intergrowth of short hornblende prisms perpendicular to the pyroxene grain boundary, irregular granules of opaque ores and minute crystals of quartz. The distribution of opaque ores in the rim is irregular; some portions show a higher concentration than others and some are even devoid of them. The width of one and the same rim may vary from place to place. In thicker portions the amount of hornblende increases progressively at the expense of opaque ores and in advanced stages opaque ores either completely disappear or are present only as occasional inclusions in hornblende. There seems to be a direct relation between the relative amounts of secondary hornblende and opaque ores in the corona rim and the degree of coronation. Since in the majority of cases coronas have formed only around pyroxene grains in contact with plagioclase felspar, an igneous origin is precluded. Hornblende coronas around pyroxenes, representing frozen stages of reaction between adjacent pyroxene and plagioclase mineral phases, can form according to the following reaction :

$$\text{pyroxene} + \text{plagioclase} + \text{water} \rightleftharpoons \text{hornblende} + \text{quartz}.$$

If water in required amounts is not available during superposed amphibolite facies metamorphism of granulite facies rocks, break-down and conversion of pyroxenes into hydrous minerals like hornblende and biotite cannot take place. This might explain the preservation of water-deficient basic granulites as relics in the hornblende-bearing rocks and rarity of coronas in the relict granulites of the area. As only small amounts of water are necessary for corona formation[4], its availability in such amounts locally[5] in the granulites must have favoured the formation of local hornblende rims around pyroxene grains.

The hornblende gneisses and amphibolites are almost free from pyroxenes. The pyroxene grains when rarely encountered are invariably clouded and do not show hornblende rims. This suggests that pre-existing pyroxene grains have mostly been converted completely into hornblende during retrograde amphibolite facies metamorphism. Further, this must have happened under sufficient or excess water conditions since such conditions are believed to favour reactions outside mineral individuals and destroy corona relations[6].

In addition, the gneisses and amphibolites show the following features characteristic of the development of amphibolite facies rocks from a granulite facies parent[7].

1. Hornblende in the gneisses and amphibolites of the area is the bluish green to grass green variety in contrast to the characteristic deep greenish brown and brown variety found in the granulite facies rocks of S. Kerala and the neighbouring Kanyakumari District of Tamil Nadu.

2. The rocks have developed gneissic structure and foliation after hydrous minerals, *viz.*, hornblende and biotite.

3. Hornblende-quartz symplekite intergrowths are common in the gneisses and amphibolites.

4. The rocks contain microcline, and the perthite present is the mesoperthite variety.

No direct evidence regarding the nature of the parent rock from which the hornblende-bearing rocks were derived during amphibolite facies metamorphism is observed. However, it is significant that charnockites, the common rock types in many parts of Kerala, are extremely rare in the area. This, together with the evidences presented above, points to the possible development of hornblende-bearing rocks mainly at the expense of charnockites through retrograde amphibolite facies metamorphism. A similar polymetamorphic origin has been suggested for the Pre-cambrian Vijayan Series rocks of Ceylon[7].

Thanks are due to Prof. K. K. Menon for facilities and encouragement, Shri. A. R. Nambiar for assistance in the field and the U.G.C. for financial assistance.

