Botanical Overview

of

Rafflesiaceae

from

Netherland Indies

With identification tables and species descriptions;
mainly from Solms-Laubach.

Edited

by

DR. S. H. KOORDERS.

(With 19 plates).

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"Netherland Indies" used in translation vs. "Netherland East Indies" or "Dutch East Indies"

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Introduction.

"Among the organized beings", —according to Miquel [4]) there are some who, completely isolated by a completely strange structure, seem at first sight to not approach any group, which leads us to ask ourselves, if perhaps they have their counterparts among the extinct forms, or if rather they could be regarded as the precursors of a new creation of vital forms. It is therefore not surprising that the extraordinary attention aroused by their discovery has even extended beyond the bounds of science, and that botanists have made every effort to lift the veil that covers their true nature, in researching with the greatest care all the particularities of their intimate structure."

Indeed, among the most remarkable parasitic flowering plants in the whole world belong without a doubt the representatives of the family Rafflesiaceae and in particular the species belonging to the genus *Rafflesia* occurring in the Netherlands Indies, especially the species with gigantic flowers, such as the Sumatran *Rafflesia arnoldi* with flowers from ⅔ to over a meter in diameter.

Yet in our Netherland Indies literature, a somewhat recently updated botanical overview provided with identification tables of the species of the Rafflesiaceae occurring in the Netherland Indies is so far completely lacking of this plant family. Already in 1891 a classic study on all then known *Rafflesia* species and a monograph of the entire plant family was published by Solms-Laubach in 1901, and notwithstanding (among others by Blume, Miquel, Teijsmann, Binnendijk, de Vriese, Suringar) and in recent times extensive publications have been published by Heinricher and by Ernst und Schmid, in which some Netherland Indian species have been treated separately, in detail.

When I (in Sept. and Oct. 1917) examined some of the alcohol collections of Netherland Indies Rafflesiaceae present in the Buitenzorg Herbarium for the purpose of the currently published overview, I found four new *Rafflesia* species, namely the ones I describe below: *Rafflesia* bornënsis *R. ciliata*, *R. witkampi* and *R. zollingeriana* Kds. The last one was collected by me in East Java in 1895 and in 1902 and the three first were discovered by the Dutch mining engineer H. Witkamp in 1907 in N.E. Borneo.

As a result, the total number of described species of the Netherlands Indian Rafflesiaceae has risen since 1916 from eight to twelve. Three of these new species are from the Outer Possessions. It is clear proof how incomplete our knowledge of the Rafflesiaceae occurring in the Netherland Indies Possessions is and how much remains to be investigated in this direction in our outer Indien Possessions.

I hope that my survey of the Rafflesiaceae will arouse wider interest in these exceptionally remarkable plants occurring in the forests of the Netherland Indies, for which the reservation of at least one original habitat of each species as a natural monument is an urgent necessity for scientific and aesthetic reasons and is a national duty. The latter, because cultivation of these jungle crops *), outside their place of growth, can either not be maintained at all, or can only be maintained with extreme difficulty and in the long run incompletely, and secondly, because most Netherland Indies species outside the Netherlands Indies are completely absent and within the Netherlands Indies are almost exclusively limited to relatively small forest areas; in other words, because our Indian Rafflesiaceae almost all have a very limited geographical distribution and very special living conditions closely related to the place of origin.

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*) Mr. T. Ottolander rightly draws attention to this point in his article: *Rafflesia* nature monuments in Sumatra (in Natuurmonumenten — Communication No 2 published by the Netherland Indies Association for Nature Conservation; currently in press).

Finally, I express the hope that the overview I have compiled, however incomplete and imperfect it may be, may contribute to making the study of our Netherland Indies Rafflesiaceae more accessible to a wider circle than hitherto with the various, sometimes very valuable books and magazines distributed and for the most part in Netherland Indies, outside Batavia and Buitenzorg, residents were either not available or literature that was very difficult to access.

Buitenzorg, 9 November 1917.

DR. S H. KOORDERS.

Rafflesiaceae.

Description of family characteristics.

Parasitic herbs. Vegetative organs (not only the stems and leaves, but also the roots) are extremely reduced; these resemble mycelium-like, filamentous, branched bundles, which proliferate within the bark and sometimes also within the other tissues of the host plant, due to the great reduction in structure. Flowers large, sometimes (*Rafflesia arnoldi* and *schadenbergiana*) huge, terminal, solitary or (not occurring in the Netherland Indies) in racemes; actinomorphic; unisexual by reduction, rarely polygamous, surrounded at the base by bud scales. Perianth with 4 or more segments. Stamens eight or more, sessile, connate. Ovary inferior, rarely (not in the Netherland Indies) superior; monolocular with four or more parietal ovules and numerous ovules or polyloculous with numerous ovules seated on all walls. Style single, undivided. The stigma is located below the edge of the disc-shaped broadened style apex. Fruit berry-like, large. Seeds very small, enclosed in pulp, with hard shell, containing oil. Embryo white oleaginous. Embryo undivided, ovoid or knob-shaped. (After Boerlage, modified from Solms).

The Rafflesiaceae family includes 9 genera, of which 2: *Rafflesia* and *Brugmansia* are present in the Netherland Indies; moreover, perhaps also a species of *Sapria* or of *Richthofenia*.

Identification table of the genera of Rafflesiaceae occurring in and near the Netherland Indies.

A. Perianth tube more or less closed on the inside by a diaphragm (crowned). Flowering lobes in the bud imbricate.
  a. Anthers polylocular. Ovary polylocular. Floral lobes 5. – Netherland Indies, (Java, Sumatra, Borneo, (?) Bali), Philippines .....**1. *Rafflesia***.
  b. Anthers 2 locular.
    aa. Ovarian polylocular. Perianth lobes 20. According to Pilger and Krause perhaps identical with *Sapria*. — Siam. .....**2. *Richthofenia***.
    bb. Ovarian polylocular (according to Hooker's Flora) or monolocular'(?) according to Griffith's description. Perianth lobes 10. — British India (Himalaya). .....**3. *Sapria***.
B. Perianth tube not provided with a diaphragm. Perianth lobes more than 5, in the bud valvately contiguous. Anthers 2-locular (*Brugmansia zippelii*) or apparently multilocular due to imperfect partitions (*B. lowi*). — Neth. Indies (Java, Sumatra, Borneo). .**4. *Brugmansia***.

OVERVIEW

Genera of the Rafflesiaceae family found outside and in the Netherland Indies

I. Tribe. Rafflesieae.

Flowers solitary, terminal. Ovary subdivided into a number of compartments by numerous, highly branched and twisted placentae.

Rafflesia. Rob. Brown. — There are 14 species of this genus found in the Netherland Indies and the Philippines; 12 of these are exclusively from Neth. Indies.

Brugmansia Blume. — Of these only two known species; these are exclusively in Neth. Indies.

Sapria Griff. — The only species is known only from British India (Himalaya).

Richthofenia Hosseus. — The only species is known only from Siam. According to Pilger and Krause in Engler und Prantl., Nat. Pflzfam. Nachtäge it is uncertain whether this genus differs generically from *Sapria*.

II. Tribe. Apodantheae.

Flowers solitary, terminal. Ovary inferior or half-inferior, with parietal sessile ovules.

Apodanthes *Poiteau. — in* Brazil and Columbia.

Pilostyles *Guillem.* (*Sarna* Karsten, *Frostia* Bertero). In tropical South America, northern Chile, southern California, Angola, Syria and Kurdistan.

III. Tribe. Mitrastemoneae.

Flowers solitary, terminal. Ovary superior, only known from Japan, Kiusiu and Shikoku y superior, monolocular with parietal placentation, bearing numerous ovules on both sides.

Mitrastemon *Makino.* — Only known from Japan, Kiusiu and Shikoku.

IV. Tribe. Cytineae.

Flowers in clusters.

Cytinus *Linn. (Phaelipaea* Thb.; *Hypolepis* Pers.; *Tyrsine* Gleditsch). — South Africa and regions in the vicinity of the Mediterranean Sea.

Bdallophyton *Eichler.* — Known only from Mexico.

Collecting and sending Rafflesiaceae research materials. On this point the reader will find some simple advice below at the end of the Rafflesiaceae incertae.

Parasitism and reduction of the vegetative organs.

Leaves, stems and roots in the Netherland Indies Rafflesiaceae are unusually reduced to irregular, filiform, multicellular, mycelium-like, repetitively branched thallus-like bundles, which in *Brugmansia* and *Rafflesia* completely overgrow the bast tissue [phloem fibers] of the host lianas and break through the cambium and send out perpendicular thallus branches to the interior of the wood.

In *Rafflesia* and *Brugmansia* the single-flowered inflorescences always originate endogenously, in the interior of the parenchymatic thallus tissue; the inflorescences, before finally emerging beyond the liana stems or roots, must break through not only these thallus clumps of tissue, but also the superimposed tissues of the host plant. This always creates – according to Solms 14) – a knob-shaped swelling on the liana stem or root. Each of these in *Rafflesia* and *Brugmansia*, about the size of a chicken's egg when young, hides in its interior a very young, still very imperfectly developed flower bud still enveloped by the bark of the liana stem or root, with very stubby peduncle and the still young and numerous flower bud scales (bractae) completely enclosing the bud. As soon as the size of the flower bud increases, the bark of the liana tears open and the flower bud of the parasitic plant emerges, still completely encased in the bracts. Flower buds of this stage and younger can generally be found in relatively large numbers on old liana stems invaded by *Rafflesia* or *Brugmansia*. But flowers which open at the same time, as a rule, at least on one and the same liana stem or on one and the same root of the host plant, are very few in number; with the large-flowered *Rafflesia* species usually at most one single open flower. According to most researchers, and also according to my observations, in both *Brugmansia* and *Rafflesia*, in many cases one or more flower buds do not develop and rot prematurely. However, sometimes fruits are formed in these cases. According to Ernst und Schmid 2) this was observed in Java according to a letter from Scheffer to Solms-Laubach.

In the prefloral state the Rafflesiaceae live completely hidden from the eye within the tissues of the host plants. Only at the beginning of flowering does this parasitic plant betray its presence in the host plant.

Seed germination and onset of parasitism. "The germination of the seed and the way in which the young plants penetrate the host tissue are completely unknown", says Solms-Laubach in 1901.

Even now (in 1917) nothing is known about the manner of germination of the seed and the penetration of the young parasitic plant into the tissue of the host plant.

What Miquel 4) published in 1864 about some experiments conducted in Buitenzorg by Teijsmann in 's Lands Botentuin with the sowing of seeds of *Rafflesia arnoldi* on roots of Vitaceae lianas cultivated there is given below under the species description of *Raff. arnoldi*.

Teijsmann, who sowed seeds of *Rafflesia arnoldi* in incisions on the roots of a few (Vitaceae) liana species grown at Buitenzorg in the Hortus, has succeeded, according to Miquel, in getting the seeds to germinate and develop further. But a description of the germinating seed or of the *Rafflesia* seedling is also lacking in Miquel 4) and it seems to me that a repetition of the Teijsmanian sowing experiments is especially desirable, because the publication does not show whether at the time (70 years ago) whether or not precautions were taken in the sowing trials:

1) sow only *Rafflesia* seed on liana roots, which were completely free of *Rafflesia* thallus bundles outside and inside;

2) no observations seems to have been made yet about the origin of the very first root thallus filaments of the germinating seeds and about the intrusion of these newly formed *Rafflesia* seedling thallus threads into the vine tissues.

About these Teijsmann sowing trials, is quoted below, in the species description *Rafflesia arnoldi*, from what Teijsmann 1) and Miquel 4) say about it.

Mr. Brewer has published some information about the partial development of small *Rafflesia* flower buds that already occur outside the original place of growth, by cultivating liana stem pieces, in Natuurmonumenten-Mededeeling No. 2, published by the Ned. Indian Society for Nature Conservation.

In this way it seems to be somewhat less difficult to cultivate *Rafflesia* outside its original place of growth, outside the primeval forest, in a tropical garden or perhaps also in a greenhouse in Europe, but in any case it may be stated that the culture of the Netherland Indies Rafflesiaceae is associated with extraordinary difficulties outside the original place of growth and therefore, among other things, for the Netherland Indian Rafflesiaceae already urgently require nature conservation measures for the original place of growth for scientific reasons.

Means of Dispersion. As far as I know, certain observations about this are lacking and only a few hypotheses have been published. The seeds of all the species of the Rafflesiaceae, even those with giant flowers, such as *Rafflesia arnoldi*, are very small. The seeds of *R. arnoldi* are about 1 millimeter long, according to the images of Robert Brown 1), and ½ millimeter wide. The seeds of only a few species are known so far. The number of mature seeds that produce a single fruit appears in some species, including *Rafflesia arnoldi*, according to Rob. Brown, to be extraordinarily large.

The fleshy nature of the fruits, the lack of special adaptations of the seeds to dispersal by water, furthermore the particular smallness of the seeds and the very strong structure of the testa, make it not unlikely, in my opinion, that the dispersal of the seeds of the Rafflesiaceae is endozoic, or exozoically by animals, presumably by smaller mammals and birds living in the forest.

In this case, as far as is known, the germinated seeds only come to further development if they are deposited on the stems or roots of that single specific species or ? species of dicot host plants, to which the occurrence of these parasitic plants seems to be linked.

The relatively very limited geographical distribution of most Netherland Indian species of Rafflesiaceae can be partly explained by this special limitation in the choice of the host plant.

Notwithstanding the extraordinarily voluminous literature on the Rafflesiaceae family, I have not found any observations on seed germination.

On the rarity of ripe seeds Haak 1) mentions the following for *Rafflesia patma*: “The production of mature seeds is not often successful because most of the buds are eaten away by vermin, dried up by insect bites or rotted by too much humidity and then because the few flowers that manage to flower are bad.” (according to Haak 1) p. 7.).

On the other hand, Ernst 2) in 1906 on a five-day botanical excursion to Noesakambangan, succeeded in collecting five fruits from *Rafflesia patma* with the help of natives and three fruits from *Brugmansia zippelii* on the first day in the Tjiapoes gorge on the Salak. He also discovered that a fruit (also the first known fruit) of *Rafflesia hasseltii* near Padang Pandjang in Sumatra and that he also obtained a fruit of *Rafflesia rochusenii* from the forests on the Salak near Tjitjoeroeg.

Ernst und Schmid 2) are of the opinion that *Rafflesia* fruits, contrary to the relevant literature references, probably occur quite often, but have hitherto been overlooked in the collection of most species, perhaps because of their very inconspicuous appearance.

Pollination. — On the pollination of the Rafflesiaceae, Solms-Laubach in Engler, Pflanzenreich IV. 75 (1901) 5 states the following: “There is a complete lack of specific information about the pollination means of the Rafflesiaceae. After all, for *Rafflesia arnoldi*, its discoverer, Dr. Arnold (with Rob Brown) stated that the flower gave off a pronounced smell of carrion, and that when he found it, swarms of flies arose from it. Haak, who paid attention to these conditions in *Rafflesia patma*, has nothing more. But Blume expressly states that he has observed the oviposition of the flies, and accordingly one can hardly doubt the adaptation to insect pollination. Like other forms lacking in odor, e.g. B. *Cytinus* behaved in this respect

remains to be seen. What is remarkable, however, is the fact that the actual Rafflesiaceae rarely manage to develop their fruit in this way".

Heinricher 1) first observed with Bartels in 1904 and openly published in 1906 that the flowers of the Javanese *Brugmansia* shortly after opening do not smell and that the unpleasant smell only occurs after the flowering has finished.

Ernst und Schmid 2) first reported the same for a few Netherland Indian *Rafflesia* species and this on the basis of the observations made by Ernst in 1906.

Ottolander, in a publication by the Netherland Indian Vereeniging tot Natuurbescherming (in Natuurmonumenten-Mededeeling No. 2), also announced that the newly opened flower of *Rafflesia arnoldi*; contrary to the bibliography, does not stink. He states this on the basis of observations made by him in 1912 in Sumatra (Bengkoelen).

Heinricher 1) was the first to express the opinion for the Javanese *Brugmansia* that the pollen does not seem to "disperse" (verstauben), but emerges surrounded by a slimy mass. He was the first researcher to find germinating pollen for the same *Brugmansia* described and depicted.

Ernst und Schmid 2) have both confirmed for the Javanese *Brugmansia* what Heinricher suspected about the appearance of the pollen grains enveloped in slime, and for a few Netherland Indian species of *Rafflesia* first made the same observation.

Due to the aforementioned discoveries of Heinricher and Ernst about the pollen grains emerging from the anthers in a slimy fluid, it may be assumed with certainty, notwithstanding the smooth surface of the exine, that the transmission of the pollen in the Netherland Indian species of the Rafflesiaceae sometimes or always occurs through the intervention of insects (including by Diptera).

Direct observations of pollen transfer in Rafflesiaceae, however, have not yet been made, to my knowledge; at least not yet published.

Host plants of the Rafflesiaceae. As far as is known, all *Rafflesia* species grow parasitically exclusively on the stems and roots of some Dicotyledons, especially of some species of lianas belonging to the Vitaceae-Cissoideae. With regard to the species or species of the host plants, further investigations, with the sending of flowering and fruit-bearing material, are desirable. For I have found that there is still a great deal of uncertainty about this, even in the most well-known species of the Rafflesiaceae, such as *Rafflesia patma* and *R. arnoldi* and *Brugmansia zippelii*.

Systematics. — About the insufficient knowledge of the species of the Netherland Indian Rafflesiaceae, Solms-Laubach 7) writes in 1910 the following: "So I hardly doubt that a more detailed investigation of North Sumatra, Malacca and Tenasserim will surprise us with further Rafflesiaceae finds." (Solms-Laubach).

The surprising results, which were already mine in Sept. and Oct. 1917 about some of the alcoholic material specimens of Rafflesiaceae kept in the Buitenzorg Botanical Museum from Java and Borneo, namely the finding therein of four new, undescribed species of the genus *Rafflesia*, confirm the correctness of the above quoted conjecture of Solms-Laubach expressed 7 years ago.

Nature conservation measures for *Rafflesia* habitats. — For what was accomplished in this direction by the official authorities on the initiative of the Nederlandsch Indische Vereeniging tot Natuurbescherming in Sumatra in 1913-1916, I can refer here to the years 1913 - 1916 for what has been written about this in the Jaarverslagen der Ned . Ind. Vereeniging tot Natuurbescherming has been briefly mentioned by me and according to what is published by Mr. T. Ottolander in the Natuurmonumenten-Mededeeling No. 2 of the aforementioned Vereeniging and furthermore to what I have written below behind the species descriptions under *Rafflesia arnoldi*, and *Hasseltii* and Rafflesiaceae spec. no. 2 and no. 3 has been mentioned by me.

In Central Java on Noesakambangan for *Rafflesia patma* and in East Java on the Gunung Watangan near Poeger for *Rafflesia zollingeriana*, also on the initiative of the aforementioned Association, nature conservation measures were taken by the local official authorities in 1913-1917; while for the *Rafflesia rochusenii*, which only occurs in a very small part of West Java, recently, also on the initiative of the Ned. Indische Vereeniging tot NatuurbeScherming, steps have been taken to achieve sustainable protection of an original habitat. Meanwhile, as early as 1912–1913, also on the initiative of the chairman of the aforementioned Association, provisional nature conservation measures were taken for an original habitat of *Brugmansia zippelii*.

Main Literature of the Rafflesiaceae, in particular from the Netherland Indies.
(After Solms-Laubach and supplemented with the new literature).

Baillon, 1. Histoire des plantes, vol. 9. (1888). Aristolochiaceae, p. 10 seq.

Beccari, O. 1. Descrizione di tre nuove specie di piante Bornensi. Atti della societa Italiana di scienze nat. Vol. XI, Seduta del 21 giugno (1868). 197.

Raffl. *tuan-mudae*, Brugm. lowii.

Beccari, O. 2. Illustrazione di nuove specie di piante Bornensi. Nuovo Giorn. botan Ital. Vol. I. (1869) p. 14 — 91 Tab. 5. Beschr. und Abbild. von *Brugmansia* lowii.

Beccari, O. 3. Osservazione sopra alcune Rafflesiaceae. Nuovo giornale botan. Ital. Vol. 7, (1875) p. 70 seq.

Kritik der Monogr. in DC. Prodr., *Hydnora*. *Rafflesia arnoldi*, *Brugmansia lowii*).

Bentham et Hooker, Genera Plantarum III. 116.

Bernard, Ch. Sur rembryogénie de quelques plantes parasites. Journal de Botanique. Vol. 17. (1903) pp. 23.

Blanco Manoel, 1. Flora de Filipinas. Editis 2 (1845) 565 et 595. — Granedicion dajo la direccion cientifica y literaria de los P.P. Augustinos calzados Fr. Andres Naves y Fr. Celestino Fernandes Villar, Vol III, Manilla (1879) p. 229 seq.

Blume, C. L. 1. Etwas ober die Rhizantheae, eine neue Pflanzenfamilie und die Gattung *Rafflesia* ins besondere. (Uebersetzt aus der Batavia'schen Zeitung (Bataviasche Courant?) und mitgetheilt von dem Herrn Verfasser durch Herrn Präsidenten Nees von Esenbeck). Flora, 8 Jahrg. Bd. II, (1825) p. 609 seq.

Wichtig, enthalt authent. Fundbericht der *R. patma* auf Noessa Kambangan.

Blume, C. L. 2. Over een nieuw plantengeslacht *Brugmansia* uit de natuurlijke familie der Rhizantheae. Bijdragen tot de natuurkunde Wetenschappen, verzameld door van Hall, Vrolik en Mulder, Vol, II, (1827) p. 419.

Blume, C. L. 3. Flora Javae. Heft 1, Rhizantheae, Bruxelles (1828) 1– 26. Tab. 1–6.

Enthält Beschreibungen und Abbild. von *Raff. patma* und *Brugmansia zippelii*.

Boerlage, Handleiding tot de kennis der Flora van Ned. Indië III. 1. (1900) 55 —59 (onder Cytinaceae).

Brown, Rob. 1. An account of a new genus of plants named *Rafflesia*, Transact. Linn. Soc. Vol. XIII (1820-1822) p. 201 seq. Taf. 15 — 22.

Uebersetzung von Nees, in Nees v. Esenbeck, Robert Brown's Vermischte botanische Schriften, Bd. II (1826) p. 607 seq., — desgl. Isis, (1823) Bd. II, p, 1365 seq.—Die Tafel 15 in Rob. Brown ist gefarbt, die tibrigen sind ungefarbt.

Brown, Rob. 2. Note sur la fleur femelle et le fruit du *Rafflesia* avec des observations sur ses affinités et la structure de l'*Hydnora*. Ann. des sc. nat. Bot. Sér. 2, Vol. 2 (1834) p. 369.

Brown Rob. 3. Description of the female flower and fruit of *Rafflesia arnoldi* with remarks on its affinities and an illustration of the structure of *Hydnora africana* Transactions of the Linn. Society, Vol. 19. (1845) p. 221 seq.

Uebersetzung davon Flora, N. Reihe, Jahrg. 7, (1848) p. 529.

Brown, William H. The relation of *Rafflesia manillana* to its host, in Philipp. Journ. Science VII. (1912). 209-226. t. 12-21.
Chodat et Bernard, Ch. Sur le sac embryonaire d'*Helosis guyanensis*. Journal de Botanique. Vol. 14 (1900).
Endlicher, Gen. Pl. (1836) 75.
Engler und Prantl, Natüliche Pflanzenfamilien III. Abt. 1. (1889) 274 — 282. Mit 10 Textfiguren. — id , Nachtrage IL (1900) 19. — id., Nachtrage III. (1908) 100 — 101. — id., Nachtrage IV. (1914) 78-80. Mit 1 Textfigur.
Endriss, Monographie von *Pilostyles* ingae (Karsten) (*Pilotyles ulei* Solm-Laub.) in Flora XCI (1902) 208-236.
Ernst, A und Schmid, Ed. 1. Embryosackentwicklung und Befruchtung bei *Rafflesia patma* Bl. Berichte deutsch. botan. Gesellsch. Bd. 27. (1909) 176-186 Taf. VIII.
Obwohl in der vegetativen Sphare bei *Rafflesia* die greeste Reduktion statt gefunden hat, verlufen dort nach Ernst und Schmid 2) sowohl die Tetradenteilung, Embryoentwicklung und Befruchtung ohne besondere Abweichungen von dein bei autotrophen Angiospermen tiblichen Verhalten.
Ernst, A. und Schmid, Ed. 2 Über Blüte und Frucht von *Rafflesia*. Morphologisch-biologische Beobachtungen und entwicklungsgeschichtlich-zytologische Untersuchungen (in. Annales Jard. bot. Buitenzorg. 2e serie. Vol. XII 1e partie (1913) p. 1 – 50
Sehr wichtige Publikation mit zahlreichen, grundlegenden neuen entwicklungsgeschichtlich-cytologischen und biologischen Beobachtungen und anatomischen und cytologischen Abbildungen fiber *Brugmansia zippelii*, *Rafflesia patma* und *R. hasseltii*. — Bisweilen von mir abgekrzt zitiert als Ernst 2).
Fawcett, W. 1. On new species of Balanophora and Thonningia with a note on *Brugmansia* lowi Beccari. Transact. Linn. Soc. Ser. 2., Bot. Vol. II p. 244 — 245 (1886). Tab. 36. Fig. 12.
Abbildung u. kurze Beschreibung einer als *Br. lowi* bestimmten Pflanze v. Sumatra.
Goebel, K. Organographie der Pflanzen. Jena. (1898-1901).
Griffith, W. 1. On the Root-Parasites referred bij Authors to Rhizantheae; and on various plants related to them. Transactions Linnean Society, Vol. 19, (1845) p. 303 seq. (*Sapria*).
Griffith, 2. *Sapria* in Proceed. Linn. Soc. I. (1844) 216.
Haak, J. 1. Iets over het eiland Noesa Kambangan en de *Rafflesia patma* Bl. Weekblad voor Pharmacie, Jaarg. 3. (1885).
Haak, J. 2. Observations sur les *Rafflesia*s. *Rafflesia patma* Bl. v. Dorp & Co. Semarang, Scheltema & Holkema Amsterdam. (1889). Pl. 1-4.
Wichtig. Mit zahlreichen, teils anatomischen Abbildungen und biologischen Beobachtungen liber *Raff. patma*.
Hayata in Bot. Mag. Tokyo XXIIi. (1909) 326; 1.c. XXV. (1911) 252 — 257 t. 7. (onder Familie Mitrastemonaceae; 1. c. XXVI. (1912) 112.
Hayata, in Engler Bot. Jahrb. LI. (1913) 164-176 tab. 1. (onder Tribus Mitrastemoneae).
Heinricher, Beiträge zur Kenntniss der Rafflesiaceae I., in Denkschr. Kais. Akad Wissensch., Wien, Math. Naturw. Klasse LXXVIII. (1905) 57-81. Tab. 1-3.
Wichtig. Erste Abbildung und Beschreibung von Frucht und Samen und von auf der Narbe gekeimten Pollenkrnern von *Brugmansia zippelii*, sowie biologische Beobachtungen von Heinricher und Bartels liber *Brugmansia* vom Pangerango-Hang,
Heijne, Nutt. Planten Ned. India II (1916) 96-97. (Gebruik, groeiplaatsen en inlandsche namen van *Rafflesia patma*).
Hieronymus, G. 1. Ueber *Rafflesia schadenbergiana* Göpp. Breslau (1885) Tafel schwarz.
Hieronymus 1 b. Kurze Notiz liber denselben Gegenstand vom Autor mit col. Tafel Gartenflora, 33 Jahrg. (1885) p. seq.
Hooker 1, Flora Brit. India. Vol V 1890) 71.
Hooker 2, in DC., Prodr. XVII (1873) 106 (onder Cytinaceae).

Hosseus, *Richthofenia* in Engler Bot. Jahrb. XLI (1907) 55— 61. Tab. 1-2.
Jack, W. 1. Description of Malaian plants, No. III, Malayan Miscellany, Appendix. Bencoolen (1827).
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Zwei von den Tafeln sind schwarz; sie tragen die Nummers IV und VI. Es sind genau dieselben, die ohne Nummern dem Mémoire vom Jahr 1853 beigegeben sind.
Dazu kommen aber hier vier andere farbige Tafeln, I, II, III, V. Der Text is wesentlich der des Mémoire, nur unter Hinzufiigung von Familien- und Genusdiagnosen und der Erklarung der neu hinzugekommenen Tafeln.
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Taf. II: Zwei offene Blüthen der *R. rochussenii* hier mit dem Stern auf der Scheibe, gezeichnet von van Aken.
Taf. III: Analysen floris masculi, alle von van Aken in Java gezeichnet.
Taf. V: Offene Blume der *Rafflesia patma*, nach einer Original-zeichnung van Aken's, die im Rijksherbarium verwahrt wird. Eine zweite ganz Minliche, die dort liegt, ist niemals publiciert worden.
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1. *Rafflesia* R. Brown.

Description of the sexual characteristics.

"Fleshy, parasitic plants, consisting of a single flower, seated on a cup-like proliferation of the tissue of the host plant, surrounded by scales at the base, and a tissue of thin, multi-branched filaments formed from one or a few rows of cells, which in the bark, and sometimes also in the other tissues of the stems of the host plant, proliferate over great distances, penetrating the layer of wood with perpendicular branches; from these branches form dense clumps of parenchyma-like tissue, from which the flower develops." Flowers dioecious, rarely polygamous. (In the Botan. Museum in Buitenzorg there is a spiritus specimen of an ex hermaphroditic flower of *Rafflesia hasseltii* Suringar. According to Haak 1) *Raff. patma* is probably polygamous). Perianth tube fleshy, semispherical at the base, disc-shaped in the male flowers, fused with the ovary in the female, widely bell-shaped above the ovary; flange [brim, skirt] 5 parts; segments in a row overlapping in an overlapping manner, broad, intact, spreading or curved back, connected at the base to a cap-shaped, fleshy, pierced in the middle, largely covering the corolla. (for other writers, including Solms-Laubach, the corolla is always called diaphragm). Central column short, broad, thick-fleshy, surrounded by a single or double ring, broadened at the apex into a disc, the surface of which often bears cone-shaped projections or warts. (These projections were formerly taken for stigmas; hence the statement by Bentham and Hooker about the numerous stigmas in the *Rafflesia*. (Ernst und Schmid 2) express the suspicion that these projections may have actually served to guide the germinated pollen tubes in the past, before the lower margin of the discus columnae was differentiated as a stigma). In the male flowers the column is contracted under the disc, and below the rim a single row of globular, sessile, polylodiculate *) anthers is found, concealed in cavities; projections, if they occur, smooth. In the female flowers the column is as in the male, but the projections are rough and warty; a stigma surface is below the annular protruding rim, and the anthers are either imperfect or absent. Ovary inferior, divided into a number of compartments by numerous, strongly branched and wound back and forth; ovules very numerous, covering the placentas on all sides and intermixed with their ramifications, anatropic, with long funiculi strongly curved beyond the center. Fruit a fleshy, juicy berry, surrounded by the scales and crowned by the persistent central column. Seeds very numerous, small, not much wider than the funiculus, elongated at the apex, curved back; seed coat maroon, crusty, with depressed markings; embryo white consisting of one layer of cells; embryo small. (After Boerlage, modified from Ernst und Schmid).

Number of species 12 on various species of Vitaceae-Cissoideae in Java, Sumatra, Borneo and the Philippines parasitic of these 10 species in Netherland Indies. According to Solms-Laubach 7) there might be a species of *Rafflesia* on Bali, but further information about this seems to be lacking even now.

Geographical summary of Netherland Indies *Rafflesia* species.

When I started (Sept. 1917) with the compilation of this overview of the Netherland Indies, the following six *Rafflesia* species are known:

1. *R. arnoldi* Rob. Brown.—Sumatra.
2. *R. patma* Bl. (*R. horsfieldi* Rob. Brown). —Java.
3. *R. rochusenii* Teijsm. et Binn.—Java.
4. *R. tuan-mudae* Becc.—Borneo.
5. *R. hasseltii* Sur.—Sumatra.
6. *R. cantleyi* Solms.— Uncertain whether from Sumatra or from Malacca.

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*) According to Ernst und Schmid 2) the anthers of *Rafflesia patma* do not open, as hitherto believed, with a single terminal pore, but the anther sacs all open separately into the terminal dimple (Grabehen) of the apex of the anthers. According to the researchers mentioned, the pollen of *Rafflesia* does not disperse (dry), but emerges enveloped in mucus.

By my investigations After Sept 1917 of the alcohol material of the Rafflesiaceae of the Buitenzorgsche Herbarium and Museum for Systematic Botany, this number was increased with new species as follows:

7. *R. zollingeriana* Kds.— East Java. This characteristic species was so far mistaken for *R. patma* (also by me) but has been kept.
8. *R. witkampi* Kds.— N. E. Borneo.
9. *R. borneensis* Kds.—N.E. Borneo.
10. *R. ciliata* Kds. —N.E. Borneo.

The number of *Rafflesia* species from Netherland Indies as a result of the survey I conducted in Buitenzorg in 1917, the Netherland Indies has risen from six to ten.

Meanwhile, I have no doubt that further botanical research of Netherland Indies — as Solms-Laubach has already supposed — the number of species of this genus and also of other Rafflesiaceae will increase considerably. Because through further research it appears more and more that the species of this family almost all have a much more limited geographical distribution than was previously assumed, for example for R. *patma* and *R arnoldi* (on the basis of identifications that turned out to be incorrect).

Identification table of all *Rafflesia* species including those outside Netherland Indies.
(Partly *) from Solms-Laubach).

A. Central column, widened at the apex into a disc, the surface of which bears numerous conical protuberances resembling styles, at least one of which (protrusion) is longer than 1 centimeter.

a. Central column surrounded at the base by a clear double vaulted ring.

aa. The outer ring of all flowers is about the same width (maximum 1 cm) as the inner ring.

I. Perianth tube lined inside with closely spaced, filamentous, partly ± 3-15 mm. long bristles, partly swollen at the apex. Flower ⅔ meter to over 1 meter in diameter.— Sumatra. **1. *R. arnoldi*.**

II. Perianth tube inside without club-shaped thickened ramenta at the top or covered with small tubercles.

* Disc provided with a clear, rather thick (4 mm. wide and 1-2 mm. high) ring on the outside. Antheral rudiments ± 20. Perianth tube flat-saucer-shaped, on the inside with not densely spaced, very small (½ mm.) and scattered tubercles, very short, at most ¾ mm. high, windows covered. N.E. Borneo (Koetei). **2. *R. borneensis* Kds**.

** Not with all these features.

Δ Perianth tube cup-shaped, partly glabrous on the inside, partly covered with non-densely spaced small nodules (½ mm.). Anther rudiments ± 30 —38. Flower ⅓ - ½ m. diameter. Java. **3. *R. patma* Bl.**

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*) The latest identification table of *Rafflesia* species, published by Solms-Laubach in his monograph, was already 16 years old when I compiled this overview in Sept 1917. It does not yet include the following fivelater discovered species: *Rafflesia cantleyi* Solms, *R. borneensis* Kds., *R. witkampi* Kds., *R. ciliata* Kds, *R. zollingeriana* Kds.

ΔΔ Perianth tube shallow-dish-shaped on the inside covered with closely spaced ½ - ⅔ cm. long, at the apex simple or branched, not thickened ramenta.

✢ The outside of the annulus exterior and the inside of the annulus interion are each provided with an upright membranous, wing-shaped serrate or serrated edge. The rampart between the anther cavities of the anther rudiments glabrous, rather broad, softly arched and unlashed. N. E. Borneo. **4. *R. witkampi***

✢✢ The annulus exterior and annulus interior both do not have a winged edge. Wal between the anther cavities very narrow, and sharp and provided with thick, erect lashes. N. E. Borneo. **5. *R. ciliata* Kds**.

bb. The outer ring of the male flower is very wide (2½ cm) and much wider than the inner ring. Flowers ⅔ m. in diameter. Borneo (Sarawak). **6. *R. tuan-mudae***.

b. Central column at the base surrounded only by a single, clearly vaulted ring. The outer ring is represented by a flat, ± smooth, annular strip.

aa. Inner side of the perianth tube (also near the insertion of the perianth) densely covered with closely spaced, small, at most 1½ millimeter, (usually only ½-1 millimeter) high thorny tubercles (rudimentary bristles). Flower diameter 15-30 cm. East Java. **7. *R. zollingerinana***.

bb. Inner surface of the perianth tube near the insertion of the perianth densely covered with filiform, club-shaped, or hat-like appendages (ramenta), some of which are at least 1 cm long.

* Petals on the inside ± smooth, without large warts. Perianth tube inner side covered with hat fungus-shaped (above 5-8 mm wide) appendages (ramenta).Malacca (?) or Sumatra (?) **8. *R. cantleyi***.

** Petals on the inside with round or elongated, whether or not confluent, with large warts (spots).

✢ The inside of the perianth tube is densely covered with hat fungus-shaped ramenta. Flower diameter less than ½ meter (Flower "minor" Solms). Philippines **9. *R. manillana***.

