commercial oil well in the world in 1859 near Titusville, Pennsylvania; the late Pattillo Higgins, whose faith and inspiration led to the discovery of Spindletop and the beginning of the liquid fuel age; and Columbus "Dad" Joiner, the aged and impoverished Oklahoma wildcatter, who proceeded on his goal in the face of "learned" advice to cease drilling and the scornful criticism of earth science leaders, to bring in the greatest oil field in North America—the vast East Texas field where more than six billion barrels of oil eventually will be produced.

There were other great contributors to the abundance of petroleum, such as William Knox D'Arcy, an Englishman, who suffered years of heartaches and hardships, while working in a locale which was so forbidding that other civilized men dared not venture into it, before his discovery led to the opening of the vast Persian Gulf oil reserves; the pioneer geologist, Charles Eckes, whose painstaking and minute geological investigations led to exploration for, and eventual discovery of, the great deposits of oil under Lake Maracaibo in Venezuela; and, Robert DeMares, whose persistence, based on his observations of oil seeps that spouted high into the tall tropical trees, enabled him to attract the wildcatting firm of Benedum and Trees to the rich production in the heart of the Colombian jungles.

These were only a few of the men who sought and found opportunity through faith, determination, and optimism and, by so doing, developed the energy and fuel for a better way of life for all mankind; this suggests that the petro-professionals in the industry should pause and re-evaluate their own contributions toward a better society and a more profitable industry. A look at the past is timely in view of the prevalent pessimism and lack of determined leadership on the part of most industry personnel, especially in the field of exploration. Successful leaders of tomorrow will be individuals in today's petroleum industry who are as dedicated, determined, and purposeful as those illustrated in this paper.

4. HENRY L. OTT, Chevron Oil Company, Western Division, Casper, Wyoming

PALYNOLOGY AND ITS USE IN PETROLEUM EXPLORATION

Palynology is basically the study of pollen and spores, both fossil and recent. Many students of modern pollen are allergists, whereas the fossil pollen student is generally referred to as a palynologist.

Most hayfever suffers become acutely aware of the presence of modern pollen and spores during the summer months. These pesky little bodies have long played key rolls in the annual plague of itchy eyes and runny noses. However, their fossil cousins have received relatively little attention until the last few decades. During this time their presence has been noted in rocks of all geologic ages dating to the Silurian.

Pollen and spores are the male and female reproductive bodies of the flowering and non-flowering plants, respectively. They are produced by the countless trillions by plants everywhere and are distributed to the four corners of the globe by winds and water. Everyone has observed the yellow film on a high mountain lake, or the yellow "smudge" on a garment after contacting the goldenrod blossom. This yellow "smudge" is pollen dust. The individual pollen grain is of microscopic size, about 3,000 of them fitting side by side on the head of a pin. In spite of their extremely small size they are hardy little individuals, being relatively indestructible both physically and chemically. For this reason they have become important to the geologist. They are widely distributed by winds and water to all environments of deposition and then may be buried and preserved to furnish a fossilized record of geologic events of the area.

Palynologists have been able to utilize the pollen record for (1) age determinations, (2) correlations, (3) climatic interpretations, (4) depositional environmental interpretations (associated micro-microfossils), and (5) oil migration and accumulation studies. The application of the science of palynology is relatively new to the petroleum industry and new and better techniques as well as continued experience may yet add other uses to the ever-growing science.

5. LOUIS F. KEATING, Imperial Oil Enterprises Limited, Calgary, Alberta

EXPLORATION IN CANADIAN ROCKIES AND FOOTHILLS

The Canadian Rockies form the most easterly ranges of the Cordilleran system for a distance of more than 1,050 miles, from the Yukon border south into central Montana. They are bounded on the east by the Interior Plains and on the west by the Rocky Mountain trench. The main deformation occurred during the Eocene, resulting in a system of stacked thrust plates which are restricted to the sedimentary section and do not involve the crystalline basement rocks. More than 100 miles of shortening in the sediments occurred as a result of this deformation.

Exploration in this structural belt has resulted in an important oil- and gas-producing province, the major reserves being located in the southern Foothills. The vast amount of information that has been accumulated in the course of this exploration through surface mapping, drilling, and geophysical work has provided excellent structural detail over a large part of the area.

Prospective structures are difficult to locate and require careful integration of all available geological and geophysical control. Reflection and refraction seismic methods have had considerable success in locating many of the presently producing fields and have provided information that is fundamental to our understanding of this complex structural belt.

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APPLICATION OF PALEOGEOMORPHOLOGY TO EXPLORATION FOR OIL AND GAS

Hydrocarbon traps are customarily subdivided into two main classes: *structural* and *stratigraphic*. A third important class, hitherto not considered separately, includes hydrocarbons trapped in buried hills, ancient sandstone-filled valleys, fossil reefs, and other primarily geomorphological phenomena. These are termed as *paleogeomorphic* traps. The analysis of and prospecting for this type of trap must proceed along purely geomorphological lines of reasoning. These include both *form* and *process:* the form creates the trap, but the process shapes the form. Trapping may be below or above the paleogeomorphological surface, and be either direct or indirect.

Paleogeomorphology includes all geomorphic phenomena recognized in subsurface geology, *i.e.,* all buried-relief features, whether formed on land or under water. Geomorphic processes may be divided into "constructive" and "destructive." Constructive forms of interest to petroleum geologists are dunes, barrier beaches, organic reefs, *etc.* Destructive processes create hills and valleys, underground drainage in carbonates, submarine canyons, *etc.*, and create or destroy porosity by weathering.