The Importance of Plant Classification in Hevea

More than 40 years work with one species of Hevea has resulted in great improvement in yield. An organized effort is now being made to select from numerous wild species living material offering new characters for disease-resistance and increase in yield.

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Introduction

Whenever a plant-utilizing industry is built upon a fragmentary understanding of the quality, potentialities and limitations of wild plant materials which could be made available to it from nature, then only a limited utilization of wild stock results and the progress which might otherwise be effectuated never materializes. Such is the situation in the rubber industry.

Hevea is one of the most recently domesticated of economic plants. Phenomenal improvements in strains of one species in it have been made during the last fifty years, but we may justifiably expect a fuller understanding of *Hevea* in its wild state to open up avenues of betterment and diversification which would astonish the scientific and commercial world. Studies and utilization of wild progenitors in cotton, sugar, potatoes, cereals and many other ancient cultivated plants have produced improvements in these crops, and comparable improvement might be achieved in *Hevea* through greater knowledge of all species in the genus and use of them in hybridization. Few of the specific and subspecific variants of *Hevea* have entered into the programme of the extensive rubber plantation industry which is based almost exclusively on material of *H. brasiliensis* originally from one small area—the Rio Tapajoz—of the vast Amazon Valley.

As a result of the short period—seventy years—of domestication of *Hevea*, the difficulty of travel where *Hevea* is native, and unavailability, until recently, of funds commensurate with the task of adequate exploration, we still lack intensive field studies upon which a definitive classification of the genus may be made.

Plant classification—or taxonomy—is a science. Many people, even today, do not understand its scope nor appreciate its aims. It has two general phases, the academic or theoretical, and the practical or applied. There never can be a sharp boundary between pure and applied science; the one is as important as the other to a scientist, even though one phase may interest him more than the other. While the numerous academic problems in *Hevea*, which only a taxonomic and phylogenetic study can solve, are of profound interest, I shall discuss in this brief article merely the practical value of taxonomy to a dollar-and-cents-conscious industry.

History, Distribution, Characteristics

Hevea is a genus belonging to the Euphorbiaceae, a world-wide family comprising some 7,000 species. *Hevea* leads all other genera in this economic-

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ally important family both from the point of view of financial investment and from that of influence on human progress. Native to South America and there confined to the Amazon Valley and several contiguous regions, *Hevea* inhabits an area three quarters the size of the United States.

Its taxonomic history began in 1775 when the French botanist, Aublet, described the genus from French Guiana. He called the type species *Hevea guianensis*. Knowledge of the genus advanced with painful slowness, however, until the field work of that most sacrificing of explorers, the Englishman Richard Spruce, whose collections from the Rio Negro of Brazil, made in 1852–53, provided the material for the description of eight additional species. The earliest synopsis of *Hevea* was published in 1873–74 by Mueller who recognized 11 species. Huber, working along the Amazon in Belem do Pará at about the turn of the century, greatly augmented the number of concepts until there were held to be 24 species. Later Pax classified the genus into 17 undoubted species. The most recent treatment is that of Adolpho Ducke who, after nearly half a century of field investigations, recognizes 12 species and numerous varieties and forms.

Although a relatively small genus, *Hevea* shows a most remarkable range of variation in the wild. Probably geologically a young genus still in a state of evolutionary flux, its classification often poses exasperatingly complex problems. There are a great number of subspecific variations, many of them biologically stabilized and with definite geographical correlations, others mere responses to environmental conditions. By intensive study of large populations in the wild state we may hope to gain a clear insight into the significance of variation in *Hevea*. Since cultivation often tends to induce additional and artificial variation, the only method is to track *Hevea* down in its native haunts. This must be done if we are to take advantage of the wide natural range of variability.

The rubber of *Hevea guianensis* and of *H. guianensis* var. *lutea* is often weak and of limited commercial application, but both the species and the variety show a most extraordinary range of variation. If fully understood taxonomically, these concepts might prove of unexpected significance in breeding work. They are jungle giants and prefer well drained land above the flood level. Some representative variants grow as high as 6,000 feet altitude, and others inhabit uninviting rock and talus slopes which are almost devoid of soil. Although known to science before any other species of *Hevea, H. guianensis,* the most widely distributed species, remains today one of the most poorly understood concepts insofar as definition of its minor variants is concerned.

FIG. 1. The earliest fundamental investigations on the species of *Hevea* were carried out in the Rio Negro area of Brazil by that most self-sacrificing of explorers, the Yorkshireman Richard Spruce. (Drawn by Gordon W. Dillon from an old photograph preserved in the Gray Herbarium of Harvard University).

