THE PULP AND PAPER INDUSTRY OF THE LAKE STATES

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Four regions of the United States are outstanding in the production of paper: (1) the Northeast; (2) the Pacific Northwest; (3) the South; and (4) the Lake States. Paper making in the first of the regions, the Northeast, dates back to 1690.[1] For more than a century the Northeast held a virtual monopoly on American paper manufacturing. Three important factors influenced the location of the industry during that early period: (1) cheap power; (2) a large volume of clear and pure process water; and (3) proximity to large centers of population.[2] The migration of the paper industry into the other three regions had to await economic developments in those regions and technological developments in the industry.

In the Lake States[3] the earliest beginnings of the paper industry appeared around 1800. Development in this region was assisted by four forces: (1) construction of canals and steam railroads; (2) adoption of steam power; (3) demand created by the Civil War; and (4) technological advancement in the industry.

Construction of canals and steam railroads accelerated the growth of population in the region. In addition, better connections with the large population centers in the Northeast and with sources of raw materials were provided. Adoption of steam power broke the industry's dependence on water power sites. The Civil War created a shortage of paper and raw materials. This condition stimulated an interest in raw materials other than rags. These raw materials,[4] some of which are abundant in the Lake States, were provided through chemical technological advancements in the industry.

An analysis of the present-day industry in the Lake States demands consideration of several facets. Among these, the distribution of manufacturing plants in the industry and the technology employed in the manufacture of the product are of prime importance. To a geographer, however, the chief interest lies in an explanation of the factors influencing the location of the component plants.

[1] "William Bradford, a printer, was one of the founders of the first paper mill in the British North American Colonies. In 1690 he, with William Rittenhouse and two others, started the first Rittenhouse mill on Wissahickon Creek in Germantown, Pa." (L. T. Stevenson, *The Background and Economics of American Papermaking*, [New York and London: Harper & Brothers Publishers, 1940] p. 7.)

[2] Cities furnished the raw material, rags, and supplied a market for the finished paper.

[3] For the purpose of this paper the Lakes States are considered to include those states west of the Appalachian Plateau which border the Great Lakes. The region includes Ohio, Indiana, Illinois, Michigan, Wisconsin, and Minnesota.

[4] Straw, wood hemp, jute, and cotton hull fiber.

TABLE 1.—STATISTICAL COMPARISON OF SELECTED MILLS

Mill	Location	Yearly Production of Paper in Tons	Daily Consumption of Water in Gallons	Source of Water	Yearly Consumption of Coal in Tons	Source of Coal	Power Used Per Year
1.	Manistique, Michigan	25,000	1,000,000		25,000	W. Va.	
2.	Green Bay, Wisconsin	40,500	33,000,000	Fox R. East R.	70,000	W. Va.	10,000 K.W.H. of electicity
3.	Appleton, Wisconsin	15,000	6,000,000	Fox R.		W. Va.	2500 Water H.P. 2500 H.P. steam turbine
4.	Cloquet, Minnesota	96,000	37,000,000	St. Louis R.	85,000	W. Va. Pa.	96,342,750 K.W.H. electricity
5.	Detroit, Michigan	30,000	20,000,000	River Rouge	60,000	W. Va.	1,200,000,000 lbs. of steam and 30,000,000 KWH electricity
6.	Kalamazoo, Michigan	75,000	8,000,000	KalamazooR.	110,000	W. Va. Ky.	
7.	Escanaba, Michigan	50,000		Escanaba R.	70,000	W. Va.	
8.	Indianapolis, Indiana	20,000		White R. City Water			
9.	Chicago, Illinois	3,500			8,000		3,000,000 K.W.H. electricity
10.	Wausau, Wisconsin	25,000		Wisconsin R. Wells	20,000	Ohio Pa.	20,000,000 K.W.H. electricity

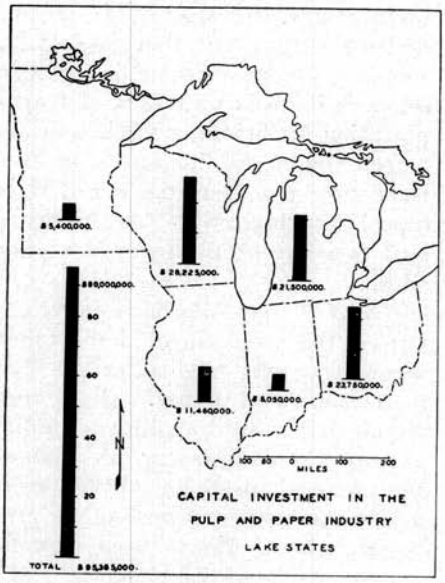

FIG. 1.

