ON A NEW CORDAITEAN STEM, *CORDAITES SAHNII*, FROM CENTRAL SHANSI, CHINA

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ABSTRACT

A silicified stem collected by F. L. Yuan from the Yang-Chü district (37° 8′ : 112° 6′) of Central Shansi, China, is considered to be a new species of *Cordaites*. The pith is fairly large and discoid. The bark is represented by some layers of crushed tissues. The secondary wood consists only of tracheides and rays and is devoid of annual rings, resin canals and resin cells. Bordered pits are confined in the radial walls of tracheides and are generally uni- and biseriate, alternately arranged, and mostly flattened into hexagons. Triseriate pits are found only at the terminal part of tracheides. The xylem rays are uni- to biseriate, about 1-10 cells high with bordered pits, confined in radial walls of ray cells. In each " cross field " there are one to four elliptical bordered pits.

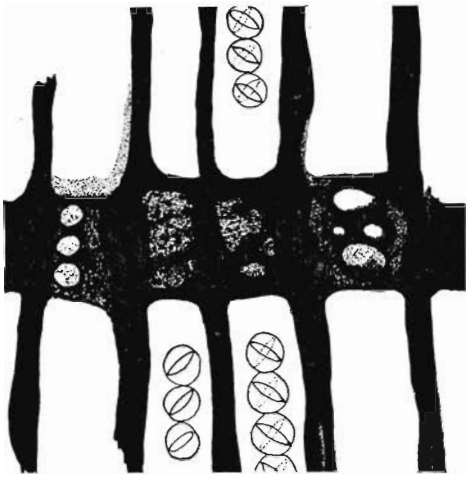
The geological age of this fossil is thought to be Upper Carboniferous or Lower Permian.

The specific name *Cordaites Sahnii* sp. nov. is suggested in memory of the late Professor B. Sahni.

INTRODUCTION

CHINA is quite rich in plant fossils, but so far as the literature is concerned our knowledge is almost restricted to impressions. The petrified specimens are rarely described and the records of petrifactions of Palaeozoic age are even more scanty. In 1933, Gothan and Sze described two petrified woods from Shansi and another one from Shantung. One of the Shansi specimens is known to have been collected from a place called Pai-Tao-Taun of the Yang-chü (formerly Tai-Yuan) district, but the exact locality of the second, it was said, had not been recorded by the collector. Both the fossils were considered by them to be Late Carboniferous or Permian and identical with the European species *Dadoxylon Rhodeanum* Goeppert. The third specimen is also described by them under the genus *Dadoxylon* but no specific name is given and no geological age has been recorded. In the next year, Sze (1934) again published a paper discussing a fossil trunk collected from an Upper Permian bed in the Tihua (formerly Urumchi) district of Sinkiang. Sze considers it to be a new species of *Dadoxylon* and named it *D. Teilhardi*. Recently Sze (1946) further recorded the fossil *Dadoxylon Rhodeanum* from Ninghsia and suggested that this species, having frequently been found in the provinces of Shantung, Shansi, Kansu, and Shensi, was widely distributed in North China in the Late Palaeozoic. A few years back Sze (1942, 1947) again described a petrified fern stem of Permian age from an Intertrappean bed of the Omeishan basalt from the Weining district of Kweichow, and named it *Psaronius sinensis* as a new species. That is all we know about the petrifactions of the Palaeozoic plants in China.

From the above summary of literature it seems that the Palaeozoic petrified flora of China is very poor as compared with that of Europe ; but this may be due only to the fact that very little field work has been done and less attention has been paid to it. For this reason we have been attempting to search for some more petrified specimens and to study them in the hope of extending our meagre knowledge of the petrified flora of China. The present paper deals with only one petrified stem collected from the same district Yang-Chü (37° 8′ : 112° 6′) from where *Dadoxylon Rhodeanum* Goeppert was first recorded. This specimen was collected by Professor F. L. Yuan of the Geology Department of National Tsinghua University, Peking, about a dozen years ago. Under critical examination this stem shows definitely Cordaitean affinities in its structure and it has some distinctive features, such as the height of the rays, the pitting on the walls of tracheides and the number of pits as seen in a "cross-field" made by ray cells and tracheides, which lead us to think our specimen definitely different from *Dadoxylon Rhodeanum* Goeppert and *D. Teilhardi* Sze, and also different from any European and American species known to us. Therefore, we suggest the name *Cordaites Sahnii* sp. nov. for it in memory of our late Professor B. Sahni. It will be the fourth Palaeozoic petrified plant from China.



TEXT-FIG. 1 — Radial section of the secondary wood showing the uniseriate bordered pits in the wall of ray cells and tracheides. ×405.

