fan, 1950; Tokida, 1939.
Remarks: Papenfuss (1967:96–97) points out that *Dermonema* Heydrich had been a nomen nudum until Heydrich (1894:289) published *D. dichotomum*. The type-locality for the genus is therefore Taiwan (see also Fan 1974:249, 253).
Dotyophycus yamadae (Ohmi et Itono) Abbott et Yoshizaki, 1981:225.
Chiang and Chen, 1983.
Liagoropsis schrammi (P. et H. Crouan in Mazè et Schramm) Doty and Abbott, 1964:443.
Fan, 1974. As *"L. maxima":* Shen and Fan, 1950; Yamada, 1944c.
Yamadaella cenomyce (Decaisne) Abbott, 1970:117.
Chiang, 1973b. As *"L. annulata":* Okamura, 1931, 1936. As *"L. caenomyce":* Chihara, 1975; Segawa, 1974; Shen and Fan, 1950; Tseng, 1941a; Yamada, 1938a.

LIAGORACEAE

Helminthocladia australis Harvey, 1863, pl. 272.
Chen et al., 1981.
Liagora boergesenii Yamada, 1938a:11.
Chiang, 1971, 1972; Chiang and Chen, 1982; Chihara, 1975; Shen and Fan, 1950; Yamada, 1938a.
Liagora ceranoides Lamouroux, 1816:239.
Chiang and Chen, 1982.
Liagora ceranoides var. *leprosa* (J. Agardh) Yamada, 1938a:21.
Segawa, 1974; Shen and Fan, 1950; Yamada, 1938a.
Liagora ceranoides var. *pulverulenta* (C. Agardh) Yamada, 1938a:21.
Shen and Fan, 1950; Yamada, 1938a.
Liagora decussata Montagne, 1849:64.
Chiang and Chen, 1982; Shen and Fan, 1950; Yamada, 1938a.
Liagora farinosa Lamouroux, 1816:240.
Chihara, 1975; Shen and Fan, 1950; Tseng, 1941a; Yamada, 1938a.
Remarks: Recently Fan and Wang (1974:492) proposed a new generic name, *Ganonema*, for this taxon. However, we follow the opinion of Abbott (1976:130), and for the time being continue to recognize this taxon as a *Liagora* (see also Norris and Bucher, 1982:190).
Liagora orientalis J. Agardh, 1896:99.
Ariga, 1920; Chiang and Chen, 1982; Fan, 1974; Okamura, 1936; Shen and Fan, 1950; Yamada, 1932b. As *"L. formosana":* Yamada, 1938a.
Remarks: Yamada (1944b:18–19) reduced his species *L. formosana* (1938a:32) into synonomy with *L. orientalis*.
Liagora rugosa Zanardini, 1851:36.
Ariga, 1920.
Liagora segawai Yamada, 1938a:1.
Chiang and Chen, 1982.
Liagora setchellii Yamada, 1938a:13.
Chiang and Chen, 1982; Shen and Fan, 1950; Tseng, 1941a; Yamada, 1938a; Yoshikawa and Yoshikawa, 1977.
Liagora valida Harvey, 1853:138.
Chiang and Chen, 1982; Okamura, 1931, 1936; Shen and Fan, 1950.

CHAETANGIACEAE

Actinotrichia fragilis (Forsskål) Bφrgesen, 1932:6.
Chihara, 1970, 1975; Shen and Fan, 1950; Tseng, 1941b. As *"Actinotrichia rigida":* Ariga, 1920.
Galaxaura arborea Kjellman, 1900:72.
Ariga, 1920; Chiang, 1962a; Yendo, 1918; Yoshikawa and Yoshikawa, 1977.
Remarks: The taxonomy and nomenclature of this genus have been confused by morphological plasticity and uncertain life histories. Since the hypothesis of an alternation of morphologically different sexual and tetrasporic forms of *Galaxaura* (Howe 1917, 1918), there has been much speculation as to which tetrasporic and sexual "species" represent stages within the same life history (e.g., Bφrgesen, 1920b; Chou, 1945, 1947; Dawson, 1953;

Taylor, 1960). We hold the opinion that until culture studies conclusively link the different reproductive stages into the life history, each reproductive form should be recognized by its previous species name.

Galaxaura canaliculata Kützing, 1849:530.
Heydrich, 1894; Shen and Fan, 1950.

Galaxaura clavigera Kjellman, 1900:76.
Chiang, 1962b; Itono, 1977a; Okamura, 1931, 1936; Shen and Fan, 1950; Tanaka, 1936.
Remarks: Papenfuss, Mshigeni, and Chiang (1982:411) consider this species to be a synonym of *Galaxaura marginata* (Ellis et Solander) Lamouroux.

Galaxaura distenta Harvey, 1859:331.
Ariga, 1920.

Galaxaura elegans Tanaka, 1935:52.
Okamura, 1936; Shen and Fan, 1950; Tanaka, 1935, 1936.

Galaxaura elongata J. Agardh, 1876:529.
Itono, 1977a; Okamura, 1936; Shen and Fan, 1950; Tanaka, 1936; Tseng, 1941b; Yendo, 1916b; Yoshikawa and Yoshikawa, 1977.
Remarks: Considered a synonym of *G. rugosa* (Ellis et Solander) Lamouroux (1816:263) by Papenfuss, Mshigeni, and Chiang (1982).

Galaxaura falcata Kjellman, 1900:73.
Ariga, 1919; Horikawa, 1919, Taniguti, 1976.

Galaxaura fasciculata Kjellman, 1900:53.
Itono, 1977a; Okamura, 1936; Shen and Fan, 1950; Tanaka, 1936; Tseng, 1941b.

Galaxaura fastigiata Decaisne 1842:116.
Ariga, 1920; Chiang, 1962a, 1962b; Chihara, 1970, 1975; Itono, 1977a; Okamura, 1931, 1936; Segawa, 1974; Shen and Fan, 1950; Tanaka, 1936; Tanaguti, 1976; Yoshikawa and Yoshikawa, 1977.
Remarks: Considered a synonym of *G. oblongata* (Ellis et Solander) Lamouroux (1816: 262) by Papenfuss, Mshigeni, and Chiang (1982).

