

A NEW GENERIC CONCEPT IN THE EUPHORBIACEAE

BY
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AN intensive investigation of *Hevea* (the genus of the commercial rubber tree) and its nearest relatives, which has been in progress in the Amazon forests during the past ten or twelve years, has added immeasurably to our understanding of the composition, distribution and possible evolutionary history of these groups. Results of this work have been appearing sporadically and have strengthened our belief that *Hevea* and *Micrandra* are close allies,¹ and may have had a more or less parallel evolution²; that both are related to the rather anomalous *Joannesia*³; and that the generic concept which had hitherto been known as *Cunuria* cannot be maintained as separate from *Micrandra*.³ It is, therefore, of considerable interest that a new genus of the *Hevea-Micrandra-Joannesia* complex has now come to light.

Vaupesia R. E. Schultes gen. nov. *Euphorbiacearum*.

Arbores magnae, elatae, parco cum succo lacteo (vel

¹This relationship was, apparently, first expressed by Bentham in 1880 (in Journ. Linn. Soc. Bot. 17 (1880) 262): "*Cunuria*, *Micrandra*, *Hevea* and *Joannesia* may be to a certain degree related to each other."

²Baldwin: in Journ. Hered. 38 (1947) 54-64; Baldwin: in Am. Journ. Bot. 34 (1947) 265; Baldwin and Schultes: in Bot. Mus. Leaf. Harvard Univ. 12 (1947) 325-326.

³Schultes: in Bot. Mus. Leaf. Harvard Univ. 15 (1952) 201-222.

saepissime apparenter absenti), foliis alternis, petiolatis, stipulis infraaxillaribus folia juniora involventibus caducis. Folia integra, penninervia, coriacea, pagina supra basim biglandulosa, costis secundariis angulo amplo decurrentibus, arcuatis, tertiis subparallelis. Inflorescentiae bisexuales, paniculiformes, valde floribundae. Pedunculi axillares et terminales, foliis subaequales vel breviores, rigidi. Flores monoeci, petaliferi. Flores staminati; sepalis quinque, valde imbricata, quincuncialia; petala calycis lobis alternantia; disci glandulae quinque, vulgo liberae, petalis alternantes. Antherae in columna centrali verticillatim insertae, inferiores disci lobis alternantes, birimosae. Flores pistillati: sepalis quinque, eis maris similia; discus hypogynus annularis vel subannularis, glanduloso-lobatus; ovarium liberum, triloculare, loculis uniovulatis; stylus sessilis, tripartitus divisionibus bifidis, erectis vel leviter patentibus. Fructus capsularis; capsula magna, subglobosa, in coccos bivalves partiens, epicarpio carnosum et endocarpio crasso lignoso. Semina magna, ovoidea, testa crustacea, immaculata, ecarunculata; albumen carnosum; cotyledones planae, latae.

Generis species typica: *Vaupesia cataractarum*.

Generis nomen regionem in qua haec arbor reperta est perstringit.

***Vaupesia cataractarum* R. E. Schultes sp. nov.**

Arbor usque ad sexaginta ad octoginta pedes alta (saepe minor) et usque ad decem pollices in diametro. Truncus erectus, columnaris, sine radicibus tabularibus, tenui cum cortice flavo-cinereo vel albedo-cinereo, exfoliato; succo aquoso valde sparsissime lacteo-albo vel frequenter sanguineo, siccitate aliquid cretaceo (vel saepe apparenter absenti). Rami saepe succo amplo aquoso sanguineo instructi, teretes, tenui cum cortice albidoluteo obtecti. Folia valde crasso-coriacea, supra atrovi-

