Botany. — *Some fossil woods from Java not yet described.* By J. PH. PFEIFFER and Jhr. F. C. VAN HEURN. (Communicated by Prof. F. A. F. C. WENT.)

(Communicated at the meeting of May 26, 1928).

Of late years the silicified fossil woods from the Dutch East Indies have repeatedly drawn the attention [1]) in connection with the possibility created by modern microscopic wood-research to trace the systematic relation of its original plants with the present living trees with a fairly great certainty. The method of describing the wood-structure designed by MOLL [2]) has enabled an investigator experienced in microscopic wood-research to make a correct determination from descriptions made according to that method, even though the material is not at his disposal.

Of late a striking proof of this was given by DEN BERGER in his treatise "Fossil woods from the tertiary of South-Sumatra" (1), in which he ascertained the correct botanic relation of a number of fossils described by KRÄUSEL (6).

In another treatise the same investigator pointed out how the topographic features perceptible with small magnification are especially suitable for the identifaction of woods and how with their aid the fossil woods from the familiy of the *Dipterocarpaceae* can be easily divided into genera or groups of genera.

As in this way the knowledge of tertiary and pleistocene flora of the Dutch Indies may be considerably enlarged, we thought it desirable to publish the results of the research on a collection of these fossil woods gathered by one of us.

This collection consisting of 30 specimens was collected in the private fields of Bolang, situated at about 35 kilometers West of Buitenzorg in the former residency of Batavia. The owners of the estate, the family VON KLITZING assisted in every respect.

Silicified wood abounds in that place. A great part however is corroded and breaks up into a more or less fibrous powder. Though in some of those corroded pieces some structure could be recognised, yet they were not collected, because in making collections of stones limitation is always required and moreover well-preserved material abounded. We carefully endeavoured to collect our specimens from spots which were fairly far apart, for instance from different small ravines, different brooks, etc. In

[1]) See bibliography at the end of this treatise.

[2]) J. W. MOLL und H. H. JANSSONIUS (11) Bd. I Allgem. Teil, p. 40.

consequence of erosion fragments of one tree have been scattered over a fairly large surface and if therefore we should collect various similar samples in a few spots, it might happen, that certain woods occurred in the collection in a number out of all proportion to the real distribution. Though naturally in collecting there remains a strongly subjective factor, yet the above circumstance has been taken into account as much as possible, so that the collection, however small it may be, yet to a certain extent gives an insight into the distribution of some of the families from which specimens occur in silicified condition.

Most pieces of silicified wood we find in cultivated soil. In primeval forests they occur less frequently. Along road-sides, on washed-over slopes in *Hevea*-gardens, in brooks and small ravines and in the small dikes around the rice-fields they usually abound. Transporting the stones however is not always easy. Many of them are so large, that one cannot lift them and the smaller ones too are exceedingly heavy. With a geologist's or carpenter's hammer one can seldom remove pieces ; some even resist a heavy sledge-hammer. If we take into account the native's aversion to carrying somewhat heavy stones and his regular attempts to get rid of this, in his opinion, useless bother by losing a number of them as soon as possible, we shall understand that this collecting, too, is not seldom attended with disappointment.

For geological and petrographical territorial details we refer to the concerning literature [1]).

Of the 30 specimens one was not to be recognized on account of strong deformation and compression ; the rest was determined as follows :

a. *Dipterocarpoxylon* 7 specimens. Nos 3, 7, 11, 13, 19, 24, 29, 31.
b. *Dryobalanoxylon* 10 specimens. Nos 1, 5, 6, 21, 22, 23, 25, 26, 32, 34.
c. *Shoreoxylon* 5 specimens. Nos 4, 9 ?, 12, 27, 30.
d. *Sapindoxylon* 4 specimens. Nos 10, 20, 28, 33.
e. *Sapindopsoxylon* 1 specimen. No. 8.
f. *Parinarioxylon* 1 specimen. No. 2.

From this list it again appears that the family of the *Dipterocarpaceae* and especially the genera *Dipterocarpoxylon* and *Dryobalanoxylon* dominate.

No attempt was made to establish, which of the species found of this family corresponded with the species previously described by KRÄUSEL (6) and named by him and DEN BERGER (1), though in all three genera more than one species was doubtlessly present.