Galaxaura filamentosa Chou in Taylor, 1945:139.
Itono, 1977a.

Galaxaura lapidescens (Ellis et Solander) Lamouroux, 1816:264.
De Toni, 1895.

Galaxaura lapidescens f. *villosa* J. Agardh, 1876:530.
Heydrich, 1894; Okamura, 1897; Shen and Fan, 1950.

Galaxaura latifolia Tanaka, 1935:54.
Okamura, 1935a, 1936; Shen and Fan, 1950; Tanaka, 1935, 1936.

Galaxaura oblongata (Ellis et Solander) Lamouroux, 1816:262.
Chiang, 1973a, 1973b; Okamura, 1935b; Su et al., 1982.

Galaxaura obtusata (Ellis et Solander) Lamouroux, 1816:262.
Itono, 1977a; Okamura, 1936; Papenfuss, Mshigeni, and Chiang, 1982; Shen and Fan, 1950; Su et al., 1982; Tanaka, 1936; Tseng, 1941b.

Galaxaura pacifica Tanaka, 1935:55.
Itono, 1977a; Okamura, 1935a, 1936; Shen and Fan, 1950; Tanaka, 1935, 1936.
Remarks: Considered a synonym of *G. rugosa* (Ellis et Solander) Lamouroux (1816:262) by Papenfuss, Mshigeni, and Chiang (1982).

Galaxaura robusta Kjellman, 1900:85.
Chihara, 1970, 1975; Okamura, 1936; Segawa, 1974; Shen and Fan, 1950; Tanaka, 1936.
Remarks: Considered a synonym of *G. obtusata* (Ellis et Solander) Lamouroux by Papenfuss, Mshigeni, and Chiang (1982).

Galaxaura rudis Kjellman, 1900:43.
Okamura, 1931, 1936; Shen and Fan, 1950; Tanaka, 1936; Tseng, 1941b.
Remarks: Considered a synonym of *G. lapidescens* (Ellis et Solander) Lamouroux by Papenfuss, Mshigeni, and Chiang (1982).

Galaxaura marginata (Ellis et Solander) Lamouroux, 1816:264.
Papenfuss, Mshigeni, and Chiang, 1982. As *"Galaxaura tenera":* Chiang, 1973a, 1973b; Okamura, 1935a; Su et al., 1982.
Remarks: Material from Taiwan determined as *G. tenera* was re-identified by Papenfuss, Mshigeni, and Chiang (1982) to be this species.

Galaxaura veprecula Kjellman, 1900:80.
Ariga, 1920; Chihara, 1975; Itono, 1977a; Okamura, 1936; Rho, 1958; Shen and Fan, 1950; Tanaka, 1936; Tseng, 1983; Yendo, 1918.
Remarks: Papenfuss, Mshigeni, and Chiang (1982) consider this species to be a synonym of *G. marginata* (Ellis et Solander) Lamouroux.

Scinaia boergesenii Tseng, 1941:100.
Shen and Fan, 1950.

Scinaia cottonii Setchell, 1914:103.
Shen and Fan, 1950.

Scinaia moniliformis J. Agardh, 1885:72.
Chiang, 1962a; Yoshikawa and Yoshikawa, 1977.

Scinaia pseudojaponica Yamada et Tanaka in Yamada, 1938b:127.
Chiang, 1962a, 1970, 1973b; Shen and Fan, 1950.

BONNEMAISONIACEAE

Asparagopsis taxiformis (Delile) Trevisan, 1845:45.
As *"A. sanfordiana":* Ariga, 1919; Fan, 1953a; Horikawa, 1919; Okamura, 1931, 1936; Shen and Fan, 1950.

Delisea fimbriata (Lamouroux) Montagne, 1844:155.
Chihara, 1970, 1975. As *"D. japonica":* Cotton, 1915; Tilden, 1929.

GELIDIALES

GELIDIACEAE

Gelidium amansii Lamouroux in Kützing 1868:16.
Cotton, 1915; Fan, 1953a; Okamura, 1913, 1915b, 1930; Oshima, 1915; Rho, 1958; Santelices and Stewart, 1985; Tilden, 1929; Tokida, 1954.

Gelidium amansii f. *elegans* Okamura, 1934a:56.
Chiang, 1962a; Fan, 1951.

Gelidium amansii f. *latioris* Okamura, 1935b:443.
Chiang, 1962a; Fan, 1951; Okamura, 1935b, 1936; Shen and Fan, 1950.

Gelidium "cartilagineum".
Ariga, 1919; Horikawa, 1919.
Remarks: As with all taxa in this paper, we are reporting the name used by the author in recording the taxon from Taiwan. We recognize that Dixon (1967) has shown the basionym *Fucus cartilagineus* Linnaeus (1753) to be correctly *Plocamium cartilagineum* (Linnaeus) Dixon. However, in this case, we suggest the material of Ariga (1919) and Horikawa (1919) probably belongs to *Gelidium,* rather than *Plocamium,* but cannot be sure what species it is.

Gelidium crinale (Turner) Lamouroux in Bory, 1825:191.
Ariga, 1920.

Gelidium divaricatum Martens, 1866:30.
Okamura, 1934a, 1936; Taniguti, 1976.

Gelidium japonicum (Harvey) Okamura, 1901:57.
Arasaki, 1964; Ariga, 1919, 1920; Chiang, 1962a; Fan, 1951, 1953a; Higashi, 1934; Horikawa, 1919; Okamura, 1901, 1915b, 1930, 1934a, 1936; Oshima, 1915; Santelices and Stewart, 1985; Shen and Fan, 1950.

Gelidium kintaroi (Okamura) Yamada, 1941:201.
Fan, 1951, 1953a; Shen and Fan, 1950. As *"G. clavatum":* Okamura, 1934a, 1935a, 1935b, 1936.

Gelidium latiusculum Okamura, 1935b:443.
Chiang, 1962a; Fan, 1951, 1953a; Okamura, 1935b, 1936; Shen and Fan, 1950.

Gelidium pacificum Okamura, 1914:99.
Okamura, 1915b; Oshima, 1915.

