

The writer wishes to thank Professor M. G. Chakrapani Naidu for his guidance and Dr. M. S. Murty for critically reading the manuscript and suggesting improvements.

Dept. of Geology, K. L. NARASIMHARAO.  
S.V. University,  
Tirupati (A.P.), India,  
August 7, 1968.

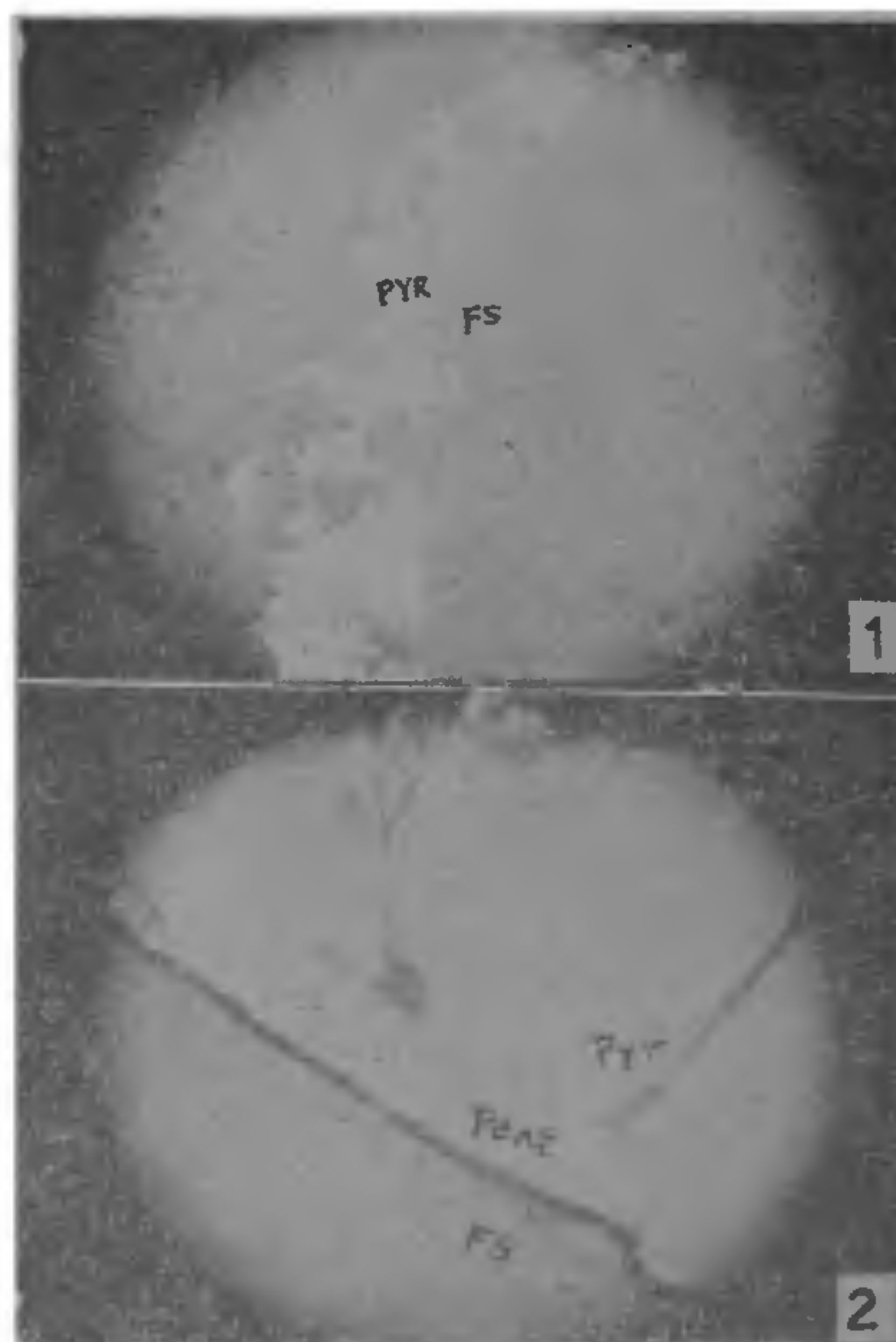
1. Hess, H. H., *Am. Mineralogist*, 1941, 26, 515 and 573
2. Muir, I. D. and Tilley, C. E., *Geol. Mag.*, 1958, 95, 403.
3. Wilson, A. F., *Trans. Roy. Soc. S. Australia*, 1960, 83, 37.
4. O'hara, M. J., *Geol. Mag.*, 1960, 97, 498.
5. Brown, G. M., *Ibid.*, 1961, 98, 333.
6. Howie, R. A., *Controls of Metamorphism*, Oliver and Boyd Co, 1965, p. 319.
7. Mueller, R. F., *Am. J. Sci.*, 1960, 258, 449.
8. —, *Geochim. et Cosmochim. Acta*, 1961, 25, 267.
9. Kretz, R., *Jour. Geol.*, 1961, 69, 361.
10. —, *Ibid.*, 1963, 71, 773.
11. Bartholomé, P., *Geol. Mag.*, 1961, 98, 346.
12. —, *Geol. Soc. Amer.*, *Buddington Vol*, 1962, p. 1.
13. Binns, R. A., *Min. Mag.*, 1962, 33 (259), 320.

