SOUTH DAKOTA

STATE GEOLOGICAL SURVEY

E. P. Rothrock, State Geologist

REPORT OF INVESTIGATIONS

No. 22

THE STONEVILLE COAL AREA

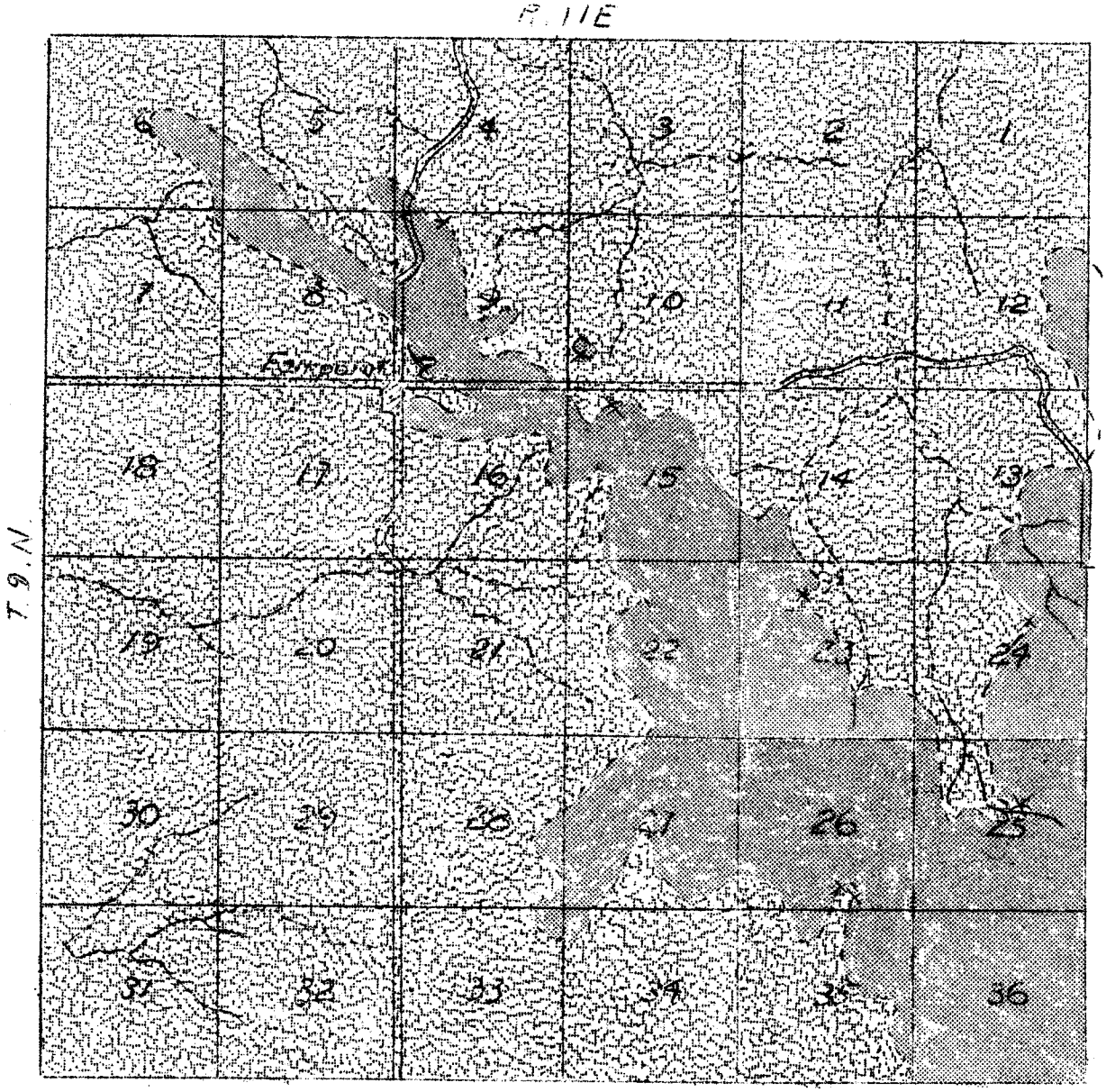
By

W. V. Searight

University of South Dakota
Vermillion, S. Dak.
September, 1934

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS



Legend

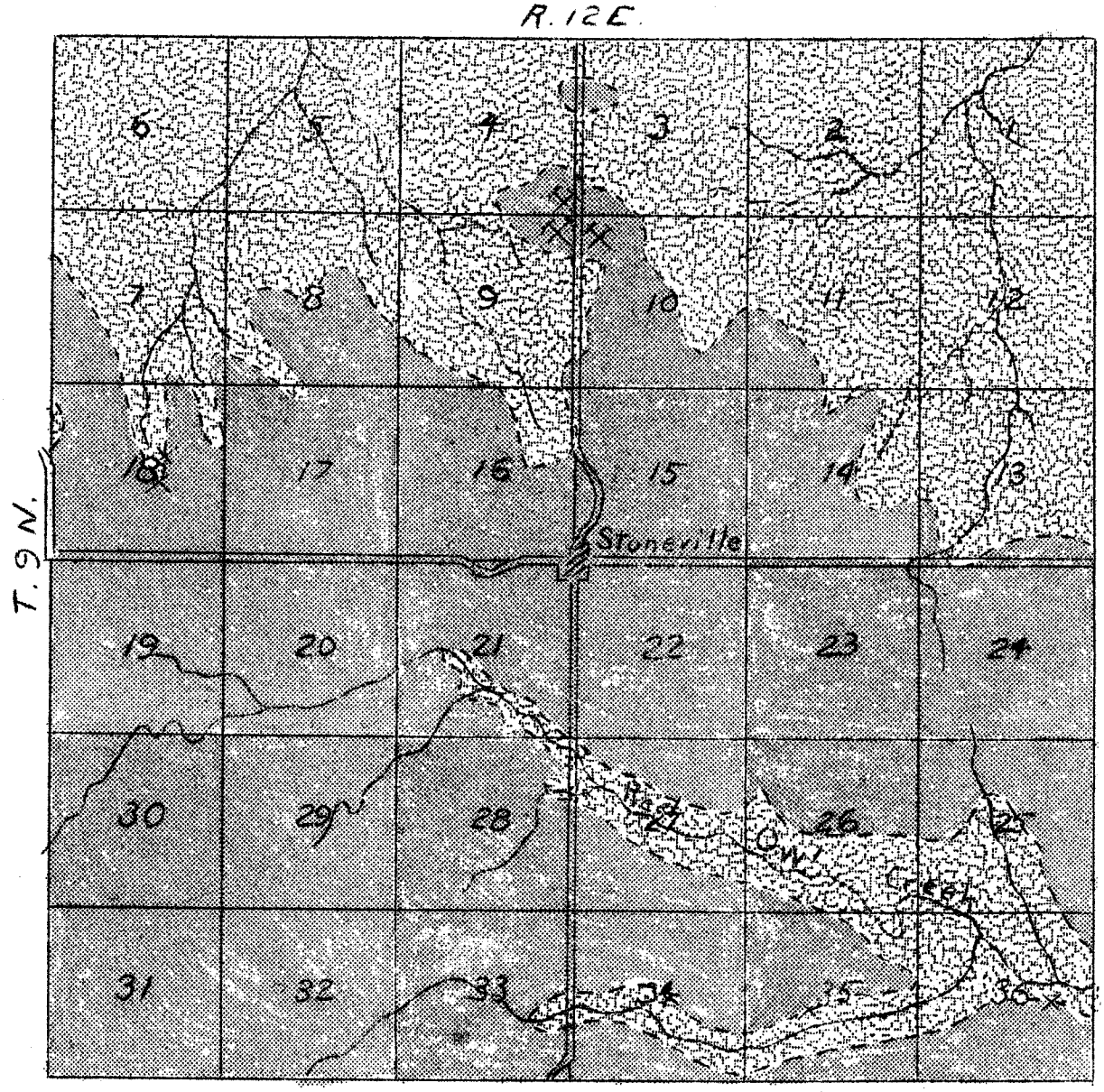
Fox Hills, including Stoneville member and younger beds.