Gelidium planiusculum Okamura, 1935b:442.
Chiang, 1962a; Fan, 1951, 1953a; Okamura, 1935b, 1936; Santelices and Stewart, 1985; Shen and Fan, 1950.

Gelidium pusillum (Stackhouse) Le Jolis, 1863:139.
Chiang, 1962a; Fan, 1951; Santelices and Stewart, 1985; Taniguti, 1976. As *"Acrocarpus pusillus":* Martens, 1866.

Gelidium pusillum f. *foliaceum* Okamura, 1934a:51.
Ariga, 1920; Taniguti, 1976.

Gelidium subcostatum Okamura in Schmitz, 1894:1.
Ariga, 1919; Horikawa, 1919.

Gelidium yamadae (Okamura) Fan, 1951:10.
Fan, 1951, 1953a. As *"G. densum":* Okamura, 1935b; Shen and Fan, 1950.
Remarks: Fan (1951) considers *G. densum* invalid on the basis of an earlier homonym.

Gelidium sp.
Ariga, 1920.

Pterocladia nana Okamura, 1934a:64.
Chiang, 1962a, 1973b; Fan, 1951.

Pterocladia tenuis Okamura, 1934a:62.
Arasaki, 1964; Chiang, 1962a, 1962b, 1973b; Fan, 1951, 1953a; Okamura, 1935b, 1936; Segawa, 1974; Rho, 1958; Shen and Fan, 1950; Taniguti, 1976. As *"Gelidium corneum* var. *pinnatum":* Heydrich, 1894. As *"P. capillaceum":* Ariga, 1920; Chihara, 1970, 1975; Okamura, 1915b; Oshima, 1915.

GELIDIELLACEAE

Gelidiella acerosa (Forsskål) Feldmann et Hamel, 1934:533.
Ariga, 1920; Chiang, 1973b; Chihara, 1975; Okamura, 1936; Segawa, 1974; Shen and Fan, 1950; Yoshikawa and Yoshikawa, 1977. As *"Gelidiopsis rigida":* Okamura, 1931.

CRYPTONEMIALES

DUMONTIACEAE

Dudresnaya japonica Okamura, 1908:209.
Shen and Fan, 1950.

RHIZOPHYLLIDACEAE

Remarks: Placed in the Cryptonemiales By Kylin (1956), this family was later transferred by Wiseman (1975) to the Gigartinales (see also Kraft (1981) and Wynne and Kraft (1981)). However, West and Hommersand (1981) noted "there is no major evidence to suggest that the [Rhizophyllidaceae] is closely related to either order," and retained it in the Cryptonemiales.

Chondrococcus hornemannii (Mertens) Schmitz, 1895:170, *'hornemanni'*.
Arasaki, 1964; Okamura, 1931, 1936; Segawa, 1974; Shen and Fan, 1950. As *"Desmia hornemannii":* Chiang, 1962a, 1973b; Chihara, 1970; Su et al., 1982; Yoshikawa and Yoshikawa, 1977.

Rhodopeltis borealis Yamada, 1931a:75.
Arasaki, 1964; Chihara, 1975; Nozawa, 1963, 1970; Okamura, 1936; Segawa, 1974; Shen and Fan, 1950; Yamada, 1931a.

Rhodopeltis gracilis Yamada et Tanaka in Yamada, 1935:30.
Arasaki, 1964; Nozawa, 1963, 1970; Okamura, 1936; Shen and Fan, 1950; Yamada, 1935.

Rhodopeltis setchelliae Yamada, 1935:33, *'setchellii'*.
Nozawa, 1963, 1970; Okamura, 1936; Shen and Fan, 1950; Yamada, 1935.

PEYSSONNELIACEAE

Peyssonnelia caulifera Okamura, 1899:8.
Ariga, 1920.

Peyssonnelia distenta (Harvey) Yamada, 1930:29.
Ariga, 1920; Chiang, 1962a, 1962b; Okamura, 1899, 1936; Shen and Fan, 1950; Yamada, 1930; Yoshikawa and Yoshikawa, 1977. As *"P. involvens":* Okamura, 1909.

Peyssonnelia rubra (Greville) J. Agardh, 1852:502.
De Toni, 1895; Heydrich, 1894; Okamura, 1897, 1931, 1936; Shen and Fan, 1950.

CORALLINACEAE

Amphiroa beauvoisii Lamouroux, 1816:299.
As *"A. pusilla":* Okamura, 1936; Segawa, 1974; Shen and Fan, 1950. As *"A. zonata":* Chiang, 1962a.
Remarks: Recently Norris and Johansen (1981:6) considered *A. zonata* to be a taxonomic synonym of *A. beauvoisii* Lamouroux.

Amphiroa bowerbankii Harvey, 1849b:97.
De Toni, 1895; Heydrich, 1894; Shen and Fan, 1950.

Amphiroa ephedracea (Lamarck) Decaisne, 1842:124.
Chihara, 1970; De Toni, 1895; Okamura, 1936; Rho, 1958; Segawa, 1974; Shen and Fan, 1950. As *"A. exilis":* Heydrich, 1894; Yendo, 1902.

Amphiroa fragilissima (Linnaeus) Lamouroux, 1816:298.
Yoshikawa and Yoshikawa, 1977.

Amphiroa multifida Kützing, 1858:27.
De Toni, 1895; Heydrich, 1894; Shen and Fan, 1950.

Amphiroa pusilla Yendo, 1902:13.
Rho, 1958; Su et al., 1982.

Amphiroa spp.
Ariga, 1920.

Cheilosporum anceps Yendo, 1902:18.
Shen and Fan, 1950.

Cheilosporum jungermannioides Ruprecht in J. Agardh, 1852:546.
Chihara, 1975; Okamura, 1931, 1936; Segawa, 1941, 1974; Shen and Fan, 1950; Tseng, 1983. As *"Amphiroa cultrata* var. *globulifera":* De Toni, 1895; Heydrich, 1894. As *"C. cultratum":* Yendo, 1902.

