ANCIENT PLANT ECONOMY AT TER, MAHARASHTRA

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ABSTRACT

Carbonized food grains and charcoals of the Satavahana to post-Satavahana period (150 B.C. to 260 A.D.) discovered from Ter, Dist. Osmanabad, Maharashtra are described. These comprise *Triticum sphaerococcum* Perc., *Oryza sativa* L., *Hordeum vulgare* L., *Paspalam scrobiculatum* L., *Cicer arietinum* L., *Pisum* sp., *Lens culinaris* Medik., *Dolichos biflorus* L., *Phaseolus* sp., *Lathyrus sativus* L., *Ricinus communis*. L. and *Zizyphus numularia* L. Wheat and rice were equally important during the Satavahana period, and later wheat predominated during the late Satavahana period. Chick-pea appeared in the late Satavahana period. The increased use of Chick-pea and the introduction of Barley and *Paspalam scrobiculatum* in the post Satavahana period at Ter have considerable significance from the view point of cultural contacts of ancient people. Castor oil seed has been discovered for the first time.

The charcoals of Bamboo, *Sonneratia*, *Terminalia*, *Tectona*, *Boswellia* and *Acacia* are identified. These not only throw light on their economic use during the late Satavahana period but also indicate the existence of a dry deciduous forest community in the vicinity of Ter.

INTRODUCTION

The paper describes plant remains comprising carbonized food grains and charcoals discovered from Ter, Dist. Osmanabad, Maharashtra during 1966-1968 by Dr. M. G. Dixit, Director of Archives and Archaeology, Maharashtra State, and kindly sent by him to the senior author for investigation. The food grains have been investigated by the senior author and the charcoals by U. Prakash and N. Awasthi.

The two radio-carbon dates available (TF-746; 1690±105 and TF-747; 2105±100) indicate that the site ranges in age from about 150 B.C. to 260 A.D., i.e., from the early historical to historical period corresponding in time to the Satavahana to post-Satavahana period in the history of Maharashtra. Plant economy of this period is earlier known from Kaundinyapur (VISHNU-MITTRE, 1966, 1968*a*, *b*), Paunar (VISHNU-MITTRE & GUPTA, 1968) and Bhatkuli in Maharashtra (VISHNU-MITTRE & GUPTA 1968-69, cf. VISHNU-MITTRE, 1968).

The senior author is thankful to the Late Dr. Moreshwar G. Dixit for the materials given for investigation.

I—REMAINS OF FOOD GRAINS

Food remains referred to below are all carbonized and Table I shows their stratigraphical position.

1. Wheat—*Triticum sphaerococcum* Perc.
Pl. 1, Fig. 1

A small number of grains of wheat (from 1-20) are found in most samples but their abundance is noticed in sample nos. 550, 553, 1225, 1137, 980, 433, 964; sample nos. 1314

AGE	Sample No.	CEREALS				LEGUMES						OTHERS		CHARCOALS					
		WHEAT	BARLEY	RICE	PASPALUM	DOLICHOS	PISUM	LENTIL	PHASEOLUS	CICER	LATHYRUS	ZIZYPHUS	RICINUS	BAMBOO	SONNERATIA	TERMINALIA	TECTONA	BOSWELLIA	ACACIA
POST-SATAVAHANA 250—400 A.D.	113	+	+	+	..	+	+	+	..	+	+	+	..	..	..	..	..	..	..
	205	+	..	+	..	+	+	+	..	+	+	..	..	..	..	..	..	..	..
	209	..	+	+	..	..	..	+	..	+	+	..	..	..	..	..	..	..	..
	354	+	..	+	..	..	..	..	+	+	+	..	..	..	..	..	..	..	..
	357	..	..	..	..	..	..	..	..	+	..	..	..	..	..	..	..	..	..
	359	+	+	+	..	..	+	..	..	+	..	..	..	..	..	..	..	..	..
	365	+	..	+	+	..	+	+	..	+	..	..	..	..	..	..	..	..	..
	877	+	..	..	..	+	..	..	..	..	+	..	..	..	..	..	..	..	..
LATE-SATAVAHANA 100—250 A.D.	2	+	..	+	..	..	..	..	+	+	..	..	..	..	..	..	..	..	..
	4	+	..	+	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..
	158	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	433	+	..	+	..	..	+	+	..	..	..	..	..	..	..	..	..	..	..
	964	+	..	+	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..
	980	+	..	+	..	..	+	+	..	..	+	..	..	..	..	..	..	..	..
	1,046	..	..	..	..	..	..	..	..	..	..	..	..	+	+	..	+	..	+
	1,119	..	..	..	..	..	..	..	..	..	..	..	..	+	..	+	+	+	+
	1,136	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+
	1,208	+	..	+	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..
	1,209	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	+
	1,314	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	1,381	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	1,396	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
SATAVAHANA 200 B.C.—100 A.D.	44	+	+	+	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	56	+	..	..	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..
	65	+	..	+	..	+	+	..	..	..	..	+	..	..	..	..	..	..	..
	533	+	..	+	..	+	+	+	+	..	+	+	..	..	..	..	..	..	..
	550	+	..	+	..	..	+	..	..	..	..	..	..	..	..	..	..	..	..
	575	+	..	+	..	..	+	..	..	..	+	..	+	..	..	..	..	..	..
	1,137	+	..	+	..	..	+	+	..	..	..	..	..	..	..	..	..	..	..
	1,225	+	..	+	..	..	+	+	..	..	..	..	..	..	..	..	..	..	..