Hevea nitida is a large tree of floodland jungles, but it may also occur in a varied form in light, highland forests. It yields a latex which coagulates into a sticky mass of no commercial value as rubber. Furthermore, the latex of this species, when mixed with that of other species, acts as an anticoagulant. Yet, in spite of its close relationship to *Hevea nitida,* the recently discovered *H. nitida* var. *toxicodendroides,* a tiny shrub-tree native to bare, dry and sun-baked sandstone hills where only a scrub vegetation can exist, yields a latex which gives a good rubber. Could we not expect the extreme resistance to drought and radiation, the apparent high resistance to leaf blight, the thick, leathery leaves, and the quality of rubber of this diminutive variety to be of value for breeding? *Hevea nitida* and its variants may be of extreme interest to the future breeder because, although it appears very distinct superficially, taxonomic studies indicate that it is rather closely allied to *H. brasiliensis.*

While *Hevea brasiliensis* yields the highest quality and quantity of rubber, the other species have unusual characteristics that might be valuable in experimenting for future plantation stock. The breeder and planter must consider not only yield and quality of latex and rubber; disease resistance; wound response; and other major factors. He must consider also a host of secondary points, such as thickness, softness and anatomical features of the bark as it affects tapping; resistance to wind; root system; utility as root-stock or crown stock in budding; characteristics of the foliage and branching; and innumerable other matters which are not always immediately obvious. The rubber industry must draw upon all of the forms which nature has already evolved. In the past, the experiments which have employed species other than *Hevea brasiliensis* have been few and limited, and opportunities of inestimable significance may thus have been overlooked.

The highly variable *Hevea Benthamiana,* growing usually in the most acidic of permanent black-water bogs, yields a very high-grade rubber. Some varieties and forms of it have very leathery leaflets and seem to prefer dry, sandy habitats. Is there not a hope that thorough study of this concept might produce interesting data for use in disease control or that the species might yield characteristics valuable for producing a clone which could grow in sites unfavourable for *Hevea brasiliensis*?

Other species and varieties might be pointed out as of prime interest to our study. Occurring in great numbers in the most swampy areas of the eastern half of the Amazon Valley, *Hevea Spruceana* is not tapped for rubber because it has a thin, non-coagulating latex. Little or nothing is known of the rubbers produced by *Hevea rigidifolia,* a very small tree of light, sandstone-hill forest and with extraordinarily coriaceous leaves adapted to long dry periods; nor of *H. microphylla,* a small forest tree whose seeds shed gently and not explosively as in all other species; nor of *H. pauciflora* and its numerous variants, inhabitants of rocky slopes and other inhospitable sites. And what may we expect when we are able to study stands of the diminutive *Hevea camporum,* known from only one incomplete herbarium specimen from granitic hills at the headwaters of the Rio Marmellos in Brazil; and when we can rediscover and introduce into cultivation *H. minor* from the Casiquiare?

Little really is as yet known of the minor variations of wild *Hevea brasiliensis* itself. Several varieties have been described, but the concept seems to be so variable that mass studies of wild populations must be made to appreciate the extent and significance of the differences.

