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ROSEBUD FORMATION IN SOUTH DAKOTA

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ROSEBUD FORMATION IN SOUTH DAKOTA[1]

by

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INTRODUCTION

Following the publication of a report on the early Miocene faunas of the Wounded Knee area (Macdonald, 1963) the South Dakota Geological Survey has continued its mapping program in the Tertiary area of southwestern South Dakota. No change has been made to date in the interpretation of the stratigraphic relationships in the Wounded Knee area. However, since the 1963 report some controversy has developed in the concept of the Rosebud Formation and its age in the type area on the Rosebud Indian Reservation.

Recently Skinner and Taylor (1967), in a discussion of the geology and paleontology of the Bijou Hills, designated a type section for the Rosebud Formation. Skinner and Taylor (1967, p. 12) did not describe or discuss their section but stated:

> "In the interest of nomenclatural stability, we selected as the type section of the Rosebud Formation the only set of exposures mentioned by Gidley that can be locally identified. These exposures are in the vicinity of the Rosebud Agency buildings on both sides of Rosebud Creek in the E. $\frac{1}{2}$ sect. 34 and the W. $\frac{1}{2}$ sect. 35, T. 38 N., R. 30 W., Todd County, South Dakota, where some 100 feet or more of pink sandy sediments are exposed below overlying Pliocene deposits."

The section selected by Skinner and Taylor (1967) represents only a fraction (about 1/3) of the total thickness of the Rosebud Formation present in this area. In addition the base of the formation is not exposed at this locality and this further confuses the issue as the upper contact is an eroded surface. Thus the "nomenclatural stability" of this designation is not readily apparent and selection of this vitally restricted exposure as the type section greatly restricts the traditional interpretation of the Rosebud Formation.

Therefore, the writers propose that the type section designated by Skinner and Taylor (1967, p. 12) be considered invalid. We also propose that the type section for the Rosebud Formation be located in secs. 27 and 28, T. 39 N., R. 30 W., Todd County, South Dakota.

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HISTORY OF THE ROSEBUD FORMATION

The name "Rosebud Beds" was first used by J. W. Gidley (1904) to delimit a series of beds on the Rosebud Indian Reservation, Todd County, South Dakota. He stated:

> "The lower formation above mentioned, for which we propose the local term Rosebud Beds, is best exposed along the Little White River and in the vicinity of the Rosebud Agency. These beds closely resemble portions of the upper Oligocene beds, both in character and general appearance, except that they contain a little more sand. In certain exposures an examination of the fossils contained in the beds is necessary to determine their horizon."

Matthew (1907) applied the name "Rosebud" to strata in the Wounded Knee and Porcupine Creek drainages of southwestern South Dakota. In doing so he referred approximately 600 feet of sediments to the Rosebud Formation but divided it into upper and lower units. As discussed in Macdonald (1963) the lower Rosebud included the upper part of what is now called the Sharps Formation, the Monroe Creek Formation, and part of the Harrison Formation. The upper Rosebud included the upper part of the Harrison Formation and the lithic equivalent of the Rosebud Formation as exposed along the Little White River. Osborn (1909 and 1918) followed Matthew (1907) in this twofold division but in figure 10 (1909) and in figure 8 (1918) he showed the Rosebud Formation to extend from late Oligocene into the early part of the middle Miocene. He believed the Rosebud was time equivalent to the top of the Brule Formations in Nebraska and extending slightly into the middle Miocene for which he showed no equivalents. Usage has thus established that the term Rosebud Formation refers to all the pink sediments above the Brule and below the Ogallala Formations which are exposed along the Little White River near Rosebud Agency and to the westward extension of these beds into the Wounded Knee Creek area.

Schultz (1938) proposed the name Marsland Formation as a replacement name for the inappropriate "upper Harrison" in western Nebraska and dismissed the Rosebud Formation as a generalized and indefinite name for deposits in the vicinity of the Rosebud Agency.

Until the senior author began working in the Wounded Knee area in 1953 little attention, except for sporadic collecting, had been paid to the area since Matthew's paper of 1907. The name Rosebud remained in use and may be found in both Simpson (1933) and Wood and others (1941) where it was applied to the rock units in Matthew's expanded usage.

