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GEOGRAPHIC NAMES FOR MEMBERS OF THE BRULE FORMATION OF THE BIG BADLANDS OF SOUTH DAKOTA

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ABSTRACT. The Brule formation as it is exposed in the Big Badlands of South Dakota is divided into two members. The lower member, which includes a major part of the classic *Oreodon* beds, is designated the Scenic member and subdivided into two units; the upper portion, which includes the *Protoceras-Leptauchenia* beds, is designated the Poleslide member and subdivided into three units.

The Brule formation, defined by Darton (1899, p. 736), includes the part of the White River Oligocene which overlies the Chadron formation. A standard section was not specified, but classically these deposits were studied and described from the Big Badlands of southwestern South Dakota, the type area of the White River group. The Brule formation had originally been termed Turtle and *Oreodon* beds by Hayden (1857, p. 153) and *Oreodon* beds by Hayden (1867, p. 59) but was later subdivided by Wortman (1893) into the *Oreodon* beds (lower unit) and *Protoceras* beds (upper unit). The *Protoceras* beds have also been called the *Leptauchenia* beds and the *Protoceras-Leptauchenia* beds. All of these terms have become deeply rooted in Oligocene literature.

Schultz and Stout (1938) proposed the name Orella member for the lower or *Oreodon* portion and Whitney member for the upper or *Leptauchenia* portion of the Brule formation as it occurs in northwestern Nebraska. Oligocene outcrops do not continue unbroken between the Big Badlands and the closest exposures in Sioux County, Nebraska. Toadstool Park, which lies just west of Orella Station, Sioux County, Nebraska, is more than 50 miles from the nearest complete Brule section in South Dakota. The scattered intermediate outcrops are of such limited vertical and linear extent as to make them of little stratigraphic use.

The lithology of the Brule formation, as displayed in the Scenic Basin of the Big Badlands, has a remarkable uniformity over a large area. But regardless of this, there is often considerable lateral variation in composition, structure, texture, color, and hardness of the strata. Numerous areas exhibit gradual changes in lithology but in other places changes are extreme over very short distances. The greater and more abrupt variations in lithology occur mainly in the north-south rather than the east-west direction. This would seem normal since several roughly parallel Oligocene streams flowed in an easterly direction, depositing their sediments in more or less separate areas. The streams may have risen in the same general region but their loads were composed of different or varying percentages of numerous types of source rocks. The load, volume, and velocity of a stream determine the physical aspects of its deposits. These factors cannot be identical in two or more stream systems. Therefore the clays, sandstones, concretions, kinds and amounts of cementing materials, etc., of the Oligocene badlands, as we find today, are not identical over very great distances. It is not surprising, then, that lithologic

correlations between member units within the Brule formation have not been made with any degree of accuracy among widely spaced areas. The lithologic boundaries of the Nebraska Oligocene do not appear to correspond closely with the lithologic boundaries of the South Dakota Oligocene. It is problematical whether exact correlations can ever be made.

Wortman, in making his subdivision of the strata of the Big Badlands, considered the boundary between the *Oreodon* beds and the *Protoceras* beds to be approximately 100 feet of barren, light-colored clays. Wanless (1923, p. 226) recognized this division but placed the contact at a "light weathering band" which occurs occasionally in the upper part of these clays.

Most field workers in recent years have attempted to follow the classification of Wanless and, in order to more closely tie in the fauna, have used a subdivision of the *Oreodon* beds into lower, middle, and upper zones. The lower and middle zones have been easily recognized as the lithology and the boundaries are uniform and distinct. However, the extent of the upper unit (upper *Oreodon* bed) has always been exceedingly difficult to determine because of locating the upper limit, i.e. the "light weathering band." This light gray band is oftentimes absent or, if present, poorly defined. Quite frequently several similar bands exist near the proximity of the contact. This makes it almost impossible, even for a worker experienced in the region, to determine with any precision the correct boundary marker.

