MICROFOSSILS IN LIGNITES OF INDIA AND PAKISTAN

D. CHANDRA

Birkbeck College, University of London, U. K.

ABSTRACT.—Fungal remains, cork or suberised periderm, and leaf cuticule as observed in polished sections have been described to illustrate the efficacy of the polished section technique in the micropalaeontological investigation of the lignites of India and Pakistan. Besides, the importance of other techniques for the study of microfossils in lignites has been discussed.

INTRODUCTION

VERY little work has been done on microfossils of the lignites of India and Pakistan by the method of polished sections. This technique was adopted by A. K. Banerji (1932), D. Chandra (1954, 1956) and E. Stach (*et al* 1956) but most other workers have used maceration methods, as exemplified by the investigations of S.R.N. Rao and S.S. Misra (1949), R. and C. Jacob (1950), A. R. Rao (*et al* 1950, *et al* 1952a, *et al* 1952b, 1954, 1955) and K.P. Vimal (1952, 1953a, 1953b).

The two techniques have their own special advantages and disadvantages, but each is as important as the other in the study of microfossils in coals. By the methods of maceration, microfossils can be seen in three dimensions whereas in polished sections observations are limited to two dimensions. On the other hand, in polished sections the structures of some of the microfossils especially the opaque or semiopaque ones, are seen particularly clearly.

In this paper will be described some of the microfossils observed in polished sections of the following lignites:—(a) Cuddalore, India (Miocene), (b) Makerwal, Pakistan (Eocene), and (c) Pidh, Pakistan.

It is hoped that this preliminary study of these particular lignites will serve to show the efficacy of the polished section method in the micropalaeontological investigation of other lignites.

PREPARATION AND EXAMINATION

Each sample of lignite was impregnated with molten carnauba wax mixed with oil-soluble olesol black, cooled and then polished by means of several grades of emery paper followed by different grades of alumina powder. The polished specimens were then examined under a reflecting microscope using oil immersion objectives to obtain suitable contrast.

DESCRIPTION

Fungal remains are common in all these lignites, occurring in the form of hyphae, fungal tissue, sclerotia, spores and sporangia. Well preserved two-celled spores found by the author in Cuddalore and Makerwal lignites are shown in Pl. 38 fig. 1 and fig. 2. They are approximately oval in shape, with nipple like projections,

and about 13-20 μ × 7-10 μ in size. Similar two-celled spores have been described by E. Stach (1952) from Hungarian lignites. Pending further detailed examination, these forms may be referred to *Sclerosporis bicellus* n. sp.

In Pl. 38, fig. 3 is shown a spore with four cells, derived from the Pidh lignite. The cells are approximately oval in shape. The author suggests for this form the name *Sclerosporis tetracellus* n. sp. Multi-celled spores in lignites are not uncommon. Already they have been noted in other lignites, particularly from Germany (Stach *et. al.* 1956).

Besides spores, sporangium has been found in the Cuddalore lignite which is similar to a form discovered by E. Stach (1935) in a soft lignite from Bohlen, Germany (Pl. 38, fig. 4a and c). These sporangia are comparable in both size and shape with those of recent species of *Syncephalastrum racemosum* (Cohn) Schöter; (Syn: *Syncephalastrum cinerium* Bainer), as shown in fig. 4b. For convenience of comparison, all the photomicrographs in fig. 4 have the same magnification. *Syncephalastrum* is a small genus of tropical mould and could well have been present during the formation of coal. The work of A. R. Rao (1954) is noteworthy in this connection. In Indian lignites he has identified the genera *Phragmothyrites* Edwards and *Microthyriacites* Cookson, belonging to the family *Microthyriacea*, and has pointed out that their presence suggests a warm temperate climate during the formation of the lignites on which they occur. Rao has also noted the world-wide distribution of some of these fungal remains.

In order to determine the nature of the change brought about in such fungal remains by pyrolysis, blocks of Cuddalore lignites were heated to various temperatures in an atmosphere of nitrogen. It was found that on raising the temperature to about 450° C, no fungal remains survived. On the other hand, in the specimen carbonised at about 350° C it was found that the microstructures were clearer than those commonly seen in unheated lignite. If it is found that there is no considerable increase in the dimensions of microfossils at this temperature it would be worth heating lignites at about this temperature for petrographic examination.

