denied all pretense to finality of conclusions; it was to get light on just those subtile changes of soil, etc., to which Mr. Daniels alludes, that the work was undertaken. Thus the criticism that we can not point out any single cause for any difference in vegetation is hardly to the point. My critic deals only with the societies, he is willing to leave the description of soils as it was published.

That the societies used are not of equal rank was pointed out by the author. Increased complexity would doubtless be accompanied in some measure by increased accuracy, but the main points would thus be almost surely lost sight of in the maze of classification. The systematist born and bred can seldom understand the horribly slipshod ways of the ecologist! The fact that Mr. Daniels puts the beech-maple and the maple-elm-agrimony societies together shows clearly that he has failed to study the southern townships. Farther north these types do tend to merge, but southward, into Indiana and Illinois, they are still distinct, as more recent studies by the author show. Likewise, the combining of the oak-hickory with the oak-hazel society indicates failure to study well the condition of things in the northern part of the county. The presence or absence of hickory in this region involves one of the most important ecological questions, one which we can not interpret clearly as yet, but one which it can do no good to slur over. On the whole, my critic's description agrees fairly well with the conditions in the central townships, but fails altogether to express the facts throughout the county as a whole. This is one of the dangers which he might be warned against, namely, that of generalizing from too small an area, no matter how many years he has botanized in it. The author must admit that he, too, is a native of Kent County, and that he has studied its flora for many years.

*Bidens frondosa* and *Solanum nigrum* are 'frequent everywhere' only in the moister soils of the Grand River valley. *Nepeta, Phytolacca* and *Euphorbia corrallata* are, throughout the area, among the most constant and characteristic members of their societies; they are not weeds excepting in areas where they originally occurred. *Echinospermum* occurs in the lowlands, a fact which may have misled Mr. Daniels, but on the uplands it is a truly characteristic plant of the most mesophytic society. Regarding the distribution of *Cenchrus* there is need of more study than either Mr. Daniels or myself has yet accomplished. Wherever it comes from, it certainly occurs only on the worst sands, *i. e.*, only in the most xerophytic group. Occasional plants of *Dracocephalum* are to be found in the beech and maple forests south of the Grand River valley.

The societies are based on forms which are evident the year round, not on summer forms nor spring forms. Of the 140 forms listed, no less than 40 are spring-flowering. There doubtless are well-marked societies of Thallophytes and Bryophytes, but those of the two higher groups are the ones chosen for study. An adequate study of the distribution of grasses and sedges will be a work by itself when the right student undertakes it. These plants were purposely omitted from the paper under discussion.

Burton Edward Livingston.
The New York Botanical Garden,
September 15, 1903.

## *SHORTER ARTICLES.*

### FOUR NEW SPECIES OF THE CENTRAL AMERICAN RUBBER TREE.

Though still in the initial and experimental stage, the cultivation of rubber-producing trees is now attracting more general attention than any other branch of tropical agriculture. Large amounts of American capital are being invested in Mexico and Central America, and the practicability of rubber culture in the tropical islands of the United States is receiving the attention of the Department of Agriculture. The first studies have been directed to the Central American rubber tree (*Castilla*), and one of the facts established is the existence of several different local types, instead of a single species extending from Mexico to Bolivia, as hitherto supposed. The species of Castilla are among

the many plants for the study of which the usual dried and shriveled herbarium material is nearly worthless, but in deference to current botanical opinion the public has continued to infer that rubber planting is equally practicable in all localities in which wild trees are found, and that all trees are equally suitable for cultivation, except the elusive 'tunu' or 'ule macho' (male rubber), which Hemsley has recently attempted to separate as a distinct species.

Until the intervening territory has been thoroughly explored it can not be known with certainty whether two supposed species from distinct localities intergrade or not, but for agricultural purposes this is a matter of little importance. There are at least two different kinds of *Castilla* in cultivation in Mexico and two in Costa Rica, and the indications are that these four are distinct species. The *Castilla* introduced from Panama to Ceylon and other British colonies represents a fifth type, while three others are of merely botanical interest, as yet, since they are not known to produce commercial rubber.

Before touching upon the characters which distinguish the species, it may be well to explain that *Castilla* is partially dicœcious, somewhat after the manner of the edible fig. The inflorescence consists, as in the fig, of a fleshy receptacle which bears either stamens or pistils; the pistillate inflorescence is turbinate, the staminate more or less flabellate or funnel-shaped. There are trees which bear only male inflorescences, or at least there are some which bear crops of males without females, but along with the females there are also male inflorescences, smaller and generally of a different shape from those of the male trees. The primary male inflorescences arise normally in groups of four, but of the secondary or complemental male inflorescences, those which subtend the females, there are never more than two, as though the female inflorescence were the equivalent of two male clusters.