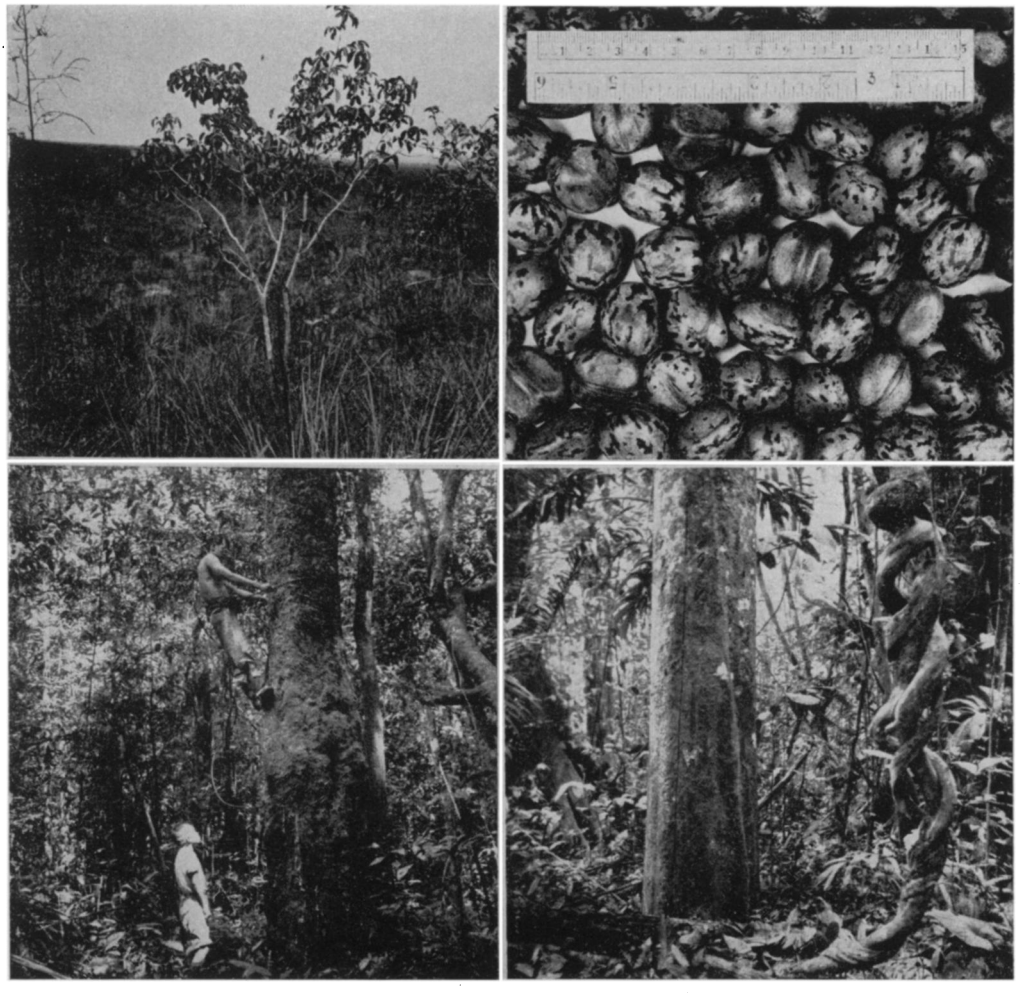

FIG. 2 (*Upper left*). *Hevea* trees may be tremendous giants of the jungle, such as *H. brasiliensis* and *H. guianensis* which often reach a height of 140 feet; or they may be, like *H. nitida* var. *toxicodendroides* in the illustration, diminutive shrubs or semi-prostrate bushes native to open, xerophytic, sandstone mountain-tops.

FIG. 3 (*Upper right*). The collection for nurseries of tons of seed of *Hevea brasiliensis* has afforded botanists an opportunity to study the variation in seeds from native populations of this species. The figure shows one type of seed of *Hevea brasiliensis* from Leticia, Colombia.

FIG. 4 (*Lower left*). An intensive search for outstandingly superior wild rubber trees has been in progress for several years in the Amazon Valley. Suitable branches are cut from selected trees and are sent to central nurseries to provide budding material. The ascent of an enormous tree of *Hevea brasiliensis*, shown in the illustration, is a difficult task because of the height and corpulence of the tree, as well as the many spiny ant-infested air-plants which clothe a great part of the trunk.

FIG. 5 (*Lower right*). Unlike many species of *Hevea*, *H. guianensis* is native to high land which is not subject to four or five months of deep inundation each year. This species is one of the most majestic trees of the high-land Amazonian jungle where it sometimes reaches 125 feet in height.

Recent Investigations

During the last five years the United States Department of Agriculture has carried out, through its Division of Rubber Plant Investigations and in cooperation with the governments of Brazil, Colombia and Peru, an ambitious programme of jungle selection of outstanding wild individuals of *Hevea* which show high yield and disease resistance. It has also encouraged cytogeographic and taxonomic studies. This work has necessarily been concerned chiefly with *Hevea brasiliensis.* But whenever fortune has permitted, material has been selected from as many of the other species, varieties and forms as possible. A significant living collection is being assembled in order that we may have at hand a museum of the wild representatives of *Hevea* for use in scientific programmes. This collection includes *Hevea Benthamiana;* several variants of *H. guianensis* and its variety *lutea; H. nitida;* and a number of others. Recently the extremely rare *Hevea rigidifolia,* not seen since Spruce collected it nearly a century ago on the Rio Negro, has been rediscovered in several localities of the same area. Further explorations may even turn up species as yet unknown.

Thousands of trees have been studied; tons of wild seeds have been gathered; chromosome counts have been made of hundreds of wild trees; and thousands of herbarium specimens, notes and photographs of numerous species of *Hevea* have been prepared. It is fully realized that seemingly academic studies are highly practical, not only to plant breeders but also to chemists. A clear classification of *Hevea* may help the chemist understand differences in properties of the latex of the numerous species, varieties and forms. Chemical differences in latices, while often influenced by ecological factors, are fundamentally correlated with the genetical make-up of the plant.

This is the first time in history that such an extensive programme has been possible with *Hevea.* The success it has met with is due largely to the sustained interest of the cooperating Latin American governments. We feel that we are finally at the dawn of a better comprehension of what *Hevea* really is and of how the genus is constituted. Only continued exploration, however, will enable taxonomy to prepare for science in general and for the rubber industry in particular a final blue-print of this most fascinating of plant groups.

The remarkable expansion of the elastomers of the so-called "synthetic rubber" industry is creating a demand for rubbers and rubber-like substances of all types for use as "fillers" or "softeners". We who are engaged in plant exploration and classification must be on the alert, for perhaps one of the humbler species of *Hevea,* today passed by because its latex is intrinsically of no commercial value, will one day assume an exalted place as producer of a superb softener for some as yet unknown elastomer.

At the present time, in our really incipient stage of knowledge of what the potentialities of the rubber trees of the genus *Hevea* are, we continually refer to the available taxonomic work, incomplete as it is, for any fundamental step in plant-breeding or selection. Should we not strive to provide a more satisfactory and complete classification as the first step in our programme for an overall betterment of the industry?