grubbed up the willows and laid out the meadow in watercress beds. He is a benefactor of his kind and has caused millions of blades of an edible kind to grow where there was none before; but I have a sore spot in my heart for the vanished warblers and the lost Grass of Parnassus. I fear, however, that the pursuit of efficiency is one of those contradictory elements in man's make-up that won't let him rest, that is always urging him against his will towards further attainment. What a dreary prospect if it only results in adding an ever greater and greater population to a world always working harder and harder! Is there any way out of this impasse? I can only again suggest the kindly force of that other element in the texture of men's minds, the passion for artistic expression. The winds of beauty come and go, but as they rustle through the tree of life, among the dropping leaves that are ourselves, men will cease from their toil to listen and pause while they tell of them in their own speech.

A. D. HALL

SOME SUGGESTIONS ON CLASSIFICATION

IN a note to SCIENCE,[1] the writer called attention to the very antiquated system of classification still in vogue among many botanists, and ventured to suggest that it might be worth while to adopt a system more in harmony with our present knowledge of the relationships of the larger division of the plant kingdom.

That a definitive classification is not possible at present the writer fully realizes; and the present communication is offered rather as a suggestion for further consideration of the subject than as a definite scheme to be adopted *in toto*.

Surveying the whole plant kingdom, we find below the mosses an immense heterogeneous assemblage of plants, which even now it has pleased most of our text-book writers to treat as a single primary division, or sub-kingdom, Thallophyta.

This, it seems to the writer, is no more justified than it would be for zoologists to consider all invertebrates as belonging to a single sub-kingdom. It might be permissible to retain the term Thallophyte as contrasted with the Embryophytes (Archegoniates and Spermatophytes), but only as the zoologist may find it convenient to discuss invertebrates in contrast with vertebrates, without any thought that the two are in any scientific sense coordinate.

Just as the invertebrates are universally recognized as comprising a number of quite distinct sub-kingdoms, so the "Thallophytes" include several groups, each of which should be treated as a primary division or sub-kingdom, coordinate with the whole group of Embryophytes.

When it comes to delimiting these sub-kingdoms, however, there may well be a difference of opinion as to how many of them should be recognized.

At the bottom of the scale are the extremely simple and presumably ancient forms like Bacteria, Cyanophyceae, Flagellata and Slime-moulds or Myxomycetes. The two latter have obvious relationships with the lower Protozoa, and we might perhaps adopt Haeckel's term Protista to include them; or, perhaps, we might unite these lowest plant-forms into a single sub-kingdom Protophyta.[2]

Above these simplest organisms are two great assemblages of plants, Algae and Fungi, as to whose origin and inter-relationships we have still much to learn.

The division of the higher plants or Embryophytes into Archegoniates and Spermatophytes is a more or less artificial one, and as they are all undoubtedly more or less intimately related, we shall probably best reduce them to a single sub-kingdom, Embryophyta.

The classification adopted by most of our text-book writers is essentially that of Eichler,[3] published in 1883, and even then decidedly antiquated.

The writer[4] in 1890 ventured to discard the term Thallophyte, and recognized the Algae and Fungi as primary divisions or sub-kingdoms. The term Protophyte was adopted from Sachs's Text-book, to include the Schizophyta, Myxomycetes and Volvocineae.

Engler in "Die Natürlichen Pflanzenfamilien"[5] divides the plant kingdom into Thallophytes and Embryophytes, the latter including the Archegoniates and seed-plants. The Thallophytes were divided into Myxothallophyta (= Myxomycetes) and Euthallophyta including Schizophyta, Algae (Euphyceae) and Fungi (Eumycetes).

In 1907 the late Professor C. E. Bessey published his "Synopsis of Plant Phyla,"[6] in which he discards the term Thallophyte and recognizes fifteen "phyla," or primary divisions. In this classification he does not include either the Myxomycetes or Flagellata. He divides the Green Algae into three phyla, exclusive of the Characeae, which he unites with the Red Algae, "Carpophyceae." The Phycomycetes are as-

[1] SCIENCE: Vol. LX, No. 1542, 64–65, July, 1924.

[2] See Sachs, Text-book, English translation, 1882, p. 244.

[3] Eichler, A. W., Syllabus, 3rd Edition.

[4] Campbell, D. H., "Elements of Structural and Systematic Botany."

[5] 1897.

