principally confined to the holes, taking as appears from the low MgO-quantity, no important place in the analyzed rocksample.

The molecular proportions yield, Fe_2O_3 being reduced to FeO and the whole being calculated on a sum of 100:

SiO_2	Al_2O_3	FeO	MgO	CaO	Na_2O	K_2O
79.46	10.66	0.66	0.07	2.90	4.81	1.45

the formula according to OSANN.

	s	A	C	F	a	c	f	n	m	k	series
(OSANN)	79.46	6.26	3.63	—	12.66	7.34	—	7.7	—	1.73	*av*
(BECKE)	79.46	6.26	2.90	0.73	12.66	5.86	1.48		(10.0)		

Here we have the rare case that

$$Al_2O_3 > K_2O + Na_2O + CaO + (Mg, Fe)\,O.$$

If, like OSANN, we add MgO and FeO in the molecule (MgFe) Al_2O_4 to C, there remains a rest of 0.77 Al_2O_3; if however like BECKE we neglect the Al_2O_3 remainder above $(K, Na)_2O + CaO$, equal to 1.50, then C = 2.90 and F = 0.73. The calculation of a + c + f = 30 yields:

	a	c	f
(OSANN)	18.99	11.01	—
(BECKE)	18.99	8.79	2.22

In the graphic notation IV denotes the place of the rock; the filled circle the values after OSANN, the not-filled circle the one after BECKE.

Botany. — "*Some systematic and phytogeographical notes on the Javanese Casuarinaceae, especially of the State Herbaria at Leiden and at Utrecht.*" (Contribution to the knowledge of the Flora of Java. N°. III).[1] By Dr. S. H. KOORDERS.

§ 1. Casuarina equisetifolia, Forst.

§§ 1. Geographical distribution outside Java: according to HOOK, Flora Br. Ind. V. 598: in British India on the East side of the Gulf of Bengal, South of Chittagong, in the Malay Archipelago, in Polynesia and in Australia. In the State Herbarium at Leiden I saw, however, also specimens from Madagascar, Mauritius, Bourbon and Senegambia, although it did not appear with certainty from the herbariumlabels, that they referred to uncultivated plants. In Herb. Leiden the species is also represented by specimens from

[1] Continued from Transactions (Verhandelingen) Roy. Acad. Sciences Amsterdam Second Section Vol. XIV. (1908). N°. 4.

Hawai and from Australia; in this case one of two specimens (from Sieber) which appear to me to be quite similar, has been determined by MIQUEL as *C. equisetifolia* FORST. and the other as *C. leptoclada* MIQ. In DIELS [Die Planzenwelt von West-Australiën südlich des Wendekreises (1906)] the occurrence of some other species of *Casuarina* is mentioned, but not of *C. equisetifolia*. Prof. Dr. L. DIELS was so kind as to supply me with the following information on this point: "Casuarina equistifolia kommt in West-Australiën sicher nicht vor. Ob er in Ost-Australiën wächst habe ich persönlich nicht festgestellt, da ich mich dort nur kürzere Zeit aufhielt. Das von Ihnen erwähnte Exemplar, leg. Sieber, stammt aus der Gegend von SYDNEY, denn dort hat Sieber gesammelt." (Diels msc. 21. IV. 1908). From the Malay Archipelago outside Java I saw *C. equisetifolia* represented in the Herbaria at Leiden and at Utrecht from the following places: Sumatra (leg. KORTHALS; TEIJSMANN & DE VRIESE). Timor (FORBES n. 3746), Moluccas (REINW.), the North of Dutch New-Guinea (Expedition of WICHMANN, determ. VALETON). The examples from Sumatra, collected by KORTHALS, generally have 8 teeth, as MIQUEL already noted for these specimens. In N. E. Celebes the species is not found wild: there I only found *C. Rumphiana* MIQ. [1]).

§§ 2. Geographical distribution and oecological conditions in Java: I have never found *C. equisetifolia* growing wild except in Western-Java in the S.W. of the residency Banten in the division Tjaringin near the village of Tjemara, and there only on a sandy sea-shore, on a small peninsula (= oedjoeng, malay) at sea-level, growing socially.

