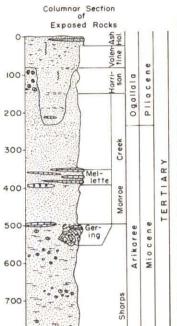
GEOLOGY OF THE PATRICIA QUADRANGLE

S. G. COLLINS

INTRODUCTION



Sandstone or sand Clay or Shale Limestone Cross-bedded conglomerate and sandstone Calcareous cement Calcareous nodules

Volcanic ash

The Patricia quadrangle was mapped with the assistance of Eldon Hovelsrud during the summer of 1959 under the supervision of Dr. Allen F. Agnew, State Geologist, as a part of the State Geologist, as a part of the State Geologist, so as part of the State Geologist, as a part of the State Geologist, and the Suth Dakota. Thanks are extended to John Harksen and Dr. J. R. Macdonald for invaluable assistance in stratigraphic correlation and pale-ontologic identifications.

The mapped area contains about 218 square miles in the north-central part of Bennett County and the south-central part of Washabaugh County. The map takes its name from the Patricia Country Store near the southeastern corner. There are no other named settlements.

The quadrangle lies in the Missouri Plateau subdivision of the Great Plains physiographic province, in the area of south-central South Dakota that is covered with Tertiary sediments. The dominant topographic features of the quadrangle are the abrupt erosional escarpments that mark the edges of the highlands in the southern and southwestern parts of the area, and the buttes and messas in the northern part, including Eagle Nest and Buzzard buttes, both of which are landmarks that can be easily distinguished many miles to the north across the White River valley. The major both of which are landmarks that can be easily distinguished many miles to the north across the White River valley. The major portion of the area is rolling to hilly low-lands that are uniformly well-drained with the exception of a small area of flat, poorly drained land at the headwaters of Spring Creek in the southeastern corner. The southwestern one-third of the area is drained by Bear-in-the-Lodge Creek and its tributary, Spring Creek, which flow toward the northwest with a gradient of approximately 15 feet per mile. Sitting Up Creek and other unnamed tributaries of Pass Creek drain the northeastern part of the area, Eagle Nest Creek drains the northwestern portion, and tributaries of Craven Creek and Long Creek drain small areas along the northand tributaries of Craven Creek and Long Creek drain small areas along the north-central boundary. All drainage in the area flows ultimately northward into the White River. There is only one natural lake, an unnamed shallow blowout pond at the south-eastern corner of the quadrangle, which holds water in years of adequate rainfall. Many small stock-water dams are scattered throughout the quadrangle, but because of the permeable nature of the soil most of these hold water only in wet seasons.

cause of the permeable nature of the soil most of these hold water only in wet seasons.

Maximum topographic relief in the quadrangle is 796 feet, altitudes ranging from 2608 to 3404 feet above sea level. Local relief is greatest in the neighborhood of Eagle Nest and Buzzard buttes, where ground elevations differ more than 300 feet within a few miles. Ranching and farming are the principal occupations. Most of the farm access roads are more or less graded and improved, but much of the area can be traversed only on unimproved trails. State Route 73 along the eastern border is the only hard-surfaced road. The north-south road along the western border of the quadrangle connecting Hisle Post Office with Martin to the south and Wanblee to the north is gravel-surfaced in part, and is graded and improved throughout.

The climate is typical of the temperate High Plains. Temperatures range from 27 degrees below zero to as high as Ill degrees above. Rainfall averages 16 inches yearly, according to records of the U. S. Weather Bureau station at Martin. Strong winds are the rule, prevailing from the northwest in winter and from the south during the summer months.

