PLANT RESIDUES OF COAL NO. 6*

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INTRODUCTION

The materials herein described are the products of maceration of a column of No. 6 coal. A modified process of Franz Schulze's method (1855) as described by McCabe[1] in 1931 was used to prepare the coal for study. The crushed coal was oxidized for four days in a concentrated solution of nitric acid and potassium chlorate and then washed, first in ammonium hydroxide to remove the brown humic matter and then in water. The residue contains various easily isolated plant fragments such as spores, epidermis, cuticle, carbonized wood fragments, resin, etc. The desired structures are removed with a small pipette and mounted in glycerine jelly, which gives clear definition in a photo-micrograph. The plant residues may be seen to best advantage in water by placing them under a binocular microscope and using a combination of reflected and transmitted light. Photography of the material in water is difficult however.

The column of coal was ½ x 1 x 76¾ inches, and was cut parallel to the bedding plane in 2 centimeter sections. The average volume of each

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[1] McCabe, Louis C., Some plant structures of coal: Trans. Illinois State Acad. Sci., vol. 24, p. 321, 1931.

section macerated was 5 to 6 cubic centimeters. The different bands varied considerably in their response to the treatment of the macerating fluid; practically all of the vitrain[2] or vitreous coal and about half of the clarain[2], which contained most of the spores and epidermis, went into solution, but only a negligible amount of the fusain was soluble.

SPORES

Spores are among the best preserved and most interesting plant residues found. They resemble in structure the pollen grains of some members of the present pine family or the spores of living ferns. Most of them are very translucent, some being almost transparent. In reflected light they have a bronze luster, and in transmitted light the color is reddish brown.

Several kinds of spores occur: (1) spores of homosporous plants, those that bore only one kind of spores, which upon germination gave rise to a new generation in the life history of the plant; (2) spores of heterosporous plants, plants that bore two kinds of spores (microspores and megaspores) as Lepidodendron or the modern Selaginella; and (3) the microspores or pollen grains of the seed plants.

The spores range in length from 1/40 mm. to 2.9 mm. The general shape is circular to oval. Some of them have bladder-like wings, some have a marginal wing, and still others have no appendages. The bladder-like wings give some of the small spores the appearance of modern pine pollen grains except for their larger size, .3 mm. including the wings. The common winged spore is about .6 mm. in diameter and the marginal wing averages .1 mm. in width. This spore also shows a feature characteristic of many of them, namely, a triradiate mark, ridge, or slit which represents the angle of contact between the spores of a tetrad or group of four spores that resulted from two successive cell divisions of the spore mother cell in the sporangium. Each mature cell was capable of reproducing a new generation in the life history of the plant. Each spore in the tetrad is about .6 mm. in diameter and has a peculiarly marked surface. On the surface opposite the triradiate mark is a design that resembles the facets in the compound eye of an insect. Most of the spores have thin membranous walls without any markings or appendages.

Some of the sections of coal contained many small spores which were about 1/40 mm. in diameter, but the great percentage of the spores ranged from .4 mm. to .7 mm. in diameter. Two of the 98 sections in the column of coal contained no spores, four contained less than half a dozen spores, but many of them contained more than 100 spores.

EPIDERMIS

Epidermis is the layer of cells on either side of a leaf or on the outside of a young stem, whereas cuticle is the protective layer of non-cellular waxy material deposited outside of the epidermis. These structures may prove to be of value in identifying the species of the coal-forming plants. Well preserved epidermis is not abundant in the residues, but the outlines of the cells are common on the many fragments of cuticle which make up a large part of the material. Some specimens of cuticle have well preserved cells as shown by the presence of stomata and by the spines or epidermal hairs.

The more common type of epidermis preserved is well distributed in the column. The asymmetrical cells are usually irregularly arranged except for two or three rows which follow the line of a vein. The individual cells average .1 mm. across. A small thick piece of epidermis with narrow cells averaging about 1 mm. in length was isolated; the stomata

[2] Stopes, M. C. Proc. Royal Soc., vol. 90, series B, pp. 470-487, 1919.

have no regular arrangement. An unusual fragment containing epidermal hairs, stomata, and cells of two shapes was also found. The epidermal hairs, .2 mm. long, are borne in areas of more or less elongate cells with no stomata. On either side of this area are areas of irregular cells and stomata which are spaced from .05 to .1 mm. apart.

WOOD AND OTHER STRUCTURES

The most prominent characteristic of wood cells in both modern and fossil plants is the pitting in the cell walls. The "pits", which formed during the thickening of the walls, represent areas of very thin membrane which provided for communication between adjacent cells. They are variously shaped, some circular and some elongate.

Some of the pitting in the wood cells is remarkably preserved. Each row of scalariform or ladderlike pits represents one side of a cell wall. The pits, the longer of which may be .07 mm. in length, average about 85 to the mm. Some carbonized wood fragments exhibit a striking resemblance to the vascular strands that may be seen at the node of a cast of Calamites. The small piece measures .6 mm. from left to right. One piece shows four spiral vessels. The spirals represent thickened walls inside the vessels.

Other interesting structures found were a seed?, sporangia, periderm tissue, cross-sections of thickened wood cells, and resin rodlets and globules.