The original description of *Castilla elastica* (the name *Castilloa* being an unwarranted emendation) was not accompanied by any indication of a definite locality, but there is every probability that Cervantes had reference to the *Castilla* of eastern Mexico, which seems to differ from all of its relatives in its robust habit and in the large size of its ripe fruits, which also have numerous and very distinct vertical grooves. Cervantes' plate shows, in addition, long, slender complemental male inflorescences.

The *Castilla* of the Soconusco district of the state of Chiapas (*C. lactiflua*) is peculiar in having the complemental inflorescence flattened and with a broad mouth; it is very similar to the primary except in the smaller size. The specific name alludes to the fact that the milk of the tree flows freely when the bark is cut, so that it can be collected in quantity and coagulated by improved 'creaming' methods instead of the rubber being harvested wholly or partly by pulling the 'scrap' (burucha) from the gashes in which it has dried. Large yields of scrap rubber are sometimes reported from wild trees, but the tapping to which they are subjected is very severe, and the removal of the rubber from the wounds delays healing and exposes the tree to the attacks of insects, so that the cultural production of scrap rubber is not likely to be profitable.

On the peninsula of Nicoya, which extends into the Pacific Ocean from the northern part of Costa Rica, is a rubber tree easily recognized by the dark olive color of its inflorescences of both sexes, and by the deeply bilobed, long-stalked primary male inflorescence; the complemental inflorescences are also long and slender and are usually grown together at the base. The branches, leaves and floral organs are also much more densely hairy than those of the *Castilla* or of the more humid eastern slope of Costa Rica (*C. costaricana* Liebmann). In *C. nicoyensis* the individual fruits are very prominent, as in the two Mexican species, but in *C. costaricana* they are separate only at the broadly rounded or flattened apex, leaving no characters by which Hemsley's *Castilla tunu,* from British Honduras, can be distinguished, except the reputed deficiency of rubber, which is by no means lacking in *C. costaricana.* It seems certain, however, the 'tunu' tree which Hemsley has recently figured and described from

materials collected by Professor H. Pittier at 'Quebrado de Potrero Grande,' in southern Costa Rica,* is quite distinct from the Belize *tunu*. The branches, leaves and fruits are only slightly hairy, the fruits, fruit-clusters and seeds are smaller, and the individual fruits are distinct to near the base. Professor Pittier also informs me that the habit of the tree is different from that of *C. costaricana,* and that the fruits do not become fleshy and soft with maturity, but simply dry up. The milk does not yield an elastic gum, but hardens into a substance which the natives call 'gutta-percha.' Since Hemsley refers to previous figures and descriptions by Hooker and himself as representing the Belize *tunu,* and places British Honduras as the first locality, it seems that the name *Castilla tunu* belongs to the more northern tree; for that of southern Costa Rica the name *Castilla fallax* is suggested.†

* Icones Plantarum, 7: pl. 2651. 1900.

† The diagnostic characters of the several species of *Castilla* are summarized in the following analytical key:

Pistillate inflorescence with a thick stipe 18–25 mm. long; stigmas short, cushion-shaped; pistils distinct to base. *Castilla australis* Hemsley; Peru.

Pistillate inflorescence sessile; stigmas slender; pistils coadnate, at least at base.

Primary male inflorescence with a distinct slender stipe 15–20 mm. long; deeply bilobed and opening widely with maturity. *Castilla nicoyensis* sp. n.; Nicoya Peninsula.

Primary male inflorescence broadly flabellate, gradually narrowed to the short stipe; not bilobed, opening only by a longitudinal slit.

Complemental inflorescence flabellate, broad and flattened like the primary, and with a broad longitudinal opening. *Castilla lactiflua* sp. n.; Soconusco, Mexico.

Complemental inflorescence obconic or pyriform, with a central aperture.

Ripe fruits very large and prominent, with numerous deep vertical grooves. *Castilla elastica* Cervantes; eastern Mexico.

Ripe fruits less prominent, the grooves shallow or wanting.

Some of Hooker's figures* ascribed to *Castilla elastica* may possibly represent *C. fallax,* but not those called *tunu* by Hooker and Hemsley. It seems, then, that the flat-fruited *C. tunu* Hemsley, from Belize, may be merely a subspecies under the older name *costaricana.* The Panama *Castilla* is also obviously related to *costaricana,* but the sharply pointed fruits may characterize a second subspecies, *C. panamensis,* of which Hooker published an elaborate plate based on drawings made in Ceylon.†

Four other specific names have been used under *Castilla. C. markhamiana* Collins has been assigned by Hooker and Hemsley to the allied genus *Perebea.* Koschny's *C. alba, C. rubra* and *C. nigra,* from northeastern Costa Rica, seem likely to prove synonyms of *C. costaricana.* The bark characters relied upon by Herr Koschny‡ as diagnostic are explainable on other grounds than that they constitute specific or even varietal differences.

