THE UNIVERSITY OF CHICAGO

THE ROCK ASPHALT INDUSTRY OF WESTERN KENTUCKY

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BY
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Mr. E. B. Swanson of the Bureau of Mines, Washington, and Mr. A. J. Wakefield of the United States Engineer Office, Louisville, I wish to thank for special reports on the industry. To officials of the Illinois Central Railroad I am deeply grateful for having been given access to unpublished statistics which made possible conclusions that otherwise would have been impossible. To many other people of the asphalt region whose names I do not know, I am indebted for bits of information which came out in conversation with them. In many cases their opinions and statements threw considerable light on the situation existing in the area and in the rock asphalt industry.

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Chapter I

GENERAL CHARACTERISTICS OF THE INDUSTRY AND THE AREA

The asphalt industry of western Kentucky is the only industry of commercial proportions in the isolated area to which it is confined. Its bustling enterprise forms a striking contrast to the lack-a-daisical air which pervades the entire region. The industry is of particular importance to this area, for it offers a source of revenue to a population which otherwise would derive a meager living from tilling the inferior soil of the hilltops and creek bottoms.[1]

The annual production of rock asphalt has increased from nearly 4,000 tons in 1901 to approximately 400,000 tons in 1928.[2] The value of the product as represented by the sales at the mines, increased from less than $25,000 in 1901 to more than three and a half million dollars in 1928. The latter year represents the peak of both production and price, $9.17 per ton being the average price for that year.[3] The

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1. The greater part of the material for this thesis was obtained by study in the area, in 1928 and 1929, while I was an instructor in the Department of Geography at Western Kentucky State Teachers College. Special work was done in the area during my vacations.
2. War Department, United States Engineer Office, Louisville, Ky.: Comparative Statement - Asphalt Tonnage.
3. A. H. Redfield: Asphalt and Related Bitumens, Mineral Resources of the U. S., 1928, Part II.

major part of the production of rock asphalt is sent to cities, and to states having extensive road building programs. As asphalt is used chiefly for road surfacing, the rapid progress of the country's roadbuilding program has been an important factor in the recent rapid development of the industry. Central, south and eastern United States are the chief consumers. Kentucky rock asphalt has been sent as far west as Kansas; and a few foreign countries, namely; Cuba, England and Canada, are using it.[1] From 1921 to 1929 Chicago has used approximately 133,000 tons, enough to surface two million square yards of streets and boulevards.[2] On an average, more than sixty per cent of a year's production is sent to states north of the latitude of Kentucky.[3] In 1927, which was a typical year, approximately 75 per cent of the rock asphalt produced in western Kentucky originated in Edmonson County.[4] Although smaller shipments were made by rail from Grayson and Hardin counties, the output of Edmonson County was transported by barges down Green River and its tributaries to their points of intersection with railroads at Bowling Green and Rockport. Here large storage supplies are kept and shipments are made from them by rail. The volume of this output is sufficient to keep a constant stream of boats plying between the river terminals and the source of production

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1. H. St. C. T. Carmichael: Interview.
2. Kentucky Rock Asphalt Co. Salesman, Interview.
3. Illinois Central Railroad figures.
4. Comparison of statistics from 3 and 3, page 1.

Oversized map is included as a separate file named Figure 1.

Fig. 1. Area of bituminous rock production in western Kentucky. The neavy line encloses the area where rock asphalt is found.

in Edmonson County. Logan County rock asphalt is about ready to be put on the market again, after an absence of several years, during which time operations have been suspended in that part of the area.

Deposits of bituminous rock are found extending from the north central part of the southern extension of the Mississippian Plateau across the eastern arm of the Western Coal Fields into the northern portion of the Mississippian Plateau, (Fig. 1). This includes a strip of country approximately 80 miles long and 10 to 30 miles wide, extending in a general north-east--south-west direction. Much of the rock is of no commercial value, due to the low bitumen content or to the nature of the base. As a result, the industry is largely confined to three completely separated districts (Fig. 2) within the "black rock" area. In these a vast amount of the rock having from 6 to 10 per cent bitumen content is found.[1]

The three commercial producing districts are known as the Grayson-Hardin County, the Edmonson County and the Logan County districts. They lie to the southwest of the Bluegrass and are on the western flank of the Cincinnati Arch. The Grayson-Hardin County District is just north of, and the Edmonson County district just south of, the axis of the syncline which forms the great synclinal basin extending west and

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1. W. R. Jillson: Kentucky Rock Asphalt (1928)

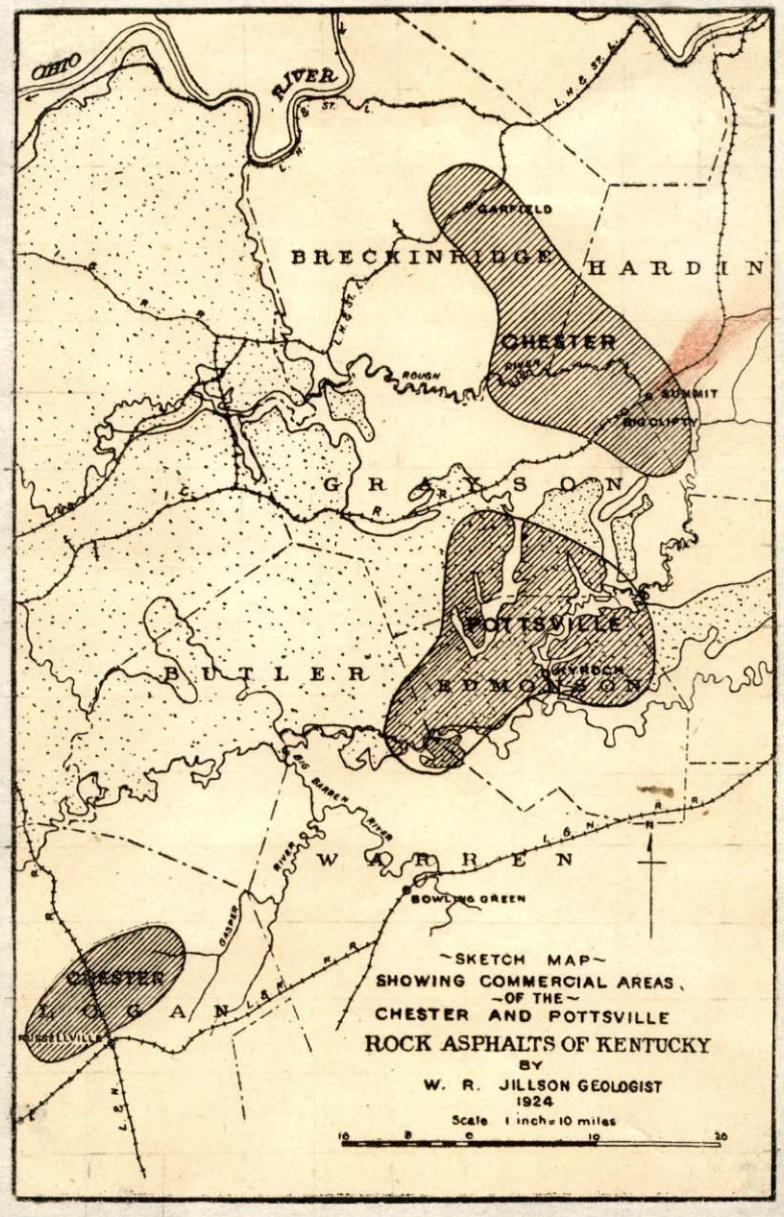

Fig. 2. Areas producing commercial rock asphalt. Shaded portions show areas of commercial production of rock asphalt.

north and which contains the coal fields of western Kentucky, Indiana, and Illinois. In the Grayson-Hardin County, and the Logan County districts, the bituminous rock is found, stratigraphically, in what is known as the Chester sandstones of the Mississippian system, and in the Edmonson County district it is found in the Pottsville conglomerate sandstone of the Pennsylvanian system.[1] While all strata of bituminous rock are of approximately the same elevation, the former have been much more worn down and present much larger comparatively level areas. The latter, which includes a small portion of southern Grayson County and that part of Edmonson County north of Green River, is decidedly rugged. The asphalt rock in the Edmonson County District lies in the same measures as the coal of the Western Coal Fields, but is a considerable distance east of the producing coal areas. Consequently the thin veins of coal, present in the area, are of inferior quality and of no importance except for local use.

The Edmonson County District is composed of alternating high, rather narrow and flat-topped ridges, and deep, steep, sometimes precipitously sided V-shaped valleys. A few knobs rise above the ridges, but in general such features are not conspicuous. The valley bottoms are narrow and bottom flats are rarely present.[2] These ridges and valleys were

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1. W. R. Jillson: Economic Papers on Kentucky Geology (1931).
2. J. M. Weller: Geology of Edmonson County (1927), 17.

originally forest covered, but half a century ago the cutting of this timber was begun and by the late nineties, had been cleared away. From that time until recently farming has been the principal interest of the area.[1] Now, however, the rock asphalt industry has become the outstanding activity. The deposits of bituminous rock, which from a commercial standpoint are the best and most workable in the area, are found near the tops of the high ridges and knobs, and the heavy production is carried on at an elevation of more than six hundred feet. The largest single company operates in this district. The name of this company's postoffice and the trade name of the product, "Kyrock", are used in the surrounding country to designate the district. The output of the district averages more than seventy-five per cent of the entire output of the region.

The development of the asphalt industry has not changed the entire work pattern of Edmonson County, nor even of the northwestern section, but it has had a striking influence on the area in which it has developed and has in turn, been greatly influenced by the natural and cultural features of the region. There have been many handicaps to overcome, some of which have been actually turned into account for the industry. Many disappointments and a few actual failures have resulted. A valuable material is at hand, however, and with

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1. M. M. Logan: Interview (1939).

proper management and sufficient capital rock asphalt is produced and marketed so as to yield satisfactory profits both to the company and the community. The quarry communities and marketing facilities and processes are of considerable importance in their respective districts. An explanation of the production of rock asphalt, of the life and character of the quarry communities, and of the problems of marketing, touches the geographical heart of the industry, for it reveals the ways in which and the extent to which, the natural endowment of the area is being utilized.

Oversized map is included as a separate file named Figure 3.

Fig. 3. Map of Edmonson County showing rock asphalt producing centers.

Chapter II

DEVELOPMENT OF THE ROCK ASPHALT INDUSTRY IN EDMONSON COUNTY

Edmonson County is divided into two practically equal parts by Green River. This stream flows in a general east to west direction and is navigable to Mammoth Cave, near the eastern border of the county (Fig. 3). A main line of the Louisville and Nashville Railroad crosses the extreme southeastern corner of the county from northeast to southwest, and near it, extending in a direct east-west line, is the Dixie Highway (U. S. Route 31W). The Brownsville Pike crosses the highway and the railroad at approximately a right angle near the Dripping Springs school. This pike extends to the county seat for which it is called, and across Green River about a mile and a half toward Leitchfield. Since the asphalt area lies wholly north of Green River, it is cut entirely off from the railroad, and is connected with the highway only by the Brownsville Pike which leads from the limestone sink country of the Mississippian Plateau toward the higher portions of the Pennsylvanian formation north of Green River.

LANDSCAPE

Landscape from the Air An airplane, winging its way southward from Louisville to Nashville, passes over a

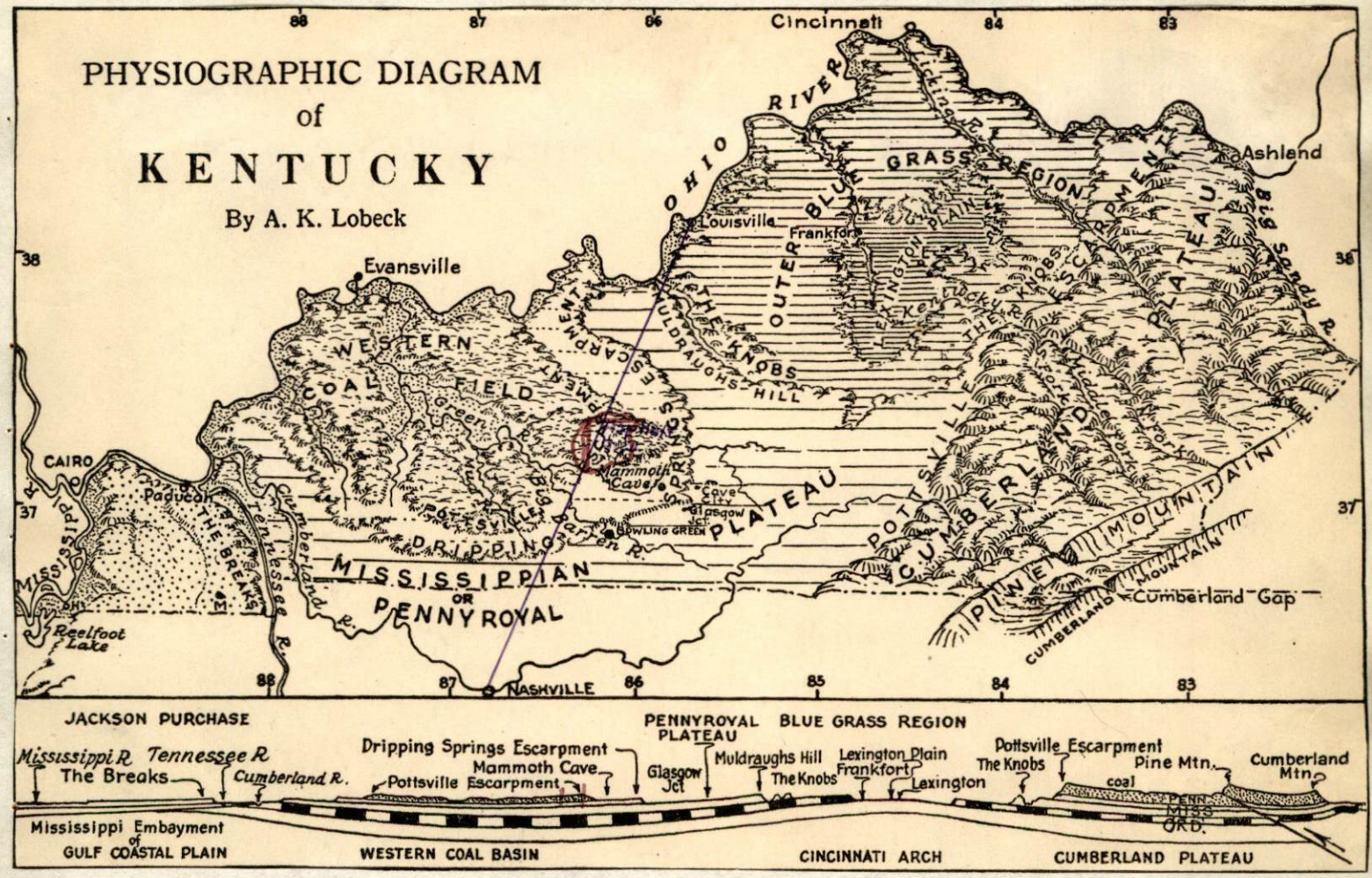

Fig. 4. Physiographic diagram of Kentucky. Area of rock asphalt production in Edmonson County is in red. Airplane route between Louisville and Nashville is shown in purple.

region of alternate lights and shadows made by deep river valleys and high narrow, flat-topped ridges. Here and there the tops of these ridges are deeply scarred or carried away entirely. The silver threads of Nolin, Bear Creek or Green River show that these streams wind their courses close to the deeply scarred hills. When the plane swings low, the great gashes become scenes of much activity, with trains made up of small hopper-like cars carrying the rock asphalt to the barges on the river below. The huge steam shovels, locomotives and other evidences of modern equipment seem strangely out of place in such an isolated region. For, on every side are the thinly forested hill-sides with an occassional cornfield, tobacco patch or meadow. Only the meandering streams or narrow strips of country road suggest a connection with the outside, a connection of great moment to the rock asphalt industry. Unless familiar with the signs of the industry, the observer from the air may pass on ignorant of the identity of the industry below. For, although the asphalt producing section of Edmonson County lies very near the most direct route between Louisville and Nashville (Fig. 4), the ruggedness of the country prevents that route being used by any means of transportation except the airplane. As no regular air line exists, the marking of the towns or quarries has not been considered necessary.

