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RED DOG LOESS NAMED IN SOUTHWESTERN SOUTH DAKOTA

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INTRODUCTION

For well over a century the White River Badlands of South Dakota have been studied and collected by a great number of geologists and paleontologists. The first fossil reported from this region was described by Hiram Prout (1846) and since that time few field seasons have passed without one or more field parties spending a few days, or a summer, collecting fossils or studying the geology of this scenic, sparsely populated region. O'Harra (1920) writes of the early exploration of this area.

While the geology of the Badlands ["badlands" when capitalized refers to the White River Badlands, or Big Badlands, of South Dakota (Macdonald, 1951)] has been intensively studied for over a century, the great majority of the work has been on the Oligocene and Miocene Strata while the Quaternary Strata has been ignored. Only a few geologic reports [for example Todd (1898), Wanless (1923), Ward (1922), and Harksen (1966, 1967)] go beyond mentioning the fact that Quaternary deposits do exist in southwestern South Dakota. Very little is now known of the Quaternary history of this area.

It is not the purpose of this paper to present the Quaternary history of southwestern South Dakota nor to review the meager literature on this subject, but simply to give notice of a new stratigraphic unit and some comments on the interpretation of this new unit.

ACKNOWLEDGMENTS

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All interpretations and opinions presented in this paper are those of the writer and are not necessarily those of the people who helped in the writing or editing of this report.

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RED DOG LOESS, new name

The midwestern United States is blanketed by broad, discontinuous deposits of Quaternary loess (Kansas Geological Survey, 1964; Lugn, 1962; Reed and Dreeszen, 1965, Frye and others, 1963; Thorp and Smith, 1952). The State of Nebraska contains strata representative of some eleven named deposits of loess (Reed and Dreeszen, 1965). Although the loess deposits of southwestern South Dakota are probably temporal equivalents and possibly lithic equivalents of one or more of the Nebraska units, the writer feels that it is abject foolishness to attempt to correlate at this time with the information presently available. Giving the South Dakota loess units Nebraska names without considerably more research would not only add to the confusion but may tend to corrupt the names now in use.

Simpson (1945, p. 1) states, "It is impossible to speak of the objects of any study, or to think lucidly about them, unless they are named." Therefore I propose a new stratigraphic name to be applied to certain deposits of Quaternary loess as outlined later in this paper. The name will allow, and hopefully instigate continued research and refining of stratigraphic terminology concerned with the loesses of South Dakota. Later if it is found that these beds are part of a previously named unit, the name can readily be relegated to synonomy. With this in mind the RED DOG LOESS is hereby proposed as a formal stratigraphic unit (American Commission on Stratigraphic Nomenclature, 1961).

The Red Dog Loess is named from exposures on Red Dog Table (fig. 1). The type section is located in the SE¼ sec. 35, T. 40 N., R. 46 W., Shannon County, South Dakota. At the type section the Red Dog Loess is 58 feet thick. It is overlain by soil zones and "lip loess" corresponding to the cliff dunes of White (1960) and underlain by 30 feet of quaternary terrace deposits (mostly sand and silt) which lie unconformably upon the *Protoceras* channels of the Oligocene Brule Formation (see figs. 2 and 3). The Red Dog Loess is a silt, tan, sandy, massive, poorly consolidated, calcareous, vertical weathering; no contained fossils have been found. The top of the loess is placed at its contact with the base of the soil zone shown on figure 3. The base of the loess is placed at its contact with a two foot thick sand which at the type section marks the top of the terrace deposits. Figure 4 shows the clastic size percentages and the carbonate percentages of each one-foot interval of the Red Dog Loess at the type section.

PHYSICAL SETTING

Red Dog Table is located between the White and Cheyenne Rivers (fig. 5) in the Badlands of northern Shannon County, Pine Ridge Indian Reservation, South Dakota. This region has some classic examples of badland topography and as could be expected, it is very difficult to cross except with horse or jeep. Vertical exposures 200 feet high are not unusual in this area.