Table 1—Chronological distribution of plant remains at TER

and 1396 contain exclusively wheat. The wheat grains range in size from 3.5—6 × 2-4 × 1.5-3 mm in dimensions. It has been possible through the determination of the L/B, L/T, B/L, T/L, T/B indices and their comparison with the similar indices of the modern primitive and advanced species of *Triticum* in India that the carbonized wheat grains from this site compare with *Triticum sphaerococcum*, a hexaploid species.

2. Rice—*Oryza sativa* L.

Pl. 1, Figs. 4, 8

The kernels of rice are scattered in most samples in small number but the abundance of spikelets is found in sample nos. 2365 and 1137. Both the spikelets and the kernels are prominently ribbed on both the surfaces and the chess-board pattern is quite clear. No evidence of awn has been found. The spikelets measure 3-5 × 2.5-3 × 1.5-2 mm and the kernels about 3-5 × 2.5-2.75 × 1-1.75 mm in dimensions. In all probability specimens belong to cultivated *Oryza sativa* L.

3. Barley—*Hordeum vulgare* L.

Pl. 1, Fig. 7

Hulled forms of Barley with adherance of chaff are found in small number (1-8 in sample nos. 359, 113 and 44) measuring about 5.5 × 2 × 1.5 mm in dimensions.

4. Millet—*Paspalum scrobiculatum* L.

Pl. 1, Fig. 3

Only 3 grains flat on one side, convex on the other, round at the base and slightly pointed on the opposite side have been found in the sample no. 365. The grains measure 2.25 × 1.75 × 1.25 mm.

5. Chick-pea—*Cicer arietinum* L.

In small number from 2-8 seeds of Chick-pea are found in sample nos. 356, 205 to 209, 113 and 359, measuring in size 4-5 × 3-4.5 × 2.5-4 mm in dimensions.

6. *Pisum* sp.

In small number upto 10 are found in quite a few samples but abundantly and exclusively in sample no. 575. They measure 2.5-4.5 × 2.5-4.5 mm in dimensions and resemble *Pisum arvense*.

7. Lentil—*Lens culinaris* Medik.

Pl. 2, Fig. 11

A few to small number of lenticular seeds with keeled edge is found scattered in a number of samples, measuring 3-4.5 × 2.5-4 × 1-2 mm in dimensions.

8. *Dolichos biflorus* L.

Pl. 1, Fig. 9

A few split cotyledons of the seeds of *Dolichos biflorus* measuring about 6.5-9 × 4.5-5 × 2-3 mm in dimensions have been found in six samples only.

9. *Phaseolus* sp.

Pl. 1, Fig. 5

Squarish cotyledones measuring about 4 × 2-3 × 1.75 mm in dimensions found in sample nos. 533, 354 and 2, and a single carbonized grain with rounded ends, measuring about 3.25 × 2 × 1.50 mm are doubtfully referred to the genus *Phaseolus*.

10. *Lathyrus sativus* L.

Pl. 2, Fig. 10

Very much compressed and wedge shaped seeds of *Lathyrus sativus* measuring 3-4 mm are found scattered in sample nos. 205, 533, 98 and 113 but abundantly in 575 and 877.

11. Castor oil seeds—*Ricinus communis* L.

Pl. 1, Fig. 6

A single seed from sample no. 575, measuring about 9 × 5 × 4 mm with the central area of both sides marked by an incomplete oval ring seems to compare with the seeds of castor oil.

12. *Zizyphus numularia* L.

Globose or ovoid stones of *Zizyphus* with smooth or rugose surface occur scattered in sample nos. 13, 65, 533. They measure 4-6.5 × 4-5.5 mm. in dimensions.

II—CHARCOALS

1. Bamboo

Pl. 2, Fig. 12

Sample Nos. 1046, 1119.