The existence of numerous species and varieties of *Castilla* shows that careful discrimination will be necessary in selecting the type best adapted for cultivation in Porto Rico and the other tropical islands of the United States. It shows, too, that the rather ad-

Leaves not cordate at base; leaves, branches and fruits nearly glabrous; fruits becoming tough and dry with maturity; seeds round, 6–7 mm. in diameter, male flowers with two stamens adnate at base. *Castilla fallax* sp. n.; southwestern boundary of Costa Rica.

Leaves distinctly cordate at base; leaves, branches and fruit densely hirsute, fruits becoming soft and deep orange or red with maturity; seeds oval or flattened 8–12 mm. in diameter; stamens 2 or 3, free.

Ripe fruits with prominent acute tips. *Castilla panamensis* sp. n.; Panama.

Ripe fruits with apices broadly rounded or flattened. *Castilla costaricana* Liebmann; eastern Costa Rica.

* *Trans. Linn. Soc. London,* 2d series, **2**: 209, pl. 28, figs. 4–6. 1885.

† *Trans. Linn. Soc. London,* 2d series, **2**: 209, pl. 27. 1885.

‡ 'Beihefte zum Tropenpflanzer,' **2**: 124. 1901.

verse results of the East Indian experiments with *C. panamensis* may not apply to the whole genus. Moreover, during the present study of the subject many reasons have been found for believing that the conditions under which *Castilla* has been tested in the East Indies are not really favorable to the production of rubber; the current idea that a continuously humid climate is required is erroneous. In short, it appears that we are still at the beginning of a scientific comprehension of the factors which determine the practicability and profitability of rubber culture. It has been ascertained that rubber can be produced agriculturally, but where, how and what to plant, and how, how much and how long we shall harvest, are questions largely answered, as yet, by speculation rather than by experiment.

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## THE NAME OF THE BREADFRUIT.

THE genus *Artocarpus* was first described in 1776 by G. and G. J. R. Forster in the 'Characteres Generum Plantarum,' a work written as a result of their botanical studies made during Captain Cook's second voyage into the Pacific and round the world between 1772 and 1775. The combination *Artocarpus communis* was given in this work for the breadfruit tree, a name which, according to nomenclatorial rules, must replace the generally accepted *Artocarpus incisa,* which was not published by the younger Linnæus until 1781.*

Forster's genus was, moreover, published as a monotype, and as his plants were from the Society Islands there can be no doubt but that he was dealing with the true breadfruit. He did not publish, it is true, any specific description, leaving all for the genus, but he did make a good binomial combination and had two good plates which are generally considered sufficient to establish a name in good standing.

Thunberg later in the same year (1776) published the names *Radermachia incisa* and *integrifolia* for the bread- and jak-fruits respectively from material collected in the East Indian Islands. Five years afterwards the younger Linnæus made his new nomenclatorial combinations on this material of Thunberg, adopting Forster's generic name and adding to it Thunberg's specific designations, and taking the credit to himself.

Further complications are met with when it is found that in the subsequent works of the Forsters, when mention is made of the breadfruit, the specific name *incisa* is used. Why they should abandon their own name is rather difficult to understand unless it was a case in which 'the king can do no wrong.'

Dr. A. Richter is fully alive to the injustice done Forster and has published a note* on the history of the name of the breadfruit which adequately states the facts in the case and further calls attention to the unfortunate revival by O. Kuntze of the pre-Linnæan name of *Soccus*, a relic of Rumphius, and of his combining with it Forster's specific name. Yet Rumphius published a specific name for the breadfruit which Kuntze has, for no apparent reason, seen fit to ignore.

A. Engler, acting on this note, has corrected in the 'Nachtrag' to the 'Natürlichen Pflanzenfamilien' the name of the breadfruit as it appears in the text of that work, and states that *Artocarpus communis* is the correct designation.

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## EUCALYPTS IN THE PHILIPPINES.

THE eucalypts, of which but comparatively few species are familiarly known outside of their native home, include some one hundred and fifty species or more, nearly all restricted to Australia and Tasmania. Many of the forms may be classed as shrubs, others attain great size, surpassing in height, as has been stated on good authority, the giant Sequoias of California, though not equaling them in diameter or girth. A few species have been found elsewhere, viz., in New Britain, New Guinea and Timor, islands north of the Australian continent, between latitude 10° S., and the equator. It is not unlikely that sooner or later other species, at present unknown, will be detected on some of the multi-

* 'Suppl.' 411. 1781.

* *Botanisches Centralblatt* **60**: 169–170. 1894.