DESCRIPTION OF THE PARKER QUADRANGLE.

By J. E. Todd.

GEOGRAPHY.

GENERAL RELATIONS.

Eastern South Dakota has its Great Plains in the broad, indefinite area in which the plains merge into the prairies of the Mississippi Valley. It is comprised within the area which in most of its surface features shows the characteristic of a drift-covered region. The country is generally level or presents rolling slopes rising to broad expanses of plains. The principal elements of relief are long ridges of terminal moraines, accumulations left by the ice, marking various stages of glacial equilibria, advance, and retreat. Further diversity of topography has been produced by the excavation of the valleys, especially that of the Missouri, which has cut a trench several miles, now fairly deep, with steeply sloping sides. Between these moraines there are rolling plains of till and very level plains due to the filling of, and by, the ice. The middle James River Valley presents a notable example of this lake-basin topography.

Location.

The Parker quadrangle is located between latitudes 47° and 48° 30' north, and between longitudes 97° and 98° 30' west, and comprises about 87 square miles. It lies chiefly in Turner County, but includes also portions of Hutchinson, Yankton, and Clay counties, S. Dak. It occupies portions of the townships of Beaver Creek, North and South parts of Turkey Ridge, and one township of the townships of Pottery and East Coteau, all of which flow southeast into Missouri River, although they are seldom exposed east of Missouri River, although they have furnished important facts concerning the position of the quadrangle, as shown by many borings, and illustrating the composition of these formations in the quadrangle as observed in certain wells.

Topography.

The surface of the quadrangle is sufficiently level for agriculture, being mostly a sandy plain, poorly drained, and having a width of from 10 to 12 miles, which are deep enough to contain water, and are somewhat larger in size than the general surface. The trough of the river is cut in the bottom of this basin and has a depth of about 100 feet and an average width of half a mile. The streams forming the tributaries of the river are cut in the same manner. The James River Valley is one of the valleys of the greater Missouri River system, extending from the point of its union with the Missouri River near Pierre, S. Dak., to the vicinity of Jamestown, N. Dak.

The James River is about 1000 feet wide, with an average depth of 10 feet. The bed of the river is composed of sand and gravel, and is frequently crossed by bluffs, which are from 50 to 100 feet high, and in some places much less than that.

GENERAL GEOLOGY.

The surface of eastern South Dakota is in large part covered with a mantle of glacial deposits consisting of gravel, sand, silt, and clay of varying thickness, which is described under the heading "Prairie deposits." The formations underlying eastern South Dakota are seldom exposed east of Missouri River, although they are covered by a mantle of glacial deposits consisting of gravel, sand, silt, and clay of varying thickness, which is described under the heading "Prairie deposits." The formations underlying eastern South Dakota are seldom exposed east of Missouri River, although they are covered by a mantle of glacial deposits consisting of gravel, sand, silt, and clay of varying thickness, which is described under the heading "Prairie deposits." The formations underlying eastern South Dakota are seldom exposed east of Missouri River, although they are covered by a mantle of glacial deposits consisting of gravel, sand, silt, and clay of varying thickness, which is described under the heading "Prairie deposits." The formations underlying eastern South Dakota are seldom exposed east of Missouri River, although they are covered by a mantle of glacial deposits consisting of gravel, sand, silt, and clay of varying thickness, which is described under the heading "Prairie deposits." The formations underlying eastern South Dakota are seldom exposed east of Missouri River, although they are covered by a mantle of glacial deposits consisting of gravel, sand, silt, and clay of varying thickness, which is described under the heading "Prairie deposits." The formations underlying eastern South Dakota are seldom exposed east of Missouri River, although they are covered by a mantle of glacial deposits consisting of gravel, sand, silt, and clay of varying thickness, which is described under the heading "Prairie deposits." The formations underlying eastern South Dakota are seldom exposed east of Missouri River, although they are covered by a mantle of glacial deposits consisting of gravel, sand, silt, and clay of varying thickness, which is described under the heading "Prairie deposits." The formations underlying eastern South Dakota are seldom exposed east of Missouri River, although they are covered by a mantle of glacial deposits consisting of gravel, sand, silt, and clay of varying thickness, which is described under the heading "Prairie deposits."
which it supplies an abundance of water. By reason of these well sites, the formation is known to underlie the central and southern portions of the quadrangle, thinning out gradually to the north and northeast. As the surface of the quadrangle is uneven the outer margins of Dakota deposits undoubtedly is irregular. In the southern part of the quadrangle the Dakota sandstone has a thickness of 200 or 300 feet, but as deep borings in that region are few and as none is definitely known to have passed through the formation, this thickness is only an estimate. Exposures elsewhere and from borings in this quadrangle it is known that the formation is composed of sheets of sandstone more or less completely separated by beds of clay and shale. The sandstone strata are usually of fine-grained, well-rounded, and very in thickness from 10 to 150 feet. The clay deposits are thick and very fine, dark clay or hard shales. The number of water-bearing sandstone strata in the Dakotas increases toward the south as the formation thickens. Three or four well-defined horizons are composed mostly of shale and clay, with occasional sandstones and siltstones of considerable thickness in some places. It was named from Benton (his species eburnea) near Devil's Tower near Washakie, Wyoming, but its most valuable water resources are probably under the central and southern portions of the Niobrara and some distance up that stream. The distinctions most easily recognized are lithologic, as already given.