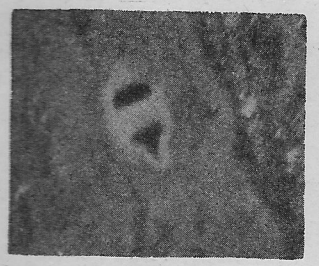
Cork, or suberised priderm, with its characteristic appearance, is a common constituent of Cuddalore lignite. In Pl. 38, fig. 5 is shown a transverse section of a ring of cork. The cells are more or less brick-shaped and arranged radially. In Pl. 39, fig. 1 some of the cells are shown at a higher magnification when the structures of the cells are clearly seen. The structure of the cork is variable and the variation is probably due to the effect of consolidation. Sometimes these suberised tissues disintergrate to form the groundmass. This suggests that the tissues are not entirely resistant to decay, as noted by Pensler (1933).

Well preserved leaf cuticle is found in Cuddalore lignite. A transverse section of a leaf is shown in Pl. 39, fig. 2. The impervious cutinised layers are clearly shown. The serrated inner edges of the cuticles are characteristic of transverse section. Seyler (1929) has even noted pallisade tissue and spongy parenchyma enclosing cuticles of leaves in thin sections of New Zealand lignite. So far the author has not noted any such tissue in polished sections but he has made no detailed systematic search for it, as yet. It should be noted

EXPLANATION OF PLATES 38

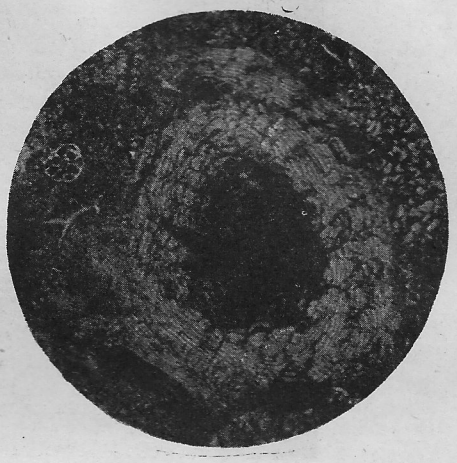
Fig. 1—Two celled spore in Cuddalore lignite. (× 750).
2—Two celled spore in Makerwal lignite. (× 750).
3—Four celled spore in Pidh lignite. (× 750).
4—(*a*). Tubular sporangium in Cuddalore lignite.
(*b*). Tubular sporangia of *Syncephalastrum cinerium* Bainer, recent species.
(*c*). Tubular sporangium in tertiary lignite from Bohlen, Germany. (× 750)
5—Ring of cork in Cuddalore lignite. (X 150).

1



2

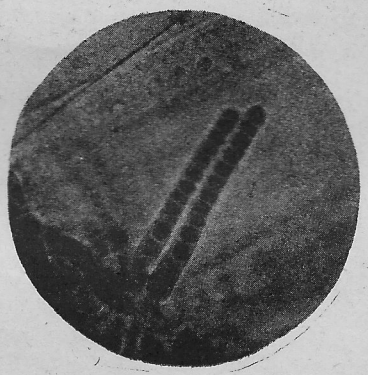
3



5

4 *a*

4 *b*



4 *c*

CHANDRA ; FOSSIL FUNGI AND SUBERISED PERIDERM IN LIGNITES

1

2

CHANDRA, : CORK CELLS AND TRANSVERSE SECTION OF A LEAF IN CUDDALORE LIGNITES

that for micropalaeontological investigations of this kind it is also necessary to employ the thin section or polished thin section techniques which were originally described by Hsieh (1932), and later developed by Teichmüller (1952), as an additional aid. Up to the present, only A. K. Banerji (1932), S.M. Lakshamanan and J.F. Levy (1956) have adopted these techniques, but it is the intention of the present author to extend his investigations in this direction also.