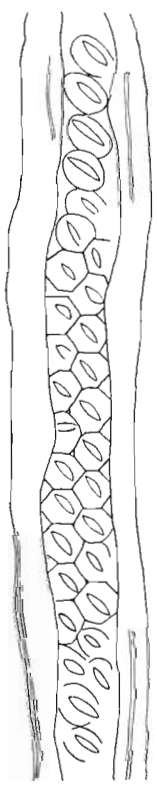
DESCRIPTION

The specimen is a silicified woody stem about 5·2-6 cm. in diameter and 6 cm. in thickness. It consists of a well-developed secondary wood enclosing a large pith, and has some remains of bark (PL. 1, FIG. 1). The wood is apparently eccentrically developed around the axis, the broader side being only about 4 cm. thick but the narrower side being only 1·6 cm. across. The figure given here only represents half of the stem in cross-section because the other half was partly exhausted in the preparation of slides. The pith measures 0·9 cm. in diameter (PL. 1, FIG. 3) and is represented by a series of compact folded diaphragms, about seventeen in number in a space of 1 cm., which make it discoid in appearance in longitudinal section (PL. 1, FIG. 4).

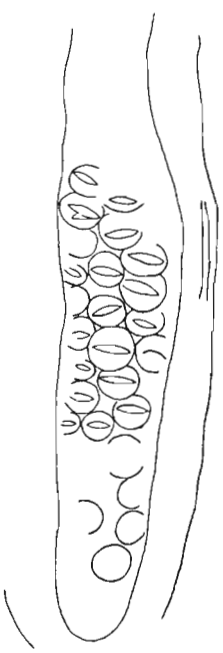
Examining the prepared slides under the microscope, we have not been able to find any interesting structure in the pith except crystals of siderite and traces of polygonal cell-like outlines which appear too faint to convince us that they were actual cells of the pith. It was impossible to make out any details of the primary xylem.

The secondary wood is well preserved. It consists of tracheides and rays only and no growth zones are visible (PL. 1, FIG. 5). Resin cells or canals have so far not been found. Near the centre of the stem a few dark, ring-like structures are seen scattered in the secondary wood (PL. 1, FIG. 6). These rings, however, have nothing to do with traumatic resin canals which are usually found in *Araucarioxylon* or some other Coniferous woods, but were merely formed by deposition of some extra minerals in the lumen of the tracheides.

The tracheides are 22-30 μ across and more or less square seen in cross-section (PL. 1, FIGS. 5, 6). Pits are found only in the radial walls of tracheides (PL. 2, FIGS. 7-10), which are uni- to triseriate, mostly biseriate (TEXT-FIGS. 1-3). When they are triseriate, the pits are confined in the terminal region of the tracheides (PL. 2, FIGS. 9, 10 ; TEXT-FIG. 3). Usually they are alternately arranged, round or elliptic, contiguous, and sometimes flattened into hexagons (PL. 2, FIGS. 8, 9 ; TEXT-FIG. 2). The diameter of the pits varies from 22 to 30 μ. The pore is



TEXT-FIG. 2—A portion of tracheide in radial section showing that the bordered pits are alternately arranged and flattened into hexagons. ×405.



TEXT-FIG. 3 — The terminal part of a tracheide, showing triseriate bordered pits. ×405.

rather large, narrowly elliptic and usually obliquely placed, and forms an inclined cross with the pore in the wall of adjacent tracheides (PL. 2, FIG. 8). But the pore of the pits on the terminal regions of tracheides appears more or less horizontal (PL. 2, FIGS. 9, 10).

The rays are small and narrow, and of 1-10 cells in height, but in most cases they are rather low, only of 1-4 cells (PL. 2, FIG. 13). Their cells are rectangular in shape and thick walled. They vary from 150 to 270 μ in length and are *ca.* 37 μ wide. They are uniseriate, rarely locally biseriate (PL. 2, FIG. 13). In tangential sections the number of rays count *ca.* forty-three in one square millimeter. The horizontal and the tangential walls of the cells of xylem rays are smooth. Pits are only found in the radial walls of these cells, bordered, ellipsoidal and obliquely placed (PL. 2, FIGS. 11, 12 ; TEXT-FIG. 3) ; sometimes they are quite big, nearly occupying the whole space of a " cross field " made by ray cells and tracheides. In each field they count from one to four (TEXT-FIG. 1) but mostly one.

The phloem is not well preserved in this specimen. Pl. 1, Fig. 2 shows some successive layers of rectangular cells which are quite apart from the secondary xylem and separated by some crushed tissues. Judging from shape and position of the cells, possibly they belong to the periderm of the cortex.