Niobrara formation.—This formation is known as the uppermost unit in wells which extend to its limits and is not definitely known to have passed through the formation. The cements of the Dakota sandstone in this region may be enumerated in chronological order as follows: (1) Cretaceous sands and gravel; (2) silt or till, separable into the yellow or upper, lower or breaking; and (3) marlstones, which include those of two distinct epochs, with minor subdivisions; (4) limestones and karstic deposits; (5) Cretaceous and Jurassic rocks. The differentiation of these epochs is usually done by the fossils associated with them. The distinction most easily recognized is lithologic, as already given.

Pierre Shale.—This formation occurs only in well records and to its limits are not definitely known to have passed through the formation. It has been described under that head.

TERTIARY DEPOSITS.

The formations of Tertiary age we have no representative except possibly of the lower Neocene (Pliocene). The light-colored, No. 5, of the section just given, may possibly belong to that age. A similar deposit is found a mile or two east of the exposure, and from a collection of well borings it appears that this formation may be in some other places under the Dakota sandstone. It seems to be a band formation—probable in nature and differs from the Dakota sandstone. It may be the deposit of some gently flowing stream or lake. It resembles in its general texture the Dakota sandstone in that it is in color and sandstone and is everywhere to be wholly more to be sandy. Part of the deep sands on Turkey Ridge below the drift may be Pliocene.

PLIOCENE DEPOSITS.

Extinct forms of life are found only in well records and to its limits are not definitely known to have passed through the formation. The drift of the Dakota sandstone in this region may be enumerated in chronological order as follows: (1) Cretaceous sands and gravel; (2) silt or till, separable into the yellow or upper, lower or breaking; and (3) marlstones, which include those of two distinct epochs, with minor subdivisions; (4) limestones and karstic deposits; (5) Cretaceous and Jurassic rocks. The differentiation of these epochs is usually done by the fossils associated with them. The distinction most easily recognized is lithologic, as already given.

This has not been proved by direct observation. In the bluff of James River at the southern boundary of this quadrangle deep deposits of drift sand, and gravel are found underlying the upper till. The lower till has not been clearly recognized, but from the depth in which it is necessary to go for water wells there is very little doubt that the till occurs above the gravel. The distance which this intercalated sheet of sand and gravel, up the valley of James River has not yet been determined.
The blue till is frequently spoken of as joint clay from the fact that it is usually divided into polygonal blocks by irregular joints crossing one another at slight angles. However, when the formation lies upon a slope, so that in the vicinity of streams, though it is less plastic than the brown earth, it is subject to landslides, which cause it to cover the underlying sands. The surface of this till in this quadrangle, and elsewhere in this region, abounds in shallow basins or lake beds, which, in the wet season, may be filled with water. In some localities these are so deep that they retain water several feet in depth year after year, but frequently the evolution of the thawed soil is followed up by the ascending water and are capable of filling. Since none of them are supplied except by rainfall, even the deepest are likely to become empty after a succession of dry years.

Morrison.—These are local developments of the till in the form of elevated ridges, usually with a rougher surface than the surrounding country. The intervening depressions and basins are also more marked than the depressions cemented. The ridges or knobs are often abrupt, rising perhaps to the height of a small hill. These ridges are well defined on the map, the process of melting persisted its further advance and the clay and gravel contained in it were dropped along a ridge. In this quadrangle there are portions of two systems of moraines. This is shown not only by the facts presented in the quadrangle, but also by the relations of these deposits to the moraines of adjacent areas. These moraines lie wholly within the area occupied by the advance of the ice sheet, and, unlike earlier advances, marked its different stages by the formation of conspicuous moraines. These, however, are not as distinctly marked in this area as in Wisconsin and in the northern part of South Dakota.