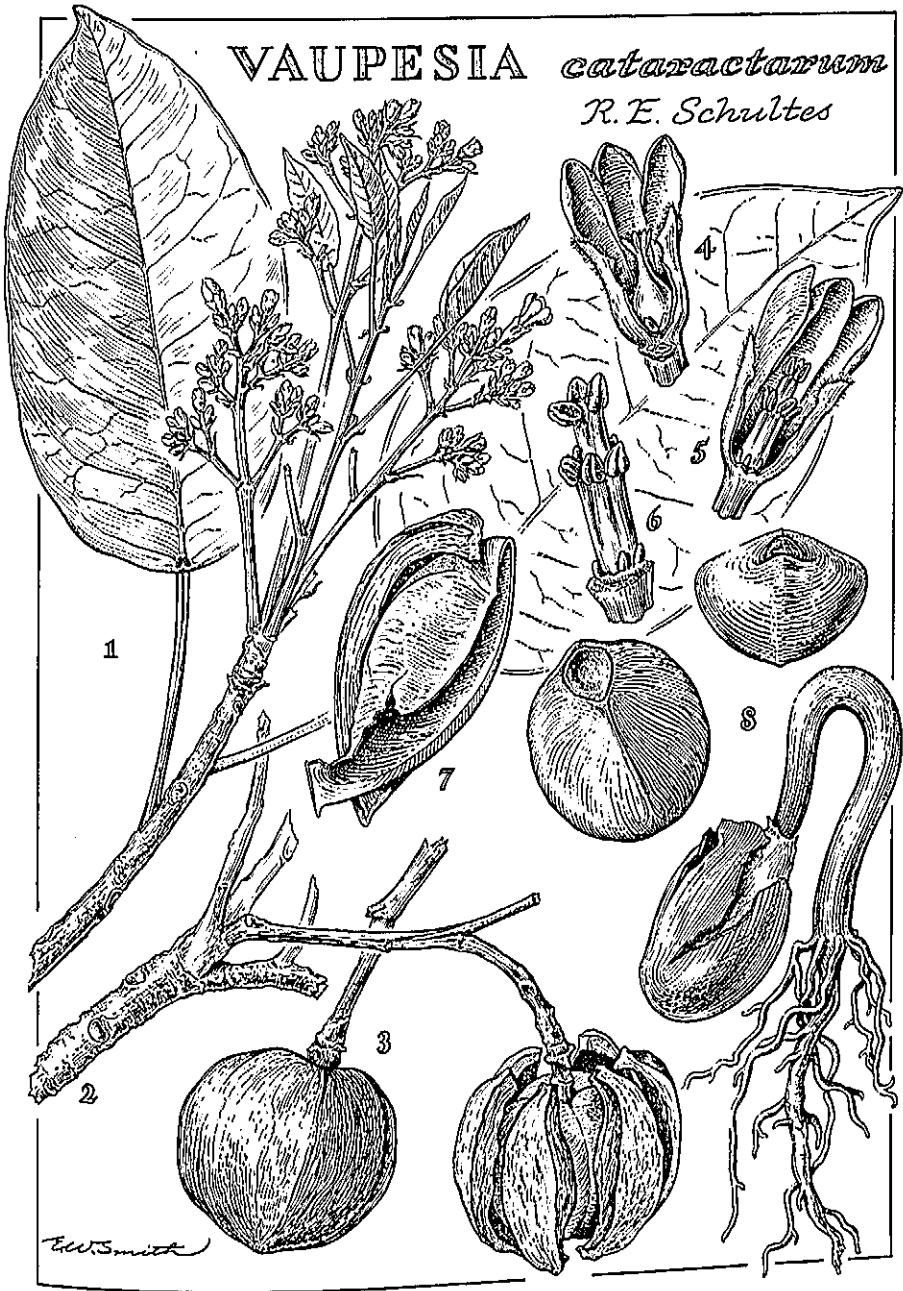
ridia laetaque, infra pallidiora hebetiaque, perfecte nervum centralem versus angulo 90° plicata, ovata vel rarer elliptico-ovata, omnino glaberrima, in specimine typico 16–19 cm. longa, plusminusve 10 cm. lata, apice breviter acuminata vel saepe obscurissime subacuta, basi vulgo perfecte rotundata, valde et conspicue marginata, venis supra non conspicuis sed infra elevatis, secundariis decem ad duodecim leviter arcuato-adscendentibus, tertiis reticulatis subparallelis, glandulis magnis, oblongis, usque ad 4 mm. longis; foliis juvenilibus papyraceis, lineari-lanceolatis, apice acuminatis, basi cuneatis, marginatis, 20–27 cm. longis, 5.5–8 cm. latis. Petiolus tenuis, siccitate striato-fibrosus, 6–9 cm. longus (saepe longior), usque ad 3 mm. in diametro. Inflorescentiae rigidae, plerumque 9–13 cm. longae, rhachide glabra, cortice rufo-purpureo. Bractee flores subtendentes stramineae, acuto-subulatae vel late triangulares, plerumque 4–5.5 mm. longae, basi 2.5–3.5 mm. latae, glabrae sed apicem versus saepe minute rufo-barbellatae. Flores lutei, in sole valde aromatico-pungentes, terminales majores saepissime pistillati sed saepe staminati. Flores pistillati: apice usque ad 5–6 mm. in diametro, calyces 10 mm. longi, extus minutissime scobiculato-pulverulenti, intus glaberrimi, $\frac{3}{4}$ partis divisi, laciniis margine conspicue ciliato-fimbriatis, tres exteriores majores, rhombico-spathulati cum apicibus lateraliter contiguus, subcucullati, apice rotundati sed in anthesi nunc vi fissi, 4 mm. longi, 3.5 mm. lati, duo interiores ovati, 3 mm. longi, 2–2.5 mm. lati; petala membranacea, obovata, 9 mm. longa, 4.5 mm. lata, apice leviter subcucullata, margine integra; discus hypogynus ovario adnatus, quinquelobatus, lobis variabilibus sed saepissime late rotundatis vel triangulati-subulatis, 1 mm. longis, 0.5–1 mm. latis, basi in vivo apparenter sanguineus; ovarium longe pyramidaliconicum, subtrigonum, glabrum, 4.5 cm. longum, plus-