#### OCCURRENCE OF PYRRHOTITE AND CHALCOPYRITE IN KASIPATNAM, ANDHRA PRADESH

IN the course of recent investigations in Kasipatnam area ( $18^{\circ} 17''$  N:  $83^{\circ} 09''$  E.), Andhra Pradesh, an occurrence of pyrrhotite in association with apatite-magnetite veins was noticed. Thin section study revealed that the material in which pyrrhotite is found is essentially ferrosalite. Pyrrhotite occupies the weaker zones of ferrosalite in the form of small veinlets and segregations (Fig. 1). Along the contacts of pyrrhotite and ferrosalite, and also along cracks and cleavage planes of pyrrhotite, small veinlets and disseminated grains of chalcopryrite occur.

Pyrrhotite has been identified from its bronze-yellow colour, tendency to get tarnished in air, strong magnetic property and easy solubility in hydrochloric acid with the liberation of hydrogen sulphide. The above mineral assemblage was studied under an ore microscope and megascopic identification of pyrrhotite was confirmed from the brownish-cream colour with high reflectivity, faint pleochroism in oil, and etch reaction with KOH which tarnishes the mineral to iridescent brown. Chalcopryrite was identified from its brass-yellow colour with noticeable faint pleochroism. In association with pyrrhotite and at its edge, a small blade-like form with

cubic cleavage is noticed. From its high reflectivity, white colour, and etch reactions (negative to KOH, temporary brown stain with aqua regia, and lack of effervescence with  $\text{HNO}_3$ , which gives a temporary brown stain), this has been identified as pentlandite (Fig. 2), an iron-nickel sulphide, which usually occurs in association with pyrrhotite.



FIGS. 1-2. Fig. 1. Pyrrhotite (Pyr) vein in ferrosalite (Fs). Polarized illumination,  $\times 16$ . Fig. 2. Pentlandite (Pent) and pyrrhotite (Pyr) in ferrosalite (Fs). Polarized illumination,  $\times 30$ .

The apatite-magnetite veins are found along the NW-SE joints of biotite-gneisses which strike NE-SW. The veins often exhibit zoning-features resembling igneous zoning in pegmatites. Ferrosalite forms the outer zone followed by inner apatite zone with or without intermediate vermiculite zone. It is believed that the ore-bearing solutions started migration after the stage of apatite formation, and occupied the fractures and other such spaces available in already congealed ferrosalite zone. The ore-minerals exhibit replacement relationship with ferrosalite. The first ore-mineral to be formed is believed to be pyrrhotite, followed by chalcopryrite which replaces the former preferably along the cleavage planes. Pentlandite is believed to



have been formed simultaneously with pyrrhotite. The occurrence of ore-minerals in other rock types and their persistence at depth needs further investigation.

The authors are grateful to Prof. A. Sriramadas for valuable suggestions and facilities.

Geology Department, K. V. S. ACHARYULU.  
Andhra University, K. V. SIVARAM.\*  
Waltair, A. T. RAO.  
July 24, 1968.

\* Fertilizer Corporation of India, Kasipatnam (A.P.).