Jania adhaerens Lamouroux, 1816:270.
Chiang, 1962a, 1962b; Okamura, 1931, 1936; Shen and Fan, 1950; Su et al., 1982; Taniguti, 1976. As *"Corallina adhaerens":* De Toni, 1905; Heydrich, 1894; Yendo, 1902. As *"Corallina decussato-dichotoma":* Okamura, 1931, 1936; Segawa, 1974. As *"J. decussato-dichotoma":* Arasaki, 1964; Chiang, 1962a; Chihara, 1970, 1975; Shen and Fan, 1950; Taniguti, 1976.

Jania radiata Yendo, 1902:26.
Chiang, 1962a.

Jania tenella Kützing, 1858:41.
Chiang, 1962a.

Jania undulata Yendo, 1902:26.
Shen and Fan, 1950.

Lithophyllum perulatum Foslie, 1900:18.
De Toni, 1895; Okamura, 1936; Shen and Fan, 1950; Yendo, 1902. As *"Melobesia pustulata":* Heydrich, 1894.

Lithophyllum spp.
Ariga, 1920.

Lithothamnium membranaceum (Esper) Foslie, 1905:72.
De Toni, 1895; Okamura, 1936; Shen and Fan, 1950. As *"Melobesia membranaceae":* Heydrich, 1894; Yendo, 1902.

Lithothamnium spp.
Ariga, 1920.

Mastophora pygmaea Heydrich, 1894:300.
De Toni, 1895; Fan, 1974; Heydrich, 1894; Okamura, 1936; Shen and Fan, 1950; Yendo, 1902.
Remarks: Fan (1974:251, 254) considers the taxonomy of this species suspect and encourages study of the type specimen and type-locality specimens to confirm the identity of Heydrich's plant.

Mastophora rosea (C. Agardh) Setchell, 1943:129.
Chiang, 1973b; Chihara, 1975; Segawa, 1974; Su et al., 1982; Taniguti, 1976; Yoshikawa and Yoshikawa, 1977. As *"M. macrocarpa":* Chiang, 1962a; De Toni, 1905; Heydrich, 1894; Okamura, 1931, 1936; Shen and Fan, 1950; Yendo, 1902.

Melobesia farinosa Lamouroux, 1816:315.
De Toni, 1895; Heydrich, 1894; Okamura, 1936; Shen and Fan, 1950; Yendo, 1902.

Melobesia spp.
Ariga, 1920.

Tenarea tumidulum (Foslie) Adey, 1970:7.
As *"Dermatolithon tumidulum":* Chiang, 1973a; Okamura, 1935b.

ENDOCLADIACEAE

Gloiopeltis complanata (Harvey) Yamada, 1932a:117.
As *"Endocladia complanata":* Ariga, 1920. As *"Gloiopeltis cervicornis:"* Ariga, 1921.

Gloiopeltis furcata (Postels et Ruprecht) J. Agardh, 1851:235.
Chiang, 1973b; Fan, 1953a; Shen and Fan, 1950.

Gloiopeltis tenax (Turner) J. Agardh, 1842:68.
Chiang, 1969, 1973a; Okamura, 1935b.

CRYPTONEMIACEAE

Carpopeltis angusta (Harvey) Okamura, 1910:66.
Ariga, 1920; Shen and Fan, 1950.

Carpopeltis cornea Okamura, 1936:553.
Arasaki, 1964; Chihara, 1975; Okamura, 1936; Rho, 1958; Segawa, 1974; Shen and Fan, 1950; Su et al., 1982.

Carpopeltis flabellata (Holmes) Okamura, 1935a:39.
Ariga, 1920; Chiang 1962a.
Carpopeltis formosana Okamura, 1931:110.
Fan, 1953a; Okamura 1931, 1936; Shen and Fan, 1950; Tokida, 1939.
Carpopeltis rigida (Harvey) Schmitz, 1895:168.
Ariga, 1920; Chihara, 1975; Okamura, 1909, 1930, 1936; Rho, 1958; Segawa, 1974; Shen and Fan 1950; Yoshikawa and Yoshikawa, 1977.
Grateloupia carnosa Yamada et Segawa in Yamada, 1938b:126.
Chiang, 1962a.
Grateloupia filicina (Wulfen) J. Agardh, 1851:180.
Ariga, 1919, 1920; Chiang, 1962a, 1973b; De Toni, 1895; Horikawa, 1919.
Grateloupia filicina f. *filiformis* (Kützing) Pilger, 1911:310.
As *"G. filiformis":* Martens, 1866.
Grateloupia okamurae Yamada, 1941:204, *'okamurai'*.
Chiang, 1973a.
Grateloupia ramosissima Okamura, 1913:60.
Chiang, 1962a, 1973a; Chihara, 1970, 1975; Dawson, 1954c; Rho, 1958; Segawa, 1974; Shen and Fan, 1950.
Halymenia ceylanica (Harvey) Kützing, 1866:33.
As *"H. formosa":* Okamura, 1909. As *"H. durvillaei* var. *formosa":* Tokida, 1939. As *"H. durvillaei* var. *ceylanica":* Ariga, 1920; Chiang, 1962a; Okamura, 1936; Shen and Fan, 1950.
Halymenia durvillaei Bory, 1826, pl. 15.
Fan, 1953a.
Polyopes polyideoides Okamura, 1895:447.
Chiang, 1973a, 1973b; Okamura, 1935b.
Polyopes sp.
Heydrich, 1894.