Fox Hills, older than Stoneville member.

Coal outcrop.

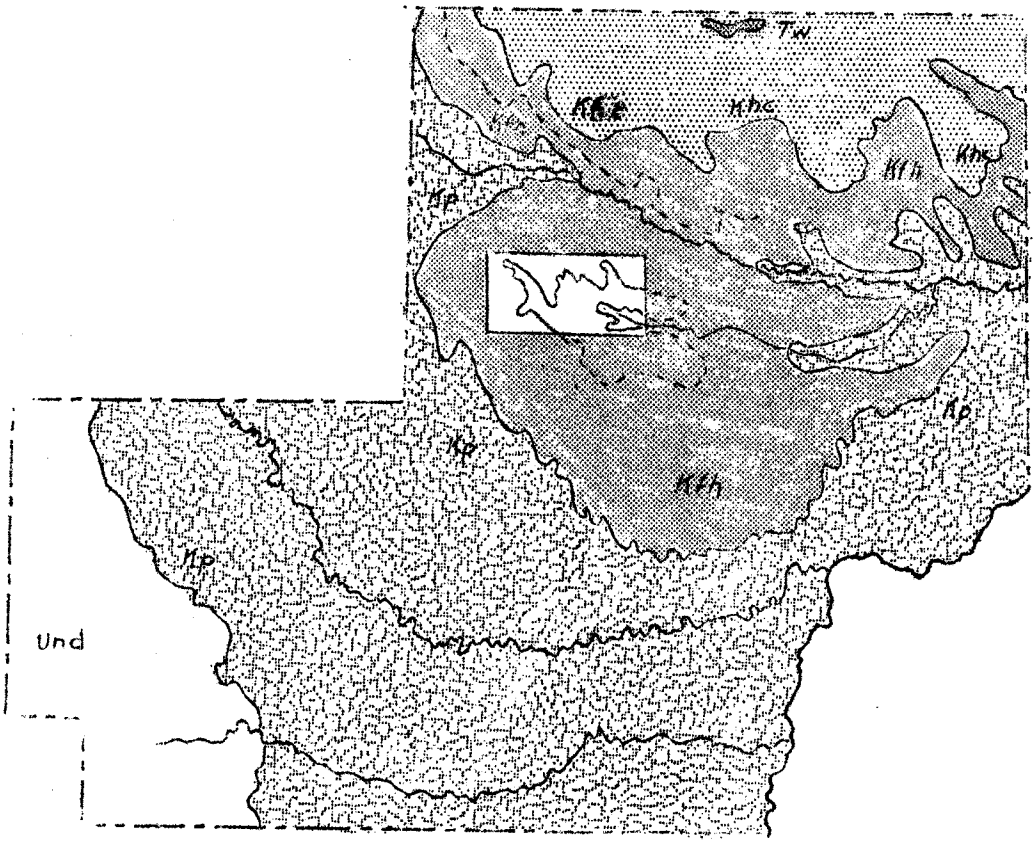
Mine. × Small mines and prospects.

PLATE I



Geologic Map of the Stoneville Area

Scale - I inch = I mile.



Geologic Map of Meade County, South Dakota
to show location of the Stoneville area.

Legend

Tw White River.

Khc Hell Creek Member of the Lanse.

Kfh Fox Hills.

Kp Pierre.

Und pre-Pierre.

Coal boundary.

FIGURE I

THE STONEVILLE COAL AREA

LOCATION, AREA, AND GENERAL RELATIONS

The Stoneville coal area lies in Meade county, South Dakota. (fig.1) The area mapped (Pl. 1) occupies two townships, T. 9 N., R. 11 E. and T. 9 N., R. 12 E., which lie to the west of the middle of an irregularly shaped outcrop of Fox Hills rocks which occupies roughly one fourth of Meade county. (fig.1)

The mapped area, and the larger area of Fox Hills rocks ofwhich it is a part, are in the Great Plains physiographic province. The mapped area is somewhat over 90 miles west of Missouri River and a little over 30 miles from the Black Hills uplift. Excepting a part of the Fox Hills outcrop in Butte county, the outcrop of Fox Hills in Meade county is the nearest to the Black Hills.

PURPOSE OF THE REPORT

The Stoneville area and the immediate surrounding area are of both scientific and economic interest. It contains the oldest coals, Fox Hills, mined in South Dakota. The Stoneville is also the southernmost coal mined in the state. It is also the nearest to the Black Hills of any minable coal in the South Dakota coal field.

The occurrence of coal and other beds of continental origin in the Fox Hills is of geologic importance. The investigation of the stratigraphy is most important to the working out of the geologic history of the late Cretaceous. This area, of which that mapped forms a part, contains, so far as known, the easternmost coals of Fox Hills age in the Great Plains province. The area was investigated to determine the amount and character of the coal and to work out the stratigraphic succession of the Fox Hills in this most critical region.

FIELD WORK

Two weeks of the field season of 1933 were spent in this and the surrounding area. The area (Pl. 1) was mapped by speedometer and by pacing. The succession was worked out, and individual members were traced throughout the area, in so far as outcrops permit. Side trips were made to the Opal vicinity, which is a part of the same outcrop area of Fox Hills and which also contains Fox Hills coal. The Fox Hills was also traced northward and northwestward

to outcrops of Pierre and Hell Creek, in order to establish definitely the position of the beds of the area.

ACKNOWLEDGMENTS

All residents were most congenial in their efforts to assist in accumulating the data on which this report is based. The Survey expresses its cordial appreciation to these inhabitants and to owners and operators of coal mines for their kindness. Dr. E. P. Rothrock, State Geologist, worked with the writer in the field, and his cooperation and helpful suggestions are greatly appreciated.

Field notes of R. A. Wilson, former Survey member, who first identified the coal of this area as Fox Hills, and his report on northeastern Meade county[1], proved to be of value.

PHYSIOGRAPHY AND GEOGRAPHY

About half of the mapped area is gently rolling or flat. The remainder is of rolling topography. About Stoneville, to the north about two miles and to the southeast, southwest, and south, the surface is flattish for the most part to the boundaries of T. 9 N., R. 12 E. Smaller flat and gently rolling areas extend into T. 9 N., R. 11 E. Sandstone capped buttes are abundant in the southwest and northwest corners of the area. Rather deeply cut valleys occur in tributaries to Sulphur (Cherry) Creek in the northeast part of the area.

Relief is low and is probably less than 75 to 100 feet over much of the area. Near the valleys at the north and northeast part of the area, however, buttes and valley walls rise 150 to 200 feet above the valley bottoms. Maximum relief in the area is probably about 300 feet.

Drainage

Drainage is entirely to Cheyenne River through tributaries to Sulphur (Cherry) Creek. Essentially all of T. 9 N., R. 11 E. and the northern three tiers of sections in T. 9 N., R. 12 E. is drained through relatively short tributaries to Sulphyr (Cherry) Creek. The remaining southern three tiers of sections in T. 9 N., R. 12 E., are drained by Red Owl Creek, the largest southern tributary to Sulphur (Cherry) Creek. Red Owl Creek drains into its main about 22 miles east of the area.

1. Wilson, R.A.,Oil and gas possibilities in northeastern Meade county: South Dakota Geological and Natural History Survey, Circular 23; 1925.