This oldest moraine of this area has been called the Almont, from its development near the town of that name in South Dakota. Representations of the earlier stages of that moraine are found in the central portion of Turkey Ridge, and in that locality they are not distinctly separated from those which, it may be presumed, were formed considerably later. The ridge is the flattest in the first portion of the eastern exposures, and the sheet moved out, and doubtless the land first exposed from the Almont, as far as the 90-foot contour, lay near the north end, a great majority of the bowlders, excepting those over 400 pounds in weight, which are steeply inclined in a southwesterly direction, and the smaller degree of elevation of the lobe. It is then that the bowlders of the Gary moraine are peculiarly as contrasted with those of the Almont, in which, it is supposed, the first drainage channel of the receding moraine lay between the James and the eastern edge of the ice beyond the borders of the Parker moraine. From the description of the Almont moraine, the drainage of the James River valley, northwest of Yankton, is indicated by the occurrence of glacial drift in the vicinity of Pipestone, Minn., and Sioux Falls, S. Dak.

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of sand until the intervening spaces were entirely filled. The material of the quartzite was laid down in the sea, and at first may have included sands, or even boulders of limestone, of which there is no trace. In time the region was lifted above the sea, and during some part of all or of the Paleozoic, Triassic, and Jurassic eras the sand, or a portion of it, it may have been submerged and have received other deposits, but if so, they have not been exposed.

In this quadrangle, as throughout this general region, there is no evidence of Palaeozoic, Triassic, or Jurassic formations. The surface of the Sioux quartzite shows marks of strong erosion at an elevation far above sea level. The Paleozoic rock nearest to this quadrangle, so far as has been discovered, was found in borings at Fosca, and at Sioux City, Iowa, and in the mountains immediately south of the Appalachian region and the extensive coal fields of the eastern part of the Mississippi Valley, where the formation was probably a land surface. It is possible that soils and vegetation that may have extended over it were removed by the advance of the sea during the Cretaceous period. At any rate, no trace of soil of any kind is found on the surface of the country.

During the Neocene period the sea withdrew from the west which now flow into the Missouri. Most of the channel which is now occupied by the Missouri was filled by sand until the intervening spaces were entirely filled. The material of the quartzite was laid down in the sea, and at first may have included sands, or even boulders of limestone, of which there is no trace. In time the region was lifted above the sea, and during some part of all or of the Paleozoic, Triassic, and Jurassic eras the sand, or a portion of it, it may have been submerged and have received other deposits, but if so, they have not been exposed.

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The original source of this supply is the rainfall, the same as in the case of shallow wells, but it is a more constant supply because the water enters it more gradually. It is more continuous and does not waste in evaporation, as in the former case. It should not, however, be considered in inconsiderable. If the supply is drawn upon too freely it may be expected that these wells will gradually fail, beginning with those in the more elevated regions. Therefore, a boring may be expected that these wells will gradually fail, beginning with those in the more elevated regions.

The way in which the water enters this stratum reaches these wells. The advantages of this are obvious. In the Parker quadrangle, the upper course of the river, the Yellow Mill Creek, is a source of the Pitchstone, and several smaller streams, as well as various oozing springs from the well, might also be added materially to this supply. Moreover, in some places, although not everywhere filled with water, especially in the lower sandstones of the Dakota formation, besides one in the sands of the Benton formation, and in the vicinity of the Upper Cretaceous shale, a more constant supply because the water enters it more gradually. Such wells are frequently developed in the till, and are more likely to be reached short of the main artesian supply. The main supply of artesian water not only under much of eastern South Dakota but in a wide area in adjoining States. It owes its efficiency to four factors: (1) It is the result of pressure and altitude of the surface the artesian flow is limited to the portion shown on the Artesian Water sheet. In boring wells, a water-bearing stratum in which the water is under pressure is generally spoken of as a "flow" and the well is classed as "artesian," although some persons would limit the term "artesian" to wells in which there is sufficient pressure to raise the water to the surface. From a comparison of the sections of different wells, it appears that the sand in the Dakota formation is more or less divided into sheets by intercalated beds of clay, the permeable sandy deposits extending out in wing-like sheets. There are in this region at least three well-marked flows in the Dakota formation, besides one in the sands of the Benton formation, but in this bed the water is not under sufficient pressure to produce flowing wells in the vicinity of the exposure, and probably not in this quadrangle. On the Artesian Water sheet the deepest of the water-bearing strata are indicated by patterns, and the areas in which flow should be expected are shown by distinctive coloring.