The Miocene Arikaree Group underlies the entire quadrangle. It is divided into the Sharps (lower), Monroe Creek (middle), and Harrison (upper) formations, all of which crop out extensively within the area. The Sharps is exposed at the lowest altitudes in stream valleys and in the northernmost part of the area. The Monroe Creek occupies the middle elevations and crops out over a greater area in the quadrangle than any other unit. The Harrison crops out extensively only on highlands in the southwestern part of the mapped area. The lower part of the Monroe Creek contains the Gering (?) channel sand facies and the Mellette limestone facies, which crop out locally in the central and northern parts of the area. The Pilocene Ogallala Group is represented by the Valentine Formation, which occupies a sizeable area above the Arikaree in the eastern part of the quadrangle, and by the Ash Hollow Formation, which covers small areas at the highest elevations as the caprock of several buttes. Small gravel deposits of Early Pilocene and indeterminate younger ages occur locally, and Quadernary alluvial floodplain deposits are present along streams.

Miocene Series. Arikaree Group, Darton, 1899.

The Arikaree Group was named for the Arikaree Indians who inhabited western Nebraska. The Arikaree was originally assigned formation rank, and was later subdivided and redefined as a group by Luga (1939). The Arikaree Group is represented in the Patricia quadrangle by the Sharps, Monroe Creek, and Harrison formations.

Sharps Formation. -- Harksen, Macdonald, and Agnew, 1960.

The Sharps Formation (Tms) was named from exposures near Sharps store in Shannon County, South Dakota, about 50 miles west of the Patricia store. In the Patricia Quadrangle the Sharps Formation is exposed at the lowest altitudes, mostly in the northern one-fourth of the area and in the valleys of Bear-in-the-Lodge and Spring creeks. The unit consists of light pinkish-gray very fine feldspathic clayey generally calcareous soft sandstone. The composition is mostly uniform although nodules and very local layers of clay and coarser sandstone also are present. In the type sandstone. The composition is mostly uniform although nodules and very local layers of clay and coarser sandstone also are present. In the type section (Harksen, 1960) and in some exposures in the Patricia area the Sharps contains characteristic elongate ellipsoidal "potato-like" calcareous nodules 2 to 5 inches in diameter. In the type area these concretions develop a characteristic brown stain when treated with hydrochloric acid, but this reaction was not noted in the Patricia area. The concretions normally occur as individuals dispersed several inches to several feet apart in the uniform fine clayey sandstone, but rarely they are present as irregular clusters of fused individuals. The upper part of the unit, including the gradational contact with the overlying Monroe Greek, is best exposed in a large gully in the NE44 of sec. 16, T. 39 N., R. 37 W. In the walls of the lower part of the gully the "potato-like" concretions are imbedded in clayey calcareous very fine sandstone. Through about 35 feet upward the number of concretions diminishes, and progressively less calcite and clay are contained in the sandstone. The top of the formation is exposed as a twelve-foot thickness of very fine gray to pinkish-gray sandstone with numerous pockets and thin seams of pink clay (probably montmorillonite) in the lower part. The upper half of this bed contains progressively more calcite so that the top stands out as a fairly well cemented prominent ledge. The contact between the Sharps and Monroe Creek formations at this location is taken as a ½- to 2-inch thick more or less continuous bed of noncalcareous pink clay lying on the cemented sandstone. No other clearly exposed section including the contact of the two members was found, and the writer feels that this exact sequence of beds probably does not extend over a wide range laterally.

In mapping, the Sharps was differentiated from the overlying Monroe

over a wide range laterally.

In mapping, the Sharps was differentiated from the overlying Monroe Creek by its content of the characteristic concretions and by its greater Creek by its content of the characteristic concretions and by its greater content of clay and calcareous material. The topography developed on the Sharps is generally more gently rolling than that characteristic of the Monroe Creek, probably because the higher clay content lowers the former's resistance to fluvial erosion. Hardpan flats that form locally on the Sharps are also probably caused by the impermeability of the clay. The rounded lichen-stained hummocks characteristic of the Monroe Creek (Collins, 1959) are absent in the Sharps. In the western part of the quadrangle the Monroe Creek forms a depressed but definite erosional escarpment above the Sharps Formation. In the northern and eastern parts of the area this escarpment is less easily recognized. Throughout the area the contact can be only approximately located. The writer questions the practicality of separating the two units in future mapping farther east, although they are probably distinguishable at isolated locations.