This may serve as a correction of the statement in KOORD. and VALETON "Boomsoorten Java" X (1904) p. 273 (line 12 from top): "*Tjemara (Banten) altit.* 200 *M. supra mare.*"

JUNGHUHN says in his Java. I. 2nd edit. (1853) 272: "Were we concerned in dealing with Sumatra, we should have to mention among the trees which grow in groups in the shore forests the Tjemara laoet: *Casuarina equisetifolia* Forst (*muricata* Roxb); nowhere, however, have I found this beach-Casuarina, although natives have assured me, that it is found in some places on the North coast of Krawang" (JUNGHUHN l. c.). It appears, however, that probably JUNGHUHN afterwards succeeded in finding this species wild in Java, namely on the Lawoe, although I have not been able to find anything

[1]) KOORDERS, S. H., Eerste Overzicht d. Flora N. O. Celebes (1898) 616; cf. KOORDERS and VALETON. Bijdrage Booms. Java X. (1904) 172 (Mededeelingen Lands Plantent. nº. 19 en 68).

in any publication about this geographically interesting discovery. My surmise is founded on a specimen labelled by JUNGHUHN himself as follows: *Casuarina equisetifolia, E monte Lawu ubi sponte crescit*". This specimen must indeed be regarded as *C. equisetifolia* FORST. according to an autograph determination-label of MIQUEL. I found this specimen in the Leiden Herbarium, registered as H. L. B. n. 10 (899—173) and can confirm the accuracy of the determination of JUNGHUHN and of MIQUEL, for I found on the young branches of JUNGHUHN's specimen, which already bore fruit, that of 14 leafwhorls which I examined, 13 had 7 vaginal teeth and 1 only 6 teeth; the fruit had 12 longitudinal rows. There can therefore be no doubt that this specimen of JUNGHUHN from the Lawoe mountains is completely conspecific with the beach-Casuarina (*C. equisetifolia* FORST.), the more so, since also all other characteristics, e.g. the deeply grooved internodes, $^1/_2$—$^3/_4$ cm. long and $^1/_2$ mm. thick, agree completely with this species. This is the first observed case, so interesting phytogeographically, of the beach Casuarina (*C. equisetifolia*) growing wild in the mountains of Java. The height of this station above sea level is not indicated by JUNGHUHN on the label quoted above. The other Javanese specimens of the State Herb at Leiden and at Utrecht, found by me, are: "Java, on the beach near Batavia and Anjol (leg. JUNGH.); Java (KORTH.; REINW.; TEIJSM.). In the Herbarium at Buitenzorg there are according to KOORD. and VALETON [Bijdr. Booms. Java X (1904) 271] some specimens from the Rahoen-Idjen mountains in Eastern Java, which mostly have 8 vaginal teeth. It appears to me, that we are quite as justified in placing these specimens from the Idjen-plateau under *C. equisetifolia*, as MIQUEL (see above) in the case of the generally 8-toothed beach-Casuarina of the West coast of Sumatra, and KOORDERS and VALETON (l. c. 271) in the case of the beach-Casuarina of S.W. Banten in Western Java, which generally has 7—8 teeth. If the specific limits between *C. montana* and *C. equisetifolia* be drawn as indicated, the distribution of *C. equisetifolia* in Java is as follows: Western Java: in the S.W. of the residency Banten, at sea-level, on a sandy sea-shore on a narrow peninsula (= oedjoeng), at the edge of the surf, growing socially (Herb. Kds in Mus. Bot. Hort. Bogor.). Central Java on the Lawoe growing wild, together with *C. montana* (Herb. JUNGHUHN in Leiden). Eastern Java: in the Rahoen-Idjen mountains, also growing wild with *C. montana* (Herb. Kds in Mus. Hort. Bogor.). Oecological conditions: Limited to soils, which always have little water or which are physiologically dry (containing much salt). Completely wanting on fertile soils, probably because it is

crowded out by other species. Although preferably growing wild on sandy sea-shores, and nearly always forming homogeneous woods, it is always wanting in the Javanese Mangrove forests. The tree resists direct sunlight very well, but deep shade very badly. On calcareous soils and in the Javanese Teak-forests it has not yet been observed wild. The species is also completely absent from the mixed, shady, evergreen forests of Java. Evidently it can only maintain itself in the struggle with other species in the above-named unfavourable localities.

§ 2. **Casuarina equisetifolia Forst. var. longiflora,** MIQ.! Flora Regensburg. (1865) p. 17; MIQ.! in DC. Prodr. XVI. 2 (1868) 339; BOERLAGE! Handleid. Flora N. I. III. 1. (1900) 404; KOORD. and VALETON Bijdr. Booms. Java X. (1904) 272.