FIG. 2.

SCOPE OF INDUSTRY

Capital Investment.—The capital investment in the pulp and paper industry of the Lake States totals almost one hundred million dollars (fig.1).[5] The three states of Wisconsin, Ohio, and Michigan account for more than three-fourths of the total investment.[6] Of the remaining fourth, Illinois provided an investment exceeding that of Minnesota and Indiana combined.

Distribution of Plants.—Pulp mills are concentrated in two widely separated areas: Northern Wisconsin and Southwestern Ohio (fig. 2). Northern Wisconsin, the larger area, has numerous mills along the Fox and upper Wisconsin rivers. Three mills in Upper Michigan and four in Minnesota are on the periphery of the Wisconsin area. Southwestern Ohio, the smaller area, has its pulp mills concentrated in the Miami Valley. Isolated mills exist at Chicago and Detroit.

The paper mills are concentrated within a rectangle which is 250 miles wide and runs on a northwest-southeast axis from central Minnesota through Ohio (fig. 3). Only eight paper mills lie outside this rectangle. The pattern is characterized by marked nucleation and linear dispersion. Four nuclei are in: (1) the Fox River Valley; (2) the Kalamazoo River Valley; (3) Chicago; and (4) the Miami River Valley. Dispersed lines are coincident with three river valleys: (1) the Upper Mississippi; (2) the Upper Wisconsin; and (3) the Middle Scioto. In addition, isolated plants are located in other river valleys and in areas served by cheap transportation.

[5] Statistics were compiled from the *Thomas Register of American Manufactures*—Seventh Edition, Vol. II, 1947.

[6] Wisconsin, 29.5 per cent; Ohio, 24.8 per cent; Michigan, 22.5 per cent; Illinois, 12.0 per cent; Minnesota, 5.6 per cent; and Indiana, 5.2 per cent.

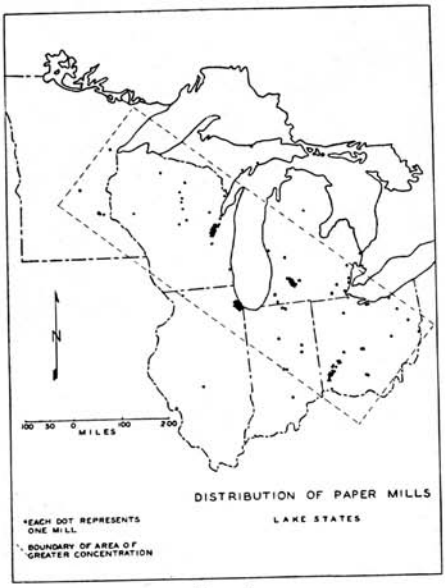

FIG. 3.

PRODUCTION PRACTICES

Use of Water.—The marked concentration of pulp mills and paper mills in river valleys reflects the heavy dependence upon the basic resource of water (Table 1). This resource plays a major role in pulp and paper production.[7] In one pulping process[8] water is played on huge grindstones to prevent burning. Large quantities of water are employed in other processes which employ chemicals.[9] In addition, water is used as the chief means of transport for carrying pulp to various stations throughout the plant. Power[10] to run the plant depends upon water, whether it is steam, hydro-electric, or thermo-electric. The importance of water, in another sense, is its use as a means of transportation for bringing raw materials to the plant and for carrying finished products from the plant. It is especially important for bringing coal to many of the manufacturing sites.

Use of Power.—Perhaps power occupies the position of importance secondary only to water in the manufacture of paper. Giant machines driven by thousands of units of power are necessary to produce the finished product. Mills commonly have their own power producing units. Power used may be one or more of four types: (1) water; (2) hydro-electric; (3) steam; or (4) thermo-electric. The latter two of these types depend upon the use of coal.

Use of Coal.—Mills annually use many thousand tons of coal per year (Table 1). West Virginia supplies most of the coal for the pulp and paper mills in the Lake States. The Great Lakes offer a cheap means of transportation which is utilized by many mills. Cheaper rates of transportation for these mills give them an advantage over mills which depend upon rail transportation for their coal supplies.

Raw Materials.—Wood pulp[11] constitutes most of the matrix purchased or manufactured for paper

[7] In a Cloquet, Minnesota, mill selected for this study, 37,000,000 gallons of water per day are used in a yearly production of 96,000 tons of paper. A Green Bay, Wisconsin, plant employs 33,000,000 gallons per day to manufacture 40,500 tons annually.

[8] Paper is chiefly cellulose in some form. Cellulose is the chief constituent of the solid framework of all leafy green plants. Pulping processes, although numerous and diverse, are all concerned with changing the cellulose of plants to paper. (Stevenson, *op. cit.*, p. 16.)

