amounts in an easterly direction. It would appear that a separate basinal area existed toward the end of Middle Jurassic time in Manitoba, receiving clastic sediments from the north and east.

The Shaunavon formation can not be traced lithologically in this facies district but approximately equivalent picks can be made from electric and radiation logs. The lithologic character of the uppermost Gravelbourg, Shaunavon, and Vanguard formations in Manitoba resembles closely that of the Sundance formation in North and South Dakota.

Callovian time is represented by the lower part of the Vanguard formation. During this time uniform basinal conditions were established across the entire area. A slight unconformity, recognizable in western Saskatchewan, marks a change from marine to brackish conditions which must have taken place in middle Oxfordian time. In the center of the basin 150 feet of marine middle Vanguard represent the Oxfordian interval. The upper Vanguard is partly marine, partly brackish and contains Kimmeridgian fauna. The lithologic character of the upper Vanguard, and the fact that it contains reworked fragments of older Jurassic faunas, indicate redeposition of material from the truncated basin flanks into the center.

The hiatus between Kimmeridgian and Lower Cretaceous is represented by a major unconformity which marks the top of the Jurassic system in Saskatchewan.

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Stratigraphy of Jurassic Type Localities of Northern United States and Correlation with Adjoining Areas

On the basis of faunal and lithologic correlations, Jurassic units can be traced northward from their type areas of the northern United States Rocky Mountains into southern Canada. The five-unit classification of the marine Jurassic in the Black Hills is useful in the subsurface for only a limited distance from the type area. The most useful nomenclature for subsurface work in the northern Rocky Mountains of the United States is probably that of the Ellis group of Montana. The Swift, Rierdon, and Piper units of the Ellis group can be correlated throughout most of the Western Interior United States. Within the central part of the Williston basin, however, these units are not yet recognizable on a lithologic basis alone, but micropaleontologic work indicates that these units may be distinguishable paleontologically.

The major tectonic elements affecting the marine Jurassic sedimentary pattern in the northern United States were the Belt island of western Montana, the Williston basin of North and South Dakota, eastern Montana, and southern Saskatchewan, and the Twin Creek trough of southeastern Idaho, central and northern Utah, and western Wyoming. Isopach maps indicate that several minor "positive" and "negative" elements were also present within the shelf area of Montana, Wyoming, western Colorado, and eastern Utah.

JURASSIC COMMITTEE

Cross Section: Jurassic Correlation in Western Canada Basin and Northern United States

The stratigraphic correlations herein proposed were prepared by a committee consisting of the following members: Hans Frebold (chairman), Miss D. M. Loranger (co-chairman), G. Blakslee, P. Chamney, M. B. Crockford, A. Klingspor, H. Lackie, W. D. MacDonald, R. Milner, J. Peterson, G. Springer, and Miss Ruth L. Thompson.

In Saskatchewan, the basal unit of the Mesozoic is the Watrous formation (Gypsum Spring). It is considered to be pre-Middle Bajocian and its lower beds might even be Triassic in age. The Watrous is overlain by the Sawtooth formation, which is equivalent to the Gravelbourg and part of the Shaunavon. The top of the Sawtooth is still under discussion, some favor placing it at the top of the upper Shaunavon. The Gravelbourg and the lower Shaunavon are equivalents of the Middle Bajocian Rock Creek member of the Fernie group. In the plains of Alberta and Saskatchewan the upper Sawtooth may include strata of Upper Bathonian age; however, no proof is currently available. The Montana and Alberta Rierdon formation represents the Lower Callovian. In Saskatchewan the lower Vanguard and perhaps a part of the upper Shaunavon are of the same age. In the Fernie group the Lower Callovian consists of the Gray beds, which are locally replaced by the facies of the *Corbula munda* and *Gryphaea* beds. In Saskatchewan the Oxfordian is represented by the middle and upper Vanguard which are equivalent to the Alberta and Montana Swift formations and to the Green beds and lower Passage beds of the Fernie group. The presence of an unconformity at the top of the middle Vanguard is possible. The sands of the middle Vanguard pinch out to the west toward the Sweetgrass arch.

Strata of Kimmeridgian age are represented in the Fernie group by at least part of the upper Passage beds. On a micro-paleontological basis, Loranger and others regard the uppermost part of the Vanguard formation as Kimmeridgian and consider this part of the section in the Alberta and Saskatchewan Plains as part of the Montana Morrison formation.