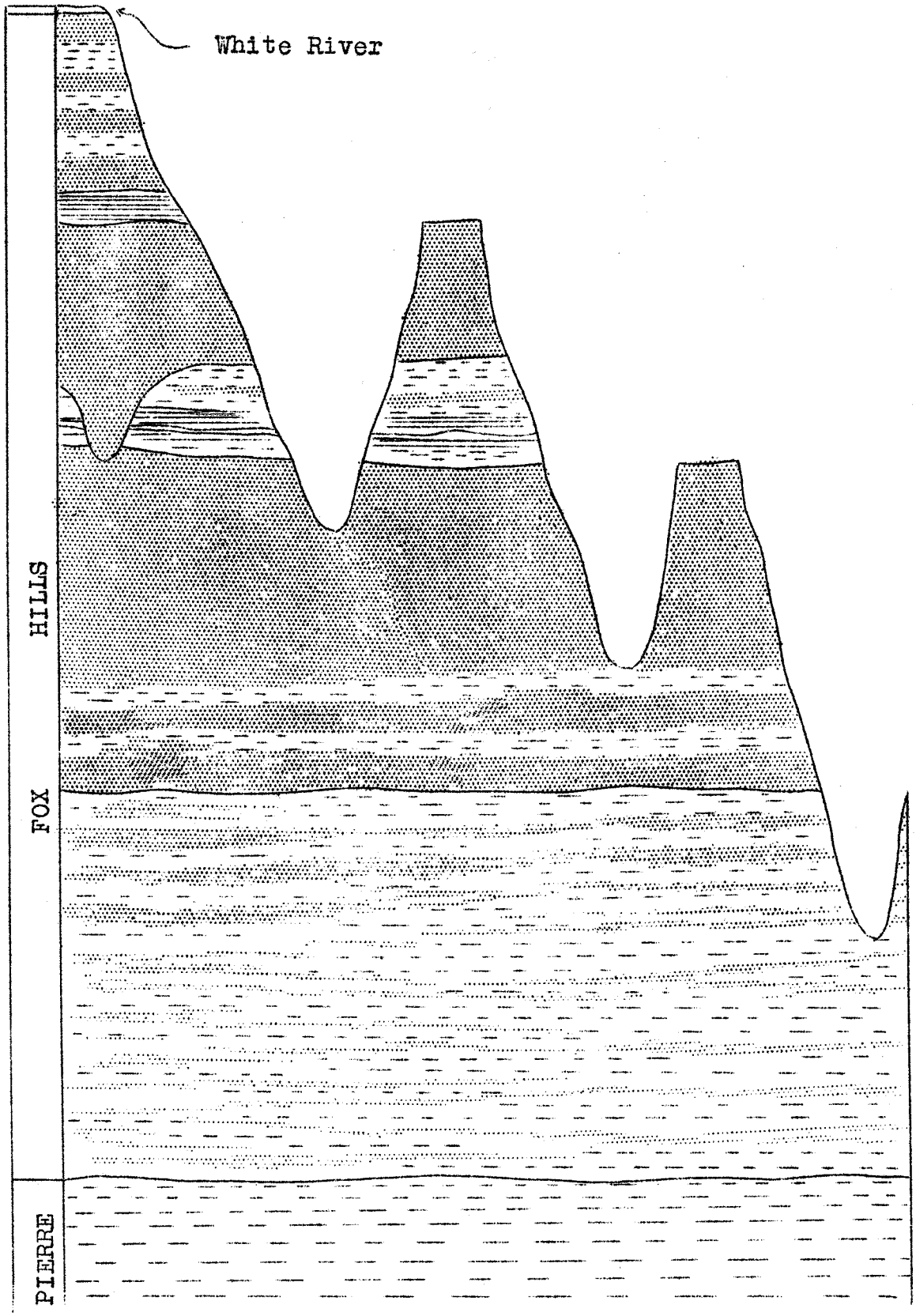


FIGURE II

Columnar section of the rocks of the Stoneville and immediately surrounding area.

Culture

The area is without incorporated towns. A postoffice, general store, and school are at Fairpoint; and a postoffice, two general stores, garage, and high school are at Stoneville. Fairpoint postoffice is in NE 1/4, NE 1/4, sec. 17, T. 9 N., R. 11 E., and Stoneville postoffice is in NW 1/4, NW 1/4, sec. 22, T. 12 N.

A graded road connects Fairpoint and Stoneville. A grade through Fairpoint connects with State Highway No. 24 south of the area and with U. S. Highway No. 212 northwest of the area. A north-south graded road through Stoneville connects with State Highway No. 24 and with U. S. Highway No. 212 north of the area.

Where the area is relatively flat there are roads around the sections. Most of these are unimproved. In rougher portions of the area, roads are scarce, and access by car is relatively difficult.

STRATIGRAPHY

Introductory Statement

Meade county, South Dakota, has within its borders a succession of rocks ranging in age from pre-Cambrian to Pleistocene (?). The surface of nearly 95 per cent of the county is underlain by late Cretaceous rocks, including the Lance. (fig.1) Strata of Fox Hills of late Cretaceous and Chadron gravels of White River Oligocene are the only beds which outcrop in the mapped Stoneville area. Most, if not all of the rocks which occur elsewhere in Meade county, with the probable exception of Tertiary intrusives, doubtless underlie the Fox Hills. Further discussion of the older rocks is outside the scope of this paper. Beds ranging from upper Pierre, which lie relatively near the area, and the Fox Hills are described in the pages which follow. These strata also appear in the columnar section. (fig.2)

Pierre Formation

The Pierre formation does not outcrop in the area mapped, but it occurs to the northwest, west, east, and south (fig.1) where the Fox Hills has been removed by erosion. Along Sulphur Creek north of Fairpoint the formation is exposed along the edge of the valley flat in the NE 1/4, NE 1/4 sec. 4 and in the NW 1/4, NW 1/4 sec. 3, T. 10 N., R. 11 E., nearly six miles north of the mapped area. Here the uppermost beds of the Pierre consist of dark gray, almost black

shale which breaks down into the gumbo so commonly observed in the outcrop area of the Pierre shale. Here also occur much broken dark gray limestone concretions containing Tardinacara (Pseudoptera) fibrosa (Meek and Hayden), and a large baculite, probably Baculites grandis Hall and Meek . Both of these are important guide fossils in the upper Pierre in South Dakota.

Fox Hills Formation

Name and Definition:

The Fox Hills formation was named by Meek and Hayden from outcrops on the divide between Cheyenne and Moreau Rivers.[1] It includes all beds in South Dakota between the uppermost transition beds of the Pierre and the gumbo clays and gumbo sands of the lower or Hell Creek member of the Lance. In South Dakota, beds which in many places are silty or sandy shale and contains Pierre fauna with some typical Fox Hills forms have been excluded from it and assigned to the transition beds of the upper Pierre. Sandstone beds at the top of the formation, which contain plant fossils in some places and brackish water fossils in others, have been included in the Fox Hills, although beds of similar position, character, and fossil content have been assigned to the Lance by some authors.

Distribution:

The area mapped is entirely underlain by Fox Hills strata. (Pl.1) The formation extends at the surface beyond the two townships mapped in all directions from 2 1/2 to 20 miles. (fig.1) At the north the formation continues at the surface to and beyond the Montana line. The outcrop may be followed northeast to the North Dakota boundary, which it crosses north and somewhat west of Mobridge.

General Character:

The Fox Hills of this and the surrounding area consists dominantly of sandstone with subordinate amounts of shale and clay. In this immediate region it also contains thin beds of coal. The formation is more or less divided lithologically into four members, (fig.2) which consist of a basal member of alternating beds of shale and sandstone overlain by a sandstone member containing thin beds of shale. This sandstone is overlain by a thin succession, the Stoneville member, composed of shale, clay, sandstone, and coal, which is in turn overlain by a member sandstone composed of thin interbedded shale. Clays occur in the upper part of this member. This

1. Meek, F. B., and Hayden, F. V., Proc. Acad. Nat Sci. Phila., Vol. 13, pp. 419, 427; 1861.

general succession is indicated in the table of succession which follows.

Generalized section of the Fox Hills of the Stoneville area.

	feet
Upper sandstone member	
4. Sandstone, with thin beds of shale. Clays occur in the upper part	139-149
Stoneville member	
3. Shale, clay, sandstone, coal	10-46+
Lower sandstone member	
2. Sandstone with thin beds of shale	135
Shale and sandstone member	
1. Shale and sandstone in alternating layers	150+
Total	435-465

The Fox Hills of this region differs lithologically and genetically from the formation in the type locality only 60-70 miles to the east. In the Stoneville area terrestrial beds containing coal occur, whereas in the type region the entire Fox Hills succession, with the exception of brackish water beds at the top, is marine. The formation in the Stoneville area also contains much more sandstone than in the type area and is considerably thicker.