No identifiable fossils were found in the Sharps, although a few chips and fragments of vertebrate remains were noticed.

No identifiable fossils were found in the Sharps, although a few chips and fragments of vertebrate remains were noticed.

The thickness of Sharps exposed in the Patricia Quadrangle is at least 153 feet, measured from the contact described above to the bottom of Bear-in-the-Lodge Greek where it leaves the quadrangle, about five miles to the north.

Monroe Creek Formation, Hatcher, 1902.

The Monroe Creek Formation (Tmmc) was named as a formation from exposures along Monroe Creek canyon near Harrison, Nebraska, about 130 miles southwest of the Patricia Store. In the Patricia Quadrangle the Monroe Creek occupies the middle elevations. It is very well exposed in the steep-walled valley of Bear-in-the-Lodge Creek in the southwestern part of the area, and in the nearly vertical cliffs of Eagle Nest and Buzzard buttes. The unit consists of medium-brown to light pinkish-gray very fine well sorted mostly quartzose non-calcareous sandstone which contains only a little clay. It is poorly to moderately consolidated, massively bedded, blocky, and weathers grayish to very light-buff. A rolling topography without flat-topped prominences is developed on the Monroe Creek, and, where it is not protected by soil cover, the unit is characterized by peculiar smoothly-rounded hummocky surfaces normally stained with black splotches of lichen.

The formation is mostly uniform in composition, but contains two well-

The formation is mostly uniform in composition, but contains two well-developed facies of sediments not typical of the Monroe Greek, as described above. These facies are mappable, have been tentatively correlated with the Gering channel sand and the Mellette limestone facies, and will be discussed separately.

In addition to these facies, a local deposit of volcanic ash was observed in sections 19, 21, 28, and 27, T. 39 N., R. 36 W., and near the Three Star School, 5 miles to the south. The ash crops out in a continuous layer around the ridges of the drainage divides. The bed lies beneath typical Monroe Creek sandstone that forms the ridgetops. It is mostly 6-8½ feet thick. The ash is mainly uncemented and free from impurities, but contains scattered through most exposures a number of thin lentils ½ to 3 inches thick, which are poorly cemented by calcite. In some zones the ash contains many Geltis seeds. In the SE¼ sec. 19, T. 39 N., R. 36 W., is another, much smaller, deposit of very impure limey volcanic ash and ashy limestone about 2 feet thick. The ash here is cemented into ledges about 2 inches thick, which form a resistant caprock for a small topographic high. This deposit is at the same elevation as limestone ledges of the Mellette facies half a mile to the North. The two deposits were probably laid down under much the same climatic conditions.

No fossils were found in typical Monroe Creek sediments.

The thickness of the Monroe Creek is difficult to measure because of the gradational character of both the lower and upper contacts. Two approximate thicknesses of 345 and 356 feet were measured, including the Gering and Mellette facies.

Gering facies, (Darton, 1808)