ACKNOWLEDGMENTS

The author wishes to thank Dr. A. T. J. Dollar, Head of the Department of Geology, Birkbeck College, London, for his help in this work. Permission to reproduce the following illustrations is gratefully acknowledged:—

(a) The tubular sporangium in Tertiary lignite of Bohlen, Germany, taken from E. Stach *Lehrbuch der Kohlenpetrographie*, Gebruder Borntraeger, Berlin, 1935 Edition. (b) Recent species of *S. cinerium*, taken from G. Smith. *An Introduction to Industrial Mycology*, Edward Arnold and Co., London, 3rd. Edition.

REFERENCES

Banerji, A. K., 1932, Microscopic Study of Some Indian Coals, *Rec. Geol. Surv. India*, Pt. 3, 333-347.

Chandra, D., 1954, Sclerotia in Indian Coals, *Quart. J. Geol. Soc., India*, 26, 1, 47-48.

——, 1956, Contribution to the discussion on 'La sclerotinite et son importance pour l'origine de la durite' by E. Stach, *Ann. Min. Beg.*, (Jan.), 86-88.

Hsieh, C. Y., 1932, Thinned polished sections of Coal, a new technique in Coal Petrography, *Bull. Geol. Surv., China*, 12, No. 1, 119-124.

Jacob, K. and C. Jacob., 1950, On spores and pollen grains from the tertiary lignites of Cuddalore, South Arcot, India, 7th. International Botanical Congress, Stockholm, 572.

Lakshamanan, S. M. and J. F. Levy., 1956, Geology and Botany of lignite from South Arcot, Madras, *Fuel*, 35, 446-450.

Pensler, W., 1933, The James Coal of New Zealand, *Fuel*, 12, 166-181.

Rao, A. R., 1954, Fungal remains from some tertiary deposits of India, *Proc. 41st. session of Indian Science Congress*, pt. 3, 165.

——, 1955, Some observations on pollen found in Indian Tertiary lignites, *Palaeobotanist*, 4, 57-59.

Rao, A. R., and K. P. Vimal., 1950., Plant microfossils from Palana lignites (? Eocene) Bikaner, *Curr. Sci.*, 19, 82-44.

——, 1952a., Tertiary pollen in lignites from Palana (Eocene), Bikaner, *Proc. Nat. Inst. Sci.*, India, 18, No. 6, 595-601.

——, 1952b., Preliminary observations on the microfoosils contents of some lignites from Warkalli in Travancone, *Curr. Sci.*, 21, 302-306.

Rao, S. R. N. and S. S. Misra., 1949., An oil bearing alga from the Palana lignite (? Eocene) of Rajputana, *Curr.* Sci., 18, No. 10, 380.

Seyler, C. A., 1929., The microscopical examination of Coal, D. S. I. R .Fuel Research, Physical and Chemical Survey of the National Coal Resources, No. 16, H. M. S. O., London, 67 pp.

Stach, E., 1935., *Lehrbuch der Kohlenpetrographie*; Gebruder Borntraeger, Berlin, 293 pp.

Stach, E., 1952, Braunkohlemikroskopie, Handbuch der Mikroskopie in der Technik, Edited by Hugo Freund, Umschau-Verlag, Frankfurt/M., 2, Pt. 1, 485-686.

Stach, E. and D. Chandra., 1956., Petrograpgische Studien am Braunkohlensklerotinit, Braunkohle, 23/24, 465-471.

Teichmüller, M., 1952., Die Anwendung des polierten Dunnschliffes bei der Mikroskopie von Kohlen und Versterinerten Torfen, Handbuch der Mikroskopie in der Technik, Edited by Hugo Freund, Umschau Verlag, Frankfurt/M., 2, Pt. 1, 237-310.

Vimal, K. P., 1952., Spores and Pollen from Tertiary Lignites from Dandot, West Punjab, Pakistan, *Proc. Indian, Acad. Sci.*, 36 B, No. 4, 135-147.

——, 1953a., Tertiary Spores and Pollen from Warkalli lignites, Travancore, *Proc. Indian. Acad. Sci.*, 38 B, 195-210.

——, 1953b., Occurrence of Botryococcus in Eocene lignite of Cutch, *Curr. Sci.*, 22, 375-376.

Explanation of Plates 39

Fig. 1—Cork cells shown at higher magnification. (× 800).
2—Transverse section of a leaf in Cuddalore lignite. (× 800).