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DWIGHT H. GREEN, Governor
DEPARTMENT OF REGISTRATION AND EDUCATION
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URBANA

CIRCULAR NO. 141

LONG-TERM MANUFACTURING OPPORTUNITIES IN THE UPPER MISSISSIPPI VALLEY

By

WALTER H. VOSKUIL

Reprint of Special Bulletin Number Six
University of Illinois
College of Commerce and Business Administration
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INTRODUCTION

A major concern in the foreseeable future is the creation and maintenance of productive employment. This is an inseparable part of our modern industrial economy and not a special problem limited to a temporary postwar transitional period, even though that period may present the problem in unusually acute form.

With the necessity for employment and for business opportunity goes also the laudable desire for profits and good wages. These two can come only from high production (a large volume of output) and high productivity (a high output per worker). A high output per worker means a large share of goods for each; and this, after all, makes for a high standard of living.

Manufacturing, transportation and communication, marketing and merchandising, construction, power supply, and the service industries today afford the largest opportunities for the creation of productive employment.

Productive employment is something more than activity for a wage; it involves the creation of values. The goal of productive employment is to achieve a high level of output, through intelligently directed coordination of men, machines, and materials. Only then is it possible to have a high standard of living, a high purchasing power in the community, and a sound basis for employment opportunity.

Modern technology, which pervades the entire gamut of our productive economy, is actually restricting the employment opportunities in agriculture and mining. Mechanization has so changed American agriculture that between 1915 and 1945 the tractor, the truck, and the automobile eliminated the need for the labor of thousands of men. Since 1900 the productivity of the adult farmer has risen from an index of 100 to 154. In such important segments of the mineral industry as coal mining, the output of the workers has nearly doubled since the turn of the century. The natural increase in farm and mine population must, in order to seek lucrative employment, turn elsewhere for opportunities. The high productive possibilities of modern technology, if fully utilized and intelligently directed to meet human wants and desires, will find their greatest productive outlet in the manufacture of consumer goods, directly or indirectly. Accompanying this trend will be a corresponding increase in trade, transportation, and services, with increasing employment opportunities in these activities.

Role of the Basic Industries

The productivity of manufacturing, both as a way of making a living and as a means of providing each of us with the multiplicity of necessities, conveniences, and luxuries which we enjoy, depends upon suitable industrial materials, the application of power, and the presence of technological skills. Given these three factors, we have the means not only to high productivity but also to an abundant variety and a wealth of selection in consumer goods.

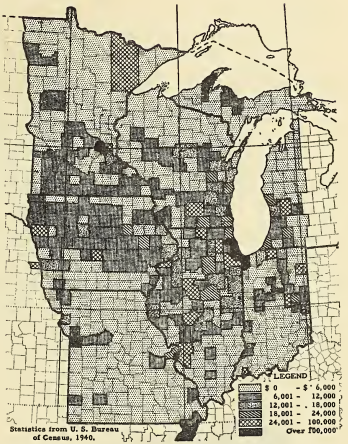
Basic industrial materials from which an array of manufacturing activities branch out are: (1) steel; (2) manufactured fuels — oil products; (3) manufactured fuels — coke; (4) food grains; (5) meat products; (6) fibers; and (7) forest products.

Sustained productivity in all phases of manufacturing activity, and in all steps of the manufacturing process, is based upon the continued functioning of those industries which supply the basic industrial raw materials.

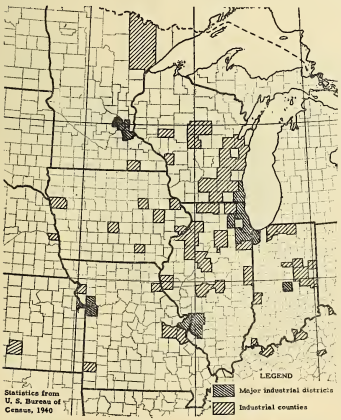
BASIC INDUSTRIAL MATERIALS IN THE UPPER MISSISSIPPI VALLEY

The raw materials of industrialism upon which the diverse and extended manufacturing activities of the Upper Mississippi Valley depend are produced in one or a few localities within the region and supplemented to some extent by shipments of these basic materials into the area. The Chicago district is almost solely the source of pig iron and steel, although a small contribution comes from Granite City. Petroleum products are produced, in the main, in three districts — Chicago, Wood River (below Alton), and southeastern Illinois. Food products, such as meat and flour, are available at convenient points in the area.

The Chicago industrial area is a leader, or at least a producer, in five of the basic industries: steel, oil products, coke, meat products, and flour. This industrial district is unique in the Upper Mississippi Valley in that it is the focus of industries that manufacture industrial raw materials and producers' goods. These industries, in turn, make many of the producers' goods for manufacturing establishments not only in Chicago itself but in other manufacturing cities in the Upper Mississippi Valley.



Map 2. Income Received in the Upper Mississippi Valley, 1939, Distributed by Counties (in thousands)



Map 1. Industrial Areas in the Upper Mississippi Valley with 2,500 or More Wage Earners, 1939

Because of this industrial interdependence of the entire Upper Mississippi Valley, and also because of Chicago's key position as the site of the basic industries which serve as gateways to more than 230 types of industries in the Upper Mississippi Valley, the starting point of any study of the industrial possibilities and future of Chicago and its associated manufacturing cities in the Upper Mississippi Valley is an examination of the basic industries, for the purpose of determining the status of those elements that are necessary for their assured continuity.

Specifically, these basic industries should be examined as parts of the structure of the Chicago industrial district. Also a study should be made of the growth and changes within the district, the raw materials used by the basic industries of the district

and the adequacy of their supply, the changing internal structure of the Chicago district as it has been affected by the rise or decline in importance among the basic industries, the trends in concentration or decentralization, and the rise of new products or changes in the older established industries.

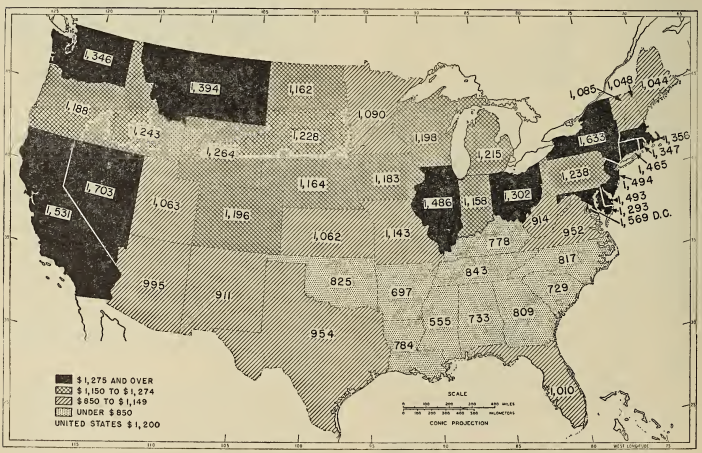
Such an examination, however, is of value only as a means to an end. What we are really trying to determine is the key role of the basic industries in the creation of industries for the manufacture of consumer goods. If we understand the function of the Chicago basic industries, we are then prepared to plan against future eventualities, e.g., provide for alternative sources of raw materials if it seems that existing sources may cease to be adequate, and promote new industries that are feasible in this economic area.

The industrial empire for which Chicago's basic industries supply the raw materials of manufacture extends over nine states or parts of states. This is illustrated in Map 1, which shows the Census distribution of leading industrial areas in the Upper Mississippi Valley in 1939. This distribution represents the pattern of industrial development, the resultant of various and varying economic forces during a period of vigorous industrial growth. The war years subsequent to 1939 did increase the level of output of industrial production but did not change the pattern substantially. A wide variety of enterprises is located in these several districts, to which the basic industries of Chicago supply such materials as foundry coke, pig iron, primary steel shapes, steel wire, prepared liquid fuels, etc. About 75 per cent of the wage earners in manufacturing in this economic region are outside the Chicago industrial district.

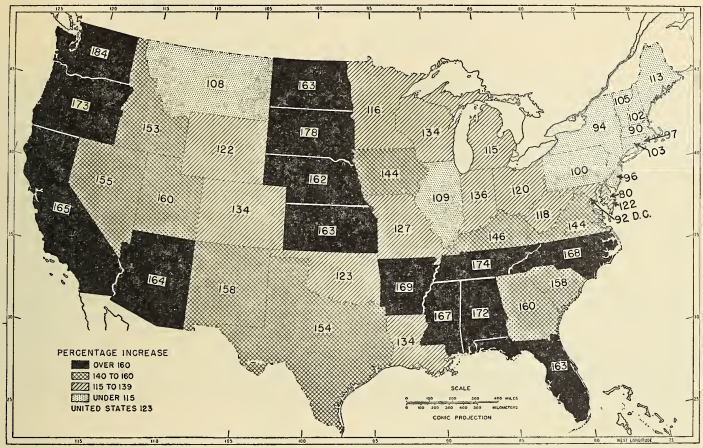
Manufacturing Opportunity and Purchasing Power

The opportunity for manufacturing outlets depends ultimately on purchasing power, and purchasing power is estimated by multiplying the number of people earning incomes by the average level of individual income.

In the prewar year of 1939, purchasing power among principal income groups in Illinois and the adjacent economic territory was nearly 20 per cent of the national total. This income was concentrated in a relatively small area.