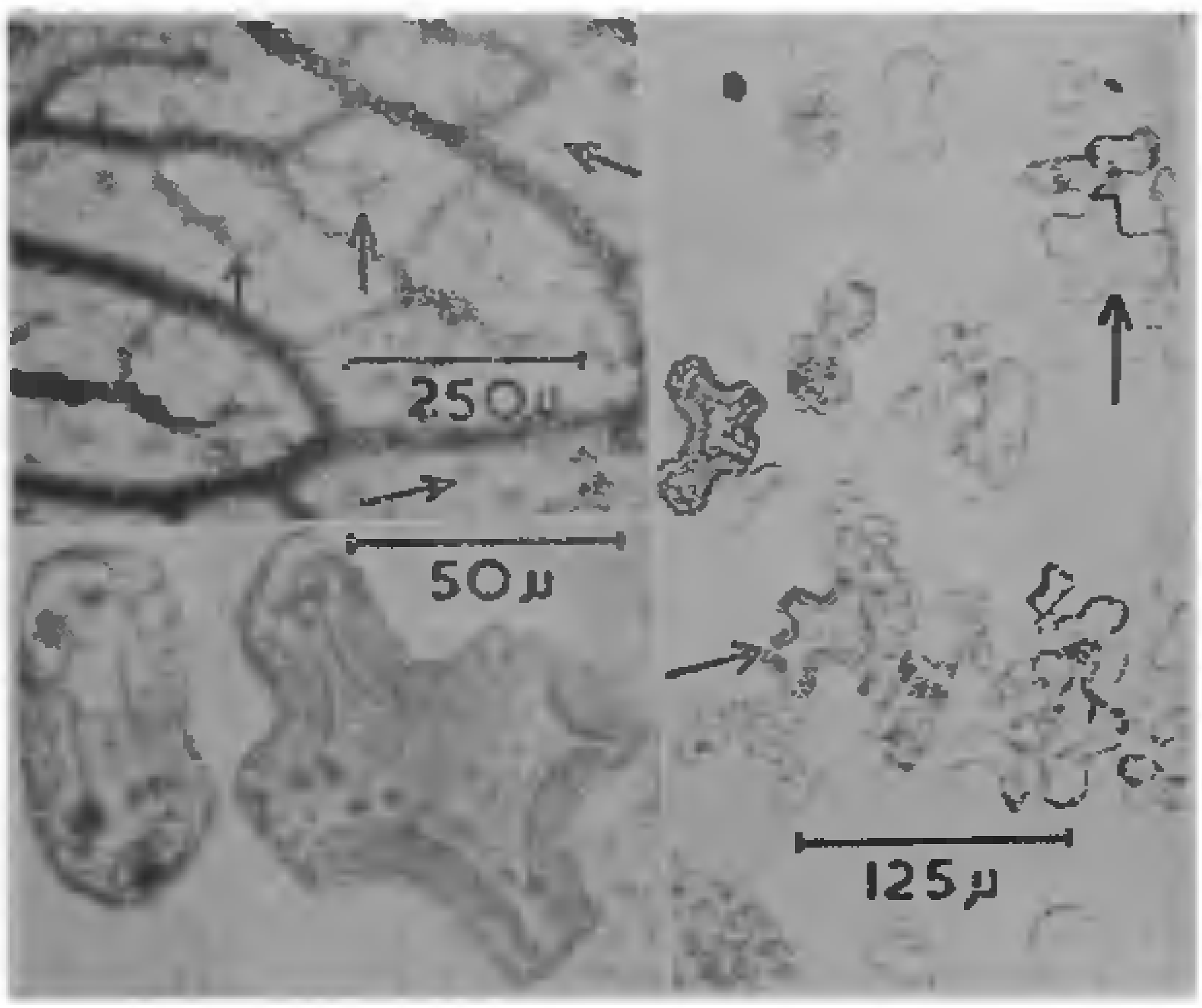
Department of Geology, P. K. R. Nair.
University of Kerala,
Kariavattom, Trivandrum 695 581,
September 26, 1975.

1. Nair, P. K. R. and Michael, G. P., *Curr. Sci.*, 1975, 44, 230.
2. Sen, A. K. and Sobhen Ray, N., *Jb. Miner. Abh.*, 1971, **115**, 291.
3. Katz, M. B., *Geol. Mag.*, 1968, **105**, 487.
4. Murthy, M. V. N., *Bull. Goel. Soc. Amer.*, 1958, 63, 34.
5. Griffin, W. L. and Heier, K. S., *Contr. Mineral. and Petrol.*, 1969, **23**, 89.
6. Bose, M. K., *Geol. Mag.*, 1961, 98, 415.
7. Cooray, P. G., *Quar. Geol. Soc. Lon.*, 1962, **118**, 255.
8. Spry, A., *Metamorphic Textures*. Pergamon Press, 1969.

FOLIAR SCLEREIDS IN *MICROTROPIS VALIDA*

The presence of sclereids (Sclerenchymatous idioblasts) is accounted in the mesophyll tissues of *Maurocenia*, *Maytenus*, *Microtropis*, *Pterocelastrus* and *Schaefferia* of Celastraceae[1]. Further details regarding their structure, distribution, density and relationship within the mesophyll are not known. In the two other genera namely *Lophopetalum* and *Kokoona* brachysclereids are reported from leaf tissues[2]. Vesiculose sclereids are present in leaves of *Goupia glabra*[3] and this taxon has been shifted into a new family Goupiaceae. The observations made on the foliar sclereids in *Microtropis valida* Ridl. are briefly reported here, *Microtropis* is an Indo-Malayan genus with about 13 species restricted in distribution to South Asia. Five species, including *M. valida*, are endemic to Malaysia and Borneo[4]. *M. valida* is a small tree growing up to 5–7 m, with thick, opposite leaves. Fresh leaves were collected from the trees growing in Kota Tinggi area, South Johore, West Malaysia. Customary methods were followed to obtain leaf clearings, sections and macerations.

