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LIGNITE IN NORTH DAKOTA

BY

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This brief review of the lignite resources in North Dakota has been prepared chiefly for students and others who desire general information on this subject.

LIGNITE IN NORTH DAKOTA

Lignite makes up a large part of the coal deposits of the world and is widely distributed, with small fields in France, Spain, Italy, and Greece and more extensive deposits in Germany, Russia, and Manchuria.

By far the greatest lignite deposits lie in the United States with North Dakota leading, (see map, figure 1). Montana is second, followed by Texas, Louisiana, Arkansas, and Mississippi.

In 1963 North Dakota produced 2,520,619 tons of lignite. Lignite production figures through 1963 are shown on figure 2.

LIGNITE PRODUCING AREA, AND ROCK FORMATIONS

The large area underlain by lignite, of which North Dakota's lignite field is a part, covers more than 50,000 square miles in North Dakota and adjacent portions of Saskatchewan, Montana, and South Dakota. In North Dakota alone, an area of approximately 28,000 square miles in the western part of the state is underlain by lignite beds. The major portion of North Dakota's lignite beds which are now considered commercial are found in the Tongue River Formation of Paleocene Age. The Tongue River Formation consists of alternating beds of lignite, shale and sandstones, and is about 1,000' thick in southwestern North Dakota.

When the great forests of Tongue River time were providing the growth required to form the lignite beds, western North Dakota and adjacent areas of Montana and Saskatchewan were occupied by large wooded fresh water swamps

which might be compared to those in parts of Michigan and Wisconsin where peat beds formed. The trees and other plants grew to maturity, died, fell and accumulated under water, were later buried under sands and clays, and in the course of time formed lignite beds.

Some of the beds of lignite in the Tongue River Formation extend over areas of as much as 500 to 1500 square miles with a varying thickness of from five to forty feet. On the other hand some beds can be seen in the outcrop which persist only over small areas. Many lignite outcrops in the Bad Lands gradually become thinner and finally terminate, while others may reappear in the outcrop within short distances of fifty yards or so.

Immediately below the Tongue River Formation are found the beds of the Cannonball-Ludlow Formations of early Paleocene Age. The Cannonball Formation is thickest in south-central North Dakota and consists of a sequence of marine sands and clays with a maximum thickness of about 300'. To the west the Cannonball grades into the continental Ludlow deposits which consist of shales, sandstone and lignite about 300' thick. These formations are of the same age but were deposited under different conditions, thus the fresh water swamps of the Ludlow provided the proper conditions for the growth of trees which gave rise to lignite beds as much as 8' thick in Bowman County. On the other hand the marine deposits of the Cannonball Formation contain no coal.

Lignite beds found in the underlying Hell Creek Formation of Cretaceous Age are generally thin and non-commercial. The Hell Creek Formation ranges from 200'-500' thick and consists chiefly of shales, bentonitic clays, and sandstones in addition to a few minor lignite beds.

Overlying the Tongue River Formation chiefly in Stark, Dunn, and Mercer

Counties are scattered exposures of the Golden Valley Formation of Eocene Age. The lignites of the Golden Valley Formation are scarce, thin, and generally non-commercial although one bed attains a thickness of ten feet in Mercer County. The Golden Valley Formation consists of two members of which the lower is the most spectacular. This basal member is composed chiefly of gray, yellow-brown, and purple clays and some thin lignites and the upper member is composed mainly of sands and silts. The Golden Valley Formation varies from a feather edge to about 170' thick.

The youngest bedrock in North Dakota is represented by the White River Formation of Oligocene Age which is found capping scattered buttes chiefly in Dunn, Stark, Slope, and Golden Valley Counties. The White River Formation consists of a basal sand and conglomerate containing clay and coarser materials such as chert pebbles and gravels. Above the basal sand a clay member is found which in turn is overlain by alternating beds of fresh water limestones and clays with a high lime content. This limestone and clay sequence is at the top of the White River Formation. No lignite is known from the White River beds which range from about 30 to over 200 feet in thickness.

Use of Lignite

Formerly much lignite was used in heating homes, but most domestic and industrial heating plants now use other fuels. The greatest use of lignite in North Dakota today is in steam electric generators.

Lignite Production

All of the major North Dakota lignite mines (figure 3) are now operated by stripping methods. The underground lignite mine is practically a thing of the past.

With two large steam electric generating plants scheduled for construction near Garrison Dam, lignite production in North Dakota is expected to be increased materially.