EXPLANATION OF THE ILLUSTRATION

PLATE XII. VAUPESIA CATARACTARUM *R. E. Schultes*.
1, flowering branch, about one half natural size.
2, fruiting branchlet, with capsule ready for dehiscence, about one half natural size. 3, capsule before the drying out of the epicarp, about one half natural size. 4, pistillate flower with part of calyx and two petals removed, about two and one half times natural size. 5, staminate flower with part of the calyx and two petals removed, about two and one half times natural size. 6, staminal column with anthers, about four times natural size. 7, one valve of the capsule with epicarp adhering, about natural size. 8, seeds, with one germinating, about natural size.

Drawn by ELMER W. SMITH

VAUPESIA *cataractarum*
R. E. Schultes



EXPLANATION OF THE ILLUSTRATION

PLATE XIII. Map showing the known distribution
of *Vaupesia calaractarum*.

Drawn by ELMER W. SMITH

minusve 2 mm. in diametro; stylus tripartitus cum divisionibus bifidis, erectis, 1.5 mm. longis. Flores staminati: terminales pistillatis similes, laterales structura aequales sed partibus omnibus minores; florum staminatorum terminalium disci glandulae ad columnae staminialis basim insertae, parvae, erectae, oviformi-ellipsoideae, 0.5 mm. longae vel breviores; columna crassissima, usque ad 10 mm. longa, basi plusminusve 1.5 mm. in diametro, supra verticillum inferiorem 1 mm. in diametro sed omnino cylindrica, non attenuata; antherae octo, quinque in verticillo inferiore, ad columnae basim 3-3.5 mm., et tres in verticillo ad columnae apicem, aequales, 0.8-1 mm. longae. Fructus globosus vel subglobosus, vivo plusminusve 5 cm. longus, 4.8-5 cm. in diametro, siccitate vix minor, apice rotundato-obtusus, basi aliquid depressus, epicarpio nitido, atroviridi, saepe maturitate paulo purpurascenti, magnopere crassissimo (vivo saepe 6 mm. crasso), endocarpio lignoso, comparate tenui (usque ad 2.5-3 mm. crasso), valvis regularibus, plerumque 4.5 cm. longis, 2 cm. latis; pedunculo vulgo longissimo, robusto, usque ad 8-12 cm. longo, 4 mm. in diametro. Semina cum testa rufo-brunnea et conspicue hebeti, in circuitu longitudinali rotundato-ovalia, plusminusve 30 mm. longa, 26 mm. lata, compressa, 18 mm. crassa, in circuitu transversali inaequaliter rhomboidea, superficiebus duabus ventralibus conspicuis, carina dorsali prominenti, hyli cicatrice conspicua, subrotundata vel subtriangulari, 6-7 mm. longa lataque, prope apicem cicatricum versus rostello instructa.

