University of Wisconsin-Extension

GEOLOGICAL AND NATURAL HISTORY SURVEY
3817 Mineral Point Road
Madison, Wisconsin 53705

M.E. Ostrom, State Geologist and Director

# A BRIEF DESCRIPTION OF THE GEOLOGY OF JUNEAU COUNTY

by

[E.F. Bean?]

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A BRIEF DESCRIPTION OF THE GEOLOGY OF JUNEAU COUNTY

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Info needed Bruce Co

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General Description

Juneau County lies about 50 miles due south of the geographic center of Wisconsin. Its area is 802 square miles which is only about 2 percent greater than the average size of the 71 counties. The County Seat is at Mauston, some 80 miles northwest of Madison. Population in 1930 was 17,264 which is an average of 21.5 inhabitants per square mile. The average for the state as a whole was 53.2 per square mile.

The County lies in two of the major geographic provinces of the State, the Central Plain which includes all or parts of adjacent Monroe, Jackson, Wood, Clark, Adams, Waushara, and Marquette counties, and the Western Upland, which includes adjoining Monroe and Sauk counties. The highest and lowest elevations are about 1350 and 850 feet indicating a maximum relief of about 500 feet. The higher elevations are concentrated in the southwest, the north and east having an average elevation of slightly above 900 feet. Details of physiography are discussed in the following paragraphs.

Fully 75% of the county is a low-lying plain sloping southward at the rate of about 4 feet to the mile. Locally the underlying sandstone rises gradually above the plain in low mounds, frequently to become exposed on their summits, or it juts abruptly above the plain in isolated crags. Excepting only its southern part, this province is monotonous and depressing. In shallow sags sedges grow rankly on small shrunken remnants of their former domains. Poplar saplings shimmer in the sun around their margins. Jack pine and scraggly dwarf oak compete for sustenance on the low swells. Harsh ground cover is thin and varies in details detectable only by trained botanists. Loose, ashen-gray sands shift in the wind. Across country stretch straight white ribs of sand on the banks of dry ditches. With blind perfection, the sole resource of the region - water - has been drained. Few settlers are to be found in this province. The intermediate province to the south, although partly plain, presents a far different aspect. Its northern

boundaries are sharply marked by abrupt change to superior vegetation which reflects a heavy clay soil and more abundant moisture. The Lemonweir River meanders sluggishly through this area. The southern major province is a rough, intricately and deeply dissected limestone and sandstone upland about 300 feet above the plain. Here on ridges and spurs are fine soils, abundant fine farms, and remnant stands of hardwoods. The steep and rock-walled narrow ravines are cool and damp and are grown to mixtures of hardwood and hemlock simulating northern forests. The valley of Baraboo River and the lower reaches of its major branches are wider, flat-bottomed, and their walls are commonly less precipitous. Here too are tilled lands and pastures. This is the sub-province of the map. The contrasts between the two major provincew are many and are deeply rooted in their Natural History.

Origin of the two Provinces

Formerly, the surface of the County had lain at a uniformly higher elevation. The sandstones and limestones of the southern province, and others now present only in counties to the south and west, had extended to the north far beyond the boundaries of Juneau County. Although commonly referred to as flat-lying, these formations are gently inclined to the south and west, and stream erosion, operating incessantly in the same direction through vast periods of time, has been wearing them away. They are still retreating in this direction. To the north, in north-eastern Wood County, they have long since been entirely eliminated. Between that region and the north margin of the southern province of Juneau County, the general slope is relatively smooth and only sandstones remain of the series of alternating limestones, shales, and sandstones hundreds of feet thick. The abrupt change of conditions at the north margin of the southern province of Juneau County is due to the presence there of a much more resistant formation at about the 1050 foot elevation. This formation has temporarily protected the weaker sandstones below

and has slowed up the process of destruction. Erosion working at the foot of the cliffs undermines them by propagating the cliff condition by causing the resistant beds to fall. The many bluffs, crags, and rocks scattered over the plain, but most numerous toward the south, are like the stragglers of a routed army. They have been cut off and surrounded, and all stages of their inevitable extermination may be seen. These general physiographic conditions have existed for geological periods. The most recent event in the history of the region is the Glacial episode.