✢✢ Inner side of the perianth tube) covered with ramenta, which are broadened at their apex in a club-shaped (not hat-fungus-shaped). Perianth lobes on the inside covered with large, partly confluent wart spots.

Δ Inner diaphragm from the foot to near the upper edge with broad, flat, obliquely truncated, warty spots. Flower diameter ⅔ meter. Middle Sumatra **10. R. *hasseltii***.

ΔΔ Inner diaphragm covered at the foot to near the edge with ramenta, which are broadened in a club-shaped manner at their top.— Philippines. **11. *R. schadenbergiana***.

B. Central column, widened at the apex into a disc, the surface of which is not covered with numerous sturdy protuberances, some more than 1 centimeter long. Flower 14-30 cm. midline. Protrusions either completely absent or at most ¾ cm long. — West Java. **12. R. rochussenii**.

Key to known species of *Rafflesia*.
(Contrary to Solms-Laubach).

A. Disc column covered with numerous styliform processes.
a. Annulus raised around the base of the column, paired, ± convex, distinct.
aa. Outer annulus raised, subequal to the inner one.
I. Interior of perigone tube densely covered with long, thickened at the tip, simple or branched ramenta, ca. 3-15 mm. Antheriferous fossae tripartite with bipartite secondary keels. Anthers basifixed. Flower ⅔ –1¼ m diam. Sumatra (southern). **1. *R. arnoldi* Rob. Brown**.
II. Interior of perigone tube ramenta with apices not thickened, or densely or loosely covered with small warts.
* Column disc with a distinct thickened outer ring, ca. 4 mm. wide and raised 1-2 mm. Periogone tube flattened-patelliform, covered inside with small warts (barely ½ mm.), with a few scattered and branched very short (barely mm. high) ramenta. Anther rudiments ca. 20. Borneo (Koetei = Kutai, East Kalimantan, Indonesia). **2. *R. borneensis* Kds**.
** Column disc lacking a thick outer ring.
Δ Perigone tube sub-deeply cupular, mostly glabrous inside, covered inside with scattered small warts (barely ½ mm. high and wide). Anther rudiments ca. 30-38. Flower ⅓–½ m. diameter. West Java (western and southern) **3. *R. patma* Bl.**
ΔΔ Perigone tube not deep, patelliform, inside densely covered with ramenta, branched, c. ½–⅔ cm. long, filiform, simple or branched, pointed or blunt apex (not thickened at the apex).
✢Annulae at the base of the female column winged (crenate or serrated, wing c. 5 mm. high). Column of female flower furrowed parallel to the sides, crested, glabrous subconvex, (rarely ciliated). N. O. Borneo. **4. *R. witkampi* Kds.**
✢✢ Annulae at the base of the male column raised high. Male flower column provided on the sides with antheriferous pits, separated by a sharp ciliated crest. **5. *R. ciliata* Kds.**
bb. Outer annulus of male flower raised, the broadest convex part is much wider than the inner one. Flower ⅔ m. diameter Borneo (Sarawak). **6. *R. tuan-mudae* Beccari**.
b. Annulus (inner) raised at the base of the column. The outer ring flat (barely elevated), inconspicuous or completely absent.
aa. Perigone tube interior densely covered with, short or very short ramenta, branches hardly up to 1½ mm. (mostly approx. ½-1 mm.). Flower 15-30 cm. diameter. — Eastern Java. **7. *R. zollingeriana* Kds.**
bb. Perigone tube densely covered with long (1 cm. ex.) ramenta, branched at the apex, or fungiform-flattened.
* Perigone lobes smooth inside, covered with verrucose spots. Perigone tube covered inside with fungiform-flattened ramenta (tip 5-8 mm. wide). — Species imperfectly known. — Malacca (?) or Sumatra (?) **8. *R. cantleyi* Solms**.
** Perigone lobes sometimes covered with anastomosing spots of warts.
✢ Perigone tube very densely covered inside with fungiform-flattened ramenta. The flower barely ½ m. diameter (see Solms: "Flos minor"). Philippine Islands. **9. *R. manillana* Teschem**.
✢✢ Perigone tube interior ramenta apices branched (rarely fungiform-flattened). Perigone lobes covered inside with large or very wide verrucous spots, sometimes anastomosing.

Δ Diagragm interior (from the base almost to the apex) covered with broad spots, little or hardly raised, verrucose, on the outside covered with few, hemispherical large warts. Flowers ⅔ m. diam.—Southern Sumatra.
10. *R. hasseltii* Suring

ΔΔ Diagragm interior (from the base almost to the apex) covered with apically branched ramenta. Flower ⅔– ⅘ m. diam. Philippine Islands.
11. *R. schadenbergiana* Goepp.

B. Disk column is subplanar, without styliform processes or rarely with few and small, barely 7 mm long processes. Perigone tube interior covered with long, thin ramenta with slightly expanded tips. Flower 14-30 cm. diameter - West Java (G. Salak). **12. *R. rochussenii*. Teijsm. et Binn.**

Description of the species of the genus *Rafflesia*.

1. *Rafflesia arnoldi* Rob. Brown.

"Perigone lobes covered with numerous small warts. Tube covered with dense, often bifurcated ramenta that are swollen at the tip. Underside of the diaphragm bearing several rows of flat, wide warts [Warzenböcker]. At the base of the column there are two strongly developed annuli, the inner one, directed upwards, falling off steeply on both sides, while the outer one is just as sharply defined towards the inside, and runs more gradually towards the outside. This outer ring is radially grooved, only a little wider than the grainy, rough inner one. The disc has a steeply notched edge that falls vertically on the outside and with numerous, long, style-shaped processes. Anthers of the ♂ flower, with the aperature directed towards the column, situated in the upper angle of the deep anther fossae, which run about halfway down the column; these divided into three divisions by two secondary keels. Lateral surface of the column below the anther fossae glabrous, granularly rough, above and at most irregularly undulate. Stigma ring of the ♀ flower clearly bordered outwards; showing the tiny anther rudiments in small indentations on its inner edge. The lateral surface of the column is covered with numerous, narrow, parallel, granular, rough, hairless ridges running down to the internal annulus, several of which come to each of the wide, flat, hardly noticeable anther fossae, while the intermediate ridges are formed only by a few, ca. 3, "something more protruding, are similarly formed" (Solms-Laubach 7). False fruit [pseudocarp] truncated, conical-spherical, ± 13 cm wide and 12 cm high. Seeds 1 mm long and ½ mm. wide, 2 "buttoned" [knöpfig].

From Koorders 44055β (received on Nov. 1917 from Mr. T. Ottolander and Slot from Subanajam-Benkulen) the following was noted by me:

Male flower buds 13 cm wide and 9 cm high already had strongly developed anthers; the interior of the same, however, was still very young and was in the tetrad division. Open male flower quite asymmetrical; the wilting has evidently already started and the perianth lobes are bent outwards and partly also sideways; the flower diameter is about 55 x 45 cm according to the colored drawing made by Mr. Bakker on the original location in the forest, and according to an estimate the flower diameter before the flowering started was about ⅔ × ½ meter. Perigone lobes unequal in size, ± 18–22 cm long and 18–26 cm wide. Diaphragm height 23 cm. Ramenta of the inside of the perigone tube (most of the ramenta have broken off during transport) ¾-1 cm long, filiform, partially swollen at the tip, the upper ones are often divided into forks and fused together in tufts. Column disk 19 cm wide at the top. Overlapping edge of disk 2 cm wide. Column from base to apex of processus 6 cm high. Processes (style-like outgrowths of the column disk) 2-2¼ cm long, numerous. Warts (= spots) on the inside of the diaphragm near the upper edge ½–1 cm diameter, not merging into larger patches. Warty spots on the inside of the perigone lobes ¾–1 cm in diameter, also not merging into larger spots. Anthers ⅔ cm diam. Liana stem on which the flower sits ± 2 cm in diameter.

Note. Variety description copied from Solms and supplemented by me from alcohol material (male flower and flower bud) from Herb. Koorders 44055β, which I received (early November 1917) through the benevolent intervention of Mr. T. Ottolander and B. E. M. Slot from the woods situated on the north-western slope of the Kabah, south of the main road from Benkoelen-Kapahiang to Muarabliti and about southwest of the administrator's house of the Soebanajam cultural enterprise and further supplemented to the natural size in colors by Mr. P. Bakker, who was then an employee of Soebanajam, on the original place of growth, in the woods in the natural size, by me as a gift (through the benevolent intervention of Heer T. Ottolander) received the drawing later as Herb. Koorders n. 44055 β alcohol-preserved male open flower about ⅔ meter in diameter.

My anatomical examination of a perigone lobe and the perigone tube of Koorders n. 44055β revealed the following: The mesophyll of the perigone lobes is built after the usual type of the fleshy petals of the angiosperms and consists of a thick, fleshy, rather loose, intercellularly permeated tissue, which spreads fairly uniformly between the epidermis of the upper and lower surfaces and in which the vascular bundles run.

The height of the warts on the upper side of the perigone lobe is ⅔–1½ mm. The surface of these warts, as well as the rest of the surface of the upper surface of the perigone lobe, is covered with fairly evenly dense, elongate papillae, which are ± 100 µ long and 50 µ wide, and which have a thin, smooth, brownish membrane and rich protoplasm with each have a distinct cell nucleus. These papillae rest on a parenchymal tissue composed of several rows of globular, thin-walled, hyaline cells. Below this tissue is a layer of tissue about 1 millimeter thick, which is composed of several flattened, thin-walled, hyaline cells rich in protoplasm (probably as a result of the loss of water through preservation in alcohol).

The remaining part of the mesophyll below it consists of a fleshy, rather loose tissue about ¾ cm thick, interspersed with intercellulars, in which the vascular bundles run. The cells of this tissue are globular or polygonal, thin-walled, and colorless; they each have a very large (40 × 30 µ) ellipsoidal cell nucleus. The vascular bundles contain several ring tracheids. The epidermis of the perigone lobe underside consists of brown-walled, relatively small cells without papillae.

Literature. Rob. Brown in Trans. Linn. Soc. XIII. (1821) 201 (male flower); Rob. Brown in Trans. Linn. Soc. XIX. (1845) 221. tab. 22-26 (female flower, fruit and seed); Gardeners Chionicle New Series I (1874) 91; Miquel, Choix de plantes rares ou nouv. (1864) tab. 1 (colored plate of flower and flower bud in natural size with leaf sprig of the host vine); Solms-Laubach in Ann. Jard. Buitenzorg IX (1891) 237 tab. 27, 28 (description and detailed image); Solms-Laubach in Engl er, Pflanzenreich IV. 75 (1901). 9. Fig. 4. *A, B a, β*; Solms-Laubach in Ann. Jard. Buitenzorg IX. (1891) tab. 28. Fig. 1. (photographic reproduction the oldest image from the British Museum) en Fig. *2* (photographic reproduction of open flower sitting on liana); Teijsmann. Nadere bijdrage over de kennis der voortteling van *Rafflesia arnoldi* in's Lands Plantentuin te Buitenzorg in Natuurk. Tijdschr. Ned. Indië XII. (1865) p. 277-281; Warburg, Pflanzenwelt I. (1913) 524; *Rafflesia Titan* Jack., Descr. Malay Plants III. (1822) 1, (reprinted in Hooker Comp. botan. Mag. I. (1835) 259.

Synonyms. The identity of *Rafflesia titan* Jack van Benkoelen, presumably published in 1822 without a date, with *Rafflesia arnoldi* van Benkoelen has been suggested by Solms-Laubach and previously convincingly proven by the late Prof. Dr. Suringar. The two species had already been united by Robert Brown in his second treatise of 1845. Jack, who died on his return journey to Europe in 1822, was doubtless unfamiliar with Robert Brown's publication of *Rafflesia arnoldi* when he wrote the description of his *Rafflesia titan* in Sumatra., which was published in London in 1822.

Flower size. — Both Hieronymus and Solms state that *Rafflesia schadenbergiana* Goeppert, which occurs in the Philippines, is surpassed in maximum flower size only by *R.arnoldii.* From a scientific point of view, this particularity is irrelevant. Nevertheless, it must therefore be mentioned here, because it confirms what has already been stated by numerous writers, among others, that *Rafflesia arnoldi* is indeed "the largest flower in the world". Specimens of *R. schadenbergiana* are larger (namely 80 cm in diameter) than medium-sized flowers of the Sumatran *R. arnoldi*, which often appear to be 2/3 meters and sometimes only more than a meter in diameter, but that, according to Jack and other writers, for large-flowered specimens the maximum diameter of flowers of *R. arnoldi* is about one meter (three feet), while according to some reports not yet documented by research material, the maximum flower diameter of *Rafflesia arnoldi* sometimes even exceeds one meter.

The natural size flower of *R. arnoldi* depicted by Miquel is 54 centimeters in diameter, while the flower I received from T. Ottolander (Herb. Koorders n. 44055 β) was 55 × 45 cm in diameter and before wilting was about ⅔ × ½ meter.

In his work Pflanzenwelt I (1913) 524, Warburg also states the following: "The Sumatran giant flower, *Rafflesia arnoldi*, is particularly famous because it is the largest flower in the world. In the bud state it resembles large heads of cabbage of 15-18 cm. diameter when open, it measures 1 meter in diameter; it has 5 cm thick, protruding, brick-red and lighter mottled petals that later curl up. The weight of this flower is no less than 10-15 pounds."— (Warburg p. 524)

In connection with the close relationship of *R. patma* with *R. arnoldi*, Solms (1. c. p. 203) rightly assumes, in my opinion, that such considerable differences in flower size will also occur in the latter species, as have already been observed for *Rafflesia patma* by Blume et al. As far as is known, these figures of the flower diameter for *R. arnoldi* lie between a meter and more than 1 meter, while the average size of this species is ⅔ m.

Flower color. About the color of the flower of *Rafflesia arnoldi*, Solms-Laubach quotes in Ann. Outz. IX. 204 includes the following from Jack, Description of Malayan Plants No. Malayan Miscellany, Appendix. Benkoelen, 1822. (This rare publication has been reprinted in Hooker, Companion to the botanical magazine I. (1835)259): "The bud before expansion is of a deep darky red. The inside of the cup is of an intense purple and more or less densely villous, with soft flexible spines of the same color towards the mouth (so not blue, as is the case with Robert Brown in the picture); it is marked with numerous depressed spots of the purest white, contrasting strongly with the purple of the surrounding substance, which is considerably elevated on their lower side. The petals are brick-red with numerous pustular spots of a lighter color" (according to Jack l.c.). However, this "brick-red" was undoubtedly more "Terra di Siena". One concludes (Solms [1] p. 205) from color of the original colored drawing of Dr. Arnold and Raffles, that the color, in the published plate of Robert Brown's treatise of 1822, appears to have been considerably altered.

In response to some contradictory statements on the colors of *Rafflesia arnoldi*, the following, in my opinion, very correct remarks of the late Prof. Suringar (in Veth, Central Sumatra 1884 p. 27 and 28) deserve to be quoted here: "However, it is difficult, without further observations, to assign a value as a characteristic to this color difference, since it is very well possible that these targets are white at first and only acquire a red color when the flower fades further. Considering that this picture was made after the drawing of Dr. Arnold, and that this, as we have seen above, was begun by him following a damaged object, hence partly from memory, and finished by others after his death, it is clear that this difference cannot be valued." (According to Suringar 1. c. 27 and 28).

Flower color according to Miquel's image. Miquel 4) published a colored image in 1864, which was probably made from nature in Buitenzorg under the supervision of Teijsmann and Binnendijk. I derive the following color statement from that image: Ground color of the inside of the perianths and of the outside of the diaphragm very pale brown with very numerous, rather

small, non-merging pure white warts (spots). The base of the column is dark brown. The upper surface of the disc and the styliform processes are very pale brownish.

The major difference in the above color specifications after Miquel and the following color specifications by Westenenk can, in my opinion, be explained by assuming that the flower described by Resident Westenenk had discolored dark brown due to the cutting of the flower and the transport from the forest, while the much lighter ground color of the image published by Miquel relates to a newly opened, not yet discolored flower.

Flower colors as stated by Resident Westenenk. The numbers 1), 2), 3), 4) and 5) below correspond to the flower detail numbers (these are not color numbers), which were noted by me on a letter dated 14 Aug. 1917 color statement given to me (unpublished, preserved in the archives of the Ned.-Ind. Vereen.) calque of the *Rafflesia* plate 2, which I have now published uncolored. The following also shows the further meaning of the above flower detail numbers 1), 2), 3), 4) and 5)..

The color numbers 8, 13, 20 and 27 mentioned below correspond to the colors thus defined by a “color number” in the Saccardo publication cited below.

The authentic color specifications of Westenenk have been quoted by me below in quotation marks. I am solely responsible for all explanatory notes *not* enclosed in quotation marks.

1). “Underground outer leaves” (Westenenk). Here follows in the statement of van den Heer W. a sample from a color sample card, which is slightly darker than the color, which I have the color number 20 in the color table of Saccardo's Chromotaxia seu Nomenclator colorum and find it described as “badius” or “kastanienbraun”, so chestnut brown from the color of the seeds of the false chestnut or horse chestnut (*Aesculus hypocastanum*). Mr. Westenenk adds: “no lighter.” So apparently in this case very dark maroon.

2). "Warts on the outer leaves" (Westenenk). Here follows in the statement of Mr. Westenenk a color sample, which I find indicated in the mentioned color table of Saccardo by color 27 and described as “cremeus” or “Sahnefarbig”, so cream-colored, yellow-white.

3). “Subsoil pistil yellowish white, the dark points tapering to brown” (Westenenk.) Here follows in the statement of Mr. Westenenk at yellow white an arrow to his color sample which I have already indicated above as color 27 of Saccardo's Chromotaxia, so “cream-colored” or yellow white. According to the number 3 on the calque of Plate 2, Mr. Westenenk means by “subsoil pistil” the wide disc upper surface of the so-called columna or column, while by the words “the dark points tapering to brown”, I suspect, the style-like projections (processes) are meant, which occur in large numbers on the upper surface of the columna or column in *Rafflesia arnoldi* and in most other *Rafflesia* species and which are visible in the photo reproduction of plate 2, but very faint and unclear.

4). “Carmine” (Westenenk). Bierbij has not included a color sample or further description by Mr Westenenk in his statement. In Saccardo's color table I find "carminium" listed as color 13 with the description "purpureus" or crimson or blood-colored.

5). “Edge pistil, slightly lighter than”. Here follows in the statement of Mr. Westenenk a sample from a color sample card, which is slightly darker than and therefore in reality corresponds well with the color, which in the color table of Saccardo's Chromotaxia bears the color number 8 and is described therein as “isabellinus” or “isabelfarbig” or “blassledерfarbig”, so isabel-colored or pale leather-colored.

In response to my request to indicate the living colors on a copy of the photo (plate 2), Resident Westenenk wrote to me in his letter of 14 Aug. 1917 the following: “It was important to read the colors of the *Rafflesia* once again on a living specimen; and as I don't have a good color box here, I am giving you cutouts from a color chart, which show the colors well, so that you will want to have the color applied to the picture yourself.”

In the meantime, due to the time circumstances, there appeared to be so many objections to having the colors applied to the photo reproduction that this had to be abandoned, mainly because of the costs and difficulties. However, I have tried to make up for the lack of colors as

much as possible by means of the color explanations given above and by references to Saccardo's color table publication, which is available in all major natural science libraries. The reason why I have discussed the colors of the *Rafflesia* so extensively is that in the literature of this genus and especially about the *Rafflesia arnoldi*; contradictory information still exists, which even today still necessitates new local research. The now reproduced observations of Resident Westenenk about the colors of the living flower are therefore of great value, especially because he gave me the opportunity, through the enclosed color samples, to determine those colors by means of international color numbers with the help of Saccardo's publication.

I would like to express my gratitude to Resident Westenenk for his careful color assignments and for his photo gift (after which the Ned. Ind. Vereeniging tot Natuurbescherming in Leiden had a picture postcard made at the Eerste Nederl. Rotographure Maatschappij).

Flower colors according to a picture made under the supervision of T. Ottolander. The reader will find some further details on the natural size at the original place of growth, in the woods, on p. 33–34 above about the image referred to here in colors, at the beginning of October 1917 by Mr. Bakker, employee of the cultural enterprise Subanajam in Sumatra, under the supervision of Mr T. Ottolander. I wish to refrain here from a further specification of the colors of the flower parts, since a colored reproduction of the aforementioned flower image, in natural size, will soon be published in a publication readily available to everyone, namely published in the Natuurmonumenten-Medeelingen by the Netherland Indies Nature Conservation Association.

It should only be mentioned here that in general the colors of this beautiful, colored image, received by me from Herr T. Ottolander at the beginning of November 1917, correspond to the above p. 37-39 specified color specification by Resident Westenenk, but differ, among other things, from the manufactured colored image published by Miquel in 1864.

The similarity referred to, among other things with regard to the brown “ground color”of the inside of the perianth flaps, can, in my opinion, be easily explained by the fact that both the flower described by Mr. pictured flower, both had been open a day or more when the colors were observed, while the sharply different pale pink “ground color” of these flower parts in the colored picture published by Miquel shows the colors immediately after the giant flower had opened. The differences are thus clarified in a very simple way by the relatively rapid brown discoloration, shortly after the opening of the *Rafflesia arnoldi* flower, something which was rightly assumed at the time by the late Professor Suringar (cf. p. 36 above).

Seed germination and culture trials. Miquel 4) stated the following about this in 1864: “It is known that it is still entirely unknown how the seeds of *Rafflesia* penetrate through the bark of the trunk, branches or roots of the *Cissus*, where they germinate down into the woody layer. But what nature produces in a way that is still mysterious, the indefatigable head gardener Mr. Teijsmann managed to achieve in an artificial way. In 1854 he had received from Mr. J. Blok, Resident of Bencoulen, a plant of *Cissus serrulata*, on the roots from which had developed several plants of *Rafflesia arnoldi*, of different sizes, but they all died with the mother plant soon after their arrival. Fortunately in one of these fully developed plants, ripe seeds were found which were inocula in the branches and roots of *Cissus scariosa* Bl. (with flattened stem) and *C. serrulata* (with cylindrical stem) these two species being, as well as others of the same genus, those on which Mr. Teijsmann had encountered the *Rafflesia patma* in Nousa-Kambangan. The inoculation was done very simply by a slight incision in the bark where the seed was placed and the opening of which was covered with a little earth and leaves. Long after the operation you could still not notice any changes, only the openings of the incisions were almost closed. Later, on examining these places again, it was evident that in several places and on different plants, both in the vicinity and at a greater or less distance from the incision, several young *Rafflesia* from the size of a pea to that of a chicken egg. Thus, for the first time, we had succeeded in cultivating a species of *Rafflesia*. “However, adds Mr. Teijsmann, we will have to wait, judging by the late growth of the plant (a year and a half after inoculation), for a long time before this

species has reached its full development. It is also a noteworthy fact that the germination of seeds does not take place just at the place of inoculation, but often above or below, and sometimes even at a considerable distance".

"According to this beautiful discovery by Mr. Teijsmann, it will be easy to inoculate the *Cissus*, planted in our greenhouses, with the seeds of *Rafflesia* that we could receive by post." (Miquel).

In connection with these interesting Teijsmann culture experiments I refer to what has been said above on p. 8 and 9 and to the following quote from Teijsmann's publication:

"This inoculation was done very simply by splitting open the bark of the thicker roots a little, and placing some seeds of *Rafflesia arnoldi* into the wound made, and then covering the whole with a little earth and leaves. For a long time after this operation nothing extraordinary was seen in the roots of the *Cissus*, except for the wound made, which, though nearly fused, is still visible today. Recently, however, reviewing that operation, it appeared very clear that in various places, both in the vicinity of the incision, and at a greater or lesser distance from it, several young *Rafflesia*s, from the size of a gray pea to that of a a hen's egg, had developed; so that we can now boast that we have also brought the *Rafflesia arnoldi* into culture. However, based on the slow growth since the inoculation, so far (1) more than a year and a half, we will have to wait at least another year until the plants are fully developed."

"This experiment is thus another step closer to the knowledge of this very important family of plants and its very complex growth habit."

"It has now been proven that this plant can be propagated by its seeds, but how this takes place in nature remains a mystery for now." (according to Teijsmann 1) p. 279).

"The time will also not be far removed when these plants can be cultivated in European gardens, provided they have been introduced only once, and strong *Cissus scariosa* is cultivated in stock, on which later inoculation can take place. These plants will have to be grown in large square or elongated containers, so that they can spread their roots or subterranean stems vigorously enough, which must serve as the basis of the *Rafflesia*s. The plants will also have to be transferred to Europe in the same way." (according to Teijsmann 1) 1856 p. 281).

About the species identification of the two *Rafflesia* photos published in accompanying plates 1 and 2. According to a letter I received from Resident Westenenk dated 14 Aug. 1917, the flowers, after which the said two beautiful *Rafflesia* photos were made in the residence Benkoelen by an "unknown German or Englishman", were not preserved at the time, but were both "thrown away" after photographing. It is true that this "throwing away" can be explained by the extraordinary difficulties, which are usually associated with the preservation of these giant flowers due to the lack of preservatives, but it is still very regrettable that the photographed flowers have not been preserved, because it is therefore not possible for me to determine with scientific certainty that we have *Rafflesia arnoldi* in front of us here on plates 1 and 2.

Fortunately, in my opinion, it can be concluded with a very high degree of probability that we are indeed dealing with the real *Rafflesia arnoldi* Rob. Brown, for the following reasons, among others:

a) from the region (Benkoelen) from which the flowers originate, no other such large-flowered *Rafflesia* is known except only *R. arnoldi*;

b) the shape and size of the warty spots of the inner side of the perianths differ sharply from *R. hasseltii* (which grows in Central Sumatra, but not in Benkoelen) and agrees well with *R. arnoldi*.

Geographical distribution: Outside Sumatra: unknown. The collected by Beccari in Borneo-Sarawak and described by him first as *Rafflesia tuan-mudae* Becc., but later by him a species united with *R. arnoldi*, according to a renewed examination of the authentic material initiated by Solms, is not identical with *R*: *arnoldi*, but a separate species, for which the original species

name *R. tuan-mudae* must be maintained. Therefore, Sarawak (Borneo) as a habitat for *R. arnoldi* from literature.

Also another, more recent bibliography, (on p. 6 of the Yearbook of the Department of Agriculture in Buitenzorg for the year 1907), which shows the occurrence of *Rafflesia arnoldi* for N. E. Borneo is, as I have now found through research of the authentic material preserved in Buitenzorg, also incorrect and is based on incorrect species identification of said material by the relevant herbarium chief. The aforementioned statement relates to a few preserved *Rafflesia* specimens collected in 1907 by the engineer H. Witkamp in N.E. Borneo and then donated to the Buitenzorg Herbarium, which, as I have now found, belong to two species, both of which belong to *R. arnoldi* differ sharply, and I'll list them below as *R. witkampi* and *R. borneensis*. Therefore, the statement about the occurrence of *R. arnoldi* in Borneo, published in 1907 by the above-mentioned herbarium chief, must also be deleted.

South Sumatra: Benkoelen: The first habitat where *Rafflesia arnoldi* was discovered is Poeloe Lebar (not Lebbar) on the river Manna or Muara Manna in the Benkoelen residence. There this species was introduced by Dr. Arnold in 1818 while traveling with Raffles. Later this species was found in the same residence (Benkoelen) by Jack in other localities and published as *Rafflesia* Titan Jack. The resident of Benkoelen L. C. Westenenk informs me by letter about the very first location, dated 14 Aug 1917, which reported the following: "The Raffles party found the giant flower somewhere between Loeboek Tapi and Poelau Lebar (p. 316 Memoir of the Life and public service of Sir Thomas St. Raffles); both places on the upper reaches of the Manna River (Loeboek Tapi is located 30 kilometers upstream from Manna, which is on the sea) at an altitude of ± 150 meters above sea level."

"In 1916 I saw a *Rafflesia* from that region, but it was considerably smaller than the Kabah flowers". (after Westenek).

According to Jack (quoted by Suringar) the flower buds of *Rafflesia arnoldi* would take three months to develop into full bloom and the flowers would show at the end of the rainy season.

Concerning a few habitats of *Rafflesia arnoldi* situated between about 500 and 1200 meters above sea level, which resides in the Benkoelen residence, at the suggestion of the Netherland Indies Association for Nature Conservation, which has been reserved as a natural monument by the Resident of Benkoelen, the reader will find information in the Natuurmonumenten-Mededeeling No. 2 in the correspondence printed therein and in what T. Ottolander himself says therein.

From the information provided to me by Mr. T. Ottolander (orally) and from the literature and from the data of the archives of the Netherland Indies I think I can draw the conclusion that *Rafflesia arnoldi* in the Benkoelen residence is mainly found at about 500-1200 meters sea level, but also occurs there below that level (e.g. at 150 m above sea level).

Central Sumatra: Solms-Laubach (in Annales Jard. Buitenzorg. Suppl. I (1897)16) mentions the following about *Rafflesia arnoldi*: "A second fruit of the same kind, also ripe, was brought by Beccari from Sumatra (Padangsche Bovenlanden, Kajoe ta-nam)". This shows that, according to Solms, *Rafflesia arnoldi* was found not only in South Sumatra, but also in Central Sumatra. However, this occurrence deserves to be tested against flowering material.

North Sumatra: The *Rafflesia* discovered and photographed by Mr. Baptist in Atjeh (Gajoelanden near Lokup), but not preserved, with "a flower of 70 centimeters in diameter and which used to be doubtfully regarded as *R. arnoldi* and under that generic name in the "official correspondence" (see below) is in my opinion probably not *Raff. arnoldi*, but a new species. However, there is no certainty about this yet. The photo of Mr. Baptist is reproduced below. The reports on the occurrence of *R. arnoldi* in North Sumatra (Atjeh) in the 1st and 2nd Annual Report of the Ned. Indisch Vereeniging tot Natuurbescherming (1912-1916) should, in my opinion, lapse, because the species observed there in 1914-1916 successively by Mr. Brewer and Baptist, were not preserved. The plants mentioned to me as *Rafflesia arnoldi*, according to flower photo and flower sketch drawing sent to me later by Mr. Baptist, are not identical with that

species, but in my opinion probably belong to two new Rafflesiaceae species, namely to *Sapria* (?) nova spec. and *Rafflesia* spec. nova. The penultimate species is, appearing in the Natuurmonumenten-Mededeeling No. 2 "official" correspondence, referred to by Mr. Baptist as "the little *Rafflesia* of the Djerneh river bank", while the latter *Rafflesia* is indicated therein as the "big one". So, as far as I have been able to ascertain, North Sumatra as a place of growth for *Rafflesia arnoldi* must for the time being be deleted from literature. Thus, with certainty only South Sumatra (Benkoelen) and with doubt Central Sumatra (Padangsche ilovenlanden near Kajoetanam) remain as habitats of *R. arnoldi*. In my opinion, even the last habitat statement requires further confirmation with flowering material, because the relevant Beccarian statement about the occurrence in Central Sumatra, as far as known, is based only on fruit-bearing material and because the species identification deserves confirmation; all the more so because the Beccarian habitat assignment for Central Sumatra is in my view perhaps also for the Central Sumatran *R. hasseltii*.

Host plant: Miquel 4) mentions *Cissus serrulata* Roxb. as the "original" host plant of *R. arnoldi* originating from Benkoelen which is now called *Tetrastigma serrulatum* (Roxb.) Planch. He also mentions that Teijsmann has succeeded in planting seeds of *R. arnoldi* to sow and develop on the stems of said species and of *Cissus scariosa* Bl., The latter liana species is now called *Tetrastigma coriaceam* (DC.) Gagnepain.

A few leaf twigs without flowers and fruits collected by T. Ottolander at the Benkoelen residence in 1914 from an "original" host plant, on which flower buds appeared from *Rafflesia arnoldi* was provisionally determined by me as a *Tetrastigma* (?) vel *Cayratia* (?) spec. indet. The herbarium material of the latter host plant with a flower bud of *R. arnoldi* was obtained as a gift by Mr. T. Ottolander (in 1914) through Mr. van Alderwerelt van Rosenburg, then curator at the Herbarium for Syst. Botany in Buitenzorg.

Further information on *Rafflesia arnoldi*'s hosts, including complete herbarium material, is highly desirable.

Native names: very doubtful. These most likely include the following names occurring in the literature: Kruboet, Amboen-ambon and Pelimoen skoedi or "Devil's sirih box."

According to an oral communication from Mr. T. Ottolander, his guides who accompanied him when he found *Rafflesia arnoldi* in the Benkoelen residence, gave it the name Djamoer, Malay. This name in the Netherland Indies generally referred to all sorts of large and small fungi (mushrooms). This deviating native name for a flower-bearing plant was presumably given to it by the native guides because of the superficial resemblance of the gigantic flower buds to some particularly large ones; also Jamur, said Fungi. Something similar applies to the native names of *Rafflesia hasseltii*.

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2. *Rafflesia borneensis* Kds. nova spec.

(msc. Sept. 1917 in Herb. Bog.)

Flos femin.: Annuli circa basin columnae bini. Annulus exterior interiori subaequatus. Discus columnae apice processibus styliformibus numerosis obsitus, extus annulo distincto circ. 4 mm lato et 1-2 mm alto munitus. Tubus perigonii subapplanato-patelliformis, intus proparte subglaber, pro parte verruculis minutis ⅓ mm, proparte ramentis brevissimis (vix ½ mm longis) dissitis obtectus. Antherae rudimentae circ. 20. Flores masc. et fructus ignoti.

Feminine flower: Annuli two around the base of the column. The outer annulus is subequal to the inner one. Column disc covered with numerous styliform processes at the apex, from the outside a distinct ring ca. 4 mm wide and 1-2 mm deep. Perigone tube sub-flattened-patelliform, mostly subglabrous inside, partly covered with minute warts of ⅓ mm, mostly covered with very short ramentae (barely ½ mm long). Anther rudiments circ. 20. Male flowers and fruits unknown.

Description: Female flower (probably badly damaged during transport on the journey) all parts discolored ink-black. Cupula flat-bowl-shaped, 7 cm dia. at the top, sessile at the base of a root only 3/4 cm thick. Bracts (scales) thin, numerous, imbricated. Perigone tube flat bowl-shaped 13 cm in diam.; 3½ cm wide and ¾ cm thick, glossy on the outside, smooth, with tiny, horizontal, dense short lines; inside with scattered, very small, ¼ - ½ mm pointed nodules and scattered, very short, rarely up to 1 mm. long, pointed at the top (not widened at the top) ramenta, which mostly stand alone and mostly are unbranched. The inside of the perigone tube also shows dense, vertical, very fine ribs and grooves. In the upper part, the inside of the perigone tube is almost without ramenta and consequently there almost smooth (subglabrous). Perigonal lobes: all broken. One of the largest fragments is 6 cm long, 4 cm wide and partly 7 mm thick and partly 2 mm thick, shiny charcoal black on the outside and with numerous small irregular superficial cracks; (?) charcoal matt black on the inside and without clear warts and without pits. Diaphragm: not properly present. A fragment, perhaps broken off from the diaphragm, is 7½ cm "long" and 3 cm wide, and 3-4 mm thick; glossy charcoal black and ± smooth on the outside; inside matt black, without warts. Column at base ± 7 cm in diameter; from base to apex of processus 3 cm. high., above (at thinnest part) 4 cm. diam. Column disc (much damaged) 8 cm dia., circular. The overhanging edge is 2 cm wide. The disc above ± flat, with numerous conical or plank-shaped processes ½-¾ cm long and on the outer edge above with a slightly erect, notched up to ¾ cm high crest. On the outside of the steep slope of the column disc, just below where this ridge is inserted, there is a distinct ± thick annular ridge. The outer wall of the column disc, as well as the disc ring bulge mentioned, is completely hairless and smooth on the outside. On the underside of the disc there is a very short hairy, not very clear stigmatic ring zone. At the base of the column two stacks of annuli developed, the inner one of which is erect, falling outwards with a steeper slope and inwards with a gentle slope, while the outer ring is so sharply delimited only towards the inside and gradually runs towards the outside. These two rings without radial cleavage and both granularly rough. Stigmatic annular surface of the female flower indistinct, surrounded on the outside by a 4 mm wide and 1 mm high, glabrous annular bulge; showing the ± 20 small (almost 1 mm wide), rounded anther rudiments in small indentations on its inner edge. Lateral surface of the column covered by numerous (± 20), broad, parallel, sparsely grainy gray, hairless, indistinct ridges that descend only to ⅓ of the height, one of which comes on the shallow anther pits. Male flower, fruit and seed unknown.

Note. The above description only refers to a single female flower, which was collected by the mining engineer Witkamp in N. E. Borneo, Koetei and which is preserved in alcohol in a very damaged condition in the Buitenzorg Herbarium.

The outer label of the only bottle containing these flower remains reads: *Rafflesia* spec. — N.O. Borneo, Kutei. – leg. Witkamp.

The old inner label, which had become partly illegible due to the black-violet, ink-like (not red-brown, as with many other *Rafflesia* species) discoloration, read, among other things, the following: "*Rafflesia* spec, affinis *R. patma* Bl.–" N.O. Borneo, Kutei.—Leg. Witkamp 28 Sept. 1907 Det "Val. 1908."