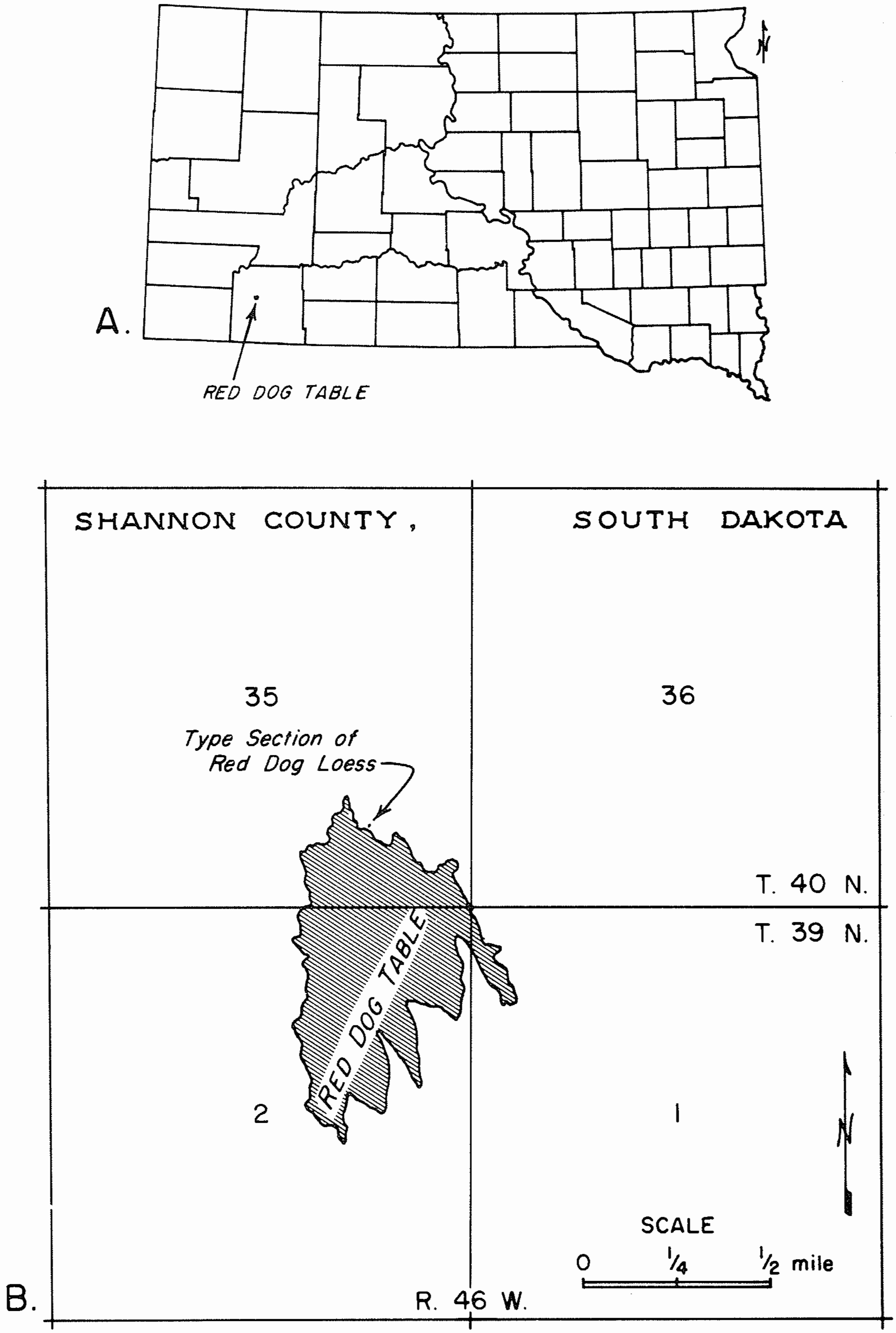


Figure 1. Index maps. A. Showing the location of Red Dog Table on a county outline map of South Dakota.
B. Showing the location of the type section of the Red Dog Loess in reference to Red Dog Table itself.

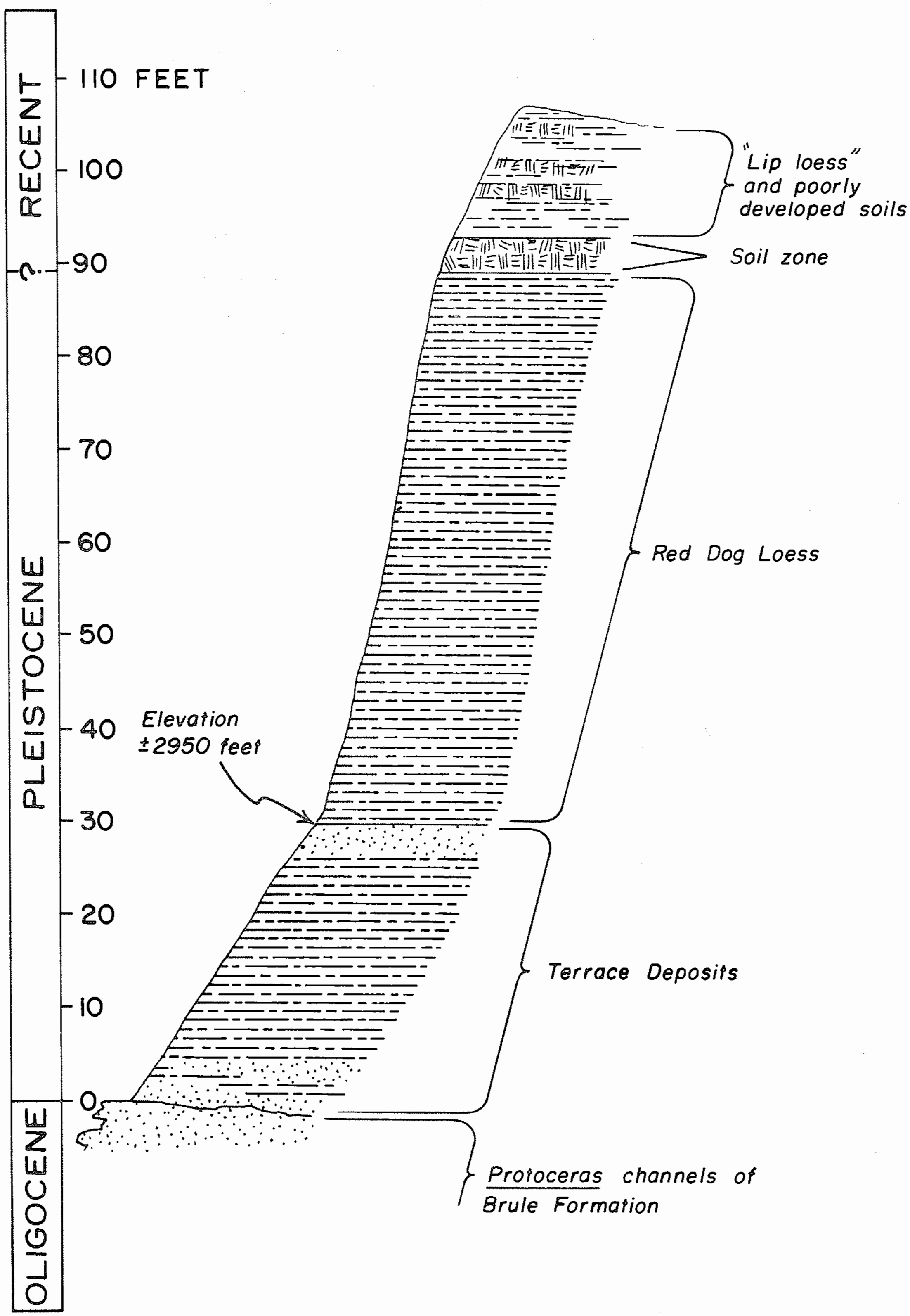


Figure 2. Columnar section of the type section of the Red Dog Loess SE¼, sec 35, T. 40 N., R. 46 W., Shannon County, South Dakota.