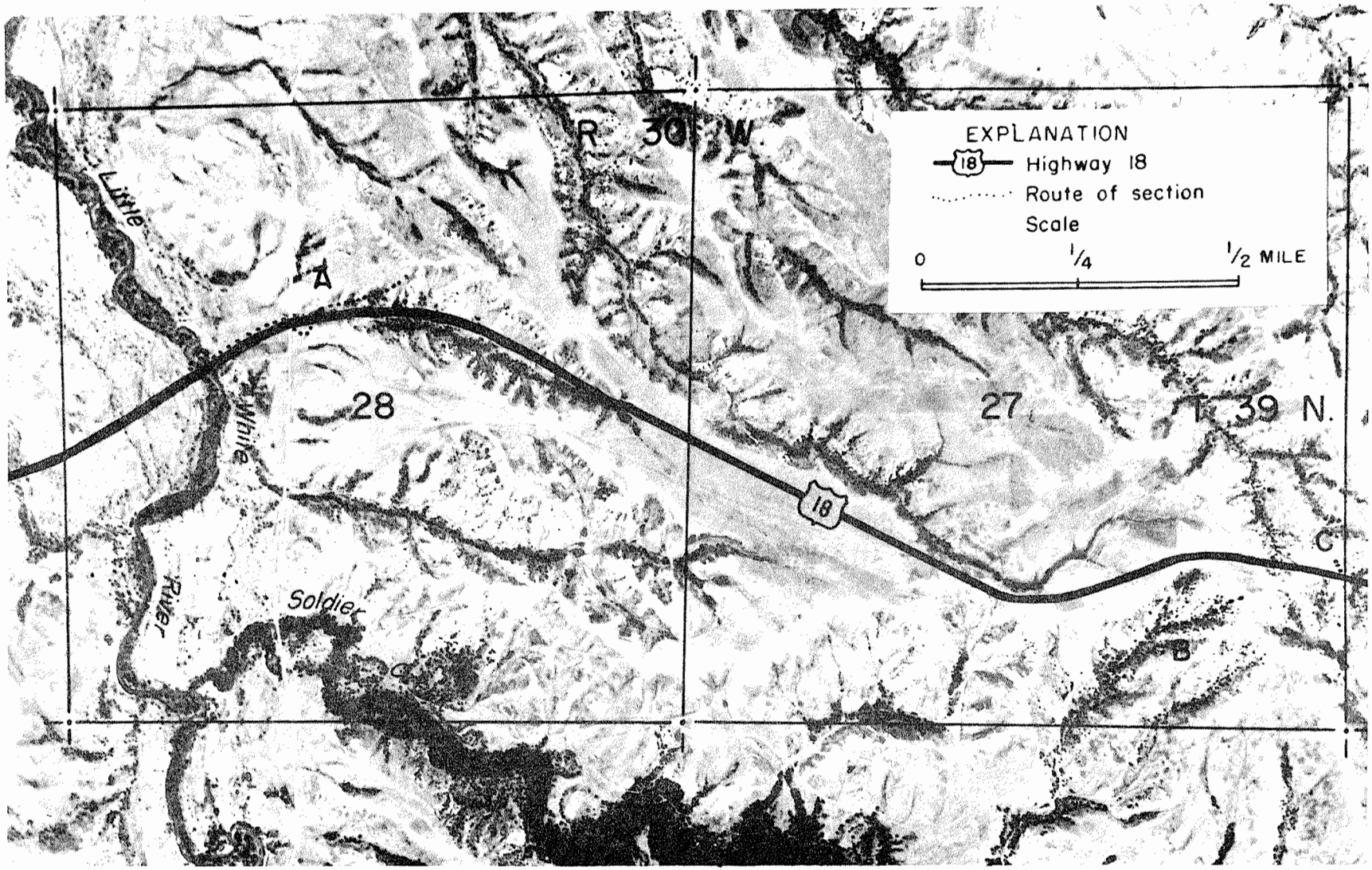


Figure 1. Areal photograph showing (dotted line) the route taken in measuring the columnar section presented in figure 2 and table 1. The section at point "c" is not presented in table 1 but is presented in figure 2 as at this point the Rosebud-Ogallala contact is immediately adjacent to Highway 18 and can be reached by all interested parties.

