

CHAPTER III

MATERIALS AND METHODS

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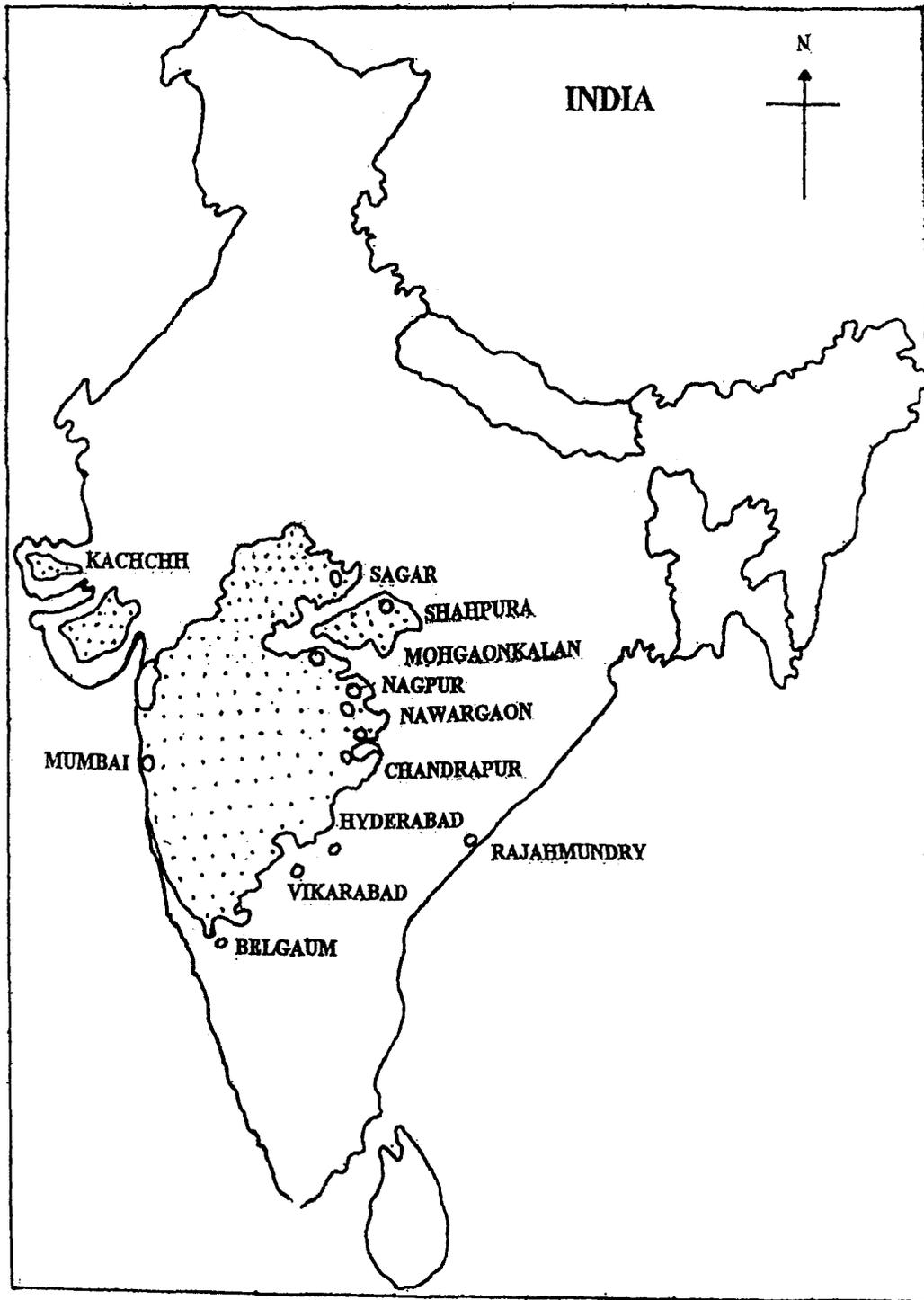
Materials collected:

My Guide, Dr. S.D. Bonde has been working on the floristic diversity of the Deccan Intertrappean Beds of India since 1974. He worked as a scientist at the Birbal Sahani Institute of Palaeobotany from 1978 to 1982. Later on he joined the Maharashtra Association for the Cultivation of Science, Research Institute (now Agharkar Research Institute) Pune as a Palaeobotanist to work on phylogeny of plants (Family Palmae). Since that time he has made a huge collection of plant fossils from the different exposures of the Deccan Intertrappean Beds of India. The plant fossils have been collected as petrifications, impressions and compressions. They have been serially numbered and deposited in the repository of the Department of Palaeobiology, A.R.I., Pune.