Map. 3. Per Capita Income of the Civilian Population, by States, 1946



Map 4. Percentage Increase in Total Income Payments, by States, 1940-1946

Map 2 shows the county distribution, for the Upper Mississippi Valley, of combined incomes derived from selected types of payment: (a) wages and salaries in manufacturing; (b) wages and salaries in wholesale trade; (c) wages and salaries in retail trade; (d) wages and salaries in mining; and (e) farm income.

Although these items do not represent all income payments within the area, they do account for approximately 80 per cent of the income, and hence provide a reasonably good index of purchasing power.

It is evident from the map that, aside from the large income payments in the urban centers, there is a belt of remarkably high purchasing power in rural Illinois, Indiana, southern Wisconsin, southern Minnesota, Iowa, and portions of Missouri. This productive urban-rural area, of which purchasing power is one measure, is the potential local market for industrial consumer goods.

The favorable economic position of Illinois in the economy of the nation is shown in two maps reproduced from the *Survey of Current Business,* for August, 1947. Map 3 shows per capita income payments in 1946 for each state, including mustering-out payments, family-allowance payments, allotments of pay to individuals by military personnel, cash terminal leave payments, and state government bonuses to veterans of World War II. Map 4 shows for each state the percentage increase in total income payments from 1940 to 1946. An examination of these two maps shows that the higher percentage changes in the southeastern and southwestern states in the period 1940-1946 did not overcome the leading economic position of the Upper Mississippi Valley states. When the distorted production pattern brought on by the war has come to an end and a peacetime economy again functions, the level of income payments in Illinois and its neighboring states will be sustained more easily than in those states and areas which were heavily stimulated by war requirements.

BASIC INDUSTRIES IN THE CHICAGO INDUSTRIAL AREA

The Chicago industrial area[1] comprises Cook, Du Page, Kane, Lake, and Will counties in Illinois, and Lake County in Indiana. Within this area there is a wide variety of industries and a considerable degree of segregation of industrial groups. Table I presents data for the principal basic industries.

In Chicago itself there are large meat-packing establishments. Toward the south and east, along the lake shore in Illinois and Indiana, are the heavy steel industries. In the western and southwestern part of the area are steel fabricating industries, machinery, light industries, etc. About one-fifth of Chicago's manufacturing activity is concerned with the production of raw materials for further processing, fuels, and basic food supplies. Historical development, as well as geographic factors, accounts for the present-day distribution of industry within the area.

More than half of the manufacturing activity of the United States is concentrated in 97 counties, which have been grouped by the Bureau of the Census into 33 industrial areas. An area is defined as having had not less than 40,000 factory workers when these groupings were first established in 1929. Among these industrial areas, Chicago is exceeded only by New York and has held second place since 1899, when it displaced Philadelphia. In Map 5 are shown the industrial areas located in northern and eastern United States and the comparative trend of growth since 1899. Although the position of New York and Chicago in first and second place remained unchanged, among the remaining 28 industrial districts there has been a relative gain in position, principally in those districts bordering the Great Lakes.

[1] The term "industrial area," as used by the Census, signifies an area having as its nucleus an important manufacturing city and comprising the county in which the city is located, together with any adjoining county or counties in which there is a great development of manufacturing industries.

Map 5. Change in Rank of Industrial Areas East of the Rocky Mountains, 1900-1939

Table I
Basic Industries in the Chicago Area, 1939
(Thousands of dollars)

Type of Industry	Salaries and Wages	Value of Product	Value Added by Manufacture
All industries.....	$784,145	$4,277,816	$1,909,989
Iron and steel[a]..	117,157	569,859	212,567
Meat packing...	33,771	389,983	68,288
Oven coke.....	5,516	56,360	10,157
Petroleum refining.....	16,408	219,884	59,184
Flour mills.....	661	11,178	2,814
Total—Basic industries.....	$173,513	$1,247,264	$353,010
Percentage—basic industries to all industries..	22.1	29.2	18.5

Source: *Census of Manufactures*, 1939.
[a] Includes products of blast furnaces, steelworks and rolling mills, and steel castings.

The relative position of each of the 33 industrial districts, as measured by the dollar value of products manufactured therein, is shown in Chart 1.

Steel

In the analysis of basic industries, steel is given first place. It occupies a key position in our industrial economy, and in the production process it performs a three-fold function. First, steel is the primary material which has made possible the creation of modern industrial productivity. Second, steel provides the raw materials for a wide variety of industries engaged in the manufacture of consumer goods and also of machines which are used in the manufacture of still other types. Third, steel creates the opportunity for the growth of other industries that contribute to the final production of goods made possible in a steel-based economy, as for example, non-ferrous metal industries, cement, chemicals, etc. Therefore, a steel center is and will remain the most favorable basis of a diversified industry.

Basis of High Productivity. High productivity is a relative term, but to the layman it means either more goods or better goods. High productivity means an abundance of food produced, more yards of cloth, more pairs of shoes, more tons of coal mined, more barrels of oil produced, more miles of transportation for the same cost in exchange for a day's work, more time for leisure after material wants have been comfortably satisfied. When man, the producer, raises the level of his output, in these and thousands of other commodities, there are more goods to be consumed, there are more goods for

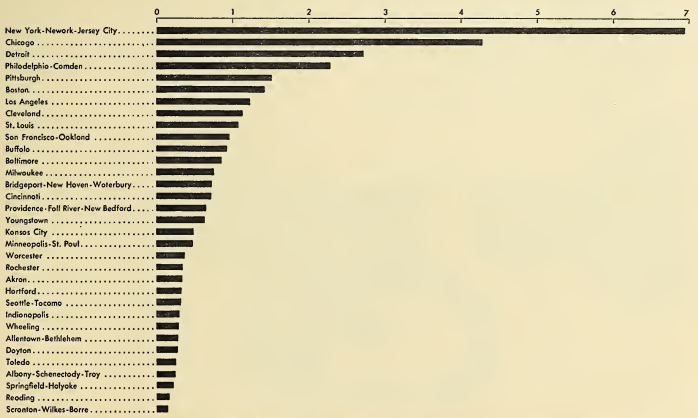


Chart 1. Rank of Industrial Areas in the United States, by Value of Product in Billions of Dollars, 1939

each person, and the standard of living goes up accordingly.

Steel plays a key role in achieving high productivity. Iron ore is abundant, and steel can be made from it at a low cost. In its alloyed forms, steel is a versatile metal: it can be made brittle or tough, hard or soft, pliable or elastic, to suit the needs of the user. It is the stuff used to make the machine tools that shape and build our mechanized plants, and also to construct the power-driven machines that, under man's skillful direction, pour out the goods. The broad requirements of modern industrial society, with its vast tonnage movements, its machines capable of rapid output, and its high-speed transportation, can be met only by iron in combination with its alloying materials. Let it be emphasized that all other industrial materials, new and old, in large quantities or small, play a role, and a necessary one, as helpers of steel in the productive process. Our industrial society is indissolubly related to steel.

Springboard for Industrial Opportunity. A steel industry is the nucleus for a wide variety of industries in a relatively small area, and this situation results in large aggregate wage payments and other forms of income. The purchasing power thus derived in turn favors the development of new industries.

The industries that naturally group around steel are:

1. Non-ferrous metal and other industries which necessarily supplement steel in the manufacture of goods, such as copper, lead, zinc, aluminum, etc.

2. Industries that come into being in connection with the steel industry, as a part of industrial production, such as structural materials for industrial plants — cement and concrete, quarry products, refractories, fluxes.

3. Industries which are located in concentrated population areas either by reason of a favorable market or because of better access to labor supply. This would include a wide variety of purely local industries such as bakery products, chemicals, apparel, printing and publishing, wholesale trade, and banking and finance. The forces that establish a population center tend to gain in strength and to bring about further concentration. This movement is borne out by the population trends up to the outbreak of the war and will, no doubt, be resumed in the postwar period.

Chicago is one of the great steel-producing districts of the United States and of the world. This district provides the raw material and serves a wide array of metal-working industries in Chicago and throughout the smaller industrial cities of Illinois, Wisconsin, Indiana, Minnesota, western Kentucky, Michigan, Iowa, Missouri, Kansas, Nebraska, and the Dakotas. The continued productivity of the industries in this large area is no more assured than the permanence of the steel basis upon which they are built.

The steel-making process involves the assembling of large tonnages of ore, coking coal, and fluxing stone. These raw materials must be available in large quantities to assure a supply for decades to come.

The magnitude of operations in steel production requires also, for economical output, a large market outlet. The survival power of a steel district is, therefore, a function of adequate resources and ability to maintain its position in its market area against the encroachments of rival districts.

Geography of Steel Districts. The most economical source of steel is that location at which the raw materials can be assembled, the steel produced, and delivery made to a large market, all at the lowest possible total cost. In determining plant location, assembly costs are most important; more than four tons of raw material must be assembled for every ton of steel produeed.

The greater proportion of the raw materials is used in the blast furnace, but integrated steel works[2] have developed from blast furnace plants because: (a) as steel approaches the finished stage, the cost of shipment becomes a smaller percentage of the cost of the product to the buyer; (b) integration assures more constant and reasonably full utilization of blast furnaces and open hearths; and (c) the economics of converting molten iron into steel and other heat conservation factors are important in the economical production of steel.