In the subsurface of the Peace River area the Jurassic is developed as Fernie group; the Nordegg member, the Toarcian and the Rock Creek member have been recognized on a lithological basis and

may be correlative with the Watrous, Sawtooth, Gravelbourg, and Shaunavon formations of the Plains. Higher parts of the Peace River subsurface Fernie may be correlated with the Rierdon, Swift, and Vanguard formations.

P. HARKER, Geological Survey of Canada, Ottawa, Ontario
Carboniferous of Western Canada, Extent and Salient Problems*

The outcrop of Carboniferous rocks in western Canada forms an almost continuous belt extending from the International Boundary to the Peace River and beyond. In the Rocky Mountains of Alberta, Carboniferous strata form the highest points of many of the mountains lying within the tectonic province of the eastern ranges. To the west they are overridden by Cambrian and other sediments; eastward, they disappear beneath the Mesozoic deposits in the complex structures of the Foothills; and are present in the subsurface of much of Southern Alberta.

Two of the major valleys which cut across the strike of the eastern ranges, the Bow and the Athabasca, gave early access to the pioneer geologists. G. M. Dawson first recognized the existence of Carboniferous strata in 1886 and a year later, McConnell published a stratigraphic subdivision of the great succession of Devonian and Carboniferous rocks in the Bow Valley. In later years McConnell's Lower Banff shales became the Banff formation and his Upper Banff limestone was renamed the Rundle formation by Kindle. From these early beginnings the Carboniferous succession in Alberta came to be subdivided into three somewhat loosely defined units, the Banff, Rundle, and Rocky Mountain formations. Paleontological studies have shown that strata representing the whole span of Mississippian time are present but there may be some gaps. Whether or not the Pennsylvanian is present is still an open question. Although the succession is not abundantly fossiliferous, the faunas offer some means of broad regional control. The Carboniferous seas were relatively shallow and of considerable extent, and correlation of lithological units deposited under these conditions could be expected to present many problems.

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Historical Review of Alberta Carboniferous Nomenclature

The early history of nomenclature has been adequately described by F. W. Beales (GSC, 1950).

P. E. Raymond working with the Harvard School in the Jasper area (Am. J. Sci., 1930) proposed the name Coronach for beds which he thought were in the Devonian but which were actually infaulted Carboniferous Banff equivalents. He proposed the name Bedson for rocks which he thought were at the base of the Carboniferous but which are actually Palliser (Upper Devonian). In another outcrop, the Banff and Rundle were recognized as separate units of Carboniferous age and grouped as the Moosehorn formation. None of these names has been used since.

Recent history has been plagued by names proposed informally, adopted with differing interpretations by numerous workers, and yet never given official status by publication and citation of a type locality. H. H. Beach (unpub., 1947) informally proposed the names Tunnel Mountain, Shunda, and Shunda and Dyson Creek as formations within the Rundle group. Later that year P. S. Warren divided the Rocky Mountain formation into Tunnel Mountain and Norquay members (unpub., 1947). L. M. Clark (AAPG, 1949) cited Beach's formations though he did not use them as his mapping units; W. B. Gallup (AAPG, 1951) used Beach's names in his paper on the Turner Valley field.

Beach intended his names to apply to rock units both in the Rocky Mountains and Foothills. But the beds to which he gave the same names in the two belts are not correlatable in the way he supposed. There is, therefore, a "mountain Tunnel Mountain," a "foothills Tunnel Mountain," and in this case also a "Warren's Tunnel Mountain"; a "mountain Shunda," and a "foothills Shunda," etc. Clark used the names in the "mountain" sense, Gallup in the "foothills" sense.

The Middle Banff (Warren, GSC, 1927) has been called "Clark's member" at the Gap in Bow Valley and this term has received wide currency on Canadian Stratigraphic Service logs for a rock unit beneath the Plains which is probably not correlatable with the Middle Banff in Bow Valley.

L. R. Laudon et al. (AAPG, 1949), working in NE. British Columbia, limited the name Rundle to the upper Rundle only; the lower Rundle he named Dessa Dawn formation, a term which was brought into Alberta by A. C. Spreng (AAPG, 1953).

R. A. C. Brown named the Greenock formation in the Jasper area (GSC, 1952) for beds which included equivalents of both the Upper Rundle and Rocky Mountain formations.

R. J. W. Douglas (ASPG, 1953) published a preliminary account of investigations in parts of the southern Foothills. He proposed the new formation names, Mount Head and Livingstone, each divided into a number of members, and named the Etherington member of the Rocky Mountain formation.

G. O. Raasch (privately circulated, 1954) introduced the name Storm Creek formation for the

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