Microscopic Structure—Fibrovascular bundles scattered in parenchymatous ground tissue as seen in the available cross-section and are more or less uniform in size and distribution, measuring about 800 μ in radial and tangential diameter. Each fibrovascular bundle consists of sclerenchymatous as well as vascular tissues. The xylem of each bundle consists of a protoxylem which occurs at the inner pole of the bundle and one conspicuously large metaxylem vessel on each side and slightly nearer to the phloem than the protoxylem. The phloem is present on the outer pole of the bundle consisting of seive tubes with wide lumina. The sclerenchymatous tissue is seen at four different positions, one at the outer (phloem) pole, one at the inner (protoxylem) pole, and two at the lateral (metaxylem) poles.

The type of fibrovascular bundles indicates its affinity with the stem of a bamboo. All attempts to match it with species of Indian bamboos have failed to indicate its nearest resemblance. However, it is identified as one of the bamboos.

2. *Sonneratia* sp.

Pl. 4, Figs. 23-26

Sample No. 1046

Microscopic Structure—Wood diffuse-porous. *Growth rings* present, delimited by the presence of smaller vessels. *Vessels* small to very small, maximum tangential diameter 90μ, maximum radial diameter 120 μ, mostly in radial rows of 2-4 or more, sometimes solitary,

open or in part plugged with tyloses, solitary vessels oval in shape, those in radial multiples flattened at the places of contact, more or less evenly distributed, 30-100 vessels per sq. mm; vessel-members with truncate or abruptly tailed ends; perforations simple; intervessel pits alternate, oval or circular, medium to large, 8-10 μ in diameter, vestured. *Parenchyma* absent. *Xylém rays* fine, almost uniseriate; ray tissue homogeneous to heterogeneous, ray cells often swollen and cystalliferous. *Fibres* non-libriform, septate, moderately thick-walled.

The above anatomical features of charcoal are found in the modern woods of *Sonneratia* especially in *S. acida*.

3. *Terminalia* sp.

Pl. 3, Figs. 19-22

Sample No. 1119

Microscopic Structure—Wood diffuse-porous. *Growth rings* distinct, delimited by lines of terminal parenchyma and thickwalled fibres. *Vessels* large to medium sized, t.d. upto 255 μ, r.d. upto 340 μ, mostly solitary, sometimes in radial rows of 2-4, oval to somewhat elliptical in shape, those in radial multiples flattened at the places of contact, somewhat graded in distribution, being larger in the early wood, grading towards the late wood, 6-18 vessels per sq. mm; tyloses not present; vessel members with truncated ends; perforations simple; intervessel pit-pairs large, 8-12 μ in diameter, alternate, vestured, oval with linear to lenticular apertures. *Parenchyma* both apotracheal and paratracheal; apotracheal parenchyma in narrow lines at the growth-rings; paratracheal parenchyma usually aliform sometimes joining adjacent vessels forming aliform—confluent to confluent bands. *Xylem rays* fine, uniseriate, upto 20 cells in height; ray tissue homogeneous, rays homocellular, consisting of procumbent cells only. *Fibres* non-libriform, more or less aligned in radial rows, septate.

The anatomical structures described above indicate its affinity with *Terminalia coriacea*.

4. *Tectona* sp.

Pl. 4, Figs. 27-29

Sample Nos. 1046, 1110

Microscopic Structure—Wood ring-porous. *Growth rings* distinct, delimited by larger pores of spring wood. *Vessels* variable in size, large in spring wood, maximum diameter upto 300 μ, mostly solitary, sometimes in radial rows of 2-3, forming a spring wood zone of 1-3 (mostly 1) vessels wide; transition from spring wood to summer wood gradual to more or less abrupt; summer wood vessels medium sized to small minimum diameter 50 μ, solitary and in radial rows of 2-3 or more vessels, mostly open, sometimes with tyloses or gummy deposits; 6-22 vessels per sq. mm; perforations simple; inter vessel pit-pairs alternate, bordered, orbicular to oval, 6-8 μ in diameter with wide border and lenticular aperture. *Parenchyma* paratracheal-zonate and diffuse; paratracheal parenchyma sparse, associated with the vessels; paratracheal zonate parenchyma associated with the first row of spring wood vessels; diffuse parenchyma extremely sparse, restricted to occasional cells in the fibrous tissue. *Xylem rays* broad, 1-5(6) seriate, upto 50 cells in height; ray tissue homogeneous. *Fibres* non-libriform, non septate.

The structural details of the wood indicate its nearest affinity with *Tectona grandis*.

5. *Boswellia* sp.