In an integrated steel industry, economies are achieved both in saving of heat and in effective use of surplus gas. For example, pig iron is conveyed from the blast furnace to the steel plant in the molten state, thereby conserving the heat in the molten metal. Surplus gas from coke ovens is used for operating air compressors and for heating the stoves of the blast furnace. Coke-oven gas also supplies the fuel for the open-hearth steel furnace and for heating the soaking pits.

Limitations imposed by the necessity for the most favorable combination of assembly, production, and delivery costs have confined steel production to a few geographical areas. The most favorable combination of the three variables is to be found at ports on Lake Michigan and Lake Erie and in the Pittsburgh district, including the Mahoning and

[2] An industry is integrated when all steps in the process from mining to production of finished steel are under a single over-all management.

Table II
Estimated Assembly Costs in the Production of Pig Iron, Summer of 1937
(In dollars per gross ton)

Producing Center[a]	Iron Ore	Coal	Flux	Total Cost
Weirton-Steubenville	$5.508	$0.468	$0.337	$6.313
Pittsburgh	5.804	0.284	0.337	6.425
Cleveland	3.497	2.714	0.241	6.452
Buffalo	3.497	2.909	0.241	6.647
Detroit	3.497	3.249	0.086	6.832
Youngstown	5.193	1.979	0.170	7.342
Chicago	3.487	3.867	0.241	7.595

[a] These districts comprise approximately 75 per cent of the blast furnace capacity of the nation.

Ohio valleys. These locations were primarily determined by the assembly costs of Lake Superior ores and the coking coals of West Virginia, western Pennsylvania, and eastern Kentucky.

Comparative assembly costs of raw materials at principal production centers in this area have been estimated as shown in Table II.

The relationship of assembly costs among these several districts, as it existed before the war, is not necessarily constant. Greatest changes have probably occurred in those districts to which a rail haul of materials is required, since there have been advances in freight rates granted to railroads. If this is the case, the most pronounced changes in assembly costs would occur in ore movements to Weirton-Steubenville, Pittsburgh, and Youngstown, and in coal movements to Cleveland, Buffalo, Detroit, and Chicago. It is noteworthy that costs of shipping coal to Chicago exceed costs of transportation to any other district. At present, all but a negligible quantity of coking coal used in the Chicago steel industry is obtained from the Appalachian fields, principally eastern Kentucky and southern West Virginia.

Steps in Steelmaking. The production of steel begins at the blast furnace, where iron ore and other materials are smelted to emerge as pig iron and slag. This is the first major step and the first intermediate product in a long series of operations ending in finished steel goods. Pig iron is converted into steel by the removal of impurities and the addition of controlled quantities of carbon and scrap and alloying materials, in Bessemer or open-hearth furnaces.

The approximate amounts of principal raw materials required per ton of pig iron are: 4,075 pounds of iron ore (assuming ore of reasonably

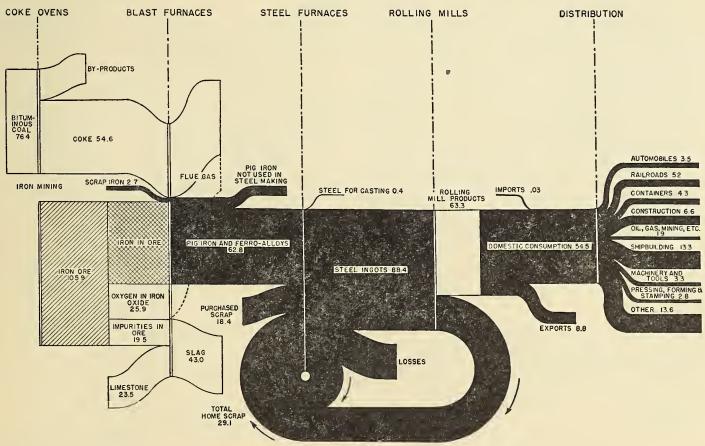


Chart 2. Flow Chart of Steelmaking, 1943

high metallic content, 50 per cent or more), 2,700 pounds of coking coal, and 900 pounds of limestone. Another 1,500 pounds of coal may be consumed for power and heating before a ton of finished steel product has left the mills.

The flow of materials through successive stages of production to finished rolled steel products is illustrated in Chart 2, which is based on Department of Commerce data and shows the materials used and the disposition of the products in a war year. In addition to depicting the various raw materials used in the production of pig iron, the diagram indicates the output of by-products, the importance of scrap in the manufacture of steel, the more important rolling-mill products, and the major consuming industries. The large proportion of the products which went to shipbuilding is explained by the fact that 1943 was a war year.

The grouping of by-product coke ovens, blast furnaces, and steel mills into an integrated productive unit affects the economics of the manufacture of steel. The by-product gases of the coke oven and blast furnaces and the by-product heat in molten pig iron can be used effectively in the process of steel manufacture.

The making of steel through the several steps in the process is shown in Chart 3.

Raw Materials for the Chicago Steel Industry. Among the materials needed to sustain a large steel-producing industry in the foreseeable future is an adequate supply of iron ore and scrap metal. There are many deposits of iron-bearing ores available in this country and abroad — ores of high or low iron content, in large and small deposits, on the surface and deep-seated in the earth.

The American steel industry is built mainly upon the Lake Superior ore district, and the Chicago steel industry relies solely upon this district for its ore. The future of Chicago is, therefore, tied up with the extent and character of the Lake Superior ores. In the future, these ores must adequately meet the competition of ores from other districts, domestic or foreign, which supply steel output in Lake Erie ports, Pittsburgh, and on the Atlantic seaboard. Therefore, it may be well to examine the present status and future outlook for ore production in the

Table III
Average Annual Production of Iron Ore by Districts, 1936-1945
(Gross tons)

District	Average Production
Lake Superior	63,773,139
Birmingham-Chattanooga	6,461,336
Adirondack	2,649,169
Northern New Jersey-Southeastern New York	443,024
Other districts	2,334,583

Source: *Annual Statistical Report*, American Iron and Steel Institute, 1945.

Table IV
Estimated Ore Reserves in Lake Superior District, as of 1944
(Gross tons)

State, District	Ore Reserves
Minnesota:	
Mesabi	1,020,138,504
Vermilion	12,636,820
Cuyuna	62,059,815
Total, Lake Superior District in Minnesota	1,094,835,139
Fillmore[a]	231,393
Total, Minnesota	1,095,066,532
Michigan:	
Gogebic	32,686,550
Marquette	51,357,761
Menominee	50,376,403
Total, Lake Superior District in Michigan	134,420,714
Total, Lake Superior District in Minnesota and Michigan	1,229,255,853
Total, Minnesota and Michigan	1,229,487,246

[a] Not included in Lake Superior District.

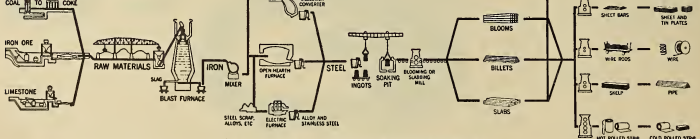


Chart 3. Steps in the Process of Steelmaking

Lake Superior district supplying Chicago, which contributed 85 per cent of the national total during the period 1936 to 1945 inclusive.

The relative importance of the major producing districts is shown in Table III.

The Chicago district (Illinois and Indiana) consumes approximately 25 per cent of the Lake Superior ores, sharing the output of this district with furnaces in Pittsburgh and Lake Erie ports.[3]

Table IV shows the estimated reserves of high-grade merchantable ore in Minnesota and Michigan as of 1944; the reserve in the Lake Superior district was estimated at 1,229,255,853 tons.[4] Iron ore from which the Chicago steel industries draw their supplies is obtained from the Minnesota and Michigan ranges shown in Map 6.

Future Ore Supplies. The following statements regarding future ore supplies were made by the authorities herein cited:

We can clearly see the exhaustion of the deposits of reasonable cost *high-grade* ore that can be consumed directly in the furnace without treatment. — L. P. Barrett (V. P., Jones and Laughlin Ore Co., Inter-State Iron Co., Pittsburgh), "Competitive Position of Minnesota Low-Grade Ore," *Skillings' Mining Review,* Vol. XXX, No. 41, January 31, 1942.

For the Lake Superior region as a whole, the *direct* shipping ore, including wash ore, constitutes less than 1 per cent of the bulk of the iron formation. — Barrett.

The supply of iron ore needed in the future must come from material running 20 per cent to 30 per cent iron. — Barrett.