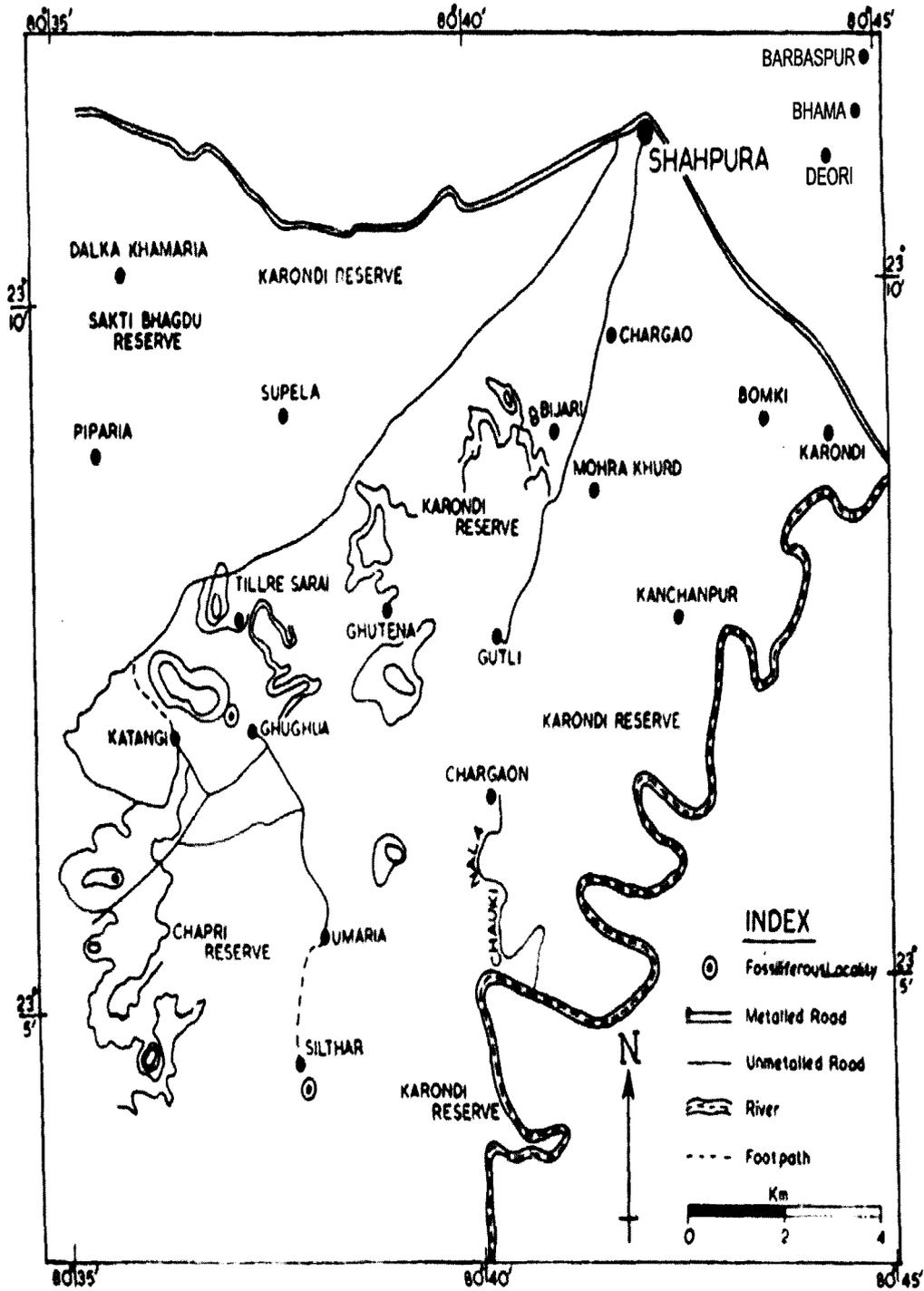
I undertook an intensive field work in Central India (Maharashtra and Madhya Pradesh) under the leadership of Dr. S.D. Bonde along with my research colleagues Mr. P.G. Gamre, Mr. S.V. Chate, Dr. D.K. Kulkarni, and Mr. C.M. Awere from 25th May to 7th June, 2007. Plant fossil specimens comprised of preserved permineralizations, compressions and impressions were collected along with the palynological samples from number of Deccan Intertrappean exposures in Central India. The Intertrappean exposures from where the plant fossil material was collected are Nawargaon-Maragsur, Sindhivihir (District Wardha and Kondhali, Takli in Nagpur district in Maharashtra State; Mohgaonkalan, Seoni, Mohgaon-Palasundar, Parapani, Samnapur, Ghughua, Umariya, Silther, Bhama, Barbaspur, Sagar in districts Chhindwara, Seoni, Sagar and Mandla in Madhya Pradesh State).