Landscape from the River If by chance the traveler is among the favored few (there are no public passenger boats),

Oversized map is the U.S. Topographical map for northern Warren County and southern Edmonson County. It was too large to scan for this project in its entirety. Instead the northern portion, which included the area of interest was scanned and included as a separate file named Figure 5.

Fig. 5. Topographic map of a portion of Edmonson County.

and approaches the region by Green River, the impression is entirely different. The river winds in and out in a narrow valley (Fig. 5) with precipitous valley walls first on one side and then on the other. At irregular intervals tiny bottom flats, washed by a recent flood, and covered by the ever-present cornpatch, are interspersed. The long distance to be traversed is increased by the incised meanders of the stream which cuts into one huge bluff of sandstone or conglomerate, and turns aside in a wide sweeping curve or elbow-like angle to another. From the river approach, the introduction to the rock asphalt industry comes when one sees a long string of barges in position at the foot of a bluff on which a shedded runway from the crushing mill leads down to the water's edge. The quarry, with its clamoring, hissing steamshovels, and its puffing locomotives is not visible from the river. Only the frazzled edge of the deep cut on the hilltop suggests any reason for the presence of the churning, clanking mill which sprawls over the hillside and spills its tons of glistening black rock into the barge waiting below.

Along the narrow valley of the river, no telltale sign reveals the identity of the industry. In one place a few cottages tucked away in a hollow give the only evidence of a settlement. In another, the only indications of a thriving town are straggling office buildings clinging to the hillside just above the river, and numerous roofs protruding through the scattered second growth timber.

Landscape from the Country Road In most instances, the asphalt district of Edmonson County is approached by bouncing in over the unsurfaced country road from the county seat. By this route the impression received is a blending of that obtained from the airplane with that from the river. From the crossing of Green River at Brownsville the road gradually ascends toward the ridge tops (Fig. 5). In about half of the distance the pike disappears and the dirt road continues. A quarter of a mile above the Steep Hollow School house the road forks. One fork, the Lower Morgantown road, leads southwestward to Asphalt; another, the Leitchfield and Morgantown, northwestward to Natural Rock; and still another, the Bee Springs road, northward to Kyrock.

Along the country road no doubt is left as to the industry spread out in view. On every side are signs telling of the ownership of land by an asphalt company, warning of the danger of high voltage wires above or of open quarries below, or simply giving the information that a store or town lies ahead. As each center of production is approached, the road leaves the ridge tops and begins its descent, for in every instance, the road leads eventually to the river which is the means of transportation of the rock asphalt. As the descent is made, the quarries gradually become less discernable, as the activities of mill and settlement become more apparent. It is only by following the devious windings of

Tonnage of the Rock Asphalt Shipped Down Green River in the Years 1901-1929 inclusive

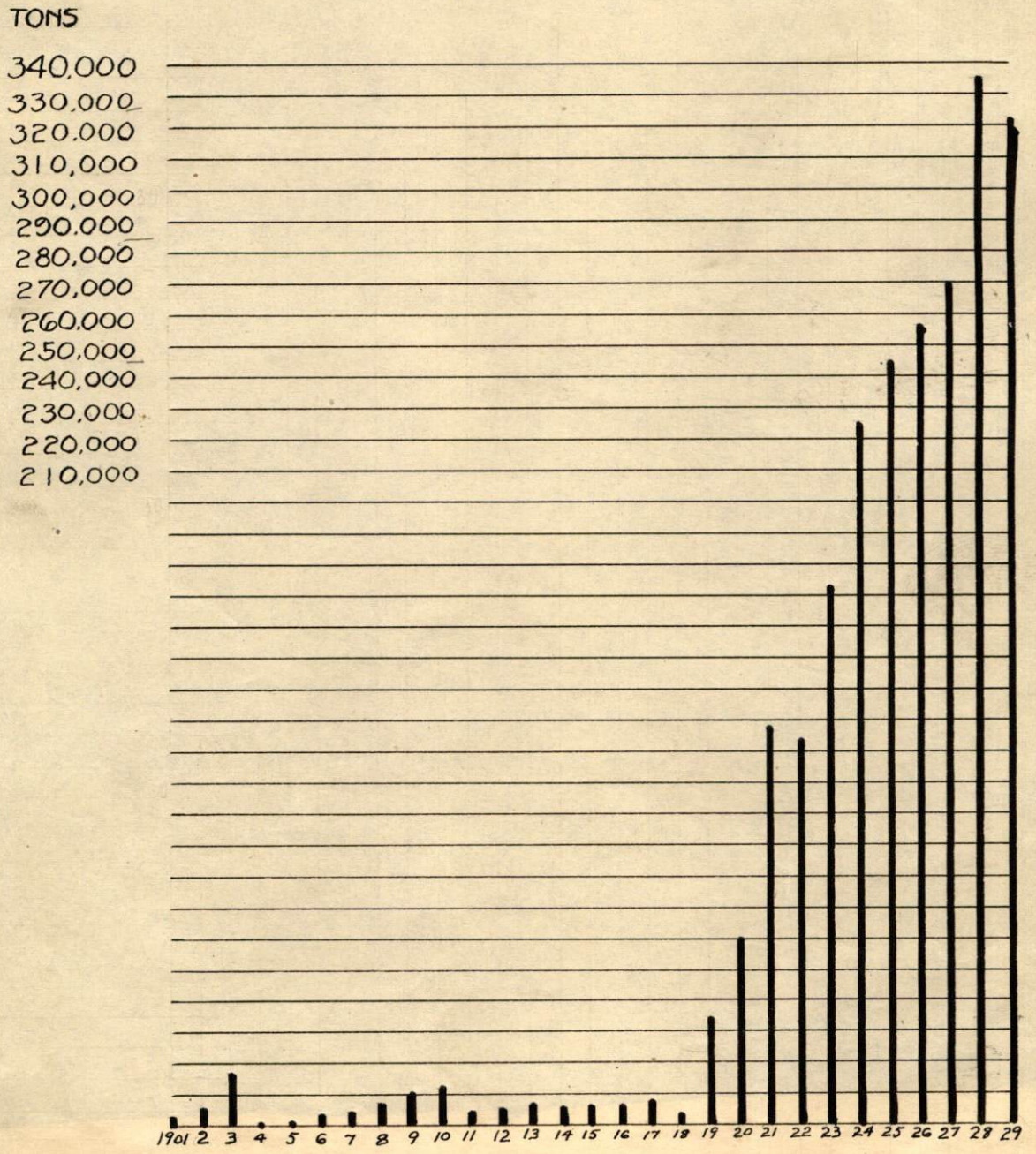

Fig. 6. Graph showing production of rock asphalt in the years 1901 - 1929 inclusive.

these roads that a wide perspective may be gained of the scattered quarries, of the sprangled narrow gauge railroad lines connecting the quarries with the crushers, and of the village spread over the ridge tops, hill-sides and hollows.

CHRONOLOGY AND ORGANIZATION

The rock asphalt industry of Edmonson County, in spite of the fact that it is set off from the outside commercial world by high hills and steep sided valleys (Fig. 5) has continued its growth steadily for a decade or more, and now leads the other regions of western Kentucky in production. Although the presence of "black rock" as it was called when first mentioned in the Geological Survey reports,[1] has been known since the county was first settled, its commercial development in the present proportions really dates from 1919. The record of shipments down Green River[2] (Fig. 6) shows the growth of the industry in the twenty-eight years from 1901 to 1929 inclusive. During that period, two distinct periods of production are recognizable, namely, 1901 to 1918 and 1919 to 1929. From 1901 to 1918, the average production was around 6,000 tons, while 1903 and 1910 stand out with 17,000 and 10,000 tons, respectively. From 1918 to 1929 the production increased from 3,000 tons to more than 34,000 tons. From that amount it has gradually

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1. Kentucky Geological Survey 1854.
2. United States Engineers Office: Special Report.

risen to more than 300,000 tons in 1928, approximately 80 per cent of Kentucky's output. At the average price for 1928, which was $2.17 per ton, the income was nearly $3,000,000. During the season of greatest output, about a thousand men are employed in the production. Three companies operate in this field at present. They are the Kentucky Rock Asphalt Company, United Rock Asphalt Sales Corporation, and the Natural Rock Asphalt Corporation. Together they represent an investment of about ten millions of dollars. Three thriving villages have grown up around the centers of production and are, save the quarry-scarred hilltops themselves, the most conspicuous changes that have taken place in the landscape. The impressive growth of the second period was due in part to the reputation of Kentucky rock asphalt established during the World War, to the improvements made in the navigability of Green River and to the advent of the Kentucky Rock Asphalt Company.

KENTUCKY ROCK ASPHALT COMPANY

Operations and Holdings. The Kentucky Rock Asphalt Company carries on the largest operations in the area, and these operations are illustrative of the conditions met and practices used in the production of rock asphalt.

The company was established in 1918 on Nolin River at the present site of Kyrock. The holdings of this company represent an investment of about five million dollars, and

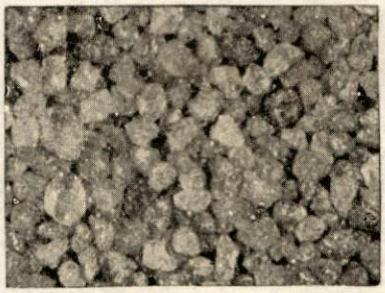

Fig. 7. Sand grains in rock asphalt. Enlarged eleven times. (Courtesy of Kentucky Rock Ashpalt Company)

include control of 45,000 acres of land in Edmonson, Grayson and Hart Counties. Of the land under control 8,000 acres are owned outright, while of the remainder the company has leased the mineral rights. The lease for mineral rights contains a clause giving the company option on the surface when it is needed for quarrying the rock asphalt.[1] The controlled area includes the land originally owned by the old Wadsworth Stone and Paving Company, a firm which operated in the late nineties and which was responsible for the discovery of the use of the rock "laid cold".[2]

The utility of rock asphalt for road making depends on its bitumen content and the sand grain. "Kyrock" is composed of a hard silicate sand (Fig. 7), each grain of which is completely coated with asphalt. For many years, it has been believed that the best roads result from rock

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1. H. St. G. Carmichael: Interview.
2. Rock asphalt as now used for road surfacing is spread in the condition in which it comes from the mill. The asphalt is spread cold over the base to be covered and it is then rolled with a very heavy roller which reduces its thickness about half. Under the pressure of the roller it is bonded into a condition approaching its original state. The discovery of the possibility of its use in this way was made by accident. It was hauled in wheelbarrows from the mill to the boat. Some rock asphalt spilled on the path over which it was being carried. The wheelbarrow passing over it, pressed it back into solid form. This fact was noted and experimentation showed that the rock asphalt laid cold could be rolled into an excellent road surfacing as a result.
   --Judge M. M. Logan: Interview.

having about seven per cent bitumen content. As rock asphalt is used chiefly for road surfacing, seven per cent bitumen content is the standard, and extreme care is taken to maintain uniformity in all material put on the market. The bitumen content varies considerably as does the depth of overburden and thickness of commercial rock. Consequently, each prospective site is carefully coredrilled to ascertain the condition of the rock and the overburden, and the quarry is located accordingly.

Cost as Related to Thickness of Overburden The overburden removed averages forty feet in thickness, though sixty feet may be removed if the underlying commercial rock justifies it. The overburden consists of bedrock, about twenty feet thick, immediately above the commercial rock and the remainder of mantle rock. The bedrock is made up of shale, sandy shale, and shaley sandstone with a thin vein of coal. The mantle rock is sand, clay, and gravel and is more easily removed than the bedrock. The variation in the thickness of the overburden is practically always a variation in the thickness of the mantlerock. Thus the cost is related directly to the thickness of the mantlerock. The overburden is first blasted loose, then cleaned off by steam shovels. The shovels load it into cars and the cars carry it to convenient dumps. These dumps are either the river bank or hollows where there is no danger of the dumped material being in the way of future work.

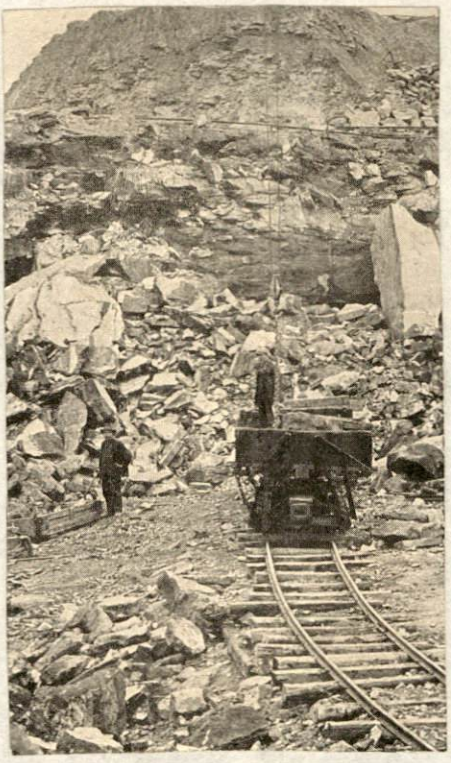

Fig. 8. Quarry of Kentucky Rock Asphalt Company. Mass of rock asphalt is shown ready for loading into dump cars. (Courtesy of Kentucky Rock Asphalt Company)

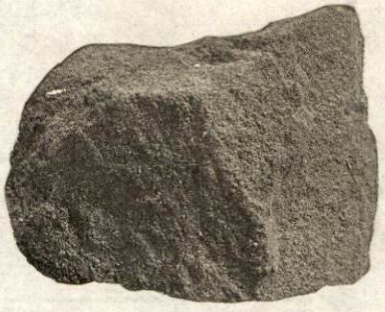

Fig. 9. Block of rock asphalt weighing more than three tons. (Courtesy of Kentucky Rock Asphalt Company).

Quarrying Processes Related to Character of Rock

The processes of quarrying are practically the same in all of the quarries, and are directly related to the character of the rock and the nature of the country. Four quarries are operated by the Kentucky Rock Asphalt Company. They are Kyrock, Indian Creek, Beaver Dam Creek, and Sweden (Fig. 3).

The veins quarried average twenty feet, varying from a trace to forty feet.[1] Rock with bitumen content averaging greater than 8 per cent or less than 6 per cent is not removed.