[6] University Studies, Vol. VII, No. 4, University of Nebraska, Oct., 1907.

sociated with Green Algae, and the Diatoms are made a class, "Bacillarioideae," of the "Zygophyceae." Four phyla of seed-plants are recognized, "Cycadophyta," Gnetales, "Strobilophyta" (Coniferae) and "Anthophyta" (Angiosperms).

Engler, two years later, published his Syllabus,[7] in which he follows Bessey's arrangement to a considerable extent, also omitting entirely the term Thallophyte. He recognizes thirteen primary divisions, *viz.*, Schizophyta, Myxomycetes, Flagellatae, Dinoflagellatae, Bacillariales, Conjugatae, Chlorophyceae, Charales, Phaeophyceae, Rhodophyceae, Eumycetes, Embryophyta-asiphonogama (Archegoniatae), Embryophyta-siphonogama (Spermatophyta).

That the authors of some of the recent text-books should prefer the obsolete classification of Eichler to the much more scientific system of Engler seems rather extraordinary.

While agreeing in the main with Engler's classification, the writer would be inclined to unite some of Engler's primary divisions. It may be questioned whether the Dinoflagellata (Peridineae), Diatoms, Conjugatae and possibly Characeae, are sufficiently distinct to warrant raising them to the rank of sub-kingdoms. The writer believes that the Conjugatae, and probably the Characeae, should be included in the Chlorophyceae, while the Peridineae might either be included with the Flagellata, or possibly be regarded as the lowest of the Phaeophyceae. It is even possible that the Diatoms might also be united with the latter.

Should these suggestions be accepted, we should then reduce Engler's primary divisions to nine.

It is pretty generally admitted that the origin of the Chlorophyceae and Phaeophyceae is to be sought among the Flagellata; but the two classes have probably arisen quite independently from green and brown flagellates, respectively.

The writer believes that the Green Algae, with the possible exception of the Characeae, form a homogeneous class, and can be traced back more or less directly to some flagellate forms not unlike Chlamydomonas. The succession of forms from the flagellate unicellular stage to the highly organized forms characteristic of most Phaeophyceae is not nearly so evident as in the Green Algae; but some of the simplest of the Peridineae closely resemble the zoospores of the Phaeophyceae and may possibly be remotely related to them.

The systematic rank of the Peridineae and Diatoms is difficult to determine; but some of the investigations on the development of the simpler Diatoms point to a possible derivation from forms related to the Peridineae, and as some of the simplest types of the latter much resemble the brown zoospores with lateral cilia, characteristic of the Phaeophyceae, it might possibly be justifiable to include the Peridineae and Diatoms with the Phaeophyceae, as the simplest members of the class. The origin of the Red Algae is more obscure and they may possibly be an offshoot of the Chlorophyceae.

In view of the decidedly doubtful origin of the Phaeophyceae and Rhodophyceae, it may be well, for the present, to unite all the Algae in a single sub-kingdom, the three main divisions being treated as classes; and perhaps the Peridineae and Diatoms might also be ranked as classes.

The relationships of the Fungi are even more obscure than those of the Algae. This immense assemblage of parasites and saprophytes have become so much changed from the normal plant-type that in most cases a comparison with the Algae is almost impossible. Whether the Fungi form a single homogeneous group, or whether they include several unrelated phyla, it is now impossible to say; and for the present, at least, we shall probably best keep them together as a single sub-kingdom.

Engler, as already mentioned, proposed the very appropriate term Embryophyta for the higher plants, *viz.*, Archegoniates and seed-plants, which he calls, respectively, E. asiphonogama and E. siphonogama, based upon the absence or presence of a pollen-tube.

The old separation of the Archegoniates into two sub-kingdoms, each coordinate with the whole assemblage of Thallophytes, is still maintained in many of the standard text-books, although the absurdity of such a divorce of the two obviously related divisions of the Archegoniates is apparent to any one with a first-hand knowledge of the close resemblances in the essential structures of both gametophyte and sporophyte in the less specialized members of the Bryophytes and Pteridophytes.

Adopting the changes suggested by the writer for Engler's system, there would remain nine sub-kingdoms, *viz.*, Myxomycetes, Schizophyta, Flagellata, Chlorophyceae, Phaeophyceae, Rhodophyceae, Fungi (Eumycetes), Embryophyta asiphonogama (Archegoniatae), E. siphonogama (Spermatophyta).

We might still further reduce the number of primary divisions by uniting the three first into a sub-kingdom Protophyta, and combining all the Algae into a single sub-kingdom. It would be logical, also, to unite all the Embryophytes into one sub-kingdom.