In the late 1950's the South Dakota Geological Survey began mapping the Tertiary geology of south-central South Dakota at the scale of one inch to the mile. Agnew (1957) in mapping the White River quadrangle (some 15 miles from the type area of the Rosebud Formation) apparently did not make a thorough study of the literature and renamed the Rosebud Formation in the White River quadrangle the Mellett Formation. Sevon carried on the mapping program in this general area and he changed the Mellett from a formation to a facies of the Arikaree (Sevon, 1959). This change was followed in later publications of the South Dakota Geological Survey (Sevon, 1960; Agnew, 1963; Agnew and Tychsen, 1965). In addition some limestone beds in the Monroe Creek Formation north of Martin were mapped as Mellett by Collins (1960) and Sevon (1960) mapped the Rosebud of the type section area as Arikaree. It remained for Assad Barari (1967) in a report on ground water for the city of Mission to be the first to clearly map the Rosebud Formation of the type area as Rosebud Formation.

In work in the Wounded Knee and Porcupine Creek area Harksen, Macdonald and Sevon (1961) named the Sharps Formation which included a part of the lower portion of Matthew's lower Rosebud. Harksen (1960) and Macdonald (1963) separated the Monroe Creek and Harrison Formations from Matthew's extended use of the Rosebud.

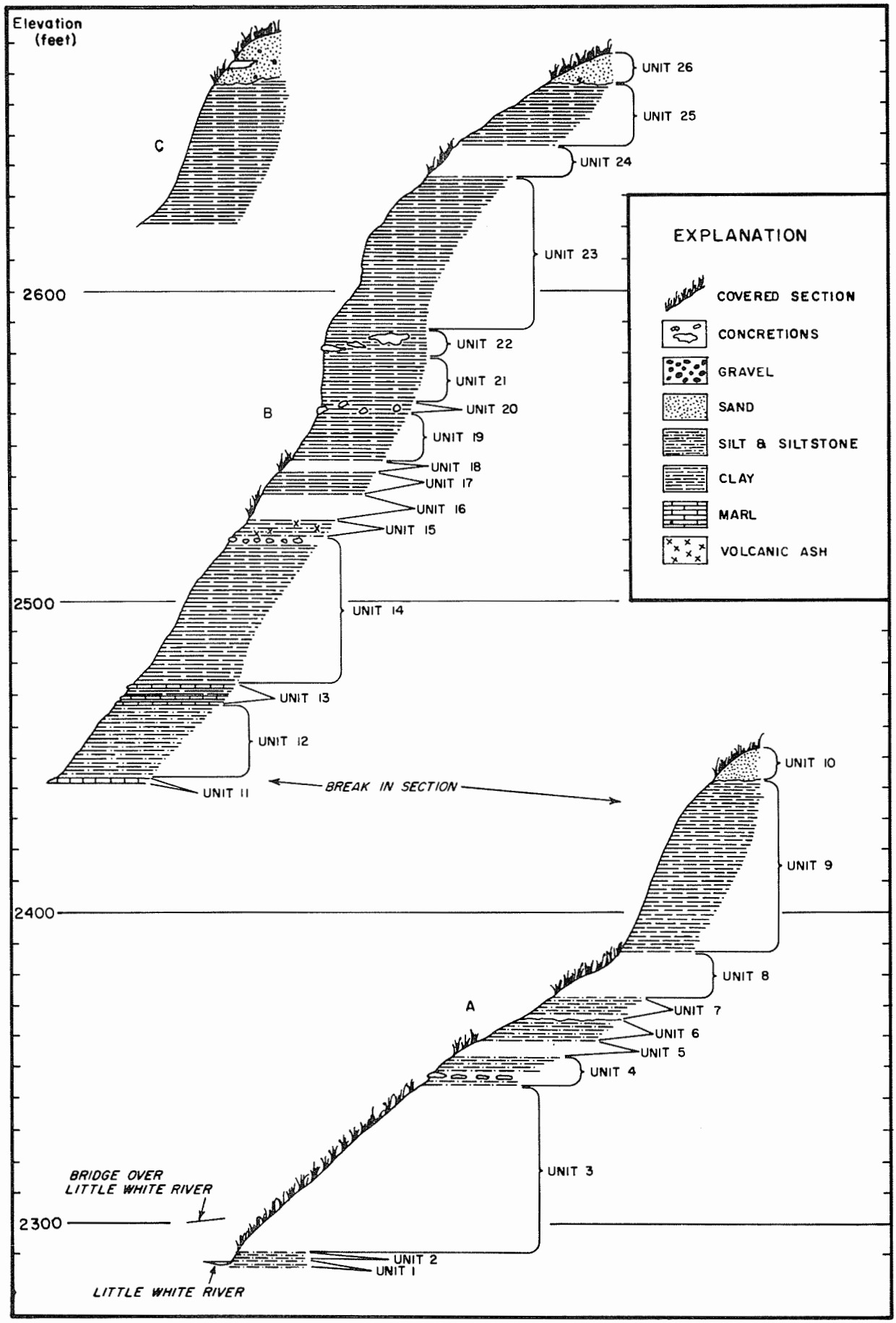
Work to date has resulted in a reduction of Matthew's expanded Rosebud to the lithic equivalent of the Rosebud along the Little White River in the Rosebud Agency area. It is believed that the Marsland Formation of western Nebraska is a junior synonym of the name Rosebud as proposed by Gidley and as used by the writers and their associates. The only "nomenclatural stability" that would result from the restriction of the name Rosebud Formation to a minor part of the Rosebud Agency section as proposed by Skinner and Taylor (1967) would be the conservation of the name "Marsland Formation" which is of a very recent vintage and has certainly had a controversial history as outlined by McKenna (1965).