In lithologic and physiographic expression, the Fox Hills of this region strongly resembles the Ludlow and Cannonball members of the Lance and the Fort Union.

Details in lithology of the Fox Hills are described in the pages which follow.

Lower Shale and Sandstone Member.

The lower shale and sandstone member of the Fox Hills has been observed in the lower Fox Hills of this and surrounding areas wherever this part of the formation is exposed. In most places, however, the member is concealed under grass-covered slopes, and in the mapped area there are exposures here and there of a few feet only.

Good exposures occur north of the mapped area in buttes and ravines in Secs. 22 and 35, T. 10 N., R. 12 E. and elsewhere in the north and northeast part of the area in tributaries to Sulphur (Cherry) Creek.

These beds consist of gray, buff, brown, and yellow shale and thin beds of gray, drab, and buff sandstone. Thin beds of these various colors and tints of various textures alternate to give this part of the Fox Hills a banded appearance in the outcrop, noted only rarely in other parts of the formation in the

area. Texture of beds becomes gradually coarser from the base up, mostly by the increasing prominence and increased thickness of sandstone beds in the succession. In the upper 50 feet of the member, there is more sandstone than shale.

The lithologic details of the lower shale and sandstone are further described in the tables of succession which follow.

Section of lower shale and sandstone and the overlying beds of the Fox Hills in sec. 22, T. 10 N., R. 12 E. on the north side of the east-west draw and in the butte to the north of the draw.

	Feet
Lower sandstone member.	
3. Sandstone, micaceous, gray and drab; cross-bedded. Contains zones of sandstone concretions to four feet in thickness near the base and in upper part of the exposure. Shale pebbles common in lower 10-15 feet - - - - - - - - - - - -	40
Shale and sandstone member.	
2. Sandstone and shale. Sandstone gray and buff; shale gray and brown. Sandstone beds range in thickness between one and three feet. Shale beds one foot and less in thickness. Shaly beds predominate in lower part, sandstone in upper. Silty zone 3-4 feet thick at about the middle - - - - - - - - - - - - - -	58
1. Shale, brown, buff, yellow and gray. Colors alternating in thin beds ranging between two inches and one inch in thickness. Contains a few thin sandstone beds about two inches in thickness - - - - - - - - - - - - - - - - - -	51
Total - - - - - - - - -	149

Section of the shale and sandstone member and associated beds exposed in a linear east-west butte capped by sandstone in the SE 1/4, sec. 35, T. 10 N., R. 12 E.

	Feet
Lower sandstone member.	
7. Sandstone, fine, soft, gray and buff, micaceous. Cemented into large concretions in zones - - - - - - - -	61
Shale and sandstone member.	
6. Sandstone, drab, silty, cemented, fossiliferous - - - - - - - - - - - - - - - - -	1
5. Silt, shale, and sandstone, banded. Contains shell fragments - - - - - - - - - -	6
4. Sandstone, fine, buff, micaceous - - - - - -	5
3. Sandstone and shale, inter-bedded. Sandstone in beds to two feet thick	

		Feet
	of buff and gray. Shale in thin beds of buff and darker gray. Three feet of soft gray massive sandstone eight feet above the base - - - - - - - - - -	44
2.	Sandstone, gray and buff. Top three feet cemented to form a ledge which is continuous more than a quarter of a mile -	5
1.	Covered, probably inter-bedded shale and sand -	35
	Total - - - - - - - - - -	96

The total thickness of this member, as indicated by sections, is well over 100 feet. The difference in elevation between the top of the Pierre in sec. 3, T. 10 N., and the base of the massive sandstone in sec.33, T. 10 N., R. 11 E. is 152 feet. The thickness of the member is thus probably about 150 feet.

Lower Sandstone Member:

The lower sandstone member lies between the lower shale and sandstone beds and the Stoneville member. The member consists of fine, micaceous, gray, buff, and drab sandstone. Outcrops are commonly massive, and the bedding thick, where it can be observed. In some places the member contains thin beds of buff and gray shale a few inches in thickness. In many places the sandstone is cemented into large concretionary masses which reach a thickness of four feet and reach a diameter of more than 10 feet. These are most abundant near the base, although a ledgelike concretion 1 1/2 feet thick and more than 50 feet in diameter occurs in the NW 1/4, SE 1/4, sec.18, T. 9 N., R. 12 E. at the top of the member.

Pebbles composed of shale have been observed in several places near the base, but they occur also near the top. These are all more or less flat. Where they occur, whether low or high in the member, the lower ones are more or less angular, whereas the higher ones are worn. They occur rather sparingly and do not in any case make up a large part of the bed in which they occur. In places an accumulation of ferruginous material has been deposited around the pebbles. On exposure, the soft shale is removed, leaving limonitic shells which form a "blister" conglomerate.

These pebbles indicate the removal of partly consolidated muds and shales from very near by, during the deposition of these sandstones. They are probably intraformational in character.

The thickness of the lower sandstone member is somewhat difficult to estimate, since the member is not completely exposed and only the upper and lower parts can be identified

from scattered outcrops. A total of 61 feet was measured in the SE 1/4, sec. 35, T. 10 N., R. 12 E., where this sandstone forms the cap of a butte just north of the mapped area. In a small westward draining draw in the SE 1/4, sec. 13, T. 19 N., R. 11 E., a sandstone, believed to lie immediately above the Stoneville coal bearing member, is separated by a covered interval of 101 feet from 64 1/2 feet of the lower sandstone member. If 30 feet of the covered interval is assigned to the Stoneville member, which is not exposed here, an additional 71 feet of the lower sandstone lies under cover. If these estimates are correct, the lower sand at this place is 135 feet thick. The thickness probably approximates this figure.

Stoneville Member:

The Stoneville member of the Fox Hills is a thin succession of beds composed of clay, sandstone and coal. It is wholly or in part of continental origin. The name, here applied for the first time, is after Stoneville postoffice, Meade county, because the thickest coal in the succession occurs near it and because the associated beds of member are well exposed in this vicinity.

The Stoneville beds have been traced, with numerous interruptions, over the area mapped. (Pl.1)

A similar succession of beds occupying a similar stratigraphic position occurs at least as far east as NE 1/4, sec.18, T. 10 N., R. 14 E. Coal, probably in this member, has been observed north of the mapped area in sec. 3, T. 11 N., R. 10 E. The member thus extends more than 20 miles east and west and possibly an equal distance north and south in this region. These beds undoubtedly have been removed by erosion to the west and south, except for a small area. They formerly extended to the west an unknown distance, probably covering part of the Black Hills region. Possibly these continental beds formerly connected with terrestrial beds of Wyoming and Colorado.

The boundary is cooextensive with that of the coal mapped in Plate 1 which indicates the outcrop accurately where the beds outcrop. The boundary is inferred elsewhere from topography and nearest outcrops of associated rocks. On the index map (fig.1) an inferred boundary of these beds has been drawn outside the mapped area on the basis of a few isolated outcrops and on topography. Although the boundary outside is subject to correction, it indicates the approximate extent of the Stoneville member as it is known at this time.

The coal bearing member is distinguished from other members chiefly by the presence of one or more thin beds of coal and by the occurrence of highly carbonaceous shale or bone, "blackjack", which contains bits of coalified plant matter. Carbonaceous shale occurs, however, in beds considerably higher in the section, as described in the succeeding pages.

Associated with the coal and carbonaceous shale of the Stoneville member are shale beds which are commonly gray, brown, or buff. Thin clays occur also in some cases under coal and are mottled light and dark gray. These are structureless and much slickensided. They are apparently true underclays or ancient soils in which the coal making plants grew. Fine textured sandstones, commonly thin, of gray, buff, and brown, are commonly associated with coal in the outcrop in the place of shales and clays of other sections.