GIGARTINALES

SOLIERIACEAE

Eucheuma arnoldii Weber-van Bosse, 1928:421.
Kraft, 1972. As *"E. cupressoideum":* Shen and Fan, 1950.
Eucheuma "audiolis"
Tseng and Chen, 1977; Tseng, 1984.
Remarks: This species name is apparently a nomen nudum (fide M.S. Doty).
Eucheuma cottonii Weber-van Bosse, 1913b:115.
Tseng and Chen, 1977.
Eucheuma crassum Zanardini, 1878:36.
Shen and Fan, 1950; Yamada, 1936a.
Eucheuma crustaeforme Weber-van Bosse, 1928:415.
Okamura, 1931, 1936. As *"E. cottonii":* Okamura, 1931.
Eucheuma gelatinae (Esper) J. Agardh, 1852:628.
Chihara, 1975; Doty and Norris, 1985; Shen and Fan, 1950; Tseng, 1983; Tseng and Chen, 1977; Yamada, 1936a.
Eucheuma muricatum (Gmelin) Weber-van Bosse, 1928:413.
Higashi, 1934; Shen and Fan, 1950.
Eucheuma muricatum f. *depauperata* Weber-van Bosse, 1928:415.
Ariga, 1920; Okamura, 1936. As *"E. muricatum":* Okamura, 1931. As *"E. spinosum":* Okamura, 1909, 1915b.
Eucheuma okamurae Yamada, 1936a:125, *'okamurai'*.
Shen and Fan, 1950.
Eucheuma papulosa Cotton et Yendo in Cotton, 1914:220.
Cotton, 1915; Tilden, 1929.
Eucheuma serra J. Agardh, 1852:626.
Chiang, 1962a, 1973b; Chihara, 1975; Segawa, 1974; Shen and Fan, 1950; Su et al., 1982; Tseng and Chen, 1977; Yamada, 1936a; Yoshikawa and Yoshikawa, 1977.
Eucheuma spp.
Ariga, 1920.
Meristotheca coacta Okamura, 1930:97.
Arasaki, 1964; Okamura, 1930, 1936; Segawa, 1974; Yoshikawa and Yoshikawa, 1977.
Meristotheca papulosa (Montagne) J. Agardh, 1876:584.
Arasaki, 1964; Chiang, 1962a; Fan, 1953a; Okamura, 1936; Segawa, 1974; Tseng, 1983.

HYPNEACEAE

Hypnea boergesenii Tanaka, 1941:233.
Chiang, 1962a; Fan, 1953a; Shen and Fan, 1950; Tanaka, 1941; Tseng, 1983.
Hypnea cenomyce J. Agardh, 1852:452.
Shen and Fan, 1950; Tanaka, 1941; Yoshikawa and Yoshikawa, 1977.
Hypnea cervicornis J. Agardh, 1852:451.
Yoshikawa and Yoshikawa, 1977.
Hypnea charoides Lamouroux, 1813:131.
Chiang, 1973b; Fan, 1953a; Shen and Fan, 1950; Tseng, 1983.
Hypnea chordacea Kützing, 1847:776.
Arasaki, 1964; Shen and Fan, 1950; Tanaka, 1941.
Hypnea chordacea f. *simpliciuscula* (Okamura) Tanaka, 1941:232.
Chiang, 1962a; Chihara, 1975; Shen and Fan 1950; Tanaka, 1941.
Hypnea cornuta (Lamouroux) J. Agardh, 1852:449.
Shen and Fan, 1950; Tanaka, 1941.
Hypnea esperi Bory, 1828:157.
Shen and Fan, 1950; Tanaka, 1941.
Hypnea hamulosa (Turner) Lamouroux, 1813:44.
Okamura, 1931, 1936; Shen and Fan, 1950; Tanaka, 1941.
Remarks: Several authors (e.g., J. Agardh, 1852:447; De Toni 1924:477; Okamura, 1936:611; Tanaka, 1941:245; Shen and Fan, 1950:339; Weber-van Bosse, 1928:453; and Zanardini, 1858:270) have incorrectly

cited "Montagne 1850:n.16 (page 9)" as the original place of publication.

Hypnea japonica Tanaka, 1941:236.
Chiang, 1962a; Chihara, 1970; Segawa, 1974; Shen and Fan 1950; Tanaka, 1941; Tseng, 1983.

Hypnea nidulans Setchell, 1924:161.
Chihara, 1975; Okamura, 1931, 1936; Shen and Fan, 1950; Su et al., 1982; Tanaka, 1941; Yoshikawa and Yoshikawa, 1977.

Hypnea pannosa J. Agardh, 1847:14.
Okamura, 1931, 1936; Shen and Fan, 1950; Tanaka, 1941; Yoshikawa and Yoshikawa, 1977.

Hypnea saidana Holmes, 1896:256.
Chiang, 1973b.

Hypnea seticulosa J. Agardh, 1852:446.
Ariga, 1920; Okamura, 1931, 1936; Tokida, 1939.

Hypnea spinella (Greville) Kützing, 1849:759.
Chiang, 1962a.

Hypnea sp.
Su et al., 1982.

Plocamiaceae

Plocamium oviforme Okamura, 1896:23.
Ariga, 1920.

Plocamium serratulum Okamura, 1932:100.
Okamura, 1936; Shen and Fan, 1950. As *"P. costatum"*: Okamura, 1923, 1931; Yendo, 1918.

Plocamium telfairiae (J. Agardh) Harvey in Kützing, 1849:885.
Shen and Fan, 1950; Yendo, 1915. As *"P. abnorme"*: Ariga, 1919, 1920; Horikawa, 1919; Okamura, 1931.

Plocamium telfairiae f. *uncinatum* Okamura, 1936:615.
As *"P. abnorme* f. *uncinatum"*: Okamura, 1913.

Gracilariaceae

Ceratodictyon spongiosum Zanardini, 1878:37.
Arasaki, 1964; Ariga, 1920; Okamura, 1936. As *"C. spongioides"*: Okamura, 1931; Shen and Fan, 1950.

Gelidiopsis hachijoensis Yamada et Segawa, 1953:112.
Yoshikawa and Yoshikawa, 1977.

Gelidiopsis repens (Kützing) Schmitz, 1895:148.
Chiang, 1962a, 1973b; Chihara, 1975; Okamura, 1931, 1936; Shen and Fan, 1950; Taniguti, 1976; Yamada 1932b; Yoshikwa and Yoshikawa, 1977.

Gelidiopsis variabilis (Greville) Schmitz, 1895:148.
Yamada, 1932b.

Gracilaria arcuata Zanardini, 1858:265.
Chang and Xia, 1976; Chiang, 1973a, 1973b, 1985; Okamura, 1935b; Su et al., 1982.