The top of the commercial rock is carefully cleaned off, then it is blasted out in the same way as the overburden and commonly comes out in blocks weighing several tons (Fig. 9). These are placed, one at a time, on the cars by cranes and guy derricks. In addition to the big rock, the blast yields considerable quantity of smaller material. The smaller material is loaded by hand into skip-boxes, which are handled by cranes and dumped into cars. As all the rock blown down is not of commercial value, it is carefully hand-picked (Fig. 10). The men who do this work, through years of experience, become so skillful that they can grade it with practically the same accuracy as is done in the laboratory tests.[2]

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1. H. St. G. T. Carmichael: Letter.
2. H. St. G. Carmichael: Interview.

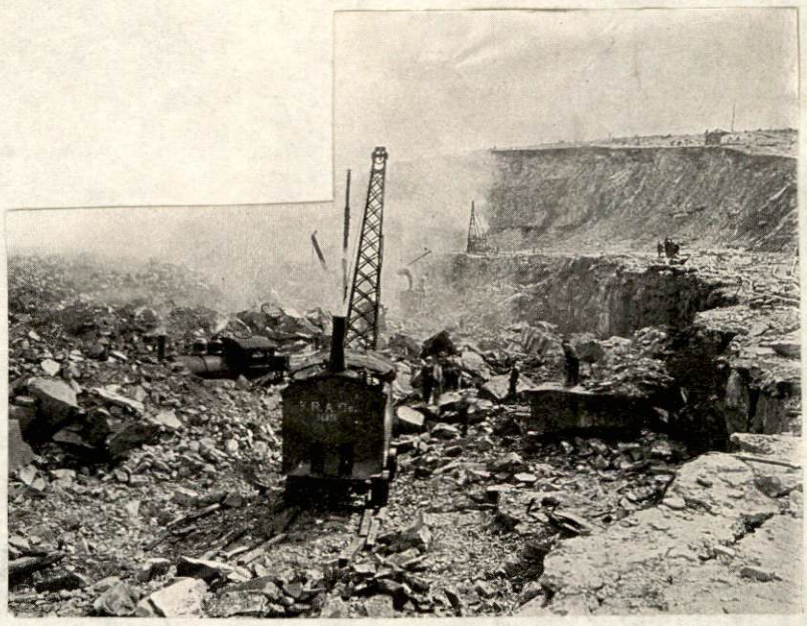

Fig. 10. Men in quarry hand picking rock asphalt before loading. (Courtesy of Kentucky Rock Asphalt Company).

Selection of Quarry Sites Related to Accessibility to Mill One of the expensive items involved in quarrying rock asphalt is to get this heavy material from the quarry to the mill. Consequently the quarry sites were selected with regard to their accessibility to the mill. Twenty steam locomotives and one hundred twenty-five side dump cars are used to remove the overburden and carry the commercial rock to the crushers. About fifteen miles of 36-inch gauge tracks are in use connecting the various quarries with the mill. These tracks are maintained on an approximate level with the quarries. The quarries occupy the tops of the ridges and knobs. This necessitates cuts, the deepest being forty feet, and fills, the highest about 100 feet.

Milling Processes as Related to the Character of the Rock The milling processes are designed to offset the fact that the rock is of varying quality. When the rock asphalt was first put on the market, some criticism was made as to the lack of uniformity. From the dump cars the rock is poured into a jaw crusher which reduces it to sizes of seven inches or under. It next is conveyed by belt to a hundred-ton capacity storage bin. Rock from all the quarries comes into this bin and is mixed. This is the first of the blending processes which insure the uniformity of the rock. The rock passes from this bin down hill to another crusher and then to another, until it is reduced to one and a half

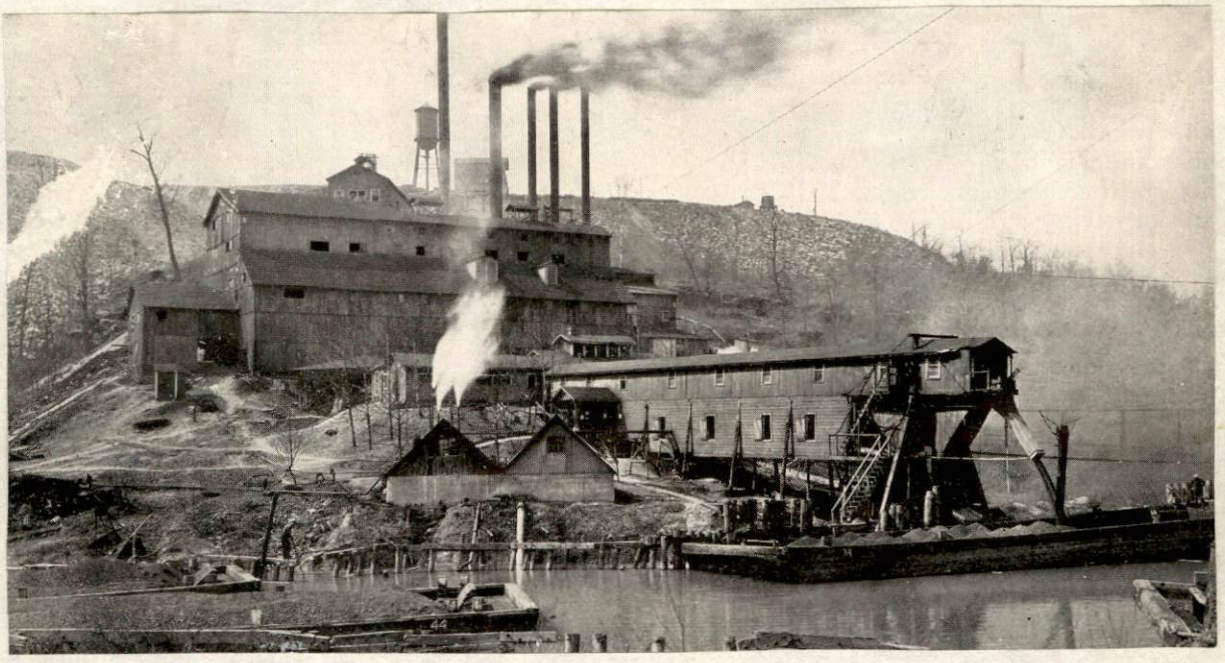

Fig. 11. Mill of Kentucky Rock Asphalt Company. Barge in foreground being fed finished product from mill. (Courtesy of Kentucky Rock Asphalt Company).

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Archivist

Fig. 12. Laboratory of Kentucky Rock Asphalt Company. Tests for Bitumen content of rock asphalt are being made. (Courtesy of Kentucky Rock Asphalt Company).

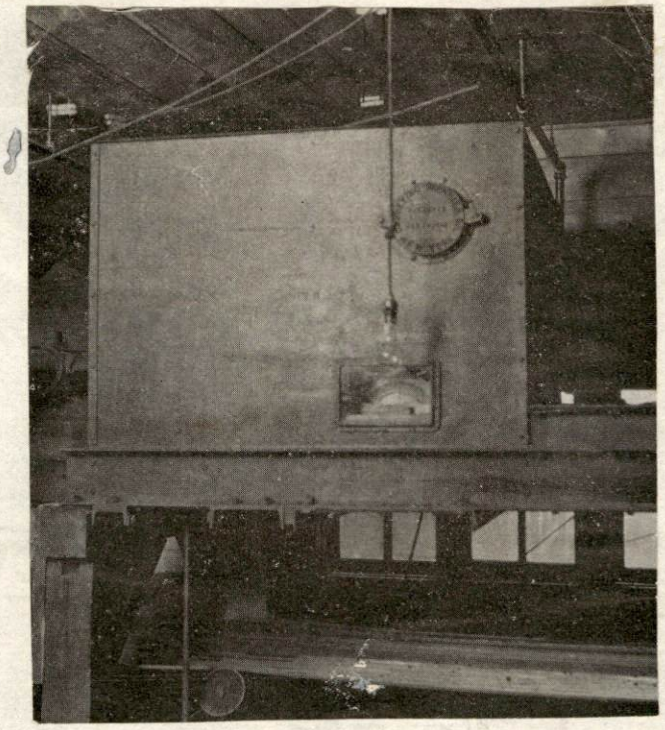

Fig. 13. Weightometer which automatically weighs rock asphalt on way to barge. (Courtesy of Kentucky Rock Asphalt Company).

inch maximum size. The larger particles go through a series of crushing rolls which finally reduce them to the original sand grain. The crushed rock is then assembled from the finishing rolls and fed by a conveyor to the barges (Fig. 11). As it passes the laboratory (Fig. 12), where automatically samples are taken out for testing, it is weighed by an automatic weightometer (Fig. 13). The finished product then is fed to barges that are kept constantly in motion to insure still further blending.

The first tests for the bitumen content of the rock are made from the core drill, when the field is being tested. The next samples come from the quarry as the rock is being loaded on the cars for the crusher. The samples automatically taken as the material passes the laboratory also are tested. When shipments are made, it is tested again. These last samples are filed with the record of the test, for future reference if needed. The extraction test[1] and ignition test[2] both are used in the laboratory at the plant.

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1. The extraction test is made by putting the material into a drum which is rotated at a high rate of speed. The cooperation of the two forces, centrifugal and centripetal, separates the bitumen from the sand, and thus both bitumen and sand can be weighed and estimated.
2. In the ignition test, after the crucible containing the material has been carefully weighed, it is put into an electric oven. The temperature is brought to between 1500 and 1800 degrees F., and kept there on an average of twenty minutes. The bitumen is destroyed by the heat. When cooled the crucible is weighed again and the per cent of bitumen estimated.

Laboratories are maintained at the storage piles in Bowling Green and the material is given a final testing just before it is shipped.

Problems of Power and Light The machinery of the mill is run by steam engines. The lights for both mill and town are furnished by a generator which is driven by steam engines. The water used is pumped from the river below. The necessary coal is brought in on the barges which carry out the rock asphalt. This back haul arrangement reduces the cost of hauling the coal greatly. The operations of the company are so large that the down stream flow of the rock asphalt always exceeds the upstream flow of other commodities. Thus the cost of the transportation of coal is but little above the cost of handling at both terminals.

Factors Favoring Low Cost of Handling A number of factors of the natural environment favor the low cost of handling the rock asphalt and were important items in the location of the plant of the Kentucky Rock Asphalt Company.

Navigable streams favor cheap transportation.--The Kentucky Rock Asphalt Company has availed itself of the opportunity for cheap transportation offered by navigable streams and ships its rock asphalt down Nolin and Green Rivers and up Barren River to Bowling Green.

Character of river valley favors loading.--The character of the Nolin valley favors loading operation. It

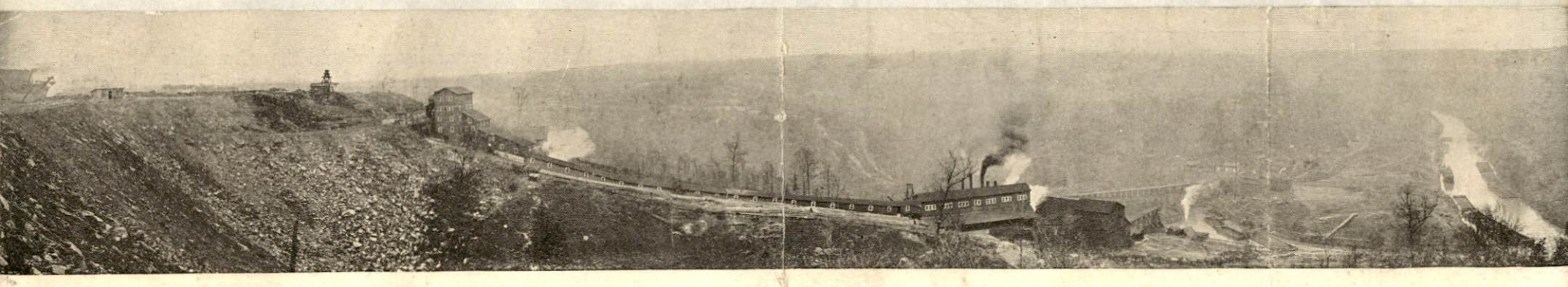

Fig. 14. Layout of Kentucky Rock Asphalt Company's Plant.
(Courtesy of Kentucky Rock Asphalt Company).

Fig. 15. Steamer "Gen. Logan" towing barges of "Kyrock" down Nolin River. (Courtesy of Kentucky Rock Asphalt Company).

should be remembered that the northern part of Edmonson County has a maturely dissected topography with an average relief of about six hundred feet, and that the beds of rock asphalt lie near the tops of the ridges. At Kyrock, the main quarry of the Kentucky Rock Asphalt Company, full advantage is taken of the lay of the land in handling the rock. The quarry lies less than a hundred yards from the river bluff, and the first crusher is placed at the top of the bluff, directly overlooking the river. Pigeon Creek flows into the river just below the crusher and a harbor has been made in the mouth of the creek. The conveyor and finishing mills are so placed along the slope as to lead from the first crusher toward this harbor (Fig. 14). When the rock has passed through the crusher and mill it is dropped by gravity down a chute to barges moored in the harbor (Fig. 11). When loaded the barges are towed, four at a time, down the river (Fig. 15).

Rock does not deteriorate when exposed to weather.-- An important feature of Kentucky rock asphalt is that it does not deteriorate when exposed to the weather for any reasonable length of time. Heat, frost, rain, or snow have little or no effect on this rock asphalt. As a result it can be quarried in open quarries, shipped in open barges and maintained in open storage piles.

Organization of Transportation on River The haul

from Kyrock to Bowling Green is eighteen hours long. The turn around would require more than twice that length of time as the current of the stream slightly slows down the trip upstream. The barges, in which the commercial rock is transported down the river, are owned by the Kentucky Rock Asphalt Company, but the towing is done by steam boats on long time contracts. The government keeps Green River navigable to Mammoth Cave and Barren River to Bowling Green. The company cooperates with the government in keeping Nolin River open. Nolin River flows into Green River about one and three fourths miles above Lock No. 6 (Fig. 3).

The locks and dams in Green and Barren Rivers keep the water at a stage high enough for navigation throughout the year. The high water of winter makes little difference to the boats plying the streams. There is practically never enough ice to interfere with navigation. The transportation of rock asphalt from Kyrock to Bowling Green continues throughout the year. There is practically never a time when there is not a fleet of barges loaded with rock asphalt, somewhere on the route between the two terminals.

The boats which carry the rock asphalt down the river bring up the river the greater part of the supplies for the quarries, mills and commissaries.

Pattern of Community Related to Nature of Country

In a hilly country such as this northern section of Edmonson

Fig. 16. Airplane view of Kyrock. (Courtesy of Kentucky Rock Asphalt Company).

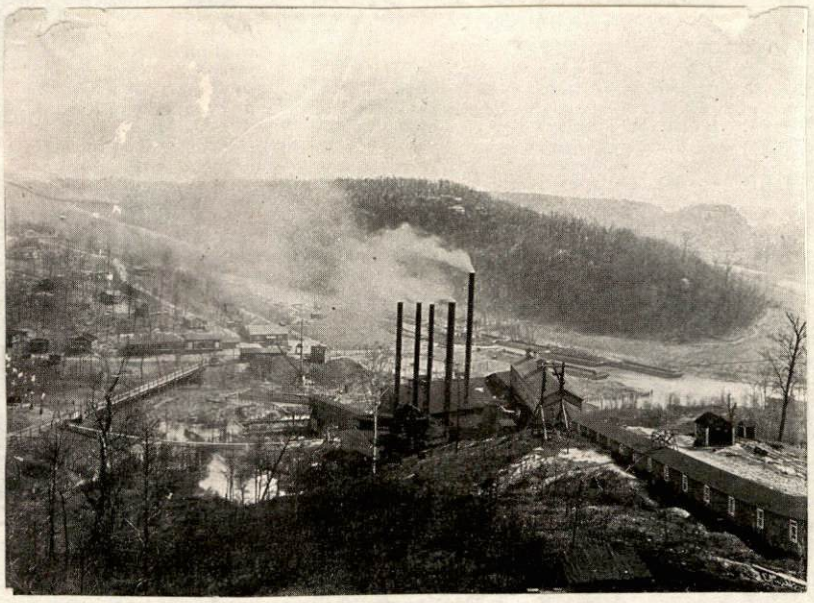

Fig. 17. Portion of Kyrock--looking north from quarry. Vehicular bridge and swinging bridge at left. (Courtesy of Kentucky Rock Asphalt Company).