Pl. 3, Figs. 14-16

Sample No. 1119

Microscopic Structure—Wood diffuse-porous. *Growth rings* not distinct. *Vessels* small to large, 40-160 μ in diameter, solitary and in radial rows of 2-6 (mostly 2-3), open for the most part, solitary vessels oval in shape, those in radial multiples flattended at the places of contact, more or less evenly distributed, 12-25 vessels per sq. mm; vessel-members 170-680 μ in length with truncate or tapered ends; perforations simple; intervessel pit-pairs orbicular to oval, bordered, alternate to subopposite, 8-12 μ in diameter with linear to lenticular apertures. *Parenchyma* scanty paratracheal, associated with some vessels. *Xylem rays* broad, 1-6 (usually 3-4) seriate, 5-26 cells high, some rays with horizontal gum canals; ray tissue heterogeneous, consisting of procumbent cells through the median portion and 1-2 marginal rows of upright cells at one or both the ends. *Fibres* non-libriform, septate. *Gum canals* frequent, horizontal in fusiform rays, 50-140 μ in diameter.

The anatomical features of the wood indicate its nearest resemblance with *Boswellia serrata.*

6. *Acacia* sp.

Pl. 3, Figs. 17-18

Sample Nos, 1046, 1136, 1119, 1209

Microscopic Structure—Wood diffuse-porous. *Growth rings* inconspicuous; terminal parenchyma appears to be present. *Vessels* large to medium sized or small, maximum diameter upto 300 μ, larger on the inner side of the ring, slightly grading towards the late wood, majority solitary, sometimes in radial multiples of 2-3, round to oval in shape, mostly occluded with black deposits, evenly distributed, 4-14 vessels per sq. mm; vessel members with truncated ends; perforations simple; intervessel pit-pairs not clearly seen. *Parenchyma* paratracheal and apotracheal; paratracheal parenchyma forming several seriate halo around the vessels or vessel groups, often joining the neighbouring vessels to become confluent; apotracheal parenchyma occurring as solitary or groups of cells in the fibrous ground mass and forming narrow lines of parenchyma at the growth rings. *Xylem rays* broad, 1-5 (usually 3-4) seriate, upto 50 cells high; ray tissue homogeneous, with rays composed of procumbent cells only. *Fibres* semilibriform to libriform, probably non-septate.

The structural features of the present wood indicate its nearest resemblance with the species *Acacia catechu* and *A. ferruginea*, but more so with the former.

7. Incertae sedis

Pl. 2, Fig. 13

The structural features indicate that it might belong to a herbaceous dicotyledon. However, at present it is not possible to assign it to any taxa among the dicotyledons.

CONCLUSIONS

The investigation reveals a rich variety of food grains, comprising all the important cereals, such as Wheat, Rice and Barley, and Lentil, *Pisum*, *Lathyrus*, *Dolichos* and Chick-pea among the legumes. These constituted the plant economy at Ter during the Satavahana to the post-Satavahana period, from 250 B.C. to 400 A.D. There are some indications of shift

in food economy during about 650 years. Wheat and Rice were equally important during the Satavahana period, and later Wheat predominated during the late Satavahana period (100 A.D. -250 A.D.). Chick-pea (*Cicer arietinum*) made its appearance in the late Satavahana period and became an important article of food during the post-Satavahana period. It is during this period that Barley and *Paspalum scrobiculatum* also entered the food economy.

Plant economy during this period at Paunar (VISHNU-MITTRE & GUPTA, 1968) in Maharashtra consisted of *Sorghum* and Rice only. No evidence of *Sorghum* has been found at Ter. The increased use of *Cicer arietinum* and the introduction of Barley and *Paspalum scrobiculatum* in the post-Satavahana period at Ter have considerable significance from the view point of cultural contacts of ancient people. Records of most of the cereals and legumes are already known from several archaeological sites in Western India (VISHNU-MITTRE, 1968) but the discovery of castor oil seed has been made for the first time.

The charcoals identified from this site belong to *Sonneretia acida*, *Terminalia tomentosa* or *Terminalia coriacea*, *Tectona grandis*, *Boswellia serrata*, *Acacia catechu* or *A. ferruginea* and Bamboo. The use of the woods of these trees either as fuel or for constructive purposes from which the charcoals may have been derived, indicates to a large extent the availability of these woods in the near vicinity. *Tectona grandis*, *Terminalia* sp., *Boswellia serrata*, *Acacia* sp. and remains of Bamboo immediately suggest a dry deciduous community that might have existed in the vicinity of Ter, a much degenerated form of which even today occurs in the southern part of Maharashtra. If the indications of this community are correctly assessed there does not seem much difficulty in inferring that both the vegetation and climate in these regions have remained unchanged during the last 2,000 years but for the human influence on the vegetation of this area in the recent past.

The identification of *Sonneratia* presents considerable difficulty. It is a plant of typical mangrove habitat and today occurs along the coastal regions of Bombay which are about 300 km west of this site. If the identification is unquestionable then the only plausible explanation that one can think of is that the wood of *Sonneratia acida* was obtained by the ancient inhabitants of Ter from the coastal region of Bombay.