Gracilaria blodgettii Harvey, 1853:111.
Chiang, 1985; Ohmi, 1958; Yang and Chiang, 1982.
Remarks: Although *"G. blodgettii"* has been reported from Taiwan (Chiang, 1985), the South China Sea (Xia, 1985), and southern Japan (Yamamoto, 1985), the relationship between them and Caribbean type specimens of *G. blodgettii* Harvey is still to be resolved.

Gracilaria bursapastoris (Gmelin) Silva, 1952:265.
As *"G. compressa"*: Chen, 1976; Shang, 1976.

Gracilaria canaliculata (Kützing) Sonder, 1871:56.
As *"Corallopsis opuntia"*: Arasaki, 1964; Segawa, 1974.

Gracilaria chorda Holmes, 1896:253.
Ariga, 1920; Chen, 1976.

Gracilaria coronopifolia J. Agardh, 1852:592.
Chang and Xia, 1976; Chiang, 1985; Ohmi, 1958; Tseng, 1983; Yamada, 1941; Yang and Chiang, 1982.
As *"G. lichenoides* f. *coronopifolia"*: Fan, 1953a.

Gracilaria crassa Harvey ex J. Agardh, 1876:417.
Chang and Xia, 1976; Chihara, 1975; Chiang, 1985; Ohmi, 1958; Okamura, 1936; Shen and Fan, 1950; Tseng, 1983; Yamada, 1933; Yang and Chiang, 1982.

Gracilaria denticulata (Kützing) Schmitz in Mazza, 1907:138.
Chiang, 1962a, 1985; Chihara, 1975; Okamura, 1931, 1936; Yang and Chiang, 1982.

Gracilaria edulis (Gmelin) Silva, 1952:293.
Nelson et al., 1983. As *"G. lichenoides"*: Chen, 1976; Chiang, 1981; Shang, 1976.

Gracilaria eucheumioides Harvey, 1859:331.
Chang and Xia, 1976; Chiang, 1973a, 1985; Okamura, 1935b; Yang and Chiang, 1982.

Gracilaria gigas Harvey, 1859:330.
Chiang, 1981; Chen, 1976; Shang, 1976.

Gracilaria incurvata Okamura, 1931:41.
Chiang, 1973a; Okamura, 1935b.

Gracilaria punctata (Okamura) Yamada, 1941:203.
Ohmi, 1958; Shen and Fan, 1950; Yamada, 1941.

Gracilaria purpurascens Harvey in J. Agardh, 1885:63.
Ohmi, 1958; Shen and Fan, 1950; Yamada, 1938b; Yoshikawa and Yoshikawa, 1977.

Gracilaria spinulosa (Okamura) Chang et Xia, 1976:148.
Tseng, 1983. As *"G. purpurascens* f. *spinulosa"*: Ohmi, 1958; Shen and Fan, 1950; Yamada, 1941; Yoshikwa and Yoshikwa, 1977.

Gracilaria salicornia (C. Agardh) Dawson, 1954b:4.
Chiang, 1985; Yang and Chiang, 1982.

Gracilaria "verrucosa".
G. verrucosa sensu Chiang, 1981, 1985; Nelson et al., 1983; Rho, 1958; Segawa, 1974; Yang et al., 1981; Yang and Chiang, 1982 [non *G. verrucosa* (Hudson) Papenfuss, 1950:195]. As *"G. confervoides"*: De Toni, 1895; Fan, 1953a; Martens, 1866; Shang, 1976; Shen and Fan, 1950; Tokida, 1954.
Remarks: A comparison with type-locality (England) specimens of *G. verrucosa* showed the Taiwan specimens are a different species (Chiang, 1985; Abbott et al., 1985), and that the Chinese and Japanese specimens identified

as "*G. verrucosa*" are the same (Xia and Yamamoto, 1985; Yamamoto, 1985; Xia, 1985) and that they too are different from the British *G. verrucosa*. Recently, Zhang and Xia (1985:177) described *G. asiatica* for the specimens from Japan and China.

Gracilaria sp.
Ariga, 1920.

SPHAEROCOCCACEAE

Caulacanthus okamurae Yamada, 1933:278, '*okamurai*'.
Rho, 1958; Taniguti, 1976; Yamada, 1933.

Caulacanthus spinellus (Hooker et Harvey) Kützing, 1849:753.
Chiang, 1973b; Shen and Fan, 1950; Yamada, 1933.

Caulacanthus ustulatus var. *fastigiatus* (Kützing) Pilger, 1920:5.
As "*C. fastigiatus*": Martens, 1866.

Phacelocarpus japonicus Okamura, 1902:79.
Shen and Fan, 1950.

SARCODIACEAE

Sarcodia ceylanica Harvey ex Kützing, 1869, pl. 33.
Chiang, 1962a; Shen and Fan, 1950; Yoshikawa and Yoshikawa, 1977.

PHYLLOPHORACEAE

Ahnfeltia paradoxa (Suringar) Okamura, 1934b:13.
As "*Gymnogongrus paradoxus*": Ariga, 1920.

Gymnogongrus flabelliformis Harvey, 1856:332.
Shen and Fan, 1950; Taniguti, 1976.

GIGARTINACEAE

Chondrus crispus Stackhouse, 1797:xxiv.
Ariga, 1920; Mikami, 1965.

Chondrus ocellatus Holmes, 1896:252.
Chiang, 1973b; Fan, 1953a; Tseng, 1983. As "*C. ocellatus* f. *typicus*": Chiang, 1962a.

Chondrus ocellatus f. *canaliculatus* Okamura, 1932:84.
Shen and Fan, 1950.

Gigartina intermedia Suringar, 1870:30.
Ariga, 1921; Chiang, 1962a; Fan, 1953a; Shen and Fan, 1950; Taniguti, 1976.

Gigartina ochotensis Ruprecht in Kjellman, 1889:31.
Ariga, 1920.

Gigartina tenella Harvey, 1859:331.
Arasaki, 1964; Okamura, 1930, 1936; Rho, 1958; Shen and Fan, 1950.

Rhodoglossum affine (Harvey) Kylin, 1928:49.
As "*Chondrus affinis*": Heydrich, 1894.

RHODYMENIALES

RHODYMENIACEAE

Chrysymenia procumbens Weber-van Bosse, 1928:470.
Okamura, 1931, 1936; Shen and Fan, 1950.