Presumably due to the transport on the journey, the perianth lobes have all broken into small pieces and are now represented only by inky black fragments the size of a few centimeters, while between these fragments diaphragm remains could not be recognized by me with sufficient certainty.

Notwithstanding this damage to the flower coverings, fortunately the column with the disc appeared to me to be only relatively slightly damaged. It was therefore possible for me to determine with certainty that this flower is superficially *Rafflesia patma* Blume, but different from it and also from all other previously known *Rafflesia* species, [thus a] sharply different new species. This new species, which I call *Rafflesia borneënsis*, distinguishes itself from *R. patma*

by having a distinct, thick ring around the outer edge of the column disc, while in *R. patma* such a ring is wholly absent. Furthermore, the perianth tube in this new species from Borneo is much more flat than in the Javanese *R. patma*. Furthermore, *R. borneënsis* has only about 20 anther rudiments, while in *R. patma* this number is 30-38.

Geographical distribution: Northeast Borneo, in the Kutei division on September 28, 1907, without further specification; discovered by H. Witkamp, then mining engineer at Samarinda. Outside Borneo and also in Borneo outside the mentioned place of growth unknown.

Host plant: The flower collected by Witkamp sits on a thin woody root, which cannot be identified, as no material is present from the leaves, flowers and fruits of the host plant.

Native name, flower color, etc., unknown.

3. *Rafflesia patma* Blume.

"Perigone lobes similar to those of *R. arnoldi*. The inside of the tube is covered with nodules *) that are not densely arranged, but (inside) bare and without thread-like ramenta. At the base of the column there are two annuli, the inner one forming an oblique outward projection, while the outer one presents a rather weak annular bulge gradually sloping on both sides. Column disc and position of the anthers similar to *R. arnoldi*; likewise, the slightly tripartite, semi-decurrent anther pits of the male flower, which are separated by narrow, sharp ridges. Surface of the columnar base and the ridges as there. Stigmatic annular surface of the female flower less clearly bordered; Anther rudiments more prominent. Under each anther rudiment the anther pit as a uniform, small, narrow, semi-decurrent furrow, with steep edges and mostly with medium secondary keeling, ridges between these furrows enormously wide, even, running into the basal, smooth part of the column." After Solms-Laubach 7). — According to Haak 1), the flowers are probably polygamous. According to Ernst and Schmid 2), the mature pollen grains of *Rafflesia patma* are ellipsoidal in shape. "Their length is 19-21 µ, their width is 15-17 µ. Their exine is smooth on the outside, without any sculptures and exit spores for the pollen tubes". According to Ernst and Schmid 2): "From our collection there are still very few measurements of *Rafflesia* fruits reporting some information about the dimensions of the fruits. Our largest fruit of *Rafflesia patma* sits on a root of 3 cm in diameter. The diameter of its cupula is 11 cm. At its upper edge is the broadened attachment of the lower bracts and perigone lobes, of which brittle remains are still present, while others filled the bottom of the perigone tube. The fruit rises from this with a total height of 8 cm and an upper diameter of 7.5 cm. The zone containing seeds sits on a dome-shaped cell body, is bell-shaped and has a maximum width of 2.5 centimeters at the apex. The wall of the fruit is about 1 cm thick laterally and articulated upwards in the highly developed fiber tissue of the column, from the edge of which only small pieces remain. Mature seeds 0.8-0.9 mm long and 0.4 mm wide; light to dark brown." (according to Ernst and Schmid. 2).

Literature on *Rafflesia patma*. Blume, Korte beschrijv. *patma* in Flora VIII. 2. (1825) 609; Flora Javae I. (1828) 8. tab. 1-3; De Vriese, Illustration des *Rafflesia* (1854) tab. 5, 6; Solms-

*). The late Prof. Suringar 1) says about *Raff. patma* very correctly "We have already noticed that the inner surface of the tube in *Rafflesia patma* is not completely bare, nor hairy, but covered with small tubercles."

It should be noted here that the description of the inside of the flower tube of Suringar 1) is, as far as I have been able to ascertain, more accurate than that of Solms-Laubach 7).

Laubach in Ann. Jard. Buitenzorg IX. (1891) 238. tab. 26; Haak, Observ. sur les *Rafflesia* (1889). Met 4 platen; Solms-Laub. in Engler, Pflanzenreich IV. 75. (1901) 9. Fig. 2, 5; Kds. Exkursionsflora Java II 1912; Warburg Pflanzenwelt I (1913) Tafel 31. Fig. D. 1-5; Ernst und Schmid, Ueber Blute und Frucht von *Rafflesia* (in Ann. Jard. Bot. Buitenzorg. 2. serie XII, 1e. partie. (1913), pp. 1. tab. 1-7 und 8 Fig. 1-3; Ernst und Schmid, Embryosackentwicklung und Befruchtung bei *Rafflesia patma* (in Berichte Deutsch, Botan. Gesellsch. XXVII (1909), 176. Tab. 8; Heijne, Nutt. Planten Ned. Indië II. (1916) – 96.97; Teysmann in Nat. Tijdschr. Ned. Indië XI. (1856) 195-196; *Rafflesia Horsfieldi* Rob, Brown in Trans. Linn. Soc. XIII. (1821) 224 et XIX. (1844) 242; Zollinger in Natuur- en Geneesk. Archief (1845) 553.

Flower size and colors. Haak states: opened flower 39 cm in diameter; color inside purple brown with pale rose colored irregular spots. Flower lobes 14 cm. long and 10 cm wide. Corona 18 cm diameter. Opening of the corona 9 cm diameter.

For the specimens discovered by Zollinger in East Java near Poeger on the Goenoeng Watangan *) and which he doubtfully assigned to *Rafflesia patma*, Zollinger (p. 554) gives the following measurements: “The largest I own are less than a foot in diameter, and most are only ½ – ⅗ foot.”

Concerning the very different size of the flowers of *Rafflesia patma*, the following is taken from Blume, pertaining only to this species: “By the way, I must confess that I found the flowers of this *Rafflesia* very different in size, without being able to notice the slightest difference in them. I found the largest in very humid places, where their diameter often exceeded 2 feet (⅔ meter); in others it was scarcely 14-16 inches. (36-42 cm.), and these latter were found on stony, more dry places, where the parasite could suck less nourishment from the roots of the *Cissus*” (Volgens Blume, cited bij Solms-Laubach p. 203).

The flower of *Rafflesia patma*, about which Teijsmann and Binnendijk informed Professor de Vriese by letter and which was developed in 's Lands Plantentuin in 1852, had only 30 cm in diameter.

The smallest figure measured by Solms for *R. patma* for the flower diameter is 30 cm and for the upper surface of the columna 9 cm. Blume 1) says (according to Solms): “The ventral part is smooth inside, brownish-red, the perianths are flesh-colored, rather smooth outside, and covered with innumerable small, warty elevations of whitish color. The disc is carmine colored.” Blume's color statements in Flora Javae are less detailed, and the plate of this work is (as Solms rightly points out) incorrectly colored.

“I take certain information about the color change of *Rafflesia patma* from a letter from Dr. G. Karsten from Buitenzorg dated 4 Dec. 1889, to whom Mr. Haak in Semarang informed that the color of the flowers was changing and going from an intense red, as shown by the old, unopened bud inside, to a pale yellow” (according to Solms 1).

The color assignments provided in a letter from Teijsmann from Buitenzorg to Professor W. de Vriese in Leiden correspond well with the description (but *not* with the plate) by Blume (as Solms notes): “The color, which dominates all the other shades, is that of shiny ocher. The color of the crown (diaphragm) is a little darker, that of the lobes lighter, that of the center of the disc is lighter, but that of the high bottom and that of the processes, especially at the base, is a little darker than the ring, without being red like Blume's figure. The inner wall of the perianth is almost brown and tinged with the darkest color. The elevations of the five lobes of the perianth are less dark in color than the background on which they are set.” This corresponds well (as

*) As far as I know, *Rafflesia patma* does not grow on the Watangan Mountain, but only the species described below by me as *Rafflesia zollingeriana*. The flower diameter observation according to Zollinger, quoted below at p, 52, has, in my opinion, so presumably [belongs] not to the former, but to the latter species.

Solms also remarks) with what Haak 2) remarks: “Outside the 5 blades of the perianth have a very dark purple color, almost black. Inside purple brown ground dotted with airy pink warts; dome of a darker brown than the petals”.

Fruiting time and seed dispersal. The following is taken from Ernst und Schmid 1) concerning *Rafflesia patma* about the results of a botanical excursion undertaken by Ernst in 1906 to Noesakambangan: “Nevertheless, with the help of some natives, it was possible in three days (April 15-17, 1906) to collect not only about 50 buds of male and female flowers of different ages, but also one open male flower and four fruits of different ages.”

According to a later publication by the same authors, the number of fruits found by Ernst for *Rafflesia patma* amounted to five. From this it follows that, as Ernst has already remarked, that the occurrence in this species is by no means so rare as hitherto assumed. Ernst und Schmid 2) report the following about the probable mode of seed dispersal in *Rafflesia patma*: “They (the seeds) are set free when the fruit rots or is trampled on. They are mainly spread by animals, the pulp containing the seeds sticking to their crevices.”

Of Preanger Specimens Collected by Scheffer—About the two bottles indicated below by Scheffer, in my opinion probably collected in the Preanger [=Prianger, now Parahyangan of W Java] about 1870, contained alcoholic material from *Rafflesia patma*, I made some observations, which are briefly mentioned below: First bottle: including part of a floral covering bract and half the length of a female flower column. Column at the base 10 cm wide; up to the disc 4 cm high. Disc 10½ cm wide. Overlapping edge of the disc column 2 cm. Annulus exterior 2½ mm wide; annulus interior 4–6 mm. broad, flaring, glabrous. Raised disc edge 1½ cm high. Styliform processes almost all broken. — Collected in the Preanger near (?) Tjisolok (probably not Tjisalak, as I think was probably incorrectly stated on the outer label).

Second bottle (also collected in the Preanger by Scheffer): Comprising 1) a male flower bud of 1½ cm in height and 10 cm in width; with polyloculate pollen-rich anthers. – 2) a female flower bud of 9 cm high and 12½ cm wide. The following was noted by me about this female flower bud: perigone tube covered with small nodules only on the inside. Raised disc edge 2 cm. Height of the column up to the disc ⅓ cm.

About the synonym *Rafflesia horsfieldi* Rob. Brown, Prof. Suringar 3) already correctly wrote in 1884: “In the first place, *R. horsfieldi* of Java, so named by Rob. Brown but not further described, after a sketch by Horsfield. As this sketch represented no more than a bud, with no further features showing difference or identity with other species of the genus, it must always be left blank, and it is therefore better not to mention it at all.” (according to Suringar).

Solms 7) noted in 1891 that the species name *Rafflesia horsfieldi* should be deleted because it is based on a no longer preserved flower bud, of which the drawing made by Horsfield could no longer be found by Solms in the British Museum.

It is wrongly asserted by many authors that nothing has been published about *R. horsfieldi* other than the brief species diagnosis in Robert Brown's 3) second treatise, published in 1834. However, as Solms rightly points out, it has been overlooked that Robert Brown already speaks in two places in his first treatise 1) about this Javanese plant of Horsfield. In the first place this plant is described by Brown 1) who stated on p. 205 a published excerpt of a letter from Dr. Arnold; therein is following: “I have seen nothing resembling this plant in any of my books; but yesterday in looking over Dr. Horsfield's immense collections of the plants of Java, I find something, which may approach to it; at any rate the buds of the flower he has represented grow from the root precisely in the same manner; his drawing, however, has a branch of leaves and I do not observe any satisfactory dissections. He considers it as a new genus; but the difference of the two plants appears from this, that his full blown flower is about three inches across, where as mine is three feet.” Furthermore, Brown says on p. 224: “The plant in question, which has been

found in Java by Dr. Horsfield several years before the discovery of *Rafflesia arnoldi*, only however in the unexpanded state, is represented in the figure to as springing from a horizontal root in the same wanner as the great flower, like which also it is enveloped in numerous imbricate bracteae as having a perianthium of the same general appearance, with indications of a similar entire annular process or corona at the mouth of the tube, a pustular inner surface and a central column terminated by numerous acute processes. It is therefore unquestionably a second species of the same genus, etc." And in a comment Brown mentioned: "This second species may be named *Rafflesia horsfieldi* from the very meritorious naturalist, by whom it was discovered. At present however, the two species are to be distinguished only by the great difference in size of their flowers, those of the one being nearly three feet, of the other hardly three inches in diameter".

It is therefore, rightly says Solms, not doubtful that the genus *Rafflesia* was first discovered by Horsfield, in Java between 1804 and 1818.

Geographical distribution. Outside Java: Not yet known for sure. Bali: "By private communication I know that there is a rather large *Rafflesia* on the island of Bali; however, attempts to obtain research material of this were in vain. It will probably be the Javanese *Rafflesia patma*." (According to Solms 1).

Sumatra: Mr. Baptist, Governor of Serbodjadi in Aceh, suspects that the "smaller" *Rafflesia* species, which occurs in his administrative division, may be *Rafflesia patma*. From a small sketch drawing made from nature by Mr. Baptist, which is now part of the archives belonging to the Netherland Indies Association for Nature Conservation, it seems to me - although the sketch contains too few details for a conclusive judgment - highly unlikely that the North Sumatran "smaller" *Rafflesia* referred to by the Lord Baptist could indeed be *R. patma*. I will come back to this point below in the Rafflesiaceae indeterminatae. Research material of this Atjehsche Rafflesiaceae has not yet been received by me. However, it was requested by me a short time ago from the Governor of Aceh and Dependencies.

In Java: Resident of Preanger Zollinger 2) mentions that *Rafflesia patma* has been collected somewhere in the Preanger residence by the assistant resident Nagel, who was later murdered. Since Junghuhn 2) now states that the distribution area of *Rafflesia patma* extends on Java from Poeger in East Java to Soekapera in the Preanger in West Java. Solms-Laubach 1) (p. 233) suspects that this species was found by Nagel at the latter place. It should also be mentioned here that the former division Sukapura now belongs to the administrative division Tasikmalaja and that on the peninsula located on the south coast of said division near Pangandaran recently (July 1917) by Mr. W. Horst (according to oral communication made to me) a flowering *Rafflesia* observed (but not collected), which he suspected to be the common *Rafflesia patma*.

In the Buitenzorg Herbarium were (1917) under the correct name (verified by me): *Rafflesia patma*, bottles with old alcohol material, which, according to the outer label, had been collected in the Preanger by Scheffer; I suspect about 1870. On one of these two bottles was added "Tjisalak" from Java, Preanger. I suspect that this (as mentioned by me before) is a copy-writing error for "Tjisolok". Because "Tjisolok" is a place located near the Preangan south coast, while "Tjisolok" is located deep in the Preangan interior. *Rafflesia patma* has been found near the south coast of the Preanger, but not deep in the mountainous interior of Tjisalak in the Preanger.

In any case, the Tjisalak addition must, in my opinion, be regarded as highly doubtful and probably incorrect. The verified westernmost site of *Rafflesia patma* is located far east of Tjisolok, but also near the south coast of the Prianger.

Banjoemas Residence, Noesakambangan [Nusa Kambangan] Island: The occurrence of *Rafflesia patma* on Noesakambangan has been published extensively by Blume 1) 3), Zollinger 1) 2) 3), Junghuhn 2), Teijsmann 1), Haak 1) and later researchers. The species appears to have been more common on Noesakambangan in earlier times than in later years. Haak says that in 1883-1887 it was found there in large numbers only in 3 or 4 places. Junghuhn 2) says that when

he traveled to Noesakambangan Island in 1847, *Rafflesia patma* was so numerous that he could hardly take a few steps there without stepping on a few specimens.

In recent years on Noesakambangan island a very considerable area of jungle has been cut down for rubber tree culture and with that a number of *Rafflesia patma* habitats have probably disappeared for good. Fortunately, however, at the proposal of the Netherland Indies Nature Conservation Association on the said island (in 1916), a large piece of beautiful old-growth, species-rich jungle, designated as a natural monument by the Chief Inspector of Forest Service of the Netherland Indies, has been reserved, and the preservation of part of the original habitats of *Rafflesia patma* for this island has thus also been assured for the future.

According to Koorders-Schumacher, System. Verzeichnis are on Noesakambangan of *Raff. patma* the following specimens have been collected by me: Kds. 39665 β (27 flowering on 2 V. 1902.) — Kds. 40311 β (flowering on 23. VI. 1898) — Kds 39515 β (28 * flowering on 3. V. 1902). All 3 numbers have been preserved in alcohol, and are still present in Buitenzorg.

All habitats on Noesakambangan are below 100 meters sea level.

Djokdja Residence: "Scattered limestone cliffs, partly tower-like up to 100 feet, are close to the place? (near Djokdja; its steep walls are climbed by *Cissus* scariosa Bl., whose roots (Junghuhn means not only the roots but also the stems — S.H.K.) are the matrix of *Rafflesia patma*; I have them in all possible stages of development collected and still find them there every day" (Junghuhn 1); cited by Solms).

The older Netherland Indies literature for *Rafflesia patma* mentioned an East Javanese habitat in the Watangan mountains near Poeger, near the south coast of the Besoeki residence, presumably an incorrect species identification; [see] below as *Rafflesia zollingeriana*. About the older literature for *Rafflesia patma* that gives the habitat in the honorable division Banjoewangi, this is what I have stated below under Species dubia No 2. As far as my investigations reach, *Rafflesia patma* Bl. does not exist in East Java and is replaced there by *Rafflesia zollingeriana* Kds.

Habitat: In Java only below 500 m, especially below 100 m sea level, and especially in damp gorges of lower mountains of the Javanese south coast, but not close to the beach. Sometimes growing together in places in a relatively large number, always exclusively parasitic on the stems and roots of one or perhaps also of several liana species of the Vitaceae-Cissoideae.

Blume 1), 3), Zollinger 1), 2), 3), Junghuhn 2), Teijsmann 1) and Flaak 1) have published detailed information about the location and occurrence of *R. patma* on Noesakambangan. In Noesa Kambangan, according to Blume, the host liana mentioned occurs on lime, which Junghuhn disputes, who thinks he has only found this liana species on sandstone. I must note, meanwhile, that the host plant collected by me [and] Mrs. Koorders-Schumacher 1) on the Watangan Mountains (under the old provisional identification *Rafflesia patma*), mentioned [these] East Javanese specimens of *Rafflesia zollingeriana* grew on limestone rocks. However, I have no data to determine whether the *Rafflesia* host plants of the Watangan "lime" mountains are identical or specifically different from the Noesakambangan lianas of *Rafflesia patma*.

When Junghuhn 2) visited Noesakambangan in May 1847, he found *Rafflesia patma* in such great numbers, "that he could scarcely write a letter without trampling on a few exemplars". Haak thinks, however, that this has probably been exaggerated by the famous naturalist. Because although Haak visited the island repeatedly in 1883-1884 over a period of eight months, *Rafflesia* was never found there in such a large number and furthermore mainly only in 3 or 4 places. During all this time he only saw two open flowers and they were both male. Later, in 1887, Haak 2) again visited Noesakambangan and found a newly opened flower, preserved in alcohol, which was sent to Europe, where it was exhibited at the World Exhibition in Paris in 1889. (Solms 7).

Schimper 1), who visited Noesakambangan in February 1890, gives the following very correct description about the location and occurrence of *Rafflesia patma*: "I myself (February

1890) have only observed the somewhat smaller *R. patma* in natural habitats, namely on the small south Javanese island of Noesakambangan, where it grows sociable in a forest that is not virgin but has been left to its own devices for many years. I wrote the following note on the spot about the location and occurrence: If you cross the narrow belt of the beach forest, you come to a thin, medium-high forest that covers the stony southern slopes uninterruptedly. The ground is almost entirely covered by a herbaceous aracee about a meter high. Hanging from the trees are the immensely long ropes of a *Cissus*, which, like most lianas, crawl with their base on the ground for long distances. These parts of the liana, which are often many meters long, are, as Junghuhn already correctly stated, the carriers of the parasites. They carry rows of buds, up to the size of a head, in all stages of development, alternating with rotten, black remains of flowers and the empty cup-like growths, which now served as a matrix for the flowers that have now disappeared. The single perfect flower, which appears to have been recently opened, is light tobacco-brown in color and exudes a carrion-like odour. Nevertheless, insects are not visible in or on the flower." (according to Schimper, Pflanzengeographie P. 365).

Culture: In a letter to Prof. Dr. W. de Vriese in Leiden dated 24 October 1850, Teijsmann and Binnendijk report that two successive specimens of *Rafflesia patma* have blossomed in 's Lands Botentuin in Buitenzorg.

Host plants. As far as is known, *Rafflesia patma* only grows parasitically on the stems and roots of two or perhaps more liana species of the Vitaceae-Cissoideae.

According to corresponding statements from Blume 1), 3), Zollinger 1), 2), 3), Junghuhn 2), Teijsmann 1) and Haak 1), *Rafflesia patma* grows in Java on the “flat stem” of “*Cissus scariosa*”, while only Teijsmann also “*Cissus serrulata* Roxb.” with “round stem”. The latter host plant is now called *Tetrastigma serrulatum* (Roxb) Planchon. The first is now called *Tetrastigma coriaceum* (Bl.) Gagnepain, to which also belong as synonyms: *Cissus coriacea* DC. and *Vitis coriacea* Miq.

In my Exkursionsflora von Java II (1912) 558, as the host plant of the *Rafflesia patma* collected by me on Noesakambangan, another species of *Tetrastigma* is mentioned with doubt, which is presumably either with *Tetrastigma lanceolarium* (Roxb.) Planch. = *Cissus lanceolaria* Roxb.= *Vitis lanceolaria* Wall. or is identical with *Tetrastigma planicaule* (Rook) Gagnepain = Vitis planicaulis Hook.

In Koorders-Schumacher 1) herbarium material for Java is mentioned of *Tetrastigma lanceolarium*, but not of *T. planicaule*, while there under *Tetrastigma lanceolarium* as native names for the Priangan Kibarera, Soend. and to Noesakambangan and Poeger Waliran, Jav.

In the same publication; Kds. Schum. 1) among the Rafflesiaceae family, as host plants for the *Rafflesia patma* collected by me at Noesakambangan and at Poeger, only with doubt the genera *Cissus* and *Cayratia* have been mentioned. However, these are the provisional, very uncertain identifications mentioned on very old collection labels, which were written down at the time and for which, in my opinion, one should now read either presumably *Tetrastigma* or *Cayratia*. I am lacking further details about the host plant of the *Rafflesia patma* collected by me on Java.

It is clear from the foregoing that it is also necessary for the so-called already “well-known” *Rafflesia patma* to carry out a new investigation into the species of host plants.

According to a Kds. 40311 β of *Rafflesia patma* from Noesakambangan, the widest part of the liana stem, on which this *Rafflesia* proliferates, is 8 cm wide and strongly flattened laterally.

Native names: *patma* or Kembang *patma*, Java; a fixed name for this species on Noesakambangan. Other indigenous names mentioned in the literature are, in my opinion, still uncertain.

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4. *Rafflesia witkampi* Kds. nova spec.
(msc. Sept. 1917 in Herb. Bogor.)

Raff. arnoldi affinis sed fl. masc. fossis antheriferis indivisis (haud tripartitis), diaphragmate intus sublaevi, maculis indistinctis (haud elevatis) circ. 2-3 cm latis munito, tubo perigonii intus ramentis filiformibus apice attennuatis truncatisque (haud capitatoincrassatis) et annulis circa bazin columnae binis alatis diversa.

Allied with *Rafflesia arnoldi* but male flower antheriferous pits undivided (rarely tripartite), diaphragm smooth inside, provided with indistinct spots (rarely raised) circ. 2-3 cm wide, perigone tube inside ramentae with filiform, apex attenuate and truncated (rarely capitately thickened) and with annuli around the base of the double-winged column.

Female flower-bud: (already well developed), depressed-globular, 25 cm wide and 23 cm high, surrounded by large smooth leathery bracts (scales). Perigone tube covered inside by dense, filiform, ½–¾ cm long, simple or mostly branched, solitary or often in clusters of 3–10, ramenta, narrowed at the top (not clavate and not swollen into a head). Perigone lobes covered internally with dense, large, roundish, 1-1½ cm wide, up to ⅓ cm above the surface, flat, non-anastomosing warts (spots). Diaphragm 4½ cm high, margins entire, inside rather smooth (not rough) without warts and without ramenta from the base to near the upper edge with indistinctly protruding, large roundish places, indented as a result of the pressure of the perigonal warts, which simulate large wide warts, which, however, do not have wart-like elevations and which I have only observed in the flower bud (an open, fully developed flower is not available) Column disc circular, 13½ cm wide with a 2½ cm overlapping margin, flashing at the top with numerous, thick, up to 3 cm high processes with few hairs at the tip; column disc provided with an upright, 2 cm high notched crest on the upper edge, which is provided with dense, fine, vertical grooves on both sides. The outer edge of the disc glabrous or with very few scattered hairs. Stigmatic ring surface of the lower edge of the disc formed by very short papillate hairs. The column is surrounded by two annuli at the base. The interior annulus juts out with a steep embankment on both sides. The exterior annulus is much narrower and less prominent, with a slightly curved slope on both sides. On the outer side of the interior annulus and on the inner side of the exterior annulus, rises a very peculiar wing-like notched or serrated narrow ½–¾ cm high, crest.

Note. The above description and diagnosis, as well as the images of this very characteristic new species, are exclusively based on the material preserved in alcohol in one bottle in Buitenzorg, collected by the mining engineer Witkamp in N.E. Borneo in April 1907, and further detailed below. This material, when I borrowed it from the Herbarium 10 years later under the label *Rafflesia arnoldi*, consisted of one half of a well-developed female flower bud already about 25 cm wide and 23 cm high. Inside the bottle I found a further indication of where to find it, but according to the year 1908 the inner label, written nine years ago by a Buitenzorg herbarium official, when I arrived in Sept. 1917, this borrowed alcohol material was already torn everywhere and has become very difficult to read due to the brown coloring. This label read as follows: "*Rafflesia arnoldi*. N.E. Borneo, North. slope Sakuruh Mountains. Collected by H. Witkamp, Mining Engineer at Samarindo, April 1907. (signed) Val. 1908".

Outside on the bottle was written only the following: "*Rafflesia arnoldi* Rob. Brown. Borneo Witkamp." During the investigation of this Borneo material, set up in Buitenzorg, it appeared to me that it cannot belong to the *Rafflesia arnoldi* known only from Sumatra, 1) because the ramenta of the inside of the perigone tube at the top are not knobby or globularly swollen but narrowed, 2) because the annulus exterior and interior are both winged, while the annuli of *Rafflesia arnoldi* are wingless, and 3) because the inner diaphragm bears no warty elevations, but is bare and smooth. Only the inner side of the diaphragm is dented here and there by the strong

pressure of the warts of the inner side of the perianths lying behind it, and so the diaphragm is only apparently with (but in reality without) wart-shaped broad elevations.

Also, in other respects, according to my research, this plant from Borneo differs very sharply from the Sumatran *Rafflesia arnoldi*, for which, due to the superficial similarity, it was previously identified [as such] on arrival at Buitenzorg and on p. 6 in the Yearbook for 1907 of the Department of Agriculture in Buitenzorg. With only those so far known from Borneo, *Rafflesia tuan-mudae* differs from *R. witkampi* at first glance because the exterior annulus in *R. witkampi* is never much wider, but narrower than the annulus. From *R. borneënsis*, *R. witkampi* differs by the densely spaced rather long ramenta on the inner side of the perianth tube and by the very peculiar winged annuli at the foot of the column.

The differences between *R. witkampi* and the other species are apparent from the above identification table of the *Rafflesia* species in and outside Netherland Indies.

The site of *Rafflesia witkampi* is indeed located in Northeast Borneo, but it still belongs to the Administrative Department, which is known as the southern and eastern Department of Borneo. The mentioned Sakuruh (on another map Lakuroe) mountain range lies on the border of the "Brouwsche Landen" and of the Kutei area at approximately 1° North latitude.

Geographical distribution and location: Northeast Borneo, North slope Sekoeroeh Mountains. Collected in April 1907 by H. Witkamp, then mining engineer at Samarinda. According to the maps of Borneo, the intended (Sekuruh) mountain range is about 1500 meters high. Therefore, the place of growth of the "Noordhelling" is in any case below this sea level. Not known outside Borneo and outside the said place of growth.

Host plant: Parasitizes on the stem of a type of liana, of which identification was not possible due to the lack of leaves, flowers and fruits.

Native name: unknown.

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5. *Rafflesia ciliata* Kds. nova spec.

(msc. Sept. 1917 in Herb. Bogor.)

Tubus perigonii (fl. masc. jun.) intus ramentis circ. ½ cm longis filiformibus simplicibus vel ramosis, apice acutis vel obtusis (apice haud incrassatis) dense obtectus. Columna floris masc. ad latera fossis antheriferis praedita, crista acuta *ciliata* separata. Discus columnae processibus styliformibus numerosis obsitus. Annuli elevati, circa basin columna bini, exalati. Flores fem. et fructus ignoti.

Perigone tube (young masculine flower) interior densely covered with ramentae ca. ½ cm long, filiform, simple or branched, acute or obtuse at the apex (not thickened at the apex). Masculine flower column at the sides provided with antheriferous pits, separated by a sharp ciliated crest. Disc column covered with numerous styliform processes. Annuli raised, two around the base of the column, raised. Feminine flowers and fruits unknown.

Rafflesia ciliata Kds. Perigone lobes inside with large, round, dense wart spots (as far as can be seen on the young male flower buds); perigone tube covered internally with dense, filiform ramenta, ½ cm long, simple or branched, narrowed at the top (not swelling at the top). The inside of the diaphragm with scattered, close-fitting, small bristle hairs, otherwise glabrous and without wart spots. Column disc with erect margins and numerous pointed processes at the top. The two annuli wingless, the internal annulus larger than the external annulus. Anthers globular, ⅓ cm wide, multi-loculate, opening up in a common, sideways pit, separated by sharp, knife-blade-like, rounded laminae, bordered with thick ciliated laminae and closed at the lower end of these rounded, ciliated laminae the shallow keels separating the anther pits. These deep pits above

decrease in depth below. Pollen 15-20 μ diameter, hyaline, globular, smooth, rich in protoplasm. Female flower and fruit unknown.

Note. Description only after a few collected male flower buds preserved in alcohol in the Buitenzorg Botanical Museum, by Mr. H. Witkamp in Northeast Borneo, in April 1907. The largest of these is 17 cm wide and 13 cm high. Also found in Borneo are *Rafflesia tuan-mudae* Becc., *R. borneensis* Kds., and *R. witkampi* Kds., all differ sharply from this species in that the wall between the anther cavities is very narrow and ciliate in *R. ciliata*, and in the other two species unciliated and not narrow. Furthermore, *R. borneënsis* differs sharply in the lining of the inner surface of the perigone tube and in *R. tuan-mudae* Becc. because there the external annulus is much wider than the internal annulus.

About the *Rafflesia* in the Yearbook of the Department of Agriculture in Buitenzorg for 1907 I find Mr. Witkamp stated on p. 6 the following:

"During the year under review (1907) the following gifts were received: from Mr. H. Witkamp, mine engineer in Samarinda (NE Borneo), some specimens of *Rafflesia arnoldi* and a collection of fungi on formalin."

It was *Rafflesia arnoldi* as the published material by the Herbarium Department chief in the 1907 Yearbook, which, according to my research, partly, at least as far as 1 bottle is concerned, does not belong to *R. arnoldi*, but to a different species (*Rafflesia ciliata*).

Geographical distribution: Northeast Borneo, collected in 1907 without other information by H. Witkamp, then engineer at Samarinda. Not known outside Borneo.

Host plant, flower color and native name unknown.

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6. *Rafflesia tuan-mudae* Becc.

"Flower 66 cm in diameter. Perigone lobes with large, distant, rounded warts; Ramentae of the inside of the tube closely spaced, red-brown, similar to those of *R. arnoldi*. The inside of the diaphragm is covered with large, very irregular, flat, bumpy, rough warts; the largest of these are up to 8 mm wide and first stick to the edge. Two annuli developed at base of the male column; the inner horizontal, similar to that of *R. patma*; the outer one of colossal width (2½ cm), twice as wide as in *R. arnoldi*, cushion-shaped, with shallow radial furrows. Column disc and anther position similar to the two previous species. Anther pits less deepened than in these, with faintly noticeable secondary keels. Female flower and fruit not known." (After Solms-Laubach 7).

Literature. Beccari in Atti della soc. Ital. di sc. nat. XI. (1868) 197; Solms-Laub. in Ann. Jard. Buitenzorg IX. (1891) 239. tab. 27. Fig. 4, 5, 9 (flower and analysis); Suringar in Veth, Midden Sumatra (1884) Botanie p. 30 (come comments).

Note. Beccari 1) has described in 1868, in a provisional communication, a *Rafflesia* collected by him in Borneo (Sarawak) as a new species *Rafflesia tuan-mudae* Becc. He named the species after his friend, the Rajah (Prince) or "Tuan Muda" of Sarawak, Sir Charles Brooke. The rather peculiar Latin specific name *tuan-mudae* for a new plant species, derived from the Malay "Tuan" = Lord or master and the also Malay "muda" = youthful, young.

According to the late Suringar (in Veth, Central Sumatra 1884. p. 30), Beccari later withdrew this for Borneo as "new species", *Rafflesia tuan-mudae* Beccari, because he considered it identical to *Rafflesia arnoldi* Robert Brown. Later, however, Solms-Laubach 7) showed by a renewed examination of the authentic material of Beccari, that this species found on Borneo is not identical to *Rafflesia arnoldi*, but an independent species, which is distinguished from *R.*

arnoldi, among other things, by the possession of an extraordinarily wide (2½ cm) outer ring at the column base of the male flower.

As to the shape and arrangement of the wart spots on the upper side of the perianth segments (according to Solms) *Rafflesia tuan-mudae* is about midway between *R. arnoldi* and *R. hasseltii*; for these wart spots are much larger and less densely placed than in *R. arnoldi*; but their coalescence into irregular-elongated figures, as in *R. hasseltii*, does not occur in *R. tuan-mudae*.

Geographical distribution Borneo: In the province of Sarawak under English protectorate, near Buroengan on the slope of Mount Poe (Beccari). Only a flower bud and an opened flower have been found there. At another, Gunung Gading, not far from Mount Poe, according to Solms, another flower bud of a *Rafflesia* has been collected by Beccari, which is too young to determine whether or not it belongs to *R. tuan-mudae*. —Outside Borneo: unknown**.**

Host plant: unknown.

Native name: In the Dayak language of Sodomac and Loenda according to Beccari: "Boeah pacma". This last name is reminiscent of the Javanese name for the *Rafflesia* of Noesa Kambangan. "Booah" means "fruit" in Malay.

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7. *Rafflesia zollingeriana* Kds. nova spec.

in Herb. Kds. 40312 β et 39975 β in Mus. Botan. Hort. Bog. (msc. Sept. 1917).

Flos fem. aperta circ. ⅕–⅓ m diam., habitu *Raff. patma* admonens sed annulo ad basin columnae unico (haud annulis duobus) valde diversa.

Open female flower ca. ⅕–⅓ m diam., habit reminiscent of *Rafflesia patma* but very different with a single ring at the base of the column (not two rings).

Female flower: perigone lobes on the inside with numerous, ± small, only slightly raised warts. Inside of the perigone tube (also at the insertion of the diaphragm) covered with densely steep, simple, unbranched, ± thorny, pointed (not swelling like a knob) ramentae, up to 1 mm long at the most. Diaphragm inside covered with dense, fleshy, forked or short candelabra-shaped-branched ramentae at the top ± thorny-pointed (not swelling like a button), up to 2 mm (usually 1-1½ mm) long. At the base of the column only the inner annulus is developed, presenting a fairly faint annular bulge, ± 4 mm wide, gradually declining on both sides; instead of the outer annulus (similar to Rafflsia *hasseltii*) there is only a flat, granular-rough or ± glabrous ± 5 mm wide annular zone. Column disc, processes, margin, etc. and position of the anthers similar to *Raff. patma*. Below each anther rudiment the anther pit as a uniform, wide, very shallow (sometimes only indistinctly visible) furrow that hardly descends halfway, with slightly arched edges and sometimes with an indistinct central secondary keel. Anther rudiments clearly prominent. Surface of the ♀ columnar base and the base of the ridges of the female flower with very short hairs under higher magnification, otherwise glabrous. The stigmatic annular surface of the female flower located at the lower edge of the disc is covered with club-shaped, content-rich, unicellular, densely arranged, curved, smooth ¼–½ mm (usually ¼–⅓ mm) long "whisk [brush]" hairs. I found a germinated pollen grain only once on this stigmatic ring surface. The stigmatic ring zone is bounded on the outside by a broad zone and on the inside by a narrow zone, which is 2–2½ mm long and with dense "protective" hairs up to 49 µ wide at the base, erect, rigid, unicellular, filled with air, unbranched, smooth, pointed above, and partly loosely awl-shaped. The disc is covered with an upright, ± entire, vertically sloping rim and numerous, ± 2 cm long, pistil-like processes.