The Gering Incies (Tmg) was originally named the Gering Formation from exposures near Gering, Nebraska, about 150 miles southwest of the Patricia Store. The lithologic unit described below and provisionally defined as a facies of the Arikaree is tentatively correlated with the Gering on the basis of its coarse composition and its stratigraphic position. In the Patricia Quadrangle the Gering facies occurs at the base of the Monroe Creek as coarse clastic sediments filling channels cut into the Sharps Formation. The contact with the Sharps is disconformable, but the nature of the contact with the Monroe Creek could not be clearly discerned. The channel sediments consist of cross-bedded conglomerates and sandstone, and of limestone concretionary structures of peculiar rounded and hemicylindrical or trough-like form. In a road cut at the north side of the NEIA sec. I, T. 40 N., R. 36 W. the disconformable contact with the Sharps is exposed. Here the channel deposits are 52 (ect thick, and consist mostly of fine to very fine calcareous gray sandstone, cemented at some horizons cylindrical or trough-like form. In a road cut at the north side of the NEW sec. I, T. 40 N., R. 36 W. the disconformable contact with the Sharps is exposed. Here the channel deposits are 52 feet thick, and consist mostly of fine to very fine calcareous gray sandstone, cemented at some horizons to a plastery or "mortar bed" consistency. Well cemented zones of very coarse calcareous sandstone containing feldspar, mica, limey clay fragments, and considerable clay occur in the upper part of the deposit, as do hemispherical masses, as much as 14 inches across, of sandy to nearly pure light-tan or grayish limestone from which concentric curved slabs have been broken by weathering. Both the coarse sandstone and the limestone contain pink montmorillonite clay in seams and small masses. On the west side of Sec. I, T. 40 N., R. 36 W. the base of the channel is a very coarse conglomerate containing 6- to 10-inch fragments of clayey very fine pink sandstone that were undoubtedly derived from the Sharps Formation. Above this is a very coarse well-cemented calcareous sandstone composed of quartz, limestone, and very fine sandstone fragments. The upper part of this exposure is covered with Qusternary deposits that make the thickness difficult to determine, but at least 10-15 feet of Gering is present. The best exposure studied is in the NE½ sec. 2, T. 40 N., R. 36 W., where the lowest channel deposit lies on material similar to the Sharps. The lowest bed is 2 feet of a poorly sorted well cemented conglomerate of nodular limestone fragments & 10-2 inches in diameter, in a concrete-like matrix of coarse calcareous quartz sandstone. Twelve feet above this is another 4-foot cross-bedded coarse calcareous quartz sandstone with a limestone-nodule conglomerate at the base. Twenty-eight inches above this bed is another similar sandstone and conglomerate that also contains many rounded fragments of pink sandstone up to 2 inches in diameter. Exposed above the channel deposit is a 25-35 foot thick very fine pinkishgray sandstone typica

Melette facies, (Agnew, 1957)

Melette facies, (Agnew, 1957)

The Mellette facies (Tmm) was named from exposures in Mellette County near White River, South Dakota, about 45 miles northeast of the Patricia Store. The unit was originally designated a formation but was redefined as a facies of the Arikaree by Sevon (1959). In the Patricia Quadrangle the Mellette consists of lenticular layers of creamy-white flaggy dense limestone containing small (1 mm) veinlets of crystalline calcite. In some localities pockets as much as half an inch across, and thin seams of pink montmorillonite clay occur in the limestone. These weather out where exposed, leaving a "wormy" appearance. The limestone weathers to a very light-gray or white color that stands out strikingly where the beds are well exposed. The facies contains one to four layers of limestone, separated by varying thicknesses of calcareous and noncalcareous pinkishgray very fine sandstone typical of the Monroe Creek. The facies is most extensively exposed in the western part of the quadrangle, where it consists of three or four more or less continuous layers. In the NWis sec. 16, T. 39 N., R. 37 W. four limestone layers are 0.7, 2.5, 4, and 1 feet in thickness (bottom to top), separated by an aggregate thickness of 23 feet of sandstone. In the NEW sec. 13, T. 39 N., R. 36 W. there are four limestones 1.5, 1, 1.3, and 0.5 feet in thickness, separated by an aggregate thickness of the facies is about 150 feet above the base of the Monroe Creek. The limestone beds are less widely developed in the eastern half of the quadrangle. Near the eastern border the lowest exposures correlated with the Mellette facies appear at the base of the Monroe Creek. The nestone layer of the facies is about 150 feet above the base of the Monroe Creek. The limestone beds are less widely developed in the eastern half of the quadrangle. Near the eastern border the lowest exposures correlated with the Mellette facies appear at the base of the Monroe Creek. In exposures on the south side of Sec. 31, T. 40 N., R. 35 W. the lime

Harrison Formation, Hatcher, 1902.