PALEONTOLOGY OF THE ROSEBUD FORMATION

The lithic unit named "Rosebud beds" by Gidley (1904) for exposures along the Little White River near the Rosebud Agency in Todd County, South Dakota, extends westward into and beyond the Wounded Knee area. Identifiable fossils are rare in Gidley's lithic unit. The identifiable remains recorded by Gidley (1904, p. 246) as determined by later reviews are:

Promylagaulus cf. riggsi (McGrew, 1941, p. 9)
Capatanka brachyceps (Matthew) (Macdonald, 1963, p. 146)
Merychyus arenarum Cope (Schultz and Falkenbach, 1947, p. 186)

Figure 2. Columnar section of the type section of the Rosebud Formation in secs. 27 and 28, T. 39 N., R. 30 W., Todd County, South Dakota. The route of the measured section is shown in figure 1. Part "C" of this section is not included as part of the type section but is included because it is a good exposure which is immediately adjacent to Highway 18 and can be seen from the highway and visited by any interested party. The unit numbers used here are the same as used in table 1.


Elevation (feet)
C
B
A
UNIT 26
UNIT 25
UNIT 24
UNIT 23
UNIT 22
UNIT 21
UNIT 20
UNIT 19
UNIT 18
UNIT 17
UNIT 16
UNIT 15
UNIT 14
UNIT 13
UNIT 12
UNIT 11
UNIT 10
UNIT 9
UNIT 8
UNIT 7
UNIT 6
UNIT 5
UNIT 4
UNIT 3
UNIT 2
UNIT 1
2600
2500
2400
2300
BREAK IN SECTION
BRIDGE OVER LITTLE WHITE RIVER
LITTLE WHITE RIVER
EXPLANATION
COVERED SECTION
CONCRETIONS
GRAVEL
SAND
SILT & SILTSTONE
CLAY
MARL
VOLCANIC ASH

Promylagaulus cf. riggsi is identical with a jaw (S. Dak. School of Mines 6277) from the Wounded Knee-Monroe Creek fauna. Capatanka brachyceps is a Monroe Creek or Harrison form in the Wounded Knee fauna. Merychyus arenarum is from the "Lower Marsland" fauna of Schultz and Falkenbach. However, the latter specimen did not come from Gidley's type but from rocks exposed near Big Spring Canyon in Bennett County where we also find the remains of Desmathyus pinensis, a Wounded Knee-Rosebud peccary.