Anthers of male flower bud located at upper edge of anther pits. Well developed male flower buds collected but opened male flowers in the Buitenzorg Botanical Museum not found. The only two bunches of *Rafflesia zollingeriana* found there are female and both belong to the herbarium Kooders (compare the β numbers, locality, etc. below). Fruit unknown.

Note. The above species description is by me solely manufactured from alcohol material from Koorders 39975 β and 40312 β.

Observations on the living flower of *Rafflesia zollingeriana*. From the notes and sketch drawing made by me in Poeger from the living flower Kds. 40312 β the following is taken: Flower diameter 25 cm. The smell of the still beautifully colored (but probably already wilting) opened flower has a strong smell. This odor is reminiscent of rotting wood mingled with the unpleasant odor of an Amorphophallus inflorescence, but less foul-smelling. Perianth bracts purple inside with numerous, rather small off-white spots (warts). Outer perianth lobes and outer bracts different, namely in some orange red with white dots, in some plain orange red, in others half white at the base and orange red at the top, finally in others near the top jet black shining. Diaphragm outside purple with numerous frosted (glaucous) spots and lines and therefore completely having a frosted (glaucous) appearance and colored completely "ripe-like". Flower buds (in youth) spherical and glossy jet black on the outside.

Comments on "East Javanese" *Rafflesia* observations by Zollinger et al. This one, because of the possession of only a single arched ring of the *Rafflesia patma*, which is superficially similar in flower shape to the sharply different *Rafflesia zollingeriana*, hitherto known only from East Java, has been named by me after Zollinger.

Although the occurrence of a *Rafflesia* for East Java has already been mentioned in the literature by Teijsmann and Zollinger, and although Zollinger, among others, has botanized the same habitat near Poeger on the Watangan Mountains, where the *Rafflesia zollingeriana* was later collected by me, this one is from *Rafflesia patma* very distinct species, yet so far eluded the attention of all researchers, even Solms.

By earlier writers (e.g. even by Solms) the East Javanese *Rafflesia* finds of Teijsmann and Zollinger in the Banjoewangi Division and of Zollinger in the Djember Division (e.g. at Poeger), apparently without comparative analysis of the opened flower, have been listed as *Rafflesia patma* Blume. However, after an analysis of the flowers, I have found that all (three) specimens of *Rafflesia* I collected at Poeger do not belong to *R. patma*, but belong to my sharply different species *R. zollingeriana*. I suspect that the other mentioned *Rafflesia* in East Java (including by Teijsmann) also appear to be identical with *Raff. zollingeriana*. However, East Javanese material from regions other than Poeger are not yet at my disposal. I highly recommend sending *Rafflesia* flowers from regions further east than Poeger (Djember Division) for further investigation.

The flowers of this East Java species, *Rafflesia zollingeriana*, are on average much smaller than those of *Rafflesia patma*. But since the flower size also varies quite strongly in other *Rafflesia* species, this point in itself is not of much importance and earlier writers who had not missed this difference with *patma* (such as Zollinger) have tried to explain this small flower diameter in the East Javanese species of Poeger to be a result of water poverty of the habitat. However, my analysis of the flowers of the *Rafflesia* found near Poeger has now shown that, in addition to the smaller size, the flowers also have a finer structure (among other things due to the absence of the exterior annulus), different than the common *Rafflesia patma* of Central and West Java near the South coast.

Geographical distribution: East Java: In the Djember Division near the south coast, on the Watangan mountains near Poeger, flowering material collected by me in 1895 and 1902. According to Mrs. Koorders Schumacher (Systematic Directory, I. § 1. Java. Fam. 75 1911 p. 6)

the following specimens collected by me originate from this place of growth, the approximately 300 or 400 meter high Watangan limestone mountains:

Kds. 39975 β (1273 * female flower on 21 VI. 1902). Kds 40312 β (1137 * female flowers, male flower buds on II-X. 1895).

These two specimens are preserved in alcohol and are present in Buitenzorg. Both were found as parasites on the stems of unidentified and not simultaneously collected lianas of the Vitaceae-Cissoideae.

Both alcohol material specimens (Kds 40312 β und 39975 β) were, when I borrowed them from the Buitenzorg Herbarium for study in September 1917, both still under the incorrect, old, provisional species identification "*Rafflesia patma*." With the oldest, namely the specimen collected in 1895, this had apparently been the case for 22 years, until I discovered in September 1917 that I was dealing here with a characteristic new species and not with *patma*.

It appears from Zollinger's publications that in the same place where I got my *Rafflesia zollingeriana*, a *Rafflesia* was collected by him, which, although it generally had much smaller flowers than *R. patma*, was still regarded by him for the time being as that species. From Zollinger there is no *Rafflesia* material from this habitat in the Buitenzorg Herbarium.

The original habitat of *Rafflesia zollingeriana* is in a forest, part of which was suggested by the chairman of the Netherland Indies Association for Nature Conservation to be reserved as a natural monument by the forestry district manager involved, Mr. Reilingh.

Concerning the "small" species of *Rafflesia* observed by Zollinger and Teijsmann in East Java, which (as mentioned above) I suspect will prove to be identical with my *R. zollingeriana* and not with *R. patma*, I derive the following to what Solms 7) quotes and to what Teijsmann has published about this.

"Probably this plant (*patma*) also occurs on Noesabaron and presumably along the limestone hills that line almost the entire south coast of Java" (Zollinger 3). "I know, however, that it is not all that rare in Java, and that it is found particularly on the south coast on hills on the border of the Pasuruan and Besuki residences. I found them myself on Mount Watangan near Puger, and they were brought to me from the same department" (thus from the Dangawar Hills, Zollinger 2).

From Teijsmann's travel journal of 24 Sept. 1854, for the stretch from Banjoewangi northwards to Watoedodol, the following is taken: "I (Teijsmann) accepted the return journey on horseback along the beach, as far as Batudodol, when the rising sea prevented me from continuing on the beach, and we were making our way through, we had to clear through dense woods to get to the road, which fortunately was not far from the beach here. Hardly had I entered the forest when I almost stumbled across an open *Rafflesia patma* (*patma* or Patmo), which occurs in abundance here, as on Noesa Kambangan." (according to Teijsmann). By way of illustration, Watoedodol is situated on the main "post road" from Banjoewangi to Badjoelmati and on to Sitobondo and Besuki, and close to Badjoelmati.

Habitat and host plant: The "authentic" site of *Rafflesia zollingeriana* is in the first altitudinal belt of Junghuhn (namely below 650 meters above sea level), in the periodically very dry climate of the Watangan limestone mountains near Poeger, in heterogeneous forest, which is rather rich in deciduous tree species. The liana species, or species, on which this *Rafflesia* parasitizes has not yet been determined with certainty. The collection labels belonging to Herb. Kds. of *Raff. zollingeriana* of 1898 and 1902 only state "on *Cissus* ." The old genus boundary of *Cissus* has been taken according to part I of Miquel, Flora Ind. Bat. According to the more recent systematic classifications of Gagnepain (Paris) and Gilg (Berlin), liana species belonging to this must now be read as follows: proliferating on a species of the Vitaceae-Vitoideae and presumably belonging to one of the following genera: *Ampelocissus*, *Tetrastigma*, *Landukia*, *Cissus* (in narrow sense) and *Cayratia*. Furthermore, on the basis of the information provided by Mrs. KoordersSchumacher 1) for the relevant habitat of my *Rafflesia zollingeriana*, namely for the Watangan Mountains near Poeger also mentioned to Herb. Kds. associated and

simultaneously collected liana species of the Vitaceae designate one or two of the following species as the presumed host plant(s) of this *Rafflesia*:

1) *Tetrastigma lanceolarium* (Wall.) Planch.=*Vitis lanceolaria* Wall. Jav.
2) *Tetrastigma papillosum* (Bl.) Planch. = *Cissus papillosa* Bl. = *Vitis papillosa* (Bl.) Mig.
3) Cissus adnata Roxb. = *Vitis compressa* (Bl). Mig.
4) Cissus discolor Vent. = *Vitis discolor* Dak.
5) Cissus nodosa Bl. = *Vitis nodosa* (Bl.) Mig.
6) Cissus repens: Lamk.= *Vitis regens* Wght. et Arn.
7) Cayratia carnosa (Lamk.) Gagnepain =*Cirsus carnosa* Lamk.
8) Cayratia pedata (Lmk.) Jus.— *Cissus pedata* Lmk.
9) Cayratia zollingeri Kds.= *Cissus verrucosa* Zollinger (Herb. Zoll., non. alior).
10) Cayratia (?) *vel Tetrastigma spec. indet.,* Kds.-Schum., Syst. Verz. Poeger. — Kds 20375β .
11) Ampelocissus arachnoidea (Hassk.) Planch.—*Cissus arachnoidea* Hassk.

One or more of these 10 or 11 liana species is probably *Rafflesia zollingeriana*'s host plant.

Native name: *patma* or Kembang *patma*, East Java. Poeger (constant, useful name for the detection of this species there).

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8. *Rafflesia cantleyi* Solms-Laubach.

Solms-Laubach [In Ann. Jard. Buitenzorg Supplement III 1 e partie (1910) 1-4] says about this very incompletely known species, among other things, the following:

"The *Rafflesia hasseltii* Suringar undoubtedly comes closest to the present form; However, it differs from it at first glance in that the inside of its perigon lobes, which are quite extensive, completely lack the wide, irregular, anastomotic wart spots that are so striking there."

Presumably either in Malacca or perhaps in East Sumatra (by Cantley) discovered according to Solms-Laubach and parasitic on *Cissus* spec.

"The entire inner wall of the perigone tube has a rough, scaly surface; it bears numerous thread-like, sometimes forked ramenta that stand very loosely, at a great distance from each other, and are provided with a cylindrical stem and a button-like tip. Near the point of attachment of the diaphragm, the pedicles of the ramenta gradually become shorter and thicker; its button-like plate widens into a disk that finally reaches a width of 5–8 mm, so that the entire ramentum then takes on the shape of a broad-edged fungus cap. At the inner base of the diaphragm these stalks then disappear completely, the terminal plates thus becoming broad, sessile warts, which can reach a diameter of 1 cm or more and also often flow together. The tube (perigone) of *R. hasseltii* also shows a similar ramification. It is (there) covered up to near the base of the diaphragm with a forest at the tip of somewhat knobbly swollen threads, which are only more delicate, more gracile, and less broadened in the apex and differ significantly due to their large number and dense juxtaposition." (Solms).

Literature. Solms, Ueber eine neue Species der Gattung *Rafflesia* in Annales Jard. Buitenzorg 3. Suppl. 1 e. Partie. (1910). p. 1-6.

Note. The only known material of the *Raff. cantleyi* species consists, according to Solms-Laubach, of a few herbarium specimens pasted on paper, preserved in the Royal Herbarium at Kew (England). According to Solms, the herbarium label contained nothing other than the statement; "from M. Cantley 1881" and without further details.

This material had been received at Kew in 1881 from the Botanic Museum in Singapore; in damaged condition, because the bottle, in which it had been preserved in alcohol by Cantley (at that time Curator of the Singapore Herbarium), had broken and run empty during the journey to Europe.

This herbarium material at Kew was examined by Solms in 1901 and identified as a new *Rafflesia* species, which he described as *R.* Cantleÿi in 1910 as described in the Annales 1. c.

Since, according to Solms, it cannot be excluded that this material may have been collected within the Netherland Indies (namely, perhaps in East Sumatra), I draw special attention to this insufficiently known species.

Geographical distribution: Origin unknown. According to Solms perhaps occurring either in East Sumatra or in Malacca.

Host plant: Species of the host plant unknown. Solms 8) states the following about this: "The *Cissus* root finally attached to one of the flowers is quite weak, barely half a finger thick; it forms a flat, woody capula under the point of attachment, which is covered on the outside with the star-shaped cork warts that Robert Brown 1) illustrated for his *Rafflesia arnoldi*."

Native name: unknown.

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9. *Rafflesia manillana* Teschemacher.

"Tip of perigone with rounded wart spots (as far as can be determined on the bud) tube with cap-shaped, stalked ramenta in such a way that the individual umbrella surfaces [Schirmflächen] almost touch each other. On the inside of the diaphragm three horizontal rows of flat, low warts with a short, thick stalks, representing shortened and widened fungus elements. Internal annulus strongly developed, forming the bent upwards columnar base, directed obliquely outwards, sharpened. External annulus as good as non-existent, developed as a bare ring zone with hardly noticeable swelling. Disc ♂ flat, with a raised but low edge and very short stalked, knob-shaped processes ending with bristly hairs at the tip. Steep drop of the disc inclined inward, anthers pendulous, separated from each other by knife-blade-like, rounded laminae, which are covered with fleshy bristles at the edge. The flat keels, which separate the anther pits, are attached to the lower end of these rounded leaflets. This is flat on top, always increasing in depth below, sharply demarcated, coming close to the annulus. Keels between them widened outwards in a triangular manner, covered with dark protuberances. Secondary keels present both in the pits and on the webs; the latter running in a divergent direction up to the annulus. Female flower not known with certainty". (Solms).

Literature and Synonyms: Teschemacher in Boston Journ. Nat. Hist. IV. (1843-1844) 63. t. 6; Ann. and Mag. Nat. Hist. IV. (1842) 381; Solms in Ann. Jard. Buitenzorg IX. (1891) 241. t. 26 Fig. 7-10; Solms in Engler, Pflanzenreich IV. 75. (1901) 9; Merrill, Review identifications species descr. in Blanco's Flora de Filipinas, in Department Interior Philipp. Islands, Bureau Gouv. Laboratories (April 1905) No. 27*; Rafflesia Cumingii* Rob. Brown in Trans. Linn. Soc. XIX. (1845) 243; *Rafflesia philippinensis* Blanco*,* Fl. Filippin. ed. 2. (1845). 563; *Rafflesia Lagascae* Blanco*,* Fl. Filippin. ed. 2. (1845) 595.

Note. Species description taken entirely from Solms 7).

Geographical Distribution: Philippines (collected by Cuming and Blanco). Outside the Philippines: unknown.

10. *Rafflesia hasseltii* Suringar.

Perigone lobes with large meandering wart spots. Tube covered with long-stalked ramenta, button-shaped and swollen at the tip. Diaphragm smooth on the inside towards the edge, in the lower part with broad, large warts. Only the inner annulus developed, notched; instead of the outer one, a flat ring zone without any ramparts. Disc in the male flower similar to the preceding species (*R. patma* and *R. arnoldi*). Anthers inserted as in these. In place of the anther pits, numerous, narrow, parallel ridges, similar to *R. arnoldi* ♀, running down to the annulus and covered with short hairs. (According to Solms 7) "The fruit of *Rafflesia hasseltii* sits on a root of 2.5 cm in diameter, which has also completely opened up in the cupula formation. The diameter of the cupula is 12.5 cm and around the 10 cm high fruit there are still numerous remains of the lower leaves and the perigonium. The zone containing the seeds of this fruit has a maximum width of 2 cm and, in the median longitudinal section, appears curved upwards like a crescent moon with a hump-like tissue body. In contrast to the fruits of the other two species, the edge of the disk has also been preserved on this fruit of *Rafflesia hasseltii*. Its underside is pressed against the column and shows an outer surface that is just as torn and crooked as the column itself. On the other hand, the style-like projections on the upper side have completely disappeared on this fruit as well." (After Ernst and Schmid 2). —Boerlage has discovered and published in 1900 in Buitenzorger Botanical Museum on bisexuality in the flower of *Rafflesia hasseltii*. I confirmed in 1917 the correctness of this discovery by Boerlage based on the same alcohol specimen examined by him. A picture of this bisexual flower is enclosed. This case discovered by Boerlage is the first case in the genus *Rafflesia* of the occurrence of bisexual flowers.

Literature. — Suringar in Acta soc. reg. sc. Neerl. (1879); in Veth, Midden-Sumatra IV. (1884) 13. tab. 1, 2; Solms-Laubach in Ann. Jard. Buitenzorg IX. (1891) 239; Solms-Laub. in Engler, Pflanzenreich IV. 75. (1901) 9. Fig. 1.

Note. According to Suringar (1. c. p. 29), the lower ring, which is seated at the base of the columna or column, is in *Rafflesia hasseltii* very faint and indicated only by a wide, radially striped, barely vaulted plain. This single characteristic alone makes it easy to distinguish this species from *R. arnoldi*, which also occurs in Sumatra, but specifically differs from this one.

Dealing with part of the publication of the Central Sumatra expedition, Prof. Veth 1) mentions the careful description by the late Prof. Dr. Suringar with the beautiful image of *Rafflesia* Hasselti, quite rightly "the greatest jewel of Botany".

Flower color. — From the colored drawing published by Suringar 1) and made by Kouwels after a photograph and sketch drawing with colors by Veth, Van Hasselt and Snelleman, kept in the Rijks Herbarium in Leiden, I derive the following color statement: Flower covers on the top dark chestnut brown with rather numerous, very large and partly confluent cream-colored or yellow-white spots (flat warts). Crown or diaphragm outside light chestnut brown with a small number of dark brown tubercles, inside dark brown with numerous whitish points. Disc (upper side) of the broad, stamen-carrying columna or column very dark chestnut brown with similarly colored protuberances resembling styles.

Polygamy. — Solms–Laubach 7) states in 1891 that the flowers of *Rafflesia hasseltii* are unisexual. Suringar described this species as dioecious in 1884. Boerlage 1) reported for the first time in 1900 that bisexual flowers also occur in this species. I examined the bisexual flower of *Rafflesia hasselti* referred to by Boerlage 1) in his Manual in the Buitenzorg Herbarium (I, 6

Oct. 1917). On this basis I believe I may confirm the correctness of Boerlage's discovery. It is therefore certain that the flowers of Rafflsia *hasseltii* are not dioecious, but polygamous

In view of this discovery of polygamy, I call attention to what has been reported by Haak on *Rafflesia patma* about suspected polygamy.

Note on a bisexual flower by *Rafflesia hasseltii* Sur. — This flower, about which Boerlage, probably in or shortly before the year 1900 published in his Manual der Flora of the Netherland Indies, was in Oct. 1917 still in Buitenzorg and was preserved in alcohol in 2 bottles, divided into pieces in a very effective way. The microscopic examination I performed showed the presence of pollen grains in multicelled anthers, which are normally built for *Rafflesia*, while in the ovarian cavities ovules were abundant. So this flower is indeed hermaphroditic.

In one bottle was a note by Boerlage (to which I added in 1917: Scripsit Boerlage, prob. anno 1899-1900) on which was written the following: "*Rafflesia hasseltii* Sur. var.?"

"Differs from the type of the species in that the subcrown has only one row of cusps close to the margin, and no irregularly dispersed cusps; next, because the foot-ring of the column is hairy like the adjoining plain. The flower is also only 43 cm in diameter. (floral tube 18 cm.; each of the lobes 12.50 cm.) Finally, the specimen is clearly hermaphroditic." (according to Boerlage; presumably the years 1898 —1900 in Herb. Bog.).

I can confirm the correctness of these observations. The differences also seem to me too small and too uncertain to separate this specimen as a variety.

Attention should also be drawn here to what the late Prof. Suringar 2) p. 5 in 1881 reported about hermaphroditic flowers in another species of *Rafflesia*, namely *Rafflesia arnoldi*: "According to a communication from M. Beccari (Nuovo giornale botanico italiano VII. 71), the former director of the Botanical Garden at Buitenzorg, Dr. Scheffer told him that among the cultivated specimens of *R. arnoldi* at Buitenzorg, bisexuals are often found. That fact would be curious."

Nature conservation measures of the original habitat of *Rafflesia hasseltii* have been taken by me, as Chairman of the Netherland Indies Association for Nature Conservation was presented to the relevant Controller at the Domestic Administration in Moeara Laboe in the Padangsche Bovenlanden, Mr. Renesse van Duivenbode.

Since it is precisely from this region that the only hermaphroditic flower of *Rafflesia hasseltii* is known so far, about which Boerlage published (see above) in his Handbook to the Flora of the Netherland Indies, the reservation of this place of growth as a natural monument is particularly important.

Geographical distribution: Central Sumatra, in the south of the Padangsche Bovenlanden, in the forests of the XII Kota between the rivers Liki and Lampatan andjang, a single male specimen was found in 1876 in flowering condition by Van Hasselt, Veth and Snelleman.— In the Buitenzorg Herbarium is located (1917) alcohol material (2 bottles) under the verified identification *Rafflesia hasseltii* Sur. from Central Sumatra and collected by the "Controleur of Moearalaboe". — Outside Central Sumatra: unknown.

Host plant: unknown.

Native name: According to Ernst und Schmid 2) the open flower at Padang Pandjang (Middle Sumatra) is called Tindawan biring (tindawan = fungus; biring = measles, scarlet fever) or also: Tindawan mata hari (Tindawan = fungus, mushroom; mata hari = the sun). This last plant name was already given to the first discoverers of *Rafflesia hasseltii*, the members of the first Central Sumatra expedition Van Hasselt, Snelleman and D. Veth, and published by Suringar 3).

Discovery of a fruit and female flower buds. Ernst und Schmid 2) mention in 1913 that Ernst, with the help of the Assistant Resident of Padang Pandjang Lulofs, succeeded to collect four flower buds and a young fruit of *Rafflesia hasseltii* in 1906 near Padang Pandjang in the bosschee op den Boekit telagakoembang (meaning: "Mountain with the bee lake") at about 1200 meters above sea level.

All 4 flower buds found by Ernst were female. This find is very important from a floristic point of view, because female flowers and fruits of this *Rafflesia* were not known until now.

The writers mentioned about the difficulties that preceded this discovery by Ernst, among other things, as follows;

"As is mentioned on page 11 (in Ann. Jard. Bot. Buitenzorg 1913), a beautiful *Rafflesia* flower had been found in this area about a year before my (A. Ernst) stay in Padang Pandjang and afterwards photographed in Padang Pandjang. The photograph was widely circulated among the Europeans settled in the Padanger Oberland, and a Swedish merchant, who a few months later traveled through the Padanger Oberland and also saw such a copy, is said to have promised the people 1000 guilders for the procurement of a similar flower apparently hoping to do great business with the wonderful flower in Europe. This well-remembered event was not likely to facilitate my collection of research material, as I was unable to make offers to meet people's high expectations. In the house of a railway supervisor in Ane-Schlucht for example, I kept a flower bud that had been cut off from the *Cissus* root and was already half rotten, which I wouldn't have been given even 10 guilders. I also asked in vain for information about the location, and the foreman, who ran a small trade in insects and other animals, said that if a flower appeared there again, he wanted to "do the business himself". That after further, fruitless searches I finally did; I owe it to the friendly mediation of the then assistant resident of Padang Pandjang, Mr. C. Lulolfs, that I came to the material mentioned above, the desired and described plant. It turned out that most of them knew the plant from their own eyes or had already heard of it. Under the direction of a native plantation supervisor and the village chief of Djao, the successful excursion to the Goenong Telaga Koembang (i.e. "mountain with the bee lake") was performed." According to Ernst und Schmid 2). The authors refer here to Ernst's excursion, during which the first female flower buds and the first fruit of *Rafflesia hasseltii* were discovered.

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11. *Rafflesia schadenbergiana* Goeppert.

"Wart spots of the perigone lobes medium-sized, squat, often merging into a net. Perigone tube as well as the inside of the diaphragm almost to the edge, in exactly the same way, covered with thread-like ramenta that are somewhat swollen at the tip. At the base of the column there is only an annulus projecting obliquely outwards; the outer one is separated by a flat ring zone devoid of ramparts. Disc similar to the earlier species, as well as the position of the anthers in the male flower. Disc edge above the anthers densely shorthaired, as well as the whole column. Anther pits very shallow, not descending halfway down the columnar slope, deepened above; Bars between them narrow here, hairy on the edge. In the female flower the stigma ring has a faint outward border; notched in front of the anther rudiments. Under each of these, a scarcely perceptible, shallow spot surrounded with hair, the rudiment of the anther fossa; Columna otherwise simple, overall short haired."

Literature: Goeppert in Hieronymus, Ueber *Raff. schadenbergiana* (1885); in Gartenflora XXXIV. (1885)3 cum ic.; Solms in Ann. Jard. Buitenzorg IX. (1891) 239. t. 26 Fig. 1– 6 et 17; Solms in Engler, Pflanzenreich IV. 75. (1901)9.

Geographical distribution: Philippines: On the island of Mindanao (discovered by Schadenberg and later also collected by Warburg). Unknown outside this site.

12. *Rafflesia rochussenii* Teysm. et Binnendijk.

Flower 14½-30 cm in diameter. “Perigone lobes with small raspberry-like granular wart spots. Perigone tube as well as the inner side of the diaphragm up to its outermost, smooth edge densely lined with ramenta, which, especially below, are slender and long-stalked and widen into a depressed, disc-like knob. Disc without raised edge and without processes, or only with minimal rudiments of both, which are then usually covered with single, long bristles. Just a sharp-edged, obliquely directed annulus; instead of the outer one, a flat ring zone without any ramparts. Disc edge of the male flower almost horizontal, sharpened like a knife; on the lower side, around the anthers, with a sharply demarcated annular zone corresponding to the stigma of the female flower, which bears isolated bristles. Anthers pendulous. Anther pits broad, reaching down close to the annulus, deeply hollowed, with a sharply defined bottom, separated by narrow ridges. This, like the annulus, is densely covered with rounded, dark-colored bumps. Anther pits of the female flower as narrow grooves separated by wide ridges, similar to *R. patma*, descending; Anther rudiments very small, at the upper end. Stigmatic surface wide, surrounded by a clear border. (The details of the female flower according to de Vriese), by the way (after Solms-Laubach 7). – “Our fruit of *Rafflesia rochussenii* is somewhat smaller than that of *Rafflesia patma* described above *) by Ernst and Schmid. Its smaller dimensions are probably due to unfavorable nutritional conditions, because it sits on a thin root of only 9 mm in diameter, which have been included and fully integrated into the cupula formation. The lower diameter of this fruit is 10 cm, tapering upwards to 5.5 cm in diameter. The height of the fruit is 7.5 cm and its median seed layer is 1.3 cm high.” (after Ernst and Schmid 2).

Literature. Teijsmann et Binn. in Natuurk. Tijdschr. Ned. Indië I. (1850) 425-430. Tab. 1 en 2; Teijsmann et Binn., Bijdrage tot de kennis der vrouwelijke bloem *Rafflesia rochusenii* in Nat. Tijdschr . Ned. Indië II (1851) 651-655; de Vriese, Mémoire sur les *R. rochusseni*, etc. (1853); de Vriese, Illustr. des *R. rochusseni*, etc. (1854) tab. 1, 2, 3;— Tab. 1. Landscape of the G. Salak. In the foreground an opened flower and a flower bud of *Rafflesia rochuseni*. De Vriese's plate statement reads: “The *Rafflesia*s are drawn from life on the spot by van Aken; the rest of the painting is partly a sketch by the same artist; the painting as completed by the talent of Rear Admiral Verhuell is made according to the notes of Mr. Teysmann and Binnendijk, etc.”; —Tab. 2. Two opened flowers of *R. rochusenii*, here with the star on the disk (upper surface) of the column drawn by Van Aken — Tab 3. Analyzes of the male flower, all drawn by van Aken in Java); —Miquel, Flora India Batav. I. 2. (1859) p. 683-684. Tab. 19 et 30. —Miquel, Analecta bot. ind. III. (1852) 23. tab. 2. et 3; —Solms-Laubach in Ann. Jard. Buitenzorg IX. (1891) 240. tab. 27 *f* 1-3.—Solms-Laubach in Engler, Pflanzenreich IV. 75. (1901) 10. Fig. 6 (fruit) 7 (flower bud cross section); — Solms-Laubach in Ann Jard. Buitenzorg Suppl. II. (1898) Tab. 1, 3-12 (Development of the ovule and seed); —Hooker, Misc. II. Suppl. II. t. 6;—Ernst und Schmid in Ann. Jard. Bot. Buitenz. 2e serie. XIL 1 e. partie (1913) pp. 1.

Flower dimensions. Solms 7) gives the following dimensions for a flower bud of *Rafflesia rochusenii* measured by him: Flower bud 8 cm high and 12 cm wide. Disc 7 cm wide. The protruding rim of the disc is 1⅔ cm wide. Column width 4 cm. Height of the column measured to the surface of the disc 2 ⅓ cm. Diaphragm opening 4 cm wide.

Compare above page 50.

Flower color and smell. According to Teijsmann and Binnendijk 1) the disc surface of the first flower they examined was provided with a 5-rayed, red star. However, this star was not visible in the later specimens of the same species found by them. In De Vriese 2) according to Solms 7) on Plate 2 (this is missing in the Buitenzorg copy of this rare plate. — S. H. K.) the color of the star is not red, but more or less yellow-brown.

The following is taken from the oldest description by Teijsmann and Binnendijk: "The color of the opened flower of *Rafflesia rochusenii* is dark red; the elevations or warts on its surface, like the ground on which they are placed, are dark red."

Deviating from this are the colors of the colored plate published later in De Vriese 2).

In the latter publication by De Vriese 2) on plate 2 the colors of *Rafflesia rochusenii* depicted approximately as follows:

Flower bud (large, almost open): Bracts brownish-dark gray outside. Outer perianth partly brownish white, partly white, mottled rose and brown. Colors of the open flower: bracts dark brown on the outside. Flower cover segments violet. Diaphragm exterior pale violet. Disc (discus) whitish.

About color and smell of one like Herb. Kds 40048 β registered on 19 Oct. 1917 through the benevolent intervention of Jhr. Tb. W. Boreel from the forest of the G. Probakti (southwest of the G. Salak and north of Parakansalak) flower received by me of *Rafflesia rochusenii* Teijm. and Binn. forma *typica* Kds. the following was noted by me: "This already brownish discolored flower, which has already bloomed, has a faint unpleasant odor". Whether this flower may have been odorless shortly after opening, as has been reported for some other Rafflesiaceae flowers in the literature, could no longer be ascertained, because the flower was already wilting when I received it. Bracts (bud scales) glossy black on the outside. Perianth lobes slanting, already discolored dark brown to black brown on the inside. Diaphragm outside colored in the same way as the inside of the perianth lobes. Column disc dirty brownish and dark flesh-colored, without projections, with softly wavy smooth surface. Perianth tube dark brown inside and densely covered with pale reddish, filamentous, spherical thickened ramenta at the apex.

Geographical distribution: West Java: In "De Vriese" 2) the location of *Rafflesia rochusenii* is stated as follows on the basis of the information provided by Teijsmanti and Binnendijk: "Habitat in the shady forests of Mount Salak at 40001. It grows on the trunk, decumbent branches and root of *Cissi serratifolia* Roxb," So on the "Salak" at about 1300 meters sea level, without a clear statement of the place. More detailed is the following (first) statement by Teijsmann and Binnendijk 1): "At the foot of the Mandalawangi, being according to Teijsmann and Binn. (but, not according to Junghuhn. S. H. K) the ridge, running from the Pangerango to the Salak, just above the coffee gardens, on the smaller ridge Pondok Tjatang, west of the tea plantation Legok njinang on the estate Tjiawi (not to be confused with the district of the same name located in the East Prianger. — S. H. K) van den Graaf van den Bosch." (according to Teijsm. and Binn.) At or not far from the same site, "near Tjitjoeroeg op den G. Salak", as far as is known, was collected the alcoholic material of this West Javanese *Rafflesia* brought to Europe by Goebe 1, Ernst et al., which was collected by Solms-Laubach 7, among others) has been described and depicted. Missing outside Java and unknown outside the said place of growth "on and near the G. Salak". In the Buitenzorg Herbarium, under the identification label *Rafflesia rochusenii*, there are currently (1917) a number of bottles with rather old alcohol material, one of which is labelled: "Tjibodas" without further specification, one bottle of "Java" without further indication and four other bottles without further outer labels, except for the stated species identification.

Location and appearance. From the quoted publication, illustration, etc. by De Vriese, the following data reproduced by De Vriese in French from Teijsmann and Binnendijk (derived from a letter dated 27 Sept. 1852) are mentioned here:

"To give some clarification about the *Rafflesia rochusenii*, we resolve to visit the place, from where so many specimens had already reached us. It was about 4000 feet above the surface of the sea, but to our great disappointment we found only a few already formed remains and a few young buds, barely the size of an egg, which did not grow on the root of the *Cissus*, but on the stem, four feet above the ground. Previously the collectors from the garden had brought some, which grew on the trunk of the. *Cissus* at a height of twelve feet. We visited two more places on the mountain where the *Cissus* was, but all the plants were already fallen; so in this respect our journey has failed in its purpose." (according to Teijsmann and Binnendijk).

Host plant: According to Teijsmann and Binnendijk parasitic on the stems and roots of *Cissus* serrulata Roxb., which is now called *Tetrastigma serrulata* (Roxb.) Planch.

In a letter to Prof. dr. De Vriese in Leiden dd. 24 Oct. 1850 Binnendijk says that the host plant of *Rafflesia rochusenii* is not identical with *Cissus scariosa*, but is a different species. According to annotation in De Vriese 2) this last host plant is *Cissus serratifolia* Roxb.

Culture: Teijsmann and Binnendijk 1) say in their first publication (in 1850) about *Rafflesia rochusenii* the following: "After some specimens were excavated and transferred with the *Cissus* to the Lands Botanic Garden, a *Rafflesia* developed and opened on it." This refers to the first of this new species, found on the ridge "Pondok tjatang" (see above) in the forest and from there in the Hortus Bogor. living transferred plants.

Native name: *Proet ki barera*, Soend. Derived from various [words in] West Java, also applying to Balanophora species parasitic on siphonogams, a corrupted Malay-Sundanese name *Proet* and from the Sundanese name *Kibarera*, which applies to the host plant and also to some other vine species of Vitaceae-Cissoideae.

Rafflesia rochusenii Teijsm. et Binn. var. *subaculeata* Kds.

(msc. October 1917 in Herb. Bogor.)

Discus columnae supra processibus 1-8 carnosis, conicis, styliformibus, erectis, apice penicillato-pilosis ± 4-7 millim. longis subaculeatis obtectus.

Top of column disc covered with 1-8 processes, fleshy, conical, styliform, erect, tip brush-hairy, ± 4-7 mm long, sub-spine-like.

Column disc covered with 1-8 fleshy, broadly conical, style-like, erect, with brush-like hairs on top, ± 3-7 mm. long processes. Otherwise similar to the type.

Comments. The above diagnosis and currently published image of this variety are made after one bottle containing a single male flower bud preserved in alcohol in the Herb. Bogor, cut lengthwise and to one bottle containing a cut female flower bud with a few cut young fruits.

Bottle No. 1. Inside the first mentioned bottle (with male flower-bud diameter, etc.) a collection label is missing; it also lacks a date and a year of collection and the name of the collector. There are 3 labels on the outside of the bottle. The oldest of these read, "Cytinaceae.—*Rafflesia rochusenii* Teijm et Binn. var.—Java, Tjibodas Leg?" The newest (cleanest) label read: "Rafflesiaceae.— *Rafflesia rochusenii* T. et B. var. "Java, Tjibodas, Leg.?" The third outer label stated the same as the last label mentioned, but in addition the following: "Flower buds and

diameter ♂ flower knob.— N. B. Slemelschije with projections.—Tjibodas (leste schedula).” Th. Fall.” Even without a date of determination.

From the nature and content of the three outer labels I suspect that this remarkable alcohol material, which I have described above as var. subaculeata Kds., may have been collected in the vicinity of Tjibodas on the Gede more than 30 years ago in West Java.

The site “Tjibodas” located on the Gede mountain would be new; At least I have only found the Salak mountain and the saddle between the Gede and Salak mentioned in the literature.

If indeed the said old alcohol sample comes from Tjibodas, I suspect that it was collected below the laboratory; because the greatest height above sea for *Rafflesia rochusenii* mentioned by Teijsmann and Binnendijk is 1400 meters, while the botanical bosch laboratory of Tjibodas is slightly higher than 1400 meters above sea level.

Bottle No. 2. In the “second” bottle of alcohol material referred to above from the Herb. Bogor., which I wrote on 12 October and received on loan in 1917 contained a severed female flower bud and a few severed young fruits. This flower bud generally shows that of the type of *Rafflesia rochusenii*, structure of the column-foot-ring, etc., but otherwise has that of the variety *subaculeata* Kds., characteristic structure of the column disc, because the disc upper surface here bears eight fleshy, conical projections resembling spines, of which the foot is broad and the apex is very pointed. The height of most projections varies between 3 and 4 millimetres; some of the projections are smaller.

This one as bottle No. 2 referred to above when I used it in Oct. 1917 on loan did not receive any information about the year and place of collection or the name of the collector. Outside on the bottle I found two almost identical labels, both stating the following:

“Rafflesia rochusenii T. et B. var.—Java, Zjisalak.—Leg. Scheffer?” — On the oldest of these two outer labels was added: Young fruit. Th. V. '07. Apparently this was presumably almost 50 years ago now by Scheffer? collected by Valeton in 1907 and identified as “*Rafflesia rochusenii* Teism. and Binn. var.”