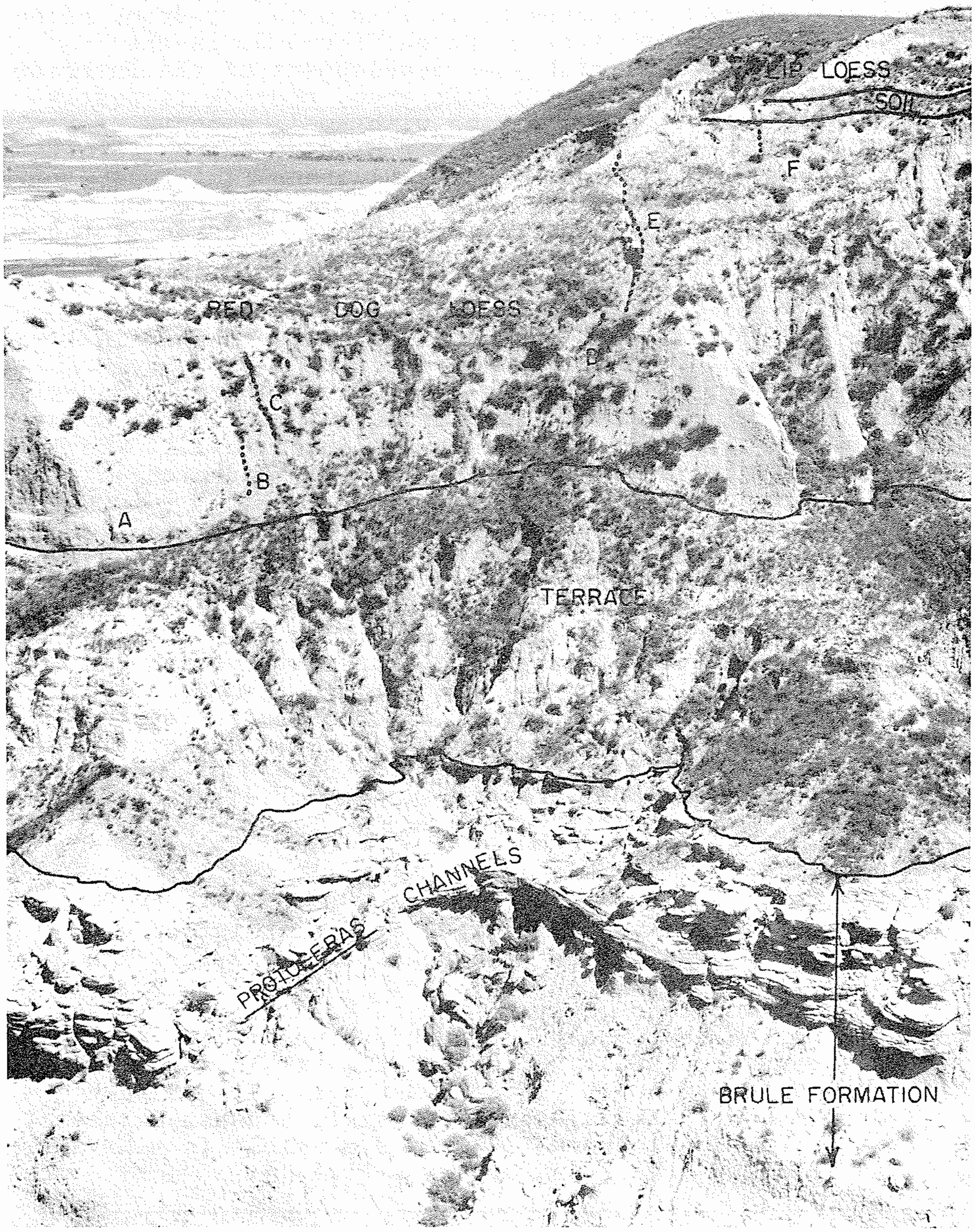


Figure 3. Photograph of the type section of the Red Dog Loess. The dotted lines indicate where the section presented in figure 2 was taken and where samples, the analyses of which are presented in figure 4, were collected. The letters with the dotted lines correspond to the suite lettering of figure 4.

Exposures of sedimentary rock ranging in age from Late Cretaceous to Recent are present in this area. Bedrock along the western edge of the area shown on figure 5, is the Cretaceous Pierre Shale with some development of the Interior Paleosol. In the remainder of this area, bedrock is mostly the Late Oligocene Brule Formation with small amounts of Early Oligocene Chadron Formation and Early Miocene Sharps Formation.

Frye (1948, p. 599) discusses the Pliocene-Pleistocene boundary in the Great Plains and says: "In this region the most profound change in physical conditions occurred at the culmination of Ogallala deposition when regional upward accumulation of clastic sediments gave place to intermittent erosion and deposition in local areas, which developed a thick section of sediments only locally where trapped in downfaulted or solution-subsidence areas."