DISCUSSION, COMPARISON AND CONCLUSION

As the pith of this stem is distinctly discoid, and the secondary wood is composed only of tracheides and rays, the pits are bordered, confined in the radial walls of the tracheides, and multiseriate, contiguous, alternately arranged and flattened into hexagonal outlines, and the cells of rays have their pits confined in their radial walls, it is quite similar to those of European and American *Cordaites* described by Jeffrey (1917), Seward (1917), and Scott (1923). So it is considered belonging to the genus *Cordaites*.

Woods of *Cordaites* or *Dadoxylon* type have frequently been found in China, as stated above. But our specimen shows some features other than those of the Chinese specimens described before. The wood described by Gothan and Sze (1933), and Sze (1946) as *Dadoxylon Rhodeanum* Goeppert has bi- or triseriate pits in the radial walls of tracheides, and their ray cells are three to twenty cells in height and biseriate ; while that of ours is lower and uniseriate and the pits in the walls of the tracheides are generally uni- to biseriate.

The fossil *Dadoxylon Teilhardi* Sze from Tihua is also different from ours as the pith of the Tihua specimen is not discoid and its secondary wood shows annual rings.

There are some features in the secondary wood of our specimen very similar to *Dadoxylon* sp. described by Gothan and Sze (1933, p. 91) from the La-Wu district of Shantung : such as the uni- to biseriate medullary rays and the uni- to triseriate bordered pits in the radial walls of the tracheides. Unfortunately they give no figure and their description is rather brief. We do not know whether the occurrence of triseriate bordered pits in the radial walls of the tracheides is a constant character or if they are confined only to the terminal portions of the tracheides. Nor do we know whether the rays are uniformly biseriate or only locally biseriate, as in ours. Among woods of other regions from China, we have limited our comparison to species of *Cordaites* or *Dadoxylon* of Permian and Carboniferous ages. Seward (1917) gives a list of such species with their characters. Every one of them is sharply distinguished from ours by one or another character. Other species are described by Elkins and Wieland (1914), Bradshaw and Sahni (1925), Edwards (1928), Chiarugi (1929), Frentzen (1931) and Arnold (1931) but again every one of these is distinguished by a well-marked difference.

Here is another interesting point we should mention that Cordaitean woods have frequently been found in China, but so far as we know this is the first Cordaitean stem with *Artisia* type of pith recorded.

As to the correlation of this wood with Cordaitean leaves, we know there are only four species recorded in China, namely *Cordaites principalis* (Germ.) H. B. Gein, *C. Schenkii* Halle, *C.* sp. (HALLE, 1927), and *C.* sp. (HSÜ, 1952). Sze (1946) suggests that *Dadoxylon Rhodeanum* Goeppert may be correlated with *C. principalis*. His suggestion may be right, because both of them have a wider distribution in China and have also been recorded in Europe. Then, to which Cordaitean leaf our specimen might be correlated is very difficult to say, and will remain an open question.

Our fossil came from the region from where Professor Halle's Late Palaeozoic

specimens were collected; it suggests that our fossil possibly belonged to the same age. As far as we know, all the fossils of this area are of the Upper Carboniferous and Lower Permian ages. Furthermore, structure of this stem clearly shows that it is a species of *Cordaites*. Cordaitean remains have not yet been found in the beds above Permian or under Middle Carboniferous. This supports the age we assign to it.

We regard, therefore, our fossil as a new Cordaitean stem of Upper Carboniferous or Lower Permian age. The diagnosis is given as the following :

Cordaitean stem with bark, discoid pith, and secondary wood. Secondary wood devoid of annual rings and composed only of tracheides and rays. Tracheides with uni- to triseriate bordered pits which are confined in their radial walls, round or elliptical, ranging from 22 *to* 30 μ *in diameter, usually alternately arranged contiguous and flattened into hexagons. Triseriate pits occurring only at the terminal part of tracheides. Xylem rays, uni- to locally biseriate, about* 1-10 *cells high, with obliquely placed bordered pits confined in the radial walls of ray cells. Each " cross field " of tracheides and ray cells having* 1-4 *elliptical, bordered pits.*

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EXPLANATION OF PLATES

(*All the figures are untouched photographs*)

PLATE 1

1. Transverse view of the specimen, showing pith, bark and the secondary wood. × 1·5.
2. Transverse section of the bark, showing badly preserved peridermal cells. × 75.
3. Trasverse section of the pith. × 4·5.
4. Longitudinal section of the pith and a part of secondary wood, to show its discoid nature. × 4·5.
5. Transverse section of the wood. × 100.
6. Transverse section of the wood, showing the dark ring-like structure produced by deposition of a mineral in the secondary wood. × 75.