Lignite Reserves

Brant (1953) estimated that 350 billion tons of lignite remain to be mined in North Dakota. This figure has been disputed by some people, because drill holes do not always show lignite under the surface in areas where it would normally be expected at distances only a mile or two from a strippable lignite outcrop.

Let us examine the question of lignite reserves in North Dakota from another point of view.

In 1951 North Dakota produced 3,280,000 tons of lignite, the highest yearly production on record. If this production were magnified ten-fold the figure would be 32,800,000 tons of lignite. If this rate of production were maintained for one hundred years the figure would be 3,280,000,000 or three billion two hundred eighty million tons of lignite. Thus ten times our highest annual production of lignite, maintained for one hundred years would equal 3.28 billion tons of lignite, an amount less than one 100th of Brant's estimate of 350 billion tons.

It appears that there is sufficient lignite available in North Dakota for a long time to come.

BIBLIOGRAPHY

- Erant, R. A., 1953, Lignite resources of North Dakota, U. S. Geol. Survey, Circular 226, 78 pages.
- Easton, G. B., 1962, Forty-fourth annual report, Coal Mine Inspection Department, 24 pages.
- Kepferle, R. C., and Culbertson, W. C., 1955, Strippable lignite deposits, Slope and Bowman Counties, North Dakota, U. S. Geol. Survey Bull. 1015 E, 182 pages.
- Leonard, A. G., 1908, The geology of southwestern North Dakota with special reference to coal, North Dakota Geology Survey, Fifth Biennial Report, p. 27-144.
- Van Royen, William, and Bowles, Oliver, 1952, The mineral resources of the World, Prentice-Hall, Inc. p. 8-22.