For this variety MIQUEL l. c. gave i. a. the diagnosis: "amentis masculis elongatis glabris; ... vaginis 7-dentatis" and as locality "Java" (BLUME!) without further detail. From the authentic material found by me in the State Herbaria at Leiden and at Utrecht, the following results. The number of vaginal teeth is sometimes 7, as indicated by MIQUEL l.c. but is often also 6, and sometimes also 8. The male catkins are characterized by the complete absence of hairs, and by their sometimes attaining the exeptionally great length of 40—50 millimetres. On the authentic label the locality is only indicated in BLUME's handwriting as: "in Javae oriental. montibus".

A specimen found by me without further indications in the Herbarium at Leiden, which had been sent in 1867 by TEYSMANN to HASSKARL, and, according to a note added by HASSKARL, was derived from a specimen standing in the Hortus Bogor. [in Herb. Lugd. Bat. sub n. 48 (899/173)], differs so little from the above named authentic specimen, that I suspect the authentic of *C. equisetifolia* FORST. var. *longiflora* MIQ. to be also derived from a cultivated specimen in the Buitenzorg Gardens. Both specimens greatly resemble *C. equisetifolia* FORST., but on account of the completely glabrous male catkins they are distinctly different from the type. The number of vaginal teeth in TEYSMANN's specimen is 7—8, and as in the authentic specimen 6—8.

I further found that not a single of the numerous other Javanese specimens of *Casuarina* in the herbaria at Leiden and at Utrecht, refer to this variety. I have never found the variety wild in Java.

To sum up, I consider it probable, that in this case of *Casuarina equisetifolia* var. *longiflora* MIQ. an error of BLUME's is the cause of the reputed indigenous occurrence of this plant in Java, an error similar in kind to that which was formerly demonstrated [1]) in the case of another tree cultivated in Hortus of Buitenzorg; it appears, that this variety must be deleted from the flora of Java.

§ 3. **Casuarina montana**, JUNGH.! ex MIQ. Fl. Ind. Bat. I. 1. (1855) 875 (cum descript.); JUNGH.! Java I. ed. 2. (1853) 551—554, 631—639, 663; *C. montana*, LESCHEN. ex MIQ.! in ZOLL. Verzeichn. (1854) 86 (nomen tantum); *C. montana*, MIQ.! in *A. DC.* Prodr. XVI. 2. (1868) 335; MIQ. Illustr. Arch. Ind. (1871) 9. tab. 7. f. 1 et 2; KOORD. et VAL. Bijdr. Booms. Java X. (1904). 273!; *C. Junghuhniana*, MIQ! Plantae Junghuhnianae I. (1854) 7; MIQ.! Fl. Ind. Bat. I. 1. (1855) 874; JUNGH.! l.c. (1853) 551.

It is evident from the above bibliography, that according to the latest rules of nomenclature this species should not be named *C. montana* MIQ., as in KOORD. and VAL. l.c., nor *C. montana* LESCHEN., as in the Index Kewensis, but *C. montana* JUNGH.

§§ 1. Geographical distribution outside Java: Bangka (TEIJSMANN n. 7650); Timor (ZIPP.; TEIJSM.; FORBES n. 3512); Molucc. (REINW. n. 1504). — On the authentic specimen of ZIPPEL (in H. L. B.) I found on young branches of flowering shoots 10—11 vaginal teeth and generally 11 teeth; internodes 1—$1^1/_3$ mm. thick and about 1 cm. long.

Two fruiting specimens from Timor, named by MIQUEL himself as *C. montana* have 11—12 teeth, like the var. *validior* MIQ., but with thin internodes, corresponding to the var. *tenuior* MIQ. — The fruiting specimen of REINWARDT from the Moluccas (without further indication of locality) had ten vaginal teeth throughout and corresponds, also as regards the diameter of the internodes, to the var. *tenuior*. — The fruiting specimen from Bangka bears in SCHEFFER's handwriting the manuscript name *C. equisetifolia* FORST. var. *bancana*; it has consistently 9 vaginal teeth, fruit cones with about 18 longitudinal rows, cylindrical internodes, $^1/_2$—$^3/_1$ mm. thick about 1 cm. long, and not deeply grooved. This specimen from Bangka cannot in my opinion be separated from some specimens of the Javanese *C. montana*

[1]) Compare the distribution of *Quercus Pinanga* BL. in KOORD and VALETON. Bijdr. Booms. Java X (in Meded. Lands Plant. LXVIII 1904) p 65 and in KOORD. Contribution No. 1 to the knowledge of the Flora of Java in Proc. Roy. Acad Sciences. Amsterdam 28 March 1908 p. 772.

var. *tenuior* MIQ. — *C. montana* var. *validior* MIQ. I did not find represented in the Herbaria at Leiden and at Utrecht from regions outside Java.