Large numbers of pieces of permineralized woods and impressions were collected from number of plant fossil exposures in Mandla district of Madhya Pradesh including those of Umariya, Silther, Ghughua, Barbaspur and others (Maps 1-3).

Most of the collection was in the form of petrified woody specimens which were collected as scattered pieces and some of them were preserved *in situ*. They showed secondary and primary structures. Only those petrified woods showing good preservation were selected for detailed investigations. The investigations included selective analysis of woody monocotyledons and dicotyledons, their stems, roots, leaves and fruiting parts and a juvenile palm.



**MAP SHOWING FOSSILIFEROUS LOCALITIES OF
DECCAN INTERTRAPPEAN SERIES**



Map 2 – Fossiliferous localities of Silther, Umaria and Ghughua, Mandla district, Madhya Pradesh

Methods of analysis

The permineralized woods were washed thoroughly with water, sometimes dilute Hydrochloric acid (HCl) was also used to remove the dirt from their surface and then they were serially numbered. They were cut into the thinnest possible slices in desired planes i.e. transverse, radial longitudinal and tangential longitudinal planes, using power driven automatic **Cutting Machine** having a diamond edged circular disc lubricated with olive oil and liquid soap solutions. Then, the surface to be studied was ground on a powder driven **Grinding Machine** with different grades of emery powder such as 60, 90, 120, 180, 240 numbers respectively. It was then ground on a glass plate with fine abrasive 'zero' or 400 grade powder till the surface become evenly smooth. The polished surface was then fixed on a suitable glass plate with the resin, **HIMEDIA Canada Balsam** (Natural). For this purpose a little amount of Canada Balsam was poured on a suitable glass plate and then heated on a hot plate controlled by thermostat to make it sufficiently thick in which the smoothed surface was fixed. The rough surface of the fixed section was further ground thin with 60, 90, 120, 180, 240 and 400 grade emery powders till the section became more or less translucent. Finally, it was ground with 'zero' grade emery powder on the glass plate. The sections were observed under microscope from time to time and ground till desired preserved characters like vessels, phloem, ground tissue, epidermal, hypodermal and other specific characters were most clear. The section was then removed from the slide by slight heating and then transferring to the Petri plate containing xylene for cleaning. The cleaned sections were mounted in commercial transparent Canada balsam on a glass slide of a suitable size and covered with cover glass. The final mounted sections were of 25 μ m to 100 μ m in thickness depending up on the desired wood characters to be studied. In certain woods some of the characters disappeared in the commercial Canada balsam, for such materials the sections were mounted directly in "Stafford and Allens Canada balsam" for about a week till they became sufficiently dried. The mounted sections were kept on a hotplate. Sometimes the sections were stained with "Alcoholic Saffranin" as suggested by Sahni (1934). But it did not give satisfactory results.

The anatomical analysis was done and the sections were photographed under Nikon Labophot-2 microscope attached with Fx-35 Dx camera. For measurement of

different cells and tissues, stage micrometer and eyepiece micrometer were used. For photography, a film with medium speed (100 ASA) and 50 ASA were used. The type specimens and the micropreparations are deposited at the Palaeobiology Group, Agharkar Research Institute, Pune, India. The original photographs and the other materials are deposited with Dr. S.D. Bonde, Palaeobiology group from whom they can be procured for reference when required.