The Harrison Formation (Tmh) was originally named from outcrops at the general level of the High Plains in the vicinity of Harrison, Nebraska. In the south-central and southwestern parts of the Patricia Quadrangle, also, the Harrison forms the general level of the high plains. In these areas the Harrison is composed of light pinkish-gray to light-gray partly calcareous very fine sand and silt, mostly poorly cemented. It is very similar to the Monroe Greek, but contains discontinuous horizontal zones of calcareous nodular concretions. The nodules are irregular in shape, 2 to 5 inches across, and generally are disseminated through a zone 8 to 12 inches thick. These nodular zones retard erosion slightly, and give rise to an irregular succession of rounded topographic steps.

These nodular zones retard erosion slightly, and give rise to an irregular succession of rounded topographic steps.

The upper part of the Harrison is complicated by a maze of channels of mostly calcareous very fine sand and silt, with some coarser sand and a little gravel. These deposits are undoubtedly of a later origin than the true Harrison, but were not differentiated from it in mapping as they are thin (rarely as much as 20 feet), very similar to Harrison in appearance, and generally local.

In the NE's sec. 20, T. 38 N., R. 36 W. a thin bed of volcanic ash of local extent was mapped in sediments of this type. The deposit is as much as three feet thick but generally less, is mostly noncalcareous except where mixed with varying proportions of sand and silt, and is mostly fairly pure. The ash and the soft calcareous sandstone in which it lies are probably Pliocene in age, and may correlate with the Ogallala or an even later unit.

even later unit.

In the northern part of the quadrangle the Harrison is exposed above the Monroe Creek in the walls of Eagle Nest and Buzzard buttes, but its characteristic nodular zones are very poorly developed and present only in isolated exposures. On Eagle Nest Butte the lowest observed nodular zone is 12 feet below the top of the Arikaree. On a regional scale the Harrison and Monroe Creek become less distinct as separate units eastward from their source area, and the writer feels that from the Patricia and Martin quadrangles eastward there can be little practical value in attempting to map them separately. They were separated more or less arbitrarily in the northern part of the Patricia area on the basis of stratigraphic position, and by the very few observed Harrison lithologic characteristics. the very few observed Harrison lithologic characteristics.

No fossils were found in sediments definitely assigned to the Harri-

The thickness of the Harrison in the southern part of the area is diffiand because of the narrison in the southern part of the area is diffi-cult to measure because of the gradational character of the lower contact and because of the general soil covering. Its maximum thickness is estimated to be 60 to 80 feet.

Pliocene Series. Ogallala Group, Darton, 1899.

The Ogallala Group was named from exposures in western Nebraska near Ogallala Station, about 150 miles south of the Patricia Store. It is represented in the Patricia Quadrangle by the Valentine and Ash Hollow

Valentine Formation, Barbour and Cook, 1917.

The Valentine Formation (Tpv) was named from exposures near the town of Valentine, Nebraska, about 55 miles southeast of the Patricia Store. In the Patricia Quadrangle the Valentine lies disconformably upon the Arikaree group in the southwestern part of the area, apparently filling a post-Miocene topographic low. The Valentine Formation consists mostly of light-gray and light olive-greenish fine to medium very poorly consolidated feld-spathic or arkosic sand, generally well sorted, sub-angular to sub-round, and containing many somewhat frosted grains. The sand is mostly non-calcareous, massive to thick-bedded, and has local cross-bedding. There are local lenses of light olive-greenish silty clay a few inches to a foot or more thick, and scattered irregular lenses that are slightly cemented by calcite. In the NE4s sec. 8, T. 39 N., R. 36 W., where one of these cemented zones has weathered out, elongate cigar-shaped structures of soft sandstone have been developed which vaguely resemble the so-called "pipey concretions" of the Arikaree in western Nebraska. They probably represent percolation channels in a previous ground water circulation pattern. The

concretions" of the Arikaree in western Nebraska. They probably represent percolation channels in a previous ground water circulation pattern. The highly silicified sandstone of the Bijou facies (Stevenson, 1958), common in areas farther east, was not observed anywhere in the Patricia Quadrangle. The lower part of the Valentine is less uniform in character than the rest of the unit. Locally, thin limey zones appear, as near the center of Sec. 10, T. 30 N., R. 36 W., where the base of the formation is a 10-to Ill-foot thickness of light-gray fine grained calcareous feldspathic sandstone.