County, the pattern of a community is necessarily quite irregular (Fig. 16). Kyrock, a town of about 2,000 population has grown with the asphalt industry and is located in the right angle formed by Nolin River and the south fork of Pigeon Creek. The three roads and two creeks converge at the apex of the angle and give a fanlike pattern to the town. The roads enter the town along the ridge tops and descend to the river by winding tortuous routes. The houses in Kyrock are strung out along the roads and creeks with clumps of trees and huge masses of protruding rock interspersed.

The mill and quarry overlook Kyrock from the bluff just south of the mouth of Pigeon Creek. A vehicular bridge across Pigeon Creek and a swinging bridge across the south fork of Pigeon Creek connect the mill with the rest of the town (Fig. 17). The offices and commissary are just north of the mouth of Pigeon Creek, across from and facing the mill, and as near Nolin River as the narrow flood plain will allow. The ice plant is located near the north end of the bridge by the commissary. The hotel, another company enterprise, is up the hill northward from the commissary.

The buildings are all frame. The three and four room cottages that make up the residential section of the town are not all built on the same plan. The town lacks the rigid uniformity that characterizes so many company-built towns and has more the appearance of a town that has

grown with the industry.

Ridgedale, Woodside, and Sweden, three small villages strung out along the country road which winds to the southwest through the hollow and toward the ridgetops are a part of the Kyrock community but are not included in the incorporated town of Kyrock.

Aspects of Community Life In addition to the industrial and commercial interests of the community, other interests have grown up. The company's investment is not all in lands and mill, but in the community itself. Because of its isolation, the community in large measure has become self-contained and provides for its own needs and desires.

The school.---Education has been fostered by the Kentucky Rock Asphalt Company to the extent of the establishment of a grade and high school. This school is under county supervision and partly supported by county funds. The company supplements these funds generously and maintains a standard four year high school. Well qualified teachers are employed and the school is one of the best in this section of the state. Many young people not only finish high school but go on to college. Doubtless some of the inspiration for this comes through the influence of the college men who occupy positions of responsibility in the company. The large frame school building has been added to from time to time as the increased enrollment has made more room

Fig. 18. Kyrock School built and maintained by the company. (Courtesy of Kentucky Rock Asphalt Company).

Fig. 19. Kyrock church. Looking northwest from main road into Kyrock.

necessary (Fig. 18).[1]

The church.--In Kyrock the one church is a conspicuous feature in the village pattern and an important social force in the community life. It is a large white frame building standing on a conspicuous knob (Fig. 19) in view of the whole community. A huge star on the church steeple, electrically lighted, can be seen for many miles across the hills and valleys. The church is approached from one side only, a branch from the Brownsville road, winds its way upward to the summit of the knob. The building was erected by the company during the early development of the community.[2] The resident pastor, though under the direction of the Methodist Mission Board, is on the company's payroll and has his house and car furnished by the company. His work includes all the people regardless of denomination. The church is literally the spiritual center of Kyrock.

Recreation.--Believing in the old adage of "all work and no play", various types of recreation are either furnished or encouraged by the company. A baseball team, (Fig. 20) which vanquishes all comers, represents the town each year. Tennis courts are maintained at the company's expense

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1. The organization and maintenance of a standard grade and high school is directly related to the presence of the rock asphalt. Without the development of that resource, the present educational facilities would be impossible in this isolated community.
2. H. St. G. T. Carmichael: Interview.

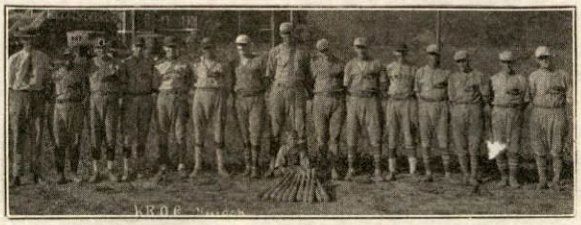

Fig.20. Kyrock Baseball team. Forty miles from a railroad, this team is made possible by the presence of industrial development in isolated area. (Courtesy of Kentucky Rock Asphalt Company).

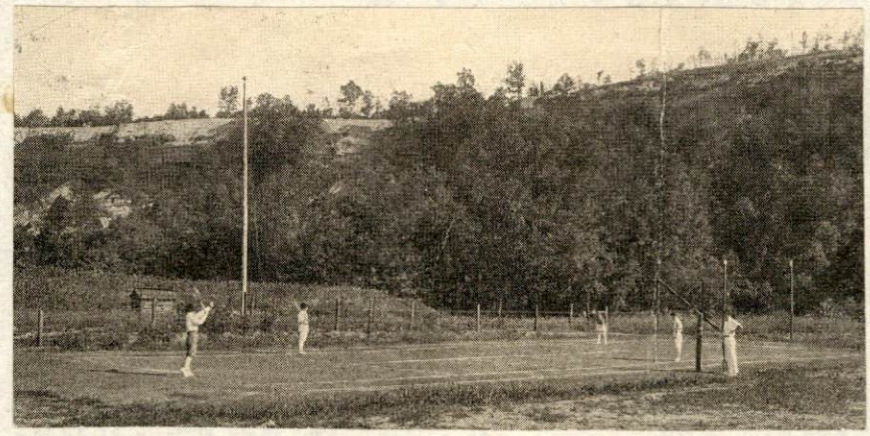

Fig. 21. Tennis courts maintained by Company. Surfaced with "Kyrock". Such recreational facilities are foreign to the area except where they have been introduced by outside initiative.

(Fig. 21). A moving picture theatre, the only one in the county and one which would be a credit to a much larger place, furnishes amusement, not only to the people of Kyrock, but to the people of the entire north section of the county. For several years a Chautauqua has been an important factor in the entertainment of the community. A ticket is sold to the head of a family for $2.50. These tickets admit the entire family and this means the numbers are well attended.

Retail and service enterprises.---Within the corporation of Kyrock all the retail and service enterprises are a part of the company's operations. A large commissary serves the needs of the people in every line. Clothing, furniture, food, drugs, ice cream, hardware and all other necessities and many luxuries are among the things supplied. A United States Post Office occupies a portion of the commissary building. Only a short distance away, a filling station stands ready to serve. The Ice Plant manufactures sufficient ice to supply the needs of the community. Electricity for the offices, commissary, hotel and many residences is supplied from the company's plant. As might be expected, a number of commercial enterprises fringe the town on its landward approach. General stores which have developed beyond the stage of the ordinary country store, take part in a lively competition for the trade of the surrounding community. This

competition is greatly augmented by the presence of an industry which gives steady employment to such a great number of people. Many garages supply the needs of motorists who make what use they can of the unsurfaced roads, for in spite of the presence of the enormous quantities of an ideal road surfacing material, dirt roads still predominate in the quarry community and in Edmonson County.

Quarry Community Affects Local Agriculture.

The local agriculture has been affected in many ways by the demands of the quarry community. Truck gardening on a small scale has grown up around Kyrock, for although there is plenty of space for gardening in the village, much of it is not advantageously located for cultivation. There are at least one hundred twenty families that must be supplied with fresh vegetables and fruit. As a result practically all surplus from gardens and orchards within a radius of fifteen miles is brought to Kyrock. At times, however, fresh vegetables are difficult to obtain, as it has been found more profitable to can them at home and sell them that way when prices are better. Milk, butter, eggs and chickens are a source of revenue to the farmers, and have brought about an increase in the number and improvement in the breed of both cows and chickens. The acreage of forage crops has been increased, also, as the midsummer stubble

fields will show. Both the dairying and chicken raising are considered simply sidelines, but add materially to many family incomes.

Much land that formerly was in farms and can now be used for crops is under the control of the company. A land agent has charge of this land and leases it to people desiring to farm it on shares. Improved methods of agriculture and rearing of better stock is encouraged by the company.

Labor Supply Related to Density and Character of Population Though Edmonson County is not densely populated (about 35 per square mile)[1] it furnishes sufficient labor to man the asphalt industry. Between five and six hundred men are employed in the various processes of production. The stock is good, being pure American whose ancestors came from Virginia and North Carolina in the early days. A few Swedish families settled at what is now the village of Sweden, but inter-marriage with the natives has brought about a complete blending of the two nationalities.[2] No labor has been imported. Instead it has been drawn from the country. In many cases workmen come to work from their homes in the neighborhood, in others they have moved into the village, glad to turn from a meager existence

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1. Abstract of the Fourteenth Census 1920, p. 31
2. J. M. Keller: Geology of Edmonson County: 1927, 20.

on land of low utility to a steady income from work in mill or quarry. Many families whose angular farms are now a part of the company's holdings, live in Kyrock. Men who work in the quarries become so skilled in the grading of the rock, by sight and feel, that their gradations check right along with the laboratory tests. This skill seems to be acquired only by those men who have spent their lives among the hills of "black rock".

Unorganized Status of Labor Related to Isolation

No labor union has as yet invaded this industrial area, nor does it seem likely to. No idea of a conflict of opinion between capital and labor seems to exist. The inhabitants of the area have known since earliest times of the presence of bituminous rock, "black rock"[1] as they called it, but not until recently has it been handled efficiently and quarried on a big scale. The company producing the rock asphalt therefore represents the interests of the local people as well as its own. Perhaps the fact that the people have seen other companies fail in an attempt to utilize this resource gives them an admiration for the leadership that overcomes the handicaps of the region and uses wisely its advantages for putting on the market the rock asphalt.

Need of Leadership in Isolated Area In all

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1. Geology Survey Publication (1854).

enterprises in a remote area like this, success depends largely on the skill with which the enterprise is planned and managed. Successful management is needed in all three phases of the enterprise, namely, in production, in transportation, and in marketing. Production must go forward in a difficult terrain, transportation depends upon the utilization of an inland waterway with all the problems which such waterways present, and marketing faces both regional and seasonal difficulties. The Kentucky Rock Asphalt Company has solved these problems through the appointment of a skillful general manager who personally directs the production, and has under his supervision both the transportation and marketing. One of the most difficult phases of production in the area, which was entirely agricultural, until the advent of the rock asphalt industry, was the training and handling of laborers. At Kyrock there appears to be a highly satisfactory relationship of the people and the general manager of the industry. Naturally a gentleman endowed by inheritance and training with a keen insight and a sympathetic understanding of human nature, the general manager has succeeded in bringing about a most satisfactory relationship between employer and laborer.

Mutual Benefits of Labor Situation While the wages are not as high as those of the nearby coal fields, the income derived from the asphalt industry is so much greater than that derived from farming that the people seem

to be satisfied. Employment is steady and for the industrious, the income regular. The office force, laboratory operators, engineers, and other positions, which require special training are filled by "outsiders", but the natives know that if they had been trained to fill such positions they would have been put into them. The quarries, therefore, offer an opportunity previously unknown.

Entire County Benefited by Rock Asphalt Development

The county as a whole has benefited by the development of its rock asphalt resources. The income of Edmonson County, through taxation, had practically doubled in 1928, as compared with the taxes based on the assessments of land at the inflated prices following the World War. The real estate adjacent to the company's holdings also has greatly increased in value. With an average daily wage of $2.50 per day for unskilled labor, which is very conservative an estimate,[1] the community receives in wages more than $300,000 per year. This does not include the skilled labor working on a salary, which would add very materially to the local income, though not much to the native income. Not since the cutting of the timber has there been anything to compare with it as a source of revenue.[2]

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1. County Court Clerk, Edmonson County: Interview
2. Logan, Judge M. M.: Interview

THE UNITED ROCK ASPHALT SALES COMPANY

Location and Approach The United Rock Asphalt Sales Company has located its mill on Green River near the mouth of Crooked Creek, about nine miles below Brownsville and about thirty miles below Kyrock (Fig. 5). The landscape in this area is quite similar to that about Kyrock. The company has developed a village which, appropriately, is called "Asphalt". The village is located more than a mile north of Green River. The quarry formerly operated on Crooked Creek between Asphalt and Green River has been worked out and a new quarry has been opened. The new quarry is a mile northeast of Asphalt, along Caney Hollow. Green River and the unsurfaced county road are the only means of approach. The lower Morgantown Road which leaves the Brownsville Pike above Steep Hollow Road extends through the area (Fig. 5). A side road to the south leads to Asphalt and the mill, while a private road to the north leads to the quarry. The lower Morgantown Road follows the ridge tops to within about a half mile of Asphalt. The side road leaves the ridge top at that point and begins its descent to the town and the river.

Organization and Equipment. The United Rock Asphalt Sales Company as it exists today, is comparatively new, though it may be said to be a direct descendant of the Wadsworth Stone and Paving Company which figured prominently

in the early history of the asphalt industry. The company which is incorporated under Delaware laws is financed chiefly by Eastern capital. It has approximately two and one half millions of dollars invested in the plant and equipment, with about 3,500 acres of land either owned or leased.[1] As is necessary in the operations of all rock asphalt companies, the machinery used is specially constructed for the purpose. The United Rock Asphalt Sales Company's machinery was manufactured in Milwaukee and shipped by rail to Evansville. The one hundred and ninety miles journey from Evansville was made by boat up the Ohio and Green Rivers.[2]

Methods of Quarrying and Milling Similar to those at Kyrock. The rock asphalt quarried by the United Rock Asphalt Sales Company is the same in character as that worked by the Kentucky Rock Asphalt Company. It has practically the same variations as to thickness of overburden, depth of rock and bitumen content. Because of this similarity the same methods of production are used. The quarry site must be coredrilled, the overburden removed and the commercial rock blasted out, graded, transported to the mill and crushed.

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1. When it is possible to do so the mineral rights only are bought, but when necessary the land is bought outright.
2. O. M. Long: Interview.

Location of Quarries Related to Thickness of Overburden. The rock in the area immediately adjacent to the asphalt mill was worked first. When the depth of the overburden became greater than could be removed with profit, the scene of operation was moved to Caney Hollow. This necessitated an extension of the narrow gauge railroad. Over this railroad the rock is brought to the mill which operates near Green River. Caney Hollow has its outlet toward Bear Creek, but the nearness of its head to Green River makes it possible for the rock to be hauled by rail over the divide, between the two valleys, and across the country to the mill on Green River.

