katchewan about 50 miles east of the Saskatchewan-Alberta boundary and 200 miles north of the International Boundary.

The presence of a productive and possibly persistent oil column along the southern part of the Dodsland field was not known until August, 1958, when three pools, known as Gleneath, Eagle Lake, and Braeburn, six miles apart were discovered. Previously the field was known only for its potential of gas reserves. Development of the oil pools is still in the early stages, and it is not yet known whether or not they will join. To date, thirty-five wells have been drilled with an unusually high ratio of successes to failures.

The field has the structure of an irregular dome on which there are several local highs. Gas has accumulated in the higher parts of the structure. Principal oil occurrences are on the southern flanks which are the center of present activity.

The productive zone of the field is a fine-grained, argillaceous, marine sandstone belonging to the Viking formation of Lower Cretaceous age. The sandstone becomes more and more argillaceous towards the northern and eastern parts of the Dodsland structure, and within the map-area grades into shale on the northern flank. The porosity of the sand averages about 23 per cent and the permeability about 15 millidarcys. Gross oil sand thicknesses encountered in wells drilled to date range from 24 to 39 feet.

Well completion procedure usually includes sand fracturing the Viking before placing the well on production. Completion costs are low due to the relatively shallow drilling depth of 2,250 feet.

Wells are drilled in all three pools on an approved 80-acre spacing pattern.

KENNETH F. CUMMINGS, Hondo Oil & Gas Company, Denver, Colorado
Buck Peak Oil Field—Moffat County, Colorado

The Buck Peak oil field in northwestern Colorado is located on the southeast end of the Sand Wash Basin. The field currently produces oil from the fractured Niobrara shale of Cretaceous age.

Fractured shale production has been known in northwestern Colorado since 1902 when Rangely was discovered. Since rotary tools were first introduced into northwestern Colorado in 1924, no new fractured shale fields were discovered until Buck Peak. Since that time many new fields such as Sage Creek, North Sage Creek, and South Tow Creek have been discovered and Rangely has experienced a new boom.

With such recent wildcat success in the Niobrara it can be assumed that the Niobrara has been overlooked for some time. Considering cumulative production in excess of 9 million barrels from the Niobrara in northwestern Colorado coupled with the recent discoveries, more individuals and companies will become interested in the Niobrara possibilities.

The method of finding fractured shale production at Buck Peak might be of some help to other individuals and companies who wish to explore for this highly elusive production.

DONALD E. DINKINS, Honolulu Oil Corporation, Billings, Montana
Geology of Stensvad Field, Montana, and Its Regional Geologic Setting, with Notes on Tyler Reservoir

The Stensvad field is a fault-stratigraphic trap situated in an east plunging syncline. An east-west fault limits the field to the south while stratigraphy controls the west and north limits.

Pre-Alaska Bench post-Heath nomenclature has been, and is, very complicated due to complex stratigraphy. Today, owing to the contributions of the many workers concerned with this interval, important formational units and unconformities are being recognized with subsequent resolution of the stratigraphic and nomenclatural problems.

The pre-Alaska Bench post-Heath stratigraphy in the Stensvad field area is most interesting, but can only be appreciated when considered in its regional setting. This sequence originated with uplift and erosion with ensuing alluvial fill of "channeled," or down-warped, areas, followed by marine transgression and regression.

Stensvad field is productive from three sandstone bodies occurring within the Tyler formation.

A. L. EVANS, Sun Oil Company, Calgary, Alberta
Red River Formation: Structural and Stratigraphic Interpretation

Ordovician strata in Manitoba comprise two vertically distinct parts, a lower clastic sequence, and an upper sequence of dolomites and dolomitic limestones. The latter have been divided into three formations having the character of para-time rock-units. These are recognizable in the outcrops of southern Manitoba and east-central Saskatchewan and can be traced into the subsurface. The lowermost, and by far the thickest, of the carbonate formations is the Red River.

The outline and shape of the depositional Williston Basin is reflected in the present structural attitude of the Red River, which also manifests the presence of a number of positive tectonic elements within the basin.

The formation thickens from the basin periphery toward the International Border, its center of maximum deposition being beyond the area of study, in central North Dakota. Both the rate of thickening and the degree of structural dip increase towards the basin center. Thinning of the formation is apparent over local positive areas.

The Red River is herein divided into Lower, Middle, and Upper units based on mass lithologic characters. The Lower and part of the Middle unit are restricted westward, indicating generally transgressive marine conditions during deposition. Minor cyclical fluctuations involving interbedded evaporites and bioclastic material are evident in the Upper Red River.

Three broad lithofacies may be discerned within the formation each of which is believed to reflect deposition within a relatively distinct environment, dependent primarily on the influence of water depth for its salient characteristics. These environmental zones blend into each other both laterally and vertically but within a single para-time unit tend to be related to structural features and to geographic position relative to the basin center. Their distribution implies the existence of a shelf-edge circumscribing the basin.

The development of porosity appears directly influenced by variations in lithology and by the degree of secondary dolomitization to which the rock has been subject.

The salinity of waters contained in the total Ordovician carbonate section is greatest nearest the basin center, fresh water predominating in closer proximity to the peripheral outcrops. Known occurrences of petroleum appear to bear a positive relationship to the distribution of highly saline formation waters.

JOHN R. FANSHAWE, Northern Consultants, Billings, Montana
New Interpretation for Wolf Springs Field, Montana

The Wolf Springs field, 7 N.-32 E., Yellowstone

County, Montana, produces 30° gravity oil from the Amsden dolomite at an average depth of 6,200 feet. Discovery was made by the Atlantic Refining Company in August, 1955.