§§ 2. Distribution in Java. The var. *validior* MIQ. I found represented in the Herb. at Leiden and Utrecht by the following specimens: 1) collected by JUNGHUHN according to his autograph note on the top of mount Kawi [the second label "Oengaran" which evidently was attached to the specimen at a later date, independently of JUNGHUHN, cannot, in my opinion, refer to this authentic specimen, for on mount Oengaran not a single *Casuarina* occurs wild]; 2) specimens from Java (without further indications (from TEYSM. & DE VRIESE and 3) a fruiting specimen from Java with the remark "Alpes orientales" (leg. WAITZ). In Herb. Kds the var. *validior* MIQ. is only represented by specimens from Mt. Wilis at 2000 m. altitude and from Mt. Ardjoeno at 2100—2400 metres; only the specimens from mount Ardjoeno are characteristic, for the determination of the variety of the specimens from the Wilis is not quite certain. The authentic specimen of JUNGHUHN from the top of Mt. Kawi (in Herb. Leiden) I found to have internodes of about 1 cm. long with a diameter of 1—1½ mm., and with 10—11 vaginal teeth. The specimen of WAITZ generally had 11 vaginal teeth. The Javanese examples of var. *tenuior* MIQ. are only represented in the Herbaria at Leiden and Utrecht by a few specimens of KORTHALS and of TEYSM. & DE VRIESE from "Java" (without further indications) and by a fruiting specimen (Kds. 37348 β Comm. ex museo bot. Hort. Bogor.), collected fruiting in October 1899 in Eastern Java on Mt. Tengger near Ngadisari at 2000 metres altitude. In the extensive alpine Casuarina-forests of Mt. Rahoen-Idjen in Eastern Java I found only var. *tenuior* MIQ. whereas var. *validior* appeared to be wholly wanting there. On Mt. Wilis in Central Java I found in the Casuarina-forests almost exclusively var. *tenuior* MIQ., but there nevertheless a small number of individuals belonging to var. *validior* MIQ. were also found; the form with internodes $1^1/_2$ mm. thick, which is characteristic for the top of Mt. Kawi, could not be found on Mt. Wilis. The youngest twigs of var. *validior* MIQ., occurring on the latter mountain, where at most 1 mm. in diameter. JUNGHUHN mentions (Java. I (1853) p. 551), that *C. montana* first occurs on the Lawoe and thence eastwards covers the tops of all the mountains, which rise above 1500 metres, but is wholly absent from Western Java. As a result of my own observations I can confirm this statement. Concerning the

vertical distribution of *C. montana* var. *tenuior* MIQ. in the Wilis mountains on the Darawati summit in the residency Madioen, I append here, what I published on this subject in 1894 in a Dutch article "On the composition of some forests in the residency of Madioen" (in Tijdschr. v. Nijverh. en Landb. in N. Indië XLVIII (1894) part 4 p. 18—22 namely in the chapter "[To the top of the Wilis. Ascent of the Darawati]: "At $7^{40} = 1670$ m. altitude the mixed shady forest of high trees suddenly ceases, at least on the ridge, for in the valleys it continues further northwards and we arrive at a small alang-alang field with scattered young trees of *Albizzia montana* BENTH. and immediately after this we see the first specimens of *C. montana* JUNGH".

From this point, at about 1700 m. altitude, the ridge, which leads to the summit of the Darawati, is completely covered with this tree alone. On the slopes (and even almost right up to the ridge) other trees grow, up to an altitude of 2000 meters. Not until this altitude is reached, do *Casuarina's* occur in the valleys." [KOORD. l. c. (1894) p. 19—20 of the reprint]. From this it results, that *Casuarina montana* var. *tenuior* is not found on mount Wilis below 1650 m. altitude, but that it occurs from there upwards to the highest top, at 2550 m. altitude. These data, and those about to be given, should be substituted for the figures of vertical distribution, published in KOORD. and VALETON Bijdr. Boomsoorten Java X (1904) p. 274.

