

MICROFOSSILS FROM AN OIL SHALE OF SALINE SERIES IN THE FATEHPUR MAIRA GORGE, SALT RANGE, PUNJAB

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ABSTRACT

Microfossils are described from an oil shale of the Saline series, collected by the late Professor B. Sahni from the Fatehpur Maira Gorge. The plant-remains include pollen grains of a definitely angiospermous character, which are reported for the first time from this formation. The microfossils support the theory of a Tertiary age for the Saline series.

INTRODUCTION

THE present paper is based upon the microfossil analysis of a sample of oil shale kindly given to me by the late Professor B. Sahni, F.R.S., under whose guidance this work was begun.

The shale (S. 57) comes from the lower gypsum-dolomite stage of the Saline series in the Fatehpur Maira Gorge of the Salt Range. It was collected by Prof. Sahni during his visit to the locality in October 1945. The shale has a chocolate-brown colour and is of light weight and compact texture. It burns with the smell of kerosene. The shale had already been examined by Prof. Sahni (1946, p. ix & Figs. 1-8) who recovered from it, among other microfossils, a number of woody fragments and alga-like bodies.

The Saline series is well exposed in the eastern part of the Salt Range, where the order of succession (E. R. GEE, 1944) is as follows:

<i>Cambrian and ? pre-Cambrian</i>	ft.
Salt pseudomorph beds	0-350
Magnesian sandstones	0-250
Neobolus shales	70-160
Purple sandstone series	240-450
<i>Saline series</i>	
Upper gypsum and dolomite stage	30-200
Salt and marl	up to 800
Lower gypsum and dolomite stage	up to at least 750

According to several geologists there is definite evidence of sedimentary contact

(which has undergone shearing in many places by earth movements of later dates) between the Saline series and the overlying Cambrian sequence. The other viewpoint is that the Saline series is of early Tertiary age, and that its position below the Cambrian strata is due to a big overthrust of post-Nummulitic date, which has thrust the older beds over the Saline series.

Technique—Thin sections of the shale along the plane of bedding as well as across it were prepared and examined under the microscope. The shale was also macerated in the following macerating agents:

1. Hydrofluoric acid.
2. Schulze's mixture (nitric acid and potassium chlorate).
3. A mixture of hydrofluoric acid, hydrochloric acid and acetone in the proportion 2:2:1. (Suggested by Prof. T. G. Halle of Stockholm in a letter to Prof. Sahni.)

To eliminate atmospheric contamination, control slides were exposed at different times of the year, namely March, July and November. Precautions were also taken during macerations against external objects introducing themselves into the preparations.