The entire County escaped glaciation although ice fields overrode the greater part of the state. They failed by miles to invade Juneau County, halting some ten miles to the north, twelve to twenty miles to the east, and about four miles to the southeast. Accordingly, there can be no morainic deposits in the County. However, melt waters from these ice fronts flowed into the County and produced slight effects. Moreover, the eastern ice-front joined the Baraboo Range not far to the southeast, forming a dam across the natural drainage way and impounding waters which rose to an elevation of about 980 feet and flooded fully 75% of the County. All of the northern and the intermediate provinces was flooded excepting the higher of the small scattered uplands and isolated crags, which existed as islands. The Southern province, with elevations rising to above 1300 feet, presented an irregular shore line with bold headlands and island fringes alternating with long narrow embayments of the lake. The Baraboo Valley and its major branches thus inundated constitutes a small distinct sub-province.

The Northern Plain Province

The surface of the northern province before flooding was evidently not greatly different from conditions existing today. The topography was mild with possibly a greater number of prominent islands. One distinct difference was the presence of deeper valleys along the present Lemonweir, Yellow, and possibly Beaver rivers. Deposits of clay here are indications of deeper water under the glacial lake and drilled wells show loose filling to considerable depths. A well at Necedah shows

a depth of 198 feet including 70 feet of clay. Others at Mauston show 30 to 100 feet of fill, chiefly sand. At Shennington, just over the line in Monroe County, two wells are reported to have passed through 26 feet of the laminated clay.

The surface materials of this northern province are mainly sands with minor amounts of chert. The latter represent the persistence of this insoluble residue from the limestone that once covered the region. The sand is mainly residual from sandstone like that now seen in Cranberry and Petenwell rocks, the Hog Island bluff, and the hills northeast of Mather. These residual materials are the Boone sands of the soils map. The areas of undifferentiated sands and peat are essentially the same though they may have been shifted by wind action and mixed with organic matter in the lower marshy tracts. At the present time the organic matter has been largely destroyed by fire. The Plainfield sands in the east represent the same with admixture of igneous sands washed in by the Wisconsin River in late glacial time.

The Glacial Lake caused two main effects. Its waves probably under-cut the base of the higher mounds causing rock fall and a steepening of the cliffs. Lower mounds entirely submerged were probably smoothed by currents and waves which shifted the sands. The general surface probably was more or less billowy with dunes of all sizes, and these were smoothed over by the lake. The second effect was the deposition of fine rock flour and clay material contributed by melt waters flowing into the lake from the ice fields. These ice fields had traversed the eastern counties that contain limestone of which they had accumulated considerable loads. Since the ice fronts lay some distance away, only the finer materials were carried into Juneau County. The only trace of these is found along the Lemonweir, the Yellow, and to some extent the Beaver. Reference has been made to the probable presence of deeper valleys along the pre-glacial courses of these streams. The clays have not been found anywhere outside these valleys. The probability is that had they been temporarily deposited in shallows, they would have been shifted into the deeper water. The clays are of variable thickness indicating either deposition upon an

irregular floor, or subsequent erosion. At Necedah they are 70 feet thick, according to the record of a drilled well. At Shennington, in Monroe County, in the Lemonweir Valley, twowells are reported to have passed through 26 feet. An exploration in them to locate a deposit for use in surfacing State Highway #21, showed 13 feet, while others a mile or twowest showed only 6 feet with sand below.

In the later stages of glacial history, while the ice dam was dissipating, and ultimately when the Wisconsin River had cut its new channel through the Dells, the lake waters gradually receded. The relatively higher ground to the north was first exposed. Its sands were probably to some extent moved gradually southward, and ultimately exposed to wind action. Any fine silt within reach of the winds was blown away. The clays are now found under several feet of sand, and this cover is perhaps accounted for by the shifting action of these receding waters. The Wisconsin River evidently continued to carry heavy loads of sand as indicated in the belt of Plainfield sand of glacial origin which forms a relatively higher deposit correlating with periods of flood. Subsequently, the river has cut its channel through these deposits.