For the identification of palm stem and root woods 'Anatomy of the Monocotyledons' by Solereder and Mayer (1928), Anatomy of Monocotyledons Vol.II, 'Palmae' and 'The Structural Biology of Palms' by Tomlinson (1961, 1990) and 'Revision of Indian fossil plants Pt. III. Monocotyledons' by Professor Sahni (1964) were basically referred. In addition, the anatomical preparations were compared with the work by Schenk (1882), Schoute (1912), Stenzel (1904), Stockmans and Williere (1943) and Unger (1850). They were also compared with the other woody monocotyledons wherever required. Araceae/Palmae (Cormack, 1896; Drabble, 1904; Schute, 1912; Mahabale & Udwardia, 1960; Tomlinson, 1961, 1990; Corner 1966; Seubert, 1996, 1996 a, 1997, 1998, 1998a; Tomlinson & Zimmermann, 1966). In addition to this, number of research papers on fossils woods were also referred wherever required. The sections were compared with those of extant palms on which a considerable work has been done in the Department of Botany, University of Pune and Agharkar Research Institute, Pune by several workers under the guidance of late Professor T.S. Mahabale.

In describing the monocotyledonous fossils of stem, root and petiole woods, the characters such as type of sclerenchyma in the fibrovascular bundles, presence or absence of fibre bundles, stegmata, auricular sinus, auricular lobes, tabular and radiating parenchyma, *f/v* ratio, distribution of vascular bundles, included or excluded nature of vascular part of fibrovascular bundles, number of vessels in the fibrovascular bundle, vessel endplate characters, size and shape of phloem tissue, nature of ground tissue, divisions of the cortical region, size of stele, presence or absence of the medullar bundles were considered. In case of roots, the method adopted by Bonde *et al.* (2009) has been adopted. It is based upon the anatomical analysis of palm roots by Seubert (1996a, 1997, 1998, a).

For the identification of Dicotyledonous woods basic work, in addition to Metcalfe and Chalk (1950) publications of Brazier and Franklin (1961); Chowdhury and Ghosh (1958), Desch (1962), Gamble (190), Howard (1942), Jane (1956),

Kahehire (1924) and Pearson and Brown (1932) were referred.

The anatomical terms used in describing the dicotyledonous wood were those adopted by the International association of wood anatomists (1957). The following anatomical characters have been considered important (Record and Chattaway, 1939; Tippo, 1945).

Growth rings - their presence of absence and distribution.

Vessels - their distribution, frequency, size, presence or absence and nature of tyloses, type of perforation plates, length of vessel elements, nature of intervessel, vessel ray and vessel parenchyma pittings.

Parenchyma - its abundance and distribution, pits between xylem parenchyma cells, their size, shape and parenchyma cell strand.

Xylem rays - their nature, frequency, width and height, pits on ray cells, sheath cells and aggregate cells

Fibres - septate or non-septate, their length, wall thickness, type of inter-fibre pits etc

In the description of the fossils I have adopted the following method which is generally adopted in describing the petrified woods:

- (i) Morphology and anatomical description of the fossil.
- (ii) Comparison with the fossil and /or living members,
- (iii) Discussion, and
- (iv) Diagnosis, if any.

Deposition of the research material

The type specimens, their labeled and numbered micro-preparations, original drawings and photographs on which the present thesis is based have been deposited with Dr. S.D. Bonde at the Department of Palaeobiology, Agharkar Research Institute, Pune India from where they can be consulted for further work, if required.