**DICOTYLEDONOUS LEAF-IMPRESSIONS FROM THE RAJAHMUNDRY SANDSTONES NEAR PANGADI, WEST GODAVARI DISTRICT, A.P.\***

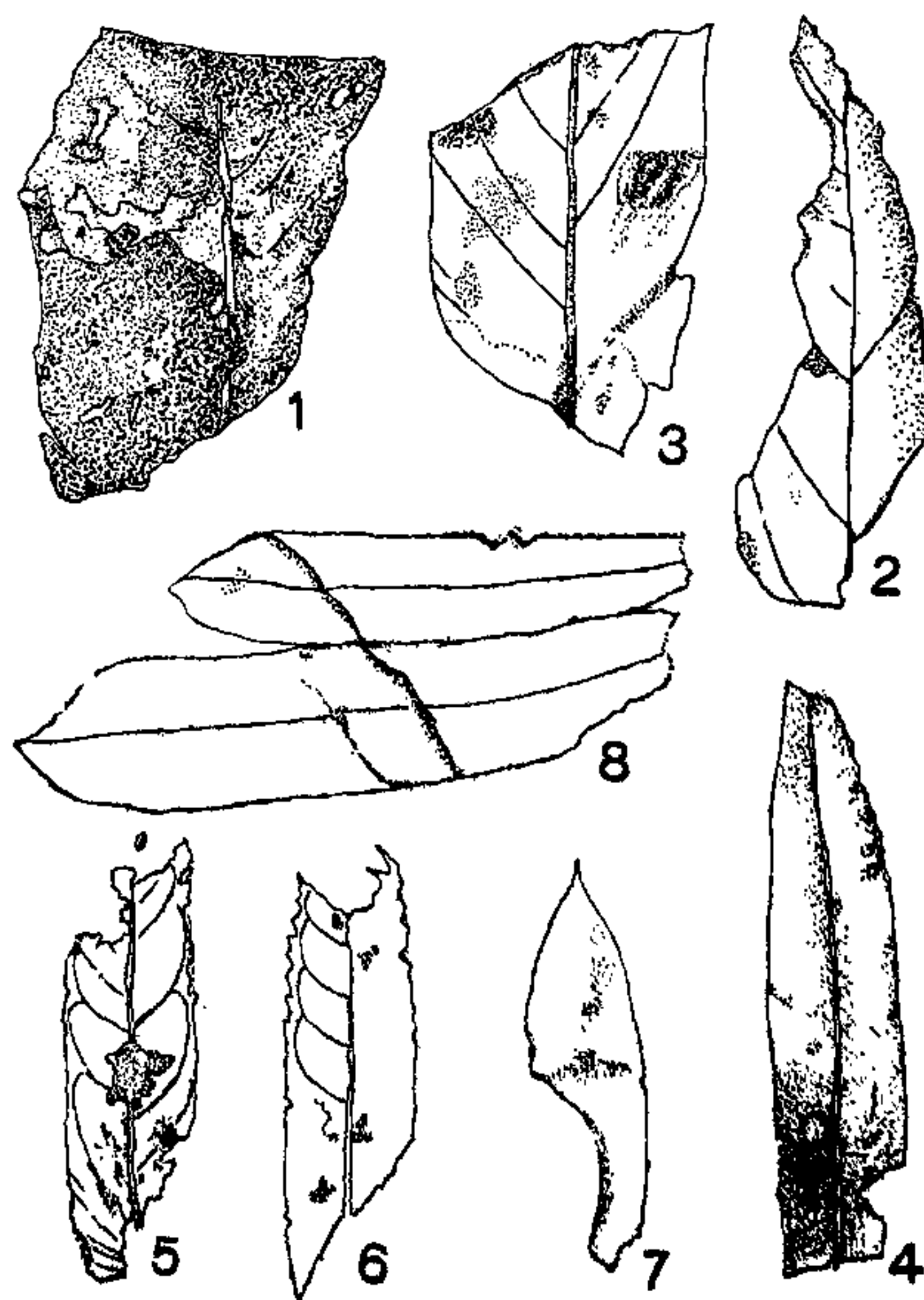
THE plant impressions collected by the authors during May, 1967, from the Rajahmundry sandstones exposed in a sandstone quarry at Minanagaram (17° 00' 30" : 81° 39' 30"), about 1.5 km., south of Pangadi, West Godavari District, A.P., are being described. In this quarry the Rajahmundry sandstones are coarse-grained, at places gritty and conglomeratic, ferruginous and current-bedded, and variegated. There are occasional interstratified thin bands of clay, shale and conglomerate. The fossils described come from these interstratified lenticular fine-grained greyish-white and pink shales, which though laminated do not easily break along the laminations.

The Rajahmundry sandstones are considered to be equivalents of Cuddalore sandstones.<sup>1-3</sup> However, in the absence of common fossils in the Cuddalores and the Rajahmundrys it is not possible to precisely correlate one with the other. The Cuddalores are considered to be of Upper Miocene to Lower Pliocene age by Ramanujam<sup>4</sup> and 'not older than Upper Tertiary' by Pascoe.<sup>3</sup> It is rather difficult to fix the age of these sandstones on the basis of the present find of leaf-impressions.

The climate of the epoch, during which these plants flourished, appears to be tropical, not much different from the one that prevails now along the east coast of South India. Of considerable interest is the absence of plants with compound foliage, conifers, other gymnosperms, ferns, grasses, sedges and fructifications among the Minanagaram fossils.

The fossils are mainly leaf-impressions and are rather not very well preserved. From their preserved shape and venation the leaves are definitely dicotyledonous, but in the absence of any dependable characters of taxonomic value it has not been possible to assign them to any specific genera. They have, therefore, been described under the form-genus *Dicotylophyllum* Saporta.<sup>5</sup> It has been possible to distinguish at least four different types of this form-genus in the present collection and the same are illustrated by camera-lucida drawings, as detailed below :

- (a) *Dicotylophyllum* sp. 1: Figs. 1-3; G.S.I. Type nos. 18342-18344.
- (b) *Dicotylophyllum* sp. 2: Figs. 4-6; G.S.I. Type nos. 18345-18347.
- (c) *Dicotylophyllum* sp. 3: Fig. 7; G.S.I. Type no. 18348.
- (d) *Dicotylophyllum* sp. 4: Fig. 8; G.S.I. Type nos. 18349-18350.



FIGS. 1-8. *Dicotylophyllum*, × 1. Figs. 1-3. *Dicotylophyllum* sp. 1. Figs. 4-6. *Dicotylophyllum* sp. 2. Fig. 7. *Dicotylophyllum* sp. 3. Fig. 8. *Dicotylophyllum* sp. 4.

The authors are thankful to Shri M. S. Balasundaram and Dr. K. N. Prasad, Geological