Low-grade ore of various types exists in many places in the Lake Superior district and the total is very large. — (Davis, p. 7.)[5]

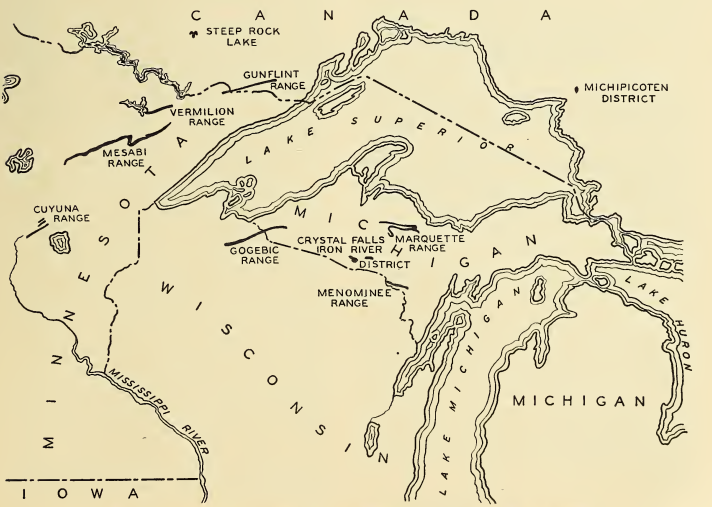
If the time should come when 30 per cent ore could be used under Lake Superior conditions, the tonnage available would be something enormous. — C. K. Leith (quoted by Davis).[5]

If the iron formation is to be considered an ore, there is enough ore in the Lake Superior region to last the world a thousand years. — J. R. Finlay (quoted by Davis).[5]

[3] *Minerals Yearbook, 1944* (U. S. Bureau of Mines), p. 547.

[4] *Ibid.,* pp. 551-552.

[5] C. K. Leith and J. R. Finlay are both quoted by E. W. Davis of the Mines Experiment Station, Minneapolis, Minnesota, in "A Report Presented to Materials Division of the War Production Board," May 20, 1942.



Map 6. Location of Lake Superior Iron Ranges and Ore Ports Serving the Ranges

While the low-grade ores occur generally over the Lake Superior ore-producing districts, the quantity on the Mesabi probably far exceeds that of any other district. — (Davis, p. 7.)[6]

The beneficiation (up-grading) of low-grade iron ores is expected to provide new sources to replace the waning reserve of high-grade deposits; and research in this field has been under way for a number of years.

The Mesabi Iron Range is about 100 miles long and from one to three miles in width. This range is a continuous deposit of a type of iron-bearing rock called taconite assaying about 30 per cent iron. — (Davis, p. 7.)[6]

Chart 4 shows a generalized cross section of this range.

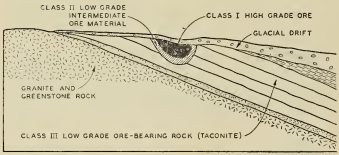


Chart 4. Generalized Cross Section of the Iron Formation of the Mesabi Range

The taconite is composed of both magnetic and nonmagnetic ore. Commercial methods are now in existence which can separate the magnetic ore from the taconite and effect a concentration.

Chart 5, reproduced from a 1942 report to the War Production Board by E. W. Davis, Director of the Mines Experiment Station, University of Minnesota, shows graphically the quantities of ore then remaining on the Mesabi. The triangular piles depict comparative amounts of various types of ore: those with diagonal bars represent Class I ores; the solid black portions, Class II ores; and the clear portions, Class III ores.

The Class I ores are high-grade and require no concentration. For these and for the Class II concentrate, accurate tonnage estimates were available. The size of the magnetic taconite pile as compared with the direct shipping ores is noteworthy. The largest pile represents immense quantities of Class II ore and nonmagnetic taconite for which no commercial method of concentration is yet known, and which can therefore not be considered an iron ore reserve.

[6] *Ibid.*

Interest is centered primarily on the Lake Superior ores, including taconite. The great mass of taconite, called "Class III low-grade ore-bearing rock" on Chart 4, contains from 25 to 35 per cent iron and from 40 to 60 per cent silica. While all of it has the same general structural characteristics,

Chart 5. Total Ore and Concentrate of the Mesabi Range, as of January 1, 1942 (in millions of tons)

important variations do occur. In general, the taconite can be divided into two classes: magnetic taconite and nonmagnetic taconite. In the magnetic taconite, the iron oxide exists as magnetite, which is a strongly magnetic mineral. In the nonmagnetic taconite, the iron oxide exists largely as hematite, a mineral that is not magnetic. From the standpoint of concentration, this is a very important distinction, because methods are now in commercial use which, with minor modifications, can be used to concentrate the magnetic taconites, whereas the nonmagnetic taconites, like much of the Class II ore materials, are much more difficult to concentrate.

After several years of research and pilot plant experimentation, one large mining company is constructing a commercial-scale plant for the production of concentrate from taconite.

The making of iron ore concentrate from taconite involves the quarrying of hard rock, crushing and grinding to a flour-like fineness in order to break apart the particles of silica and the particles of iron ore. The iron ore is then separated from the silica by running it under magnets, if it is in magnetic form, or by a process known as froth flotation, if it is in nonmagnetic form. Since the product is in the form of fine particles, it is necessary to sinter or agglomerate it so as to get it into lumps large enough to be shipped and used in furnaces. The taconite deposit extends in a band the whole length of the Mesabi Range, a distance of about 75 miles. It exists in such enormous quantities that it offers an assured source of iron ore for an indefinite time in the future.

According to the Bureau of Foreign and Domestic Commerce, United States Department of Commerce, iron ore deposits of commercial grade and size also exist at Steep Rock, Canada; Bell Island, Newfoundland; and on the Quebec-Labrador boundary in Canada. These may also be considered as available, when needed, to the Great Lakes steel industry.

Coal and Coke. Coal requirements for steel are of two kinds: (a) general fuel for power and heating, and (b) metallurgical coke. The manufacture of a ton of steel requires about 2,700 pounds of coking coal and about 1,500 pounds of coal for power and heating. Coal for general fuel is cheaply available in unlimited quantities from Illinois and Indiana fields. Coal for the production of metallurgical coke used in the Chicago area is supplied principally by five states—Pennsylvania, West Virginia, Kentucky, Virginia, and Illinois.

Steel as an Industrial Raw Material. Steel is an alloy of iron, carbon, and small quantities of one or more alloying metals, principally manganese, nickel, chromium, molybdenum, vanadium, tungsten, copper, aluminum, and silicon.

The unique qualities of iron—and its alloy, steel—single out this metal as the basic material upon which the industrial structure of the nation is built. The physical and economic characteristics of iron which give the metal this distinctive function in industry are three:

1. Low cost—Natural abundance, relatively low cost of mining the ore, and relatively low cost of reducing it to metal result in low cost for steel.

2. Versatility of iron and its steel alloys—The methods of heat treatment and the use of one or more of the group of metals known as the ferro-alloys have provided the steelmaker with the means of producing a variety of steel alloys, each of which is endowed with a combination of properties by which a particular use of steel is most efficiently served.

3. Property of magnetism—This property, which is present in a pronounced degree only in iron, is fundamental to the development of modern electrical machinery. The entire range of magnetic and electric appliances is dependent upon this property in the metal. It is essential for the construction of the generator, the electric motor, the telephone, the radio, and a large number of electrical measuring instruments. The electrification of industry and the widespread application of electric power in manufacturing, transportation, and communication are based upon the magnetic property of iron.

Chart 6 demonstrates the truth of the statement that ours is a steel age. During 1944, according to a progress report on disposal of iron and steel war

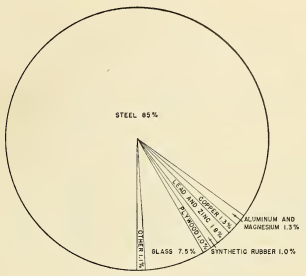


Chart 6. Steel Among Industrial Raw Materials, 1944

plants, approximately 110,000,000 tons of processed metallic and nonmetallic basic materials were used by manufacturing industries in the United States. On a tonnage basis, steel accounted for 85 per cent.

It is noteworthy that the light metals, aluminum and magnesium, accounted for less than 2 per cent. There has been much speculation about postwar displacement of steel by light metals. Yet it may be seen in the figure that if all light metals which we have the present capacity to produce were to be used in lieu of steel, such a development would still have a relatively small effect on over-all steel consumption.

Market Territory Served by Chicago Steel. The great steel centers adjacent to the Great Lakes would not have developed if outlets for at least a considerable part of their products had not been close at hand. The market for steel produced in the Chicago industrial area embraces all of Wisconsin, all of Illinois except the vicinity of Granite City, western Michigan, and northwestern Indiana. Within this area there is an unusually high degree of concentration of industries closely related to primary steel production for their supply of industrial raw materials.[1] These industries embrace: (1) products of iron and steel; (2) machinery; (3) automobiles and equipment; (4) transportation equipment.

Table V shows that in the United States 26 per cent of all workers were employed in these industries in 1939, and in the territory served by Chicago steel 31 per cent of all workers were so engaged.

[1] A wide array of semi-finished steel goods and consumer products is made from steel.

Table V
Persons Employed in Manufacturing, Upper Mississippi Valley and the United States, 1939

Geographical Division	(a) Number Employed in Manufacturing	(b) Number Employed in Industries Closely Related to Raw Steel	Percentage of (b) to (a)
Illinois	759,710	235,835	31
Indiana	340,563	147,332	43
Michigan	621,173	424,944	68
Wisconsin	254,625	87,499	34
Minnesota	104,445	22,304	21
Missouri	223,467	36,199	16
Iowa	88,789	20,025	23
Total, Upper Mississippi Valley	2,392,772	974,138	41
Total excluding Michigan	1,771,599	549,194	31
United States	9,622,923	2,457,197	26

Source: *Census of Manufactures*, 1939.

Coke and Coal

Coke is an artificially prepared fuel, the residue that remains after certain bituminous coals have been subjected to destructive distillation. Its characteristics are hardness, porosity, and strength, the qualities essential in a fuel that must be quick-burning and also able to withstand the heavy pressure in the blast furnace without crushing.