The young fruits lying in the bottle undoubtedly belong to *Rafflesia rochusenii* and probably also to this variety *subaculeata*. The latter, however, can no longer be attributed to this somewhat damaged material, because the spiny protrusions of the upper surface of the column disc are no longer present.

A few broad old scars, however, visible on this disc surface make it probable that these fruits belong to the same variety subaculeata as the female flower preserved in the same bottle.

This form, separated by me as a variety of *subaculeata*, which is characterized by the possession of 1-8 styliform 3-7 millimeter long projections on top of the column disc, seems to me connected to the type gradually by transitions with one more or less than 3 millimeter high projections (which I have not separated from the type).

The most common form of the type has a column disc which is entirely without protuberances.

It was already known to Teijsmann and Binnendijk, de Vriese and also to Solms-Laubach that, in exceptional cases, 1 or 2 very small styliform protrusions (processes) have been observed on the column disc.

Taken together, then, there is perhaps almost as much pro and con for the fact that the var. *subaculeata* was separated with one or more projections, one or more of which are at least 3 millimeters high.

Geographical distribution: West Java: Male material from Gede, near (presumably below) Tjibodas, probably collected only once more than 30 years ago; the name of the collector and date of collection are missing on the labels. Also female material (flower bud and young fruit) at Tjisalak. Leg. Scheffer? Presumably this refers to the surroundings of the tea plantation Tjisalak located between Gede and Salak [mountains]. Date and year of collection is also missing from the labels. Outside West Java and not known outside the mentioned site.

Host plant: unknown species of liana.–

Native name: unknown.

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2. *Richthofenia* Hossen*.

Parasitic single-flowered plant, similar in habit to *Sapria*. Flowers large, flesh-colored and hermaphroditic, solitary, surrounded at the base by large scales (bracts). Flower-covering lobes 20, placed in 2 rows overlapping in the bud; perianth tube above, with 20 longitudinal grooves on the inside. Perianth tube by a saucer-shaped protruding diaphragm, closed except for the middle part. Outer diaphragm covered with 5 series of filiform, apically swollen, stamen-like ramenta. Male flower: Anthers 20, ovate, two-loculate, opening at the apex by a single common opening. Male column (central column) slender, broadened at the top in a ± flat surface. Female flower: Staminodes 20. Ovary, polyloculate; ovules anatropous, with an integument. Female column (central column) rather thick. Fruit unknown. (after Hosseus 1).

Only 1 species known: *Richthofenia* siamensis not yet established in the Netherland Indies.

***Richthofenia* siamensis Hosseus**. In Englers, Botanische Jahrbacher. Bd. 41. (1908) 55-61 Tab. I—II.

Flower bud ± 7 cm wide and 8 cm high. Opened flower 10 cm high and 20 cm wide. Flower cover 8 cm long and 5½ – 6 cm. wide. Flower bud light pink, white at the base. The cup-shaped broadening, on which the flower sits, brownish. Flower covers on the inside red, with white spots (warts). Flowers, even after rotting, almost odorless. Fruits unknown. (after Hosseus).

Note. Description entirely copied from Hosseus. This one not yet in Netherland Indies, only species known from Siam is here included, because according to later writers *Richthofenia* is probably identical with the genus *Sapria* and because there may be a species of *Sapria* (or van *Richthofenia*) in the Netherland Indies.

Geographical distribution: In Siam at 1100 m above sea level, in humid jungle, parasitic on plant roots, discovered by Dr. Hosseus. So far unknown outside of Siam.

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3. *Sapria* Graf.

Leafless, parasitic, dioecious plant, consisting of a solitary large flower, which is surrounded at the base by opposing, shingle-like covering bracts, and which are seated on a cup-shaped outgrowth of the bark of the liana stem, in which the plant proliferates. Male flower: Perianth tube provided with 20 slots on the inside; perianth 10-merous above; flower heads placed in 2 rows, spread out. Perianth tube almost closed by a saucer-shaped diaphragm. Diaphragm covered from the outside with closely spaced filiform ramenta resembling stamens. From the base of the perianth tube rises a stout central column (columna), broadened at its apex into a cup-shaped, strongly hairy disc. Anthers about 20, sessile, placed in a circle around the underside of the rim, spherical, 2-3 lobed, with a single common dehiscence opening. Female flower: Perianth, built like the female [sic. Male] flower. Ovary polylocular. (Ovary traversed by longitudinal sinous cells, the walls of which are covered with anatropous ovules. — According to Hooker's Flora) or (?) monolocular (according to Hosseus). Fruit spherical, crowned by the perianth lobes.

Outside Netherland Indies only one species is known: S. himalayana Griff., which has so far only been found in the Himalayas, in the English Indies and has not yet been established in Netherland Indies.

To this genus, or to a related genus, I presume, may belong one in Sumatra (Atjeh) briefly described and illustrated by Mr. Baptist in two letters, referred to by the latter as the "little *Rafflesia* of the Djerneh river bank", by me hereinafter treated as Rafflesiaceae spec.

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1. *Sapria himalayana* Griffith.

Flower buds spherical by purple and white colored bracts. Flowers smelly, ± 13-16 cm in diameter. Perianth tube-inside blood red. Perianth lids fleshy, with warts on the inside. Disk of the central column (columna) colored rose.

Note. Description from Hooker, completed by Solms.

Geographical distribution. English India, Assam, foothills of the Himalayas, in the Mishni hills, parasitic on the roots of a liana belonging to the Vitaceae-Vitoideae, discovered at 1000-1350 meters above sea level by Griffith. Not yet found in Netherland Indies

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4. *Brugmansia* Bl.

(= *Zippelia* (non Bl.) Reichenbach; *Mycetanthe* Reichenb.).

Description of the sexual characteristics.

"Flowers hermaphroditic or by reduction, unisexual. Perianth fleshy; tube fused with the ovary at the base, broadly club-shaped above the ovary; hem many-part (according to Beccari either 14-16-split or 5-6-split and each of the segments again more or less completely split in two or three); segments narrow, contiguous in the bud, with the tips turned inwards, spread out or folded back during flowering. Central column at the top knob-shaped broadened part convex, furrowed, hairy in the middle, contracted, pressed down from above, serrated at the upper edge. Anthers numerous, 40-60, in a single row, corresponding to the furrows of the top of the column, arranged in a whorl about its base, more or less spherical, connate, or (*Brugmansia zippelii*) 2-loculate, usually with 2 pores, placed one above the other, dehiscent; or (*Brugmansia lowii*) by imperfect partitions with more than 2 loculae. Ovary inferior, 1-locular; style thick, columnar, with undivided cup-shaped top with stigma surface; ovules anatropous, very numerous, covering all sides of the numerous parietal placentae. Fruit more or less berry-shaped. Seeds very numerous, small, obovate or pear-shaped, with recurved funiculi."

"Fleshy parasitic plants, consisting of a single flower, seated on a cup-shaped proliferation of the tissue of the host plant, surrounded by scales at the base and a tissue formed of branched threads, which permeates stems and roots of the host plant" (after Boerlage; modified by Beccari).

Number of species two, parasitic on the roots and stems of partly unknown plants in Borneo, Sumatra and Java.

Table of *Brugmansia* species of the Netherland Indies.

1a. Hair covering, both on the inside of the perianth cover tube and on the inside of the basal part of the perianth, consisting exclusively of 6-7 mm long, ± erect, woolly single-celled hairs, which are often hooked-curved at the top and a few possess short, antler-shaped branches. Flowers 8-15 cm in diameter, usually hermaphroditic, sometimes by reduction male and rarely (according to Heinricher) female. Perianth segments, 14-16, rarely all (including the basal part) free from each other; usually only the naked apical part free and the basal part of each 2, 3 or 4 segments more or less coherent.
West-Java. **1. *B. zippelii***.

1b. Hair covering of the inner side of the basal part of the perianth exclusively of a dense and very short (at most ½ mm high) felt, which is formed from single celled, apically curved, closely spaced and many-branched deer antler-shaped hairs. The inside of the perianth tube is covered exclusively with flat, rather thinly placed, single-celled, straight, very pointed at the apex and unbranched, about 7½ mm long hairs. Flowers 22–28 cm in diameter (according to Beccari sometimes 40 cm), always unisexual. All 16 perianth lobes (including the basal part) completely or almost completely free and linear-lanceolate.
Sumatra, Borneo. **2. *B. lowi*.**

Description of the species of the genus *Brugmansia*.

1. *Brugmansia zippelii* Blume.

Parasitic herb. Flowers bisexual, sometimes unisexual by reduction, ± 8-15 cm diam. Flower bud scales glabrous on the outside and very dark violet. Perigone tube inside, as well as the basal part of the perigone lobes (also inside) ± evenly haired with wooly or shaggy; with 6-7 mm long, unicellular, often hooked at the tip or, e.g. T. sparsely antler-like branched ± erect, hairs. Perigone tube in the pharynx, inside with 14-16 strong glabrous longitudinal ribs; on the inside with very numerous (± 40-50) fine, vertical grooves. Perigone lobes 14-16, broadly triangular-lanceolate, sometimes all completely free from the base, mostly (the usual form) at the base in groups of two or three, more rarely in groups of four united with each other. The 14-16 glabrous, callous tips of the tepals are almost always largely free. – "The fruit of *Brugmansia zippelii* is similar to that of *Rafflesia*. As far as size is concerned, Heinricher (1906, p. 76) states a diameter of the basal cupula of 4.1 cm, a height of the fruit of 5.5 cm and a maximum width of 4.4 cm for the specimen in his possession. The fruits in our collection are all slightly smaller. The best developed sits on a root only 5 mm thick. The diameter of its cupula is 4.6 cm, that of the fruit 3.6 cm. The height of the same is 3.9 cm and above it sits the column of 1.5 cm, which is more distinct from the lower part than in *Rafflesia*. (according to Ernst and Schmid 2).

Literature. Blume, Flora Java I. (1828) 12. tab. 4-6; Solms-Laubach in Engler, Pflanzenreich IV. 75. (1901)12. Fig. 9; Koord , Exkflora Java II. (1912) 179; Kds.—Schum., System. Verzeichnis I. § 1.c. Zweiter Nachtrag (1913) 75. Familie p. 6; Heinricher, Beitrage zur Kenntniss der Rafflesiaceae in Kg. Kais. Akademie Wissensch. Wien, Mathem.-Naturwiss. Klasse, 28 Band. (1906) p. 57-81. Fig. tab. I, II, III und Textfig. 1,2 (Dort p. 66: *Brugmansia bakhuizenii* Heinricher).

Note. Description from Blume, Solms, Ernst and Heinricher and a range from Herb. Kds.

Geographical distribution: Unknown outside the Netherlands Indies and outside Java. In Java: only in the western part, between 400-1300 meters sea level and so far only in the residences of Batavia and Preanger. In the former residence only in the Buitenzorg section on Salak mountain, in shady, evergreen, heterogeneous forest, including in the Tjiapoeskloof, where spots used to grow together in very large numbers. But due to the repeated collection of *Brugmansia* research and demonstration material by numerous people over many years in succession, whereby a very large number of specimens, usually flower buds, were collected, the number of specimens of *Brugmansia zippelii* on the Salak mountain seems to have already decreased. Almost all the rich *Brugmansia* material, which since this species was first described by Blume after material from the Gunung Salak, is now present in the various botanical museums in Europe, originates from this classical habitat (Gunung Salak). This *Brugmansia* from the Gunung Salak is also in large number in the Buitenzorg Systematic Botany museum, partly by me under the label *Brugmansia zippelii*, partly under *Brugmansia* spec., and partly by Gunung Salak, partly without reference by me flower buds preserved in alcohol found in 1917. Also from the Gunung Salak. Herb Kds 40380 β blooms collected on 3 XI. 1912, parasitic on the roots of a *Tetrastigma* species; in the Tjiapoes gorge (Gunung Salak) at 500 meters above sea level; in the company of the root parasite belonging to the Orobanchaceae, rare in Java: *Aeginetia pedunculata* Roxb.

From Pasir Datar (Gunung Pangerango) flowering material, collected in alcohol by Valeton in 1908, is available in Buitenzorg. The first fruits of *Brugmansia zippelii* were discovered independently and in very short succession by Heinricher and Ernst. By Bakhuizen van den Brink and Heinricher is of *Brugmansia zippelii* in 1904 a new place of growth, discovered on the slope of the Gunung Pangerango, in the Dept. Soekaboemi of the residence Preanger, in the jungle near the tea plantation Pasir Datar. The latter place is about 1000 meters above sea level.

In the Preanger a new habitat of this species was discovered a short time ago by the Heeren Bakhuizen van den Brink and Winckel, namely in the woods near the Tjidadap plantation, south of Tjibeber, in the Tjiandjoer division. In the Buitenzorg Systematic Botany museum contains 2 bottles from this habitat with flower buds in alcohol, which I borrowed under the label "*Brugmansia* spec." on November 23, 1917, but which, in my opinion, are without doubt both *Brugmansia zippelii* Blume. From the same habitat is present in the same museum, already identified as *Brugmansia zippelii*, alcohol material, which was collected by Backer in June 1917.

Zygomorphy. The zygomorphy of the flowers sometimes observed in *Brugmansia zippelii* (and also in *Rafflesia* species) is explained by Heinricher 1) as follows: "The establishment of a floral cushion within the *Cissus* root can obviously take place at the most varied points within the root; sometimes on top, sometimes on a side surface, sometimes on the underside turned towards the earth: the opening of the flower should always take place above the ground. One sees that in the advanced, growing buds of unfavorably oriented rudiments, growth processes are initiated which aim at bringing the flower to light. Such growth processes give rise to irregularities in the flower, which is regular according to the disposition, which give the buds or the flowers the impression of a more or less pronounced zygomorphy. The same can also be expressed in the development of the Columna genitalis."

Smell of the flowers. On the basis of information from natives, Blume says that the flowers of *Brugmansia zippelii* give off an unpleasant odour. The observations made in Java by, among others, Heinricher, Knuth and Ernst*) contradict this and state that the newly opened flowers are completely or almost odorless. I also noticed the latter in the open flowers I observed in 1912 on Gunung Salak in the Tjiapoes Gorge, two of which were Herb. Kds. 40380 β which have been collected by me.

*) To Mr. F. Bley, I hereby express my gratitude for the information he kindly provided about the latest literature.

I quote from Heinricher 1) about the *Brugmansia* he examined at Pasir Datar about the unpleasant odor that only appeared after the flowers had wilted:

"Mr. Bartels wrote to me: "The flower that has just blossomed is odorless. I didn't see any insects on the fresh flower." On the other hand, he writes of the first blossom, the duration of which he had observed, and which he illuminated for the second time on the third day after it had blossomed in the afternoon and for the third time on the fourth day in the morning. "The faded flower had an unpleasant smell, small ants ran around in it and small mosquitoes also sat on it." (He mentions that by the fourth morning the flower had already turned a deep brown). On the third morning after blooming, Mr. Bartels reports that the second flower that Mr. Bartels had observed and that had bloomed more quickly: "This morning it had almost completely faded, but had no unpleasant smell." From all this it seems to be clear that that the fresh flower of the *Brugmansia* (at least that is true of those of Pasir Datar) does not emit a carrion odor or unpleasant odor, but that such a smell appears as the blooming is advanced." (Heinricher).

Flower colors. The most detailed data on the colors of the flower parts of *Brugmansia zippelii* have been published by Heinricher 1). In his Denkschriften der Kais. Akademie der Wissenschaften in Wien, an interesting *Rafflesia*e treatise published in 1906, deserves to be cited (abridged) as follows: "I only wrote down a more precise description of the flower in general and with regard to the coloring of the individual parts after observing the second flower, which had opened the day before when I received the first. The shades of color change rapidly, and the bloom is quite fleeting. I reproduce these notes and can, from recollection, describe the changes which have taken place compared with those taken on the first day, evidently that of the opening of the flower. The tips that were in the bud state were pure yellowish-white, ivory-colored in the case of the younger-picked flower, and somewhat darker in the case of the older one. The base of the tepal bulge is dirty white, that of the free tepal sections light flesh-colored; everywhere it is covered by its long, cinnamon-colored hair. About 60 brown colored lines running radially outwards run through the inside of the tepal bulge, which can still be traced to the free tepal sections. Between these there are a few weaker ones, which end inside the bulge of the perigone. After each angle, which is formed by two of the diverging perigone sections, there are strongly protruding bulges inside the perigon bulge."

"On the outside of the perigone, which is reddish white, one notices small indentations; these dimples appear as lighter white spots on large buds and the fresh flower, on the older one they had turned brown. As should be noted immediately, there is a large stomata in each of these places."

The Columna genitalis is distinguished by a dark brown ring zone, which surrounds the apical, crater-shaped depression. In the *Brugmansia* species described and illustrated, this ring zone is neither mentioned nor made visible in the illustrations; but I suspect that it is not a peculiarity specific to that of Pasir Datar, but that it has escaped attention owing to poor preservation—or the flowers present being too old, discolored, and browned. The rest of the column is ivory, yellowish white."

"However, Blume's illustrations (of *Brugmansia zippelii*) are colored. In this case either the coloring turned out to be very unnatural, or if it is reproduced well, the difference between *Brugmansia zippelii* and the *Brugmansia* of Pasir Datar is also quite considerable in this respect. According to this depiction, the hairs of *B. zippelii* on the inner surface of the perigonium should be assumed to be white, while that of Pasir Datar is colored cinnamon brown." (Aldus Heinricher).

About the color of the flowers found on the Gunung Salak I have only the following very short note:

At Herb. Kds. n. 40380 β (from G. Salak) was noted by me on 3 Nov. 1912 perianth tube (living) pale brownish on the inside. Perianth lobes inside (= upper side) grey-white or whitish. Flowers odorless. The open flower resembles a multi-rayed star.

Further, detailed notes on the color of the flower parts of the specimens growing on the Salak are highly desirable.

Nature conservation measures: Already very shortly after the establishment of the Netherland Indies Nature Conservation Association, at my suggestion as chairman of the Association, nature conservation measures were taken for one of these classic habitats of *Brugmansia zippelii* on Salak mountain, namely for a piece of forest in the Tjiapoes Gorge. These measures were taken in 1913 by the late Mr. J. F. Sol, who was still alive and Administrator of the Private Land Tjomas — Gunung Salak, on which the intended classic *Brugmansia* habitat is located. The following was published about this habitat in the "First Annual Report of the aforementioned Association (1912 — 1913)":

"Tjiapoes-Gunung Salak (Natural Monument No. 30.2). — Under the management of the Chief Administrator of the Private Land Cultural Society Tjiomas-Buitenzorg, located in the jungle of the Tjiapoes-gorge of the Gunung Salak in the Buitenzorg division.

In this mountain gorge, known for its natural beauty and its interesting, very rich forest flora, there is a piece of jungle, which is particularly remarkable, because there are a few rather rare plants (including *Brugmansia zippelii*, which belongs to the Rafflesiaceae family)."

"Since last year, that piece of woods has been protected against damage and destruction as a natural monument [based] on the proposal of our Association. This protection is provided by Mr. Sol, Chief Administrator of the Cultural Society Tjiomas-Buitenzorg, by the staff of this society. The land of this natural monument is privately owned and belongs to the shareholders of the aforementioned Culture Society. According to a letter received from Mr Sol (December 13, 1913), there are provisional objections to a request for surrender of the less than 10 Hectares large piece of land (with the forest standing on it). However, in that letter a promise is again made that the said piece of forest will be left in pristine condition". (Thus stated in the annual report of the Netherland Indies Association for Nature Conservation).

In addition to *Brugmansia zippelii*, which is mentioned above under Kds. 40380 β, also reported was the rare in Java *Aeginetia pedunculata* belonging to the Orobanchaceae.

Host plant: Presumably a species (or perhaps more than one species) of Vitaceae-Cissoideae, which is called Kibarera or Aroi Kibarera, Soend.

Blume 3) reports that *Brugmansia* parasitizes the roots of *Cissus tuberculata* Bl. This refers to *Tetrastigma lanceolarium* (Roxb) Planch, which is synonymous with said *Cissus* species.

Native names: In the Buitenzorg Dept. near Tjiapoes (Tjiomas) now: Proet ki barera, Soend. then again *patma*, Sund. The latter name applies elsewhere to a few species of the genus *Rafflesia*. The first native name is partly Malay, partly Sundanese, and refers not only to *Brugmansia zippelii*, but also to a few root parasites belonging to the Balanophoraceae family. The ordinary, non-botanical meaning of the Malay word "proet" (which is called böting in Sundanese) is, however, quite different, which deserves no mention here.

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2. *Brugmansia lowi* Becc.

Flowers unisexual. Inflorescence (as far as this can be determined from the flower buds) at the base of concave, close-fitting, brittle, roundish ovoid, entire, imbricate bracts, bulbous-ovate, narrowed at the top and rounded below, glabrous on the outside, shiny, with 14-16 longitudinal grooves, which are unite irregularly at the apex of the flower bud. Perigone tube bell-shaped, on the inside, especially on the throat, with very long hairs (longe piloso-barbato), with 14-16 longitudinal ribs and (just as much on the inside) felty-hairy. Column spherically depressed, loosely hairy, short-stalked; the stalk densely and finely serrated. Open flower after Low approx.

40 cm diameter. (referred to Beccari). Open flower (according to Forbes) strongly smelly; (according to the picture) approx. 22 cm in diameter. Perigone tube inside with 50-60 delicate longitudinal stripes. Perigone lobes 16, all free, ± protruding, the lower half of the lobes linear-lanceolate, the upper half of the same linear. Fruit unknown. (after Beccari and after Fawcett).

I noted the following about the alcohol material Kds. n. 44052 β (obtained through the intermediary of Mr. T. Ottolan der from Benkulen province (Sumatra)): There is an open male flower of approx. 28 cm in diameter, two large male ones 10 cm high flower buds and two very small, spherical flower buds, partly destroyed inside by animal damage, all sitting on thin roots of an unknown dicotyledonous host plant. Leaves, flowers and fruits of the host plant are absent.

The largest of the two larger flower buds (Herb. Kds. n. 44052 β from Sumatra-Benkulen: height from the base of the cupula to the tip 10 cm. Greatest width of the flower bud 6 cm at height of the cupula. Height of the disc columns 1½ cm. Stalk of the column ⅓ cm high. Column disc 2 cm in diameter. The glabrous (hairless) inwardly curved part of the perigon lobes 6⅓ cm long. Hair covering of the inside of the perianth dimorphic. Perigone tube inside only with about 75 mm long, unicellular, unbranched, red-brown, attached, loosely covered with soft, thin hairs like spider webs. The lower half of the perigone tube has very numerous (± 80) fine longitudinal stripes on the inside, but no ribs, but there are 16 strongly protruding and ± wide, vertical ribs in the upper half of the perigone tube. Perianth limb inside with 16 strongly protruding longitudinal ribs and just as many inwardly curved lobes. The perianth limb is covered with a felt-like, short (only ½ millimeter high) coat of hair on the inside up to the point where the bare inwardly bent perigon lobes are integrated. This felt consists of only ½ millimeter high, upright, reddish-brown, unicellular, peculiar, branched at the top like deer antlers, fine-grained rough on the outside hairs.

The bud scales of Kds. n. 44052 β (from Sumatra) are constructed exactly as Beccari described them for his *Brugmansia* lowi from Borneo.

The open flower (Kds. n. 44052 β from Sumatra Benkulen): about 28 cm in diameter. The number of perigone lobes is 16; they are all completely free, even at the base. The basal part of the perigone lobe is linear-lanceolate, ± 6 cm long and 2 cm wide at the base, glabrous on the outside, but on the inside only covered with the above-described, only ½ mm high felt of deer antler-like hair. The apical part of the perigone lobes is completely glabrous on both sides, ± 6 cm long, laterally curled at the base and ± ⅓ cm wide, very pointed at the top and only ± 1 mm wide. According to Mr. Ottolander, all 16 tepals of the living plant stand out almost horizontally. As a result, the open flower has a very peculiar appearance that is reminiscent of a giant spider. The glabrous thread-like apical part of the perigon lobes is sharply demarcated from the basal part (with felty hairs on the inside). As a result, the perigone lobes are articulated almost in the middle. Perigone tube 7 cm high, glabrous on the outside, without felt covering on the inside, but covered with ¾ cm long, single-celled, straight, unbranched, loosely fitting hairs. The hairiness of the perigonium is exactly the same in the open flower as in the almost developed flower bud. This (single) flower is male. The ovary compartments are formed, but without ovules. In this *Brugmansia*, too, the pollen does not appear to be dusted, but to be expelled embedded in a slimy mass, as Heinricher and Ernst observed in another *Brugmansia*. The pollen is globular or oblong, 20-30 µ long and 20-25 µ wide, hyaline. The exine and intine are distinct. The exine is smooth, completely without sculptures and also without exit pores for the pollen tubes. Germinated pollen grains were not found on the stigma of this (male) flower. The number of anthers arranged in a delicate ring is ± 60.

Literature. Beccari in Atti Soc. ital. sc. nat, XI. (1868) 197 et in Nuovo Giorn. bot. ital. I (1869) 84. tab. 5 (Bloemknoppen met analyse) et VII. (1875) 74; Solms-Laubach in Engler, Pflanzenreich IV. 75. (1901) 12; Fawcett, on *Brugmansia lowii* in Trans. Linn. Soc. Series 2. II. (Botany) (1886) 244-245. Tab. 36. Fig. 12.

Note. The alcohol-preserved flower buds of the Benkoelen residence (South Sumatra), recently received by me (beginning of Nov. 1917) through the benevolent intervention of Mr. T. Ottolander, and as cataloged material Herb. Kds 44052 β, appeared to me to agree so accurately with the illustration and description published by Beccari as *Brugmansia* lowi from the material collected by Low in English North Borneo, which, although the fruits of both habitats (Borneo and Sumatra) are still unknown, and although authentic comparison material is lacking in Buitenzorg, Kds 44052 β from Sumatra, is most likely identical with *Brugmansia lowi*.

The open flower of Benkoelen-Sumatra (Kds 44052 β) also appears to correspond so well with the image of a flower collected by Forbes on Gunung Dempo (also in South Sumatra), which Fawcett identified as *Brugmansia lowi* Becc. and published that Kds 44052 β and Forbes' flower are presumably identical. I therefore think with some probability that I must draw the conclusion that Solms-Laubach's doubts about Fawcett's species identification of Forbes' flower of the Gunung Dempo are not sufficiently founded to now consider the Sumatran *Brugmansia* (from Benkoelen and from Palembang) as a new species separate from the Borneo *Brugmansia* lowi Becc.

From a plant geographic point of view this conclusion is therefore important, because as far as I know this is for Netherland Indies the first case in which a species of the Rafflesiaceae family is spread over two relatively distant islands (Sumatra and Borneo).

All other types of the Netherland Indies Rafflesiaceae, as far as our still very incomplete knowledge shows, have a limited geographical distribution.

It should also be mentioned that for *Brugmansia lowi* Becc., so far only three open flowers are known. The one flower is the one collected many decades ago by the English naturalist Forbes on Gunung Dempo in the residence Palembang (South Sumatra), and described and depicted by Fawcett. This flower is kept in the British Museum in London.

The second flower is the one cataloged as Kds 44052 β and described by me above, which I recently received from Mr. T. Ottolander from the residence Benkoelen (South Sumatra).

With regard to the discovery of this flower, Mr. Ottolander informed me orally that the habitat was first pointed out to him by Mr. Lens, who lived in the vicinity of the Soebanajam cultural enterprise.

The third flower was collected by Teijsmann in Borneo and was only represented in the Buitenzorg Herbarium in 1917 by a few fragments, including part of the column and a few pieces of perianth.

Geographical distribution: Outside the Netherland Indies: In English North Borneo, discovered by Low on an islet in a branch of the Broenei River. —In Netherland Indies: Collected by Teijsmann in the Westerafdeeling residence of Borneo, in the Landak department, near Tampardjawa and represented in the Buitenzorg Herbarium by one specimen preserved in alcohol, labeled as *Brugmansia lowi* (fragments of an open flower). — South Sumatra: In the residence Palembang on Gunung Dempo at about 1300 meters sea level, discovered blooming by Forbes. In the Benkoelen residence near the *Rafflesia* nature reserve site Soebanajam, located at the cultural enterprise Soebanajam, between 600-1000 meters above sea level, in a ravine, in old mixed, evergreen forest, parasitic on the roots of an as yet unknown host plant. (Kds. 44052 β. – With male flower buds and one male open flower in October 1917. Received from Mr. T. Ottolander).

Host plant: According to Beccari, the *Brugmansia lowi* collected in English North Borneo was found parasitic on the roots of an unidentified species of *Cissus*.

Local name: unknown.

Undetermined Rafflesiaceae.

(Rafflesiaceae indeterminatae).

The currently undetermined Rafflesiaceae of the Netherland Indies include the following:

Rafflesiaeae no. 1 (Bali). – According to Solms, a species of *Rafflesia* may be found in Bali. The only thing I could find on this is the following:

"I know from private information that a fairly large *Rafflesia* is still on the island of Bali; my efforts to procure specimens have been in vain. Presumably it will also be the Javanese *R. patma*. (according to Solms 7).

In 1917 no material from Bali was found in the Buitenzorg Herbarium under Rafflesiaceae.

To this I can add that in my opinion the *Rafflesia* occurring in Bali, according to the statement referred to, will probably not be identical with *R. patma* and this, because the (newer) investigations I have conducted into *R. patma* have yielded the result that *R. patma* in the easternmost, closest to Bali residence of Besuki, at least near Poeger near the south coast, is replaced by another species, namely by *Rafflesia zollingeriana* Kds.

I therefore suspect that the Balinese doubtful Rafflesiaceae referred to by Solms is either identical with the latter or will appear to belong to one of them and also different from the species *R. patma*, or does not belong at all to the family Rafflesiaceae. Even the latter is quite possible, for I have found that non-experts not infrequently consider the giant arum inflorescence of *Amorphophallus rex* Prain (*A. campanulata* Blume, ex parte) and of other *Amorphophallus* species with particularly large inflorescences for a *Rafflesia* flower. To determine this, sending research material from Bali is highly desirable. The first steps have already been taken by me to obtain this, by letter dated 25 Sept. 1917 to the Civil Lieutenant Governor W. Baptist, who at that time was active on the islands of Pali and Lombok for a short period of time. Said Lord Baptist, who had already made himself useful by observations about Rafflesiaceae in the deepest interior of the Gayu countries belonging to Aceh (Sumatra) and whose name is mentioned below, among others, on p. 107 and 109, his goodwill had informed me (by letter 9 Nov. 1917) of some of his recent *Rafflesia*c sightings in Bali, Lombok and Borneo. To this letter, which was in reply to a letter from me dated Sept. 1917 I derive the following information about Balien Lombok; "Being in Lombok I already started research into *Rafflesia* species, but little interest of the Europeans living there in the Netherland Indies flora compelled me to do the research on my own. Although I was only briefly stationed in Lombok, I can say that I have been very well in the woods and have used my eyes very well."

"I was also charged with the administration of the Djembrana section in Bali for 2½ months; there also I made inquiries into this giant flower; however, I have not been able to find a *Rafflesia* species. Information obtained from the population, mainly from the most well-known forest runners, did not bring me on the track of this invasive plant, nor do I believe that it is native to those two islands." (Baptist msc. 9 Nov. 1917).

Rafflesiaceae spec. no. 2. (Banjoewangi).— In East Java near Watoedodol, in the Banjoewangi section of the Besoeki residence, Teijsmann mentions the occurrence of a *Rafflesia*, which he took for *R. patma*, but whose identity I have with *R. patma* in connection with the geographic distribution of this species verified by me. However, this cannot be determined without research material.

In the Buitenzorg Herbarium material from the division Banjoewangi is missing under the Rafflesiaceae. The only *Rafflesia*, which is represented there from the same residence (Besuki), but from a different section (Djember) in the Buitenzorgsche Botanical Museum, namely two specimens belonging to the Herbarium Koorders, are, as I mentioned above (p. 67- 72) have shown, not *Rafflesia patma*, under which incorrect type name they have been in the collections at

Buitenzorg for more than 15 years, but a new one, above on p. 67-72, a sharply different species from *R. patma*: *Rafflesia zollingeriana* Kds.

Rafflesiaceae spec. no. 3. (Djerneh-Aceh).– From Mr. W. Baptist, then Lieutenant Governor of the Acehnese subdivision Serbodjadi, I received a sketch drawing of a flower made by him and some further written information dated 2 February, 1916.

For this information I express my gratitude to the Lord Baptist.

Research material of this extraordinarily curious, in my opinion either perhaps belonging to a new species of *Sapria* or perhaps belonging to an entirely new Rafflesiaceae genus of parasitic plant, is not at my disposal. As soon as I have received the necessary material (flower and if possible also fruit), I hope to return to this plant.

The first discovery of a representative of the Rafflesiaceae family on the Djerneh River belongs to Mr. F. W. J. Brewer, who long ago submitted to me his written observations on this subject for publication. Apart from his in the Natuurmonumenten Announcement No. 2 of Netherland Indies Association for Nature Conservancy, which will soon be published (currently going to press), contains a sketch map in the archives of our aforementioned Association, written by Mr. Brewer, on which the Rafflesiaceae habitats discovered by him in the Atjehsche Gajoelanden (North Sumatra) are indicated.

I hereby express my gratitude to Mr. Brewer for the important information he has provided me with about the Rafflesiaceae discovered by him on the Djerneh River in 1914.

In my opinion, the genus *Sapria* is somewhat reminiscent of what Mr. Baptist writes to me about the occurrence of closely spaced stamen-like ramenta on the diaphragm, which according to his sketch drawing is almost closed. But because of the small number (5) of the perianths, this curious plant, provisionally held by the Lord Baptist for a species of *Rafflesia*, deviates from the genus *Sapria*. Because in *Sapria* the number of perianths is not 5, but according to Griffith 10 and in the genus *Richthofenia*, which may be identical with *Sapria*, this number is (according to Hosseus) even 20.

Sending flowers and fruits of this still very insufficiently known Rafflesiaceae that grows on the Djerneh River, preserved in alcohol (or methylated spirits) in tin or zinc [containers], will be greatly appreciated and the costs will be gladly reimbursed by me immediately. *)

In the interest of later investigations I must point out a contradiction in the statements of Mr. Brewer and Baptist, who visited successively, the first in 1914, the last in 1915 and 1916, the original habitat of this as yet insufficiently known species of the Rafflesiaceae. The contradiction is that Mr. Brewer in his travel journal only speaks of Rafflesiaceae flowers of a meter in diameter, while Mr. Baptist only found Rafflesiaceae flowers of ⅛ m to less than ½ meter in the same habitat. The question, which can only be answered by a renewed investigation of the habitat, is now this: 1) are there perhaps two species of Rafflesiaceae growing on the bank of the Djerneh River (Aceh) in question, namely the one with a size of about a meter and the others with flowers less than ½ meter in diameter, blooming at different times (which would clear up the contradiction) or 2) is there only a single Rafflesiaceae species growing on the Djerneh River?

Mr. W. Baptist had the kindness to write to me on 9 November 1917 in more detail about this species of the Rafflesiaceae observed by him on the Djerneh River in North Sumatra in 1915 and 1916: “The small *Rafflesia* flower was a beautiful dark reddish-brown, no bumps or spots and was velvety; the shape was like a washbowl with straight walls, but somewhat with an inwardly curved edge” “R. Roos, Lieutenant Governor for the Interior of Serbodjadi is an extremely helpful man, who, if you request him personally, will certainly support you in your research and will certainly provide you with the most extensive information.” (according to Baptist).

Already at writing No. 637/35 dated Lököp 7 Nov. 1917 I obtained from Lieutenant Governor R. Roos the benevolent undertaking to cooperate in obtaining research material of these Rafflesiaceae and already in his letter of 6 December (1917) No. 743/35, Mr. R. Roos

informed me that he had succeeded in finding the desired "little *Rafflesia*" and in preserving two flowers of it in methylated spirits. An extract from this last letter is reproduced here:

Afschrift.

Onderafdeeling Serbodjadi. Lököp 6 December 1917.
Aangeteekend.
No. 743/35
Bijlage een kwitantie.

Aan den Heer Dr . S. H . Koorders
Voorzitter der Nederlandsch Indische
Vereeniging tot Natuurbescherming
te Buitenzorg.

"Under polite presentation of the enclosed receipt, I have the honor YourEdZGel. to inform me that the box with the absolute alcohol has not yet come into my possession. The can will probably be shipped by water transport and I will receive it in the course of this month."

"I hereby politely note that my investigations have already led to the finding of two presumably small *Rafflesia*, which I may well have preserved with methylated spirits in a closed can. I couldn't solder the can since Dikep doesn't own a soldering device. However, this instrument has already been ordered by me."

De Gezaghebber
(was drawn) R. Roos.

In a letter dated Buitenzorg December 25, 1917, I expressed my gratitude to Mr. Roos. But my expressions of gratitude probably did not reach him alive. Because according to a message included in the daily newspaper "Javabode" of January 3, 1919, Lieutenant Governor Roos was killed on December 30, near the kampong Semboeang in the Acehnese Berbodjadi subdivision.