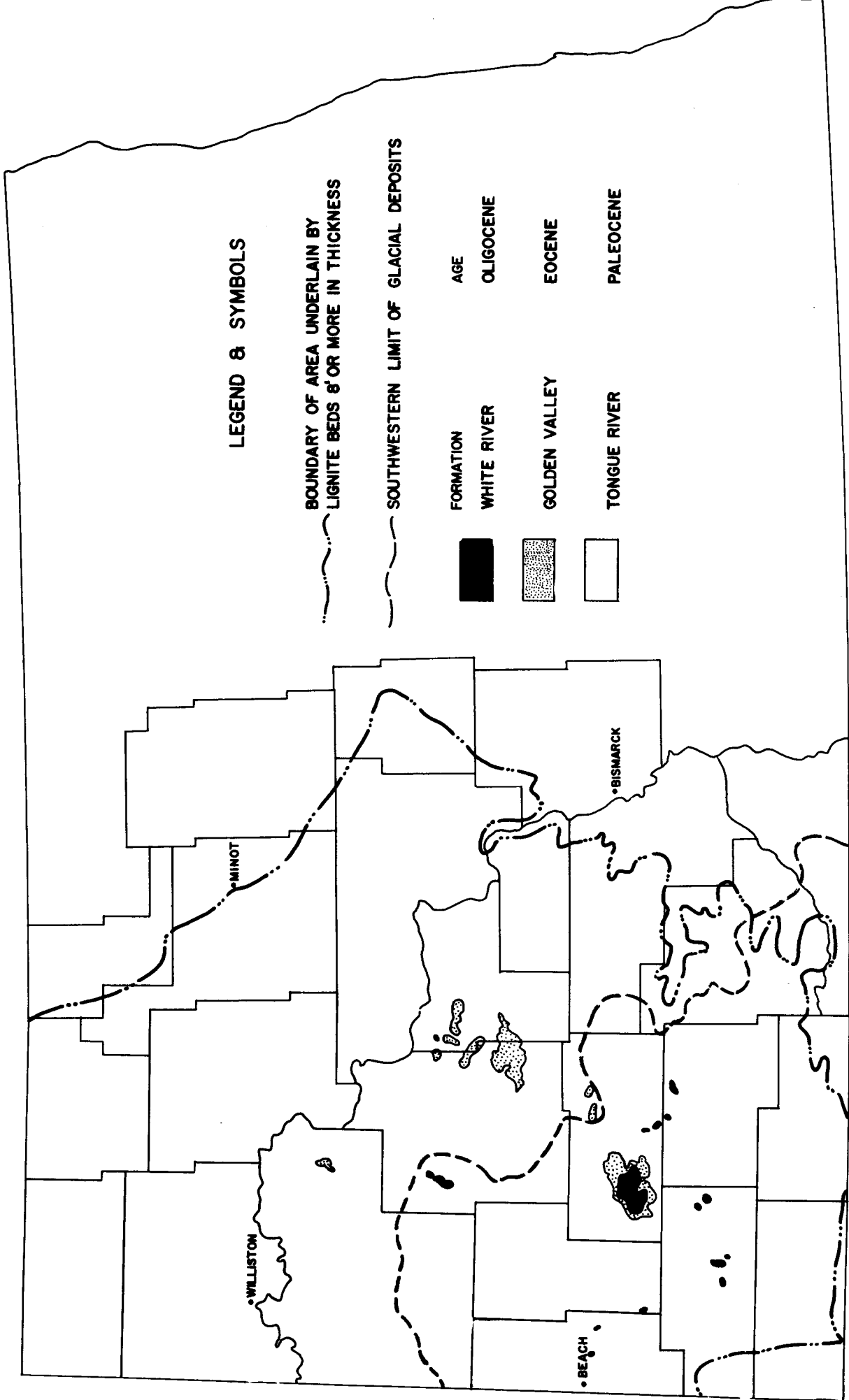
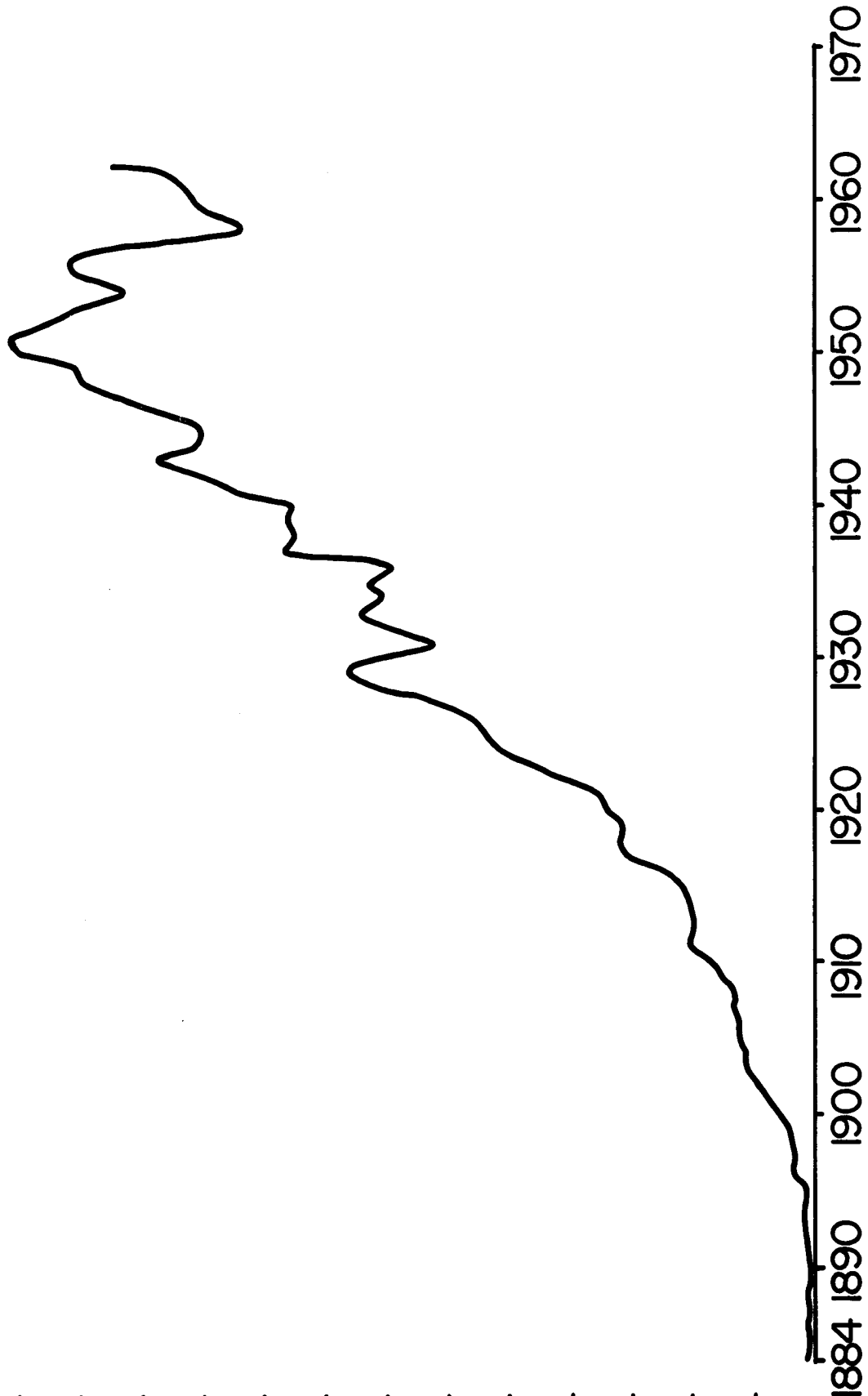