Quarrying Processes Related to Character of Rock The United Rock Asphalt Sales Company operates one quarry and the quarrying processes are related to the character of the rock. The procedure is the same as that of the Kentucky Rock Asphalt Company and is related to similar features of the natural environment. The overburden is blasted loose, cleaned off by steam shovels and hauled away by "dinkie" trains, to convenient dumps. The commercial rock is blasted down, carefully hand-picked by native "rock graders" and hauled by train to the mill. Much care is taken to maintain the uniformity of the bitumen content of "Unirock" as the product put out by the United Rock Asphalt Sales Company is called. After the careful

hand-picking, laboratory tests check on this grading and make uniformity certain.[1] Tests are made of samples from the core-drill, as the rock is taken from the quarry, as it is received for storage and as each car is shipped. Samples with record of analysis and name of chemist are filed for reference if needed. After these tests the asphalt is guaranteed for five years against deterioration, whether stored or laid, and bond is sometimes put up for the amount.[2]

Milling Processes Related to the Character of the Rock. The milling processes are regulated to insure the uniformity of the commercial product. The rock quarried varies from six to eight per cent bitumen content and must be thoroughly crushed and mixed before it can be put on the market. The rock from the quarry is dumped into a huge crusher at the top of the hill. From this crusher it passes through a series of bins and rollers and reaches the barges waiting on the river, two hundred feet below (Fig. 22), a finished product, ready to be marketed with its uniformity guaranteed.

Problems of Power and Light. The power for the mill is furnished by the Kentucky-Tennessee Light and Power Company. Steam locomotives are used for bringing the rock

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1. The ignition test is used. The sample is put into an electric oven and kept at a temperature of 900°C. for thirty minutes.
2. S. P. Rawlins: Interview.

from quarry to mill. The electric lights for the town, quarry and mill are furnished by the same company as the power for the mill.

Factors Favoring Low Cost of Handling The United Rock Asphalt Company, like the Kentucky Rock Asphalt Company, has taken advantage of all available facilities to lessen the cost of production of rock asphalt.

Lower elevation of Green River Valley gives downhill haul for loaded trains.--The quarry from which the commercial rock is being taken, is near the top of the ridge which forms the divide between Caney Hollow and the valley of Green River. This gives a downhill haul from the quarry to the mill. The advantage of this can be seen readily since this is the direction of movement of the rock. Even a slight variation in level affects the amount of power necessary for the movement of a heavy commodity like rock asphalt.

Character of river valley favors loading.--The character of the valley of Green River favors the loading operations. While this part of Green River Valley is more advanced in its erosion than the valley of Nolin, there are many steep high bluffs overlooking the river. The United Rock Asphalt Sales Company, like the Kentucky Rock Asphalt Company, has availed itself of the advantages offered by such a location and placed its first crusher at the top of

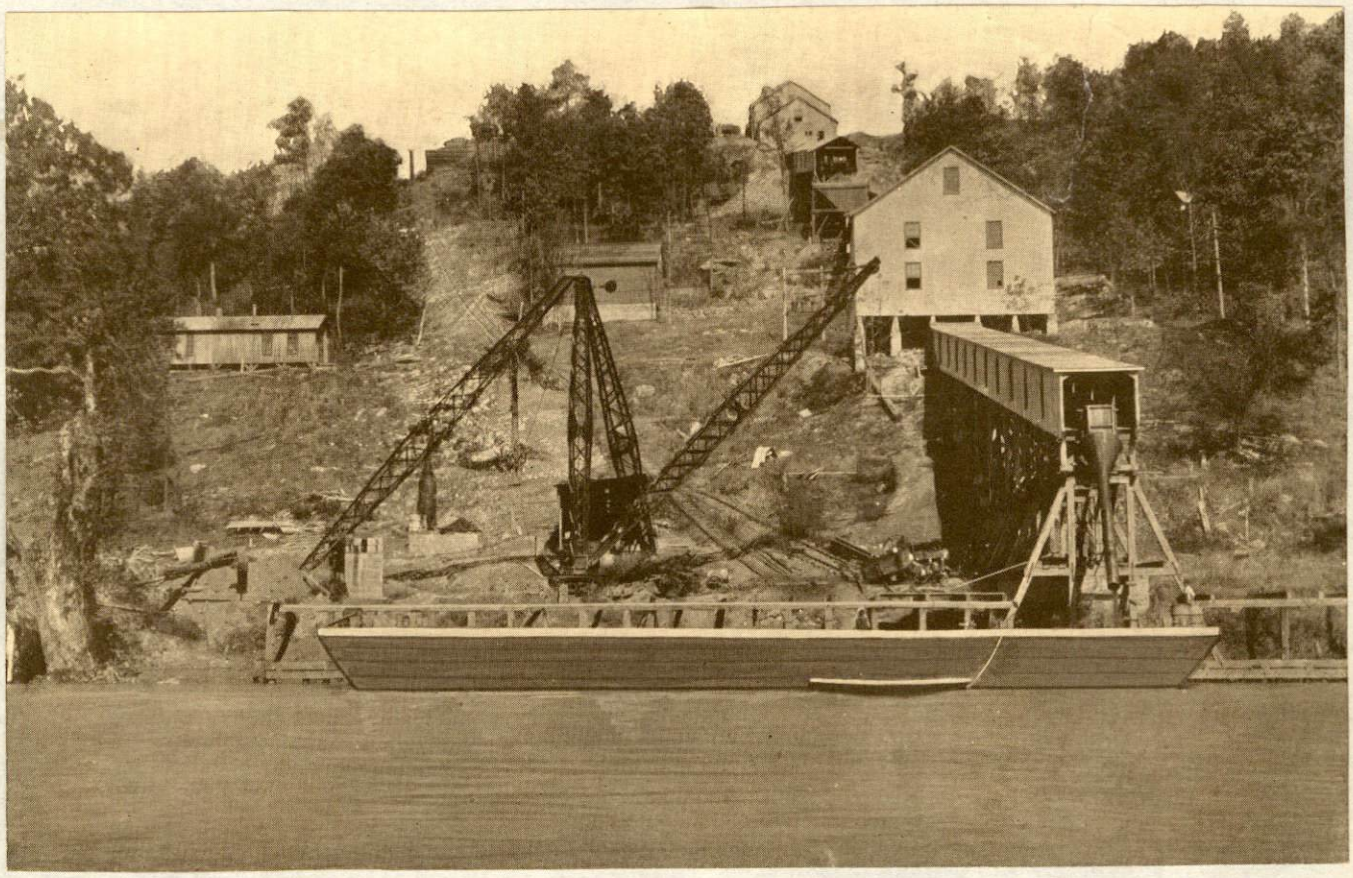

Fig. 22. Mill of United Rock Asphalt Company on Green River. (Courtesy of United Rock Asphalt Company).

the bluff and the rest of the mill on down the hillside toward the river. When the milling process is completed, the rock passes through the spout to the barge below on Green River (Fig. 22).

Navigable stream favors cheap transportation.--The use of Green River for transportation makes possible much cheaper freight rates than would be possible otherwise. The nearest point on the railroad is about ten miles distant by air route and probably twice that by the winding country roads. The cost of an overland haul would be so great as to make it prohibitive.

Rock does not deteriorate when exposed to weather.--"Unirock", like "Kyrock", is unaffected by exposure to the weather. Taking advantage of this fact, it is transported in open barges and stored in open piles.

Organization of Transportation on River. The United Rock Asphalt Sales Company transports its rock by barge from the mill on Green River at the mouth of Crooked Creek to Bowling Green on Barren River. The barges, tow boats, and terminals, owned by the company represent an investment of about $80,000.

Community Pattern Related to Nature of Country. The United Rock Asphalt Sales Company community, consisting of quarry, mill, and village, is spread over approximately two square miles, but its pattern is closely related to the

nature of the country. It may be recalled that the mill is located on Green River because of the river's transportation facilities and the hillside furnishes a gravity haul from the crusher at the top to the river below. The quarry, some two miles distant, was so located on account of the slight overburden and a downhill haul to the mill.

The village of Asphalt, which is composed of company's offices, commissary, and about a dozen cottages, occupies the broad summit of a low ridge a little more than a mile northwest of the mill on Green River. Here is one of the few level stretches to be found in the area. Second growth timber furnishes ample shade for the small cottages. The houses are owned by the company and are arranged in two rows at right angle to each other, enclosing the commissary within the angle. The frame commissary is of the same doll-like structure as the tiny frame cottages. They are all painted green and white. The trees, flower beds, and general tidy appearance of the place, give one approaching the impression of entering a park. Just outside the line of the company's property a country store vies with the commissary for the trade of the quarry community. A few scattered houses fringe the limits of the company's property. Many features of a more advanced settlement, as church, school, and recreation are lacking here. The operations are on a much smaller scale and fewer people are concerned

with them.

Labor Supply Related to Density and Character of the Population An abundance of labor is available from the residents of the community. Many of them live in their own homes in the country and walk or drive to the scene of their labor. As the field is non-union, the number of working hours is suited to the demand of the output, varying from 8 to 12 hours per day. During the rush season, a night shift is put on. The wages range from twenty-five cents to seventy-five cents per hour, depending on the degree of skill required. All the common laborers are supplied locally, but it has been necessary to import a few skilled operators for the machinery used. However, as the natives grow up in the industry, they become more skilled and a number of shovel handlers have been recruited in this way. As "rock graders" the local workmen are pre-eminent.

Nature of Area around Asphalt Unchanged. While the landscape of the area around Asphalt has been somewhat changed by the presence of the quarry, narrow gauge railroad and mill, the area itself has not become industrialized but maintains its identity as rural. The population is supported, in large measure, by subsistence agriculture. The topography and lack of transportation facilities have been important factors in limiting it to subsistence. Each small farm has a cornfield, a meadow and vegetable garden.

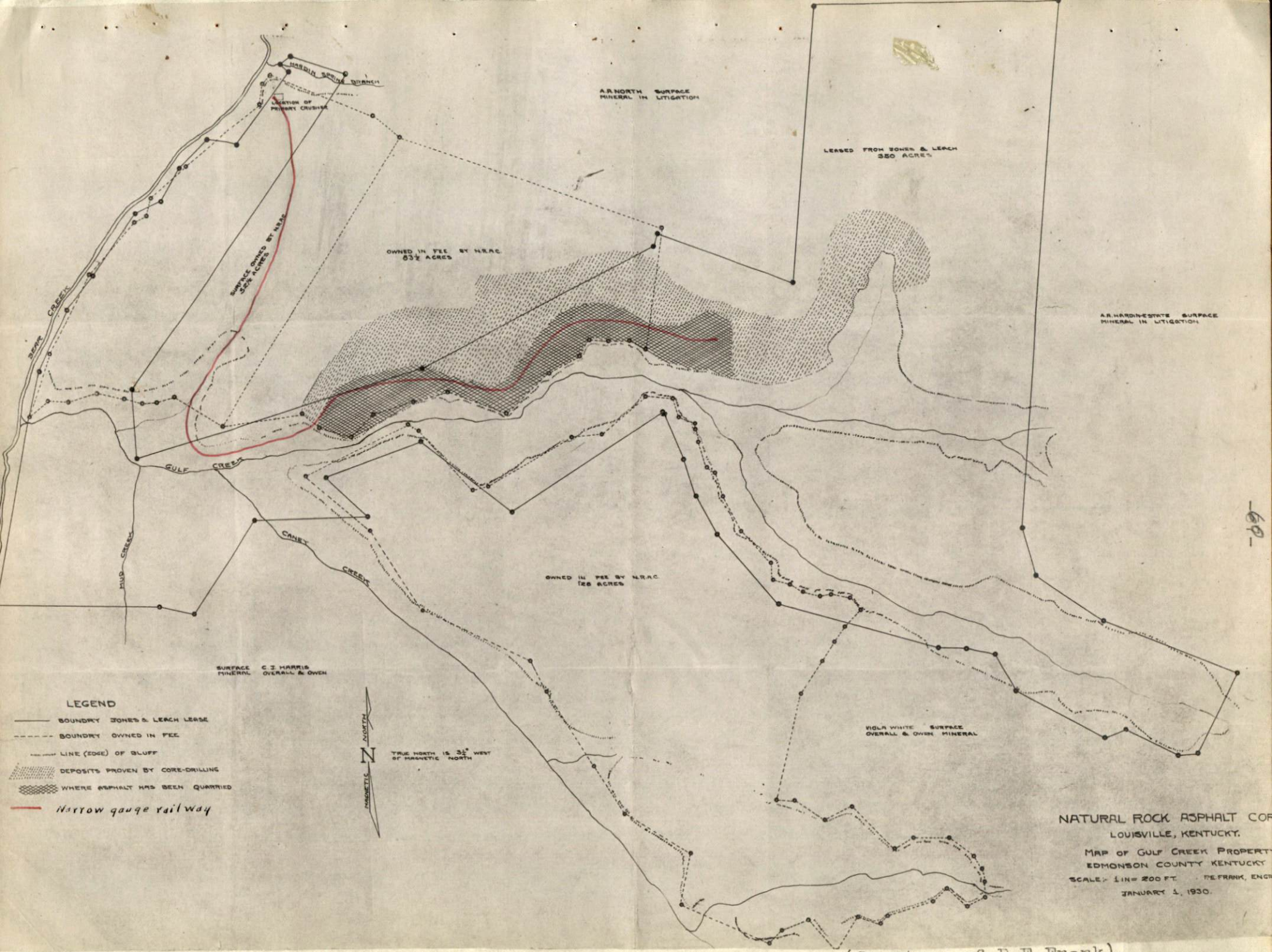

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Fig.23. Gulf Creek property of Natural Rock Asphalt Corporation . (Courtesy of P.E.Frank).

An occasional tobacco patch dots the landscape and considerable acreage of land is covered by second and third growth timber. Many men who work in quarry or mill live on their own farms and go back and forth to work night and morning. Some of them work full time while others supply during the rush season in summer.

NATURAL ROCK ASPHALT CORPORATION

Location of Operations. The Natural Rock Asphalt Corporation carries on its operations on Bear Creek, about eight miles above the point where the creek flows into Green River (Fig. 5). The mouth of Bear Creek is about four miles down stream from the mill of the United Rock Asphalt Sales Company. The crusher is at the top of a high bluff overlooking Bear Creek while the two quarries are on Gulf Hollow (Fig. 23) which flows into Bear Creek. The landscape is quite typical of Edmonson County north of Green River and similar to that around Kyrock.

Isolation and Growth Natural Rock, as the Quarry community is called, is the most isolated of any of the quarry communities in Edmonson County. Bear Creek is very small and used only by the Natural Rock Corporation. Only a branch of the country road leads in to it from the Brownsville, Leitchfield and Morgantown road. The isolation of the community, however, has not prevented the growth of the plant. In the six years of its existence it has attained

Fig. 24. Quarry of Natural Rock Asphalt Corporation on Gulf Hollow. Removal of overburden and rock asphalt go on at the same time. (Courtesy of Natural Rock Asphalt Corporation).

a capacity of 400 tons per day with a possible extension to 600 tons per day, if necessary.[1] The above figures do not mean year-round production, however, as shipments are practically at a standstill during the months of December, January and February. During these months little or no rock is quarried, but overburden is removed in order to facilitate operations in the following season.

Quarry Processes Related to Overburden and Character of the Rock. The same conditions of overburden, thickness of commercial rock and variation in bitumen content make necessary the same procedure in its quarrying, as in the other plants discussed. The overburden averages about thirty feet and must be removed by being blasted loose and cleaned off by steam shovels (Fig. 24). The commercial rock is removed in the same way as the overburden. The commercial rock is carefully handpicked as it is loaded at the quarry, to insure uniformity of bitumen content.