The mere find of charcoal of these timber trees at Ter should not be looked upon as indicating the use of their wood as fuel. Some of these might have been used for other purposes also, such as beams, wooden frames, handle, etc. of which the supporting evidence from the archaeological discovery from this site will be very interesting. *Sonneratia apetala* is known to be used as fuel. Even if the specimen turns out to be *Sonneratia apetala* and not *Sonneratia acida* one remains to wonder why only for the sake of fuel the people at Ter had chosen to transport it from a pretty long distance. Surely they must have found a different use of it.

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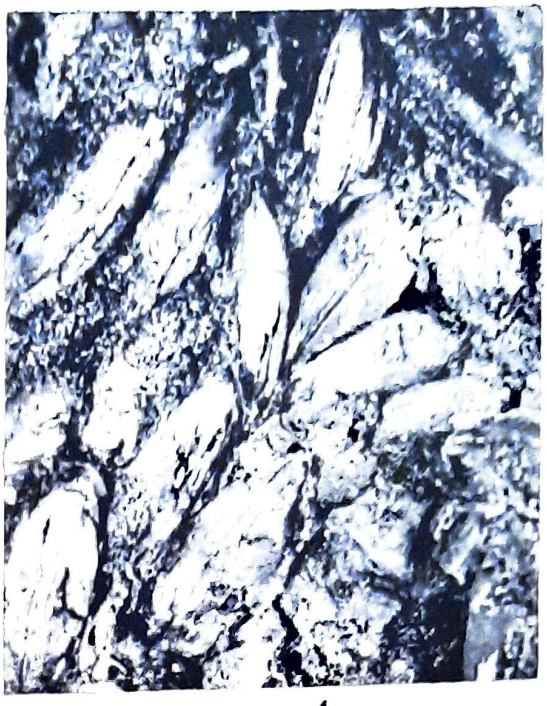

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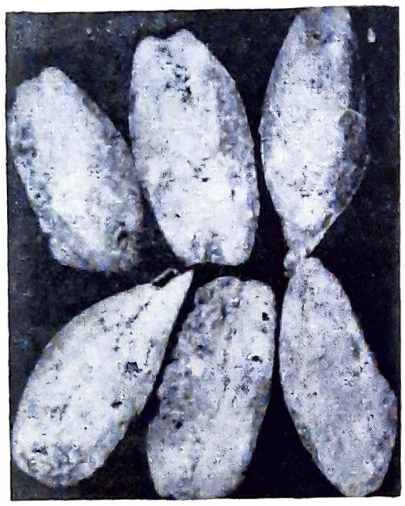

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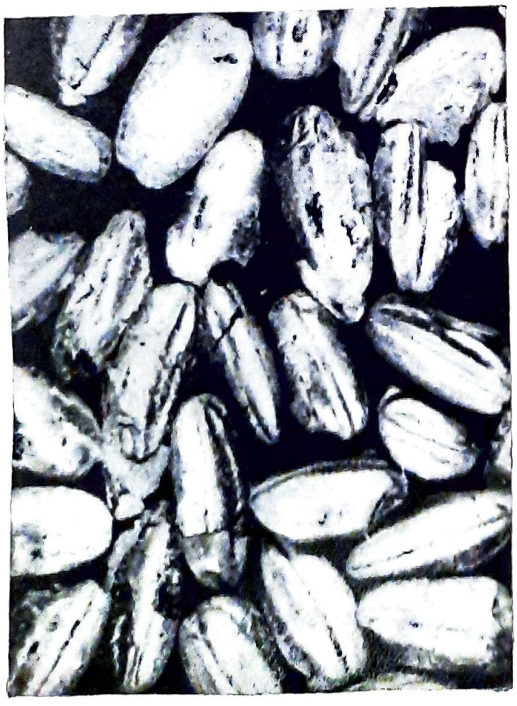