In this we were led by the consideration that, seeing the great similarity the anatomical structure of cognate, still living species, shows, such an attempt would be very speculative and the result that might be obtained in that way, may for the present be esteemed of secondary importance.

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[1]) See F. C. VAN HEURN (4) and (5). The illustrations given in (4) Nos 2, 3 and 4 correspond with the Nos 1, 25 and 9 of the collection discussed here.

All of the four *Sapindoxylon*-samples show such a very close resemblance, both mutually and with the *Sapindoxylon Janssonii* KRÄUSEL described by KRÄUSEL (6), that they may be considered identical with them and we may forbear giving a description.

This is not the case with the fifth petrefaction, also showing resemblance to woods from the family of the *Sapindaceae*, but deviating perceptibly from the four mentioned above. Because, as far as we know, a description of the structure of such a fossil species does not exist, it is given below.

For the same reason a detailed description of the sample indicated as *Parinarioxylon* has been given here and it has been provided with a specific name.

However before giving these descriptions, we should make a few remarks on the conclusions which may be drawn from this collection, about the probable composition of the forest in which these fossil-species grew at one time.

Much farther than ascertaining the presence of those genera, of which at present the genus *Dryobalanops* is no more found in Java, we must not go in our opinion.

It is possible, that the species found occurred in about the same numerical proportion in which they are found at present, but it may be questioned whether from these data much may be concluded concerning the share they had in the total forest stand.

In spite of this it is quite possible that future researches in the adjoining Bantam might yield more decisive figures.

If it was to be traced by counts, what numerical significance may be attached to VAN SANDICK's observation (12), "that in some spots they are, as it were, whole forests with felled trunks lying regularly side by side", and it was to appear, that they were all or for the greater part *Dipterocarpaceae* we might draw conclusions by comparing the present number of trees per hectare.

It is a striking fact, that among the 29 fossils only one specimen was found showing a really abundant growth of tyloses. In the others this formation does not occur at all or only sporadically or locally. It is true in many samples in the woodvessels structures are observed, which at first sight are very much like tyloses, but on examination in polarised light they appear to be formed by the mutual contact of crystalsphaerites.

In KRÄUSEL's photos only in *Shoreoxylon palembangense* (KRÄUSEL) d. B. (*Caesalpinoxylon palembangense* KRÄUSEL) and in *Dryobalanoxylon Tobleri* (KRÄUSEL) d. B. an abundance of tyloses are observed.

Hence we may put the question, wether this phenomenon is connected with the fact, that timbers in which tyloses are rare, are easily penetrated. It sounds plausible that those very woods which are quickly and completely permeated with water containing silicic acid, have a greater chance of being converted into well-preserved fossils, without undergoing a biological or

chemical analysis, than those rich in tyloses ; this might explain the great number of woods poor in tyloses among the silicified fossils.

How this process of silicification takes place is likely to continue an open question for a long time. It is remarkable, that in many cases the minute crystal-structure seems to have no connection with the microscopic structure of the wood, and that nearly all organic substance has totally disappeared. The loss on ignition of such pulverised, petrified wood was determined at 0.5 % ; this must be chiefly attributed to loss of moisture. What substance or substances therefore give rise to the parking in the fossil wood is likewise unknown.

The description of the species mentioned sub. *c* (sample N^{0}. 8 of the collection) is as follows :

Topography. (See fig. 1.)

Growth-rings. Mostly poorly defined, sometimes fairly distinct ; narrow ; characterised by a period in the fibrous tissue that is denser in the late wood than in the other parts of the growth-ring.

Boundary: moderately sharp on account of the transition of the more compact late wood to the moderately compact early wood of the next growth-ring.

Wood-vessels: Grouping : nearly all single, groups of two or three vessels are very rare ; arrangement of the wood-vessels : scattered ; number : few (average 3—4 per mm^2), sometimes a tangential zone is found, in which the vessels are somewhat rarer ; size : for the greater part wide or very wide (300—500 μ), some moderately wide (200—300 μ); Surrounding tissues : usually surrounded by medullary rays on one of the two flanks, for the rest by paratracheal parenchyma and sometimes partly by fibrous tissue.