From a comparison of depths, pressure, and amount of flow, it is inferred that not only are the water-bearing sandstone beds mainly in sheet form but these sheets rise as they approach elevated portions of the underlying formations. Against this each sandstone stratum along a line marking the position of the sandstone at the time the sand was deposited. Hence the beds do not extend so far north and east as the Upper Cretaceous and are more slowly sloped along their eastern margin. It is not impossible that, by the interpretation of carefully taken pressures, evidence may be found showing that different water-bearing sandstone sandstones communicate imperfectly with one another along the contact of the quartzite. As the sandstones lie in widely extended sheets, with intervening deposits of shale or clay, they dissolve very gradually in the water-bearing strata, and in some cases may be considered at any length apart from the sandstone-well supply. Many tubular wells, especially on the eastern margin of these strata, as well as various oozing springs from the well, might also be added materially to this supply. Moreover, in some places, although not everywhere filled with water.
the surface, which, although it appears to be a level plain, in fact slopes 250 feet or more to the south. The number of flows and the distance between them become important questions to those who may desire to sink wells near the margin of the artesian area. If the uppermost water-bearing stratum has not sufficient pressure to force the water to the surface, the drilling must be continued until another stratum with sufficient head is reached. In the colored areas on the Artesian Water sheet showing depths to the water-bearing beds appear irregularities which are largely from this cause. Other conditions, however, conceivably produce irregularities.

At least five factors affect the problem, viz.: (1) the altitude of the point considered; (2) the pressure in the underlying water strata, which decreases in all strata toward the direction of front leakage, and increases with the depth of the strata below the surface; (3) the dip of the strata, in this quadrangle usually toward the southeast, while in the northern province, it must be taken into account; (4) the number of underlying water-bearing strata, which is usually two or three; (5) the vertical distance between successive strata. According to the reports of wells in the vicinity of the James River Valley the most important strata are from 75 to 100 feet apart. This appears from the following data: In a well in NW 1 sec. 54, T. 95, R. 57, there are two at 300, 400, and 475 feet; at the Excelsior Mill well, Yankton at 300, 375, and 450 feet; in sec. 20 T. 94, R. 54, at 250 and 300 feet; and in the southern part of T. 95, R. 54, at 250 and 500 feet, with a flow between the common observation well and Yankton reports flows at 375, 390, 405, 450, and 450 feet, indicating subdivision of the usual strata of the usual depth. Most wells show fewer than three flows, hence, in the western part of T. 95, R. 55, it has been assumed that the middle stratum of the three is as weak as to be ignored. This harmonizes with the records of wells a few miles east and south, which show the well a few miles west had to go as deep.

Amount of flow.—Artesian wells vary greatly in the freedom with which they supply water. Compared with the larger wells those of small diameter, because of the greater friction of the smaller pipe, afford a supply much smaller than the ratio of the diameters of their discharge. It may be thought that differences in completion of supply are primarily due to differences of pressure, but this is not the case. For example, some wells in the vicinity of Leecher, in the Mitchell quadrangle, deriving water from the second water-bearing sandstone, offered only a small flow from a 2-inch pipe, and yet the pressures ran up to 50 or even 70 pounds; while others in the vicinity deriving their supply from the third water-bearing sandstone, offered several hundred barrels a day with less than half the pressure. The primary factors, therefore, regulating the amount of discharge are the porosity of the water-bearing strata and the perfection of the equipment of the wells. In general the artesian water sheet is of coarse texture, and the usual supply of the water therefore more free. For example, at Leecher there are two wells not far apart which are of the same depth. The pressure of either taken alone is about 40 pounds, while about a mile away another well supply from the same water-bearing stratum is of the same depth. The pressure of either taken alone is about 40 pounds, while about a mile away another well supply from the same water-bearing stratum is of the same depth. The pressure of either taken alone is about 40 pounds, while about a mile away another well supply from the same water-bearing stratum is of the same depth.