Erythrocolon podagrica (Harvey ex J. Agardh in Grunow) J. Agardh ex Kylin, 1931:14.
Shen and Fan, 1950.
Remarks: For discussion on the complicated nomenclature of this taxon see Abbott and Littler (1969:168).

Rhodymenia spinulosa Okamura, 1934b:33.
Okamura, 1934b, 1936; Yoshikawa and Yoshikawa, 1977.

Weberella micans Hauptfleisch in Schmitz and Hauptfleisch, 1897:402.
Arasaki, 1964; Okamura, 1936; Segawa, 1974; Shen and Fan, 1950; Yamada, 1932b.

CHAMPIACEAE

Champia parvula (C. Agardh) Harvey, 1853:76.
Chiang, 1962a; Higashi, 1934; Okamura, 1931, 1936; Shen and Fan, 1950.

CERAMIALES

CERAMIACEAE

Carpoblepharis schmitziana var. *erecta* Yamada, 1932b:273.
Okamura, 1936; Shen and Fan, 1950.

Carpoblepharis warburgii Heydrich, 1894:297.
De Toni, 1895; Heydrich, 1894; Okamura, 1936; Shen and Fan, 1950.
Remarks: Hommersand (1963:196) and Fan (1974) noted "*C. warburgii* has never been re-examined, but . . it appears unlikely that this taxon belongs in *Carpoblepharis*."

Centroceras clavulatum (C. Agardh) Montagne, 1846:140.
Ariga, 1920; Chiang, 1962a, 1962b, 1973b; Chihara, 1970, 1975; De Toni, 1895; Okamura, 1931, 1936; Rho, 1958; Segawa, 1974; Shen and Fan, 1950; Taniguti, 1976; Yamada, 1928; Yoshikawa and Yoshikawa, 1977.
As "*Ceramium clavulatum*": Heydrich, 1894.

Centroceras minutum Yamada, 1944c:42.
Chiang, 1962a.

Ceramium aduncum Nakamura, 1950:159.
Nakamura, 1950, 1965; Itono, 1972, 1977b. As "*Ceramium clarionense*": Dawson, 1954c.

Ceramium ciliatum (Ellis) Ducluzeau, 1805:64, var. *robustum* (J. Agardh) Mazoyer, 1938:322.
Nakamura, 1965; Itono, 1972, 1977b.

Ceramium flaccidium (Kützing) Ardissone, 1971:40.
As "*C. gracillimum* var. *byssoideum*": Itono, 1972, 1977b.

Remarks: See Womersley (1978:234–238) for discussion on the nomenclature and toxonomy of this taxon.

Ceremium gracillimum (Kützing) Griffiths et Harvey in Harvey, 1848b, pl. 206.
Nakamura, 1965; Yoshikawa and Yoshikawa, 1977.
Remarks: Womersley (1979:234) considers *C. gracillimum* to be a synonym of *C. flaccidium* (Kützing) Ardissone.

Ceramium nakamurai Dawson, 1954a:6.
Nakamura, 1965; Itono, 1972, 1977b. As *"C. equisetoides":* Nakamura, 1950.

Ceramium paniculatum Okamura, 1896:36.
Nakamura, 1965.

Ceramium tenerrimum (Martius) Okamura, 1921:112.
Chiang, 1962a; Okamura, 1936; Rho, 1958; Shen and Fan, 1950; Itono, 1972, 1977b.

Ceramium tenuissimum (Lyngbye) J. Agardh, 1851:120.
Ariga, 1921; De Toni, 1895; Heydrich, 1894; Okamura, 1936; Rho, 1958; Shen and Fan, 1950; Tseng, 1983; Yamada, 1928.

Dasyphila plumarioides Yendo, 1920:7.
Arasaki, 1964; Itono, 1977b; Okamura, 1923, 1931, 1936; Segawa, 1974; Yendo, 1920.

Gymnothamnion elegans (C. Agardh) J. Agardh, 1892:27.
Itono, 1977b. As *"Plumaria ramosa"*: Okamura, 1936; Shen and Fan, 1950; Yamada and Tanaka, 1934.

Microcladia elegans Okamura 1907:1.
Chiang, 1962a.

Ptilothamnion cladophorae (Yamada et Tanaka) Feldmann-Mazoyer, 1941:375.
Fan, 1974; Itono, 1977b. As *"Spermothamnion cladophorae":* Okamura 1936, 1937; Shen and Fan, 1950; Yamada and Tanaka, 1934.

Reinboldiella schmitziana (Reinbold) De Toni, 1895:35.
Ariga, 1920.

Spyridia filamentosa (Wulfen) Harvey ex Hooker, 1833:337.
Ariga, 1920; Chihara, 1975; De Toni, 1895; Heydrich, 1894; Okamura, 1913, 1936; Rho, 1958; Segawa, 1974; Shen and Fan, 1950.

Tiffaniella codicola (Yamada et Tanaka) Doty et Meñez, 1960:137.
Fan, 1974; Itono, 1977b. As *"Spermothamnion codicola":* Okamura, 1936, 1937; Shen and Fan, 1950; Yamada and Tanaka, 1934.

Wrangelia velutina Harvey, 1854:546.
Okamura, 1931; Shen and Fan, 1950.

Delesseriaceae

Caloglossa bombayensis Bφrgesen, 1933:127.
Fan, 1952.

Claudea batanensis Tanaka, 1967:18.
Tanaka, 1967; Yoshikawa and Yoshikawa, 1977.

Haloplegma duperreyi Montagne, 1842:258.
Yamada, 1936b; Tseng, 1983.

Holmesia neurymenioides Okamura, 1932:98.
Okamura, 1936; Shen and Fan, 1950.

Martensia denticulata Harvey, 1854:537.
Ariga, 1919, 1920; Horikawa, 1919.

Martensia flabelliformis Harvey ex J. Agardh, 1863:826.
Chiang, 1962b; Chihara, 1975; Segawa, 1974; Shen and Fan, 1950; Yamada, 1936b.

Nitophyllum sp.
Ariga, 1920.