The following scheme is offered as a suggestion based upon the above proposal:

Sub-Kingdom Protophyta	I,	Class 1, Myxomycetes Class 2, Flagellata Class 3, Schizophyta

[7] Engler, A., "Syllabus der Pflanzenfamilien," Berlin, 1909.

- Sub-Kingdom II, Algae
  - Class 1, Peridineae (Dinoflagellata)
  - Class 2, Bacillarieae (Diatoms)
  - Class 3, Chlorophyceae
  - Class 4, Phaeophyceae
  - Class 5, Rhodophyceae
- Sub-Kingdom III, Fungi
  - Class 1, Phycomycetes
  - Class 2, Ascomycetes
  - Class 3, Basidiomycetes
  - Class 4, Lichenes
- Sub-Kingdom IV, Embryophyta
  - A. Bryophyta
    - Class 1, Hepaticae
    - Class 2, Anthocerotes
    - Class 3, Musci
  - B. Pteridophyta
    - Class 1, Filicineae
    - Class 2, Equisetineae
    - Class 3, Lycopodineae
    - Class 4, Psilotineae
  - C. Spermatophyta
    - Class 1, Cycadophyta
    - Class 2, Coniferae
    - Class 3, Gnetales
    - Class 4, Anthophyta (Angiosperms)

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GUADALUPE ISLAND: AN OBJECT LESSON IN MAN-CAUSED DEVASTATION

IN these days when conservation of natural resources is happily coming to occupy an important place in the nation's thought and plans, it may be of value to consider a most striking example of the utter ruination which man, within comparatively few years, is capable of effecting in nature's long-developed scheme. I refer to Guadalupe Island, a volcanic peak which rises out of the ocean some 150 miles west of Lower California and which I have twice visited during the past two years in the interests of the Natural History Museum of San Diego.

In contrast with most of the other islands on the west coast of the peninsula, which are completely arid, Guadalupe's crest is lofty enough to tap the clouds, and as a result its summit was blessed in bygone days with forests of cypress, oak, pine and palm, as well as with many other smaller shrubs and flowers. This flora became a natural refuge for many birds, although Guadalupe was too far from the mainland to be entered by any land mammals. Through the ages, many of the plants and birds, by their long isolation, became differentiated from mainland forms, and this gave the island a unique natural history interest.

The first event to shock the tranquility of the place, so far as our knowledge goes, was the discovery by sealers, about the end of the eighteenth century, of several rookeries of fur seals (*Arctocephalus townsendi*) on the rocky shores of Guadalupe. In the ensuing years, Russians, British and Americans seem all to have had a hand in the slaughter of the seals, which was continued relentlessly till about 1830. It is believed that many of the skins were used in the Oriental trade, which was flourishing at that time. During this period stone houses were erected for the seal-hunters, the walls of which still remain. It was probably as a result of these first human invasions that the common house mouse was introduced on Guadalupe and, with it, the domestic cat. These two animals, so foreign to the natural fauna of the island, were destined later on to play a lamentable part in the overturning of nature's balance. When the fur seal rookeries became so depleted as to offer their exploiters no further profit, the sealers left the island, although they had not completed the extermination of the animals.

The next, and by far the most serious intruders upon Guadalupe were the whalers, although, during their brief visits, they did not stop much longer than was necessary to fill their water casks. However, to the whalers is attributed the grave responsibility of having liberated goats upon the island. It is supposed that their idea was to have a convenient place where fresh meat might be obtained on later cruises. No doubt their plan was logical, so far as it concerned themselves, and for a time their demands may have prevented undue increase of the goats. But, with the advent of more settled routes of transportation and boats with better facilities, the goats that had been released on Guadalupe were forgotten and left to their own resources. The place proved to be a goats' paradise, for with plenty of low herbage and not a single enemy, they had life their own sweet way. They increased by tens of hundreds, devouring everything green that was in sight and gnawing their way into the very heart of the primeval forest.

Meanwhile, the northern elephant seal (*Mirounga angustirostris*), another native resident of Guadalupe and its adjacent waters, began to be sought after and persecuted. Whales were becoming scarce and their hunting grounds more distant. Therefore, when the great blubbery elephant seal could be found sunning himself on the sandy beaches, he fell a ready prey to the whaler and his try-pot. At this time, gold had been discovered in California and the demand for whale oil was tremendous, for it filled the place of kerosene in those early days. Man, in his greed, turned to the easiest thing obtainable and the elephant