[9] Chemicals dissolve out all materials in the wood except cellulose. After the cellulose has been extracted it is washed to remove the cooking liquor.

[10] Early sites made use of water power.

[11] A notable exception is an Appleton, Wisconsin, plant which was selected for this study. This plant manufactures fine personal and business writing paper from cotton fibre pulp. The pulp is made of cotton cuttings from garment factories and of cotton linters. The cotton cuttings come from distributors in Chicago, New York, Rochester, and St. Louis. Cotton linters come from 450 cotton seed oil mills located throughout the south.

making in the Lake States. Sources of supply for mills which purchase their wood pulp are: (1) Canada; (2) Scandinavia; (3) New England; (4) the Pacific Northwest; and (5) the Lake States. The mills which manufacture pulp utilize several woods[12] from Canada, Wisconsin, Minnesota, and the Upper Peninsula of Michigan. The supply in these areas, however, is not great. This condition, if not corrected by conservation measures, offers the only threat to continued advancement of the industry.[13]

Eleven minor materials are included in the manufacture of pulp and paper. The chemical pulping processes employ lime and limestone, alum, sulphur, soda ash, salt cake, chlorine, and sulphate aluminum (Table 2). Filler of clay and starch and rosin size add body and finish to the paper. Some mills also make use of dyes.

Transportation. — Three methods of transportation serve the mills: (1) rail; (2) water; and (3) truck. Finished products, representing a great diversification of types of paper and paper board, go to all parts of the United States and foreign countries.[14] The greatest amounts, however, are destined for cities in the Lake States region. Large total population in the region provides a ready market for much of the production.

Table 2.—Source of Minor Raw Materials

Lime and limestone	Michigan, Wisconsin, Illinois
Sulphur	Texas
Soda ash	Ohio
Salt cake	Montana, Canada
Chlorine	New York, Michigan
Alum	Missouri
Rosin size	Wisconsin, Alabama
Clay	Georgia
Starch	Illinois, Iowa
Sulphate aluminum	Wisconsin
Dyes	Delaware

Factors Influencing Location of Mills

The foregoing analysis of technology employed in the production of pulp and paper demonstrates the factors which influence the location of mills. As in the early days of the industry, these locational factors primarily are: (1) a large volume of clear and pure water; (2) cheap power; (3) proximity to sources of the chief raw material; and (4)

[12] Spruce, balsam, poplar, aspen, jack pine, birch, tamarack, and hemlock.

[13] "The pulp and paper industry in the Lake State (the Lake States here include only Michigan, Wisconsin, and Minnesota) is not self-sufficient in local sources of raw materials. In recent years the region has imported about one-fourth of the pulp wood it consumes—mostly spruce and balsam from Canada. Scandinavian countries contributed a small part of the region's wood pulp needs prior to the late war and have resumed shipments on a limited basis. . . . The only new pulpwood logging areas of substantial size in the Lake States are in northern Minnesota, particularly within the boundaries of state and national forests. Seventy per cent of the Lake States' remaining supply of jack pine is in Minnesota and 33% is within the boundaries of the Superior National Forest. . . The pulp and paper industry in the Lake States region is strategically located with regard to local and national markets. If sufficient attention is given to the problem of providing raw material, the industry can be maintained indefinitely and may even expand. However, there must be a change of attitude on the part of the industry toward the use of raw materials. The forest must be treated as a renewable resource rather than as a mine. Also, pulp wood operations must be integrated with those of other forest users.

"The 50 million acres of commercial forest land in the Lake States can meet the requirements of accessibility, productivity, and cheapness to reproduce if handled under proper management. More rapid forest growth rates in the South and West are offset by higher freight charges to national markets. Under normal conditions of competition, the pulp and paper industry of the Lake States has as good, if not better, opportunities for permanent and sustained production as those of any other region." (*Pulpwood Stands, Procurement, and Utilization* [New York: Technical Association of the Pulp and Paper Industry, 1947] pp. 40, 43, and 51.)

[14] Newsprint production has declined in the area. The high cost and increased scarcity of spruce has eliminated this product from the region. (Ibid., 40.)

proximity to markets. Transportation facilities must be added to this list. Availability of unskilled labor is also an important consideration in the location of present-day mills.

The Lake States area contains many sites which provide the chief factors influencing location of pulp and paper mills. At these sites mills have started, multiplied, and developed to proportions which place this region among the four outstanding in the country in the production of pulp and paper. The Lake States region has a good chance for continued and sustained production. The only real hazard to the future of the industry in the Lake States region lies in the possible failure to provide for the replenishment of pulp wood.

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