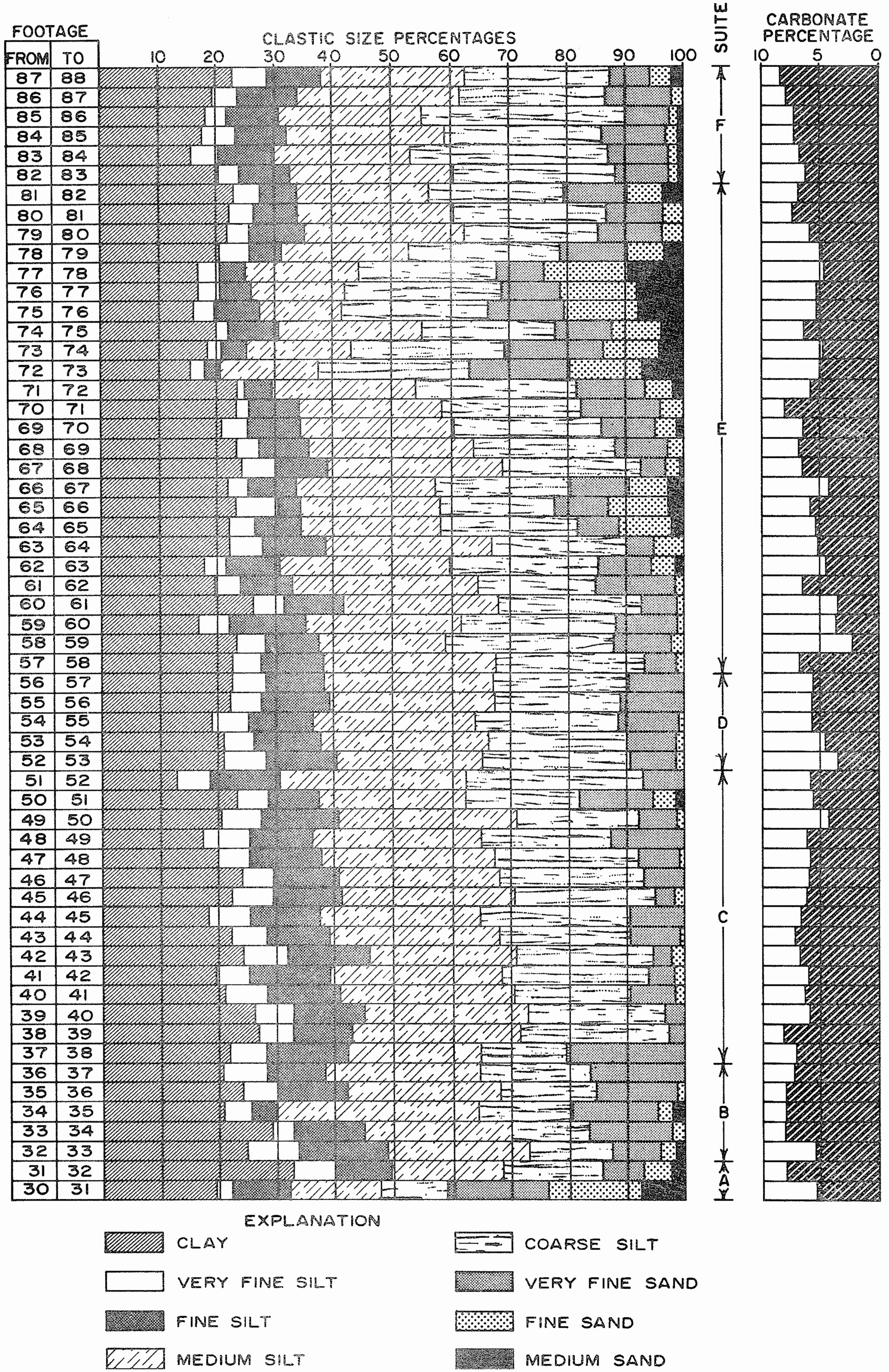
The idea that the Tertiary was primarily a time of deposition while the Quaternary was a time of erosion in the Great Plains was first conceived by Henry Englemann in 1859 (Englemann, 1876). This theory has been generally accepted and expanded by later writers.

The formation of the tables and buttes as shown on figure 5 are somehow related to Quaternary erosion or a combination of erosion and deposition. The top of Cuny Table consists of remnants of early Quatenary channel deposits, dune sand, and loess. The surface of the Red Shirt Table is a sequence of Quaternary terrace levels, the oldest at the south end and the youngest at the north end. Stirk Table is covered with dune sand. Babby Butte, Red Dog Table, Castle Buttes and Sheep Mountain Table have deposits of loess on their surfaces. The area between the tables contains great expanses of Late Quaternary terrace deposits and variable amounts of alluvium, loess, and dune sand.

AGE

One of the major keys to the ages of the Pleistocene deposits of this area is the occurrence of Pearlette? Ash in stream channel deposits on Cuny Table. This ash is here called Pearlette because only one major ash fall has been reported from the Quaternary of the Northern Great Plains (Reed and Dreeszen, 1965). The Pearlette Ash is a widely distributed volcanic ash of late Kansan age. It has been reported from South Dakota, Iowa, Nebraska, Kansas, Oklahoma, and Texas by Frye and others (1948) and possibly from Nevada, Utah, and Idaho by Powers and others (1958).

Figure 4. Chart showing the clastic size analyses and carbonate percentages of one-foot samples of the type sections of the Red Dog Loess. Suite numbers refer to samples taken from a continuous trench and correspond to the suite lettering on figure 3. Clastic sizes are as presented by the National Research Council (1947).



FOOTAGE
FROM
TO
CLASTIC SIZE PERCENTAGES
SUITE
CARBONATE PERCENTAGE
A
B
C
D
E
F
EXPLANATION
CLAY
VERY FINE SILT
FINE SILT
MEDIUM SILT
COARSE SILT
VERY FINE SAND
FINE SAND
MEDIUM SAND