ll-foot thickness of light-gray fine grained calcareous leidspathic sandstone, possibly containing a little volcanic ash. At the top of this calcareous sand, and below typical Valentine sand, is a 1- to 8-inch layer of cream-colored soft to fairly hard limestone, mostly quite pure, but locally sandy. In a blowout in the NEIs sec. 8, T. 39 N., R. 36 W. were found remains of Lower Pliocene vertebrates identified by Dr. J. R. Macdonald as Pliohippus sp., Neohipparion sp., Nannippus sp., Merycodus sp., ? Prosthenops sp., and gomphotherids.

The Valentine appears to grade upward into the conformably overlying Ash Hollow Formation. For this reason it was impossible to determine the upper limit of the unit precisely, but a 202-foot thickness of Ogallala was measured in Sec. 24, T. 39 N., R. 35 W., at least 175 feet of which is Valentine.

Ash Hollow Formation, Englemann, 1876.

Ash Hollow Formation, Englemann, 1876.

The Ash Hollow Eormation (Tpa) was named from exposures in Ash Hollow Canyon, near Lewellen, Nebraska, about 140 miles south of the Patricia Store. In the Patricia Quadrangle the Ash Hollow is very restricted in extent, occupying the highest elevations as the caprock on Eagle Nest Butte, Buzzard Butte, and two small unnamed buttes in the eastern part of the area. On Eagle Nest and Buzzard buttes the Ash Hollow lies unconformably upon the Arikaree, but in the other two localities it grades downward into the Valentine Formation. The unit consists of well-sorted fine feldspathic or arkosic sandstone, moderately well-cemented by calcite to a characteristic plaster-like or "mortar bed" consistency. The sandstone is very light olive-gray to light-gray stained to a darker gray in patches by lichen. Many veinlets and tubules of caliche and silica, probably the remains of plant rootlets, form acriss-cross network in the sandstone. These are more resistant to weathering than the rest of the rock, and cause a characteristic "boxwork" surface on weathered surfaces that are partially protected from mechanical erosion. The upper portion of the unit is more calcareous than the lower, and in local thin zones it is very well cemented and is a sandy limestone.

No lossils were found in the formation other than multitudes of Celtis

The lower contact of the Ash Hollow is mostly covered where it lies on the very friable Valentine sands, and in these locations accurate thick-nesses could not be measured. On Buzzard Butte and Eagle Nest Butte the lower contact is well exposed. The maximum thickness measured was 81 feet.

Pliocone (?) Gravel and Sand

Several small bodies of channel sand and gravel that have been mapped as <u>Pliocene sand</u> (Tps) and <u>Pliocene gravel</u> (Tpg) lie along a line that extends northwestward from Sec. 17, T. 38 N., R. 36 W. to the western border of the quadrangle. These deposits generally lie on the tops of small hills at altitudes decreasing toward the northwest. The deposits are mostly unconsolidated sand and coarse gravel, with rounded crystalline rock

ly unconsolidated sand and coarse gravel, with rounded crystalline rock fragments as much as 5 inches in diameter. In some local areas the gravel is cemented by calcite or silica to a hard, coarse conglomerate that resembles low-grade concrete. A considerable amount of garnet is contained in all of the deposits, and in some, streaks of nearly pure garnet are as much as an inch thick. Very few of the garnet grains are more than 1.5 mm in diameter. In Sections 5 and 6, T. 39 N., R. 37 W. several ill-defined terrace levels of gravel-capped hills are found, the highest about 150 feet above Bear-in-the-Lodge Creek. The highest of these is as described above, but the lowest terrace is clearly of recent origin and consist mostly of very fine sand and silt and locally derived calcareous nodular material, with only a small percentage of igneous and metamorphic rock fragments. The gravels at intermediate altitudes contain varying proportions of western- and locally derived material. The age of the higher deposits is by no means certain, as no identifiable fossils were found in them, but the writer feels that they are closely related to deposits in the Martin quadrangle (Collins, 1959) in which were found remains of the Early Pliocene horses Nannipuss and Neohipparion. It is mostly for this reason that they have been tentatively dated as Pliocene. The distribution of the gravels suggests that they were deposited in a stream ancestral to the present drainage, but the present stream pattern could just as well have developed subsequently in response to the distribution pattern of the gravels. The advanced cementation suggests a pre-Pleistocene origin, as does the almost complete lack of locally derived material. The deposits could be pre-Valentine channels, or may be a post-Ash Hollow correlative of the Sidney gravels (Lugn, 1939) of western Nebraska.