Fibrous tissue: moderately dense, in the late wood denser than in the rest of the zone of growth.

Medullary-rays: one kind ; structure : made up of horizontal, for a considerable part short, high cells, sometimes with a row of upright cells along the edges ; width : narrow (20—30 μ), wide one row of cells, a few some what wider (to 35 μ) ; number : moderately numerous (9—10 p. mm) [1]); height : for the greater part extremely low and very low (200—800 μ), some low (to 1.4 mm).

Parenchyma. Paratracheal tissue surrounds most of the vessels as narrow, usually fairly complete layers with tangentially directed thickenings on the flanks.

"Definitely arranged" parenchyma is absent [2]).

"Scattered" parenchyma occurs here and there as scattered strands or as small complexes.

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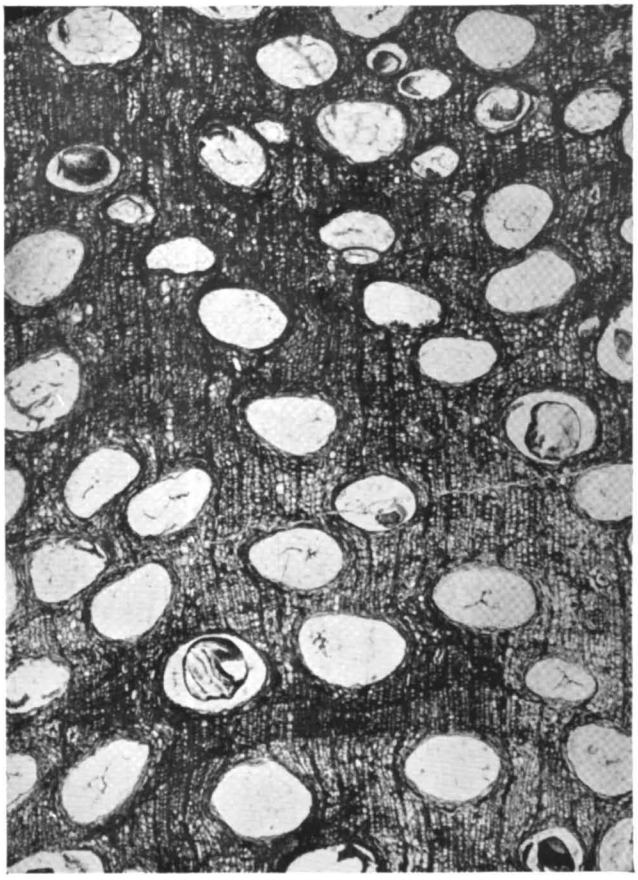
[1]) In the parts slightly compressed in radial direction 8 p. mm.

[2]) On the meaning of the terms "definitely arranged" and "scattered" parenchyma see PH. PFEIFFER (10), pp. 37—42, 78—85, 104—107.

Sapindopsoxylon Klitzingi Pf. & v. H.



Microphoto by Dr. P. Kruizinga.

Fig. 1. Cross section, enlarged 31 times.

Special formations were not observed.

Description of the elements.

Wood-vessels. Perforations single; dimensions: in tangential direction 200—500 μ wide, in radial dirrection 150—350 μ; vascular articulations average 2 per mm. 300—600 μ long; no noticeable pitting of the walls; contents lacking, except some wood-gum [1]) here and there.

Parenchyma-cells. Dimensions: 8—25 μ thick, 20—50 μ broad, 30—130 μ long; the cells adjoining the woodvessels usually flat and short; here and there crystal-fibres are found containing short, broad cells; pitting not noticeable; contents: brown wood-gum and occasionally crystals.

Fibres. Dimensions: radially 12—35 μ, tangentially 15—30 μ, length not perceptible; contents: sometimes wood-gum.

Medullary-ray-cells. Dimensions; in radial direction 20—120 μ, in tangential direction 20—35 μ, in axial direction 15—50 μ; pitting not noticeable; contents: presumably wood-gum.