The primary function of coke is to reduce iron ore to the metallic state. The reduction of iron ore in the blast furnace, using coke as a fuel, is so far superior in terms of economy to any other method of ore reduction that it has no rivals. This fact is of fundamental significance, for the use of coke is at present the only means which we have for obtaining iron cheaply.

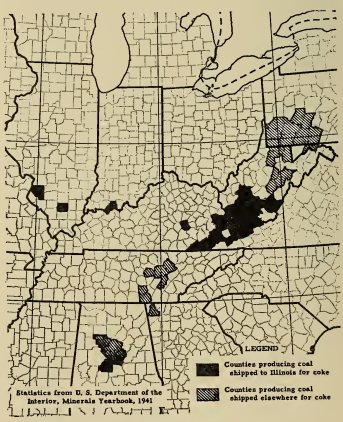
The evolution of coke manufacture, first in the beehive oven and, more lately, in the by-product oven, stands as one of the significant developments in the transformation of society from the handicraft and semi-handicraft stage to a power-operated economy. For, in addition to its unique characteristics as a fuel for the reduction of iron ore, an adequate coke supply freed the metallurgical industry from the sharp limitations of fuels hitherto available for smelting ores—charcoal and anthracite.

With the introduction of the coke oven and the blast furnace, the requisite for industrialization — cheap steel — emerged as a reality. These two instruments of production, the coke oven, as the producer in mass tonnages of a requisite fuel, and the blast furnace, as the highly efficient producer of pig iron, also in mass tonnages, are the gateways to a highly productive, versatile, complex, industrial economy. Other methods of obtaining iron have been proposed but, so far, none shows any possibility of replacing the blast furnace fired by coke. The coke oven, then, together with the blast furnace, becomes the symbol of productiveness, the basis of a high standard of living, and of power.

Sources of Coking Coal. Coal presently suitable for the manufacture of coke occurs in a limited portion of the Appalachian fields, principally in Pennsylvania, West Virginia, Alabama, and eastern Kentucky. Minor quantities have been contributed by other states east of the Mississippi River.

In Map 7 are shown the counties in the United States that produce coking coal. Shipments of coking coal to ovens in the Chicago industrial district are reported from six states. The counties that are most important contributors to this large consuming market are shown in solid black. The importance of each state as a source of coking coal for the steel industry in the Chicago district is shown in Table VI.

In the Chicago district, assembly of coal for the steel industry is one of the important elements of



Map 7. Counties in Eastern States Which Produced Coking Coal, 1939

Table VI
Tons of Coal Purchased for Coking Purposes, Chicago District, 1939-1944

Source	Average for Six-Year Period
West Virginia	7,236,605
Kentucky	5,380,882
Virginia	651,619
Pennsylvania	464,105
Illinois	262,233
Indiana	35,269

Source: *Minerals Yearbooks*, 1939-1944 (U. S. Bureau of Mines).

cost. Out of a total assembly cost of coal, ore, and flux, as indicated by a study of conditions in 1937, the cost of shipping coal to the Chicago district was 51 per cent of all costs, as compared with 4 per cent for Pittsburgh, 7 per cent for Weirton, 27 per cent for Youngstown, 42 per cent for Cleveland, 44 per cent for Buffalo, and 48 per cent for Detroit.

One of the key problems, therefore, in maintaining the competitive position of the Chicago steel industry is a reduction in coal assembly costs. The crux of the situation is the high cost of shipping coking coal from coal districts in southern West Virginia and eastern Kentucky to Chicago. A substantial contribution to lower costs of coal can possibly be made through the development of processes for the coking of a blend of Illinois and eastern coals. Investigations of this possibility are in progress, with apparently promising results.

Production of steel becomes less dependent upon coke in an aging industrial economy. As more scrap becomes available, the quantity of coke required for each ton of steel is reduced. This is illustrated in

Table VII
Coke Consumed in Steel Production, the Chicago District and the United States, 1916 and 1940
(Thousands of net tons)

Material; Ratio	United States		Chicago District	
	1916	1940	1916	1940
Metallurgical coke used*	47,875	45,471	6,227	7,637
Steel produced	47,907	66,983	7,856	13,385
Tons of steel per ton of coke used	1.00	1.47	1.26	1.75

Sources: *Minerals Yearbook*, 1940; *Mineral Resources of the United States: Part I, Metals*, 1916 (U. S. Dept. of the Interior).

* Coke is used in producing pig iron, which is the first step in steel production.

Chart 7, which shows the tons of steel produced per ton of furnace coke used from 1915 to 1945. The Chicago steel industry is less dependent upon coke and new sources of metal than some of its rival districts, as is shown by the comparative ratios in Table VII.

The heavy demand of the blast furnace industry for the coking-coal supplies of the Appalachian fields is the most critical factor in the supply of new metal for a steel industry. The present outlook is favorable for the immediate future, and in the meantime the contribution of scrap to the annual requirements of the steel industry and the development of new coking-coal sources in Illinois will have the effect of extending the life of the critical coking-coal reserves. Investigations of the coking properties of coal are under way to bring additional reserves of coal within the category of coking coals.

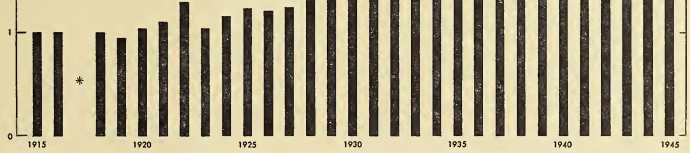


Chart 7. Tons of Steel Produced per Ton of Furnace Coke Used, United States, 1915-1945
***Data not available**

LIQUID FUELS IN THE ECONOMY OF THE UPPER MISSISSIPPI VALLEY

The wide use of machinery powered by liquid fuel units is woven into the very fabric of the American industrial economy. Altogether a stimulus of economic activity amounting to 10 to 12 per cent of the national productivity springs from the desire to own and operate an automobile.

Direct users of oil, which include motor-car owners, owners of oil-heated homes, bus lines, and ocean liners, have an immediate interest in adequate liquid fuel supply.

But back of the automobile owner, for example, are vast manufacturing and service industries each of which is dependent upon the automobile. Among these are steel, alloys, rubber, plastics, lead (mining), cement, sand, gravel and stone quarrying, plate glass, and, in a minor way, resins, paints, and textiles.

Automobile manufacturers under a peace economy normally take 15 to 18 per cent of the steel output, 80 per cent of rubber manufactures, nearly half the output of the plate glass industry, and a large amount of lead, used in storage batteries. One quarter of the cement output goes into highway construction, which is a direct outgrowth of automobile travel; associated with the industry also are large tonnages of sand, gravel, and crushed stone.

Paralleling the manufacturing and construction industries are the vast wholesale and retail distributive activities and service industries, which together employ a million persons with an aggregate yearly pay roll of one billion dollars.

The pattern of agricultural production in the Upper Mississippi Valley is becoming geared to machine production powered by the internal combustion engine. Gasoline, kerosene, and Diesel fuel are the fuels used in the agricultural economy. "Mechanization of farms is responsible for much of the steady rise in the efficiency of farm labor."[8] "Production per farm worker in 1944 was twice as great as in 1910."[9]

The adaptation of power machinery to crop production is especially effective on the level farm lands and large farm units of Illinois, Iowa, and neighboring states. "Mechanical power in its earlier stages was best adapted to large farms, and the large farms gained in efficiency much faster than the small ones. Now machines are being developed for small farms as well, and these farms may be expected to make more rapid strides toward increased output per worker."[10] The key to the continued expansion of mechanization is an assured supply of low-cost liquid fuels.

The importance of mechanical power and transportation powered by internal combustion engines in the Upper Mississippi Valley states is shown in Table VIII.

Supply of Liquid Fuels

Requirements and Supply. The productive pattern of agriculture, manufacturing, transportation, and power production in the states of the Upper Mississippi Valley as it is organized on a peacetime basis requires the refined products of petroleum in about the following annual quantities:

	Barrels
Gasoline	133,000,000
Kerosene	19,000,000
Fuel oil	65,000,000
Tractor fuel	2,000,000

There is no doubt that these requirements will be substantially increased in the future.

To supply the various consumers, refineries are located at strategic points in Illinois — in Chicago, at Wood River near Alton, and in the southeastern part of the state.

The supply of liquid fuel for home heating, for farm power, and for manufacturing, at low costs to the users, arises out of the price interrelationships among the refined products obtained from crude petroleum. In the production of motor fuel — the "cash crop" of the industry — the refinery also yields by-products of heavier fuel oils which enter the market at relatively low prices. Abundant supplies of low-priced oil for industrial fuel and for home heating are contingent upon an abundant flow of crude and a high demand for motor fuel.

The relative outputs and values of the major refined products from crude oil as they leave the refinery are portrayed in Tables IX and X. Modern refinery technology is continually finding ways to increase the yield of motor fuel and correspondingly reduce the yield of by-products (see Table XI).

Petroleum Reserves and Supply. The over-all oil needs of Illinois and the Upper Mississippi Val-

[8] *Report of the Chief of the Bureau of Agricultural Economics, Fiscal Years, 1943-44* (U. S. Department of Agriculture), p. 16.

[9] *Ibid.*, p. 15.