Location of Quarry Related to Depth of Overburden and Available Dump for Waste Material. The two quarries, Upper and Lower, are located along the edge of Gulf Hollow about a half mile from Bear Creek where the rock asphalt outcrops (Fig. 23). The operations are carried on along

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1. P. E. Frank: Interview.

Fig.25. Rock being dumped into barge from crusher of Natural Rock Corporation on Bear Creek. (Courtesy of P.E.Frank).

the edge of Gulf Hollow as the overburden is comparatively thin here and the Hollow furnishes a convenient dump for the waste material. This waste material is dumped over the edge of the Hollow.

Milling Process Divided. The milling process of the Natural Rock Asphalt Corporation is divided into two parts. The first part is done at Natural Rock on Bear Creek, and the second part, or finishing, is done at Rockport. The commercial rock is hauled over a narrow gauge railroad from the quarry to the bluff overlooking Bear Creek. The rock is dumped from the cars into the crusher which reduces it to about four-inch pieces. From the crusher it goes by gravity down the chute to the barges below on Bear Creek (Fig. 25). The barges carry it downstream to the finishing mill at Rockport in Ohio County, on the Illinois Central Railroad.

Division of Milling Process Related to Topography and the Nature of Community. The topography near Bear Creek at Natural Rock was so rugged that there was not space sufficient for the complete mill without more crowding than was advisable. The primary crusher only was installed at Natural Rock and provision was made for finishing the milling process at Rockport. The dual division of the milling process has naturally divided the interest of the company. As a result, neither end of the development

has affected the community in which it is carried on as it might if both processes were carried on in one place. A commissary with a post office, the offices of the company and a few cottages constitute Natural Rock, the designated focus of the interests on Bear Creek. A hundred and twenty-two men are employed regularly in the quarry and mill. During the rush season, however, this number may be greatly increased, sometimes to more than two hundred. The majority of them continue to live on their rural homes and "commute" to and from work on mule back or in Fords. As with the other companies, the Natural Rock Asphalt Corporation employs local laborers on all work for which they are fitted. The superintendent, chemists, and master mechanics are not natives, however, as the industry has not been in the community long enough to train men for this type of work. At the mill at Rockport the number of men needed is usually not more than a dozen and they are recruited either from the nearby rural population or the town of Rockport just across the river.

Location of Finishing Mill. The mill site at Rockport was the nearest point available at the time of the construction of the mill. Since the rock could be carried away from the quarry only by streams, and railroad facilities were necessary for its distribution, a point

Fig. 26. Bqrge of natural rock being towed down Bear Creek. (Courtesy of Kentucky Geological Survey).

where a railroad crossed the stream was desirable. Bowling Green, where the Kentucky Rock Asphalt Company maintained its storage piles, was the nearest crossing, but at this time Bowling Green was having an oil boom and absolutely all available space in the town was occupied by the oil industry. At Rockport an easy landing place was available near the Louisville and Memphis Branch of the Illinois Central Railroad and the land was relatively cheap. The management of the Natural Rock Asphalt Corporation believed it was better to ship freshly crushed rock and consequently placed the finishing mill at Rockport instead of merely maintaining storage piles.

Method of Transportation Related to Size of Streams

The coarsely ground commercial rock is placed in barges at Natural Rock and taken down Bear Creek (Fig. 26) by small boats with Diesel engines, to Green River. The remainder of the one hundred mile journey down Green River is made by river steamers. Since Bear Creek is used only by the Natural Rock Asphalt Corporation, the company keeps it navigable from their plant to its mouth and operate their own small Diesel boats. The towing on Green River is done by contract, the asphalt company guaranteeing a minimum tonnage.

Problem of Power and Light. The crusher and other machinery at the mill is run by steam. The coal

Fig.27. Unloading coal at Natural Rock. (Courtesy of P.E.Frank).

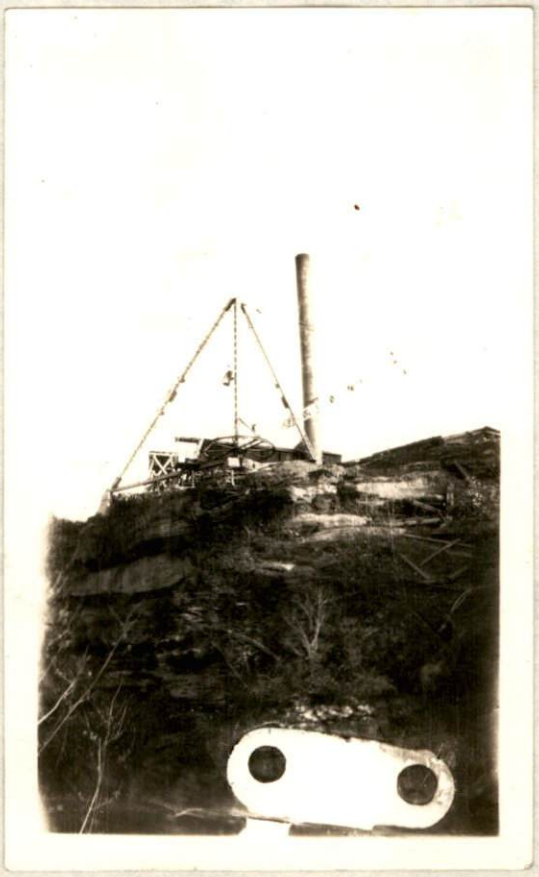

Fig.28. Derrick and clam-shell bucket for unloading coal at Natural Rock. (Courtesy of P.E.Frank).

Fig.29. Natural Rock Asphalt Corporation plant at Rockport. Mill at left foreground. Office and laboratory at the center in the middle-distance. Barges and derrick for unloading at right foreground. Illinois Central Railroad bridge across Green River at extreme right.

Fig. 30. Steam shovel moving "Natural Rock" from barge to hopper, at Rockport.

Fig. 31. Gondola cars on side track of Natural Rock Asphalt Corporation mill at Rockport.

Fig.32. Storage pile of finished "Natural Rock" at mill at Rockport. Finished product being dropped from bucket on aerial tramway.

Fig. 33. Partly crushed "Natural Rock" in storage at Rockport. (Courtesy of D.W.Neff).

needed is brought from the High View Mines, on Green River above Rockport. It is brought upstream in the barges in which the rock asphalt is taken downstream to Rockport. The cost of the hauling of coal is little more than the cost of loading and unloading. At Natural Rock it is unloaded and lifted to the top of the bluff by a derrick and clam-shell bucket (Figs. 37, 38). Electricity for lights is generated by a small dynamo run by steam. Small steam locomotives draw the cars between the quarry and mill.

Mill Designed to Offset Lack of Slope. At Rockport the barges are moored at the dock (Fig. 29). Steam shovels take the partially crushed rock from the barge and drop it into hoppers (Fig. 30). These hoppers are taken on a belt up the bank to the mill. In the mill the rock goes through the first crusher into buckets on a belt and is conveyed to the top of the mill. From the top of the mill, the rock makes its way down through a series of rollers and is reduced to the proper proportions for marketing. It goes from the last roller into the gondola cars waiting for it on the side track by the side of the mill (Fig. 31). Two storage piles are kept. One is the finished product (Fig. 32), ready for shipment, and the other is the partly crushed rock (Fig. 33) which is transferred directly

to it from the barge and left there until needed. It is then "dragged"[1] back into the mill and crushed to the required fineness.

Importance of Leadership in Development of Community. Like the Kentucky Rock Asphalt Company, the Natural Rock Asphalt Corporation has found the qualities of leadership in the general manager of utmost importance. The Sinclair Oil interests have recently acquired control of the corporation and through them a most desirable situation seems to exist at Natural Rock. This situation was doubtless brought about through the wise leadership of the general superintendent who is an engineer of ability and wide experience and knows how to handle men as well as instruments. The growth of the development has been slow, but, under the present management, its future seems assured.

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1. A term used at the mill to mean only the transfer by buckets from the storage pile to the mill.

Fig. 24. Grayson County. Rock asphalt producing points are in extreme northeast, along the Illinois Central Railroad.

Chapter III

THE DEVELOPMENT OF THE ROCK ASPHALT INDUSTRY IN GRAYSON AND HARDIN COUNTIES

The asphalt producing area of Grayson and Hardin counties is near the northern end of the asphalt rock region (Fig. 1). The area is crossed in a northeast-southwest direction by the Louisville and Memphis branch of the Illinois Central Railroad (Fig. 34). A ready means of transportation is available for the commercial rock and the chief operations in this area are located on the railroad and near the middle of the area. Federal Highway No. 62 parallels the railroad. Highway 62 is a part of the projected International Highway across the United States between Canada and Mexico. Bituminous rock of varying quality is found throughout Grayson County, but not all of it is of commercial quality. Only the rock asphalt of the Chester sands has been developed commercially. The commercial development centers about Summit and Big Clifty (Fig. 34) near the southeastern end of the Chester formation. Grayson and Hardin Counties are much less rugged than Edmonson County and do not have the narrow, steep river valleys. Only the headwaters of small streams affect the area and they have not become deeply intrenched. As a result, a greater area of ridge tops is visible in the

small section of northeast Grayson County that makes up this part of the rock asphalt producing area. The bituminous rock is quite similar to the rock asphalt in Edmonson County. The operations carried on, however, are much smaller. In 1939 the production of commercial rock in the Grayson-Hardin County district was approximately only fifteen hundredths of the Edmonson County yield.

Rock Asphalt Produced on Same Level as Railroad. The rock asphalt which is found at an elevation of about 600 feet is quarried, milled and loaded on approximately the same level as the Illinois Central Railroad. This railroad passes through the asphalt producing area on a grade near the tops of the broad ridges, with an occasional shallow cut, and many wide curves. The creek bottoms and hollows are crossed on high trestles. Because of this conformation to the high levels, the quarries, mills, and communities are on one level and thus the landscape of the quarry community differs materially from that of the Edmonson County area where ridge top and creek bottom combine in furthering the processes of the industry.

Rock and Production Compared with Edmonson County Field. The commercial rock in the Grayson-Hardin County region is found in the Chester sandstones of the Mississippian system. It differs but slightly, however, from that of Edmonson County rock which occurs in the Pottsville

sandstone of the Pennsylvanian. The hard silicate sand grains are slightly smaller and the bitumen content of the rock is higher. This combination, however, is as it should be, as the smaller sand grains give a greater number per unit area, with a resulting greater surface to be covered. The overburden to be removed and the variation in the thickness and character of the commercial rock is practically the same in the Grayson-Hardin County region as the Edmonson County region. Consequently the quarrying and milling processes are the same.

Chronology and Organization. The Grayson-Hardin County field figured prominently in the first attempts at development in Western Kentucky, but none of the early companies have survived. The first of the present companies began operations in 1923. The output from this section has grown from about 21,000 tons in 1923 to double that in 1929. The greatest amount shipped in any one year was a little more than 54,000 tons in 1926. The chief companies operating are the Ohio Valley Rock Asphalt Company at Summit in Hardin County and the Crown Rock Company at Big Clifty.

OHIO VALLEY ROCK ASPHALT COMPANY

Operations and Holdings. The Ohio Valley Rock Asphalt Company began operations in 1923 and is located at Summit, fifty-eight miles southwest of Louisville on

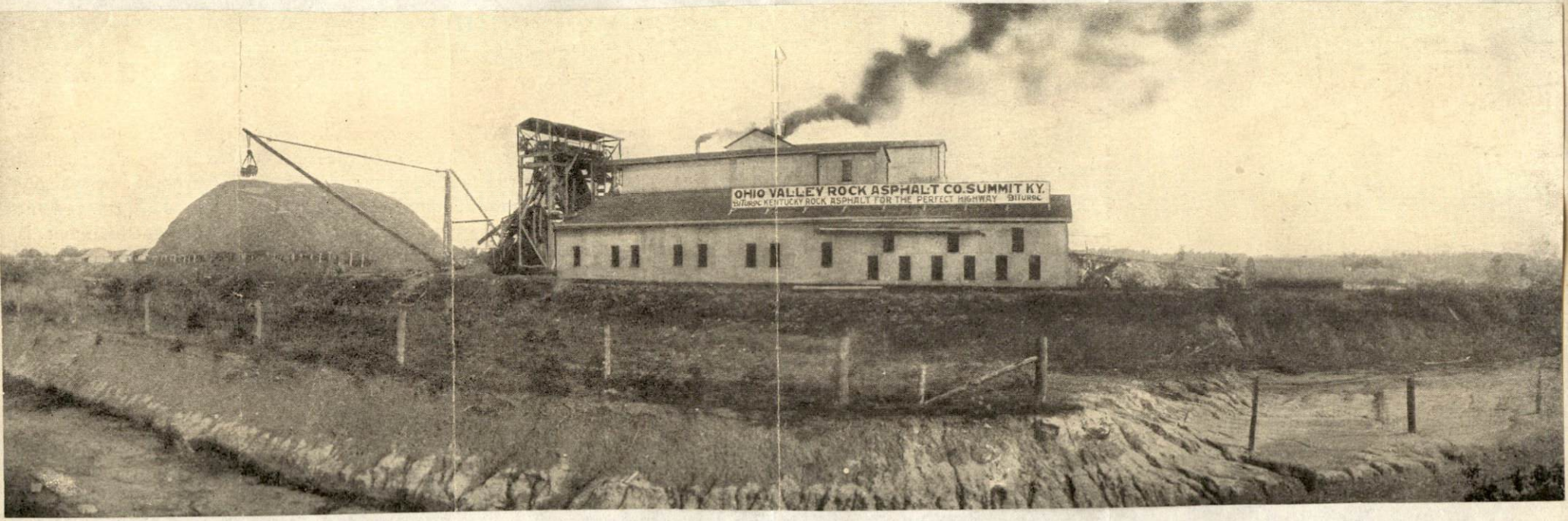

Fig. 35. Mill and storage pile of Ohio Valley Rock Asphalt Company at Summit, Kentucky. (Courtesy of Ohio Valley Rock Asphalt Company.)

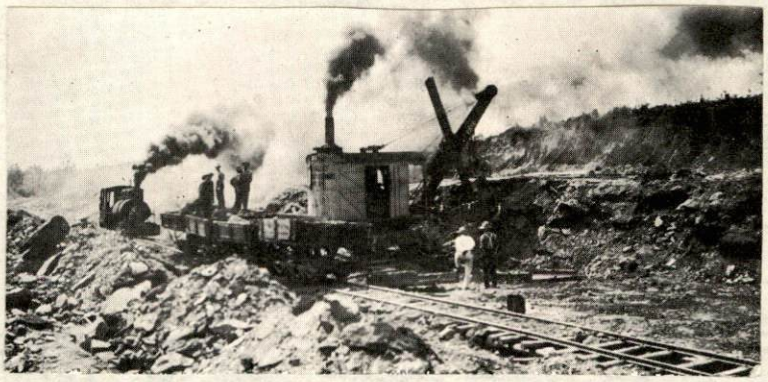

Fig. 36. Steam shovel at work in quarry of Ohio Valley Rock Asphalt Company. (Courtesy of Ohio Valley Rock Asphalt Company).

the Illinois Central Railroad (Fig. 35). The estimated value of the company's property is $750,000. It includes about 20,000 acres of land near Summit and a well-equipped plant consisting of two quarries and a mill. This plant operates eight months of the year and its product is called "Bituroc".