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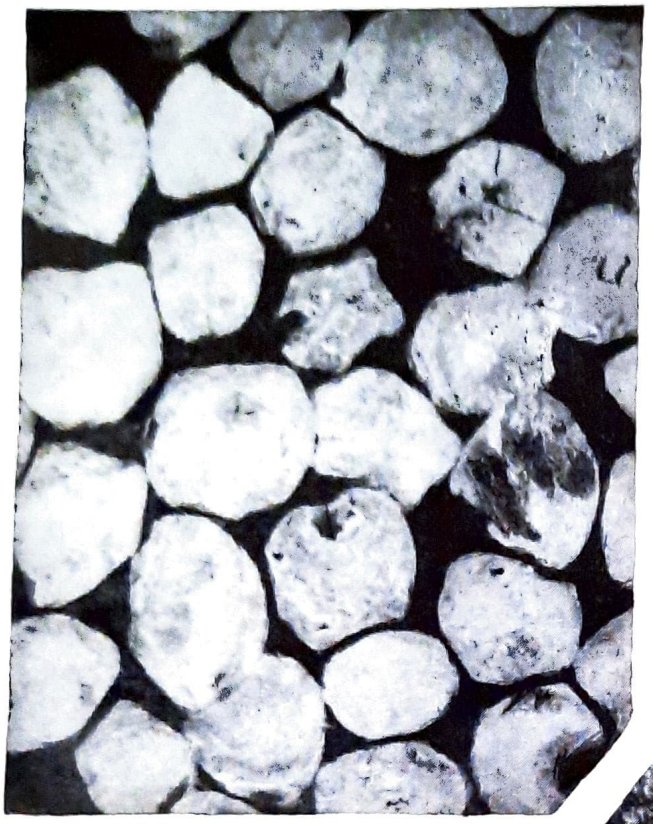

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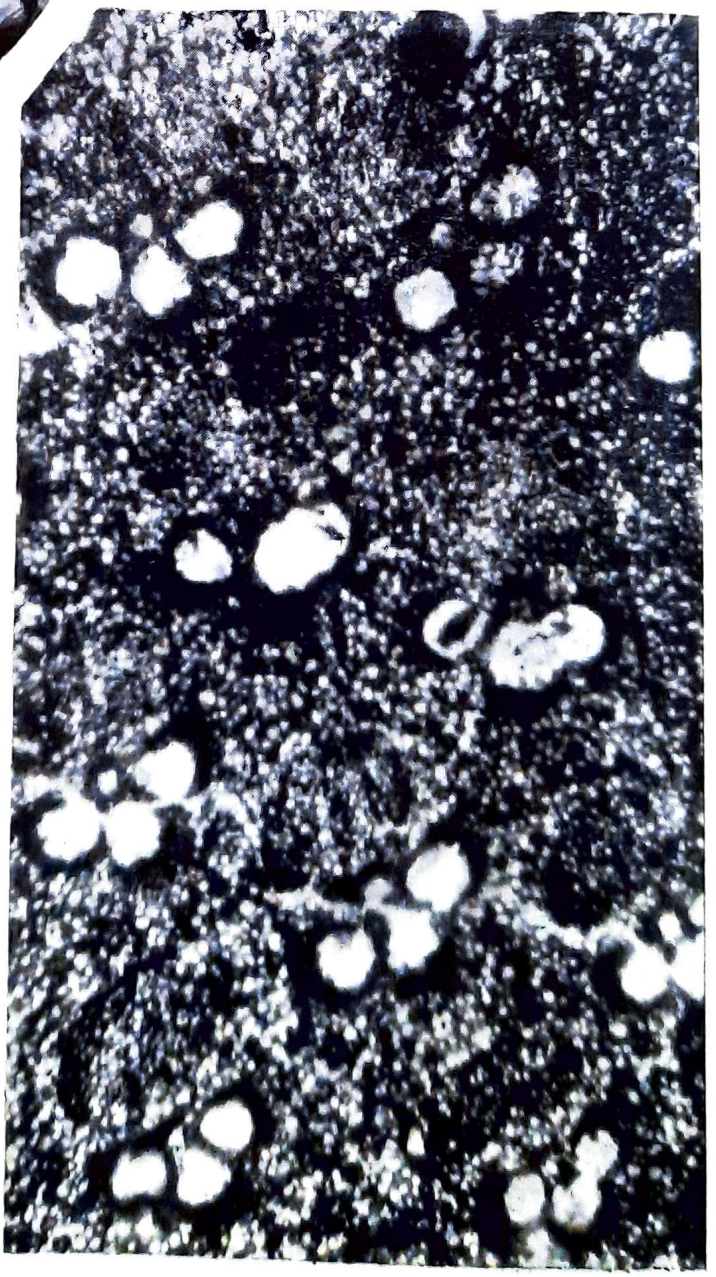

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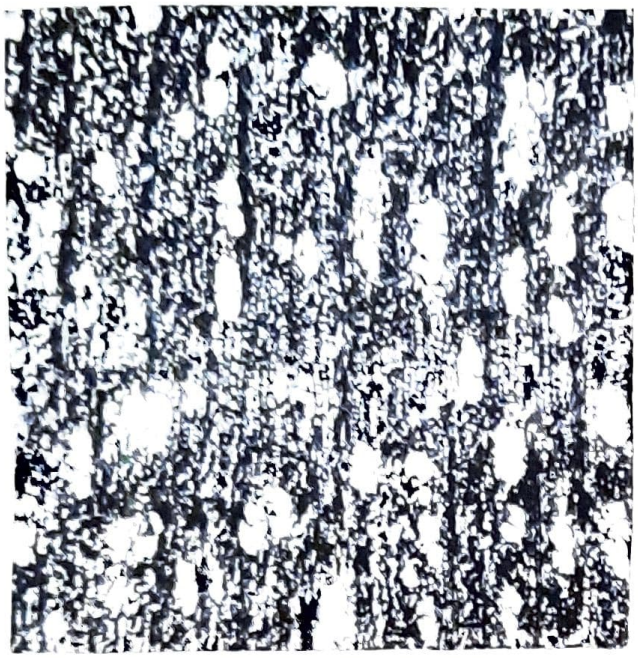