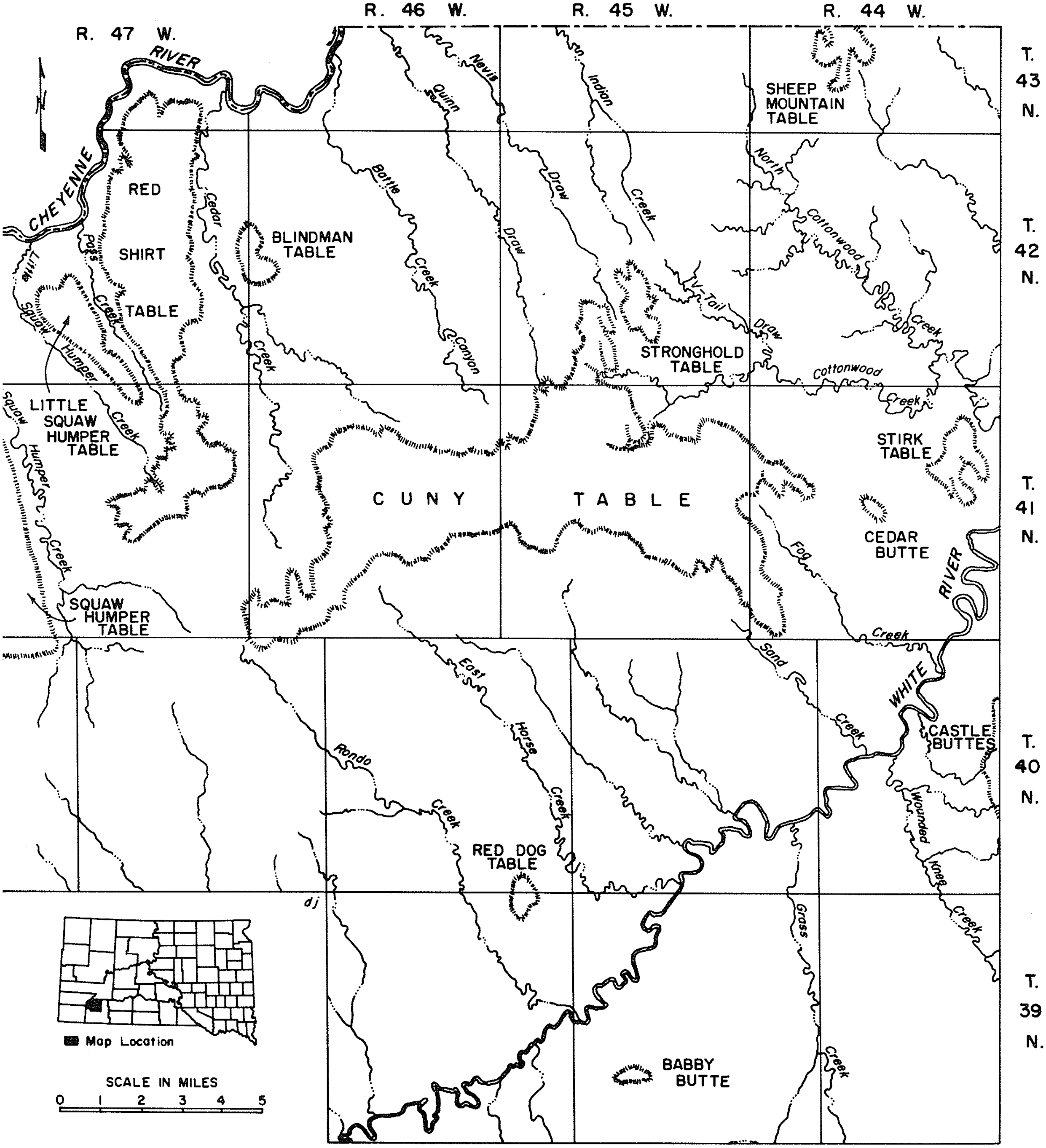


Figure 5. Map showing the physical features of a portion of northern Shannon County, South Dakota.

On the west end of Cuny Table, in the NE¼ sec. 29, T. 41 N., R. 46 W., a small deposit of volcanic ash is associated with a channel deposit. This ash was first made known to the writer by Morris F. Skinner (personal communication, 1964) who believed the ash to be Pearlette and very important in the time-stratigraphic studies in this region. Figure 6A is a photograph of the ash bed and figure 6B is a picture of the channel deposit associated with this ash.

It is believed that the depositional surface on top of the Ogallala, in the vicinity of the west end of Cuny Table, stood at an elevation of about 4,000 feet at some time prior to the end of the Pliocene. Post Ogallala-pre Pearlette Ash erosion amounted to about 770 feet. Between Red Dog Table and Babby Butte, the White River is at an elevation of 2,765 feet; therefore, the local drainages have cut down 465 feet since the deposition of the Pearlette Ash.

At the present time there is some controversy over the absolute ages that have been assigned to Pleistocene events. Classically the Pleistocene was considered to have had a length of one million years. This concept is apparently still followed by Blackstone (1966) who places a 1.25 million year date in the latest Pliocene. Ericson and others (1964) put a 1.5 million year length on the Pleistocene while Obradovich (1965) states that the Pliocene-Pleistocene boundary in California is at least 3 million years old.

The writer accepts the age of 1.7 million years for the Pearlette Ash (Claude Hibbard, personal communication). This figure is strengthened by Cox and others (1965) who state that the Blancan-Irvingtonian boundary is between 2.3 and 1.4 million years old.

As was stated above the local drainages, in the Red Dog Table and Cuny Table area, have cut down 465 feet since the deposition of the Pearlette Ash. Accepting a 1.7 million year age for the Pearlette Ash it is a simple matter of division to find that the local drainages have been downcutting at an average rate of one foot every 3,656 years.

At the type section of the Red Dog Loess the contact between the loess and the underlying terrace deposit is at an approximate elevation of 2,950 feet. The White River here (as was mentioned above) has an elevation of 2,765 feet. The difference between these two elevations (185 feet) when multiplied by the years to downcut one foot (3,656) would mean that the terrace on which the Red Dog is deposited has a maximum age of 676,000 years or late Yarmouthian to early Illinoian. This would give the Red Dog Loess an age of less than 676,000 years or post late Yarmouthian. No dateable fossils have been collected from any of the major loess deposits. Therefore, at the present time the best age that can be assigned to the loess would be post late Yarmouthian.