Quarrying Processes Related to Character of Rock. Removal of the bituminous rock from the two quarries in operation, follows the usual methods. The area is core-drilled to ascertain the depth of overburden and the thickness and character of the bituminous rock. The overburden is blasted loose and then removed by steam shovels (Fig. 36). The steam shovels place it on "dinkie" cars which carry it over a narrow gauge track to a nearby hollow where it is dumped. When once the overburden is removed, the bituminous rock is blasted loose. On account of the variations in the bitumen content, the rock is carefully handpicked as it is loaded on the cars to be taken to the mill. Native "rock graders" perform this task with great skill, and thus insure the uniformity of the material going to the mill.

Transportation of Rock from Quarry to Mill Related to Elevation. The rock asphalt is quarried at approximately the same elevation as that at which it is milled, though a shallow hollow intervenes between quarry No. 2 and the mill. This accordance of levels makes possible a

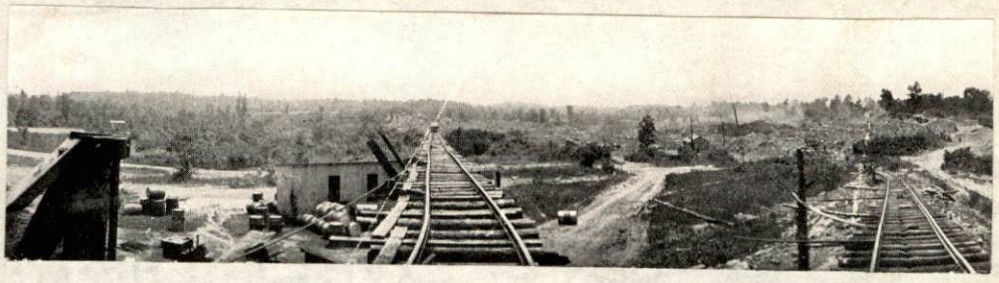

Fig. 37. View from crusher of Ohio Valley Rock Asphalt Company. Track at left leads to Quarry No. 2, 5700 feet distant and track at right to Quarry No. 1. (Courtesy of Ohio Valley Rock Asphalt Company).

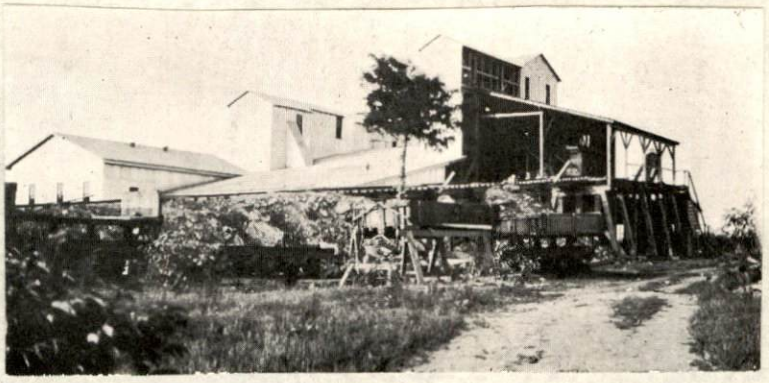

Fig. 38. Incline at mill of Ohio valley Rock Asphalt Company. (Courtesy of Ohio Valley Rock Asphalt Company.)

unique system of transportation from quarry to mill. Quarry No. 1 is only a few hundred feet west of the mill and quarry No. 2 is 5700 feet southwest of the mill (Fig. 37). After being carefully handpicked, the rock which is to go to the mill is loaded on the dump cars either by hand or steam shovel. The cars are then hauled to the crusher by means of a cable instead of being pulled by an engine. A signal for the car to be moved is sent from the quarry to the mill by an electric bell. The movement of a lever at the mill starts the rotation of a huge wheel which winds the cable and draws the cars to the mill. The haulage system is so arranged that one cableway serves for both quarries. The cable from Quarry No. 2 may be diverted while cars are being drawn in from Quarry No. 1, and vice versa. A switch near the crushing plant makes it possible to send the empty cars back to either quarry. The haulage system from Quarry No. 2 includes a spur on which empty cars may be sidetracked while two loaded cars from the quarry pass. At the mill the cars are drawn up an incline (Fig. 38) and the rock is dumped into the initial crusher.

Milling Process. The milling process is designed to reduce the selected bituminous rock to a size and nature to meet road specifications as to both texture and bitumen content. From the initial crusher the rock

Fig. 39. Cars on side-track of Ohio Valley Rock Asphalt Company. (Courtesy of Ohio Valley Rock Asphalt Company).

Fig. 40. Steam shovel loading "Bituroc" into railroad cars from storage pile at mill at Summit. (Courtesy of Ohio Valley Rock Asphalt Company).

goes by conveyor to a bin for blending. It is let out of the bin through gates into a moving belt. By belts and hoppers the rock asphalt is carried up and down through the mill to the various crushers. From the last roller the reduced rock goes into the gondola cars on the side track (Fig. 39) or is shunted to the storage piles. Just before the rock leaves the mill, samples are taken, by hand, from the hoppers for testing according to road specifications.[1] From the storage piles the rock is loaded by steam shovels into the cars for shipment (Fig. 40). No crowding of the mill and storage pile is necessary here as there is ample acreage of nearly level land (Fig. 41).

Plant Equipment Related to Undeveloped Community.

Due to the fact that the Ohio Valley Rock Asphalt Company's quarries and mill are located in a farming region at considerable distance from any other industrial plant, the plant is self-contained. Thus in addition to the quarry and mill, the company provides its own power, furnishes

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1. To test the Kentucky Rock Asphalt for total bitumen, at least one sample of approximately five pounds shall be taken from each five tons of the entire quantity to be sampled. The sample shall be taken uniformly and systematically from said quantity so that they shall be representative of the entire quantity. The samples shall be thoroughly mixed and successively reduced by quartering until a ten gram sample remains for test. After this sample has been thoroughly ground and dried, the bitumen shall be removed by the standard ignition test, allowing a permissible variation of twenty-five one hundredths of one per cent.

its water and makes its own repairs. The power for the plant is furnished by a semi-Deisel engine. Any unit of the plant may be operated individually, permitting one part of the plant to run without the other. A 16,000 gallon wooden tank on the top of a nearby hill holds the water supply needed. The water is pumped to it by a gasoline engine. A shop equipped to repair any part of the plant is maintained.

Labor Supply Related to Type of Community. All the unskilled and some of the skilled labor is recruited from the farming community in which the plant is located. In this development, therefore, the company has not built a village.

About 300 men are employed during the busy season of eight months. Most of the men live in their own homes and within a radius of ten miles. All the roads over which the men must travel are dirt roads except the main highway (Route 62). The plant is not in operation, however, during the winter months when these roads would be impassable so there is little difficulty about transportation.

These men were originally farmers and had to be trained in the rock asphalt industry. They make good workmen and have been a factor in the development of the industry. Because of their familiarity with the "black rock", they make excellent "rock graders". Probably five times as

many men are available in the community as are employed in the plant.[1]

Industry Affects Local Prosperity. While the operations have not reached any great proportions yet, they have added greatly to the income of the small community affected by the industry. The community has become much more prosperous than it could have ever been by agriculture alone.

THE CROWN ROCK COMPANY

Location of Operations and Company. The operations of the Crown Rock Company take place at Big Clifty in Grayson County about five miles southwest of Summit, on the Illinois Central Railroad (Fig. 2). The Crown Rock Company is financed by Cincinnati capital and has its home office in Cincinnati. No land is leased, but 102 acres are owned outright. It is on the south side of the railroad, and the mill is about a quarter of a mile from Big Clifty. A spur from the main line has been built by the Crown Rock Company to the mill.

Operations Related to Depth and Nature of Rock. The Crown Rock Company's operations present a new phase of the asphalt industry. Rock of any bitumen content is mined and mixed. The rock asphalt in this locality is

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1. Stokely Bowling, Superintendent: Interview.

more than a hundred feet below the general surface of the area as it is on the down side of a fault near the Hardin County line. It was found more economical to mine the commercial rock than quarry it. A hard limestone overlying the rock asphalt forms a substantial roof to the mine. The bituminous rock is about eight feet thick. The rock, which varies in bitumen content from two to twelve per cent, is drilled and shot-down like coal, loaded on small cars and brought up the slope of the mine to the surface by mules.

The mill is located at the mouth of the mine and the content of the car is dumped immediately into a crusher. The rock asphalt passes through crushers and rolls that reduce it to the sand grain unit. If the bitumen content of the rock is too high to meet the desired specifications, sand is added. If the bitumen content is too low, oil or "flux" is added. This produces a material that can be laid cold, like natural rock asphalt and is called the "cold lay". A "Super-Sheet Asphalt" is also produced, but it is not a natural rock asphalt and must be laid hot. About 200 tons of crude rock are produced per day and 150 tons of mixed product.

Influence of Industry on Community Unimportant.

The development of the Crown Rock Company is comparatively small and its influence on the community is correspondingly

unimportant. About forty men are employed in the mine and mill. They all come from Big Clifty and live in their own homes. The road from Big Clifty has been surfaced with cinders, by the company and the distance can be traversed in less than ten minutes in a car. No settlement has grown up about the plant. In the past, operations have not been carried on continuously by the company, so the income has not been regular. It has merely supplemented the equally irregular income from farming.

Chapter IV

DEVELOPMENT OF ROCK ASPHALT INDUSTRY IN LOGAN COUNTY

The rock asphalt industry in Logan County, like that in Grayson and Hardin Counties, figured in the earlier developments of the industry, but none of the original companies were permanent. Roads built of the rock asphalt from the earlier operations are still in existence and giving satisfactory service. The present developments were begun in the Fall of 1928 and at the time of writing had amounted to very little. As a result, an investigation of the geographic relationships in the area must be based on meager data. An attempt is made, however, to check the probable relationships against those which are established in the producing districts.

The Kruger Interests were in control of the Logan County developments during the first period of the present development. Some changes were made in the personnell of the company soon after it was organized, but the nature of these changes was not given to the public. This company is financed by Chicago and Eastern capital. Harry Sinclair of the Sinclair Oil interests is reported to be a stockholder in the company. It is given out from presumably reliable sources that sufficient capital is available to

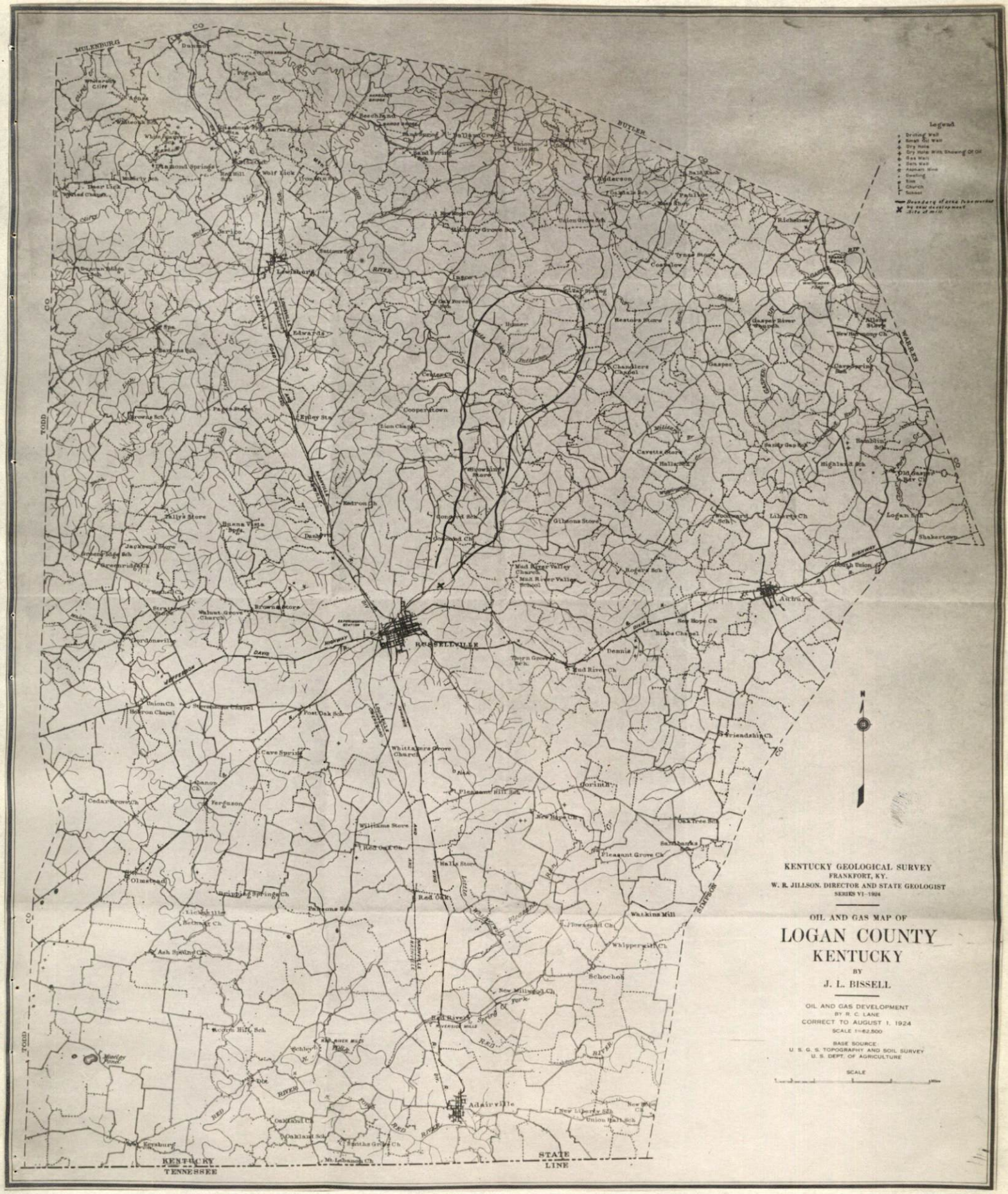

Fig.41. Map of Logan County. Location of area to be worked for rock asphalt is enclosed by heavy line.

carry forward to completion the developments which have been begun. Thus, at the time of writing, there appears to be no probability of having to close down on account of lack of funds. Careful investigations were made before the field was entered for working, so that enterprise has been on a sound business basis from the beginning.

Location and General Characteristics of Rock Asphalt Producing Area. The Logan County field furnishes another example of the occurance of rock asphalt in the Chester sandstones. The area of the Chester sandstone takes the form of an ellipse with the longest axis extending northeastward and southwestward (Fig. 2). It lies northwest of Russellville and is crossed about midway by the Owensboro branch of the Louisville and Nashville Railroad. The rock of commercial value apparently is confined to the northeastern section of the county between the Owensboro branch and the mail line of the Louisville and Nashville Railroad (Fig. 41). The surface of this northwestern section of Logan County though high is less rugged than the asphalt producing area in Edmonson County. No stream of any size extends through the area. Only a few creeks, tributaries of Green River, furnish drainage. The rock asphalt is found at an elevation between 560 and 700 feet. The rock is greyish in color and for that reason has been passed up as inferior in quality. The analyses show, however,

that some of the highest quality rock asphalt has been found in some of the poorest looking samples. In Logan County the rock asphalt is not found ready for use as is the case in Edmonson County. As a result, the volatile oils and the bitumen in excess of the amount required by the Federal Highway Commission and the highway departments and commissions of the many states using rock asphalt, must be removed before the rock is ready for market.