[10] *Ibid.*, p. 17.

Table VIII
Liquid Fuel Consumption in the Upper Mississippi Valley, 1939

Geographical Division	Gasoline Consumption[a] (thousands of barrels)	Number of Tractors on Farms (1940)[b]	Motor Vehicle Registrations[c]				Fuel Oil Consumption[d] (thousands of barrels)	Number of Oil-heated Homes[e]
			Private and Commercial		Publicly Owned Vehicles, Federal, State, County, etc.	Motorcycles, Including Official		
			Passenger Cars, Busses, and Taxis	Trucks, Tractor Trucks, etc.				
Illinois	33,803	126,069	1,624,031[f]	225,592[f]	13,863	7,256	22,561	159,822
Indiana	15,973	73,221	824,196	136,646	8,751	5,405	8,977	19,034
Wisconsin	13,494	81,195	705,751	142,907	10,515	3,695	5,793	76,091
Minnesota	13,111	105,075	721,473	118,577	8,522	2,343	5,909	117,362
Michigan	27,455	66,524	1,326,808[g,h]	145,503[h]	3,305[g]	4,645	10,119	89,860
Iowa	13,103	128,516	671,858[f]	94,554[f]	7,815	2,838	2,969	60,238
Missouri	15,590	45,155	735,485	141,609	4,852	2,317	9,339	34,897
Upper Mississippi Valley (a)	132,529	625,755	6,609,602	1,005,388	57,623	28,499	65,667	557,304
United States (b)	539,963	1,567,430	26,201,395	4,413,692	394,783	126,233	456,943	2,907,980
Percentage (a) to (b)	24.5	39.9	25.2	22.8	14.6	22.6	14.4	19.2

[a] *Minerals Yearbook*, 1941.
[b] *Census of Agriculture:* 1940, Third Series.
[c] *Statistical Abstract of the United States*, 1940.
[d] *Minerals Market Reports*, M.M.S. No. 892, January 31, 1941.
[e] *Census of Housing:* 1940, Second Series.
[f] Busses included with trucks.
[g] State, county, and municipal vehicles included with private and commercial vehicles.
[h] Taxicabs included with trucks.

Table IX
Production of Refined Petroleum Products, Central Refining District, 1944
(In barrels)

Product	Quantity
Gasoline	142,276,000
Residual fuel oil	56,890,000
Distillate fuel oil	34,544,000
Kerosene	13,665,000
Lubricating oil	4,526,000

Source: *Minerals Yearbook*, 1944 (U. S. Bureau of Mines).

Table X
Dollar Value of Refined Petroleum Products, Central Refining District, 1940

Product	Value
Gasoline	$447,695,850
Residual fuel oil	69,961,450
Distillate fuel oil	60,336,360
Kerosene	30,411,360

Source: *Platt's Oil Price Handbook*, 1940.

Table XI
Percentage Yields of Refined Petroleum Products in the United States, 1916-1944

Year	Gasoline	Kerosene	Fuel Oil	Other Products
1916	19.8	14.0	45.0	21.2
1920	26.8	12.7	48.6	11.9
1925	35.1	8.1	49.3	7.5
1930	46.6	5.3	40.2	7.9
1935	47.3	5.8	37.3	9.6
1940	46.1	5.7	38.6	9.6
1944	44.5	5.4	47.2	2.9

Source: United States Department of the Interior.

Table XII
Proved Reserves of Petroleum in Selected States, as of January 1, 1946
(In barrels)

State[a]	Proved Reserves
Oklahoma	889,839,000
Illinois	349,620,000
Arkansas	303,674,000
Michigan	64,186,000
Kentucky	56,721,000
Indiana	41,243,000

Source: Quarterly bulletin of the American Petroleum Institute, April, 1946.
[a] These states furnish the bulk of the oil for the Upper Mississippi Valley.

ley are approximately 30 per cent of the total for the nation. This large consumption reflects the highly mechanized agriculture, industry, and transportation of the region.

In Illinois and in near-by states are located reserves of petroleum which supply refineries in the Chicago district, at Wood River, and in southeastern Illinois; additional reserves of petroleum for the needs of the Chicago refineries are available from the Mid-continent states and are transported by pipe line and barge. The estimate of proved reserves as of January 1, 1946, is shown in Table XII.

Present estimated reserves represent only a portion of recoverable petroleum supplies. Each year exploration uncovers new supplies to replace the oil withdrawn for use. In the past ten years all states that directly supply oil to the Upper Mississippi Valley district, with the exception of Oklahoma and Michigan, have added more reserves than a ten-year production. Chart 8 shows data reported in the quarterly bulletins of the American Petroleum Institute for April, 1945, and April, 1946, and the *Oil and Gas Journal*, January 25, 1947. Kansas figures for 1946 include Nebraska and Missouri; Kentucky figures for 1946 include Tennessee.

Estimates of Reserves Are Conservative. The estimates used in this report include only blocked-out reserves of crude oil known to be recoverable under existing economic and operating conditions. They do not include: (a) oil under unproved portions of partly developed fields; (b) oil in untested prospects; (c) oil that may be present in unknown prospects in regions believed to be generally favorable; (d) oil that may become available by secondary recovery methods from fields where such methods have not been applied.

Oil Supply for the Future. Modern technology is showing the way by means of which a permanent supply of liquid fuel can be assured. In addition to the known supplies of petroleum in developed pools and fields, and the additional discoveries that will continue to be made each year, there are five reserve sources from which liquid fuel may be obtained if the present supply becomes inadequate.

The First Reserve — Refinery Products. The first reserve is that portion of the refinery product which is made up of heavy residual oils and still gases. Modern technology is continually developing and improving processes whereby more of the highly valued products are recovered from crude oil in the refinery process.

The Second Reserve — Natural Gas. Gasoline and other liquid hydrocarbon may be made from natural gas at a manufacturing cost, for the gasoline, of approximately 5 to 6 cents a gallon if natural gas is available at about 5 cents a thousand cubic feet.

The known reserves of natural gas in the Texas Panhandle and in Kansas can be made to augment existing sources of liquid fuel without impairing the services to existing natural gas markets. (*Science-Supplement*, Vol. 106, No. 2627, May 4, 1945, p. 12.)

Proved reserves of natural gas in the United States are estimated to be in excess of 140 trillion cubic feet. In the principal gas-producing states in

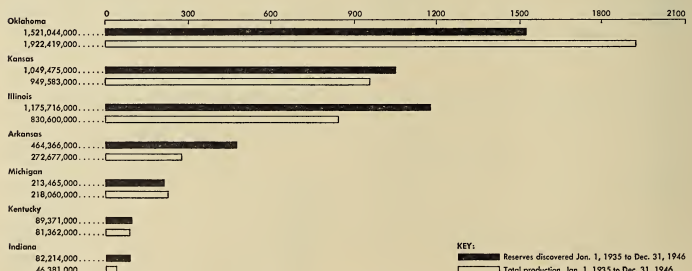


Chart 8. Petroleum Reserves: Discovered and Accumulated Production, 1935-1946 (in millions of barrels)

the Mid-continent, the reserves are estimated as follows:[11]

	Trillion cubic feet
Kansas	11
Oklahoma	6
Texas	82
Louisiana	17

Substantial additions to this reserve are anticipated from future discoveries.

The Third Reserve—Secondary Recovery. The recovery of oil from fields or pools by the application of gas pressure or water flooding has added a reserve over and above the estimates. This method of production is practiced in Illinois and has added to the recoverable supply of oil.

[11] Testimony of E. DeGolyer before the Federal Power Commission in hearings at Kansas City on September 18, 1945, and reported in the *New York Times* of September 19, 1945.

The Fourth Reserve — Imported Oil. Oil from South America can supplement domestic supply in quantities ample to meet domestic requirements for many decades.

The Fifth Reserve — Coal and Shale. "This natural and competitive development of substitute processes, plus information from abroad, has already shown us how to make unlimited quantities of gasoline from coal at prices lower than those prevailing after World War I and, if allowed to continue the natural course, will almost certainly reduce the costs of gasoline made from coal or the richer oil shales to a figure not over 5 cents per gallon above present gasoline costs from crude petroleum."[12]

[12] R. E. Wilson, "Liquid Fuel from Non-Petroleum Sources," *Chemical and Engineering News*, Vol. 22, No. 15, August 10, 1945, p. 1245.

FOOD SUPPLY

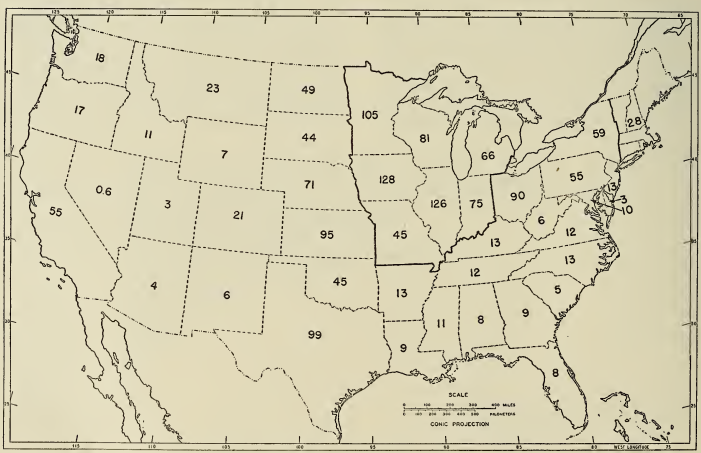
Indispensable as a foundation of an enduring productive economy is a sustained and assured supply of food at low cost. Low-cost food is a resultant of several environmental factors — fertile soil, level or gently rolling topography, mechanization of agriculture, and low-cost transportation. These conditions are met in a superior manner in the Upper Mississippi Valley. Upon the level prairie and cleared woodland areas, vast in extent and almost unbroken by intervals of wasteland, mechanization in agriculture has achieved its highest degree of development. The same factor of topography has favored low-cost transportation and encouraged alternative methods. Both rail and highway transportation play an important role in the cost of assembling food materials and in distributing food products.