I may further add, that also on journeys undertaken by me after the above-named year (1894) in the residency of Madioen, I *nowhere* found *C. montana* growing wild below 1650 m. altitude. It is indeed interesting, that this species at once forms forests, almost from the spot, where it first appears, and above 2000 m. not only covers the higher ridges, but also the valleys, almost to the exclusion of other trees. In the teakforests of Madioen, as in other parts of Java, I have only found *C. montana* and *C. equisetifolia* here and there cultivated (e. g. near pasanggrahans, along road-sides, etc.) but never growing wild. On the Idjen-plateau in the residency of Besoeki *C. montana* var. *tenuior* descends somewhat below the vertical limit of 1500 m. At this lower limit of distribution *C. montana* var. *tenuior* grows only on the dry mountain ridge, whereas it is crowded out from the ravines and moist places by other trees. On Mt. Tengger in 1899 I made the following note on the var. *tenuior*: A large tree attaining 35 m. with a trunk of $1^1/_2$ m. in diameter; on steep rocks at 2000 m. altitude often only 20 m. high with a trunk 30 cm. diam. On Mt. Tengger forming forests, especially between 2200—

2800 m., but on the ridges of the N.E. side of the range descending to 1600 m. altitude.

Although adult trees cannot well stand deep shade, this does not apply to very young individuals. This is evident from the following note made by me in 1891 [1]): Small trees of *Albizzia moluccana* Bentil., which had shot up after a forest fire in August 1891 on mount Wilis (in Java) at an altitude of about 1800 m., had were $1^1/_2$—2 m. high, when I ascended the mountain on October 15th 1891, and there so crowded together, that these naturally grown Albizzia-woods resembled nursery beds. Under these, in fairly deep shade, I found numerous seedlings of *Casuarina montana*, growing wild and about 0.2 m. high.

The distribution and the oecological conditions of *C. montana* var. *tenuior* may be characterized as follows: Extraordinarily great power of resisting drought, strong winds and the strong direct sunlight of the alpine region, and, but only in earliest youth (*not* later) power of resisting shade. Very common in Central Java at 1650—3000 m. and in the eastern part of Eastern Java at about 1400—3000 m. altitude, but wild growing quite unknown west of mount Lawoe, indigenous not known either from the mount Oengaran [in contradiction to the inaccurate statement of Miquel. in his Flora Ind. Bat. I. 1. p. 875].

§ 4. Means of distribution of Casuarina equisetifolia and C. montana.

Both species appear to be well adapted for distribution by wind, and in spite of the negative results of Guppy's floating experiments, they seem also adapted for distribution by ocean currents.

In the winged fruit of Javanese specimens, examined by me, I observed the following dimensions. *C. equisetifolia* Forst.: fruits $1^1/_2$ — 2 mm. long and 1 — $1^1/_2$ mm. broad compressed laterally, with a very thin, obovate wing, 5 mm. long and 3 mm. broad. In *C. montana* var. *tenuior* Miq.: fruits $1^1/_2$ — $1^3/_4$ × 1 — $1^1/_2$ mm., strongly compressed laterally, with very thin ovate wing, 2—$2^1/_4$ mm. long and $1^1/_2$ — $1^3/_4$ mm. broad.

In his well-known experiments, on the floating of fruits and seeds Guppy found, that the fruit cones of *Casuarina equisetifolia* Forst. remain floating on a $3^1/_2$ percent solution of common salt for 1– 2 days at the most. This period is not, however, sufficient to account for the known, wide over-sea distribution of this species. On repeating the experiment of Guppy, I could only confirm the shortness of the

[1]) Compare Koord. and Valeton Bijdr. Booms. Java II. (1895) 294.

floating period for separate fruit cones. I found, however, that the floating period on a similar salt solution is so much greater for fruitlets, which have been liberated from the cone (e. g. by dessication), that the wide distribution now becomes quite intelligible, if one but supposes, that the germinative power is not damaged by a sojourn of one month in sea-water. On this point, however, no experiments have as yet, to my knowledge been made. Meanwhile I feel justified in deducing from the anatomical structure of the fruitlets, that the embryo is most probably sufficiently protected against the entry of sea-water. In some flotation experiments I found that after one month 100% of the fruitlets of *C. equisetifolia* FORST., and upwards of 75% of those of *C. montana* JUNGH. var. *tenuior* MIQ. remained floating.