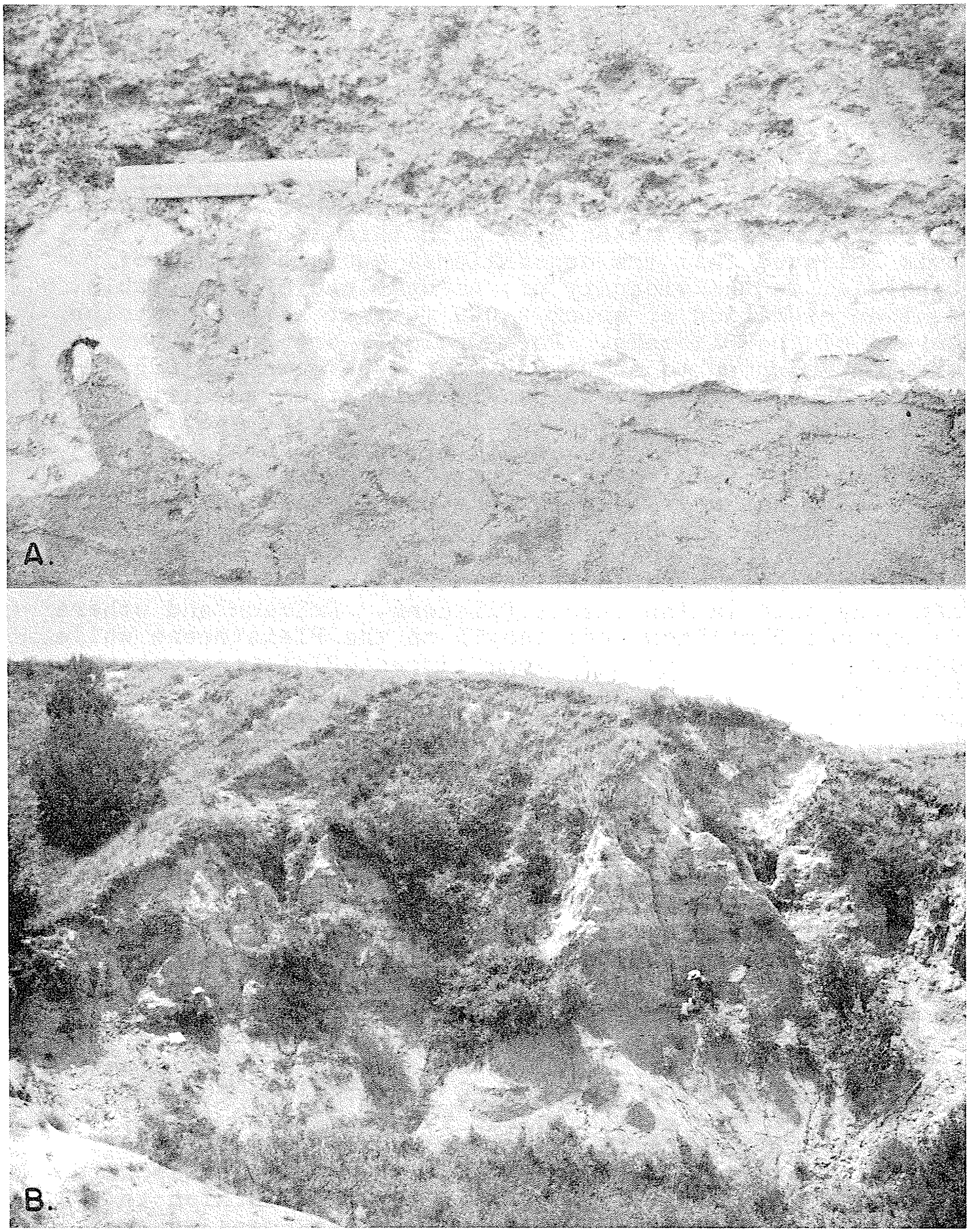


Figure 6. Quaternary deposits on Cuny Table. A. Photograph of a deposit of Pearlette Ash occuring at an elevation of 3230 feet in the NE1/4 sec. 29, T., 41 N., R. 46 W., Shannon County (six inch ruler for size). B. Channel deposits occuring just to the east of the ash locality in the NW1/4 sec. 28, T. 41 N., R. 46 W. The two men are just above the contact between the Quaternary channels and the Oligocene Brule Formation.

DISTRIBUTION

Deposits of loess are found scattered across most of southwestern South Dakota. Extensive deposits of loess are found on Moccasin Top Flat (fig. 7). In the SE¼ sec. 5, T. 38 N., R. 39 W., Bennett County loess overlies volcanic ash at an elevation of 3,415 feet again believed to be Pearlette Ash. Deposits of Red Dog Loess 90 feet thick occur on Babby Butte (see fig. 8). Other loess deposits are described by Harksen (1967, and in press).

Two loess deposits are believed to occur in southwestern South Dakota. Pearlette Ash is known to occur beneath soil and gravel at an elevation of 3,100 feet in the SW¼ sec. 2, T. 37 N., R. 34 W., Bennett County. Underlying the ash at this location is a second loess which on megascopic inspection looks much like the Red Dog Loess.

ORIGIN

Because very little work has been done on the loess of South Dakota, one can look to the neighboring state of Nebraska for some ideas on the origin of the loess deposits of South Dakota. Kirk Brian (1944, p. 246) made the statement, "In Nebraska the relative influence of glacial and desert sources is acute. It should, however, be borne in mind that the Platte and Missouri Rivers and all their Rocky Mountain tributaries, were in Pleistocene time overloaded, glacially-fed streams. To the extent that their floodplains are the source of Nebraska loess, this loess is essentially a glacial rather than a desert loess."

Observing the coarse sediments derived from the Black Hills which can be found at two elevations on Cuny Table, the abundance of coarse terrace deposits on Red Shirt Table, along the Cheyenne and White Rivers, and near the town of Fairburn, South Dakota, it would seem that at several times during the Pleistocene the local drainages were indeed overloaded seasonal streams. It is believed by the writer that the floodplains of these drainages served as a source of part but not nearly all of the Red Dog Loess.

The Red Dog Loess on Red Dog Table is 60 feet thick; whereas the Red Dog Loess on Babby Butte is 90 feet thick. The prevailing wind in this area, at least during the late Pleistocene, was from the north-northwest (Harksen, 1967). It is therefore not improbable to assume that the extra 30 foot thickness of loess on Babby Butte resulted entirely from sediment being blown off of the nearby White River floodplain and deposited to the south of the White River.

