regarding sandstone deposition and reservoir quality.

The Cut Bank Sandstone of the Red Creek area consists typically of black chert and quartz; it is conglomeratic at the base, grading upward into fine-grained, commonly clay-cemented sandstone. It is largely a blanket sandstone throughout the field. However a definite thinning of the major basal unit takes place on the eastern side of the field. The area of thinning coincides with development of a stratigraphically separate, relatively "tight" upper unit. The accumulation is largely structural, and the reservoir is filled nearly to the spill point. Approximately 45 ft. of critical closure is mapped on the reservoir beds, but shallower beds indicate only a north-plunging nose.

The main reservoir sandstone at Fred and George Creek shows evidence of having been deposited in a deeply eroded channel, probably at or near drainage base-level. Evidence of channel scour is prominent here as it is in some areas of "Moulton" deposition on the northwestern side of the arch.

The reservoir sandstone at Flat Coulee is, in depositional detail, considerably different from the sandstones at Red Creek and Fred and George Creek, although it may be nearly equivalent stratigraphically to the latter. At Flat Coulee, the reservoir sandstone appears to be a part of a major sandy shale unit (Ribbon) from which the shale has been removed, probably by shallow near-shore current activity.

28. DUDLEY W. BOLYARD, Clark Oil and Refining Company, Denver, Colorado, AND ALEXANDER A. McGREGOR, Samuel Gary, Denver, Colorado

STRATIGRAPHY AND PETROLEUM POTENTIAL OF LOWER CRETACEOUS INYAN KARA GROUP IN NORTHEASTERN WYOMING, SOUTHEASTERN MONTANA, AND WESTERN SOUTH DAKOTA

The Inyan Kara is a diversified group of sandstone, shale, conglomerate, variegated siltstone, claystone, and some lignite at the base of the Cretaceous in the Black Hills and surrounding subsurface area. Its unconformable contact with underlying formations reflects epeirogenic uplift and gentle folding in very Late Jurassic to very Early Cretaceous time. Thickness ranges from 22 ft. or less in central South Dakota to about 700 ft. in Black Hills outcrops.

Two dominantly sandy formations, the Lakota and the overlying Fall River, comprise the Inyan Kara Group. They are separated by a regional disconformity. The Lakota is a continental deposit with conglomeratic material, claystone, and variegated beds. The Fall River, which has greater regularity and bed continuity, consists of offshore shale, neritic to littoral sandstone, and deltaic and other marginal marine deposits of the first major Cretaceous marine transgression. The Fall River intertongues northwestward with the overlying marine lower Thermopolis Shale.

Persistent shale breaks divide the Fall River into three members (ascending): Liscom Creek, Morton, and Coyote Creek. Gross arrangment of members is shingle-like, for where one is thick the others tend to be thin or absent.

Most of the Inyan Kara sediments were transported seaward by streams originating on the Sioux uplift. During Lakota deposition, a major northwest-flowing river developed along the regional syncline which lay east of the Chadron arch and extended through the site of the Black Hills into Montana. Southward encroachment of the sea and shifting of deltas explain the thickness and facies relationships of the members of the Fall River Formation.

Many oil fields on the eastern flank of the Powder River basin in Wyoming have producing sandstones up to 80 ft. thick. Most of the oil is produced from channel sandstones in the Coyote Creek Member of the Fall River. Some important fields produce from Lakota channel sandstones. The oil is trapped behind convex updip permeability barriers at the margins of sandstones deposited in meandering channels which are approximately parallel to structural contours. Favorable stratigraphic and structural conditions for petroleum accumulation also exist in parts of southeastern Montana and western South Dakota.

29. JAMES A. BARLOW, Barlow and Haun, Inc., Casper, Wyoming, AND JOHN D. HAUN, Colorado School of Mines, Golden, Colorado, and Barlow and Haun, Inc.

STRATIGRAPHIC ACCUMULATION OF OIL IN SALT CREEK FIELD, NATRONA COUNTY, WYOMING

Salt Creek field has produced about 420,000,000 barrels of oil. Most of this production is from the second Frontier sandstone, which is one of many sandstone bodies that are interbedded with marine shale in the lower part (between the top of the Mowry and the base of the Niobrara Shales, hereafter referred to as interval A) of the Upper Cretaceous, Rocky Mountain area, United States and Canada. Interval A is thick (over 1,000 ft.) in central, northeastern, and west-central Wyoming and southeastern Montana. Another area where interval A is thick is in northwestern Montana and western Alberta. In some areas, interval A is entirely marine shale; in other areas the interval contains abundant sandstone bodies. The sand was transported by a series of river systems that formed deltaic complexes at several places at the margins of the early Upper Cretaceous sea. These deltaic deposits are represented by the "D" sandstone of the Denver basin, the Ferrin Sandstone of Utah, the Cardium and Badhart Sandstones of Canada, and the Frontier Sandstone of Wyoming.

The second Frontier sandstone that produces at Salt Creek field is an offshore bar associated with the eastern terminus of one stage of the Frontier delta. The sandstone body is several miles wide, over 60 mi. long, and up to 100 ft. thick. Salt Creek anticline (formed at the end of the Cretaceous) is located in an area of excellent sandstone conditions and caused structural accumulation of primarily stratigraphic oil.

There are other sandstone bodies related to the Frontier delta containing stratigraphic oil that are not draped over an obvious anticline. The Wind River and Bighorn basins and parts of the Green River and Powder River basins probably contain more Salt Creek-type fields.

30. ROBERT J. WEIMER, Colorado School of Mines, Golden, Colorado

PATRICK DRAW FIELD, SWEETWATER COUNTY, WYOMING—AN OLD STRATIGRAPHIC TRAP

The search for new petroleum reserves can be greatly implemented by a more thorough understanding of why petroleum is trapped where it is. The Patrick Draw field, discovered in 1959, started a wave of exploration effort in the Rocky Mountains area to find additional giant stratigraphic traps in the Upper Cretaceous rocks where porous and permeable sandstones pinch out on structural noses. The failure to find another Patrick