In leaf clearings 90% of the sclereids show diffuse distribution. Since the leaf is thick (480 µ), epidermal surfaces are covered by thick cuticle, and sclerieds are confined to the middle spongy layers, the sclereid distribution is somewhat hazily seen in leaf clearings (Fig. 1). Comparatively they are more clearly seen from the lower epidermis side than the upper. Regarding terminal sclereids, either they are solitary or occur in groups of 2–3 at vein endings (Fig. 1).



FIGS. 1–4. Fig. 1. Leaf clearing showing sclereid distribution (vertical arrows—terminal sclereids, horizontal arrows—diffuse sclereids). Figs. 2, 3. Brachy- and vesiculose sclereids enlarged to show shape and cell wall thickness. Fig. 4. Part of macerated tissue showing similarity in shape between spongy mesophyll cells and vesiculose sclereids (arrows).

In macerated preparations two types of sclereid forms are seen; the first type of spheroidal or oval-shaped brachysclereids and the second type of vesiculose sclereids. The former are unbranched whereas sclereids of vesiculose type show 3–4 lobes, some of them with flattened, enlarged ends, or each lobe branched further with two flat edges (Figs. 2, 3). Both the types of sclereids are primarily oriented parallelly to the surface of the lamina.

The transverse sections of the lamina reveal that the sclereids are mostly confined to spongy mesophyll tissue, most of them being present in the middle layers. In the macerated preparations the close similarity in cell shape between the sclereids and spongy mesophyll cells is clearly seen (Fig. 4). The bigger spongy mesophyll cells are lobed, each lobe with a curved or dome-shaped outline. In distinction from the spongy cells the sclereid cells have enlarged 2–3 times, with flat or branched cell lobes. But the sclereids do not radically deviate in shape from the spongy mesophyll cells (Fig. 4). The oval-shaped (length 45 µ × width 20 µ) sclereids are smaller than the vesiculose sclereids (63 µ × 42 µ), and these are the average figures obtained from 20 measurements in each case. The cell wall is thick (6 µ), lamellated, with many simple pits, evenly spaced. In some, the wide lumen consists of degenerated nucleus and cytoplasm.

The constancy of cell shape has been considered as an important criterion in classifying sclereids under monomorphic and polymorphic types[5,6]. The range of variation seen under monomorphic types is limited and the two types of sclereids in *M. valida* are of monomorphic type. Additional evidence from sclereid characters has been recently produced lending support for the recognition of a separate family, Goupiaceae[3]. Genus *Goupia* was originally included in Celastraceae. In view of this, detailed studies on sclereids are necessary in different genera of this family. A preliminary survey made on other species of *Microtropis* has shown that foliar sclereids are absent in *M. bivalvis*, *M. curtisii*, *M. discolor*, *M. kinabaluensis*, *M. petelotii*, *M. platyphylla*, *M. sumatrana*, *M. tetrameris* and present in *M. elliptica*, *M. fukinensis*, *M. osmanthoides* and *M. wallichiana* (= *ramiflora*). Details of leaf anatomy and sclereid characters in this genus will be published elsewhere.

I am thankful to Mr. R. Tay and Mr. D. Teow for their technical help.

Botany Department, A. N. RAO.
University of Singapore,
Singapore, *September* 27, 1975.

1. Metcalfe, C. R. and Chalk, L., *Anatomy of the Dicotyledons*, Clarendon Press, Oxford, 1950.
2. Janser, W. T. and Baas, P., *Blumea*, 1973, 21, 153.
3. Rao, T. A. and Bhattacharya, J., *Curr. Sci.*, 1975, 44, 132.
4. Ding Hou, *Celastraceae*, *Flora Malesiana*, Walters-Noordhoff Publ., Groningen, 1972.
5. Rao T. A. and Bhupal, O. P., *Proc. Indian Acad. Sci.*, 1973, 77, 41.
6. De Roon, A. C., *Acta Bot. Neerl.*, 1967, 15, 585.