COLOMBIA: Comisarias del Amazonas and Vaupés, Río Apaporis, Cachivera de Jirijirimo and vicinity. Altitude about 800 feet. "Tree 50-55 feet tall. Diameter 8-10 inches. Flowers yellowish. Latex chalky white. Bark flaky, grey-white. Leaf like *Cunuria Spruceana* with which it grows. Common." September 16, 1951, *Richard Evans Schultes & Isidoro Cabrera 14006* (TYPE in Herb. Gray).—Same locality. "Tree 60 feet tall. Diameter 1 foot. Bark greenish grey. No

latex." June 12, 1951, *Schultes & Cabrera 12431*.—Comisaría del Vaupés, Río Kananari, Cerro Isibukuri, at base of mountain. Quartzite. Altitude about 800 feet. "Large tree. Bark whitish grey, rough. Latex very watery, reddish." August 4, 1951, *Schultes & Cabrera 13339*.—Same locality. "Tree 100 feet tall. Latex red only in the branches." January 23-25, 1952, *Schultes & Cabrera 15059*.—Comisaría del Vaupés, Río Vaupés, between Mitú and Javareté, Randal de Tapira. In rocky high land covered with humus along rapids. "Fluted tree. Diameter 26 inches. Bark yellowish, tawny, papery, peeling easily. Inner bark reddish. No latex. Wood hard, centre reddish brown. Height 80 feet. Crown large. Leaves folded at right angles along midrib, slightly paler beneath, somewhat crassulent or fleshy. Bark on extreme branches whitish yellow. Seeds brown, dull. Capsules with thin woody wall, thick epiderm green but reddening before breaking. Desano = *ma-há-wa-soo*. Together with *Micrandra Spruceana* and *Hevea pauciflora* var. *coriacea*." May 14-24, 1953, *Schultes & Cabrera 19344*.—Same locality and date. *Schultes & Cabrera 19345*, *19346*, *19347*, *19353*.—Comisaría del Vaupés, Río Papurí, Teresita. Caatinga forest. "Large columnar tree; diameter 18 inches; height 60 feet. Crown large. No latex. Bark papery, yellowish grey." May 27, 1953, *Schultes & Cabrera 19440*.—Same locality and date. "Large columnar tree, 60-70 feet tall. Crown large. No latex. Seeds eaten after boiling." *Schultes & Cabrera 19444*.—Same locality and date. *Schultes & Cabrera 19451*.

All of the collections cited above are from Colombian territory, but, in several cases, they were made along rivers (the Vaupés and the Papurí) forming part of the boundary between Colombia and Brazil. I have seen hundreds of trees of *Vaupesia cataractarum* on the Brazilian bank, so we must report this species as occurring in both countries. It might, also, later be found in that part of Venezuela adjoining the Río Negro and the Río Guainía, even though relatively intensive studies of *Hevea* and *Micrandra* in that area have not, as yet, disclosed its presence there.

When I first met with *Vaupesia* in the field, I thought that I had found a new species of *Micrandra* (including *Cunuria*), notwithstanding the presence of petals. The general habit and appearance of the tree is, indeed, so

EXPLANATION OF THE ILLUSTRATION

PLATE XIV. Trunk of the tree from which the type
of *Vaupesia cataractarum* was taken.

Photograph by RICHARD EVANS SCHULTES

PLATE XIV



strikingly similar to several of the species of *Micrandra* with which it grows that even the Indians of the region use the same name for *Vaupesia cataractarum* and for *Micrandra Rossiana* R. E. Schultes and *M. Spruceana* (Baill.) R. E. Schultes. Close examination, however, discloses the extraordinary distinctness of the new concept.