The structure of this wood usually corresponds in many respects with that of the woods from the family of the *Sapindaceae*. Its determination with the aid of a card-system arranged for this purpose by one of us, likewise led to this family. The wood however deviates considerably both from the wellknown *Sapindaceae* occurring in the Dutch East Indies, and from the *Sapindoxylon* described by KRÄUSEL (6), in one respect: that almost all the pores occur singly. Moreover the number of wood-vessels is greater than in the described *Sapindoxylon*-species, and in the other samples belonging to this genus of the collection described here.

For this reason the species described here is regarded to belong to a different genus than the *Sapindoxylon*-species and it was given the name of *Sapindopsoxylon Klitzingi* Pf. & v. H. after the owners of the private estate in which the collection was made.

It is not the intention to express with this name a certain relation between this fossil and the genus *Sapindopsis* Font., of which fossil leafrests have been found in North-America and in Europe.

The description of the structure of the fossil mentioned sub *f* (N°. 2 of the collection) is as follows:

Topography.

Growth-rings: as a rule wanting; here and there slightly indicated by the occurrence of a strip poor in parenchyma or by a weak period in the number of parenchyma-lines, being a little closer together in the late than in the early wood.

Boundary: where they are to be observed, vague and characterized by the sudden difference in mutual distance of the parenchyma-lines.

Woodvessels: Grouping: nearly all single; arrangement:

[1]) Where woodgum, etc. are mentioned here we mean formations likewise consisting of silicic acid, which have wholly preserved the appearance of the substances mentioned.

scattered, only here and there an indication of complexes or more or less oblique, winding rows ; size : moderately wide and wide (200—400 μ), a very few a little wider (to 430 μ), rather variated in size, but without definite arrangement [1]); number very small (1—2 per mm^2); surrounding tissues : in a transverse section usually on both, nearly always on one of the two flanks bordered by medullary rays ; for the rest almost completely by parenchyma.

Fibrous tissue: dense and very uniform.

Medullary-rays: one kind ; structure : usually built up of horizontal cells bordered by one or two rows of high or upright cells ; here and there medullary rays with more rows of short, high cells occur, but they do not distinctly represent a different type. Width : very thin to thin, as a rule formed by one row of cells, very sporadically partly by two rows ; number : numerous, average 12 per mm ; height : for the greater part extremely low, a very few very low to low (to 1.2 mm).

Parenchyma : Paratracheal tissue present as very thin, sometimes incomplete layers, seeming to belong as it were for a great part to the metatracheal parenchyma-lines. "Definitely" arranged parenchyma occurs as numerous (average 5 per mm) very thin to thin (15—40 μ), tangentially directed, metatracheal lines, as a rule one row of cells wide, which rather undulate, change their direction or are interrupted, and locally change into definitely arranged complexes or series of scattered parenchyma. "Scattered" parenchyma only occurs here and there as scattered strands or complexes, but as a rule as rudiments of a line or series of arranged parenchyma.

Special formations: lacking, except pith-flecks observed here and there (see fig. 2).

Description of the Elements.

Woodvessels. Perforations of the vessels : single ; dimensions, radially 200—400 μ, tangentially 150—325 μ; length of the vascular articulations 450—800 μ ; average 1½ mm ; thickness of wall 3—5 μ; pits : not perceptible ; absolutely no contents.

Fibres. Dimensions : radially and tangentially 20—35 μ, mostly in tangential direction a little more stretched, length not to be observed ; thickness of wall : 5—9 μ; pits : not perceptible.