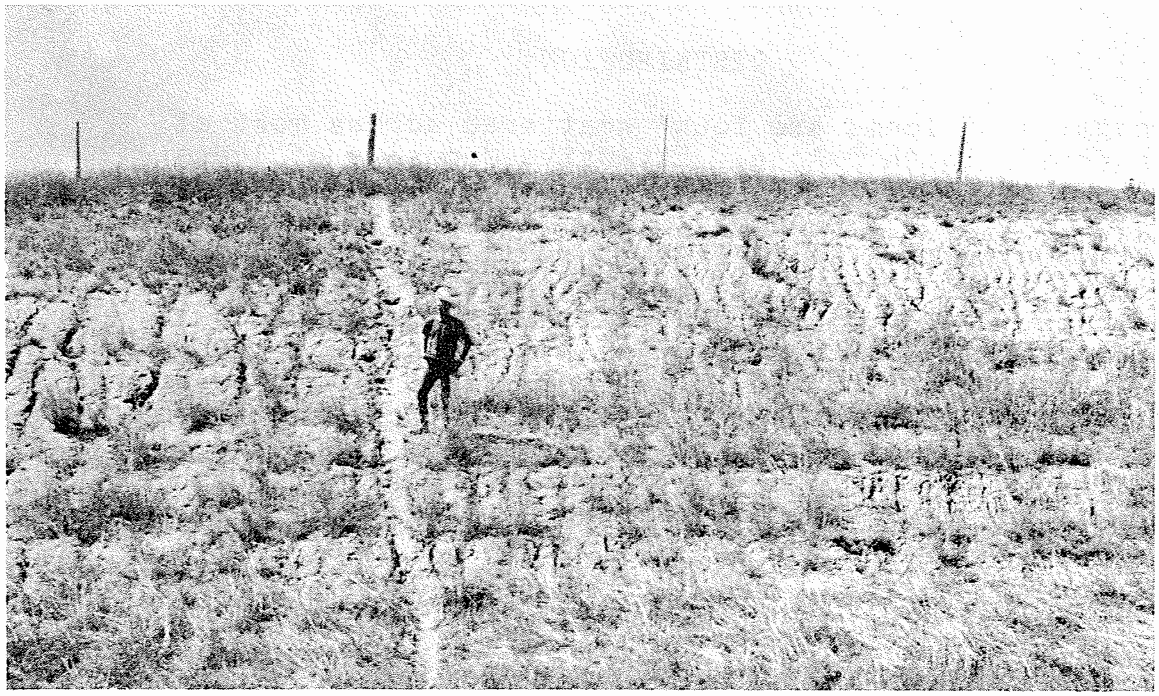


Figure 7. Photograph of Red Dog Loess on Moccasin Top Flat in the NE1/4 sec. 7, T. 38 N., R. 39 W., Bennett County, South Dakota. 23 feet of loess is exposed in this roadcut.

The material which served to build the loess deposit on the Red Dog Table may to a small extent have been derived from the White River floodplain and may to an even smaller extent have been derived from the Cheyenne River floodplain. The writer believes that the major source for the Red Dog Loess is the Badlands as shown in figure 9.

Lugn (1962) believed that the major source of the loess deposits of Nebraska was the Great Sand Hills area. He felt that winds during the Pleistocene had removed the fine materials from portions of the Ogallala Group leaving behind a lag concentrate in the form of the Sand Hills while the finer materials were deposited as loess to the south and east of the Sand Hills.

Reed and Dreeszen (1965) disagreed with Lugn's theory on the formation of the loess. They felt that the fines were not blown directly out of the Ogallala Group but were first sorted through stream action and then subjected to removal and later deposition by the winds.