In 1964 two oreodont skulls were found by the authors about 100 feet above the base of the Rosebud Formation along the Little White River in the type area. The skulls have been identified by Malcolm McKenna and Morris Skinner as cf. Desmatochoerus wyomingensis and D. geringensis. These two species are known from the Sharps Formation in the Wounded Knee area; therefore, it is suggested by McKenna and Skinner (personal communication) that the Rosebud Formation of the type area is not the same as the lithic unit named the Rosebud Formation near Big Spring Canyon in Bennett County, and in the Wounded Knee area. In 1966 a maxillary of Leptocyon cf. vafer was found near the top of the Rosebud Formation to the west of the village of By-the Way, on U. S. Highway 18; this further confuses the interpretation of the formation's age, as present records indicate this species is no older than late Miocene or Barstovian.

All specimens referred to above, exclusive of those in Gidley's list, indicate an age of the Typical Rosebud beds, in the type area, that ranges from Sharps time (early Arikareean) into possibly the Barstovian. Fossil and lithic facts suggest that the Rosebud Formation represents an expanding depositional environment resulting from localized conditions of deposition and climate. The fossil evidence shows this condition lasting for much of the Miocene in the type area and spreading westward into the Wounded Knee area and southwestward into Nebraska at the beginning of Hemingfordian time.

Skinner (personal communication) reports that an unnamed lithic unit carrying typical Harrison fossils overlies the Rosebud at Turtle Butte, some 35 miles southeast of the Rosebud type area, but this fact does not mean that all of the Rosebud Formation is older than the Harrison Formation. It is quite conceivable that such pockets of sediments could exist within the zone of Rosebud deposition. Lateral variation in continental sediments is not unknown.

It is possible to differentiate the formations represented to the west, from the Rosebud Formation in the type area, as different depositional environments are involved. Thus the term "Rosebud Formation" is used for the entire lithic sequence in the Rosebud Agency area, and for the same lithic unit elsewhere in southwestern South Dakota where it happens to represent a restricted portion of Hemingfordian time.

STRATIGRAPHY OF THE ROSEBUD FORMATION

The writers doubt that the designation of a type section for the Rosebud by Skinner and Taylor (1967, p. 12) meets the minimum qualifications as set forth by the American Commission on Stratigraphic Nomenclature (1961) and should be treated as nonexistent. We feel that the type section is more

Figure 3. Photograph showing the diagnostic nodular weathering of an exposure of Rosebud in sec. 23, T. 38 N., R. 31 W., Todd County, South Dakota. The pick is 12½ inches long.