*) After this page had already been received by me in proof from the printer, I received the following letter below on p. 110 from the successor of Mr. Baptist, who died on December 30, 1917 in the Acehnese subdivision of Serbodjadi preserve.

Rafflesiaceae spec. no. 4 (Taroedjag-Atjeh). — In North Sumatra, in the Gayu countries belonging to the Aceh and Dependencies Governorate, East Coast Division, Serbodjadi (Lôkôp) Subdivision, according to the report issued by the Civil and Military Governor of Aceh and Dependencies Lt. General Swart to the Board of the Netherland Indies Society for Nature Conservation, dated February 3. 1916 directed letter by Mr. W. G. Baptist, then Lieutenant Governor of the Serbodjadi subdivision, discovered in the forest in the mountains, "an hour's walk" S.W. of the village of Taroedjag, a flowering specimen of a Rafflesiaceae, then provisionally held by him for *Rafflesia arnoldi*, with a flower of 70 centimeters in diameter.

Immediately after the discovery of this giant flower with a diameter of 70 cm, the Lieutenant Governor of the Serbodjadi subdivision (Lôkôp), Mr. W. G. Baptist, immediately took the necessary nature conservation measures against reclamation or damage to the original place of growth, in a way that cannot be appreciated enough. This as a result of me as former Chairman of the Netherland Indies Nature Conservation Association to the Governor of Aceh and Dependencies, Lt. General Swart has requested that a few *Rafflesia* habitats be located and protected within the said Acehsch administrative area. These nature conservation measures for this particularly remarkable *Rafflesia* were taken according to the extract of the journal of the Lieutenant Governor of January 20, 1915, which is published in the press, published by the aforementioned Association in the edition published by our Association, by den Mr. Ottolander compiled Natuurmonumenten-Dilededeeling No. 2.

From the small but successful photograph made by Mr. Baptist of that giant flower and donated to the Board of the Nature Conservation Association in 1916, it has become apparent to me on closer examination that the flower in question may not be *Rafflesia arnoldi*, but that we here may have a new, as yet undescribed, species of the genus *Rafflesia*.

Only when I receive research material or a detailed drawing of the flower parts can I make a decision about this.

Mr. W. Baptist had the goodwill to answer some questions in his letter of Nov. 9. 1917 about this "big" *Rafflesia* with a flower of seventy centimeters in diameter to provide the following further information:

"The large *Rafflesia* flower found by me was generally a dark reddish-brown; on the perianth lobes were thickenings, which appeared as warts and were lighter in color. The corolla was also reddish-brown outside with paler warts, while the inside was a slightly paler and redder brown in color and looked like velvet, with irregular white spots on it, which were also wart-shaped, and were neither petiolate nor hat fungus-shaped, but were only local elevations (bumps). The fact that these white spots are visible on the photo is because I had torn out part of the crown and placed it inside out on top, in order to make the white spots stand out well. This flower was over 70 cm in diameter. (according to Baptist)

The aforementioned photo of this North Sumatran Rafflesiaceae No 4 (Taroedjag) has now been reproduced by me in this publication.

Tips for collecting and preserving *Rafflesia* research material.

If, because of the gigantic flower dimensions, it should prove too inconvenient or too costly to send me a few whole flowers undamaged in pure strong alcohol, soldered in zinc or tin, from Sumatra, etc., then at least it is urgent and desirable that a male and a female flower with a ripe fruit (if necessary in methylated spirits or gin), divided into pieces in the manner indicated below, be sent to me. The costs of this will be gladly refunded by me.

Hereby the five thick, fleshy perianth lobes with the cap-shaped subsidiary crown (diaphragm) grown to them are divided into 5 pieces by longitudinal cuts reaching near (but not into) the foot of the thick central column. Furthermore, the central column (columna), which resembles a gigantic "pistil", is carefully wrapped with white cotton cloth or wood wool or indjoek (areng palm fibers [*Arenga pinnata*]) against damage to the brittle protruding parts. All six pieces

belonging to a single flower (the column plus the five perianth strips) with one and the same collection number, written in soft pencil on sturdy paper. A list of collection numbers to be sent separately will state the colors and dimensions of the living flower parts, the smell of the flowers, the exact location, date of the find, sea level, name of the person who collected the plant, etc.

When the *Rafflesia* flowers have been divided, packaged and labeled in this way, they take up so little space that even for a flower of a large *Rafflesia* species two ordinary petroleum cans are often sufficient, while with sufficient copious use of alcohol (methylated spirits, arrack or gin) research material is obtained according to this simple method, which is very useful for various scientific investigations, including for species identification; at least provided care is taken that the finer flower parts (including the filamentous protrusions of the perianth tube and the protrusions of the disc) do not break during transport.

According to Prof. Ernst 2) who has achieved excellent results, it is recommended to preserve the Rafflesiaceae material specially intended for cytological investigations as follows. For anthers and young fruits and ovaries, alcohol is first used (1 or 2 days) for "fixing" with acetic acid, chromoacetic acid or chromosmic acid solutions and then preserved definitively in absolute alcohol in glass stopper bottles and not in cans or zinc. In this special preservation method for nuclear research, the bud scales, perianth and diaphragm are removed beforehand.

This latter, "special", finer preservation method is, however, as already noted, not necessary for obtaining ordinary alcohol material, which is only intended for the identification of the species or for the preparation of the systematic-botanical species descriptions of Rafflesiaceae. It is sufficient for this to be preserved in soldered zinc cans or petroleum cans with ordinary so-called. "pure" alcohol (of about 90-97%, strength) or, failing that, with the help of ordinary methylated spirits or arrack or, if necessary, with gin. It is not necessary to fill the can completely with liquid, but only 2 or 3 liters per petroleum can, because the alcohol vapor works to sufficiently preserve, if not too little alcohol is taken.

If it is especially important to obtain beautiful demonstration material of Rafflesiaceae flowers, then according to Heinricher 1) it is advisable to either immerse the flower in boiling water for a short time before preserving it in alcohol or to immediately use warm alcohol. Heinricher found that the unsightly ink-black discoloration of the flower parts, which otherwise almost always occurs with *Rafflesia* and *Brugmansia* flowers in (cold) alcohol, was completely omitted.

However, for obtaining ordinary identification alcohol material of Rafflesiaceae it is not necessary and in many cases not desirable to first put the flower in boiling water or to preserve it in hot alcohol, but it is sufficient to immediately wash the flowers with "cold" alcohol or canned methylated spirits.

However, special care is always required for the packaging and wrapping of flower parts because the flower parts of the Rafflesiaceae, preserved in alcohol, are extremely brittle.

Dr. S. H. KOORDERS.

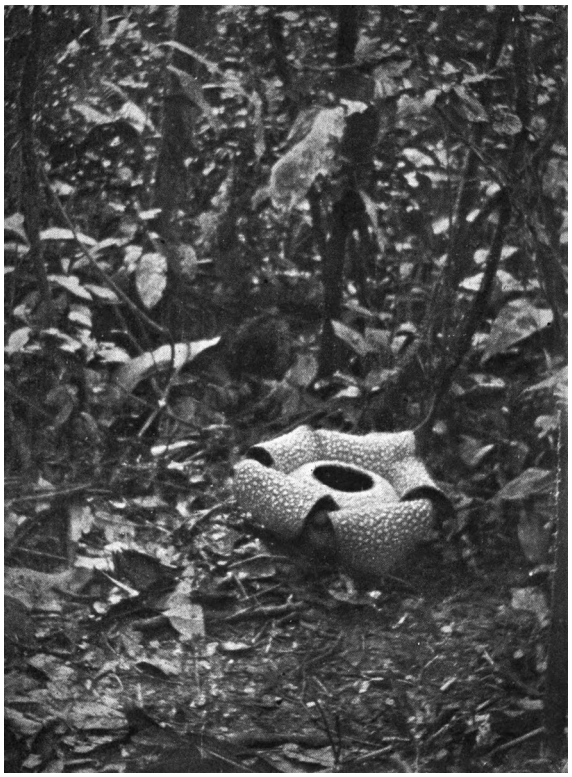
Buitenzorg, 6 January 1918.

Plate legends.

Plates 1 en 2. (opposite p. 1.)

***Rafflesia arnoldi* Rob. Brown**. The open flower of this species has a diameter of ⅔ meter to over a meter. These two plates are made after enlargements, which were made in Batavia by the reproduction workshop of *G. Kolf & Co.* are made after a nature monument post card from our association. I had the postcard in question made in June 1916 in Leiden at the *Eerste Nederlandsche Rotographure Maatschappi*. Due to the time circumstances as a result of the World War, it was not possible to send me the box with printed *Rafflesia* postcards from Holland to the Indies, which had been ready in Leiden long before the end of 1916. Fortunately, from the member of our society living in Leiden, Major W. Fischer, who had supervised the proof of the postcard in Leiden, I received a single copy of our *Rafflesia* postcard. It is from this single postcard copy, which finally reached me in the Indies, that I made the two enlarged autotype reproductions by G. Kolff & Co. in Batavia, which are now published as Plates 1 and 2. I had the picture postcard in question made after two small, very beautiful photos, which I (as chairman of the Netherland Indies Nature Conservation Association) of Mr L. C. Westenenk, Resident van Benkoelen by letter dated 23 May 1916 for publication (as postcard) for gifts received. I received further information in a letter from Resident Westenenk about this important photo gift on 14 Aug. 1917. This showed that the two photographic nature shots of the *Rafflesia* flowers were made by an "unknown German or Englishman", after the flowers had been cut off and placed on a lawn. Both flowers were then "thrown away". These flowers were found at Muara Aman in the Benkoelen residence.

However, "The *Rafflesia*" (as Mr. Westenenk further writes) also occurs in many other places in the Benkoelen residence. You can therefore say with equal justice that this flower is a representation of the *Rafflesia* occurring in the places in Redjang (also residence Benkoelen) that we make natural monuments, located on the western and northwestern slope of the volcano Kabah, height 500 to 700 meters." (After photographic nature shots; gift from the Resident L. C. Westenenk).



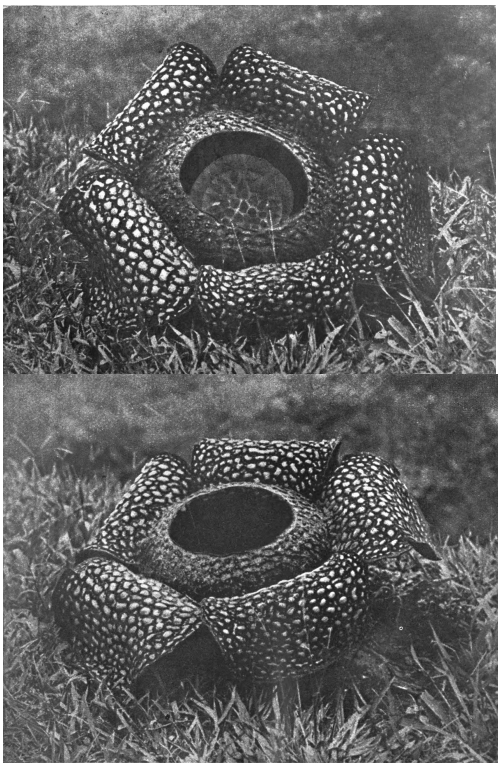


Plate 3. (opposite p. 31.)

***Rafflesia arnoldi* Rob. Brown**. *A* Liana stem with flower buds of the proliferating *Rafflesia arnoldi*; *B* Female flower bud in longitudinal section; *C* Female flower bud seen on side, after all sheathing bracts and perianth lobes have been cut away; *D* Ripe fruit with numerous seeds in longitudinal section; *E* Seed, viewed from side; *F* Seed in longitudinal section; *G* Section from the anther bearing column; 3 anthers are visible; *H* An anther seated in a piece of the rim of the disc-shaped upper part of the column; *J* ditto longitudinal section; *K* idem cross-section; the numerous anther locules are visible; *L* Pollen grains (all figures after Robert Brown; *A—D* reduced; *E—L* enlarged).

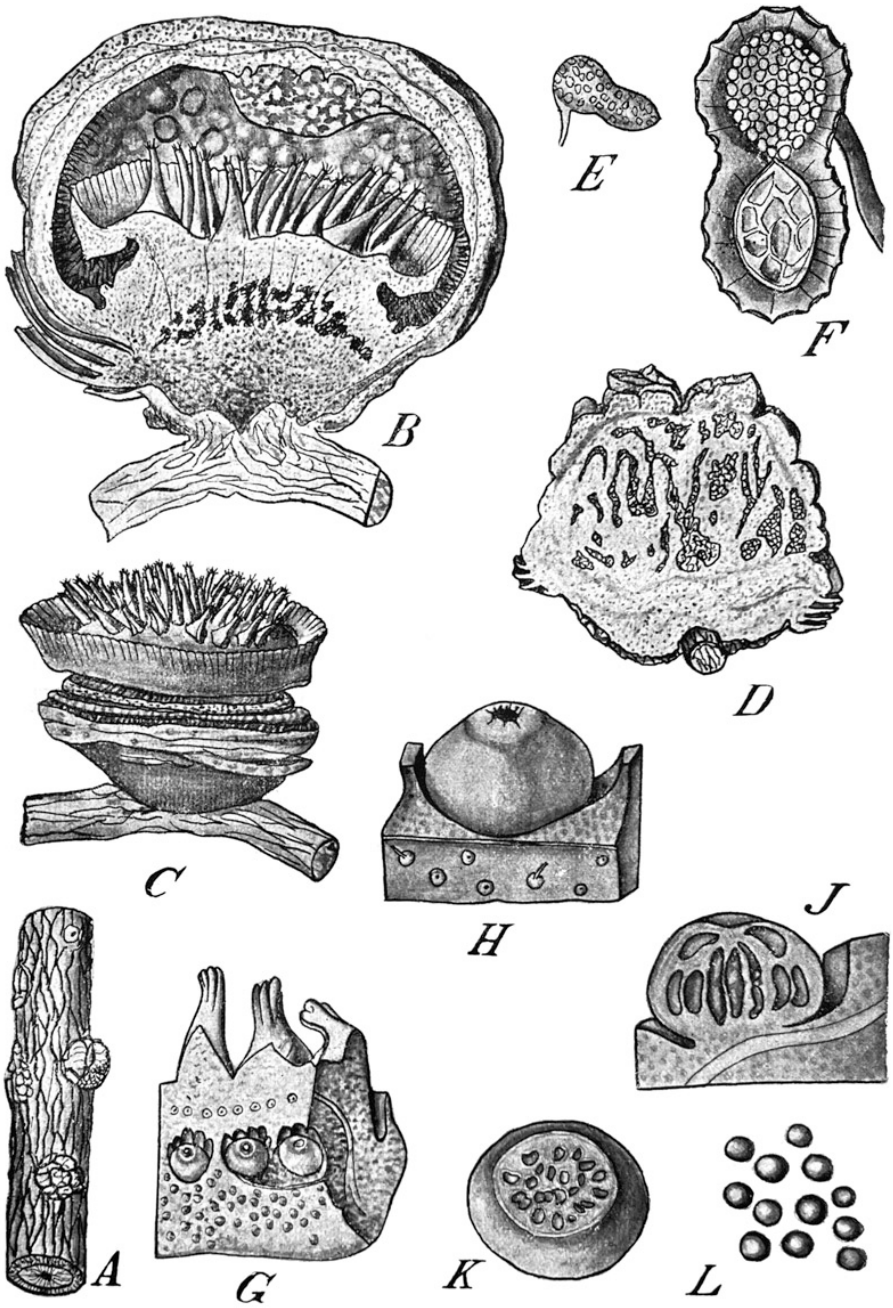


Plate 4. (opposite p. 47.)

***Rafflesia borneensis* Kds**. *A—C* Female flower; *A* Column with ovary and cupula sitting on a root of the host vine; seen on side; *B, C* Sections of the columnar disc viewed from the side (a comb-shaped, oblique serrated edge; *b* Annular thickening on the outer side of the columnar disc; *c* Flat portion of the outer side of the columnar disc; *d* Six seated staminodes; *e* Staminodial grooves; *f* underside of the columnar disc). (*A—C* Original, after alcohol material)

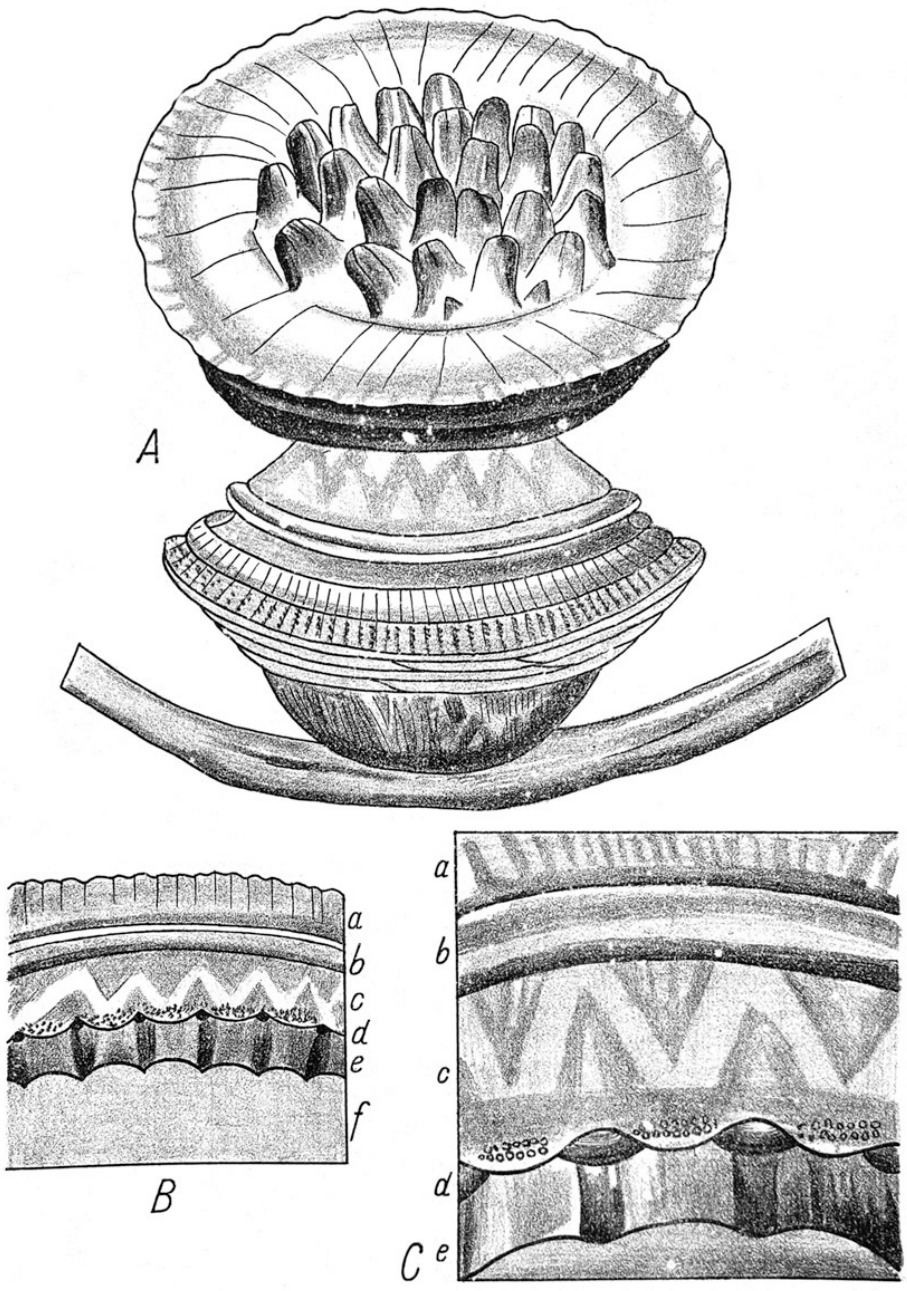


Plate 5. (opposite p. 49.)

***Rafflesia* borneënsis Kds.** *D* Part of the column with the two basal annuli, part of the perianth tube and the cupula; *E* Part of the column (in longitudinal section; *D, E* Original, after alcohol material).

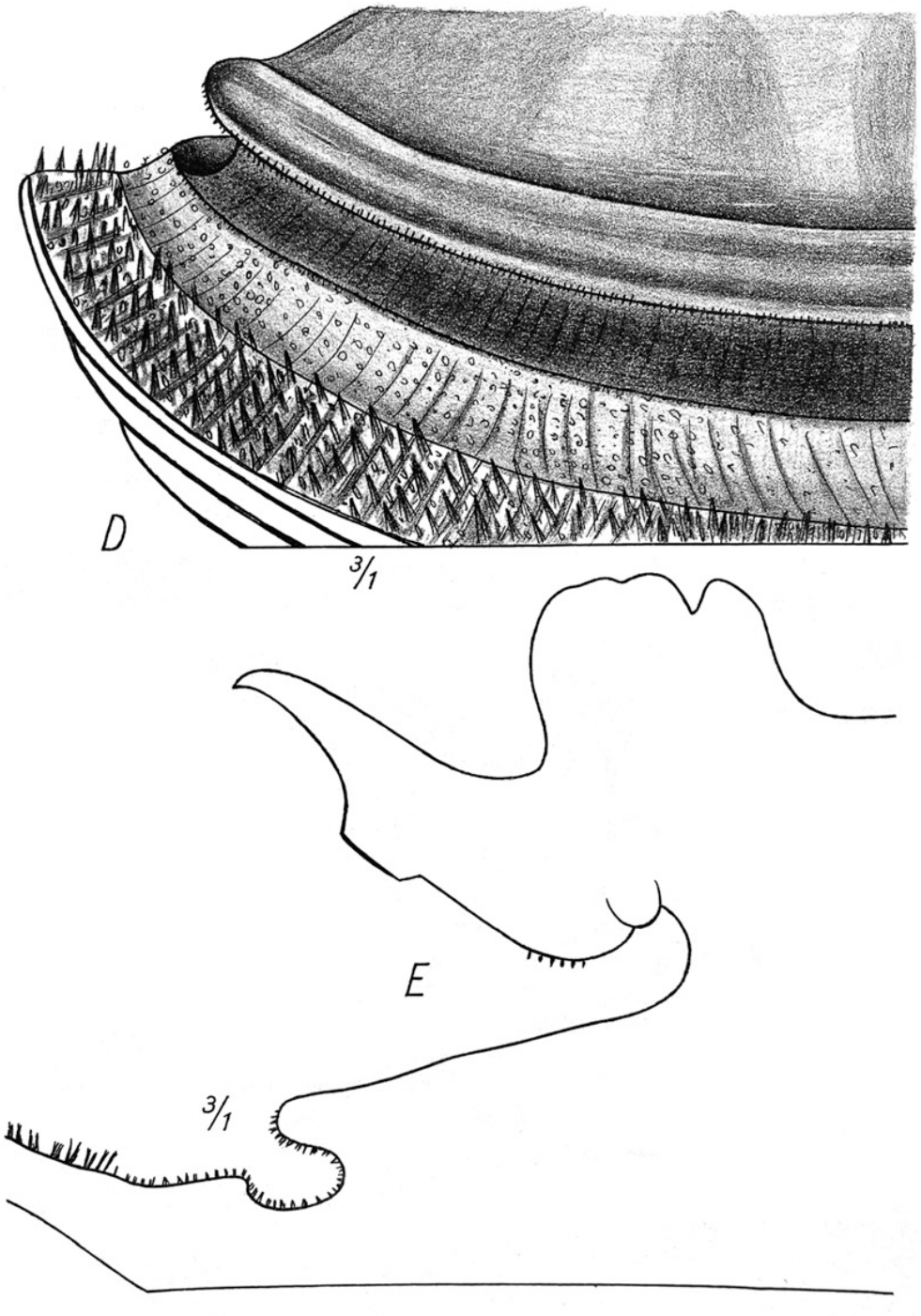
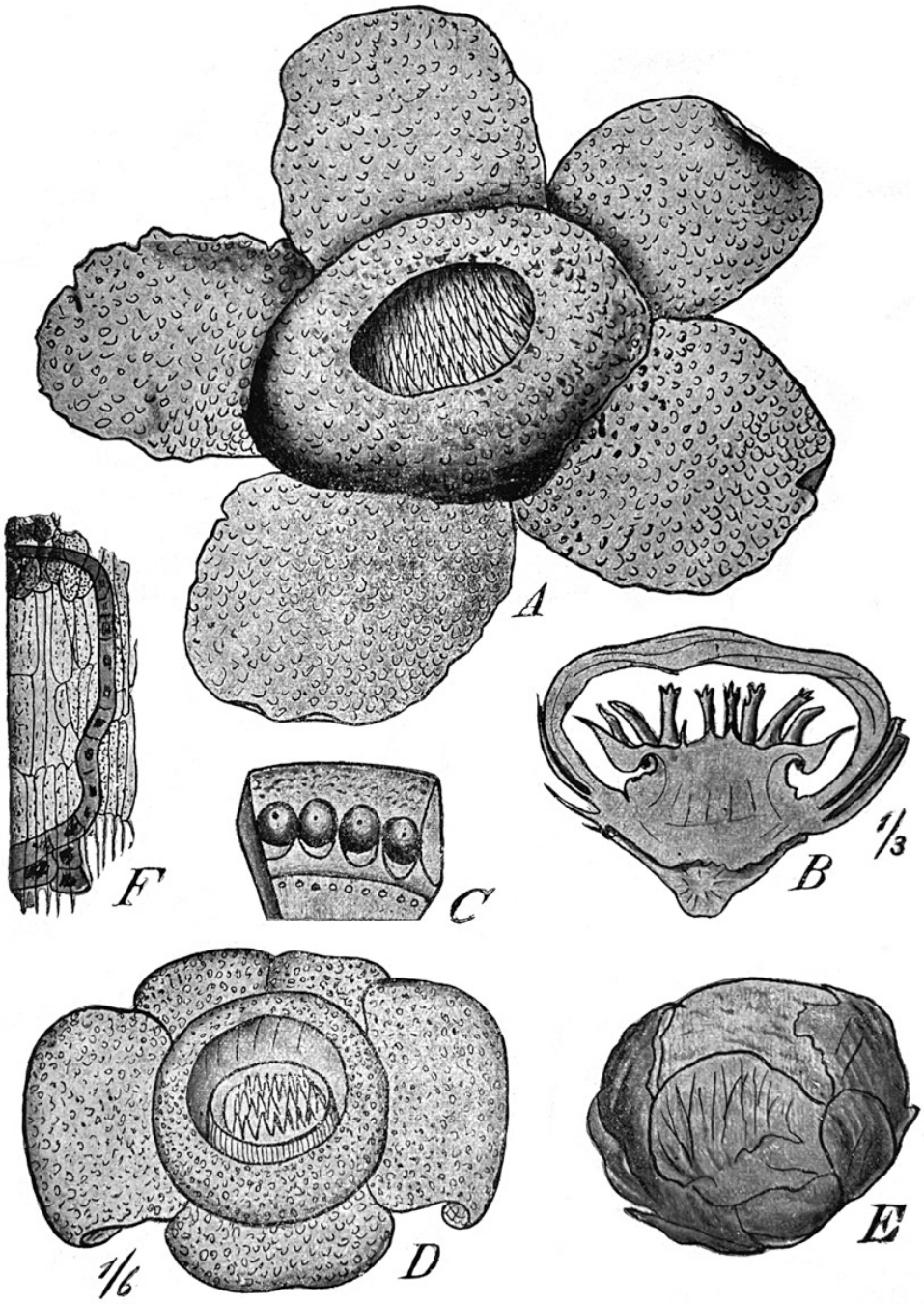
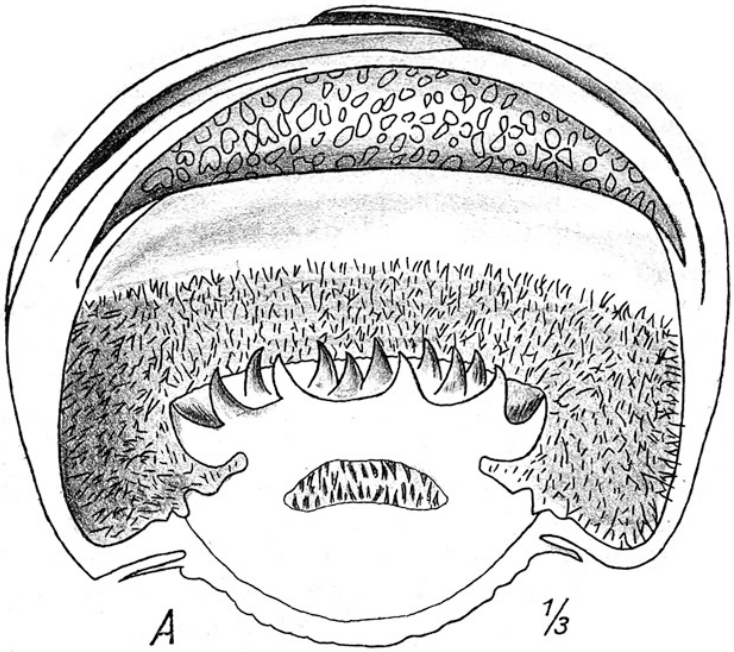


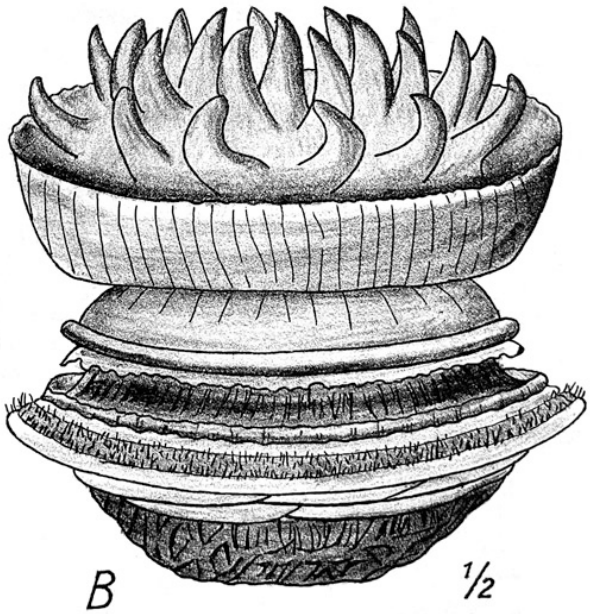
Plate 6. (opposite p. 51.)

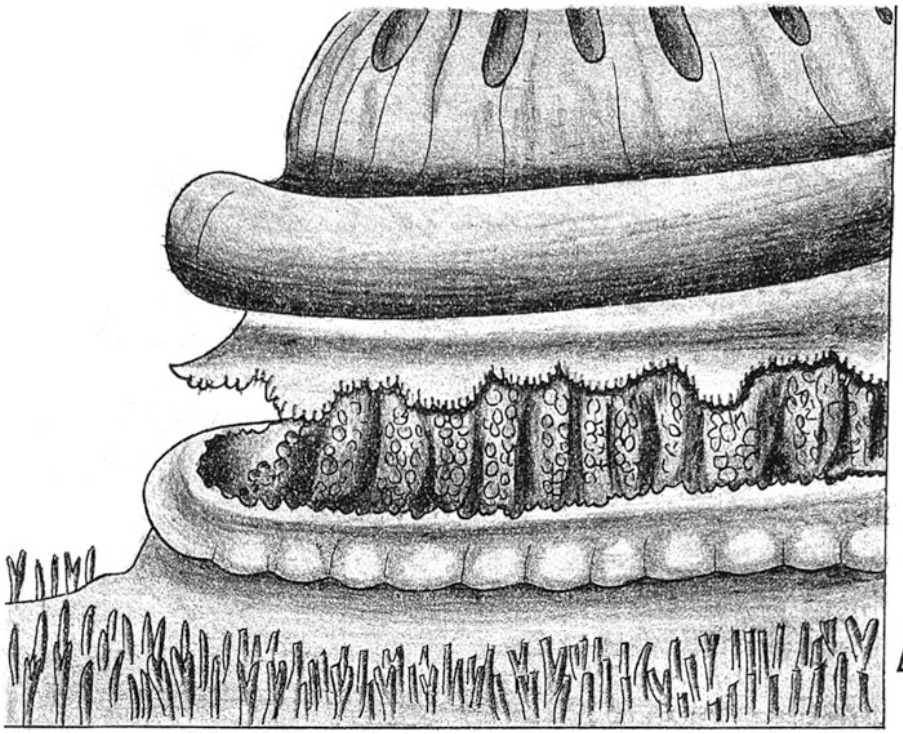
***Rafflesia patma* Bl**. *A* Living Flower; *B* Male flower bud in longitudinal section; *C* Section of the stamen-carrying column with four anthers; *D* Flower; *E*. Flower bud; *F* Thallus thread of *Rafflesia patma* within the secondary bark of a liana species belonging to the Vitaceae-Cissoideae. (*A—C* After Haak; the diameter of the living flower was 39 cm; *D, E* After Blume; *F* after Engler und Prantl).



Plates 7 en 8. (opposite p. 61 and 63.)
***Rafflesia witkampi* Kds**. *A —F* Female flower bud: A Flower bud in longitudinal section; *B, C* Column (viewed from side and longitudinal section); *D* Base of the column seen on the side, with part of perigone tube; *E* Types of ramenta from the inner side of the perigone tube; *F* Two rudimentary anthers in the glabrous, short anther cavities, which are separated by a rather glabrous dividing wall. (*A — F* Original, after alcohol material).



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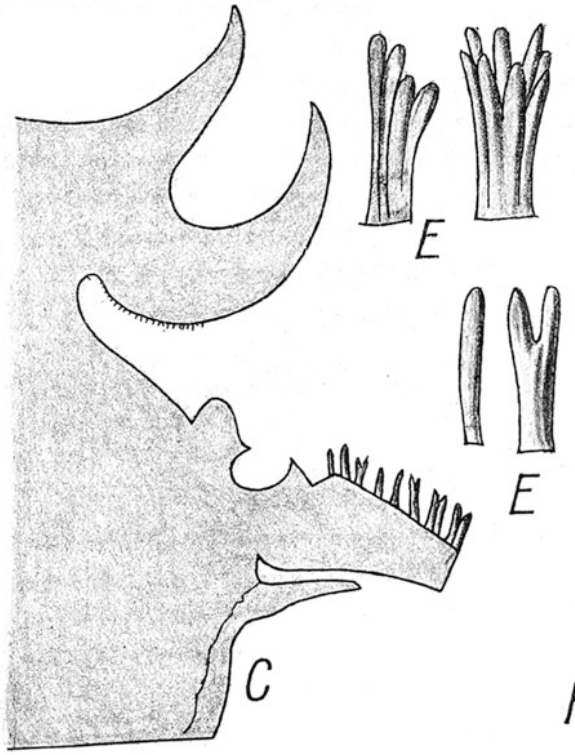
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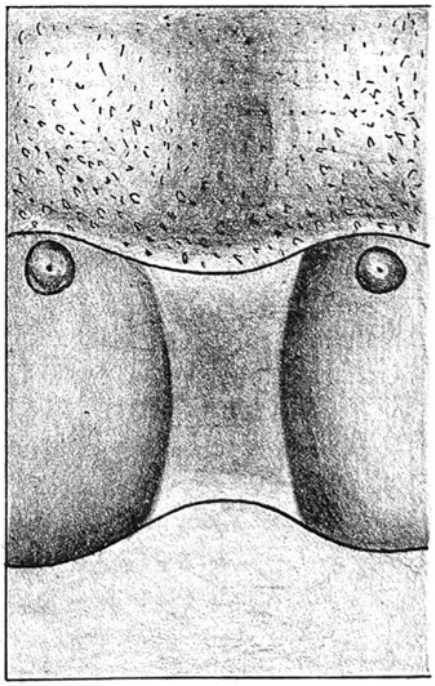

F

Plate 9. (opposite p. 65.)

***Rafflesia ciliata* Kds**. *A* Column longitudinal section; *B* Part of column with anther in longitudinal section; *C* Three anthers and anther cavities seen from the front; *D* idem of two anthers (enlarged); the lashed narrow rampart between the two anther cavities is clearly visible; *E* Pollen grains, all with rich protoplasmic content; *F* A pollen grain (higher magnification). *G* Ramenta of the inner side of the perianth tube. (*A–G* Original; after alcohol material).