Considerable variation in the nature and thickness of components of the member occur. In some sections, particularly where the coal and carbonaceous beds are thickest, no sandstone is reported, whereas elsewhere most of the zone is sandstone. In order to indicate these variations in lithology as fully as possible, all of the sections taken in the mapped area are shown graphically in a later section on coal. Representative sections have been chosen and are described in the tables of succession which follow.

Section of Stoneville member of the Fox Hills and associated beds exposed in the outcrop along the east-west ravine and in the mine opening of a small drift mine in the NW 1/4, sec. 23, T. 9 N., R. 11 E.

	Feet
Upper sandstone member.	
9. Covered	50
8. Sandstone, upper member cross-bedded, buff and gray. Base uneven; cuts at least 18 feet into underlying beds, perhaps 33 feet.	46-64 or 46-79?
Stoneville member.	
7. Coal, black, bony	3/4
6. Clay shale, light to dark gray, some resemblance of bedding, much slickensided in upper part. Appears to be a true underclay	2
5. Sandstone and clay, inter-bedded, brown and gray mottled	2
4. Coal, bony, black, uneven in thickness, possibly thicker in mine	1/3-3/4
3. Shale, lavender brown, lignitic, much plant debris. Platy	3
2. Silt, buff, sandy, grades gradually into overlying and underlying beds	10
Lower sandstone member.	
1. Sandstone, fine, buff, micaceous; cross-bedded. Grades upward into Bed 2	15
Total	129 1/12-147 1 or 129 1/12-162 1

Section of Fox Hills including the Stoneville member and the underlying and overlying beds in the SE 1/4, NW 1/4, sec. 36, T. 9 N., R. 12 E.

		Feet
Upper sandstone member.		
9.	Sandstone, buff and gray, massive, micaceous - - - - - - - - - - - - - - - - - -	10
8.	Sandstone and shale, banded in lower part. Three foot bed of carbonaceous shale in upper part - - - -	12
7.	Sandstone, buff, and gray; massive. Large concretions 20 feet long, 3 1/2 feet thick 10 feet above base. Biscuit shaped concretions above -	38
Stoneville Member.		
6.	Shale, highly carbonaceous on lower half; weathered "blackjack". Becomes hard, gray, with less carbonaceous debris above. Streaks of bright, glance coal in upper one foot - - - - - - - - - - - - - - - - -	11
5.	Sandstone, fine gray, buff, friable - - - - - - - - - - - - - - - - - - -	4 1/2
4.	Coal and bone. Coal bony, has been stripped at both ends of bluff - - -	1
3.	Sandstone, micaceous. Interlaminated with paper thin carbonaceous layers. Contains limonite concretions to three inches in diameter- - -	3
2.	Coal and carbonaceous shale, coal bony. Shale sandy. Weathers down to blossom and bony, lignitic flakes. Pinches out to 1/3 foot in thickness to the north - - - - - - - - - - - - - - - -	1/3-1 1/4
Lower sandstone member.		
1.	Sandstone, gray and buff, fine, micaceous, massive - - - - - - - - - - - -	39
	Total - - - - - - - -	118 5/6-119 3/4

Shaft log of York mine, in the NE 1/4, NE 1/4, sec. 9, T. 9 N. R. 12 E. Reported by Mr. D. E. York.

		Feet
Stoneville member.		
8.	Shale -	20
7.	Sand with rock - - - - - - - - - - - - - - -	7
6.	Blackjack - - - - - - - - - - - - - - - - - -	4-6
5.	Soapstone, light gray - - - - - - - - - - -	4
4.	Blackjack - - - - - - - - - - - - - - - - - -	6
3.	Coal- -	2 5/6-4 5/12

	Feet
2. Blackjack -	0-5/6
Lower sandstone member	
1. Hard sand, in sump - - - - - - - - - - - - - -	3 1/2-4
Depth of shaft to bottom of sump - - - - - -	49 1/2

The Stoneville member of the Fox Hills is extremely variable in thickness. In many places, where the coals are thin, the thickness appears to be less than 10 feet. North of Stoneville the thickness, including coal, carbonaceous shale, shale, and thin sandstones, is at least 46 feet.

The Stoneville member lies disconformably below the upper sandstone member in at least one place. In the NW 1/4, sec.23, T. 9 N., R. 11 E. (section described on page 9) the base of the upper sandstone cuts through the Stoneville member and possibly into the lower sandstone member. Channelling followed deposition of the Stoneville beds and preceeded deposition of the upper sandstone in this place and perhaps elsewhere in the area.

Upper Sandstone Member:

The upper sandstone member is a conspicuous succession composed mostly of sandstone. It includes a lignitic shale 20 to 40 feet above the base and shales and gumbo-like clays in the upper part.

The basal part of the member is massive, buff and gray sandstone of fine, even texture. It is identical in appearance with the massive sandstone below the Stoneville member. In good, fresh exposures, cross-bedding is conspicuous. Above a small coal mine in the NE 1/4, SW 1/4, sec. 14, T. 9 N., R. 11 E., cross beds make up beds to 2 1/2 feet thick. The cross laminae are marked by detrital plant matter. Dips of cross bedding of 23, 24, and 26 degrees to the north were measured here.

The sand at the base of the upper sandstone member is mostly friable sand. In nearly every exposure, however, concretions of cemented sandstone occur in many places of large size. These are from two to five feet thick and range in diameter from a few feet up to 40 feet or more. In the SW 1/4, SW 1/4, sec. 10, T. 9 N., R. 11 E., a sandstone concretion five feet above the base measured 5 feet in thickness, 10 feet in least diameter, and 40 feet in greatest diameter.

The basal sandstone varies from 20 up to more than 46 feet in thickness. In the NE 1/4, sec. 25, T. 9 N., R. 12 E., it is 20 feet thick; in the SE 1/4, NW 1/4, sec. 36, T. 9 N., R. 12 E., it is 38 feet in thickness; and in the NW 1/4, sec. 23, T. 9 N., R. 11 E., where the top is not exposed, 46 feet of it lie above the Stoneville member, and it cuts into the Stoneville member an additional 18 feet, possibly 33 feet.

A bed of highly carbonaceous shale or "blackjack" immediately overlies the basal sand of the upper sandstone member in the southeastern part of the mapped area. The bed apparently intergrades with sandstone and shale in some places. Streaks of coal and some glance coal occur in it here and there. This bed is well exposed in the SE 1/4, NW 1/4, sec. 36, T. 9 N., R. 12 E.; in the NE 1/4, sec. 25, T. 9 N., R. 2 E.; in the SE 1/4, sec. 13, T. 9 N., R. 11 E., and is probably the bed prospected for coal in the SW 1/4, SW 1/4, sec. 26, T. 9 N., R. 11 E. In the latter locality, however, the bed appears to be split by a bed of sandstone. The bed varies from 3 up to 15 feet except in the locality last cited, where a bed of carbonaceous shale 8 feet thick is separated from a bed 11 feet thick by sandstone.

Beds of the Fox Hills lying above those described are for the most part poorly exposed. They consist, however, of beds of gray, brown, and buff sandstone at intervals of from 10 to 30 feet and interbedded clays and shales. The sandstone beds are of fine micaceous sand, for the most part friable, but here and there they are case-hardened. About 90 feet above the Stoneville member, a zone containing large concretions of cemented sandstone occurs. Clays which occur 35 to 45 feet below the top weather into gumbo clays, suggestive of the Hell Creek. They are overlain, however, by sandstone beds of typical Fox Hills character and are therefore included in the Fox Hills formation.

The lower part of the upper sandstone member has been described in sections on preceeding pages. (pages 9-10) Two additional sections, the first including the underlying beds, are described in tables of succession which follow.

Section of the Fox Hills formation exposed along the westward draining valley in the SE 1/4, sec. 13, T. 9 N., R. 11 E.