Figure 1

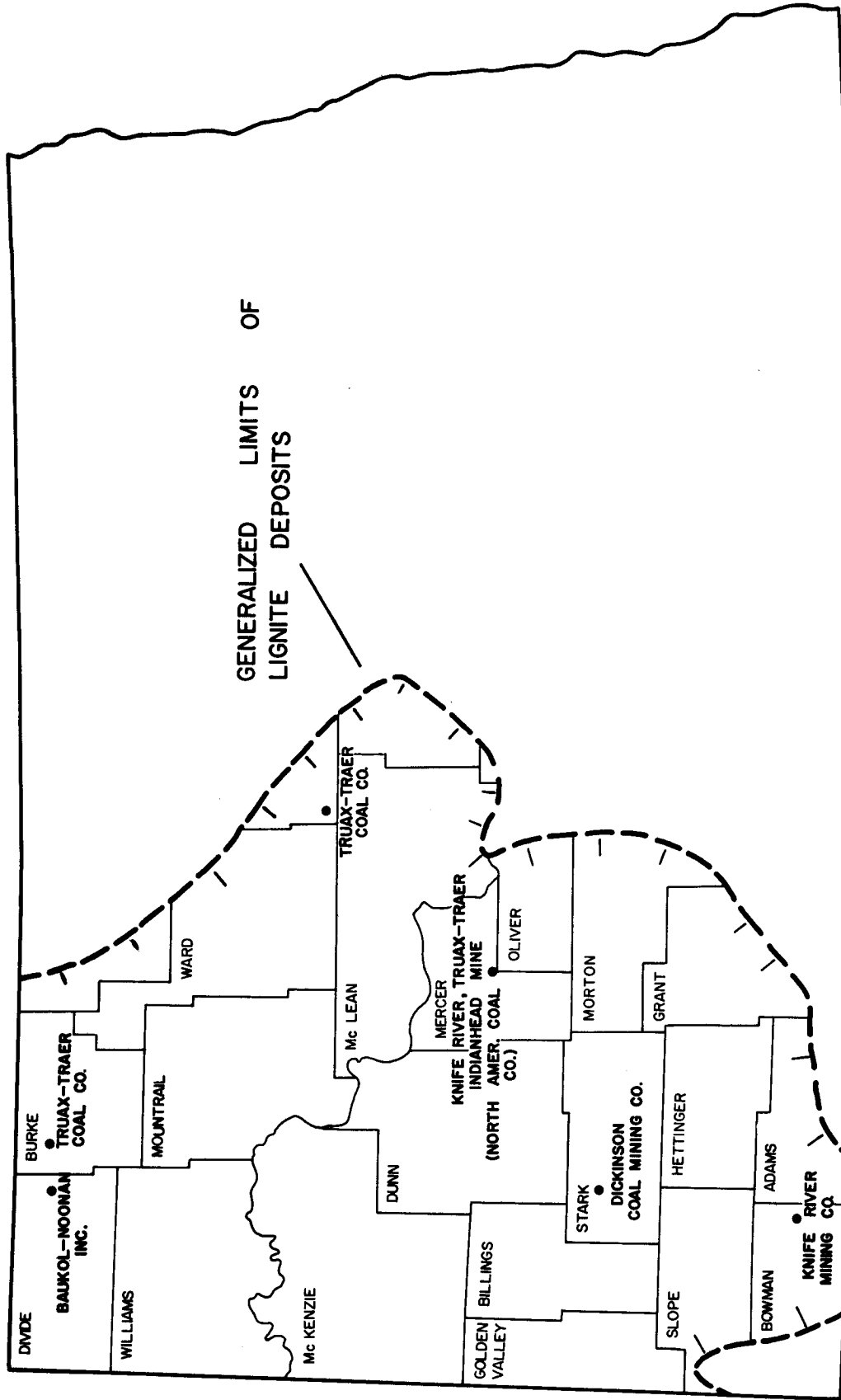
THOUSANDS OF TONS

3500—
3250—
3000—
2750—
2500—
2250—
2000—
1750—
1500—
1250—
1000—
750—
500—
250—



LIGNITE PRODUCTION PER YEAR

Figure 2



MAJOR LIGNITE MINES IN NORTH DAKOTA

PRODUCTION OVER 100,000 TONS ANNUALLY

Figure 3