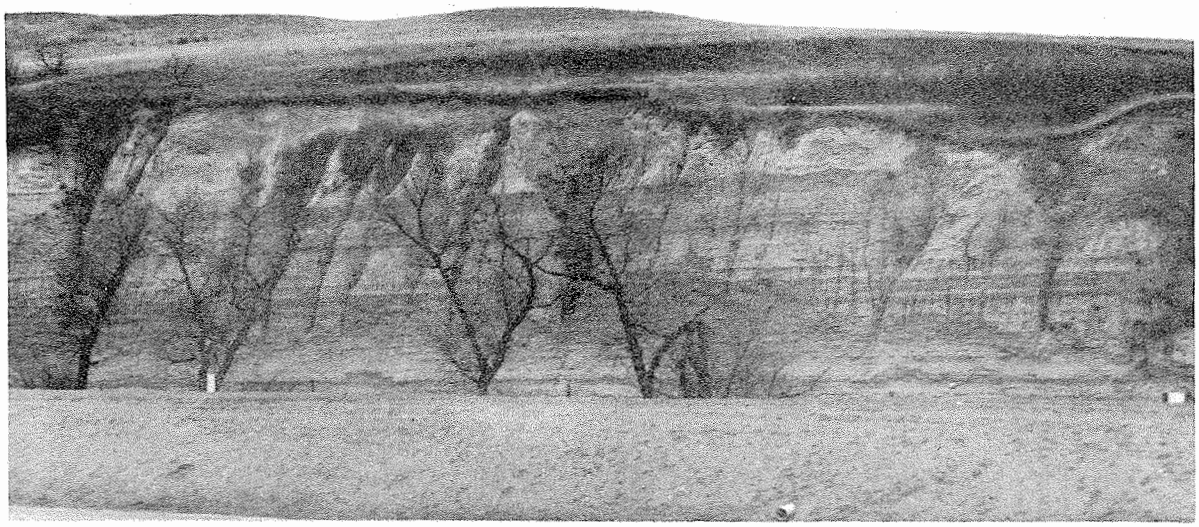


Figure 4. Exposure of the Rosebud Formation directly to the west of both the Little White River and the sewage lagoon at the Soldier Creek housing project. Undercutting by the Little White River has caused the vertical exposure.

Figure 5. Photograph showing the extent of the unconformity between the Miocene Rosebud Formation and the Pliocene Ogallala Formation in sec. 4, T. 38 N., R. 30 W., Todd County. The arrow points to a man standing to the left of exposures of Rosebud. The stream between the camera and the man is cutting down through the Ogallala Formation.

Table 1.--Rosebud type section

This section of Oligocene, Miocene, Pliocene and Quaternary rocks was measured in secs. 27 and 28, T. 39 N., R. 30 W., Todd County, South Dakota. This section was measured along Highway 18 in the areas indicated on figure 1 of this report. The unit numbers used here correspond to those on figure 2.

Unit		Feet
PLIOCENE - Ogallala Formation		
26	Section covered, but some very poor exposures of sand, light-gray to light greenish-gray, fine to medium, unconsolidated.	10
	Total thickness Ogallala Formation	10
	The Ogallala rests unconformable on top of the Rosebud Formation. The unconformity represents a great deal of time and in places the unconformity may represent several hundred feet of relief in several hundred feet of horizontal distance. The contact is placed at the confluence of the gray sands of the Ogallala and the pink clays of the Rosebud.	
MIOCENE - Rosebud Formation		
25	Clay, rosy-tan, noncalcareous; many small (almost microscopic) hollow reed-like openings which may represent paleo-rootlet holes; many nodules and crack-fillings of pink montmorillonite; weathers to a nodular surface.	20
24	Section covered.	10
23	Clay, rosy-tan, noncalcareous; bedding quite obvious toward the base of this unit while the upper part is massive; many small (almost microscopic) hollow reed-like openings which may represent paleo-rootlet holes; many nodules and crack-fillings of pink montmorillonite, weathers to a nodular surface.	50
22	Clay, silty, tan, well compacted, noncalcareous; contains tan, highly calcareous massive ledgy concretions and nodules of pink montmorillonite; weathers to a nodular surface.	7
21	Same as above only without the concretions.	15
20	Clay, silty, tan, well compacted, noncalcareous, massive, nodules of pink montmorillonite and many randomly spaced, tan, nodular (to 8 inch diameter) highly calcareous concretions; weathers to a nodular surface.	4

Unit		Feet
19	Same as above only no concretions.	15
18	Section covered.	4
17	Clay, pink, noncalcareous, massive; grades upward into a pink, silty clay.	7
16	Section covered.	9
15	Silt, tan, high percentage (40% ?) of volcanic ash, poorly consolidated, massive; insects have dug many holes in the surface of this exposure.	15
14	Clay, rosy-tan, lighter toward the top of this unit, noncalcareous; many small hollow reed-like openings are present as well as nodules, cracks, and root holes which have been filled with pink montmorillonite; the weathered surface is nodular with the surface rapidly breaking down into sand-sized or smaller particles; this unit is capped with a layer of gray tabular calcareous concretions.	46
13	Clay, light yellowish-green, waxy; some silt and veins and sand-sized nodules of calcite; many veins of pink montmorillonite; several 2-inch layers of calcareously cemented tan silty clay with veins of pink montmorillonite and clear calcite weathering out in relief.	5
12	Silt, grayish-tan, some volcanic ash, noncalcareous, massive; some nodules of pink montmorillonite; weathers blocky; upper part of this unit is in part covered.	$26\frac{1}{2}$
11	Silt, tan, calcareously cemented; weathers into a prominent ledge. The bottom of this unit is at an elevation equal to the top of unit 9.	$1\frac{1}{2}$