Dasyaceae

Dasya sp.
Ariga, 1919, 1920; Horikawa, 1919.

Rhodomelaceae

Acanthophora aokii Okamura, 1934b:35.
Okamura, 1934b, 1936; Shen and Fan, 1950.

Acanthophora muscoides (Linnaeus) Bory, 1828:156.
Shen and Fan, 1950.

Acanthophora orientalis (Sonder) J. Agardh, 1863:820.
Ariga, 1920; Chiang, 1962a, 1973b; Chihara, 1975; Fan, 1953a; Okamura, 1931, 1936; Segawa, 1974; Shen and Fan, 1950; Tokida, 1939; Yoshikawa and Yoshikawa, 1977.

Acrocystis nana Zanardini, 1872:145.
Chiang, 1973b; Chihara, 1975; Okamura, 1931, 1936; Segawa, 1974; Shen and Fan, 1950; Tseng, 1983.

Amansia glomerata C. Agardh, 1822:194.
Ariga, 1920; Chiang, 1973b; Chihara, 1975; Okamura, 1930, 1931, 1936; Segawa, 1974; Shen and Fan, 1950; Yoshikawa and Yoshikawa, 1977.

Bostrychia tenella (Vahl) J. Agardh, 1863:869.
Ariga, 1920; Chiang, 1962a; Taniguti, 1976; Yoshikawa and Yoshikawa, 1977.

Chondria armata (Kützing) Okamura, 1907:69.
Ariga, 1919, 1920; Chiang, 1962a, 1973b; Chihara, 1970, 1975; Fan, 1953a; Horikawa, 1919; Okamura, 1930, 1931, 1936; Segawa, 1974; Shen and Fan, 1950; Tokida, 1939; Tseng, 1983.

Chondria dasyphylla (Woodward) C. Agardh, 1822:350.
Ariga, 1920; De Toni, 1895; Yoshikawa and Yoshikawa, 1977. As *"Laurencia dasyphylla":* Martens, 1866.

Digenia simplex (Wulfen) C. Agardh, 1822:389.
Ariga, 1920; Chihara, 1970, 1975; Fan, 1953a; Higashi, 1934; Okamura, 1931, 1936; Rho, 1958; Segawa, 1974; Shen and Fan, 1950; Tseng, 1983.

Herposiphonia subdisticha Okamura, 1899:37.
Chiang, 1962a; Okamura, 1931, 1936; Shen and Fan, 1950.

Herposiphonia sp.
Chiang, 1962b.

Laurencia brongniartii J. Agardh, 1841:20.
Remarks: Specimens from Nanwan, Taiwan (collected

by Ger Dzeng-Joung; 21 August 1979; #*US*-071851), were identified by J. Norris as *L. brongniartii* and establish the presence of this taxon in southern Taiwan.

Laurencia flexilis var. *tropica* (Yamada) Xia et Zhang, 1982:538.
Tseng, 1983.

Laurencia forsteri (Mertens ex Turner) Greville, 1830:lii.
Ariga, 1920.

Laurencia glandulifera Kützing, 1849:855.
Ariga, 1920.

Laurencia grevilleana Harvey, 1854:545.
Ariga, 1920, Su et al., 1982.
Remarks: Saito and Womersley (1974:839) considered *L. grevilleana* to be a taxonomic synonym of *L. brongniartii* J. Agardh.

Laurencia obtusa var. *densa* Yamada, 1931b:226.
Dawson, 1954c; Shen and Fan, 1950; Yamada, 1931b, 1936c.

Laurencia palisada Yamada, 1931b:196.
Chiang, 1962a; Shen and Fan, 1950; Su et al., 1982; Yamada, 1931b, 1936c.

Laurencia papillosa (Forsskål) Greville, 1830:lii.
Ariga, 1920; Chihara, 1975; Cotton, 1915; Okamura, 1931; Shen and Fan, 1950; Tilden, 1929; Yamada, 1936c; Yoshikawa and Yoshikawa, 1977.

Laurencia perforata (Montagne) J. Agardh, 1876:648.
Ariga, 1920; De Toni, 1895; Heydrich, 1894.

Laurencia pinnatifida (Gmelin) Lamouroux, 1813:42.
As *"L. pinnatifida* var. *simplex":* De Toni, 1895; Heydrich, 1894.

Laurencia tropica Yamada, 1931b:223.
Okamura, 1931; Shen and Fan, 1950; Taniguti, 1976; Yamada, 1931b, 1936c.

Laurencia venusta Yamada, 1931b:203.
Okamura, 1931; Shen and Fan, 1950; Yamada, 1936c.

Laurencia sp.
Ariga, 1919; Fan, 1953a; Horikawa, 1919; Taniguti, 1976; Tokida, 1939.

Leveillea jungermannioides (Martius et Hering) Harvey, 1854:539.
Ariga, 1920; De Toni, 1895; Chiang, 1962b; Heydrich, 1894; Okamura, 1931, 1936; Rho, 1958; Shen and Fan, 1950; Tseng, 1983; Yoshikawa and Yoshikawa, 1977. As *"Polyzonia jungermannioides":* Okamura, 1897.

Murrayella periclados (C. Agardh) Schmitz, 1893:227.
Tokida, 1941.

Murrayella squarrosa (Harvey) Schmitz, 1893:228.
Shen and Fan, 1950; Yamada, 1936b.

Neurymenia fraxinifolia (Mertens ex Turner) J. Agardh, 1863:1135.
Chiang, 1973b; Okamura, 1931; Shen and Fan, 1950; Tanaka and Itono, 1969.

Polysiphonia harlandii Harvey, 1859:330.
Segi, 1951; Tseng, 1944, 1983; Yamada, 1933; Yoshikawa and Yoshikawa, 1977.

Polysiphonia kampsaxii Bφrgesen, 1939:122.
Segi, 1951.

Polysiphonia pulvinata J. Agardh, 1842:124.
Segi, 1951.

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INCERTAE SEDIS

WURDEMANNIACEAE

Remarks: Taylor (1960:348, 361, 633) assigned the Wurdemanniaceae to the Gelidiales; however, Farr et al. (1979) have referred *Wurdemannia* to incertae sedis.

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