The deposits are variable in thickness, but are generally from 5 to 20

ern Nebraska.

The deposits are variable in thickness, but are generally from 5 to 20 feet, and locally more than 30 feet thick.

Locally derived Quaternary grave] (Qg) caps small sharp hills along major drainages in the northern part of the quadrangle. The gravel consists of about 55-75 percent fine and medium sand and 25-45 percent poorly to moderately rounded soft limey concretionary and nodular fragments 1 to 4 inches in diameter. Some deposits contain from 1 to 3 percent western-derived igneous and metamorphic rock fragments, mostly moderately to well-rounded. These deposits all lie about 100 feet above the present streams, and all slope to the northeast. A second, lower, terrace level of similar material was noticed at two locations. These lower, presumably younger deposits are 50-60 feet above the stream bottom, and less than 16 feet in thickness. The maximum measured thickness of the higher gravel is 65 feet, and the average of five measurements is 48 feet. No identifiable fossils were found, although a few poorly preserved fragments of bone were noticed.

ticed.

Locally derived floodplain <u>alluvium</u> (Qal) of silt and fine sand were mapped along Bear-in-the-Lodge Creek. The thickness of these deposits could not be determined.

Information available on the subsurface rocks of the Patricia area is provided by the English #1 Kocer oil test, in sec. 30, T. 37 N., R. 36 W. (10 miles southwest of Patricia Store). This wildcat, drilled from a surface elevation of 3,079 feet and completed at a total depth of 3,370 feet, pene-

		feet
Tertiary	Arikaree and White River	
	silt, sand, clay	0-1208
Cretaceous	Pierre shale	-1855
	Niobrara marl	-2060
	Carlile shale	-2382
	Greenhorn limestone	-2440
	Belle Fourche-Mowry shales	-2715
Jurassic?	Morrison-Sundance?	
	siltstone, sandstone	-2902
	shale	-2940
	sandstone	-3110
Permian?	Opeche? shale	-3165
Permo-Pennsylvanian?	Minnelusa?	
	sandstone, shale	-3315
	shale, sandstone	- 3370
and the first of the particular and the second	2010 110 2115 1205	10 2215

The sandstones from 2940 to 3110, 3165 to 3205, and 3240 to 3315 are

STRUCTURAL GEOLOGY (See Collins, 1959)

The Patricia Quadrangle lies on the northeastern slope of the Chadron The Patricia Quadrangle lies on the northeastern slope of the chaoron Arch and is at the northern edge of the small Kennedy Basin of northern Nebraska. No reliable datum is exposed at the surface in the quadrangle. Subsurface measurements on the Greenhorn limestone and Newcastle sandstone show easterly dips of 40 and 50 feet per mile, respectively. Two structural datum surfaces below, and the Precambrian surface, show dips of the same magnitude to the southeast and south.

ECONOMIC GEOLOGY

Sand, gravel, ground water, and limestone are the only economic deposits in the Patricia Quadrangle that have so far been developed. Potentially economic deposits of volcanic ash and clay materials are known. Petroleum or other mineral resources may also occur in the subsurface.

Sand and Gravel from the western-derived deposits of probable Pliocene age have been quarried at a number of locations within the quadrangle. During the summer of 1959 approximately 60,000 city do of these materials were removed from pits in Sec. 6, \(\Gamma\). 39 N., R. 37 W. for road construction. In general the deposits are free from excess fine material, and serve as sources of bituminous or concrete aggregate.

