DINOFLAGELLATES AND THEIR USE IN PETROLEUM GEOLOGY

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ABSTRACT

Dinoflagellates, their planktonic nature, world-wide distribution, and their geologic record from the Permian, are reviewed. Re-interpretation of their morphology indicates that in fossil forms which appear to show the plate-like arrangement and the sulcus and groove of the theca of the motile stage of dinoflagellates, this is merely a reflection of those structures on the walls and outward-projecting processes of an internal cyst. The walls of the cyst itself may lie close to the thecal walls in some forms and thus faithfully reproduce the features of plates and grooves. In others, the cyst appears to occupy a small space in the center of the thecal cavity and is supported against the theca by spines or other structures. Some dinoflagellates are short-ranging, but widespread, and have sufficient distinctive features to make them valuable stratigraphic markers. Paleoecology of these entities is not yet well known.

INTRODUCTION

Dinoflagellates are unicellular planktonic microorganisms that live today in fresh, brackish and marine waters the world over. Although not generally familiar to the layman by name or by sight, their indirect influences are profound and well known. Next to diatoms, dinoflagellates are the most important fundamental food organisms of modern seas. They are also the agents chiefly responsible for the “phosphorescence” of the sea at night. Although they are very small—most fall in the range from 20 to 100 thousandths of a millimeter—at times they are so prodigiously abundant that the water becomes syrupy from their crowded bodies and acquires a reddish or yellowish color from the tiny pigment granules in their minute masses of protoplasm. Occasionally such population explosions or “blooms,” popularly known as “red water” or “poisonous tides,” produce toxic conditions in near-surface waters that are devastating to fish life. Along some coasts certain molluscs, notably mussels, whose diet includes dinoflagellates, become unsafe to eat during the summer months. At that time the dinoflagellate population is particularly large, and substances highly toxic to man but not to the molluscs are derived from the dinoflagellates and accumulate in the tissues of the mussels.

Fossil dinoflagellates were first illustrated by Ehrenberg, the father of micropaleontology, in the 1830’s. He first found them in Cretaceous rocks of Germany and Poland. Today they are known from rocks as old as Permian (Tasch, 1963), but are not commonly encountered in strata older than Middle Jurassic. During the century following Ehrenberg’s pioneering studies, fossil dinoflagellates were the subject of only rather casual mention in a small number of paleontological papers. Then, about 30 years ago, several European paleontologists (notably O. Wetzel, A. Eisenack, G. Deflandre and M. Lejeune-Carpentier) began a series of studies of Jurassic and Cretaceous dinoflagellates that laid the foundations for our present knowledge. In the last few years, interest in fossil dinoflagellates has expanded rapidly as their widespread occurrence in Mesozoic and Tertiary rocks and their potential use in stratigraphic paleontology have become more widely appreciated. Today they rank in usefulness along with fossil spores and pollen as tools for correlation and dating of rocks from the younger portions of the stratigraphic column.