All of the characters of *Vaupesia* place it in the *Micrandra-Hevea-Joannesia* complex. The leaves are very definitely micrandroid, departing sharply from the three-foliolate leaves of *Hevea* and the usually five-foliolate ones of *Joannesia*. The capsule, valves and seeds of *Vaupesia* likewise resemble those of *Micrandra* very strongly. Indeed, if I had collected nothing but fruiting material, I would, without hesitation, have described it as a new species of *Micrandra*.

The type of inflorescence and the petaloid flowers resemble those of *Joannesia* to a remarkable degree, even though the calyx is quite micrandroid and entirely unlike the undivided calyx of *Joannesia*. The presence of a watery red resinous liquid in the bark of many trees of *Vaupesia* recalls a similar condition in *Joannesia heveoides* Ducke.

The whorled disposition of the anthers on a fleshy staminal column definitely indicates a relationship with *Hevea*. Nevertheless, the morphology of the column might be interpreted as rather intermediate between *Joannesia* and *Hevea*. We are able to point out a complete series, tending towards fusion of the filaments, from *Micrandra* (with free filaments) and *Joannesia* (with the filaments basally connate) through *Vaupesia* (with the filaments totally fused into a column which, however, shows by fluting the position of the individual filaments) to *Hevea* (with a perfectly terete column).

A comparison of the disks of both the pistillate and staminate flowers suggests, perhaps, a closer alliance with

Joannesia than with either *Hevea* or *Micrandra*. The structure of the stigmas, on the other hand, is definitely micrandroid.

Dr. Grady L. Webster, Research Fellow in Biology at Harvard University, has made a study of the pollen grains of *Vaupesia* and of related genera. His observations follow:

"The pollen-grains of *Vaupesia cataractarum* are characterized by a 'Croton-pattern' of ornamentation, as defined by Erdtman⁴. When expanded in lactic acid, they are spherical, about 72-77 μ in diameter, and apparently non-aperturate. The ornamentation is due to a dense exinous layer of knob-like processes arranged, as illustrated by Erdtman for *Manihot* and *Jatropha* (op. cit., 170), in rings of five or six around a dim, circular area. The knobs in *Vaupesia* are about 4 μ long and roundish or 3-5-angled in cross-section.

"Of the genera in the *Hevea*-complex, *Joannesia* shows the greatest similarity to *Vaupesia* in pollen morphology. The grains of *Joannesia princeps* are about the same size and have a very similar pattern of exinous knobs. In fact, one could not, on the basis of pollen morphology alone, distinguish the two genera. *Micrandra* and *Hevea*, on the other hand, have colporate grains and, palynologically, at least, stand further away."

Are we not justified in believing that *Vaupesia* represents, perhaps, a concept linking more closely the *Micrandra*-*Joannesia*-*Hevea* complex? And, likewise, may we not interpret *Vaupesia* as possibly a vestige of an ancient prototype of what we now see differentiated into *Micrandra*, *Joannesia* and *Hevea*?

Speciation in both *Hevea* and *Micrandra* has occurred to a much greater extent in the basin of the upper Río

⁴ Erdtman, G.: Pollen Morphology and Plant Taxonomy (1952) 173.

Negro and Vaupés than in any other area. Here are represented not only the greatest number of species of these two widespread groups, but endemism indicates that both *Hevea* and *Micrandra* may represent very ancient elements of the flora of this phytogeographically critical region.

The genus *Joannesia* is not represented, so far as we know, in this area. Its distribution is rather local: one species occurs in the coastal region of Brazil near Rio de Janeiro; a second is known from the Rio Tapajóz in the eastern Amazon.