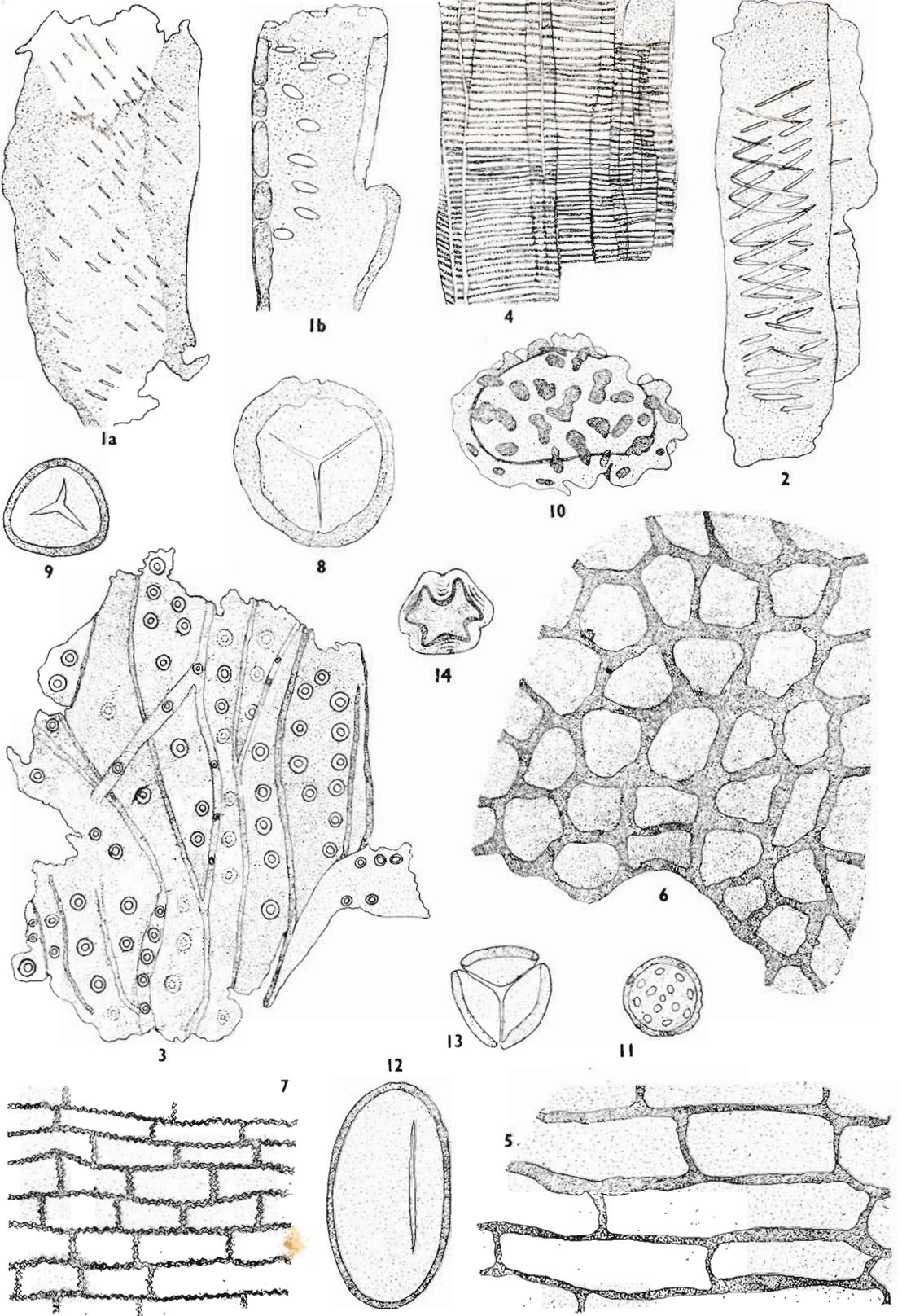
DESCRIPTION

The largest number of microfossils was obtained from the samples macerated in hydrofluoric acid. It appears from the preparations that a considerable proportion of the shale is composed of organic matter which, however, is present in a highly disorganized state. The mineral content of the shale is comparatively small. The microfossils recovered are referable to angiosperms, gymnosperms and pteridophytes.

Wood Fragments—Text-figs. 1a and 1b show elements with simple pits on the walls. These are of common occurrence.

Text-fig. 2 shows another fragment of wood with pits tending to be very much elongated transversely.

Text-fig. 3—Tracheides with bordered pits. The pits are uniseriate but at places



TEXT-FIGS. 1-14

also occur in two rows. They are distantly spaced.

Text-fig. 4 — Elements with scalariform thickening, probably portions of pteridophytic tracheides. They are also quite common in the shale.

Cuticles — Several fragments of cuticles showing the form of epidermal cells, but without stomata, have been obtained.

Text-fig. 5 — Cuticle with thick-walled rectangular epidermal cells. Cuticle pieces of this type are fairly abundant.

Text-fig. 6 — Cuticle with thick-walled, polygonal and nearly isodiametric cells.

Text-fig. 7 — Several fragments of cuticle shown here have been found. The cells are rectangular with thick and markedly sinuous walls. The sinuous nature of the walls recalls the epidermal cells of grasses.

Spores and Pollen — A fairly large number of spores and pollen grains have been obtained, some of the pollen being of undoubtedly angiospermous nature.

Text-fig. 8 — Spore (41μ in diameter) with thick wall and trilete with long arms. Abundant in the shale.

Text-fig. 9 — Spore (30μ across) with thick wall and triradiate scar.

Text-fig. 10 — Pollen grain with fairly thick wall which is thrown into large and prominent papillae all over the surface. No germinal furrows or pores are evident. It measures 50.5μ along the long axis.

Text-fig. 11 — Small spherical pollen grain, between 20μ and 25μ in diameter. Germ pores vary between 19 and 30 in number. The specimen is extremely like the pollen grains of some *Chenopodiaceae* and *Amarantaceae*.

Text-fig. 12 — Monolete grain measuring $30 \times 18 \mu$. Of fairly common occurrence in the shale.

Text-fig. 13 — Tricolpate grain with a thickened exine. The surface has a slightly raised network.

Text-fig. 14 — Thick-walled tricolpate grain.

The microfossils described above belong to vascular plants. Some of the pollen grains are of definitely angiospermous nature. Their occurrence indicates for the shale a post-Cambrian, probably Tertiary, age.

REFERENCES

- GEE, E. R. (1944). Age of the Saline series of the Punjab and Kohat. *Proc. Nat. Acad. Sci. India*, **14** (6) B: 269-312.
- SAHNI, B. (1946). Microfossils and the Salt Range Thrust. *Proc. Nat. Acad. Sci. India*, **16** (2-4) B: (i-1).

TEXT-FIGS. 1-14 — 1 a & b. Elements with numerous simple pits. 2. Another element with much elongated pits. 3. Tracheides with bordered pits. 4. Tracheides with scalariform thickening. 5. A fragment of cuticle with thick-walled rectangular cells. 6. A fragment of cuticle with thick-walled polygonal cells. 7. A cuticle with rectangular cells possessing sinuous walls. 8, 9 Spores with triradiate scar. 10. A thick-walled pollen grain with numerous papillae on the exine. 11 Pollen grain with many germ pores. 12. Monolete pollen grain with elongated slit. 13. Pollen grain with three germinal furrows. 14. Thick-walled tricolpate pollen grain.