Saskatchewan

LIGNITE

Under A Microscop

by PAUL L. BROUGHTON*

During the geologic time period geologists call the Paleocene, a forested and swampy terrain covered southern Saskatchewan, western North Dakota and eastern Montana. Now, 60 to 70 million years later, this great expanse of temperate climate vegetation has been transformed into one of the largest lignite coal deposits in the world. This lignite-bearing series of sand, silt and clay is called the Ravenscrag Formation in southern Saskatchewan, but is known as the Fort Union Formation in the adjacent northern American states.

Today, the coal-bearing strata of the Ravenscrag Formation covers most of the southern third of the province: roughly that area bounded between the International Boundary on the south; Manitoba on the east; Alberta on the west; and the southern Saskatchewan towns of Stoughton, Ceylon, Wood Mountain, and Shaunavon on the north. The lignite seams are usually poorly exposed because of weathering and a glacial soil mantle. However, most residents of Saskatchewan have at one time driven through the Estevan area and observed its three large strip mine operations. These can readily provide the visitor with a look at a fresh lignite coal seam while it is being mined.

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The lignite itself may look uni teresting to the casual observer, b when a piece of it is carefully prepar for study under a microscope, becomes fascinating subject material. is the intent of this article to give a br introduction to the microscopic natu of some of our Saskatchewan lignit All the samples used for this purpo were collected from a working face the Utility Mine southwest of Estev The coal blocks collected are prepar on specially designed grinding a polishing machines to produce a waf thin slice of lignite firmly affixed b ween two glass plates. The norma opaque lignite is ground so thin t light readily passes through.

There are many different classi cation systems used by coal resea scientists when examining t microscopic components of coal su stances. I use what is called the Stop Heerlen system adapted for thin secti characteristics. This system has th major groups of microscopic co ponents (termed macerals): vitrin exinite and inertite.

All of the woody remains found coal are called vitrinite, and may c stitute as much as 80 per cent of

These remnants may occur with all cells preserved, or they may grade structureless vitrinite where the become progressively destroyed collapse under continued burial ure. Two components make up this p: the material comprising the cell (telinite) and the material filling ell cavity (collinite).

e second group, exinite, is made up ollen, spores, cuticles, resins, and :. A cuticle is the protective skin on es and needles of plants. It is highly tant to decomposition and usually s a significant percentage of Saskat-an lignites. The spores and pollen almost always compressed and rted. Resinous and waxy bodies nite) are another important com-nt of exinite. They are usually d as isolated globular bodies but may be clustered.

e third major group in the Stopes-len system, inertite, includes an ue, finely divided detritus (massive inite), about which very little is vn. Perhaps the most important onent of inertite may have formed result of forest fires. Known as ite, it would be essentially a fossil coal. However, the effects of us micro-organisms can also trans- wood materials into fusinite sub-es. Generally speaking, fusinite of t fire origin has normal cell walls eas that of biological origin has len cell walls. The remains of al colonies give rise to another inert rial, scleretinite; it is very common gnite coals of this age.

very common component of Saskat-an lignites is groundmass vitrinite. substance is a complex mixture of al of the above components. Essen-y it is finely divided vitrinite par-s intimately mixed with pollen, spores, resinous particles, and often fusinite.

The photographic plates illustrating this article show that lignite is actually a complex mixture of wood fragments and tissues, spores, pollen, and other components. Careful examination of the relative amounts of these different components enables coal research scientists to understand the environmental conditions millions of years ago.

For example, a coal scientist can compare the relative abundance of structured vitrinite and fusinite with finely divided vitrinite and exinite. Using this basic framework we can infer that a dominating forest environment, rather than swampy conditions, existed if the coal is essentially woody tissue and fossil charcoal. On the other hand, a high proportion of groundmass vitrinite, spores, pollen, and other particles easily transported by water, would seem to indicate a reedy moor or swampy environment. An open water deposit would be indicated if the lignite section has a very high proportion of silts and clays, as well as the easily transported spores and pollen, but is very low in fossil charcoal (fusinite). These principles are generally valid, though there is considerable variability when examined in detail. By studying how the relative abundances of these components change through different levels of a lignite seam, the coal scientist is better able to understand the environmental factors in the gradual development of a peat bog into coal and to utilize this knowledge for the benefit of man. Knowing such qualities can direct more selective mining of the coal so as to mine the best coal at the least expense. Coal with high percentages of pollen, spores and resin has the highest heating value, and is thus the best to mine. The coal research scientist plays an important role in determining such characteristics and thereby determining the best mining practices.