Besides by anemophilous and hydrophilous distribution, *C. equisetifolia* and *C. montana* can spread by rootsuckers. The latter are however rarely found in these species further than 10 m. from the main trunk. Should the main trunk die off (for instance in consequence of a fire) one can often observe, e. g. with *C. montana*, that a young copse round the dead trunk has grown up from these rootsuckers. The distribution over very large intervals of sea, however, no doubt takes place in *Casuarina montana* and *C. equisetifolia* by means of the winged fruits, first through wind transport and then through ocean currents.

§ 5. On a monstrosity of Casuarina.

In the Herbarium at Leiden I found a specimen, which had been labelled by BOERLAGE as a monstrosity, collected by JUNGHUHN in Java [in H. L. B. sub. n. 50 (899—173)]. This malformation proved to be a fruiting branch, resembling a witches' broom (in German "Hexenbesen") and belonging to *Casuarina montana* var. *tenuior* MIQ. Besides the above mentioned aberrant mode of branching, this specimen shows the peculiarity, that the axis of all its fruit cones has continued to grow. The axis, thus continued, gives the characteristic appearance to the shoots; are these branched like a witches' broom, have abnormally thickened internodes and bear abnormally developed leafsheaths. The shoots in question also bore a small number of normally formed young twigs and thus the determination was possible to me. These normal branches, have regular cylindrical internodes, about 1 cm. long and $^3/_4$—1 mm. thick, generally with 11 vaginal teeth, as is often the case in the above variety. I was unable to find a fungus or other cause for the formation of these witches'brooms in the herbarium-specimen referred to.

§ 6. Phyllogenetic note on Casuarina montana Jungh. and on C. equisetifolia Forst.

In the Herbaria at Leiden and at Utrecht I found herbarium-specimens of young seedlings and of very young shoots, developed from adventitious buds.

Accompanying one of the former specimens I found a manuscript note by MIQUEL, to the effect that these young seedlings had been raised from seed of *Casuarina montana*, imported in 1846 from Java to the Hortus at Rotterdam. These seedlings have on their youngest twigs internodes of about 2 mm. length and $^1/_8$ mm. diameter, with 4—5 deep grooves; in the 24 leaf sheaths examined by me, the number of vaginal teeth was as often 4 as 5, but never more and never less. The accompanying note of MIQUEL, indicates, however, that although 4—5 vaginal teeth were most common, he had also observed 6 teeth. The teeth are narrowly lanceolate and finely acuminate. The stems of these seedlings are only $2^1/_2$—3 mm. in diameter. MIQUEL has added in autograph: "Casuarina montana (*non* alior)" and below also *C. Brunoniana*. The species *C. Brunoniana*, which MIQUEL had described from young hot-house plants from the Rotterdam and Berlin Gardens, afterwards proved to be nothing but the "Jugendform" of *Casuarina equisetifolia* and *C. montana*. From two authentics of this species in the Herbarium at Utrecht, I could see that MIQUEL himself has withdrawn his *C. Brunoniana*, and regarded it partly as *C. equisetifolia* and partly as *C. montana*. It appears to me possible, however, that all the specimens named by MIQUEL *C. Brunoniana* belong to *C. montana* JUNGH. only. For the young specimens, named by MIQUEL as *C. equisetifolia* agree well with this. Of young seedlings, which are derived with certainty from *C. equisetifolia*, I have here no material at my disposal for investigation. In Java I have only observed the constant unusually small number of vaginal teeth in young seedlings of *C. montana*, of the var. *tenuior*. In the very young seedlings I examined, the number was never more than 4—6 as in the seedlings of *C. Brunoniana* of the Utrecht Herbarium.

Concerning a herbarium specimen (Kds 37348 β in Herb. Lugd. Bat.) of *Casuarina montana* var. *tenuior* MIQ., collected in Oct. 1899 at 2000 m. altitude near Ngadisari on Mt. Tengger in Eastern Java, I observed the following: The specimen consists of ordinary fertile old branches, and of some young sterile shoots, which had evidently developed from adventitious buds, after an older thicker trunk had been cut down near the ground. These young