		Feet
Upper sandstone member.		
8.	Sandstone and silt, mostly sandy silt. Shale layers one inch thick sparingly distributed through upper beds. Sandstone concretions in upper part - - - - - - - - - - - - - - - - -	33
7.	Clay shale, mottled brown, yellow. Plant debris sparingly distributed. Hard, buff, sandy zones. Shows gumbo jointing on surface in upper six feet - - - - - - - - - - - - - - - - - - -	61
6.	Shale, carbonaceous, much plant debris. Contains streaks of glance coal. Brown and lavendar brown -	15
5.	Sandstone and sandy silt, poorly exposed -	30-40

		Feet
4.	Covered interval. Includes Stoneville member and upper part of the lower sandstone member	101
Lower sandstone member.		
3.	Sandstone, buff, fine, micaceous, poorly exposed	35
2.	Sandstone, buff, fine, micaceous. Thin beds of shale two feet above base	7 1/2
1.	Sandstone, shale streaks in upper part. Massive, fine, micaceous; sandstone concretions five feet below top	22
	Total	304 1/2-314 1/2

Section of the upper sandstone member of the Fox Hills in the S 1/2, SW 1/4, sec. 9, T. 9 N., R. 11 E.

		Feet
16.	Sandstone, buff, micaceous	20
15.	Clay shale, buff, and light medium gray. Sandy	16
14.	Sandstone, buff, contains large sandstone concretions	5
13.	Clay shale, buff and gray	6
12.	Sandstone, friable, light gray. Contains large sandstone concretions	10
11.	Shale, gray, flaky	2
10.	Clay, gray, weathers to gumbo	3
9.	Covered slope; probably clay	30
8.	Sandstone, friable, buff	5
7.	Covered slope	10
6.	Sandstone, gray, concretionary, weathers into hard fragments	8
5.	Covered slope	3
4.	Sandstone, gray, concretionary, weathers into hard pieces	3
3.	Covered slope	8
2.	Sandstone, gray, concretionary, weathers into hard fragments	7
Stoneville member.		
1.	Banded shale and sandstone	5
	Total	149

The upper sandstone member of the Fox Hills is at least 149 feet thick.

Fossils:

Fossils are of rare occurrence in the Fox Hills of this region, although beds of carbonaceous shale contain bits of

carbonized plant debris and, here and there, leaf impressions occur in the sandstones.

Marine fossils have not been observed, but in four outcrops, outside of the mapped area, sandy beds contain brackish water fossils. At two of these localities, one in the SW 1/4, sec. 18, T. 9 N., R. 14 E., brackish water pelecypods occur abundantly in six feet of sandstone under approximately 30 feet of banded beds. These beds are thus approximately 160 feet below the Stoneville member of the Fox Hills. Similar fossils occur through seven feet of sandstone at the top of the lower shale and sandstone member in the SE 1/4, sec. 35, T. 10 N., R. 12 E. This bed is approximately 135 feet below the Stoneville beds.

Ostrea globra Meek and Hayden occurs in SE 1/4, SE 1/4, sec. 35, T. 12 N., R. 10 E., and in the NE 1/4, NE 1/4, sec.1, T. 11 N., R. 10 E., 125 feet, more or less, below buttes capped by Fox Hills sandstone and below coal outcropping along U. S. Highway 212, between NW 1/4, sec. 2 and NE 1/4, sec. 3, T. 11 N., R. 10 E.

In NE 1/4, sec. 18, T. 10 N., R. 13 E., brackish water pelecypods are contained in a sandstone lense 0-5 feet thick lying on a zone of shale and coal, the Stoneville member of the Fox Hills.

Thus, there are at least two horizons containing brackish water fossils in the Fox Hills of the region, one at or near the top of the lower sandstone and shale member and the other immediately above the Stoneville member.

The shells are poorly preserved internal molds. All, however, apparently belong to the genue Corbicula. They are members of a brackish water facies fauna and are commonly associated with numerous other brackish water forms, such as Ostrea globra, Melania wyomingensis, M. insculpta, and Anomia micronema. In the type region of the Fox Hills, the fauna occurs in the uppermost beds of the Fox Hills. Members of the fauna, however, occur west of South Dakota in beds much older and in South Dakota in beds much younger than Fox Hills.

The fossils have been identified as follows:

Fossils collected from sandstone at the top of the shale and sandstone member of the Fox Hills in the SE 1/4, sec. 35, T. 10 N., R. 12 E.

Corbicula cardinaeformis White.

C. cf. C. cleburni White.

C. (Lepitesthes) fracta Meek.

C. subelliptica Meek and Hayden.

Fossils collected from sandstone lense above Stoneville member of the Fox Hills in the NE 1/4, sec. 18, T. 10 N., R. 13 E.

Corbicula cf. C. (Lepitesthes) fracta Meek.

Corbicula cf. C. nebrascensis Meek.

C. subelliptica Meek and Hayden.

Correlation and Age:

The Fox Hills beds of the Stoneville area, as indicated in the preceeding pages, lie above Pierre shale containing fossils typical of the Pierre-Fox Hills transition beds. The beds have also been traced northward toward Fox Ridge and Mud Buttes where they pass below the Hell Creek member of the Lance. They thus occupy the stratigraphic position of the marine Fox Hills of the type locality and of the formation in many places in the Dakotas, Montana, and Wyoming.

The portion of these beds to be correlated with the Colgate sandstone, which extends southeastward into South Dakota from the Glendive region of Montana, can only be surmised until tracing and study is continued. Some of the sandstone succession of the Stoneville area above the lower shale and sandstone member is probably of the same age as the Colgate. Possibly all of the lower sandstone member, the Stoneville member, and the upper sandstone member are to be correlated with the Colgate sandstone, although it is suspected that only the upper sandstone member is equivalent to the Colgate. T he terrestrial beds of the Stoneville area occupy a position above a marine succession. The marine succession apparently occupies the same stratigraphic position and is possibly to be correlated with the Fox Hills of the Denver basin. If this correlation is substantiated, the sandstone members and the Stoneville members of the Meade county Fox Hills are equivalent, at least in part, to the Laramie of the Denver basin and probably the "Laramie" in many places in Colorado and Wyoming. This possible interpretation is substantially in accord with that of Thom and Dobbin[1] and furnishes additional suggestion of the identity in age of the Laramie with part of the Fox Hills of the type locality.

White River Formation

Fragments of the more durable materials from White River deposits occur as residuum and in gravel of much later age at

1. Thom, W. T., Jr., and Dobbin, C. E., Stratigraphy of Cretaceous-Eocene transition beds in eastern Montana and the Dakotas: Bull. G. S. A., vol.35, pp. 497-499; 1924.

higher levels in the area.

In one exposure, cemented Chadron gravel lies on yellow Fox Hills sandstone in the NE 1/4, NW 1/4, sec.22, T. 9 N., R. 11 E. The gravel ranges in size of piece from coarse sand up to pieces two inches in diameter. Most of the pieces are clear quartz, but feldspar and dark flint are also present. Grains and pebbles are all more or less worn, although some are subangular. A thickness of three feet is exposed.

The deposit is basal Chadron in age. It is very similar in character to coarse sands and gravels at the base of the White River in Fox Ridge, northern Meade county and elsewhere in South Dakota.

Pleistocene (?)

Thin deposits of gravel occur here and there in the higher parts of the area. The gravel is composed of harder parts of materials from the White River deposits which formerly covered much of western South Dakota. The thickest gravel in the area is exposed at the top of a gently rounded hill cut through by the Fairpoint-Stoneville road, in the NW 1/4, NW 1/4, sec. 20, and the NE 1/4, NE 1/4, sec. 19, T. 9 N., R. 12 E. This deposit is described in the table of succession which follows.

Section of Pleistocene (?) gravel exposed where Fairpoint-Stoneville road cuts through gravel at the top of a gently rounded hill in the NW 1/4, NW 1/4, sec. 20 and NE 1/4, NE 1/4, sec. 19, T. 9 N., R. 12 E.