Limey gravel from the Quaternary deposits contains too much silt and soluble material to be useful as concrete aggregate, and is too soft to serve as a high quality road metal, although it has been used locally for this purpose. The gravel might be used successfully as bituminous aggregate, and is not appeared to the propose of the propo

is excellent as sub-base material. Very large quantities are available. is excellent as sub-base material. Very large quantities are available. Ground water of good quality is available throughout most of the Patricia Quadrangle sufficient for household and livestock requirements, but in quantities inadequate for large-scale irrigation. Most wells in the area produce from the Arikaree sands. Shallow wells in alluvial deposits also produce water generally of good quality.

Partial chemical analyses of samples from six typical wells within the area appear in the following table.

Table. -- Chemical Analysis of Water from Selected Wells in the Patricia Quadrangle

	Solutes in Parts Per Million											
Farm Name and Well Location	Source	Fe	Mn	Mg	Ca	*OH	CI	Na	504	Class for Irrigation	Total Hardness	Total
C. J. Clem NW4 sec. 28, T. 39 N., R. 36 W.	Tmmc	Trace	w(++)	5	50	14 143	1	4	15	1	146	260
Leslie Hancock E. side sec. 2, T. 40 N., R. 36 W.	Tmmc	Trace		4	72	184	13	20	34	I	194	367
Ernest Zickvick SWA sec. 25, T.41 N., R. 36 W.	Tms	1. 4	Trace		21	32 316	7	123	59	II	212	570
Ross Hicks Cen. sec. 18, T. 39 N., R. 35 W.	Tmme		Trace	1	20	237	3	95	32	III	55	396
Earl Hayes SE'4 sec. 1, T. 38 N., R. 36 W.	Tmmc			13	59	25 220	2	10	21	I	199	356
Mangel Maldonade SWI4 sec. 26, T. 41 N., R. 37 W.	Tms				39	199	1	49	13	11	97	340

*Concentrations given above are determined by phenolphthalein; below by methyl orange

Analyses by State Chemical Laboratory, Vermillion, 1960.

Limestone from the Mellette facies has been crushed elsewhere for Limestone from the Mellette facies has been crushed elsewhere for concrete and bituminous aggregate. In the Patricia Quadrangle it has been used only by local residents for walls and sidewalks. It is hard and dense enough for most crushed stone requirements. Deposits are extensive, but are generally thin and covered by considerable thicknesses of overburden. Volcanic Ash is present in considerable quantity. Deposits of this material are of good purity, and it could be used in the manufacture of abrasive or specialty concrete products. Analyses have indicated that too much iron is present in the ash to allow its use in the manufacture of clear class. But it rould be used for brown or colored class.

glass, but it could be used for brown or colored glass.

<u>Clay Materials</u> from the Arikaree Formation have been tested for firing qualities according to local reports, and may be potentially useable as raw material for brick and tile or other ceramic manufacture.

<u>Petroleum</u> and <u>uranium</u> occur elsewhere in the Great Plains in areas stratigraphically and structurally similar to the Patricia Quadrangle, and may possibly occur here in subsurface units.

REFERENCES CITED

Collins, 1959, Geology of the Martin Quadrangle: S. Dak. Geol. Survey,

Collins, 1959, Geology of the Martin Quadrangle: S. Dak. Geol. Survey, map and text.

Harksen, J. C., 1959, personal communication.

1960, Geology of the Sharps Corner, Malone, and Manderson 7/2-minute Quadrangles: S. Dak. Geol. Survey, maps and texts.

Lugn, A. L., 1939, Classification of the Tertiary System in Nebraska: Bull. Geol. Soc. America, v. 50, p. 1245-1275.

Macdonald, J. R., 1959, personal communication.

Sevon, W. D., 1959, Geology of the Okreek Quadrangle: S. Dak. Geol. Survey, map and text.

Stevenson, R. E., 1958, Revision and Reinterpretation of the Bijou Formation: Proc. S. Dak. Acad. Sci., v. 36, p. 134-8.