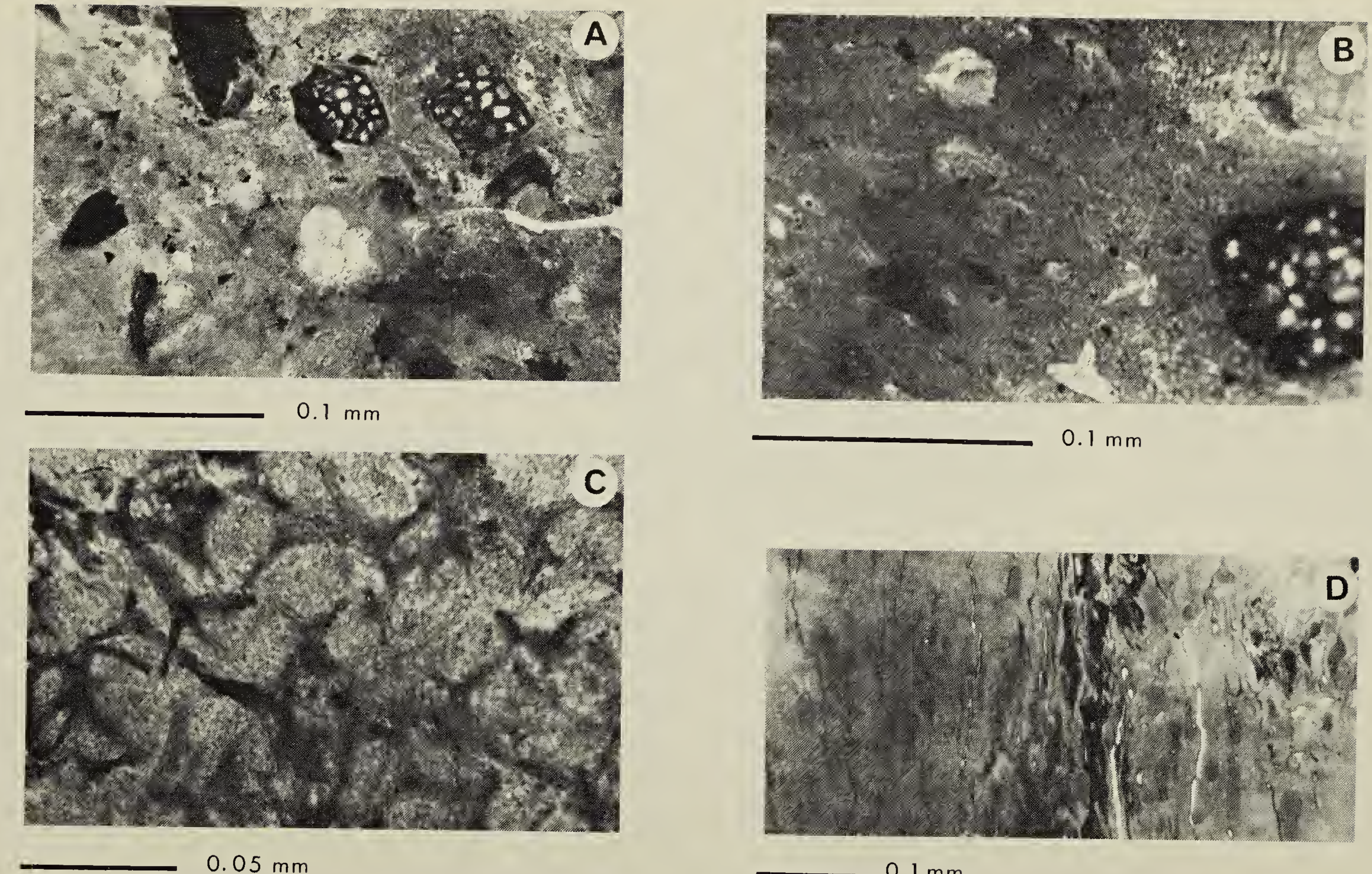

PLATE 1

A. Groundmass vitrinite with two large-celled fragments of fusinite, as well as disseminated inertinite, vitrinite, and resinite.