Highly fertile soil adds to the productivity of mechanized agriculture and of the farmer because each acre operation results in a high yield per man-day effort. "Use of tractor and motor power has, since 1920, released more than 60 million acres of crop and pasture land from feed production for work stock into production of commodities for sale. If the trend away from horses and mules continues until 1950, another 8 to 10 million acres will be made available for commercial production."[18] A large part of this change has occurred in the states of the Upper Mississippi Valley. Census figures for the past twenty-five years show a consistent decline in the number of horses and mules on farms in those states, from 6.7 million in 1920 to 2.8 million in 1945, a decrease of almost 60 per cent.

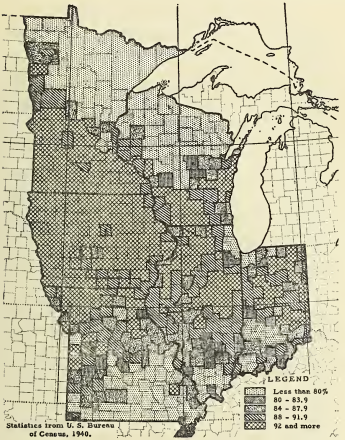
Thus one of the limiting factors to population growth and industrial expansion — a land base for food supply — is still expanding in this area as mechanical power continues to replace animal power, releasing millions of acres of land hitherto used in producing feed for work animals to become available for commercial production.

Map 8 shows the distribution of tractors on farms in the various states, and the percentage of land in farms in the Upper Mississippi Valley is depicted in Map 9.

[18] *Report of the Chief of the Bureau of Agricultural Economics, Fiscal Years, 1943-44*, p. 17.



Map 8. Distribution of Tractors in the United States, 1940 (in thousands)



Map 9. Percentage of Farm Land in Counties of the Upper Mississippi Valley, 1939

The importance of agriculture as an industry in Illinois and other states of this region may be observed in Table XIII, which presents data as shown in the most recent Census of Agriculture, that for 1945. The proportion of soybeans produced in the Upper Mississippi Valley is outstanding. Oats, corn, and swine raised in these states represent a significant proportion of national production.

Meat Packing and Food Supply

The position of meat among the major items of food produced in this country is shown in Table XIV. Meat products account for 32 per cent of the value of product of the principal items of food and allied products (not including liquors), and form a large part of the American worker's food budget.

In the Upper Mississippi Valley states the meat-packing industry occupies a position of fundamental significance. In Illinois it leads all others in number of workers, and in the Chicago district it is exceeded only by the steel industry. Data on employment in this industry over two decades are shown in Table XV.

The further development of this industry in Chicago and in the smaller industrial centers in the Upper Mississippi Valley is limited only by the potential productivity of the farm lands in this fertile and productive economic region.

There are two ways in which the food potential of these states has been expanded in the past two decades: (a) by the addition of acreage formerly devoted to feeding work animals; and (b) by improving the productivity of the land itself through soil treatment, control of diseases and pests, fertilization, hybridized crops, and improved breeds of plants and animals.

Table XIII
Agriculture in Illinois, the Upper Mississippi Valley, and the United States, 1945
(In thousands)

Geographical Division	Acreage of					Number of		
	Farm Land	Wheat	Corn	Oats	Soybeans	Cattle	Swine	Sheep
United States (a)	1,142,818	64,740	91,202	41,503	10,873	81,909	59,759	40,922
Illinois (b)	31,602	1,211	9,140	3,142	3,833	3,278	4,690	625
Indiana	20,027	1,257	4,554	1,175	1,780	1,900	3,231	549
Wisconsin	23,615	57	2,667	2,718	87	3,962	1,336	358
Minnesota	33,140	1,139	5,773	4,305	335	3,790	2,615	1,122
Iowa	34,454	113	10,993	4,697	1,997	5,432	7,652	1,354
Missouri	35,278	1,175	4,658	1,804	685	3,261	2,771	1,257
Total, Upper Mississippi Valley (c)	178,116	4,952	37,785	17,841	8,717	21,623	22,295	5,265
Percentage (b) to (a)	2.8	1.9	10.0	7.6	35.3	4.0	7.8	1.5
Percentage (c) to (a)	15.6	7.6	41.4	43.0	80.2	26.4	37.3	12.9

Source: *Census of Agriculture:* 1945.

Table XIV
Value of Product, Principal Items of Food Manufacture in the United States, 1939
(In thousands of dollars)

Commodity	Value of Product
Meat-packing products	$2,648,326
Bread and bakery products	1,211,024
Canned, dried fruits and vegetables	587,343
Beet and cane sugar	524,266
Creamery butter	492,221
Candy	297,762
Ice cream and ices	285,807
Condensed, evaporated milk	209,756
Sausages, prepared meats, etc., not prepared in meat-packing establishments	208,048
Biscuits, crackers, pretzels	200,793

Source: Bureau of the Census.

Table XV
Employees in Wholesale Meat-Packing Establishments in the Upper Mississippi Valley, 1919-1939

Year	Upper Mississippi Valley	Illinois	Other States[a]	Illinois Percentage of Total
1939	67,747	23,492	44,255	34.7
1937	69,706	26,120	43,586	37.5
1935	65,127	25,217	39,910	38.7
1933	65,631	23,704	41,927	36.1
1931	63,298	23,680	39,618	37.4
1929	73,805	29,618	44,187	40.1
1927	71,782	29,609	42,173	41.2
1925	73,414	30,236	43,178	41.2
1923	84,331	36,144	48,187	42.9
1921	74,695	32,136	42,559	43.0
1919	111,670	54,179	57,491	48.5

Source: *Census of Manufactures.*
[a] Indiana, Wisconsin, Minnesota, Iowa, Missouri, Kansas, and Nebraska.

Flour and Other Mill Products

The milling of flour is important not only as the first step in converting wheat and other grains into edible foods but also as the springboard for industries engaged in the manufacture of prepared foods. This includes breadbaking, the manufacture of biscuits, crackers, pretzels, macaroni, spaghetti, etc. The flour milling and food processing industries, in the main, serve local or regional markets.

The relative position in flour milling of the states in the Upper Mississippi Valley and the western wheat-growing states is shown in Table XVI, as is also the position of the four principal cities engaged in flour manufacture.

Table XVI
Dollar Value of Flour Milling Products in the Upper Mississippi Valley, 1939

State — City	Value of Product
Kansas	$69,859,000
Minnesota	67,437,000
(Minneapolis-St. Paul: 39,981,000)	
Missouri	48,097,000
(Kansas City: 34,513,000)	
(St. Louis: 9,757,000)	
Illinois	42,766,000
(Chicago: 11,178,000)	
Indiana	24,569,000
Nebraska	17,485,000
Iowa	10,021,000
Wisconsin	8,355,000
North Dakota	5,304,000
South Dakota	1,227,000

Source: Bureau of the Census.

SUMMARY

Growth in industrial opportunity must be based on the type of resources available for industrial production, the extent of these resources, and the purchasing power of the area in which a market is being sought. Through the past six decades the Chicago industrial area and its interrelated districts in the Upper Mississippi Valley have grown remarkably. The most important factor in attracting this population has been the great economic opportunities offered here. The vital question in the foreseeable future is the prospect of maintaining these opportunities, for a population can be supported only if there is adequate basis for employment. This report presents a preliminary investigation of the conditions in the basic industries needed to sustain employment.

In the postwar world hard work and high productivity will be essential over a long period of time. The waste of war is reflected in a high national debt — a deficit which can be erased only by both high production and high productivity.

One of the primary requisites of high productivity — that is, a high output per man and a high degree of total employment — is freedom to select the most efficient methods of production and the most economical location of industry with respect to markets, materials, and fuel.

For continued production and employment at a high level, assuming efficiency in production and economy in location, an industrial area must be amply supported by basic raw materials, fuels, and food supplies. The industries which are considered basic in the Upper Mississippi Valley and which supply the necessary elements for a large industrial base are steel, coke, oil products, meat packing, and flour milling.

Steel and Coke

Steel is the raw material for a wide variety of manufacturing industries, large and small, not only in the Chicago industrial area itself but also in the smaller manufacturing cities of downstate Illinois, Wisconsin, Minnesota, Iowa, Missouri, and Indiana. The ultimate source of the primary steel produced in the Chicago district is the vast ore bodies of the Lake Superior district. To reduce this ore to steel requires metallurgical coke, made largely from coal mined in the West Virginia fields. Although the drafts upon high-grade ore have been heavy, there is a vast reserve of low-grade ore, practically inexhaustible, that can, when needed, continue to sustain the steel industry of the Chicago district. Coking coal is in no danger of early exhaustion. It is now becoming evident that Illinois coals, when blended with eastern coal, can supply a substantial portion of the coking-coal needs of the steel industry in the Chicago district.