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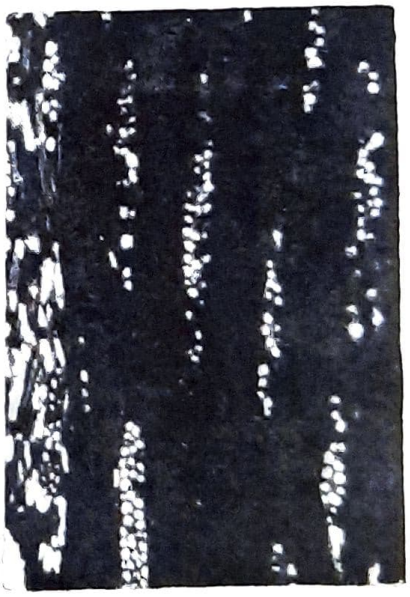

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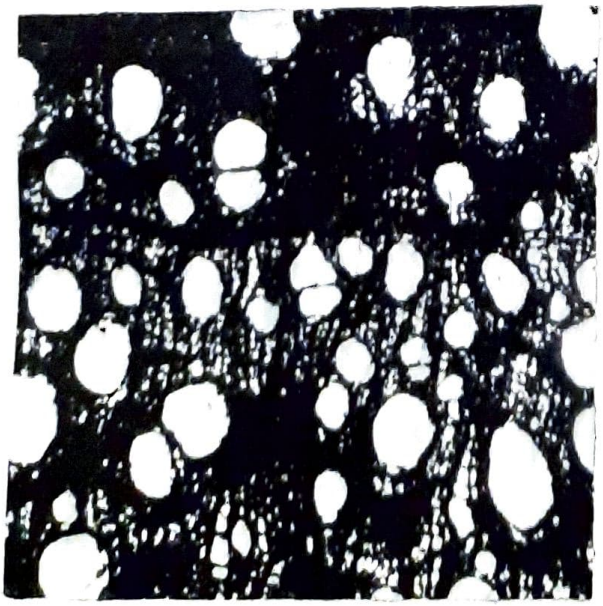

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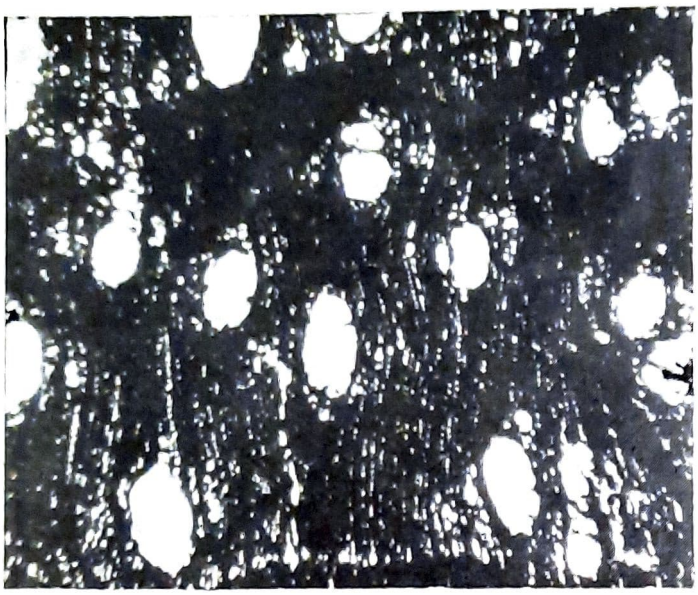

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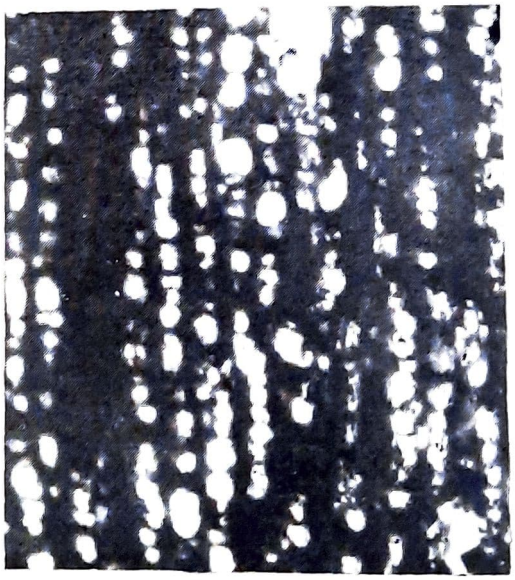