The flora of the caatingas and caatinga-forests in the upper Río Negro-Vaupés basin shows very close affinities with that of the ancient Venezuela-Guiana land-mass. In fact, these caatingas (locally called "savanetas" in Colombia) are found in eastern Colombia either on the isolated quartzitic mountains of Cretaceous age (or on extensive sandy stretches associated with such mountains) or on granitic hills of the pre-Cambrian "Brazilian shield." The very numerous rapids in the rivers of the Colombian Comisaría del Vaupés are likewise associated with these quartzitic rocky outcrops or, along the Brazilian boundary, with granitic outcrops. *Vaupesia cataractarum* has been collected from caatinga-forests along both the quartzitic and the granitic cataracts: the type locality (the Falls of Jirijirimo on the Río Apaporis) and the base of Cerro Isibukuri, the western and southernmost stations known for the genus are quartzitic; the Falls of Tapira on the Río Vaupés and at Teresita on the Río Papurí are granitic. Both of these geological associations support peculiar and, presumably, ancient floras and seem to be repositories for endemic and apparently primitive species. We might enumerate many, but it will perhaps suffice to name several allies of the new genus: *Hevea rigidifolia* (Spruce ex Benth.) Muell.-Arg., *Micrandra*

Lopezii R. E. Schultes and *M. Sprucei* (Muell.-Arg.) R. E. Schultes, known only from the granitic caatinga-forests; *H. nitida* Mart. ex Muell.-Arg., *H. pauciflora* (Spruce ex Benth.) Muell.-Arg. var. *coriacea* Ducke and *Micrandra Rossiana* from both the granitic and quartzitic areas; and *H. nitida* var. *toxicodendroides* (Schult. & Vinson) R. E. Schultes, exclusively from the quartzitic mountains.

Vaupesia cataractarum occurs in caatinga-forests in close association with *Micrandra Spruceana* and *Hevea nitida*. Other tree-associates are *Monopteryx Uauco* Spruce ex Benth. and *Couma cattingae* Ducke. In the locality on the Río Papurí, it grows in stands which comprise almost exclusively *Vaupesia cataractarum* and *Micrandra Sprucei*.

The habitat of *Vaupesia cataractarum*, as the specific epithet implies, usually consists of hilly or sloping areas alongside or very near rapids. The ground is strewn with huge rocks, between which humus and sand has accumulated, creating a highly acid condition. In addition to the ample rainfall (more than 8 meters a year) which drenches the forests of this region, the sites chosen by *Vaupesia cataractarum* are almost perennially soggy as a result of the numerous rills and freshets that flow down from the higher hinterlands to empty into the river near the rapids.

The Desano Indians, speaking a Tukanoan dialect, refer to this tree as *ma-há-wa-soo* ("macaw-cunurí"), the same name which they apply to *Micrandra Rossiana* and *M. siphonioides* Benth. They know the superficially similar *cunurí* (*Micrandra Sprucei*) as *wa-soó*.

From late March through May, the large seeds of *Vaupesia cataractarum* fall in astonishingly large amounts. They are harvested from the ground by the Indians for food. Like the seeds of *Hevea* and *Micrandra*, they are

extremely poisonous, until boiling breaks down the cyanic substances. They are also extremely rich in oil.

There is one important aspect of *Vaupesia cataractarum* which is still a puzzle. Sometimes a white, watery latex is present in the bark of the basal part of the trunk, but usually no trace of such a latex can be found. When present, it is a curiously resinous liquid drying to form a rather chalky white substance which easily crumbles in the hand. One tree (*Schultes & Cabrera 13339*) had a watery latex of a reddish color in the trunk, whereas nearly all of the more than eighty trees which I examined closely in the several localities possessed this reddish latex abundantly in the terminal branches, even when no evidence of it could be found elsewhere in the plant. Information from the Indians indicates that these anomalous conditions are not seasonal, and my own studies convince me that there is no relationship between the presence or absence of latex and its color and ecological factors. At first, I suspected that perhaps distinct varieties or forms might explain the problem, but there is no morphological evidence that we have at hand any taxonomic variants. In thus reluctantly leaving this interesting puzzle unsolved for the present, I must emphasize again the presence in *Joannesia heveoides* of a very similar thin, watery, red latex. *Joannesia*, of course, does not have the white latex common to all of its presumed allies, nor do these allies—*Hevea* and *Micrandra*—possess the red latex of *Joannesia* and *Vaupesia*.

The drawing of *Vaupesia cataractarum* and the distribution map published herewith were made possible through a grant from the United States Department of Agriculture with which I was associated when this new genus was discovered. I wish to express my appreciation to Dr. Julian A. Steyermark for his interest and advice in my treatment of this new concept.