PLATE 2

7. Radial section of the wood, showing uni- and biseriate pits in the radial walls of tracheides. × 100.
8. Radial section of the wood enlarged, showing the alternate arrangement of the biseriate pits, and the uniseriate pits of other tracheides. × 500.
9. Radial section of the wood, showing one of the tracheides with triseriate pits at its terminal part. × 273.
10. A part of the above-mentioned tracheides, enlarged. × 455.
11. Radial view of wood, showing one to three bordered pits in a " cross field " of tracheides and the ray cells. × 580.
12. The same, showing 1 and 4 bordered pits in a " cross field " of the tracheides and the ray cells. × 455.
13. Tangential view of wood. × 100.

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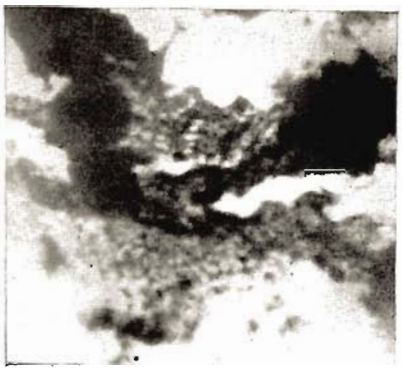

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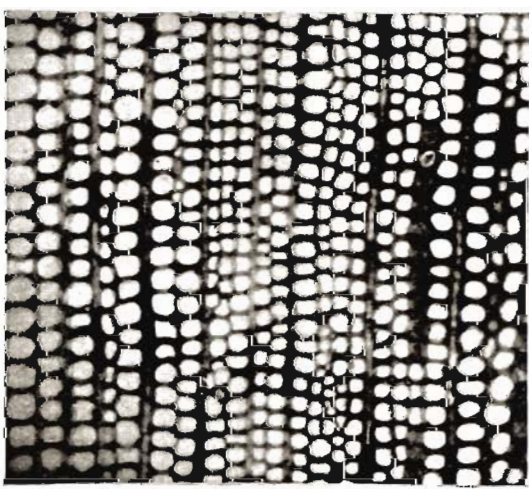

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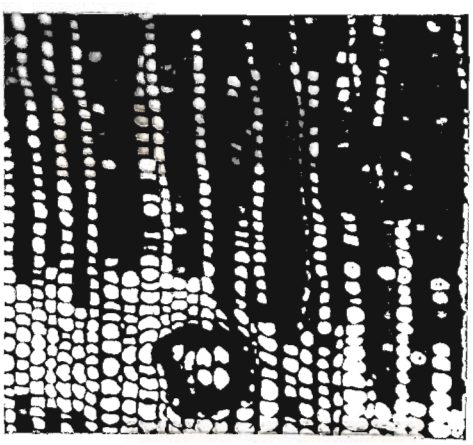

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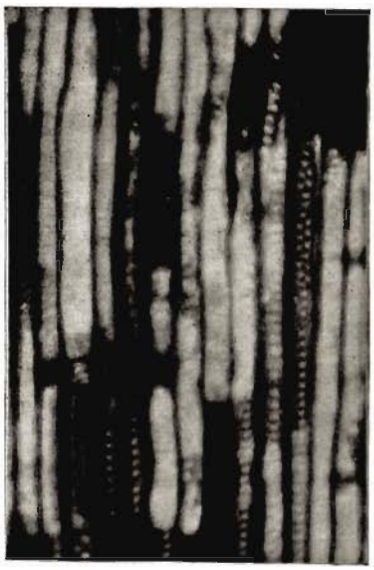

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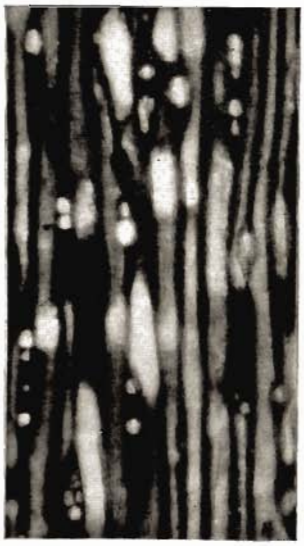

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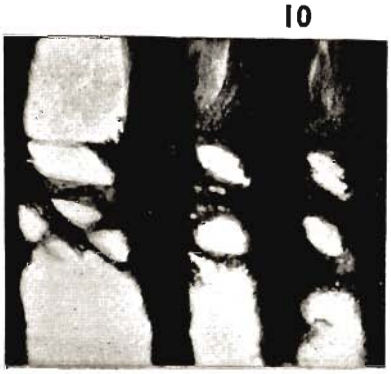

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