Prior published comment considers the oil pool to be an accumulation due to hydrodynamic tilt to the northeast of the axis of the Wolf Springs anticline, as contoured on top of the Amsden formation. Wells drilled during 1959 add regional information which casts doubt on the hydrodynamic thesis. An interpretation is offered whereby the oil pool localization is shown as being due entirely to stratigraphic factors.

FRANK W. FOSTER, Consulting Geologist, Bismarck, North Dakota

Oil Sands at Base of Pennsylvanian in Williston Basin

The strata discussed in this paper belong to the shale and lenticular sandstone sequence which has been called the Heath formation of Mississippian age in the Williston Basin. This unit is of economic importance as a source of oil in southwestern North Dakota.

Information has accumulated to indicate that these sediments are Pennsylvanian in age and are correlatable, at least in part, with the Tyler sandstone in the Sumatra area of central Montana. The name Tyler formation is, therefore, proposed for these sediments in North Dakota.

This formation is found over much of western North Dakota and may possibly be equivalent to sediments which occur over much of South Dakota. The Tyler of the Williston Basin in North and South Dakota rests unconformably on truncated Big Snowy (Otter and Kibbey) and on truncated Paleozoic strata. It is overlain by carbonates of the Minnelusa and (or) Amsden formations, and locally by sands and shales of the Jura-Triassic.

A dark gray to brown fossiliferous limestone which overlies the Tyler sediments in parts of North Dakota is believed to be a stratigraphic equivalent to the Alaska Bench member of the Amsden in Montana.

The Tyler formation varies from zero to 300 feet thick in North Dakota. A detrital deposit composed of pre-unconformity rock types has been recognized in cores and samples from the base of the Tyler. Over much of North Dakota the formation is black, carbonaceous, fossiliferous shale; however, over many areas the upper fifty per cent of the formation is dark red shale. Locally red, maroon, yellow and green shales occur in the upper twenty to forty feet of a predominantly black shale interval. Sands are developed more extensively in the black shale unit, but occur in some areas in the red shale. Toward its outer limits to the north and east in North Dakota, the Tyler becomes more sandy and red colors are dominant. In areas where the Tyler has red shales in the upper portion and dark gray to black shales below, the sequence appears to be lithologically similar to the Tyler formation in the Sumatra area of central Montana.

Apparent correlatives of the Tyler formation in South Dakota exhibit varicolored shales, and tan carbonates in the upper half, with dark green and black shales and dark colored limestones and sand in the lower half. A sand at the base, called Fairbanks by earlier workers, lies across the truncated edges of Madison and older Paleozoics.

The sands in the Tyler appear to be bar-type sand lenses which are channeled into the basal detrital beds, and occur interbedded with black to red and varicolored shales in higher parts of the unit. A near-shore lagoonal, fresh water to marginal marine environment seems apparent. Fossils indicate a Pennsylvanian age for these sediments in North and South Dakota and suggest correlation with "true Amsden" at least in part.

Tyler sand fields, in southwestern North Dakota have produced, since the first discovery in 1954, a cumulative total of 364,615 bbls. of oil as of July, 1959.

Cores from this formation on the Nesson Anticline have had good oil shows in well developed porous sands, and suggest that more oil is yet to be found in these strata.

J. G. C. M. FULLER, Amerada Petroleum Corporation, Calgary, Alberta

Ordovician and Silurian of Central and Southern Parts of Williston Basin

Ordovician and Silurian rocks, mainly dolomitic limestone and dolomite, underlie the eastern half of Montana, nearly all of North Dakota and a large portion of South Dakota. They reach a thickness of about 2,000 feet near the basin center (where the cover exceeds 12,000 feet) but are bevelled radially by pre-Devonian and later surfaces of unconformity. Only Ordovician rocks escaped removal from areas of present-day outcrop at the southern rim of the basin.

For historical reasons the outcrop and subsurface nomenclature of the stratigraphic column differ, but a series of sedimentary units which can be traced in basin-wide stratal continuity exists. The Bighorn dolomite of the Pryor-Bighorn Mountains in Montana is demonstrably continuous with and equivalent to the combined Red River, Stony Mountain and Stonewall formations of the northern part of the basin. Similarly, the Whitewood dolomite of South Dakota equates with a small section of the lowest Red River.

Sedimentary thickness and distribution maps reveal former contiguity of the Williston and Nebraska-Iowa-Illinois depositional areas. During pre-Stony Mountain sedimentation the northern Nebraska and northeastern Iowa areas lay on the southern flank of a Red River basin centered in North Dakota.

Ordovician sedimentation (post-Beekmantown Deadwood formation) commenced with deposition of a sandstone on an erosion surface cut across Cambrian and Precambrian rocks. It continued with a shale and sandstone formation (Winnipeg, Simpson) which overstepped the initial sandstone and behaved as a basal deposit to the overlying carbonates of the Red River (Viola), and Stony Mountain-Stonewall (Maquoqueta) formations.

The lower three-quarters of the Red River comprise an uninterrupted succession of marine fossiliferous limestones, highly dolomitized at their periphery, but the upper quarter is a strongly rhythmic carbonate-evaporite sequence. These evaporites spread over most of the basin interior, the earliest having the greatest extent.

An influx of shale in the lower part of the overlying Stony Mountain abruptly smothered the evaporite rhythms. Evidence of facies variation within the lower Stony Mountain, coupled with a shift in the center of maximum accumulation of later formations points to appreciable re-disposition of sedimentary influences. Evaporite rhythms returned after the shale incursion and lasted through the remaining Stony Mountain and the Stonewall formations.

Silurian rocks, the Interlake group (Hunton), are almost wholly dolomite, characteristically pale in color and micrograined. Evaporitic anhydrite beds occur locally but have either the spread nor the rhythmic succession of those in the Ordovician. Correlation and subdivision of Interlake group sections is much aided by the existence of several persistent sandy non-sequential