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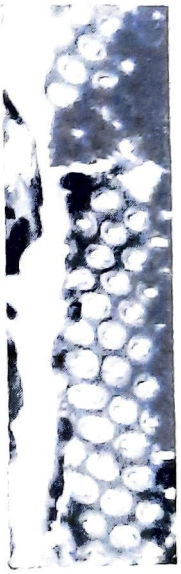

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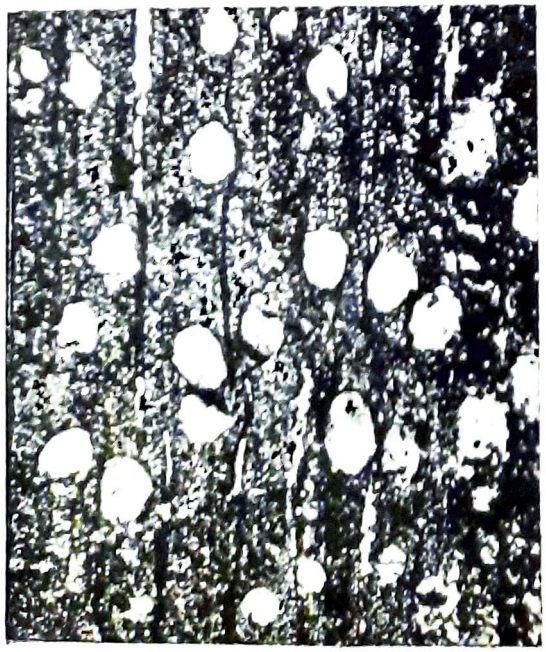

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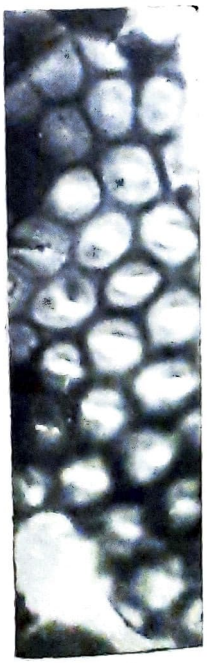

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EXPLANATION OF PLATES

Plate 1

1. Carbonized wheat, *Triticum sphaerococcum*. × 4.
2. Unidentified specimen. × 4.
3. *Paspalum scrobiculatum*. × 8.
4, 8. Carbonized spiklets of Rice. × 4.
5. *Phaseolus* sp. × 4.
6. Castor-oil seed. × 4.
7. Barley. × 5.
9. Seeds of *Dolichos biflorus*. × 5.

Plate 2

10. Seeds of *Lathyrus sativus*. × 5.
11. Seeds of Lentil. × 5.
12. Bamboo stem—cross-section to show the fibrovascular bundles. × 35.
13. A herbaceous dicot stem. × 50.

Plate 3

14. *Boswellia* sp.—Cross-section showing the vessel distribution. × 30.
15. *Boswellia* sp.—Tangential longitudinal section showing the xylem rays. Note a horizontal canal in one of the ray. × 50.
16. *Boswellia* sp.—Intervascular pitting. × 400.
17. *Acacia* sp.—Cross-section showing the vessel distribution and parenchyma pattern. × 30.
18. *Acacia* sp.—Tangential longitudinal section showing the xylem rays. × 80.
19. *Terminalia* sp.—Cross-section showing the vessel distribution and the parenchyma pattern. × 30.
20. *Terminalia* sp.—Intervascular pitting. × 650.
21. *Terminalia* sp.—Tangential longitudinal section showing the uniseriate xylem rays. × 100.

Plate 4

22. *Terminalia* sp.—Another cross-section showing the vessel distribution and the parenchyma pattern. × 30.
23. *Sonneratia* sp.—Radial longitudinal section. Note the swollen ray cells. × 135.
24. *Sonneratia* sp.—Cross-section showing the vessel distribution. Note radial vessel multiples. × 40.
25. *Sonneratia* sp.—Tangential longitudinal section showing the xylem rays. Note the swollen ray cells. × 110.
26. *Sonneratia* sp.—Intervascular pitting. × 500.
27. *Tectona* sp.—Cross-section showing the vessel distribution and the parenchyma pattern. × 28.
28. *Tectona* sp.—Tangential longitudinal section showing the xylem rays. × 46.
29. *Tectona* sp.—Intervascular pitting. × 650.