Mountain features of this region are the result primarily of Laramide vertical uplifts of oval or irregularly broad shape. They generally lack linear, narrow, or sinuous aspect. Some are conspicuously asymmetrical; others are fairly symmetrical; others approach gentle quaquaversal form. The structural relief ranges from 500 feet (Bowdoin dome) to 40,000 feet (Wind River uplift). Later Tertiary faulting, subsidence, sedimentation, and igneous activity have modified these Laramide uplifts considerably in places.

When the thrust faults are charted, they are found to be for the most part marginal to the uplifts. The uplifts of low and intermediate amplitude generally do not have associated border thrusts, but those in which Precambrian rock is exposed in the core commonly are bordered on one side or both by outwardly displaced thrusts. A firmer tie of uplift to border thrust is found in those where a structural relief of 25,000 feet or more exists.

These relations suggest that vertical uplift was the primary deformation and that thrusting was a secondary lateral deformation caused by gravity sliding and flowing. Since the basins were filled with sediments as the uplifts rose, it appears that thrusting is apt not to be related directly to the structural relief of uplift over adjacent basins, but to absolute relief at any one time as uplift exceeded sedimentation.

Anticlines suitable for oil and gas accumulation seem to be related to the marginal gravity creep from the uplifts. The locale is one of interplay of thrusting and folding of the surficial strata, and of sedimentation.

The Rocky Mountain region of uplifts is essentially the igneous province of alkalic and calc-alkalic rocks. Consideration of the origin of these rocks, of the nature of the uplifts, and of geophysical data lead the writer to postulate that the uplifts are due to megasills or lopoliths deep in the silicic (granitic) layer, perhaps near the boundary of the silicic and basaltic layers. It is expected that model experiments will indicate size, shape, and depth of intrusion to produce the various surface structures, and the nature of the border faults.

27. Laramide Sediments along Wind River Thrust, Wyoming: ROBERT R. BERG, Embar Oil Company, Denver, Colorado

The Wind River Mountains of west-central Wyoming are bounded on the southwest flank by a thrust fault which dips 20° NE. and has a maximum vertical displacement of 35,000 feet. Seismic data show the magnitude and character of the fault zone. The fault originated from an overturned basement fold which was subsequently broken and thrust toward the southwest. Uplift of the mountains began by folding during the late Cretaceous, continued throughout the Paleocene, and culminated in thrusting at the end of the Paleocene. Non-marine sediments in the Green River basin adjacent to the uplift were deposited without interruption in a dominantly quiet-water environment, but as uplift progressed, increasingly numerous coarse clastics were derived from the mountain flank. After thrusting, early Eocene fluvial sediments from the uplift spread basinward. Gas occurs at Pinedale in tight sandstones of the Paleocene Hoback formation in a basinal facies. Possibilities for both gas and oil exist farther west where cleaner fluvial sandstones interfinger with the basinal shales.

28. Tectonics and Oil Accumulation in Central Montana: JOHN R. FANSHAWE, Consultant, Billings, Montana

The east-west structural complex, known as the Big Snowy anticlinorium, is believed to be mid-Miocene in age. It was a stable area during the Laramide orogeny, which terminated during the Eocene. Injection of igneous material accompanied and followed the deformation in central Montana. The then increase of crustal thermal conditions probably aided the structural growth, which was principally vertical in expression rather than arcuate and compressional.

Jurassic formations overlie the Amsden, of Pennsylvanian age, throughout the structural province. Paleozoic structure is at variance with the observable surface geology (involving Paleocene through Jurassic formations). This ancient tectonic control is more significant in areas not affected by the mid-Miocene deformation that formed the big and obvious features like Porcupine dome, the Big Snowy Mountain dome, and Woman's Pocket anticline.

Generation and accumulation of oil and gas occurred under structural conditions that existed before the mid-Miocene tectonic pulsations. The present distribution of petroleum pools is due to traps that were not materially affected by the post-Laramide deformation, or traps that were due to secondary migration into newly formed structures. The latter condition has been subject to severe attrition by the increasing effect of artesian waters. The search for new oil should be guided by the more subtle geologic factors of Jurassic and pre-Jurassic stratigraphy and tectonics.

29. Possible Early Devonian Seaway in Northern Rocky Mountain Area: CHARLES A. SANDBERG, Geologist, U. S. Geological Survey, Denver, Colorado

A seaway may have occupied a geosynclinal trough in Washington and Oregon during Early Devonian time. Its existence is postulated from the distribution and sedimentary environment of isolated deposits of Early Devonian and probably Early Devonian age in the northern Rocky Mountains. Regional evidence suggests that the Beartooth Butte formation of Early Devonian age was laid down along the eastern margin of a sea and on the landmass that bordered it in southern and central Montana and northern Wyoming. The Williston basin area in North Dakota was apparently a part of the landmass. The Water Canyon, Maywood, and Ghost River formations which may be in part correlative with the Beartooth Butte were laid down in a near-shore, shallow-water marine environment in northern Utah and southern Idaho, western Montana, and west-central Alberta, respectively. These lie west of the marginal marine deposits of the Beartooth Butte but several hundred miles east of the postulated north-south axis of the seaway.

Discontinuous deposits of the Beartooth Butte formation, which formerly was considered to be a local channel filling at a few localities in northern Wyoming, have now been widely recognized. The formation consists of grayish red and yellowish gray silty dolomite and dolomitic siltstone, sandstone, conglomerate, and breccia. It is generally less than 10 feet but locally as much as 170 feet thick. The continental beds of the Beartooth Butte were laid down on a land surface of generally low relief with karst topography in places. Redbeds filling channels and sinkholes were derived mostly from red soils that had developed on carbonate rocks possibly in a humid, tropical, or subtropical climate. Marginal marine beds of the formation were probably deposited in estuaries, bays, and lagoons along a drowned coast characterized by long, narrow marine embayments.

The Water Canyon formation of Early Devonian age in northern Utah is about 400 feet thick. It is composed of intraformational breccia, silty dolomite, cherty dolomite, and dolomitic sandstone and sandy dolomite con-