serious extent, has important climatic significance. If the observations so far made are valid, then the length of the so-called growing season as based upon the interval during which temperatures are supposed to be advantageous for growth has little influence on the thickness of the annual ring. Apparently the trees must make their growth while water is available. If it is available all summer, growth continues for a longer time; but if water is dependent upon winter precipitation and receives no replenishment later, growth ceases sooner or later during the summer according to the availability of the water. The Digger pine from the foothills below Sonora was the most advanced in growth of all trees from which core samples were taken on July 5 and 6.

Such evidence as has been obtained suggests that the time of ring formation constitutes a problem which deserves study by taking core samples periodically during an entire growing season of trees from the lower forest border up to timber-line. The presence in any particular area of trees which depend solely upon winter precipitation has a climatic and ecologic significance different from the presence of those which depend upon a summer rainy season.

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Tucson, Arizona,
September 4, 1936.

A NEW SPECIES OF CHAETOMORPHA FROM CHINA

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On a recent visit to the California Academy of Sciences in Golden Gate Park, San Francisco, my attention was called by Dr. F. M. McFarland, President of the Academy, to a small tortoise which had been recently asquired through the generosity of Princess Olga Shahovski, who had brought it from China. Its back was densely covered with "green hair," so popularly designated. Such a symbiotic relationship, if such it may be called, is of very rare occurrence in western America, if indeed it has ever been observed and reported among our native species. However, it has been reported several times as occurring in the eastern part of the United States, and apparently is of common occurrence in parts of China and Japan. Wang (5) states that the "green haired tortoise" has been a well known animal in the provinces of Changshu, Kiangsu, and in the northern part of Yushan. In China the "green hair" grows on relatively small species of tortoise. These of course are not of the basking kind, and on account of the popular interest which they create in domestic aquaria they are commercialized to considerable extent.

The specimen in the public aquarium at the California Academy rarely fails to excite the interest and curiosity of visitors, often calling forth strange expressions indicative of total igno-

rance as to the real nature of the organisms, the visitors never having previously seen nor read of similar or like phenomena. It thus seems desirable to publish a few brief statements concerning them. The so-called "green hair" on the tortoise is of course not a part of the animal but is a distinct organism belonging to the plant kingdom, and to a group known as Chlorophyceae, or green algae. The determination of the species, however, is not in this case such a simple matter as it would seem at a glance.

A brief search through the literature revealed the fact that several papers have been written concerning the occurrence of species of green algae growing on the backs of the tortoise.

Collins (1) reports *Chaetomorpha chelonum* growing on the back of *Chrysemys marginata* and *Aromochelys odorata* found in Michigan. Evermann and Clark (2) later reported the same species growing on *Chrysemys marginata* in Indiana, and still later Tiffany (4) found it growing on *Chrysemys marginata belli* in Iowa. Hoffmann and Tilden (3) described a species growing on *Chelydra serpentina* found in Minnesota, which they considered related to Collins' *Chaetomorpha chelonum* but sufficiently different to warrant the establishment of a new genus, *Basicladia.* Various other authors in this country and in Europe have incidentally mentioned, in connection with their study of the tortoise, the occurrence of green algae growing on the backs of these animals but without any attempt to name the species to which the algae belong. Yendo (6) found plants in Japan growing on *Clemmia japonica* which he described as a new variety of *Chaetomorpha chelonum* Collins. The most recent paper with which the writer is familiar, dealing with the subject, is by Wang (5), who seems to have made the most exhaustive study of species growing in China. He states that he has examined four hundred and seventy-five specimens of the tortoise *Geoclemys reevesii.* He reports two species in this paper, viz., *Basicladia crassa* Hoffmann and Tilden, and *Cladophora glomerata* var. *nana* Wang.

The green alga on the "green haired tortoise" with which this paper is especially concerned is growing on a small tortoise, *Ocadia sinensis.* Only one living specimen is available for this study and this has been in captivity at the Academy some four or five months. Apparently the reproductive stage of the alga has passed. The presence of many empty segments, each with a specialized pore for the escape of reproductive cells, gives ample evidence of the fact that the plants are normal, but there seem to be no more fertile segments, hence I am unable to report on the character of the reproductive cells. Strange to note, not one of the authors dealing with these plants has described the reproductive cells, not even Mr. Wang, who examined the large number of specimens mentioned above. Knowledge of the character of these cells is of very great importance in connection with this species of plant, since it has morphological characters linking it

closely with at least four different genera, viz., *Chaetomorpha* Kuetz., *Rhizoclonium* Kuetz., *Basicladia* Hoffmann and Tilden, and *Cladophora* Kuetz. The principal distinguishing characters of these genera may be noted as follows:

Chaetomorpha

Fronds rigid, septate coenocytes, unbranched, always attached in the juvenile stage by more or less branched, nonseptate rhizoids from the basal segment and whose walls become thickened and whose contents disappear in age; asexual reproduction by biciliated zoospores.

Rhizoclonium

Fronds septate coenocytes, usually narrower and more flaccid, not attached, unbranched or producing few to many short, irregular, septate or nonseptate, rhizoidal branches from any of the segments; asexual reproduction absent.

Basicladia

Fronds consisting of numerous, multicellular, erect, somewhat rigid, sparingly branched, more or less cylindrical filaments arising from creeping rhizome-like filaments which are fastened to the substratum by hold-fasts having free or coalesced branches; . . . reproduction by zoospores (?). (An extract from the original description of the genus.)