		Feet
3.	Soil -	1
2.	Gravel, composed of White River wash. Pieces to four inches in diameter; white. Fairly well sorted and bedded - - -	5
1.	Fox Hills - - - - - - - - - - - - - - exposed	
	Total - - - - - - - - - - -	6

Coal

Distribution, Boundaries, and Area:

The coal of the Stoneville area has been traced over the mapped area as indicated on the map. (Pl. 1) The boundary, which is concealed under grass covered slopes to a great extent, has been determined as accurately as possible by plotting of

FIGURE III

Graphic sections including coal and carbonaceous shale in
T. 9 N., R. 11 E., Meade County, South Dakota

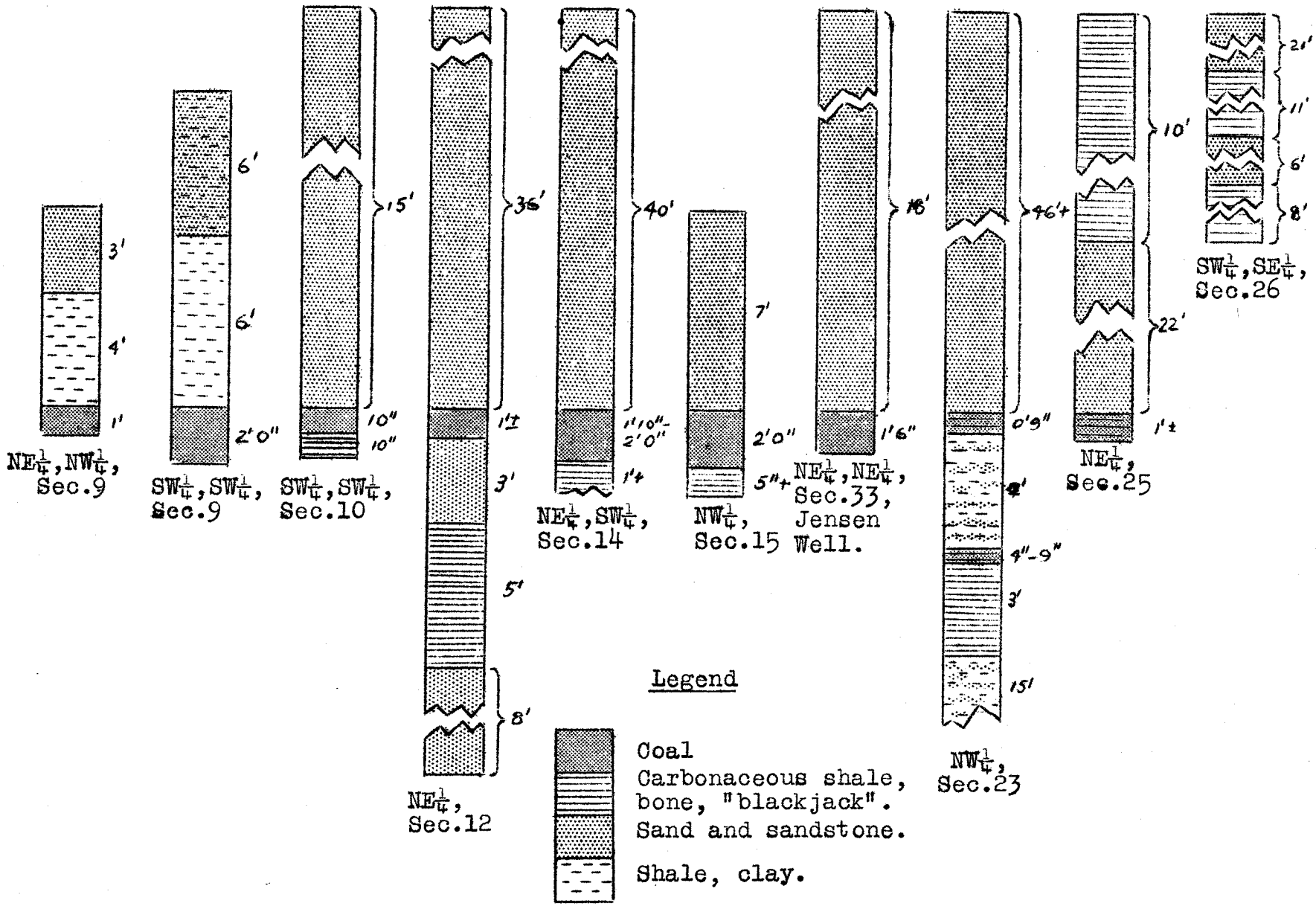
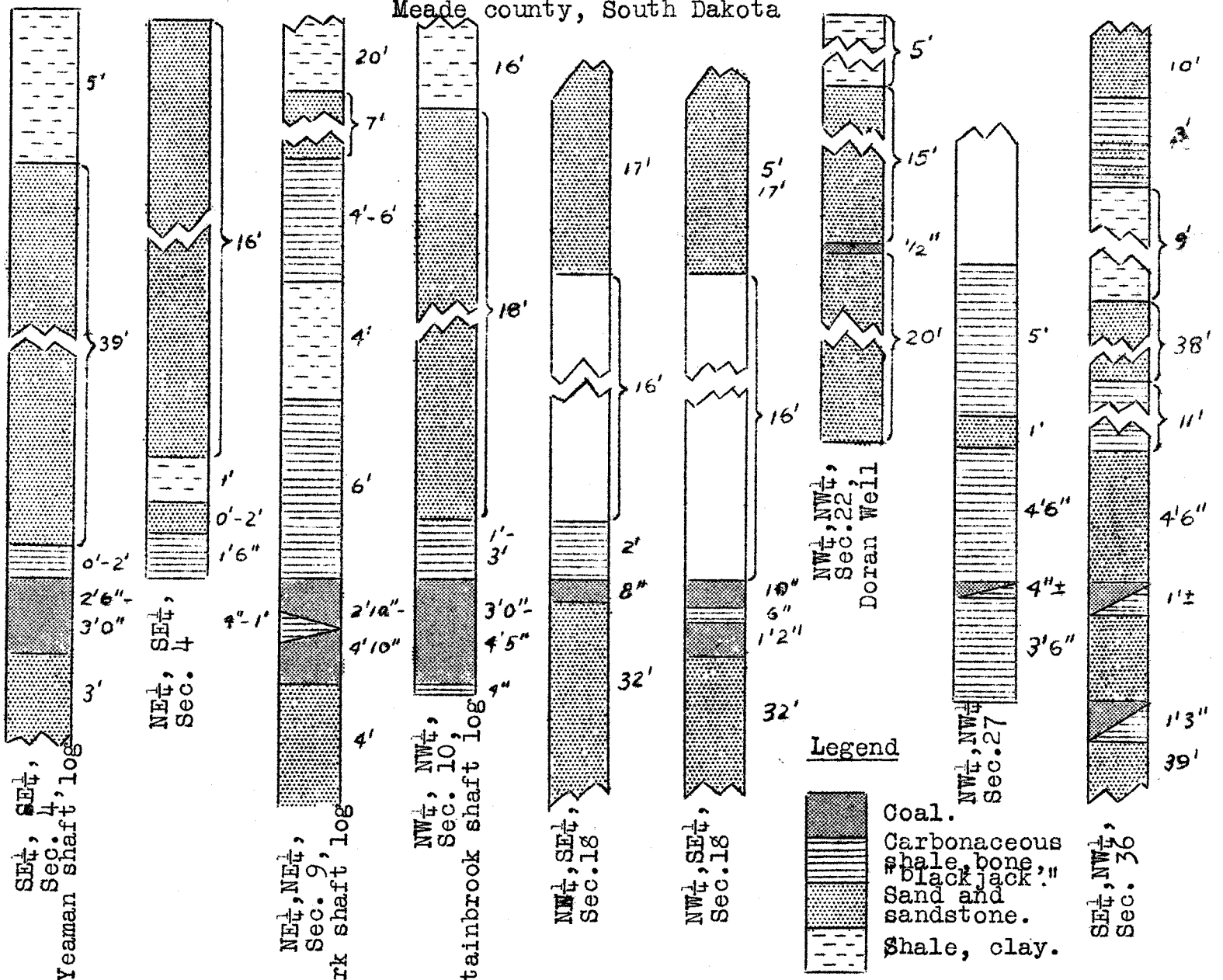


FIGURE IV

Graphic sections including coal and carbonaceous shale in T. 9 N., R. 12 E., Meade county, South Dakota



outcrops of the coal and associated beds. Where determinable outcrops are abundant, the boundary is accurate. Elsewhere the boundary has been inferred from available outcrops and topography and errors are therefore probable. The boundary across secs. 15, 16, 22, 27, 28, 33, 34, 35, T. 9 N., R. 11 E. is based on relatively meager outcrops. The boundary as drawn across secs. 11, 12, 13, and 24, T. 9 N., R. 11 E., and in secs. 7 and 8, parts of secs. 9, 16, and 17 and across secs. 21, 25, 26, 27, 33, 34, and 35, T. 9 N., R. 11 E., is also subject to error.