BREAK IN SECTION

QUATERNARY - Terrace deposits

10	Section covered. A moderate grass-covered slope with some very poor exposures of poorly sorted brown sand.	10
	Total thickness Terrace deposits	10

The terrace deposits rest unconformable on top of the Rosebud. The contact is placed at the base of the brown sands and at the top of the pink clays.

Unit		Feet	
MIOCENE - Rosebud Formation			
9	Clay, light rosy-tan but ranging from brick-red to light grayish-green, occurring as massive splotches, noncalcareous, massive bedding; many small to microscopic hollow reed-like openings which may represent paleo-rootlet holes. The weathered surface is nodular with many light lines, representing clay-filled cracks, zig-zagging across the outcrop; weathers to sand-sized and smaller particles. The top of this unit is at an elevation equal to the bottom of unit 11.	55	
8	Section covered.	15	
7	Siltstone, pinkish-tan, calcareous, massive; weathers to a powdery sruface.	8	
	Total thickness Rosebud Formation		303
	Rosebud rests unconformably on the Brule with the contact placed at the base of the massive pink non-calcareous clays that weather to a nodular surface and contain pink montmorillonite and at the top of the bedded pink calcareous silts and clays. Local reworking of the Brule sediments to form the Rosebud makes the contact hard to define with certainty.		
OLIGOCENE - Brule Formation			
6	Siltstone, pinkish-tan, calcareous, bedded; weathers blocky.	6	
5	Section covered	6	
4	Siltstone, pinkish-tan, calcareous, bedded; layers of tabular sandy calcareous grayish concretions that have a wormy appearance; weathers to a very irregular surface.	10	
3	Section covered.	53	
2	Clay, light-tan with brown mottling, many small flakes of muscovite, calcareous, massive; breaks with a hackey fracture.	1	
1	Siltstone, light-tan, calcareous, flat-bedded; blocky weathering, crops out adjacent to the Little White River.	1	
	Total thickness Brule Formations exposed		77

realistically located in secs. 27 and 28, T. 39 N., R. 30 W., Todd County, South Dakota. The section here not only is more in accordance with the concept of Gidley (1904) in that "along the Little White River" has word priority over "in the vicinity of Rosebud Agency" but also shows the thickness, contact relationships, and morphological expression of the unit -- criteria which are indispensable in the descriptions of most lithic units.

The Rosebud Formation in the type section area (fig. 1) consists of approximately 300 feet of pink silts and clays (fig. 2). It unconformably overlies the Oligocene Brule Formation and is unconformably overlain by the Pliocene Ogallala Formation. While the Rosebud ranges from gray silts to tan, highly calcareous concretionary ledges, it is usually represented by a rosy-tan noncalcareous clay with many small to microscopic reed-like openings, nodules and crack fillings and root hole fillings of pink montmorillonite. Exposures weather to a nodular surface (fig. 3) while in megascopic inspection the exposures are crescent-shaped with the points of the crescent pointing down slope. Exposures of the Rosebud usually look much like slumps. One exception to this is the exposure of Rosebud shown in figure 4 which has been undercut by the Little White River.

Table 1 presents the measured section of the Rosebud type section. This section is 303 feet thick. In this area both the underlying and overlying contacts are unconformable and represent considerable relief. Figure 5 shows one area where nearly 200 feet of relief is present between the Ogallala and the Rosebud.

The Code of Stratigraphic Nomenclature (American Commission on Stratigraphic Nomenclature, 1961) states that the "type section cannot be changed." However, the code is equally emphatic in delineating procedures which must be followed to establish formal units. The writers feel that Skinner and Taylor did not meet the minimum qualifications for establishing a type section and feel that there will be a better understanding of the Rosebud now that the type section is in secs. 27 and 28, T. 39 N., R. 30 W., Todd County, South Dakota.

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