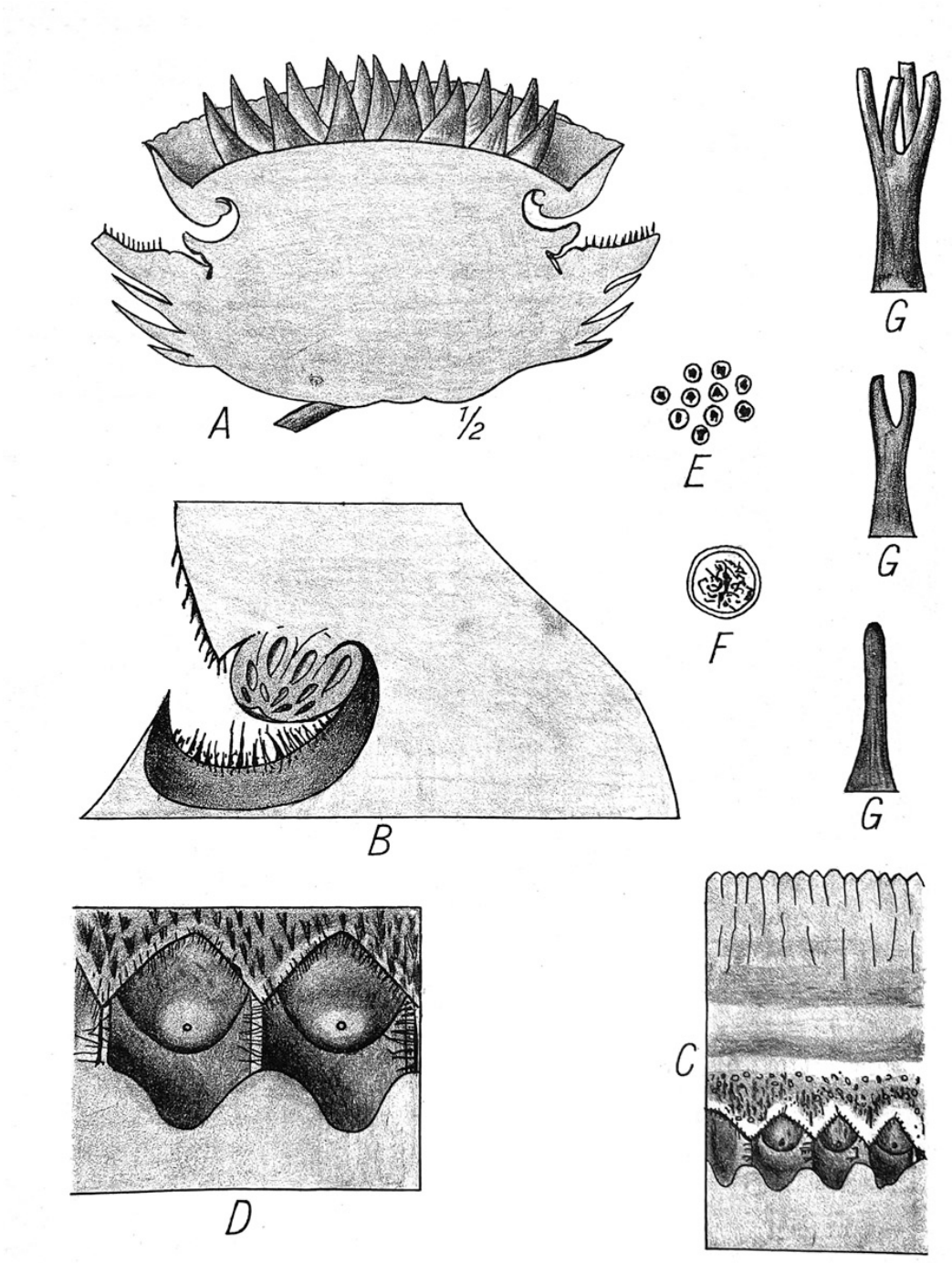


Plate 10. - (opposite p. 69.)

***Rafflesia zollingeriana* Kds**. *A* Male flower bud, longitudinal section; *B* Female flower bud, longitudinal section; *C* Part of the placenta with ovules (greatly enlarged); *D* ditto (magnified more); *E* Longitudinal section through the Solm's "stigmatic Ringflache" of the lower edge of the disc (a protoplasmic hairs of the "stigmatic Ringflache", in which I found a germinated pollen grain; *b* Almost empty, only air-filled guard hairs, seated on the outside of the stigmatic Ringflache; *c* Parenchyma tissue of the disc); *F* Perianth lobe (*a*) with part of the perianth tube (*b*) and part of the diaphragm (*c*); *G* Inner side of the perianth tube; *H* Three types of ramenta of the inner perianth tube; *J* Inside of the diaphragm; *K* Three types of ramenta from the inside of the diaphragm (All figures original, after alcohol material from Herb. Kds. 40312 β and 39915 β).

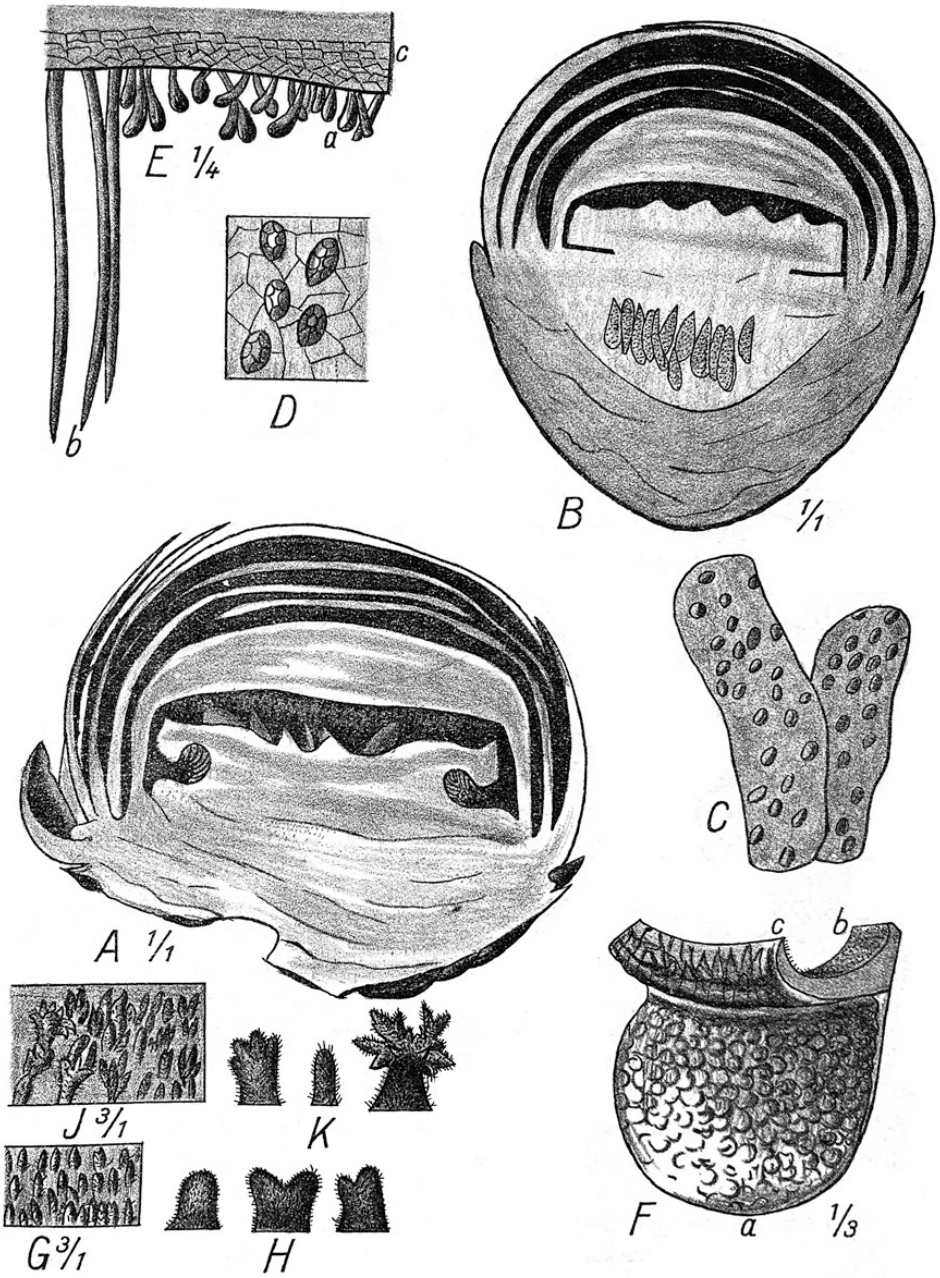


Plate 11. (opposite *p. 72.)*

***Rafflesia zollingeriana* Kds.** *A* Female column with the cupula sitting on a liana stem. The perianth and bracts are omitted in the image; *B* Living female flower viewed from above; *C* Longitudinal section through half of the column of the female flower; *D* Exterior of the female column showing the rudimentary anthers and the very indistinct, very shallow rudimentary anther grooves. (*A, C, D* original, after alcohol material Herb. Kds 39975 β . — *B* somewhat schematic sketch made by me from the living open flower).

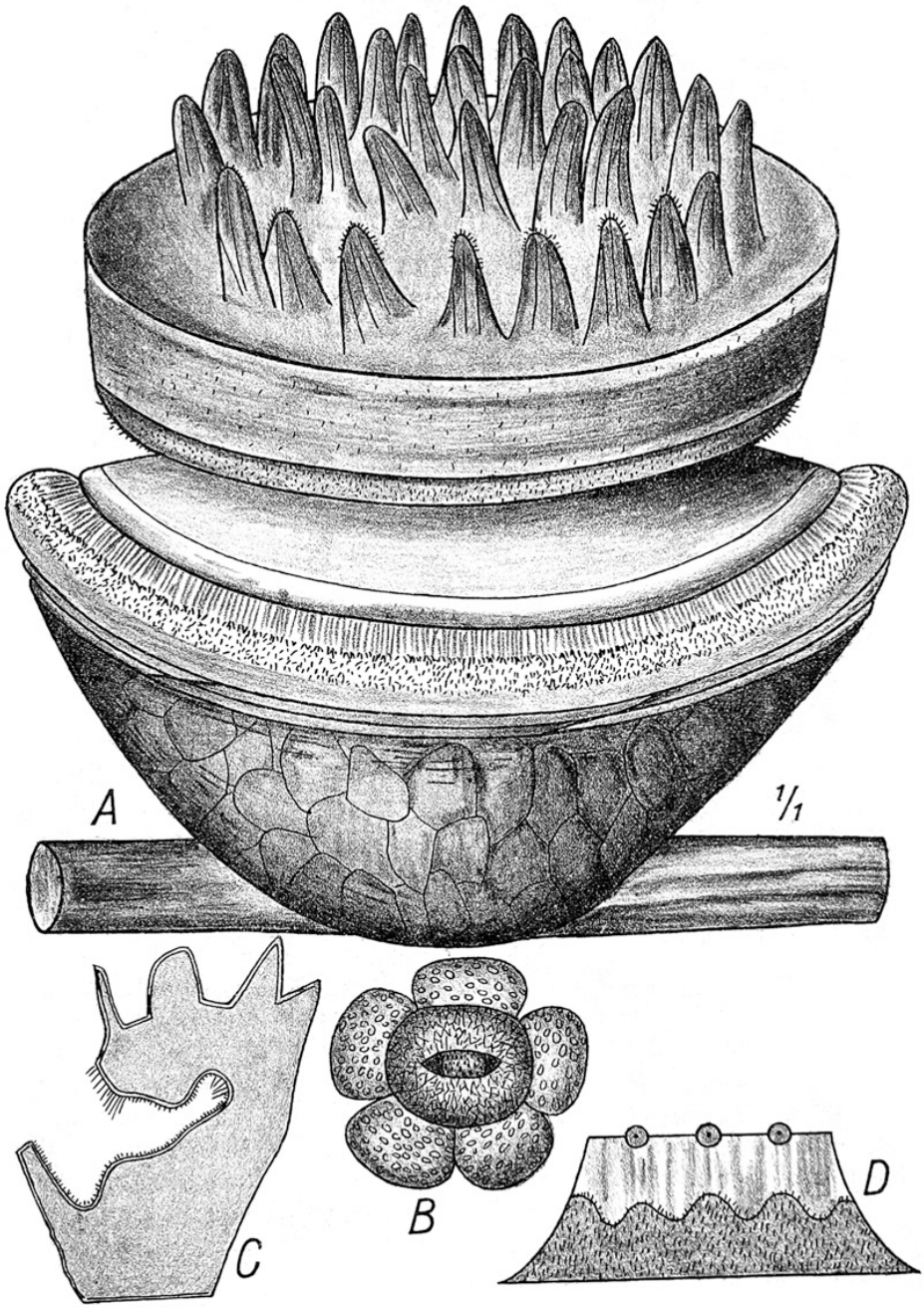


Plate 12. (opposite p. 79.)

A—E ***Rafflesia hasseltii*** **Sur.** *A* Foot of the column with the disc edge and the foot of the perianth tube; *B* Anther cavities with three anthers, seen from the front; *C* Two cells of the ovary of the same flower half; *D* Petal inner side; the large confluent wart-spots are very conspicuous; *E* Flower seen from above (⅒); *F— H* ***Rafflesia rochusenii*** **Teijsm. & Binn. var.** ***subaculeata*** **Kds.,** *F* Longitudinal section of column with part of perianth tube of male flower bud; *G* Disc protrusion from Ditto; *H* Longitudinal section of column of female flower bud. (All original after alcohol material; *A—E* after a hermaphroditic flower, which was presented to the Herb. Bogor. by the Controller of Moearalaboeh from Central Sumatra, and which was first recognized as hermaphroditic by Boerlage; *F, H* from alcohol material of Scheffer and of unknown provenance in Mus. Bot. Hort. Bogor.).

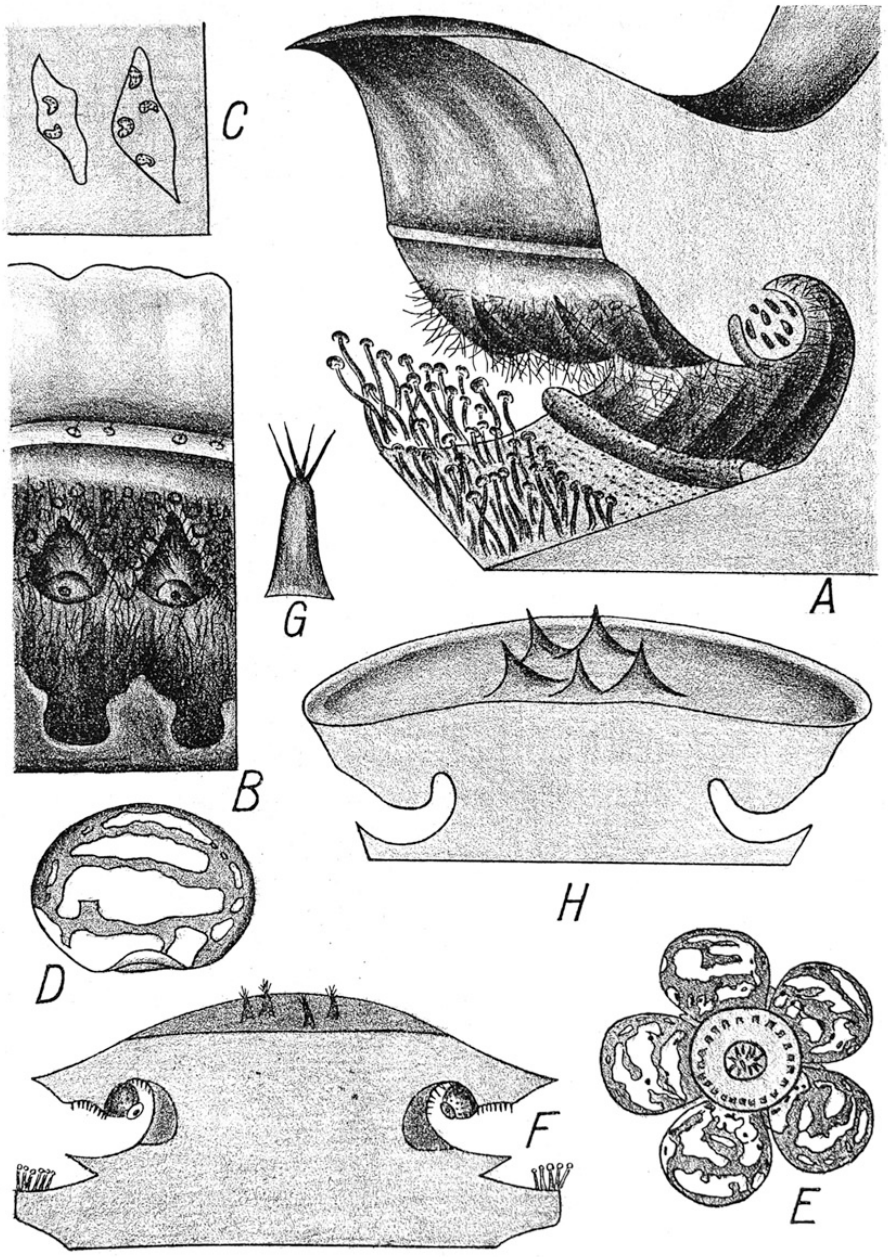


Plate 13. (opposite p. 83.)

***Rafflesia rochussenii* Teijsm. et Binn.** *A* Habit. Flower bud and flower on a creeping liana; *B, C* Longitudinal section of flower buds (*B* female and *C* male flower bud; *D* Longitudinal section of a female flower seated on a vine; the bracts and perianth segments have been cut away to highlight the "naked" upper surface of the broad column; *E* Ovarian sacs with ovules; *F* Ovule; *G* Section from the anther-bearing column; *H* Anthers; longitudinal section; *J* Pollen grains; *K* Ripe fruit with seeds; proliferating on a liana; (All figures after W. de Vriese).

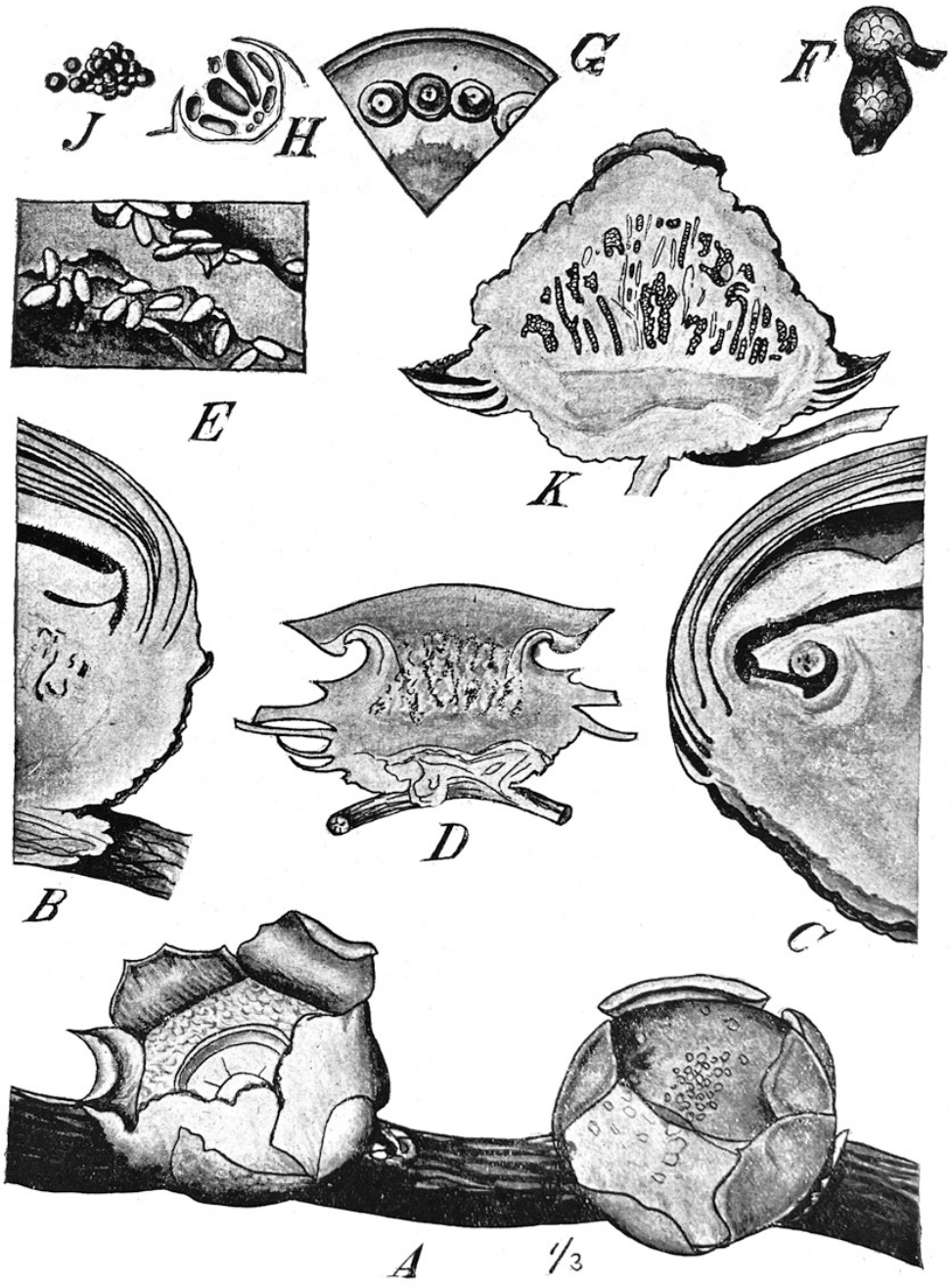


Plate 14. (opposite p. 87.)

***Rafflesia rochusenii* Teijsm. et Binn.** Flower proliferating on a liana root (Herb. Kds. n. 40448 β) by me from Jhr. Th. W. Boreel received as a gift on 19 Oct. 1917, from the forest of G. Probakti (West Java), located S. W. van den G. Salak. Since the upper surface of the disc column is only gently undulating and has no pointed projections on it, this flower belongs to the forma typica. (Original, after a photo by P. Hermann of the flower mentioned above.

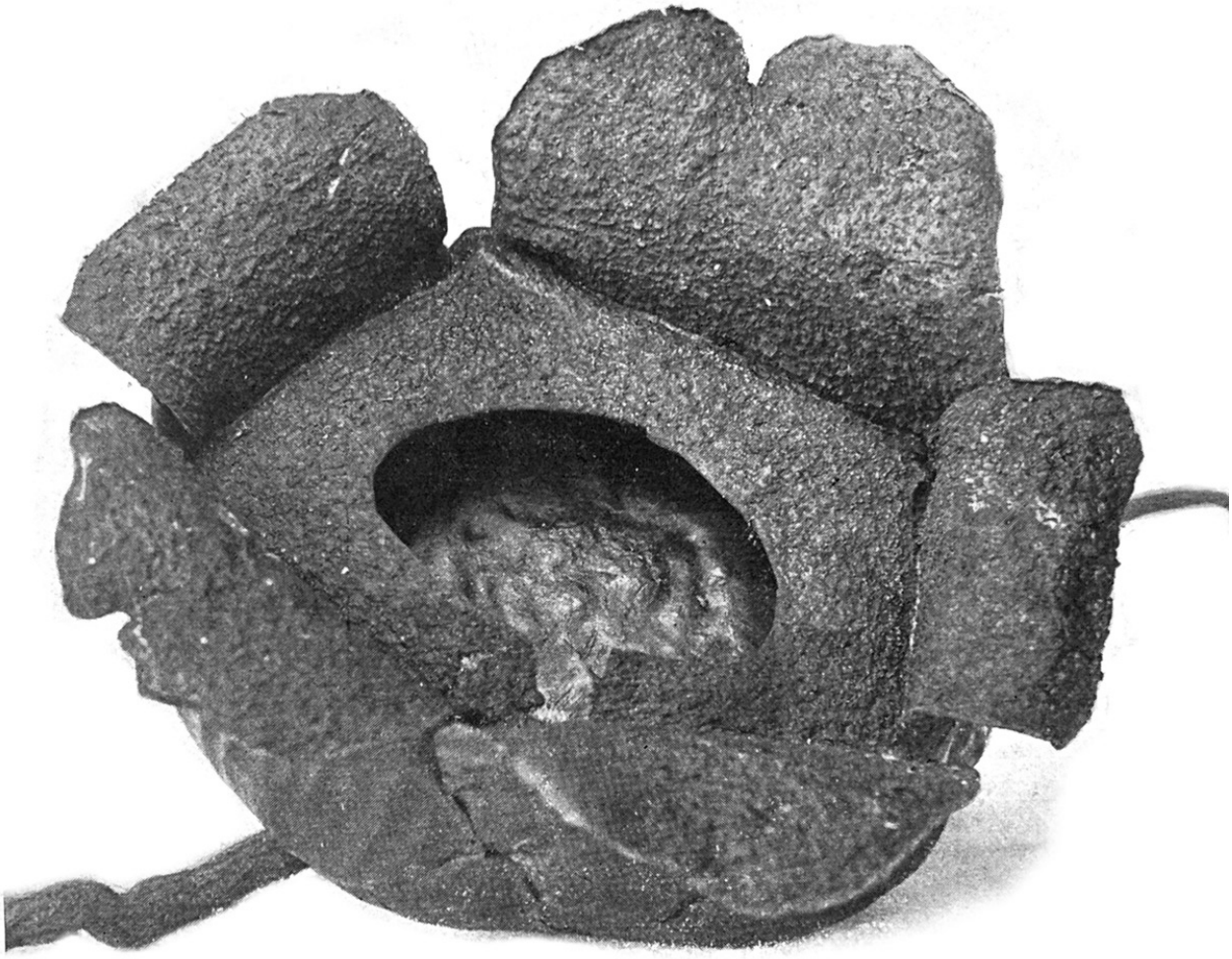


Plate 15. (opposite p. 91.)

A ***Sapria himalayana*** **Griff.**; *B—F* ***Richthofenia siamensis*** **Hoss.**; *G* **Rafflesiaceae spec. indet: No 3 (Atjeh).** *A* Flower cross-section; *B, C* Column of male flower (*B* on side and *C* seen from below); *D* Anthers in longitudinal section; *E* Ovule; *F* Ramenta of the diaphragm; *G* Opened flower, viewed from above. (*A* Copy after Solms-Laubach, *B— F* after Hosseus); *G* Original after pencil sketch drawing by Baptist 2. II. 1916).

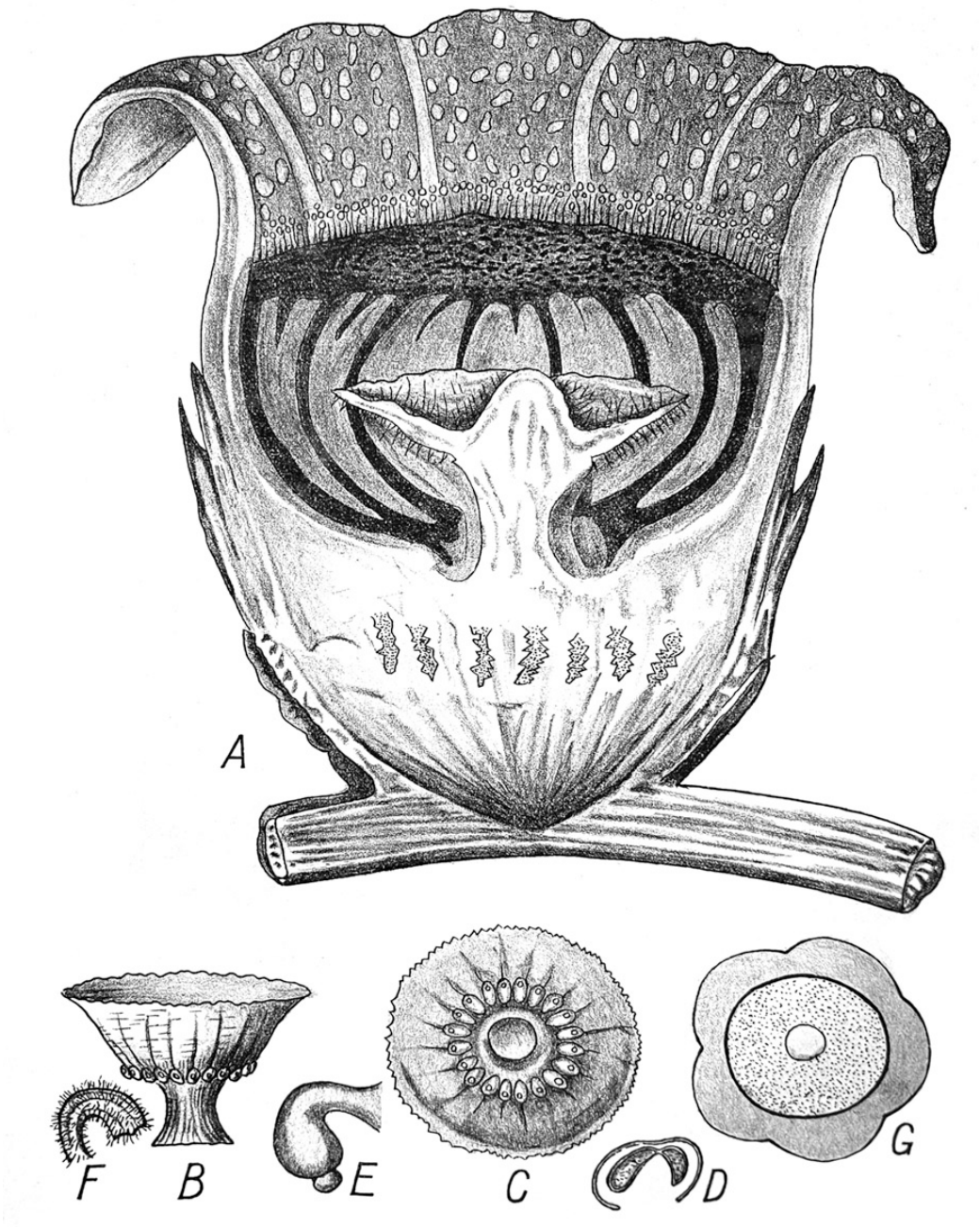


Plate 16. (opposite p. 95.)

***Brugmansia zippelii* Bl**. *A* Flower and flower buds proliferating on liana root: *B* Bisexual flower bud in longitudinal section; *C* The stamen-bearing column; *D* Anther in section. *A, C, D* From Blume; *B* After Engler and Prantl.

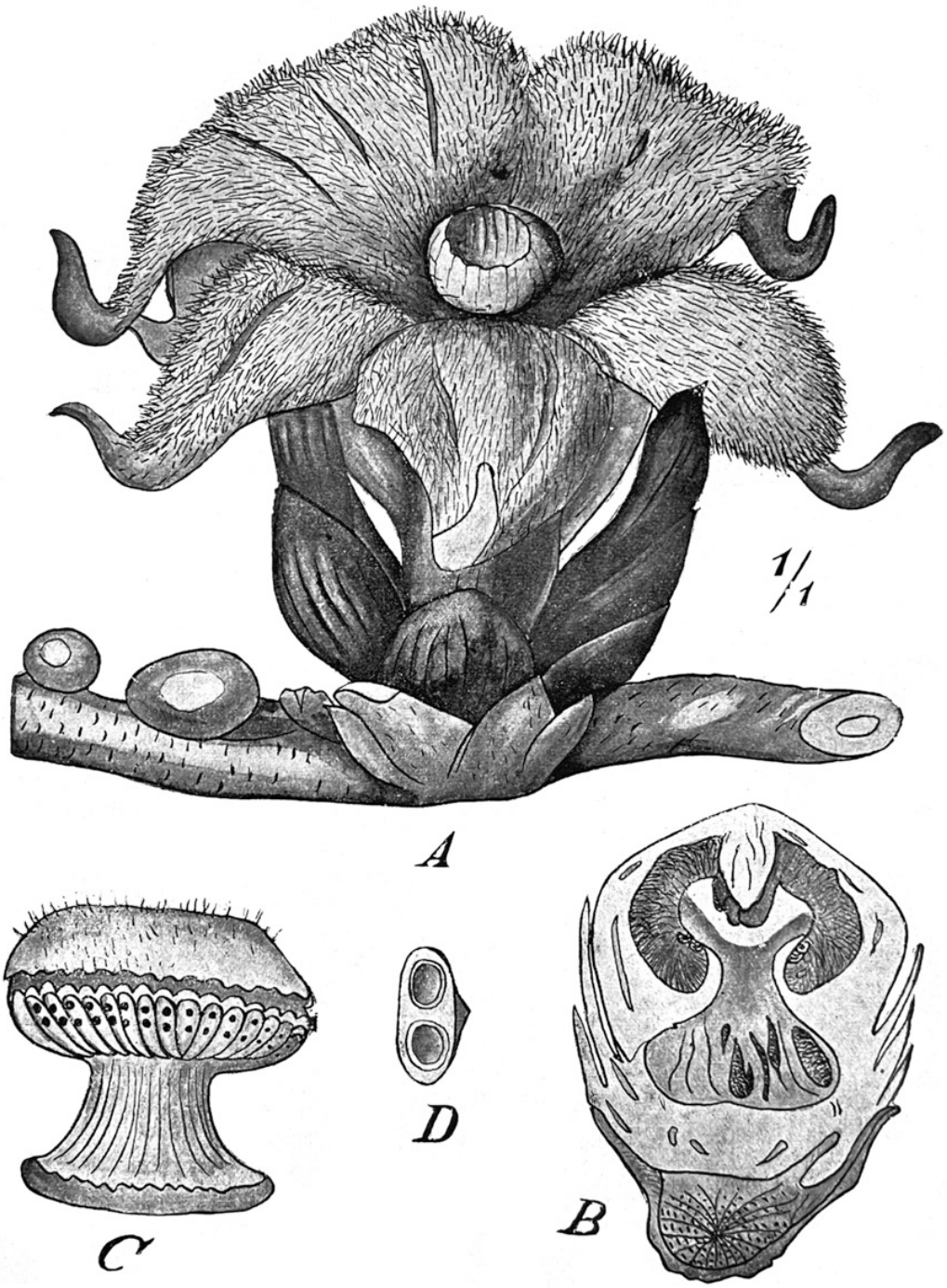


Plate 17. (opposite p. 102.)

A ***Rafflesia hasseltii*** **Sur.;** *B* ***Rafflesia arnoldi*** **Rob. Brown**; *C—E* ***Brugmansia lowi*** **Becc**. (*A* Copy after Suringar and Engler und Prantl; *B* after an unpublished, colored, after nature drawing donated to the archives of the Netherland Indies Nature Conservation Association by T. Ottolander, C, D after Beccari; *E* after a colored drawing from Forbes published by Fawcett).