In still later time, the Lemonweir and to some extent the Yellow, have removed the sand cover and cut channels into the laminated clays. There are various mixtures of fine sand, silt, and clay. Combined, they represent the Superior soils of the soils map.

In the sand plain, although there is little traffic to be served, the town roads, and State Highway #21 which runs straight west through Necedah, have required some kind of binding material to hold the loose sands. The only two local materials are the clays and deposits of bog iron ore. The clays are confined to the southern belt and bog ores have been used to some extent in the north and along part of Highway #21. The bog ores are not very satisfactory particularly in dry weather for they produce a very disagreeable red or yellow dust. They are essentially cementations, or crustifications of iron oxide in the loose sand. There

are all gradations between mere coatings on the sand grains and hard, thoroughly cemented rock-like masses comparable to the sandstones of the higher areas.

The origin of the ores is simple. The ground water carries ferrous iron in solution probably as the bicarbonate. At the water-table atmospheric oxygen comes into contact, oxidizes the iron and causes precipitation of hydrated iron oxide. Interesting observations were made in the valley of Yellow River, on the north line of section 11, T. 19, R.3E. A hole was dug through a hard, rock-like deposit just below surface. Below this were loose sands extending down to water table. At the latter horizon the sands were mixed with a slimy deposit of yellow limonite. The purpose of the work was to examine the relative acidity conditions through the soil profile. The yellow deposit was strongly acid. The sands both above and below water-table were neutral or slightly alkaline. Similar results had been obtained elsewhere and the explanation seems to be that the carbonic acid, set free by the oxidation of the ferrous carbonate, although a weak acid, gives the observed acid reaction.

The ultimate source of the iron in the ground water is not so clear. The sands certainly contain too little iron to account for the deposits. They are nearly pure silica. The cements of the sandstones of the region are reported to contain iron carbonate, however, and the leaching of this by the solutions produced in the decaying peat in the marshy tracts, is a possible source of the iron.

It is interesting to note that the yellow deposit just described on Yellow River lies two to three feet below the upper crust. This region has been rather thoroughly drained by ditches which dropped the ground-water level rather suddenly. The two deposits of bog ore are separated by about four feet of loose sands.

It is of further interest to note that the deposits farthest northeast, therefore on higher ground, are most commonly the deep red variety and fairly loose. The present ground water table is 6 to 10 feet below surface, suggesting that these bog ores were deposited very soon after the withdrawal of the lake. Since that time the

deposit of hydrous limonite has become dehydrated, and the volume shrinkage has reduced the mass to the granular state.

The cementation by iron oxide is observable to some extent throughout the plain province. Many holes were dug throughout the province, however, and the deposits rich enough to be called bog ores seem to be more abundant between the Yellow and Wisconsin rivers. None of any note were found very far west of the Yellow.

The Southern or Upland Province

The dissected upland province was also probably very much like its present condition in glacial time. It, of course, stood above the level of Glacial Lake Wisconsin. Its surface materials also are mainly of residual origin. The rock formations, as indicated in discussing the origin of the provinces, are flat-lying sandstones, shales and limestone. The highest elevations are slightly above 1300 feet. At this elevation and down to about 1275 feet occurs Lower Magnesian limestone. Its areas are small. The surface material here is a tough, heavy clay with blocks and fragments of chert. These represent the insolubles from which the lime and magnesia have been leached. The limestone had once extended completely across the County but has been reduced by erosion to these few small, irregularly shaped areas. On nearby lower ground are scattered blocks of chert from the very resistant basal member of the formation. The chert pebbles found not uncommonly out on the plain to the north are of this origin.