shoots were characterized by internodes of $^1/_2$ mm. diameter with 5—6 deep longitudinal grooves and only 5—6 vaginal teeth. On the other hand the youngest twigs, which had been formed on the ordinary ascending older branches of the same individual, had cylindrical internodes, not deeply-grooved, $^3/_4$—1 mm. diameter, with 9—10 vaginal teeth. For the sake of completeness the morphologically unimportant, but physiognomically striking circumstance should be mentioned, that a great number of the youngest twigs of these young root-suckers were malformed at their tops to ovate or irregularly formed galls, about 3—5 mm. long and $2^1/_2$—3 mm. thick. In these galls I could generally still detect the insect which had produced these malformations. It need scarcely be mentioned, that the above description of the morphologically aberrant structure of the twigs, refers only to normally constituted ones, and not to the pathological malformations on the rootsuckers, formed from adventitious buds. I may further allude to a specimen collected by TEYSMANN and DE VRIESE in 1859—1860 in Java? (without further indications as to locality) and labelled by MIQUEL "*Casuarina equisetifolia* FORST., *monstrosa?*" This specimen, found by me in the Herbarium at Leiden, appears to me to be quite similar to the one, described above, of the ordinary *Casuarina montana* var. *tenuior* MIQ., with young root-suckers, partly deformed by galls at the shoot-tops, the number of vaginal teeth in this specimen, examined by MIQUEL is (also in the youngest twigs not attacked by galls) invariably only 6—7, never more.

Summing up (and wholly leaving out of account the above-described malformations due to galls) we find briefly the following:

1. In these very young seedlings of *Casuarina montana* var. *tenuior* MIQ., some internodes are provided with 4, others with 5—6 deep longitudinal grooves, while the number of vaginal teeth is 4—6, (never more) and in the youngest stages only 4.

2. Very young shoots formed in *Casuarina montana* var. *tenuior* from adventitious buds in the base of the trunk, had similar deeper grooved internodes with 5—6 (never with more) vaginal teeth, like the young seedling mentioned sub 1.

3. It appears that in the species here in question (*C. montana*) the youngest developmental stages of the seedlings show phylogenetically older phases of development than the young shoots from adventitious buds of the trunk examined above.

4. The structure of the seedlings referred to sub 1 seems to point to both *Casuarina equisetifolia* FORST. and *C. montana* JUNGH. being mutants of parent forms with quadrangular internodes and 4 deep longitudinal grooves, with 4 vaginal teeth. Such forms, which in my

opinion are older (e. g. *C. nodiflora* FORST. and *C. sumatrana* JUNGH.) still survive for instance, in Australia, in Sumatra, Borneo, Celebes, and in the Moluccas, but recent forms are now wanting in Java, and fossil ones have not yet been found in Java.

5. Of the two Javanese indigenous species of *Casuarina*, *C. montana* JUNGH. appear to be phylogenitically younger than *C. equisetifolia* FORST.; the former species is probably a mutant, which has only maintained itself within the region of the Malay Archipelago, and which has arisen from the latter species.

6. Probably *C. montana* var. *validior* MIQ. is a mutant, which has maintained itself in Java only and which has arisen from *C. montana* var. *tenuior* MIQ.

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Now we shall proceed to the investigation of some properties of the loci of the points of intersection of $\frac{d^2\psi}{dx^2}=0$ and $\frac{d^2\psi}{dv^2}=0$, in the first place when this locus is a closed figure, lying wholly at volumes larger than b. Let us write.

$$(v-b)^2+x(1-x)\left(\frac{db}{dx}\right)^2=x(1-x)\frac{c}{a}v^2$$

in the form:

$$v^2\left\{1-x(1-x)\frac{c}{a}\right\}-2vb+\left\{b_1^2+x(b_2^2-b_1^2)\right\}=0 \quad . \quad . \quad (\varphi)$$

The form of the third term in this equation appears only to depend on the first power of x, because $b^2+x(1-x)\left(\frac{db}{dx}\right)^2$ may be written $b_1^2+2xb_1\frac{db}{dx}+x^2\left(\frac{db}{dx}\right)^2$ and to this added $x(1-x)\left(\frac{db}{dx}\right)^2$. The third term then becomes $b_1^2+\frac{db}{dx}\left(2b_1+\frac{db}{dx}\right)x$, in which $\frac{db}{dx}=b_2-b_1$.

If we put $x(1-x)\frac{c}{a}=A$, the equation (φ) becomes

$$v^2(1-A)-2vb+b_1^2+x(b_2^2-b_1^2)=0 \quad . \quad . \quad . \quad (\varphi')$$

Let us seek the points of this line in which the tangent is parallel to the x-axis, and so in which $\frac{dv}{dx}=0$; then we find another equation