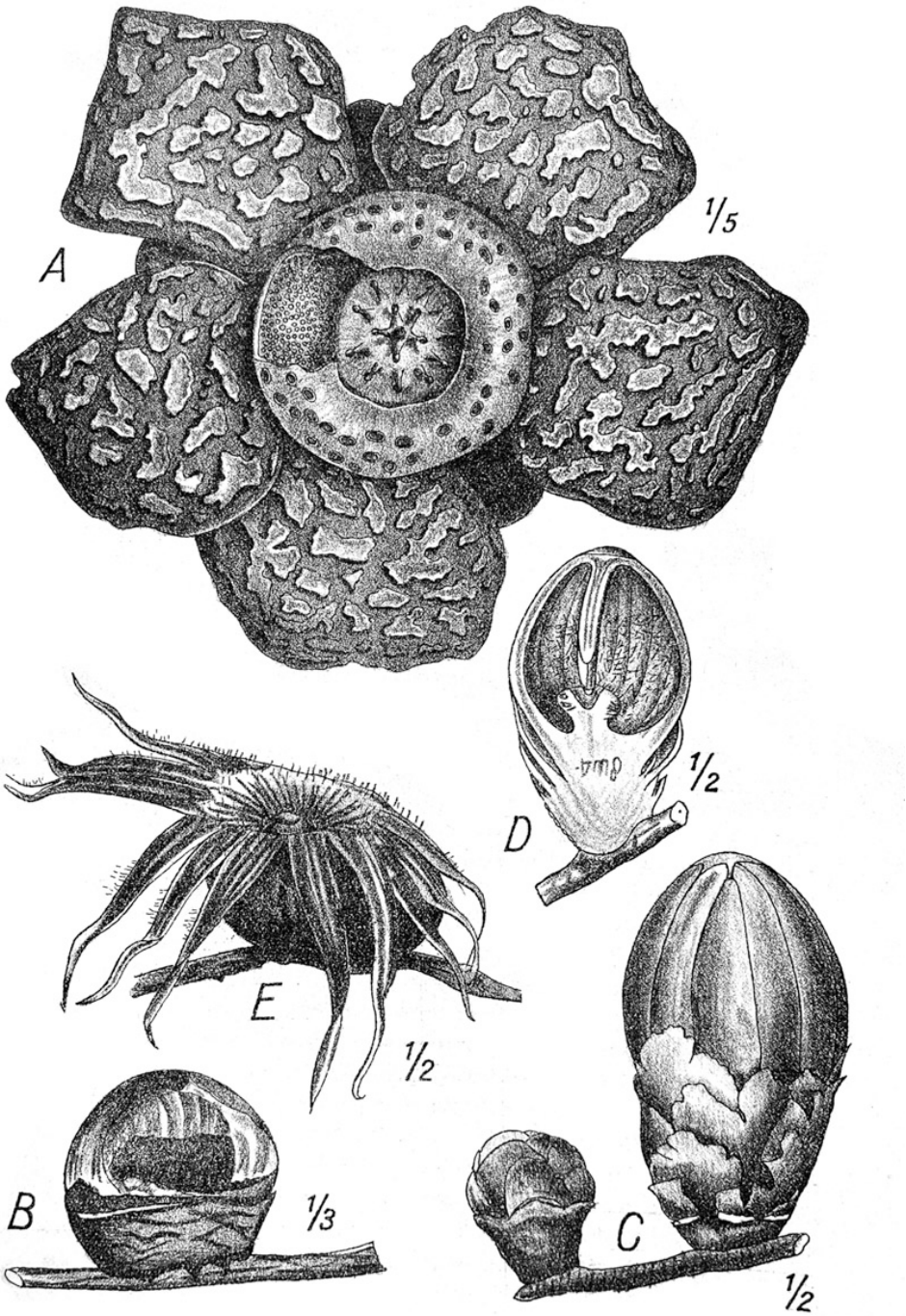
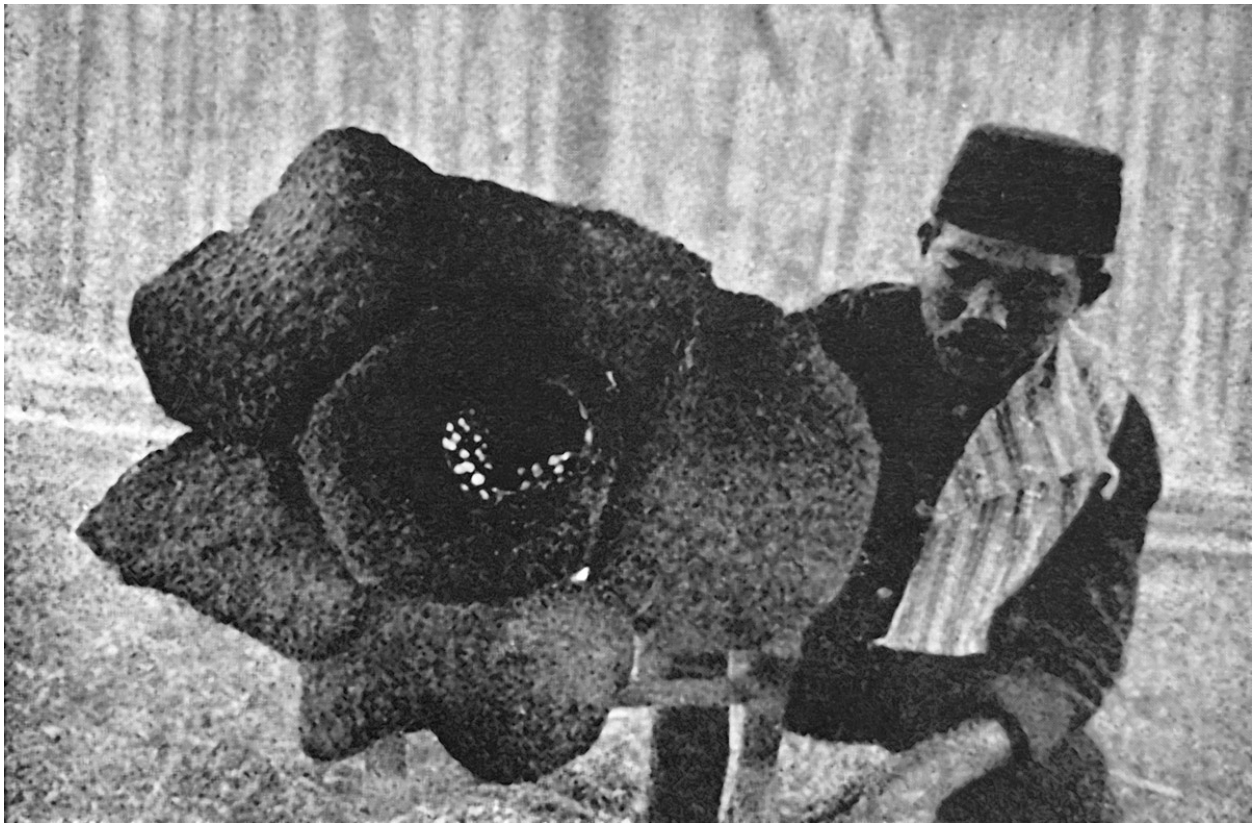


Plate 18. (opposite p. 111.)

Rafflesiaceae spec. indet No 4; flower with a diameter of 70 centimeters discovered by the Civil Lieutenant Governor Baptist in 1916 “one hour’s walk” west of Taroedjak, and southwest of Lôkôp, in the Gaju lands, in Aceh, North Sumatra. The woodland area, where this giant flower was discovered, was immediately reserved as a natural monument after the discovery. The flower, which had a diameter of more than 70 centimeters, was photographed cut off by Mr. Baptist. Further details are mentioned above on p. 112, zoomed in above on p. 111 mentioned extract of the travel journal of said Lieutenant Governor of the Serbodjadi division (Atjeh) dated 20 January 1915.



Addendums and Corrections.

p. 64 ***Rafflesia witkampi*** **Kds**. — Add the following to the conclusion of p. 62-64: After the description of this species had already been printed, I received from Mr. H. Witkamp, dated 30 Nov. 1917 (from America) a letter with information about the habitat of his *Rafflesia* finds, from which the following is taken by me (in excerpt):

"In possession of your two letters dated September 27 and 28, 1917, I have the honor to inform you as follows":

"The *Rafflesia*s you refer to were collected by me in 1907 on the north slope of the Sékérat Mountains, an impressive mountain colossus, between 600 and 700 meters high, which rises steeply from the plains of Borneo's eastern coast between the mouths of the Sekoerau and the Kari River. The Sêkêrat Mountains are largely built up of limestone and show all the properties and phenomena of limestone areas, caves, sinkholes, ring-shaped valleys without exit, underground watercourses, etc. The Kari-Orang River winds around the North foot of that mountain and the *Rafflesia* site is near the river, on the south or on the north side, I can't remember at the moment. I wrote a letter to the Botanical Garden advising the shipment of *Rafflesia*s and, if I am not mistaken, I also enclosed a sketch. I cannot find a copy of that letter, as well as of the answer from Buitenzorg at the moment, as they must be in suitcases left behind at Pangkalan Brandan".

"I found on the ground several dark brown spheres of various sizes, I estimate about a dozen. I probably should not have noticed them, as it was already late afternoon and it was already getting dark in the dense forest, had it not been for one of the coolies cutting open the path, who had given a blow to one of the buds, so that the light color [showed] on the inside. On some looking around I discovered a very large sphere, which I regretted not being able to put in the only container I had available, viz. a kerosene can, so that I was forced to divide it in two. Besides the buds on the ground I also discovered some grown on vines about a meter above the ground. I found only one flower open, which is one of the specimens sent to Buitenzorg, and I believe that this was one of the specimens occurring above ground on a liana."

"As far as I can tell, I must rely here on my recollection of ten years ago, the opened flower showed the image of the *Rafflesia arnoldi* Rob. Brown, of which you enclosed a plate in your second letter to my brother, and which I hereby return to you, but appear less mottled and less warty, I think. The crown consisted of five petals and on the bottom was a saucer-shaped elevation, the diaphragm you intended. The color on the inside of the flower was pale flesh-colored and the diaphragm was teeming with countless small flies and gnats, attracted by the olfactory nerves less more appealing smell, somewhat reminiscent of rotting flesh. I understood that I was dealing with *Rafflesia*, whose occurrence in Benkulen in giant specimens was known to me. However, I had not yet heard of an occurrence in Borneo (later I learned that a *Rafflesia* species also grows on Noesa Kembangan), so I thought it would be a good idea to send the flower in question plus the buds to Buitenzorg. I don't remember exactly whether I sent them on methylated spirits or on formaline, I used both liquids for preservation at the time. The tin with the half large button first went to Samarinda and was soldered there by the good care of Mr. L. A. Grashuis and sent on to the Botanical Garden. In the letter of reply, which I received from Buitenzorg, and which can probably be found in the archives there, just like my letter, I was informed that the specimens sent belonged to a new species, and that the liana on which I had found them, (the specimens growing on the ground were also on a liana walking just below the surface), a *Cissus* species."

As for the sea level, I estimate from memory about 50 meters, perhaps a little more, but certainly not above 150 meters. With a detailed map in front of me of the area I crossed between the Sêkêrat Mountains and Sangkulirang Bay, I would probably be able to indicate more precisely the location as well as the sea level, but at the moment that is not really possible for me. I could only consult this map at the offices of the Bataafsche Petroleum Maatschappij in

Balikpapan, Batavia or The Hague, the only places where copies of it are kept. There were also 1 or more specimens of the unopened buds of the Bornean *Rafflesia* in a collection, which I donated to the University of Utrecht in 1910." (according to H. Witkamp).

p. 65 line 11 from the top read instead of: both: all three
p. 65 line 13 above read instead of: with both: with the
p. 85 line below read instead of: 40001: 4000[1].
p. 96 on lines 15-16 from the bottom and p. 100 on line 1 from the bottom, read instead of: *Aeginetia pedunculata* Roxb.: *Aeginetia centronia* Miq.

New Addendum. (May 1, 1918). *)

(Continued from p. 124 of the Botanical Overview
of the Rafflesiaceae of the Netherland Indies).
p. 124. — At the end of page 124, add the following:

APPENDIX No. 1.

Some authentic and other data in memory of the centennial anniversary (on May 20, 1918) of the *Rafflesia* discovery by Arnold and Raffles.

CONTENTS. Page.

§ 1.

To discover something from the life of Dr. Arnold and Sir Stamford Raffles.

In Encyclopaedia of Netherland Indies of Van der Lith and Snelleman, Boerlage mentions the following about *Rafflesia*:

"*RAFFLESIA*. This giant flower, three feet in diameter, was discovered by the medical naturalist Jos. Arnold, who accompanied Stamford Raffles in 1818 on his first journey inland from Benkoelen. Dr. Arnold found it at Poeloe Lebar on the Manna River (Encycl. Ned. Indies II, page 462), where the natives called this flower kroeboet, elsewhere it was called amboen-ambon.

In 1819 Raffles sent a letter announcing this discovery from Dr. Arnold, to Joseph Banks at London; in 1821 followed an extensive description and illustration of the *Rafflesia arnoldi*, supplemented by Arnold's successor W. Jack (Encycl. Ned. Indies II, p. 97), which was published by R. Brown in Transact. Linn. Soc. T. XIII. Rarely has a botanical discovery attracted so much attention as that of the giant flower of Sumatra; translations of the description soon found their way into all countries; in our language one finds it in the Alg. Konst- en Letterbode 1820 II, pp. 318 and 1822 II, pp. 8. (Boerlage in Encycl.).

To the aforementioned Encyclopaedia of Ned. Indies (vol. III. pp. 355 and 356) is also borrowed the following:

Raffles, Thomas Stamford) Born July 5, 1781 in Port Morant (Jamaica) on board the ship Anna from the marriage of B. Raffles, ship's captain, to Miss Lindeman. Coming from an impoverished family, in 1795 he became an extraordinary clerk at the O. I. Comp. (East Indian House) in London; he attracted so much attention there that in 1805 he was sent as under-secretary to Penang, where a new government was to be established. There he was, since 1806 as secretary, the soul of the board; By constantly coming into contact with the natives, he became acquainted with their manners and customs, so that the Governor-General of British India, Lord Mint, saw in him the right man to serve as his agent with the Malay states at Malacca (1809).

*) Issued on May 20, 1918, the centennial anniversary of the discovery of *Rafflesia arnoldi* by Dr. Arnold and Raffles.

There Raffles established relations with various states in the Archipelago and acquainted himself as much as possible with the conditions existing there; when Lord Minto set out in 1811 with a fleet for Java to seize that island, he was accompanied by Raffles as his secretary. After the conquest of the island, Raffles was appointed Lieutenant-Governor of Java and Dependencies (Sept. 18, 1811); he held this position until March 11, 1816. Returning to England, he was ennobled; in Oct. 1817 became Sir. T. S. Raffles, was appointed Lieutenant-Governor of Benkoelen, where he endeavored as much as possible to counteract the influence of the Dutch on Sumatra and to replace it with the English, which he failed to do, however, as Benkoelen was at the treaty of March 17, 1824, was ceded to the Netherlands and Raffles had to resign his post as a result."

"Although Raffles has always shown himself hostile to the Netherlands *) and he has done much harm to our authority and our trade, his great merits have been widely recognized, also by Dutch writers. His reforms in Java, which mainly benefited the natives, constitute a turning point in our colonial administration, which has since been established on more liberal foundations than before. (Encyclopaedia N.I.).

I couldn't find much about Dr. Arnold. Following is Stamford Raffles' appreciative judgment published on him in Mrs. Sophie Raffles's book:

"I was extremely unfortunate in the death of Dr. Arnold, who accompanied me as a naturalist from England; he fell a sacrifice to his zealous and indefatigable exertions in the first journey, which he made into the interior; but not until he had immortalized his name by the discovery of one of the greatest prodigies in nature, which has yet been met with, a flower of great beauty, but more remarkable for its dimensions; it measures a full yard across, weighs fifteen pounds, and contains in the nectary no less than eight pints, each petal being eleven inches in breadth, and there being five of them. I sent a short description of this plant, with drawing, and part of the flower itself, to Sir Joseph Banks, from whom, or some of the members of the Royal Society, you may probably have heard more particulars. I have now with me, as a botanist, Dr. Jack, a gentleman highly qualified; and we are daily making very important additions to our herbarium." (St. Th. Raffles.- Singapore, 10 June 1819.- In Sophia Raffles, Memoir p.21.)

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*) The following quotation, which I have appended, from a letter from Stamford Raffles to the Duchess of Somerset, which letter was published in the above-mentioned book by Mrs. Sophia Raffles, may clarify this for a single case:

"Letter to the Duchess of Somerset (in England. In this country, you will be happy to hear that we have completely turned the tables of the Dutch. The occupation of Singapore has been the death-blow to all their plans; and I trust that our political and commercial interests will be adequately secured, notwithstanding the unhandsome and ungenerous manner in which ministers have treated me individually, or the indiference they have shown to the subject." (St. Th. Raffles, At sea, in the bay of Bengal, Nov. 9, 1820.- In Sophia Raffles, Memoir p. 65).

§ 2

Reprint of Raffles' authentic account of the discovery of the giant flower on May 20, 1818 by Dr. Arnold and Raffles.

About the discovery of the South Sumatran giant flower (*Rafflesia arnoldi*) on May 20, 1818, so now exactly one hundred years ago, by Arnold and Raffles, the authentic travelogue is taken below from the publication published by Lady Sophie Raffles, after the death of her husband, titled: “Memoir of the life and public services of Sir Thomas Stamford Raffles F. R. S., etc. particularly in the Gouvernment of Java, 1811-1816, Bencoolen and its dependencies, 1817-1824; with details of the commerce and resources of the eastern archipelago and selections from its correspondence. By his widow (Lady Sophia Raffles) A new edition in two volumes. — Volume I. (1835)”.

This very rare book is missing in the library of 's Lands Botentuin in Buitenzorg in Ned. Indies. I received through the benevolent intervention of the secretary of the Association for the Library in the Netherland Indies, on loan from the library of the Encyclopaedic Bureau of the Department of Domestic Administration in Batavia. To the aforementioned secretary of said Association Dr. I express my gratitude for this to H. J. van Lummel and to the Chief of the aforementioned Encyclopaedic Bureau Mr. L. van Vuuren.

In the above-mentioned authentic travel journal of Sir Thomas Stamford Raffles, published by Lady Raffles, about his journey through the interior of Benkoelen and the discovery of the giant flower on May 20, 1818, the following is stated:

19 May 1818. “We left Manna on the morning of the 19th May, and proceeded on horseback as far as the village of Tanjung Agung, on the Manna river, where we halted during the middle of the day; the distance about twenty miles. In the afternoon we walked through the woods to a place called Merambung, about ten miles further up”.

20 May 1818. “On the next morning (the 20th), at half-past five, we commenced our journey towards Passumah on foot; the party, consisting of myself, Lady Raffles, Dr. Arnol d, and Mr. Presgrave, the Resident of Manna, with six native officers, and about fifty coolies (porters) carrying our food and baggage. Our journey lay near the banks of the river during the whole day, but frequently over high cliffs, and almost entirely through thick forests. On approaching Lebu Tappu, where a village had once stood, we first fell in with the tracts of elephants; they were very numerous, and it was evident they had only preceded us a short time. We here passed over much ground, which at one period must have been in cultivation, but which had long been in a state of nature. After breakfasting at Lebu Tappu, under the shade of the largest tree we could find, we preceded on to place called Pulo Lebar, where it was arranged we were to sleep. This also had been the site of a village, but no trace of human dwelling or cultivation was to be found; we reached it at half-past four in the afternoon, having walked for upwards of eight hours. We immediately set to work and erected two or three sheds to sleep in, collecting the materials from the vegetation around us. The river here was broad, but very rocky: the scenery highly romantic and beautiful. During the night we were awakened by the approach of a party of elephants, who seemed anxious to inquire our business within their domains: fortunately they kept at some distance, and allowed us to remain unmolested”.

“The most important discovery throughout our journey was made at this place. This was a gigantic flower, of which I can hardly attempt to give anything like a just description. It is perhaps the largest and most magnificent flower in the world, and is so distinct from every other flower, that I know not to what I can compare it—its dimensions will astonish you — it measured across from the extremity of the petals rather more than a yard, the nectarium was nine inches wide, and as deep; estimated to contain a gallon and a half of water, and the weight of the whole flower fifteen pounds”

“The Sumatran name of this extraordinary production is Petimum Sikinlili, or Devil's-Siri (beetle) box. It is a native of the forests, particularly those of Passumah Ulu Manna.”

“This gigantic flower is parsite on the lower stems and roots of the *Cissus* angustifolia of Roxb. It appears at first in the form of a small round knob, which gradually increases in size. The flower-bud is invested by numerous membranaceous sheaths, which surround it in successive layers and expand as the bud enlarges, until at length they form a cup round its base. These sheaths or bracts are large, round, concave, of a firm membranaceous consistence, and of a brown color. The bud before expansion is depressive, round, with five obtuse angles, nearly a foot in diameter, and of a deep dusky red. The flower, when fully expanded, is, in point of size, the wonder of the vegetable kingdom; the breadth across, from the top of the one petal to the top of the other, is three feet. The cup may be estimated capable of containing twelve pints, and the weight of the whole is from twelve to fifteen pounds. The inside of the cup is of an intense purple, and more or less densely yellow, with soft flexible spines of the same color: towards the mouth, it is marked with numerous depressed spots of the purest white, contrasting strongly with the purple of the surrounding substance, which is considerably elevated on the lower side. The petals are of a brick-red, with numerous pustular spots of a lighter color. The whole substance of the flower is not less than half an inch thick, and of a firm fleshy consistence. It soon after expansion begins to give out a smell of decaying animal matter. The fruit never bursts, but the whole plant gradually rots away, and the seeds mix with the putrid mass."

“If I am succesful in obtaining a draftsman, your Grace shall have a perfect representation of it. I have made a very rough sketch of it myself, but it is not in that state that I could venture to present it. It seems to be a flower unknown to most of the natives, as well as to naturalists; its colors red, yellow, and purple, are most briliant. The chemical composition being fungos, it would not keep; and not having sufficient spirits, we could not preserve it entire. A part of it, with two buds almost as big as a child's head, will be sent home”. (Authentic travel journal of Stamford Raffles from 20 Mei 1818).

§ 3

Reprint of part of the oldest scientific publication on *Rafflesia* by Robert Brown.

To the oldest scientific publication on *Rafflesia arnoldi*, namely from those made by Robert Brown on June 30, 1820, in the Linnaean Society, and in Volume XIII. (1822) p. 201-234 (with 8 plates) in the published communication entitled: “An account of a new genus of plants, named *Rafflesia*”, By Robert Brown, F. R. S., Libr. F. S. the following message is taken below about the discovery of this giant flower:

“It is now nearly eighteen months since some account of a flower of extraordinary size was received by my lamented friend and patron the late revered President of the Royal Society, from Sir Stamford Raffles, Governor of the East India Company's establishments in Sumatra.

“This gigantic flower, which forms the subject of the present Communication, was discovered in 1818 on Sir Stamford 's first journey from Bencoolen into the interior. In that journey he was accompanied by a naturalist of great zeal and acquirements, the late Dr. Joseph Arnold, a member of this Society, from whose researches, aided by the friendship and influence of the Governor, in an island so favourably situated and so imperfectly explored as Sumatra, the greatest expectations had been formed. But these expectations were never to be reallized; for the same letter which gave the account of the gigantic flower, brought also the intelligence of Dr. Arnold's death.

“As in this letter many important particulars are stated respecting the plant which I am about to describe, and a just tribute is paid to the merits of the naturalist by whom it was discovered, I shall introduce my account by the following extract.

“Bencoolen, 18th August, 1818.

“You will lament to hear that we have lost Dr. Arnold: he fell a sacrifice to his exertions on my first tour into the interior, and died of fever about a fortnight ago.

"It is impossible I can do justice to his memory by any feeble encomiums I may pass on his character; he was in every thing what he should have been, devoted to science and the acquisition of knowledge, and aiming only at usefulness.

“I had hoped, instead of the melancholy event I have now to communicate, that we should have been able to send you an account of our many interesting discoveries from the hand of Dr. Arnold. At the period of his death he had not done much; all was arrangement for extensive acquirement in every branch of natural history. I shall go on with the collections as well as I can, and hereafter communicate with you respecting them, and in the meantime content myself with giving you the best account I can of the largest and most magnificent flower which, as far as we know, has yet been described. Fortunately I have found part of a letter from poor Arnold to some unknown friend, written while he was on board ship, and a short time before his death, from which the following is an extract.

“After giving an account of our journey to Passummah, he thus proceeds:

“But here (at Pulo Lebbar on the Manna River, two days journey inland of Manna) I rejoice to tell you I happened to meet with what I consider as the greatest prodigy of the vegetable world. I had ventured some way from the party, when one of the Malay servants came running to me with wonder in his eyes, and said: "Come with me, Sir, come, a flower, very large, beautiful, wonderful". I immediately went with the man about a hundred yards in the jungle, and he pointed to a flower growing close to the ground under the bushes, which was truly astonishing. My first impulse was to cut it up and carry it to the hut. I therefore seized the Malaya's parang (a sort of instrument like a woodman's chopping-hook), and finding that it sprang from a small root which ran horizontally (about as large as two fingers, or a littie more), I soon detached it and removed it to our hut. To tell you the truth, had I been alone, and had there been no witnesses, I

should I think have been fearful of mentioning the dimensions of this flower, so much does it exceed every flower I have ever seen or heard of; but I had Sir Stamford and Lady Raffles with me, and a Mr. Palsgrave, a respectable man, resident at Manna, who, though equally astonished with myself, yet are able to testify as to the truth.

"The whole flower was of a very thick substance, the petals and nectary being in but few places less than a quarter of an inch thick, and in some places three-quarters of an inch; the substance of it was very succulent. When I first saw it a swarm of flies were hovering over the mouth of the nectary, and apparently laying their eggs in the substance of it. It had precisely the smell of tained beef. The calyx consisted of several roundish, dark brown, concave leaves, which seemed to be indefinite in number, and were unequal in size. There were five petals attached to the nectary, which were thick, and covered with protuberances of a yellowish white, varying in size, the instrices being of a brickred color. The nectarium was cyathiform, becoming narrower towards the top. The centre of the nectarim gave rise to a large pistil, which I can hardly describe, at the top of which were about twenty processes, somewhat curved and sharp at the end, resembling a cow's horns; there were as many smaller very short processes. A little more than half-way down, a brown cord about the size of common whip-cord, but quite smooth, surrounded what perhaps is the germen, and a little below it was another cord somewhat moniliform.

"Now for the dimensions, which are the most astonishing part of the flower. It measused a full yard across; the petals, which were subrotund, being twelve inches from the base to the apex, and it being about a foot from the insertion of the one petal to the opposite one; Sir Stamford, Lady Raffles and myself taking immediate measures to be accurate in this respect, by pinning four large sheets of paper together, and cutting them to the precise size of the flower. The nectarium in the opinion of all of us would hold twelve pints, and the weight of this prodigy we calculated to be fifteen pounds.

"I have said nothing about the stamina; in fact, I am not certain of the part I ought to call stamina. If the moniliform cord surrounding the base of the pistil were sessile anthers, it must be a polyandrous plant; but I am uncertain what the large germen contained; perhaps there might be concealed anthers within it.

"It was not examined on the spot, as it was intended ot preserve it in spirits and examine it at more leisure; but from the neglect of the persons to whom it was intrusted, the petals were destroyed by insects, the only part that retained its form being the pistil, which was put in spirits along with two large buds of the same flower, which I found attached to the same root: each of these is about as large as two fists.

"There were no leaves or branches to this plant; so that it is probable that the sterns bearing leaves issue forth at a different period of the year. The soil where this plant grew was very rich, and covered with the excrement of elephants.

"A guide from the interior of the country said, that such flowers were rare, but that he had seen several, and that the natives called them Krûbût.

"I have now nearly finished a colored drawing of it on as large drawing-paper as I could procure, but it is still considerably under the natural size; and I propose also to make another drawing of the pistil removed from the nectarium.

I have now, I believe, given you as detailed an account of this prodigious plant as the subject admits of; indeed it is all I know of it. I would draw your attention, however, to the very great porosity of the root, to which the buds are attached.

"I have seen nothing resembling this plant in any of my books; but yesterday, in looking over Dr. Horsfield's immense collections of the plants of Java, I find something which perhaps may approach to it; at any rate the buds of the flower he has represented grow from the root precisely in the same manner: his drawing, however, has a branch of leaves, and I do not observe satisfactory dissections. He considers it as a new genus; but the difference of the two plants

appears from this, that his full-blown flower is about three inches across, whereas mine is three feet".

Sir Stamford proceeds:

"Dr. Arnold did not live to return to Bencoolen, nor to fulfil the intentions expreseed in the above extract; but we have finished the drawing of the whole flower, and it is now forwarded under charge of Dr. Horsfield, to who I have also intrusted the pistil and buds.

"I shall make exertions for procuring another specimen, with which I hope we shall be more fortunate".

To the Right Honourable Sir Joseph Banks

(Signed) "T. S. Raffles".

APPENDIX No. 2.

Description of a new species of *Rafflesia* from Atjeh.

p. 65 at the end of *Rafflesia ciliata* add: the following data concerning a new species of *Rafflesia* received by me after printing the previous pages from North Sumatra (Atjeh):

5a. *Rafflesia atjehensis* Kds. (msc. 12.1V. 1918 in Herb Kds.) nova spec. Gemma masc. (adhuc clausa) ± 25 cm lata et 14 cm alta: Discus columnae processibus styliformibus numerosis ± 2-2½ cm longis obsitus, extus annulo *(R. borneënsi* modo) destitutus. Annuli elevati ± convexi, distincti, exalati, circa basin columnae bini. Annulus elevatus exterior fl. masc. subplano-convexus latissimus interiori multo latior, ± 2 cm latus, subglaber, intus distinctus et sulco profundo a annulo interiori separatus, extus valde distinctus et lineis radiatis densissime obtectus. Annulus interior valde distinctus subglaber, ± 3-4 mm altus; basi ± 4 mm apice 1½ mm latus. Perigonii Tubus intus basi (usque ad 2 cm altitudinis) subglaber et ramentis verruculisque destitus, medio et apice ramentis filiformi bus, brevibus, ± 3-6 millim longis simplicibus vel ramosis, apicie attenuatis (haud incrassatis) dense obtectus. Perigonii Lobi intus maculis verrucosis parum eleVatis ± 1⅓ –⅓ cm longis, ½–⅓ cm latis et ⅓ cm altis, parvis vel mediocribus, simplicibus (haud anatomosatibus) dense obsiti. Diaphragma ± 3 cm altum, intus (a basi usque ad apicem) maculis planis (haud elevatis) 1–⅔ cm longis et ⅔ cm latis, simplicibus vel interdam anatomosantibus subdense (et ramentis filiformibus brevibus paucis) obtectum. Antherae ± 30, semiglobosae, multiloculares, ± 4-5 mm diam., apice poro magno munitae. Pollen laeve, globosum vel oblongo-globosum, ± 21 —25 μ diam. Flores aperti, gemma femin. et fructus adhuc ignoti.

Male floral bud (still closed) ± 25 cm wide and 14 cm high: Columnar disc covered with numerous styliform processes ± 2-2½ cm long, missing an exterior annulus (mode of *R. borneensis*). Raised annuli two, ± convex, distinct, raised high around the base of the column. Outer annulus of male flower raised, subplano-convex, much wider than the inner one, ± 2 cm wide, subglabrous, inside distinct and separated from the inner annulus by a deep groove, outside very distinct and densely covered with radiating lines. Inner annulus very distinct, subglabrous, ± 3-4 mm high; base ± 4 mm tip 1½ mm side. Perigone tube inside the base (up to 2 cm high) subglabrous and destitute of branching and warts, in the middle and at the tip of the branching filiform, short, ± 3-6 mm long simple or branched, densely covered with thinned (rarely thickened) tips. Interior of perigone lobe with slightly elevated warty spots ± 1⅓ –⅓ cm long, ½–⅓ cm wide and ⅓ cm high, densely covered with small or medium-sized, simple (rarely anastomized) spots. Diaphragm ± 3 cm high, covered inside (from the base to the apex) with flat (rarely raised) spots 1–⅔ cm long and ⅔ cm wide, simple or sometimes subdensely anastomized (and a few short filiform ramifications). Anthers ± 30, hemispherical, multilocular, ± 4-5 mm diam., apex protected by a large pore. Pollen smooth, globose or oblong-globose, ± 21 -25 µ diam. Open flowers, female floral buds and fruits are still unknown.

Rafflesia atjehensis Kds. nova spec. The only male flower bud I have is ± 25 cm long, ± 25 cm wide and ± 14 cm high. It is perched on a terete unidentified vine of 2½ cm diameter. (leaves, blossoms and fruits are not available from the liana). Height of the column from the round to the tip of the processes ±6 cm. Overhanging edge of column disc 2 cm. The vertical outer wall of the column disc measured from the outside 2½ cm and from the inside (the rising edge) ± 1½ cm. The cupula is fairly flat and 10 cm diameter. Outside, the cupula, which is matt black on the outside, shows angular facets about 1 cm wide, similar to those observed in several other *Rafflesia* species. The base of the bud is externally encased by semicircular, rounded, high bracts that are ±5-7 cm high, stiff-leathery, smooth on both sides, and colored black in alcohol. The upper part of the flower bud protruding from the bracts is smooth, glossy black; it consists of the outer wall of the perigone tube and the perigonal lobes. The latter lie imbricately firmly on top of each other. The insertion of the tepal lobes is clearly visible on this bud and the distance from this insertion site to the top of the cupula is ±12 cm. The basal part of this ± 12 cm high, perigone

tube is remarkably thin-walled (± 2 mm.), but the upper part of the tube has a 5-15 mm thick wall. Perigone lobes inside (as far as can be seen on the bud) with numerous ± small, rounded to elongated ± dense warts, which are ⅓ – 1⅓ cm long, ⅓ – ½ cm wide and at most ⅓ cm high and do not anastomose. The perigone lobes are (in this bud) relatively thin (¾ cm) and protrude with their tips up to 3 cm deep into the cavity of the flower bud. Perigone tube at the base (including the outwardly very slightly convex annulus exterior) covered on the inside with dense, fine, radially running, straight, shallow grooves; Completely hairless from the bottom to about 2 cm inside and not only without ramenta but also without nodules or warts, but covered from 2-9 cm inside with ± densely standing ramenta. These ramenta are largest and densely placed in the upper part of the perigone tube, there they are ½–⅔ cm high, simple or multiply forked, always pointed at the top and not widened like a button. In the middle part of the perigone tube, the ramenta stand loosely and are only 2-3 millimeters high, thin thread-like (not knot-like) pointed at the top and unbranched. Diaphragm ± 3 cm high, internally on the whole surface (also above and below) 3-4 horizontal rows of flattened sessile tubercles, which are ⅔-1 cm long and ⅔ cm wide. Some of these warts anastomose into oblong patches 3 cm long and ½ cm wide. Between the wart spots there are very few scattered thread-like ramenta only 1-2 mm high. The upper edge of the diaphragm is splayed, not notched and imperforate. Internal annulus strongly developed, forming the upwardly curved columnar base, directed obliquely outwards ± sharpened, ± 1½ mm wide, granular-rough, with indistinct broad radial transverse bands, on the inside with a oblique, abrupt slope, on the outside a vertical slope. Annulus exterior colossal (± 2 cm) wide, granular-rough, pillow-shaped, slightly convex, with dense, parallel, radial, shallow, straight ridges, on the inside with a steep ± 3 mm high slope and there by a crevice about 3 mm wide separated from the interior annulus, on the outside with a very weakly curved, almost flat slope, which gradually merges into the ± flat part of the inner wall of the perigone tube without a clear border. The exterior annulus is sharply defined only on the inside. Column disc ♀ flat, circular, below ± 15 cm, above ± 16 cm in diameter, with ± 2-2¼ cm high, outside and inside glabrous, finely notched, short, bristly margin and numerous conical up to 3 cm high, ending in a point at the top, short-bristly processes. Steep drop of the column disc inclined inwards, without annular formations on the outside. Stigmatic annular surface of column disc with scattered, straight, protruding bristles. Anthers of the male flower bud already well developed ± 4–5 mm wide and high, ± hemispherical, narrowed at the top, multi-locular, with the mouth directed towards the column, located in the upper angle of the very deep anther pits, which run down to about half the column; these divided into three compartments by two indistinct secondary keels, and separated from one another by knife-blade-like laminae bordered with protruding long bristles. Columnar base otherwise ± level and granular gray or nearly smooth, glabrous. This anther tip is surrounded by a whitish, waxy mass, which consists of the pollen grains glued together. Pollen grains spherical to oblong ± 21–24½ µ long and wide, hyaline; exine and intine distinct, both smooth and entirely unsculpted; Pores of pollen not distinct. Ovary, rudimentary absent in the male bud. Opened flower, female flower bud, fruit and seed, as well as color and host plant unknown.

Geographical Distribution: Known only from the administrative department of Serbodjadi in Atjeh, North Sumatra, near Lokop, in the lower mountains, parasitic on a hitherto unidentified liana (Herb. Kds. n. 44060 β.- Received from Mr. Captain Terhaar.- 15 III.1918.)

The above data (species description, etc.) are based exclusively on a single male, alcohol-preserved flower bud of ± 25 cm in diameter and 14 cm in height. I received this flower bud as a gift from the Civil Lieutenant Governor of the Administrative Department of Serbodjadi, Gajoe and Alas countries in Aceh, North Sumatra, Mr Terhaar, Captain of the Infantry in Lokop (Serbodjadi) by letter dated March 15th. (1918). For sending these as Herb. Kds n. 44060 β registered flower bud, which is now part of the collections of the Department in Buitenzorg, and

which is the very first *Rafflesia* material received from Atjeh, I express my sincere thanks to Captain Terhaar.

Further details about the habitat are not yet available to me, but will be published as soon as I receive them. For now I limit myself to the publication of the above description of this *Rafflesia* species that is new to science.

The tin, in which the flower bud, which had been well preserved in alcohol, was soldered, had received a few deep dents during the transport to Buitenzorg, as a result of which one half of the flower bud had become dented and damaged. Fortunately, it turned out that the other half of the flower bud had remained completely undamaged and that the column, which was important for identification, had not suffered any damage during transport.

Using the characteristics listed above in the species diagnosis, *Rafflesia atjehensis* obtains in my species table on p. 27 and 30 a place between the *Rafflesia tuan-mudae* Beccari and *R. ciliata* Kds. The new *Rafflesia* from Atjeh (*R. atjehensis*) sent by Captain Terhaar (*R. ciliata*) differs from the latter species in that the annulus exterior at the foot of the column is much wider than the amnulus interior, which characteristic of *R. atjehensis* with *R. tuan-mudae* has in common. From this latter species, which occurs in Borneo, *R. atjehensis* differs in the following features, which are mentioned above on p. 30 sub *bb* can be inserted in my identification table:

I. Perigone lobes loosely covered with large verrucous spots on the inside. The perigone tube of *Rafflesia arnoldi* is just inside (almost from the base to the tip) densely covered with long branchlets thickened at the tip.

***Rafflesia tuan-mudae* Beccari.**

II. Perigone lobes densely covered with small or medium-sized verrucous spots on the inside. Perigone tube inside the base (up to 2 cm high) destitute of ramifications and verruculi, in the middle and at the apex of ramifications densely covered with brevibits (3-6 mm) not thickened at the apex.

***Rafflesia atjehensis* Kds.**

Buitenzorg, 1 May 1918. S. H. KOORDERS

Index of native and Latin plant names. *)

(Index nominum indigenorum et systematicorum).
[page numbers from original document]

*) All Latin names of plants that do not belong to the Rafflesiaceae family and all species synonyms of the Rafflesiaceae, as well as all native plant names are printed in plain letters, while the latest Latin species names of the Rafflesiaceae and all genus names of this family are printed in bold.