B. Groundmass vitrinite with scleretinite (upper left), pollen, and spores.

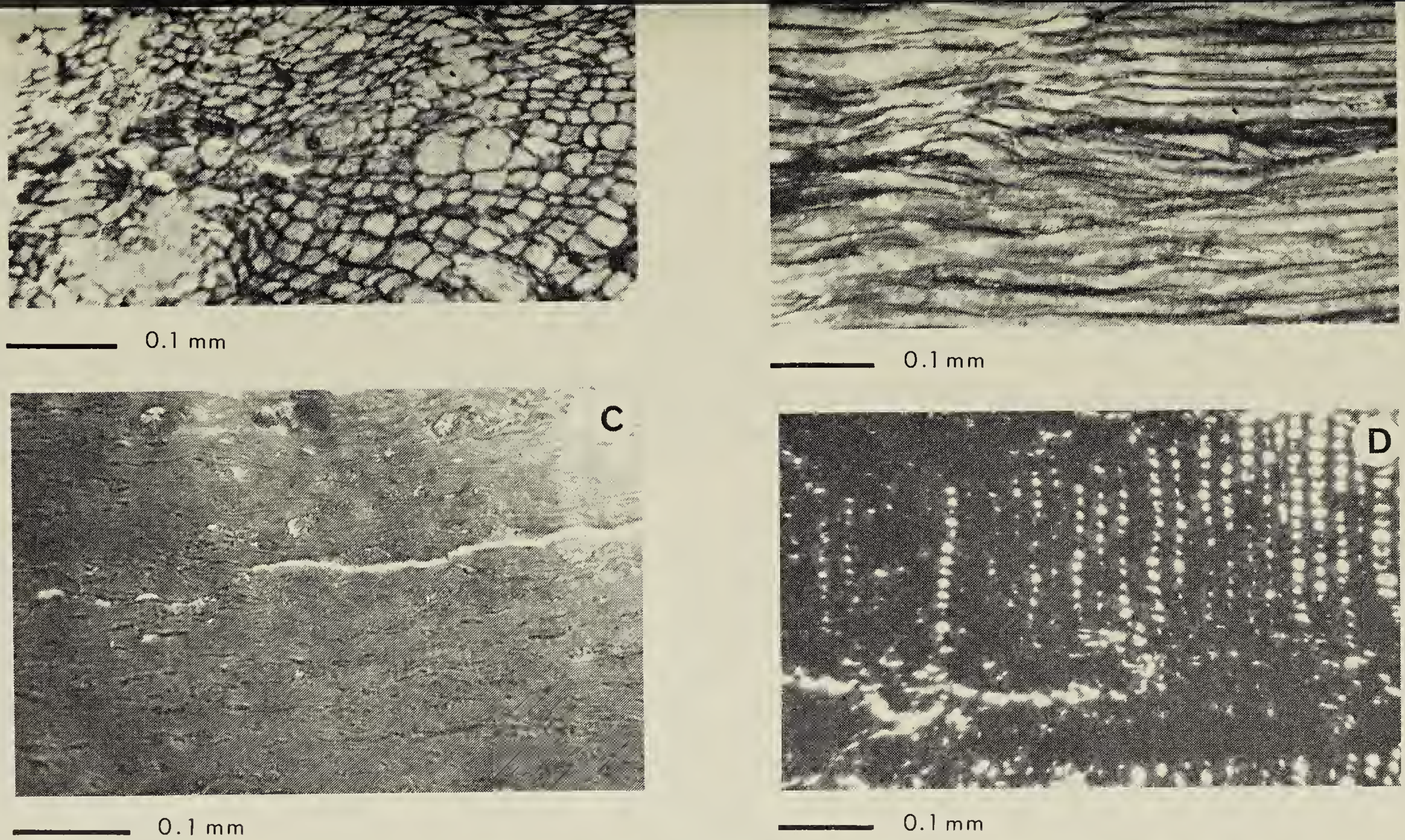

PLATE 2

A. Cross section of a limb structure. The cell cavities of vitrinite have been partly replaced by gypsum.

B. Longitudinal section of a limb structure, vitrinite.

C. Vitrinite with an advanced stage of cell collapse.

D. Fusinite. The cell cavity voids have been partially replaced by gypsum, calcite, and kaolinite.