The *Protoceras* channel sandstones produce a fauna that has long been considered Whitneyan in age. In at least one area of the Big Badlands these channels cut into the "upper *Oreodon* beds" to a depth of more than 30 feet. This should present no age problem but some workers have considered the fauna of these lower channels as of Orellan age.

It seems essential at this time to designate standard sections and assign geographic names for the subdivisions of the Brule formation of the Big Badlands of South Dakota, which have, in part, been recognized as members. These fall, respectively, within the Orellan and Whitneyan provincial ages as established by Wood et al. (1941), which, in intention, were defined primarily by the faunas of these two units.

The unit formerly known as the *Oreodon* beds (Wortman), minus the upper *Oreodon* bed, is hereby designated the Scenic member. The following standard section is in the SW¼ Sec. 23 T. 3 S. R. 13 E., two and two-tenths miles south of Scenic, Pennington County, South Dakota.

Feet	Description
	Upper Nodular Zone
12	Light cream-colored clays with narrow layer of fossiliferous clay-lime concretions. Lime content of latter higher than in those of the lower nodular zone and with little oxidation on their surfaces. Overlain by upper Brule clays.
22	Gray clays with scattered and rounded silt concretions containing few fossils. Near-vertical weathering.
89	Mostly gray clays but with irregularly spaced brown banding and containing bedded, lens-shaped silt concretions. Fossils rare.

Lower Nodular Zone

Feet	Description
36	Pink-gray clays weathering on the surface to brown-gray color. Contains numerous clay-lime concretions which oxidize to rusty color on surface. Highly fossiliferous. Underlain by Chadron limestone and clays.

The Chadron-Brule contact is easily identifiable here and the lower and upper concretions are well developed. *Metamynodon* channel sandstones are absent but occur two miles to the south. This member is conveniently divided into two units: the lower and upper nodular zones. There has never been any difficulty in recognizing the lower nodular zone; its lithology is remarkably uniform throughout the Big Badlands. This is also true of the upper nodular layer, and thus the Orellan-Whitneyan contact may be located without difficulty.

The unit known as the *Protoceras* beds (*Leptauchenia* beds) is designated the Poleslide member. The standard section is in the NW¼ Sec. 23 T. 43 N. R. 44 W., eight and one-half miles south of Scenic, South Dakota and on the south rim of Sheep Mountain Table, Shannon County, South Dakota.

Feet	Description
	Upper Zone
85	Gray silty ash. Horizontal bedding. Weathers in vertical walls and columns. Overlain by basal Arikaree white ash (Rosebud of Matthew).
	Middle Zone
111	Buff and gray-colored clays. *Protoceras* channel sandstone at several levels in upper 40 feet but not within 10 feet of upper gray ash. Sandstones highly fossiliferous. Clays moderately fossiliferous.
	Lower Zone
13	Light gray color with narrow brown band above and below (Light weathering band of Wanless).
90	Gray clays with brown hue. Least fossiliferous horizon of the Brule formation. Underlain by the upper nodular zone.

Few sections in the Big Badlands display this member so adequately. The upper gray ash beds and *Protoceras* channel sandstones are especially well developed and exposed. The *Leptauchenia* nodules, which constitute an important feature of the middle member in many sections, are absent but may be found a mile to the north on the west wall of the Table.

This member may be subdivided into three units. The lower zone includes approximately 100 feet of rather barren clays, capped with a light gray clay band as recognized by Wanless. The middle zone is that section where *Leptauchenia* nodules are developed and, in most instances, where channel sandstones are found. The upper unit is composed of vertically weathered silty ash. The contrasting lithology and weathering characteristics

of each unit make it usually possible for anyone to establish his position even though he may be unable to locate the exact boundary for the unit.

Lithologic units within a formation present rather broad chapters of the history of that formation. These afford a means by which paleontological evidence may be more accurately recorded. Thus, of prime importance are reliable boundary markers within the formation. The members and subdivisions of the Brule formation of the Big Badlands of South Dakota, as here designated and defined, fulfil these requirements.

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