The total area underlain by coal, as mapped, is 30.5 square miles of which approximately 8.3 square miles are in T. 9 N., R. 11 E., and approximately 22.2 square miles are in T. 9 N., R. 12 E. Only a small part of this amount, however, can be mined because of the depth of the coal below the surface and because of lack of sufficient thickness.

Thickness:

The coal varies in thickness from a few inches up to a thickness of 4 5/12 feet. Over most of the area the thickness probably averages less than two feet. In a small area of approximately 225 acres in sec. 3, sec. 4, sec. 9, and sec. 10, the coal thickens to an average of about 3 1/2 feet. Here, however, variation in thickness is great and ranges between a minimum of 2 1/2 feet and a maximum of 4 5/12 feet in this part of the area. Variation nearly as great, from 2 5/6 feet up to 4 5/12 feet occurs in one mine.

As noted in a preceeding page, the entire coal member is absent in one place, and the position of the coal and associated beds is occupied by the upper sandstone member.

This condition is probable elsewhere in the area. Furthermore, beds of carbonaceous shale or blackjack, so commonly associated with the coal, possibly occupy the position of the coal in many places.

The thickness of coal and of carbonaceous shale is indicated in graphic sections in the accompanying figures. (figs. 3 and 4)

Tonnage:

A total of nearly 50,000,000 tons of coal underlies the Stoneville area as mapped. The figure is computed on the basis of the mapped coal boundary with an estimated thickness of one and one half feet of coal, except in secs. 3, 4, 9, and the NW part of sec. 10, T. 9 N., R. 12 E., where the average thickness was estimated to be 3 1/2 feet. Of this amount only a very small percentage can be recovered. Indeed, except in areas such as this, where imported fuel is expensive, coal of

the rank of the Stoneville beds is not mapped where it is less than 2 feet 10 inches thick. The small area of about 225 acres, in secs. 3, 4, 9, and 10, T. 9 N., R. 12 E., contained approximately 1,300,000 tons of coal before mining was begun. It is estimated that less than 40,000 tons have been recovered from this part of the area and that between six and nime per cent of this part of the area is mined out. Between 1,180,000 and 1,220,000 tons yet remain underground, of which half can be recovered by careful mining methods.

Floor and Roof:

The floor of the coal of the Stoneville area consists of black, carbonaceous shale ("blackjack"), sandstone, or clay. Both the shale and sandstone are satisfactory materials for mine floors. The "blackjack" is tough and somewhat fibrous and does not buckle or squeeze readily, especially under conditions of relatively shallow mining such as those which prevail here. The sandstone, although commonly friable, contains large flattish concretions of cemented sandstone. Even where these are not present, saturation with water does not render the rock plastic.

Clays have not been reported or observed as mine floors, although they probably will be encountered as clay of the underclay type which has been observed in outcrops. Although these clays probably become plastic when water soaked, the mines of the area are mostly dry because of their situation above drainage. Furthermore, the clays are so thin that they should cause little or no difficulty in inducing upheavels of the floor.

Roof rocks are "blackjack", shale, and sandstone, which are good roof materials for the most part. The "blackjack", a tough, dark, carbonaceous shale, is most commonly immediately above the coal; in many cases, particularly where the coal is thickest, it is of considerable thickness. (figs.34) Gray shale, which is jointed into small pieces, occurs in some mines. In these cases, however, the shale is thin and occurs where the coal is thin. All or most of the shale is thus brushed down over openings and entries and causes no particular difficulty.

Mining Methods:

Mining methods in the area are simple. In secs. 4, 9, and 10, T. 9 N., R. 12 E. the coal bed is reached by shafts 39 to 50 feet in depth. Elsewhere most of the thin coal is mined from drifts into the sides of valley walls and hills. Topographic position of the coal eliminates stripping for the most part, although small amounts of coal have been recovered by this method.

In the shaft mines, where the coal is between 2 1/2 and 4 5/12 feet thick, only the main entries are brushed down to head height. Timber is used little, if at all. Rooms 12 feet wide and 20-30 feet long are turned off the main entries. Pillars

4 by 6 feet are left for roof supports in some cases, but in others two or three small pillars 2 1/2 to 3 in diameter are left in the larger rooms. The coal is hoisted to the loading tipple above in buckets, horses being used on the hoists. Coal is shot from the solid. Dynamite and pyratol were formerly used, in one mine at least, but because of the relatively brittle character of the coal, slow black powder is now used in blasting.

Character of the Coal:

The coal of the Stoneville member of the Fox Hills is bright, black, hard, and relatively brittle. The streak, color of the powdered substance, like other South Dakota coals, is brown. It is much darker, however, than that of most South Dakota coals. In the outcrop it is horizontally banded and is jointed vertically into blocks.

The coal is composed for the most part of alternating very thin lenses of dull and bright coal, the bright being sufficiently abundant to give the coal a bright surface where it is freshly broken. Coal along joints, on the other hand, is dull and red stained in many places and much dull coal occurs in some outcrops. The entire bed appears to be mostly dull and bony in many outcrops and small mines.

This coal, like the Isabel-Firesteel bed of the Hell Creek of Corson, Dewey and Ziebach counties, contains resin bodies in unusual amounts. These are pale lemon yellow, irregularly shaped bodies of brittle fossil resin. Some specimens show several to the cubic inch of coal ranging from mere specks up to one fourth inch in diameter. They are reported to attain the size of over one half inch.

In many places, the coal contains small, pebble-like masses of light gray shale to one half inch or more in diameter. The lower bench in SE 1/4, NW 1/4, sec. 36, T. 9 N., R. 12 E. contains small sandy pebbles.

Fusain or "mother of coal" occurs rarely in the Stoneville coal. This substance is charcoal-like in appearance and occurs as scattered fragments on bedding planes in the coal.

Rocks and Structures in and Associated With the Coal:

In addition to pebbles and pebblelike masses in the coal, sandstone dikes have been reported, and carbonaceous shale commonly occurs in the coal beds. Vertical sandstone dikes, four inches to one foot thick, occur in the coal.[1] They average between four and eight inches in thickness. They originate below the "blackjack" of the floor, continue upward through the coal into the "blackjack" of the roof. The dikes

1. York, D. E., Stoneville, So. Dak., personal communications, 1933.

are strongly impregnated with iron pyrite. No vertical displacement of coal has occurred at the sides of the dikes since the coal on one side is on a level with that on the other. The sand appears to have been squeezed upward through these beds from sandstone below through joints and shrinkage cracks in the coal and the associated beds.

As previously described, carbonaceous shale occurs both above and below the coal. It also occurs in the coal bed and has been reported to be between four inches and one foot in thickness in the NE 1/4, NE 1/4, sec. 9, T. 9 N., R. 12 E., where it lies at about the middle of the coal bed. Outcrops suggest that in some places the position of the coal is entirely occupied by carbonaceous shale.