Liquid Fuels

A substantial part of the Upper Mississippi Valley liquid fuel requirements are supplied from near-by oil fields in Illinois and the Mid-continent, and the area has access to more distant supplies from Louisiana, Texas, and, if need be, from South America, available by low-cost tanker, river-barge, and pipe-line transportation.

Meat Products

The supply of meat products from the Upper Mississippi Valley area — the most important item in the American workman's diet — is potentially greater than that necessary to supply the population of this area. This has been increased during the past two decades by bringing under cultivation several million acres of land in areas adjacent to the Upper Mississippi Valley states and by improved crop technology and feeding practices.

Although Chicago's percentage of meat packed has decreased, this means merely a decentralization of this activity in the Upper Mississippi Valley and an increase rather than a decrease in the amount of meat available at a minimum of transportation and distribution costs.

Grain-Mill Products

The production of flour and other grain-mill products is decentralized throughout the Upper Mississippi Valley cities. Minneapolis, Milwaukee, and Kansas City are more important than Chicago as centers for the processing of grain products.

Market Opportunity

The uniquely favorable combination of a highly industrialized area in the midst of a highly productive agricultural area has created a region of locally high purchasing power — the summation of agricultural crops sold and wages paid in manufacturing, retail and wholesale trade, mining and other industries.

Finally, the primary industries of the Chicago district and the abundant raw materials of the Upper Mississippi Valley states offer most of the favorable conditions necessary for an era of sustained productivity.

APPENDIX

Table 1
Consumption of Coal by Manufacturing Industries, 1939

Industrial Area[a]	Number of Wage Earners	Tons of Coal Consumed[b]	Average Tons Consumed per Worker
United States	7,886,567	142,787,289	18.1
New York-Newark-Jersey City	849,608	5,585,366	6.6
*Chicago	483,593	13,615,216	28.1
Philadelphia-Camden	321,725	4,253,159	13.2
Detroit	311,332	7,329,380	23.5
Boston	237,496	2,372,195	10.0
Pittsburgh	191,903	16,594,696	86.5
Cleveland	140,653	6,540,233	46.5
*St. Louis	126,831	1,971,454	15.5
*Milwaukee	98,414	1,596,678	16.2
*Minneapolis-St. Paul	48,608	632,207	13.0
Indianapolis	38,838	769,458	19.8
Total, Eleven Districts	2,849,001	61,260,042	21.5
Total, Illinois Coal Market Area	757,446	17,815,555	23.5

Source: *Census of Manufactures:* 1939.
* Cities in Illinois Coal Market Area.
[a] This term signifies an area having as its nucleus an important manufacturing city and comprising the county in which the city is located, together with any adjoining county or counties in which there is a great development of manufacturing industry.
[b] Includes 1,788,246 tons of anthracite.

Table 2
Tons of Coal (excluding railroad fuel) Shipped to Consumer States in the Illinois Coal Market Area, 1945-1946

Consumer State	Total Shipments[a]		Shipped by Rail		Shipped by Water	
	1946	1945	1946	1945	1946	1945
Illinois	37,110,823	40,261,246	35,387,957	38,200,066	1,722,866	2,061,180
Wisconsin	12,456,486	12,995,171	3,754,143	4,106,165	8,702,343	8,889,006
Iowa	6,839,142	7,228,858	6,720,991	7,122,466	118,151	106,392
Kansas	1,364,254	2,079,281	1,364,254	2,079,281	.....	.....
Minnesota	5,548,302	5,587,158	1,632,711	1,676,937	3,915,591	3,910,221
Missouri	6,467,394	7,854,271	6,467,394	7,854,271	.....	.....
Nebraska	1,668,896	2,116,632	1,661,327	2,108,321	7,569	8,311
North Dakota	305,469	270,036	93,573	61,102	211,896	208,934
South Dakota	818,696	819,462	466,293	470,687	352,403	348,775
Total, Nine States	72,579,462	79,212,115	57,548,643	63,679,296	15,030,819	15,532,819

Source: *Monthly Coal Distribution Reports* (U. S. Bureau of Mines), No. 172 (1945); No. 184 (1946).
[a] Does not include shipments by truck, for which data are not available.

Table 3
Consumption of Fuel, by Kind and Quantity, and Cost of Fuel and of Purchased Electric Energy, in Manufacturing Industries in the Illinois Coal Market Area, by States, 1919, 1929, and 1939

State and year	Coal (net tons)	Coke (net tons)	Fuel Oil (barrels)	Gas (M cu. ft.)	Total Cost of Fuel and Purchased Electric Energy	Total Cost of All Fuels
Illinois						
1939	10,270,060	2,705,566	6,663,773	160,962,119	$ 94,433,401	$ 63,431,740
1929	20,315,068	5,018,738	11,151,489	55,534,753	163,925,284	130,932,032
1919	16,769,792	3,903,043	4,876,501	3,557,698	125,668,595	*
Iowa						
1939	1,132,933	56,459	232,800	9,857,796	11,858,637	6,824,085
1929	2,392,687	103,287	739,623	374,054	17,804,999	12,459,845
1919	2,171,655	134,841	573,958	181,957	14,060,998	*
Kansas						
1939	139,803	12,299	2,541,433	25,966,766	8,793,739	5,667,459
1929	636,569	30,871	3,056,301	36,319,485	14,428,979	10,730,514
1919	1,410,002	60,523	3,168,330	13,022,876	15,477,575	*
Minnesota						
1939	1,626,162	210,841	778,292	16,981,571	16,159,612	10,522,302
1929	2,965,300	464,538	757,854	14,384,487	26,884,058	20,790,065
1919	2,529,596	440,452	292,661	1,438,853	22,311,828	*
Missouri						
1939	1,702,026	80,135	1,300,443	19,880,166	19,721,994	10,445,030
1929	3,322,325	156,925	2,401,441	10,517,620	30,082,748	19,201,640
1919	4,133,992	194,758	1,839,968	1,658,684	26,555,791	*
Nebraska						
1939	162,436	9,133	151,363	5,166,991	4,044,618	2,240,541
1929	694,098	99,877	538,709	108,010	6,777,227	4,766,025
1919	920,908	56,904	430,064	75,956	7,030,388	*
North Dakota						
1939	74,021	636	15,827	141,240	662,291	388,777
1929	232,890	1,965	18,451	66,235	1,112,891	888,194
1919	194,378	1,498	2,559	6,451	971,825	*
South Dakota						
1939	31,737	996	19,962	2,058,430	1,086,789	620,099
1929	132,283	5,341	60,458	853,379	1,497,829	1,082,387
1919	99,950	9,103	73,454	11,992	1,079,684	*
Wisconsin						
1939	3,638,095	83,535	1,649,029	2,130,951	32,439,443	20,898,959
1929	5,794,275	272,010	1,628,872	8,016,028	46,545,165	34,122,235
1919	5,387,834	542,938	616,799	1,270,809	42,248,215	*

Source: *Census of Manufactures:* 1939.
* Figures not available.

Table 4
Average Value per Net Ton of Coal at Mines, 1880-1946

Year	Anthracite	Bituminous	Year	Anthracite	Bituminous
1880	$1.47	$1.25	1914	$2.07	$1.17
1881	2.01	1.12	1915	2.07	1.13
1882	2.01	1.12	1916	2.30	1.32
1883	2.01	1.07	1917	2.85	2.26
1884	1.79	0.94	1918	3.40	2.58
1885	2.00	1.13	1919	4.14	2.49
1886	1.95	1.05	1920	4.85	3.75
1887	2.01	1.11	1921	5.00	2.89
1888	1.91	1.00	1922	5.01	3.02
1889	1.44	0.99	1923	5.43	2.68
1890	1.43	0.99	1924	5.43	2.20
1891	1.46	0.99	1925	5.30	2.04
1892	1.57	0.99	1926	5.62	2.06
1893	1.59	0.96	1927	5.26	1.99
1894	1.51	0.91	1928	5.22	1.86
1895	1.41	0.86	1929	5.22	1.78
1896	1.50	0.83	1930	5.11	1.70
1897	1.51	0.81	1931	4.97	1.54
1898	1.41	0.80	1932	4.46	1.31
1899	1.46	0.87	1933	4.17	1.34
1900	1.49	1.04	1934	4.27	1.75
1901	1.67	1.05	1935	4.03	1.77
1902	1.84	1.12	1936	4.16	1.76
1903	2.04	1.24	1937	3.81	1.94[a]
1904	1.90	1.10	1938	3.92	1.95
1905	1.83	1.06	1939	3.64	1.84
1906	1.85	1.11	1940	3.99	1.91
1907	1.91	1.14	1941	4.26	2.19
1908	1.90	1.12	1942	4.50	2.36
1909	1.84	1.07	1943	5.06	2.69
1910	1.90	1.12	1944	5.57	2.92
1911	1.94	1.11	1945	5.90	3.06
1912	2.11	1.15	1946	6.68	3.44
1913	2.13	1.18			

Source: *Minerals Yearbooks* (U. S. Bureau of Mines).
[a] After 1936, selling costs are included.