On lower ground, down to between 1000 and 1050 feet, depending on location, the higher formations are sandstones, more or less shaly and at the top slightly dolomitic; and below them are thin-bedded shaly sandstones also containing some lime or dolomite. On the higher ground in this interval the surface material is mainly sand, Boone of the soils map, and originating, of course, in the break-up of the higher sandstones. Conical rock hills are not uncommon. In the lower range, surface materials are silt, and fine sandy silt mixtures. These are the

Knox loams of the soils map. They occur over the greater area of high ground in this province. Rock exposures show thin-bedded sandstone and yellowish shales with a sprinkling throughout of dark green sand. Some thin beds are almost pure concentrates of the green sand. In many of the rock exposures, pits have been dug by the highway authorities to get material for surfacing the roads. The sides of these pits show a gradation upwards from rock to fine textured loams containing fragments of thin-bedded sandstone. To some extent, therefore, these surface materials are of residual origin. There has been no removal of residual material by the glacial method and the fine texture of the soil correlates well with the fine sands and shale matter in the formations of the interval. They are coextensive with the spurs and ridges just above the cliffs of sandstones. However, the fact that wind blown material, loess, is abundant farther west on these uplands, compels consideration that some of the finer constituents of these soils were of loessial origin.

At the edge of the upland spurs and ridges, occuring at about the 1050 foot elevation along the north side, but at lower elevation to the southwest, there occurs a change in the rock. The green sand ~~disappears~~ and the shales have disappeared. A hard brownish red sandstone and a red shale occur at this position. The slope below is precipitous over yellowish sandstone cliffs. The ravines are commonly V shaped in their upper ends and the loose material is generally sand. In the lower reaches the bottoms widen out and are flat with stratified silty and fine sandy soils. These lower reaches were covered by the glacial lake. Their stratified silts and clays are analogous to those along the Lemonweir. At Wonewoc, they are 54 feet deep.

The sandstones that form the walls of the ravines extend down to considerable depth, and of course, at depth they are continuous out under the northern province. The various crags and mounds such as Mile Bluff, Sheep Pasture Bluff, Petenwell, and Cranberry rocks and the many lower sandstone exposures are residuals of these formations. The greatest depth to which they are known to extend is to the 463 foot

elevation in a well near Wisconsin Dells. With the highest point some 1275 feet, the maximum thickness was about 812 feet. The base of the sandstones was an irregular surface so that at the few points where it has been located there is considerable variation in elevation. Thus at Necedah it lies at 620 feet, at Wonewoc it is at 480 feet, and in sections 13 and 14 of T. 18, R.3E, in the vicinity of Necedah, it lies at about 720 feet. The sandstone formerly covered Necedah Mound, of course, and at that point it was about 190 feet thick.

## Intermediate Province

The contact between the two major provinces is not sharp. Instead, there is a zone of variable width which is outlined on the map as an intermediate province. It is low and plain-like, particularly along its north side, although along the south there are low sandstone areas of greater relief resembling the southern province. It was covered by the glacial lake. Its surface materials are generally finer textured than those dominating the plain, and they are therefore transported materials. Where frost action has not been extreme, they show stratification indicating deposition in the glacial lake. They include the laminated clays along the Lemonweir and various mixtures of clay, fine sand, and silts. Three agencies have to be considered when accounting for their origin, washing from the fine sand and silt areas on the upland, wave and current action bringing fine suspensions from the ice front to the east, and the wind. The clays are reported to contain a considerable amount of lime carbonate which would strongly suggest derivation of that fraction from the east. The silts of the upland, in part possibly wind blown, are the most immediate sources and the direct contribution of wind blown material from farther west is also a possibility.

## Basement Rock

The basement rock of the entire County below the sandstones is but slightly known, but has been struck in drilled wells as indicated in other connections.

It is exposed only in Necedah Mound which is quartzite. A similar rock was struck at Wonewoc. Four diamond drill holes put down many years ago in the vicinity of Necedah Mound to test the possibility that there might be iron formation struck quartzite, diorite, and granite. These few points indicate that the basement rock is mainly igneous with some areas of quartzite.