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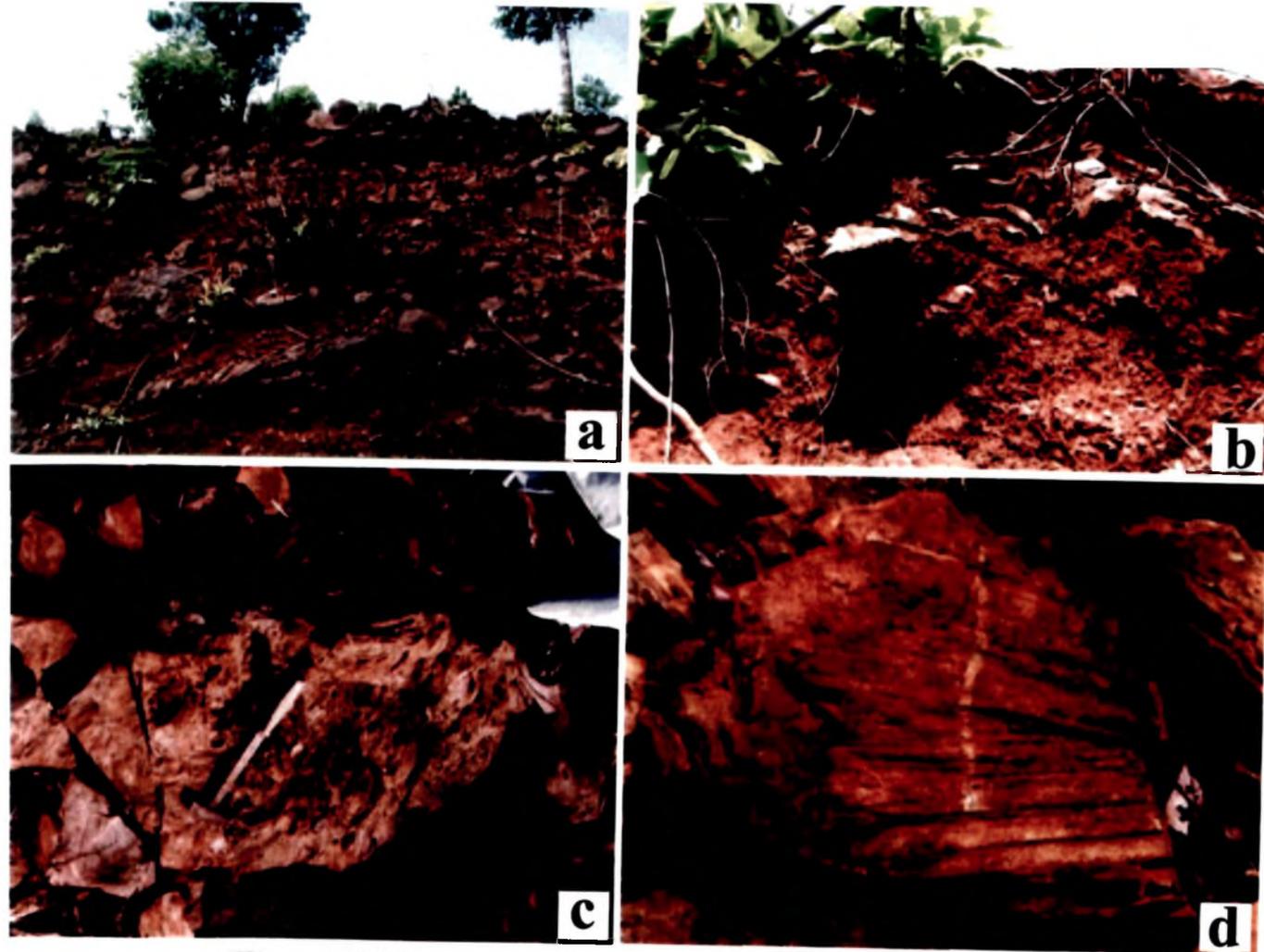
PLATE-I

Study Area

(Figs. a-d)

- Fig. a & b - Hillock slope showing permineralized woods embedded in the soil.
- Fig. c - A piece of large chert showing fruits embedded in the chert matrix.
- Fig. d - A very large piece of chert showing lamina of a large palmately compound leaf.

PLATE - I



Fossiliferous locality of Silther

PLATE-II

Study Area

(Figs. a-d)

Fig.a – Entrance gate of National Fossil Park at Ghughua showing a replica of dinosaur.

Fig.b – Petrified woods in the National Fossil Park, Ghughua.

Fig.c – A team of researchers at the Ghughua National Fossil Park.

Fig.d – Fossil locality of Umaria.

PLATE - II



Fossiliferous localities of Ghughua and Umaria