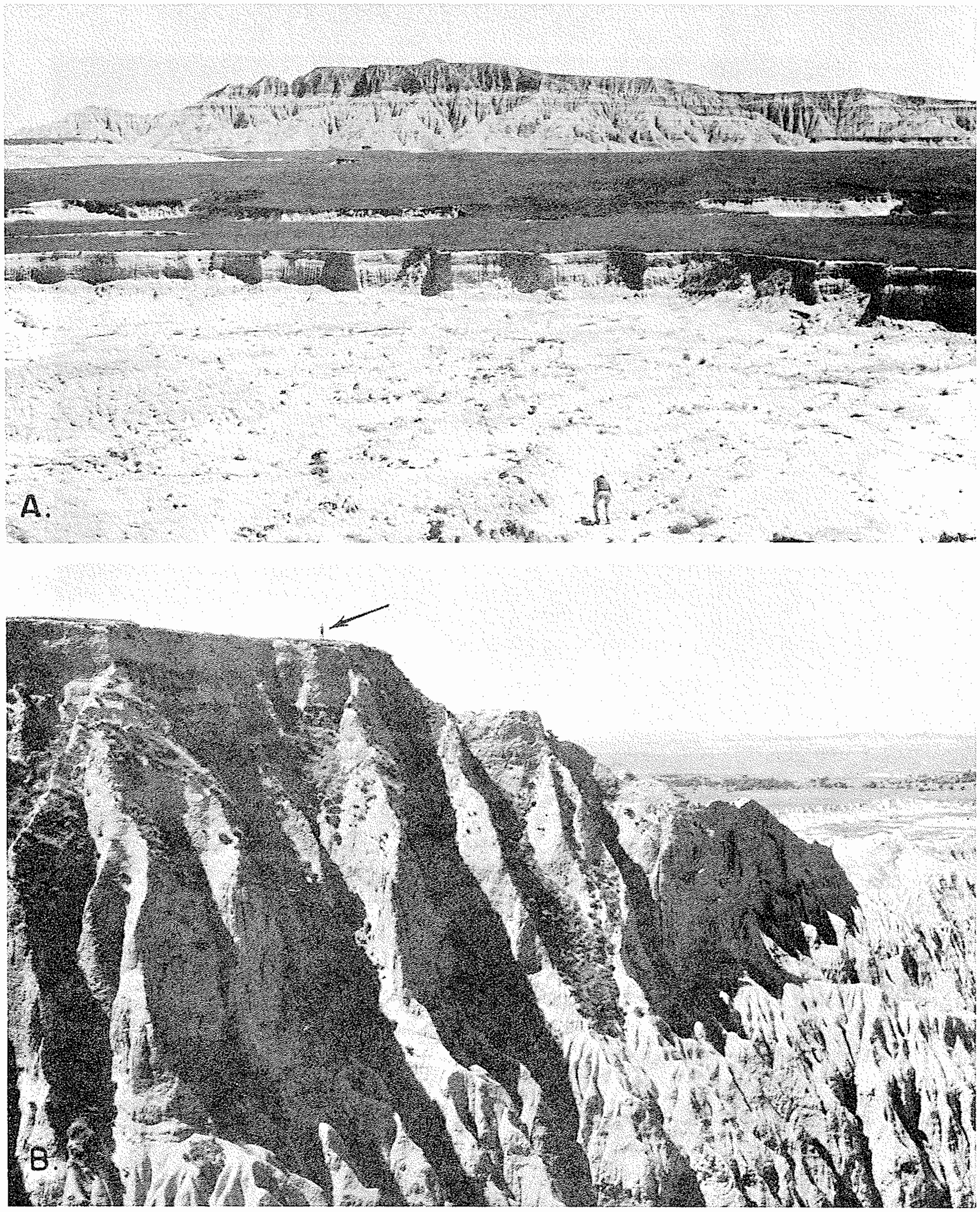


Figure 8. Babby Butte. A. Photograph of Babby Butte showing the darker Pleistocene deposits capping the lighter Brule Formation. Grass covered terrace deposits occur in the middle distance and the Brule Formation is again exposed in the foreground. B. Photograph showing the units which are exposed on the north face of Babby Butte which are lip loess, soil zone, Red Dog Loess, terrace deposits, and Brule Formation. These are equivalent to the units on Red Dog Table, which are presented in figure 3. The arrow points to a man standing on top of the butte.

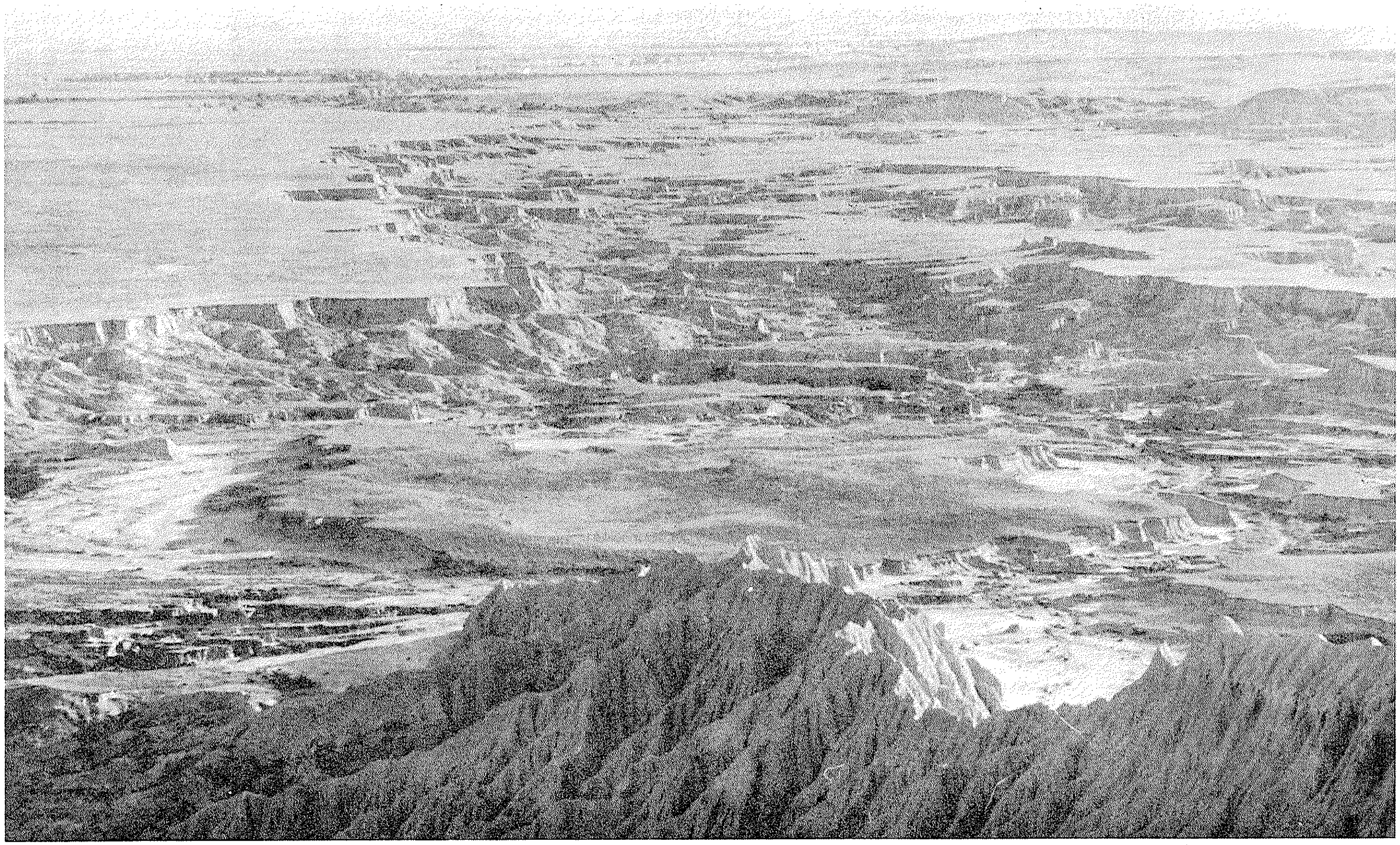


Figure 9. Photograph taken from the top of Babby Butte showing the vast amounts of terrace deposits and colluvium present in this area of South Dakota.

Extensive tracts of dune sand can be found throughout the Badlands. A local example is that both the east and west ends of Cuny Table have tracts of dune sand. To a great extent this sand is the lag left behind after the wind has blown away the finer materials. The great amount of dune sand in the Badlands suggests that a great deal of fine material must have been blown out of this area to form so much lag concentrate.

CONCLUSIONS

The writer believes that Badland areas such as shown in figure 9 have been the major source for the Red Dog Loess. It is believed that the age of the Red Dog Loess is post late Yarmouthian based on its stratigraphic relationships with the Pearlette Ash. More work is needed to determine its precise age, its geographic extent, and its temporal equivalents.

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