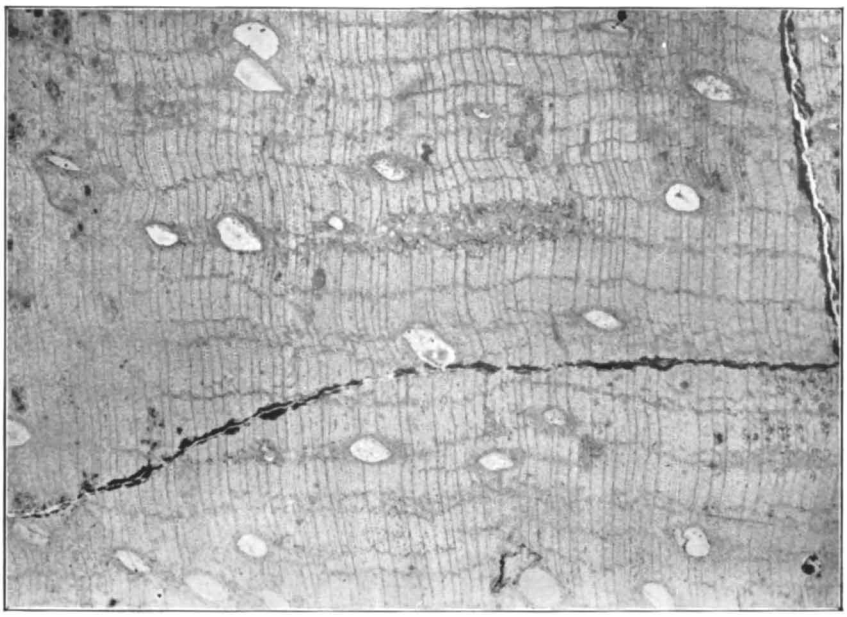
Parenchyma-cells. Dimensions radially and tangentially 20—45 μ; axially 60—100 μ; pits : not perceptible ; contents : here and there presumably wood-gum.

Medullary-ray-cells. Dimensions : radially 20—25 μ, tangentially 12—20 μ, axially 10—25 μ; pits : not perceptible contents : here and there presumably some wood-gum.

The structure of this wood shows so great a resemblance with the

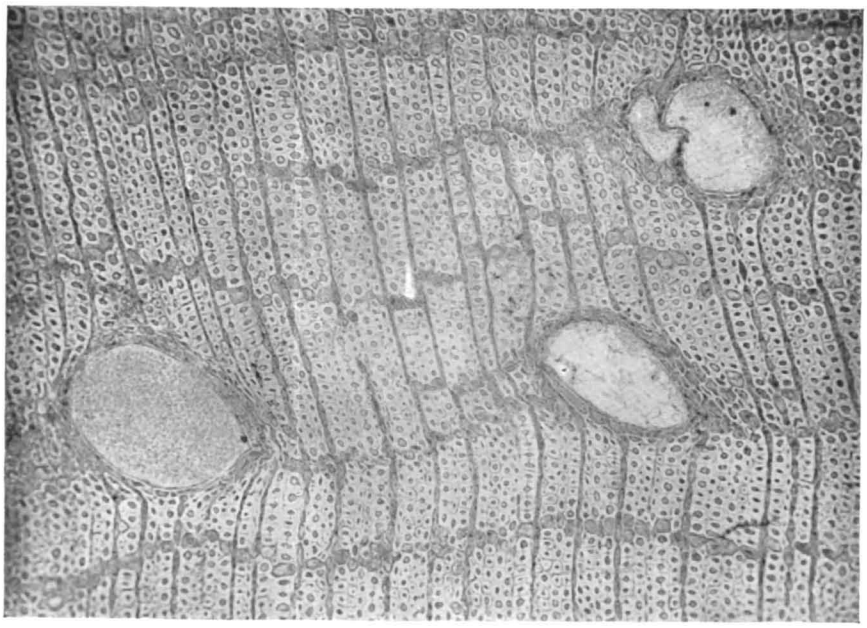
[1]) The woodvessels in the photographed part are somewhat deformed by compression in radial direction.

Parinarioxylon Itersonii Pf. & v. H.



Microphoto by Dr. P. Kruizinga.

Fig. 2. Cross section, enlarged 21 times.
In the centre a pith-ray fleck is shown.



Microphoto by Dr. P. Kruizinga.

Fig. 3. Detail from fig. 2.
Cross section, enlarged 85 times.

woods from the family of the *Rosaceae*, sub-family of the *Chrysobalanoideae*, that the relation is not at all dubious. For the rest the above description fits in details some of the *Parinarium*-species [1]) growing in the East Indies, especially *P. sumatranum* BENTH.

We therefore thought fit to give this species the name *Parinarioxylon Itersonii* Pf. & v. H. after Prof. Dr. G. VAN ITERSON Jr., through whose intermediary the laboratory of Technical Botany at Delft has been instituted.

[1]) See e.g. MOLL und JANSSONIUS (11) Vol. III, p. 222—230, DEN BERGER (2) p. 39 and J. PH. PFEIFFER (10) p. 191—195.

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