Cladophora

Fronds septate coenocytes, rigid to flaccid, always moderately to profusely branched, always attached in the juvenile stage by the discoidal basal segment, later often producing more or less abundant septate, rhizoidal filaments from the lower parts; asexual reproduction by four-ciliated zoospores.

The following is a diagnosis of the species under consideration:

Chaetomorpha sinensis sp. nov.[1] Erect fronds producing tangled, more or less rope-like masses, very sparsely branched, the branches being either similar to the main axes or rhizoidal in character, attached by relatively extensive, prostrate, irregular,

Chaetomorpha sinensis sp. nov.

[1] Frondibus erectis sparsissime ramosis structuram compositam funibus irretis aliquantum similis producentibus; ramis axis principalibus similibus vel rhizoideis, filamentis amplis, septatis, prostratis irregularibus plus minusve ramosis adjunctis; filamentis substrato superficiebus nec hapteris praecipuis nec ramis rhizoideis adhaerentibus; ramis filamenta secundaria, 8–12 cm. alta, 60–95 μ diametro, filamentis primariis similibus aliquando emittentibus; filamentorum erectorum segementis maximam partem etiam in generatione cylindriciis, sed interdum leviter doliiformibus longitudine maxime variabilibus basim 2 mm. superne diametro 3–4-plo longioribus; filamentorum parietibus comparate tenuis et tenacibus, hyalinis demum plus minusve lamellatis; chromatophoris densis; pyrenoidibus parvis, numerosis; cellularis generationis foraminibus caminis parvis similibus in regione equatoriale segmentorum fertilium discedentibus; cellularum generationis natura ignota.

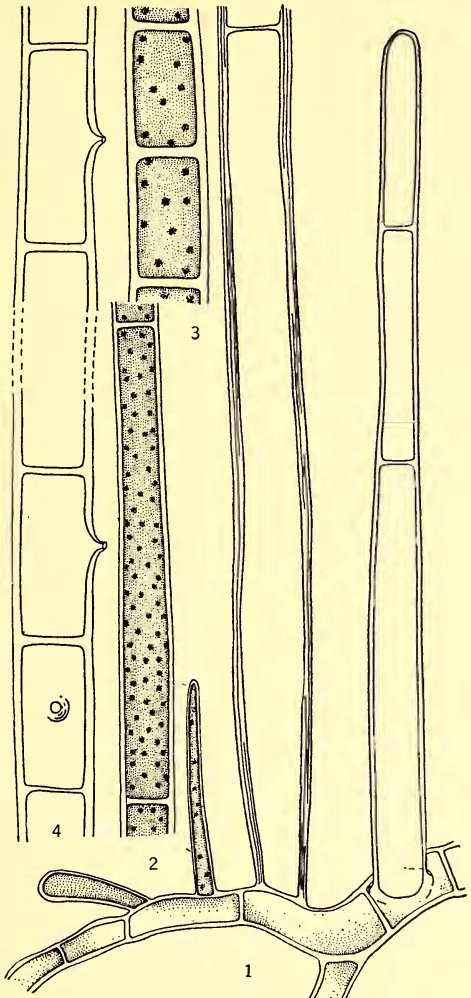

PLATE VIII. CHAETOMORPHA SINENSIS GARDNER. Filaments × 100. *1*. Fragment of a creeping filament, with one small juvenile erect filament, to the left; one segment of a normal erect filament showing laminated cell wall, in the center; and one dead erect filament with three segments, to the right. *2*. Single segment of a medium sized filament showing numerous pyrenoids embedded in normal chromatophores. *3*. Two wider, shorter segments. *4*. Fragment of a normal filament showing empty segments with the chimney-like pores through which the reproductive cells have escaped.

more or less branched, septate filaments adhering to the substratum by their surface and not by specialized hapteres or rhizoidal branches, and at times giving rise to secondary filaments similar to the primary ones, 8–12 cm. high, 60–95 μ diam.; segments of erect filaments mostly cylindrical, even in reproduction, but occasionally slightly dolioform, very variable in length, up to 2 mm. at the base to 3–4 times the diameter in the upper parts; walls relatively thin and tough, hyaline, more or less lamellate in age; chromatophore dense; pyrenoids small and numerous; reproductive cells escaping through specialized chimney-like openings formed in the equatorial region of the fertile segments; the nature of these reproductive cells not determined.

Growing principally on the back of a fresh-water tortoise, *Ocadia sinensis,* brought from Kiangsu Province, China. Type, Herbarium of the University of California no. 543979.

By comparison of the above diagnosis with the principal distinguishing characters of the four genera mentioned above, it may be seen that it has overlapping morphological characters. It is relatively harsh and rigid, like *Chaetomorpha;* an occasional true branch on the erect filaments links it with *Cladophora;* the more abundant rhizoidal filaments from the erect fronds are homologous with the same in *Rhizoclonium* and similar to those found at times in *Cladophora.* The extensive prostrate, attaching filaments are similar to those upon which, partially, the genus *Basicladia* was established. They differ, however, from these in the method of attachment as stated in the diagnosis of that genus. It is therefore essential to know the character of the reproductive cells before determining positively to which genus it should be associated. Are the reproductive cells gametes or zoospores, and if the latter, are they biciliated or quadriciliated? For the present I am placing it as a new and eccentric species of the genus *Chaetomorpha,* with a more extensive attaching system than the general run of species, and with an extremely occasional true branch on a very few plants.

University of California,
Berkeley, June 12, 1936.

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