Projected Development. In September 1939, the developments in the Logan County field were progressing steadily. They furnish a good example of the necessary first steps in the rock asphalt industry. An intensive campaign for options on land was made. Many difficulties in obtaining options were encountered. The region, though lying between two railroads, is somewhat isolated, due to poor roads and rugged topography. Earlier attempts at asphalt developments and also oil and gas, had made the landowners wary. Consequently, many farmers held up their options. Some hoped to get better prices for the land while others regarded the developments as merely a flurry of speculation. In addition, there were other reasons or excuses for, according to the point of view. Work was discontinued at one time in an effort to influence the "hold outs" to give options. This plan worked in many instances.

As soon as options on the desired minimum amount of

land were secured, testing for the asphalt was begun. It included 100,000 feet of core drill holes, more than 35,000 churn drill holes and a large number of test pits. The results of the tests were known only to the company and the landowner. The employees of the company were forbidden to divulge any information concerning the character of rock under any piece of land, thus protecting the landowner against any damaging reports. A geologist was in charge of the testing. Work on several sections went on at the same time. As each section was tested, the owner of the land was notified of the result and where the land proved to contain asphalt of the desired quality, deeds were drawn and abstracts made.

Location of Mill. In the Russellville development, the mill will be located in relation to transportation facilities on the one hand and to the beds of asphalt rock on the other. Under the present plan, the mill will be placed about two miles northeast of Russellville on the north side of the main line of the Louisville and Nashville Railroad. A spur, following the ridgetop will be built from the railroad to the mill. The rock asphalt will be brought from the area to the north-northeast--an area drained by the headwaters of the Notts Lick and Patterson Creeks (Fig. 41). In this area the commercial rock lies

near enough to the surface to be quarried profitably.

Commercial Product. Much of the rock asphalt will be marketed for road building. In addition to this it will be used for vitriolic brick, battery boxes and synthetic rubber products. The Kruger interests also have a process, known only to them, for the extraction of material for a synthetic oil similar to ambergris.[1] This material will be used for the manufacture of high grade perfume and is quite valuable. The essential oils will be extracted and shipped. The other products will be prepared near the quarry.

Labor Supply. Local men have been employed in the activities of the early stages of the development of the industry and local labor will be used in the quarries and mills and also in their construction. The population is probably sparser in the asphalt producing section of the county than in other sections on account of the poor agricultural land and the absence of any other industry. The new industry, however, will find an ample and interested supply of labor. The income derived from the development of the chief natural resource of the section will add greatly to the general development of

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1. The natural ambergis is an oil found, only in whales having tumor or cancer. Consequently, it is very rare and expensive, about $36.00 an ounce.

the area.

Local Interest. The citizens of Russellville, the county seat of Logan County, have manifested much interest in the new industry and have lent a helping hand wherever possible. The area under development is directly tributary to the little city and will not only add to the general welfare of the county, but will greatly affect the prosperity of Russellville. The Commercial Club has been active in encouraging the development company and the local newspaper has given them a great deal of desirable publicity.

Chapter V

MARKETING PHASES OF THE ASPHALT INDUSTRY OF WESTERN KENTUCKY

Rock asphalt in Western Kentucky is produced primarily for road surfacing. In fact, the industry so definitely depends upon its road surfacing trade that a permanent decline in road building would lead to a corresponding decline in the industry. In a normal year, approximately 90 per cent of the production from the Western Kentucky field is used for surfacing streets and highways. Naturally, profits to the producers vary with prevailing prices as well as with the quantity produced, but the important fact is that year by year an increasing market exists for the rock asphalt.

Statistics of early shipments (Fig. 6) show the struggle the industry went through in getting established. For years after production began the sales were all to cities as hard surfaced roads in rural areas were little thought of at that time. The rapid development of the automobile and increase in its use after the war, with its accompanying demand for good roads, was an important factor in the development of the industry. The first sales for country roads were made to the highway department

Fig. 42. Eighteenth Street Road, Louisville. It was paved with rock asphalt in 1910.

of New York State.

The means of attaining importance as a road surfacing material, and methods of marketing it, form an important part of the production of Kentucky rock asphalt.

Omit ?

Government Experiments. Experiments carried on by the Federal Government did much to win recognition for Kentucky rock asphalt as a road surfacing material. In 1907, the United States Office of Public Roads surfaced a mile of road on the "Cemetery Pike" just out of Bowling Green, with Kentucky rock asphalt. In 1910, the road was found to be in excellent condition.[1] Again in 1918 when the United States Government was seeking the best road surfacing material available, for its many army camps, Kentucky rock asphalt was tried experimentally and found to be an excellent material for their needs. The Eighteenth Street Road, over which all the heavy traffic between Louisville and Camp Knox passed had been surfaced with Kentucky rock asphalt in 1910 (Fig. 42). The fact that it stood up under heavy war traffic without any need for repairing attracted considerable attention and was largely responsible for the recognition received by Kentucky rock asphalt immediately following the war.

State Surveys, Experiments and Publicity. The Kentucky Geological Survey had shown an interest in the

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1. Logan, Judge M. M.: Interview

"black rock" of Edmonson County, for many years. Immediately following the World War, it made surveys of the area and carried on experiments with the rock asphalt. With a view to aiding the development of the mineral resources of the state, a number of articles dealing with rock asphalt as a road surfacing material were published by members of the survey.[1] This gave a desirable publicity to rock asphalt and directed the attention of road builders to it.

State newspapers, interested in the progress of any industrial enterprise within the state, frequently called attention to the development going on and to the service given by the roads surfaced with Kentucky rock asphalt.[2]

Promotional Activities of Producing Companies[3]

Much advertising was done by the producing companies. Newspapers, magazines (especially industrial and technical magazines), and signboards were used extensively.

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1. Richardson, C. H.: Road Materials of Kentucky 1924
   Jillson, W. R.: Kentucky Rock Asphalt 1924
   Jillson, W. R.: Mineral Resources of Kentucky 1927
   Weller, J. M.: Geology of Edmonson County 1927
2. Park City Daily News, October 25, 1924
   The Courier Journal (Louisville, Kentucky) June 26, 1929
3. "Mining Rock Asphalt in Kentucky", Cement, Mill and Quarry, December 5, 1918.
   "Asphalt Rock Mined in Kentucky", Canadian Engineer, July 8, 1924.
   "Citizens the most Valuable Product of the Asphalt Quarry", Manufacturers Record, (Baltimore, Md.) June 27, 1929.

At the same time, experiments were being carried on to ascertain the various uses to which the rock asphalt might be put. Many uses were found. As early as 1904 the Wadsworth Stone and Paving Company discovered the practicability of the use of rock asphalt for floors in breweries, livery stables and other places, where there is likely to be considerable water on the surface.[1] At present the producers are urging its use for tennis courts, bridge floors, station platforms, school playgrounds, airport runways, walks, especially in parks, and for patching sheet asphalt. Besides the surfacing uses, it has also been found practical to make it into brick for laying where the use of the pulverized product would be impractical. Shingles are also being made of it and put on the market.[2] Experiments are constantly being carried on, not only to find new uses but to better the present uses.

The Kentucky Rock Asphalt Company has salesmen in all states east of the Mississippi River.[3] After the sale is made, service men follow it up to see that the rock asphalt is laid properly. The other companies follow similar practices.

DISTRIBUTION CENTERS AND FACILITIES

Just as there are several unconnected areas

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1. Logan, Judge M. M.: Interview
2. Long, C. M.: Interview
3. Carmichael, H. St. G. T.: Interview

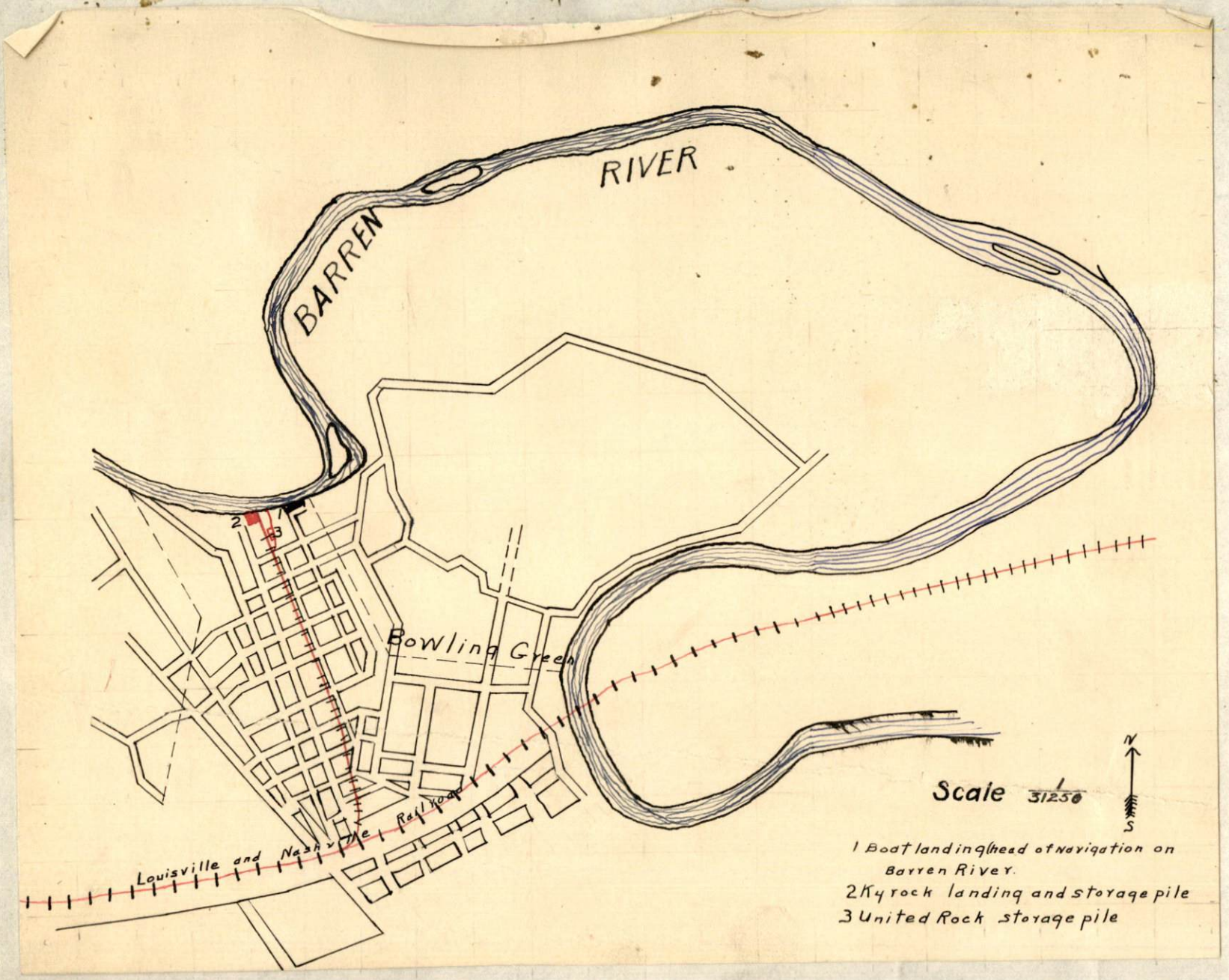

Fig. 43. Section of Bowling Green Showing side track from Louisville and Nashville Railroad to boat landings on Barren River.

of production of rock asphalt, so there are a number of widely separated distributing centers serving the various areas.

Begin

Bowling Green. At Bowling Green, seventy miles from Kyrock by river (and twenty by air,) the Kentucky Rock Asphalt Company maintains its supply of commercial rock asphalt for shipping by rail. Bowling Green was selected as the center of distribution because it is the nearest point to the producing area at which river and railroad intersect. (It will be recalled that) the barges of rock asphalt are towed from Kyrock, down Nolin River to Green River, down Green River to the mouth of Barren River and up Barren River to Bowling Green, the head of navigation. Bowling Green is on the main line of the Louisville and Nashville Railroad between Louisville and Nashville and is the only point on the navigable Green-Barren waterway crossed by a railroad.

At Bowling Green the storage piles and office of the Kentucky Rock Asphalt Company are located near the river in the northern part of the city. This location gives them ready access to the river. Connection with the railroad is made by means of spurs leading from the main sidings to the company's property (Fig. 43). By means of a steel stiff-leg derrick and clam-shell bucket the barges are unloaded into a steel hopper. This hopper

Fig. 44. "Kyrock" being unloaded at Bowling Green. (Courtesy of Kentucky Rock Asphalt Company).

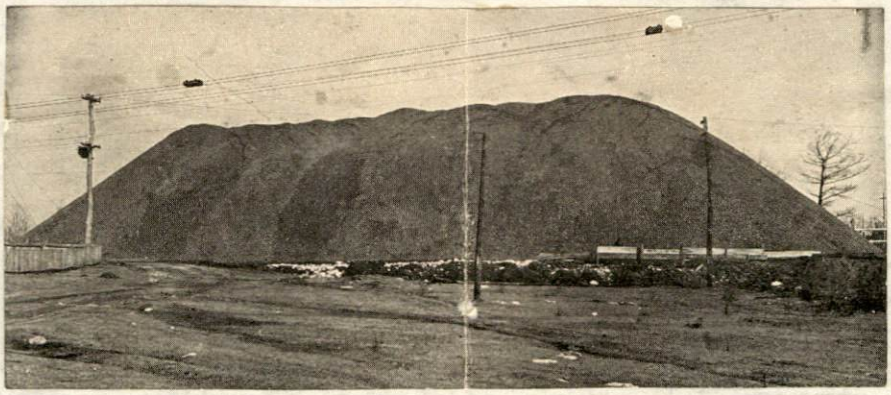

Fig. 45. Storage piles of Kentucky Rock Asphalt Company at Bowling Green. (Courtesy of Kentucky Rock Asphalt Company).

discharges the commercial product into cars (Fig. 44). These cars are hauled up a double incline and carried on an aerial tramway to the storage pile and dumped (Fig. 45). The storage piles have a capacity of 150,000 tons and cover standard railroad tracks. The tracks are used for gondola cars into which the rock asphalt is loaded by steam shovels for shipment. The side tracks belong to the Kentucky Rock Asphalt Company, but are connected by spurs with the main-sidings of the Louisville and Nashville Railroad. Two or three hundred thousand dollars worth of rock asphalt is always on hand in the storage piles. Nearby are offices and a laboratory in which the samples taken from the shipments are handled. Executive offices are maintained in Louisville, and the General-Manager's offices are at Kyrock, but all orders are filled from the storage piles, regardless of where received.

From time to time, storage piles are maintained at Rockport 80 miles down Green River from Bowling Green. Here the river bank adjacent to the Illinois Central Railroad is utilized. This location is of much less importance than the one at Bowling Green, but is kept in case of the receipt of orders from a direction in which shipments over the Illinois Central Railroad would be more direct, and consequently cheaper. A complete dependence on the Louisville and Nashville Railroad is also avoided in this way.

The marketing plan and lay-out of the United Rock Asphalt Company closely resembles that of the Kentucky Rock Asphalt Company. The finished product is sent from the mill on Green River, to Bowling Green where the reserve supply is kept. The barges loaded with "Unirock" are moored near those of the Kentucky Rock Asphalt Company and the rock asphalt is transferred to the storage piles in practically the same way. A steel stiff-leg derrick and clam-shell buckets unload the barges into steel hoppers. The hoppers dump the rock asphalt into cars which are conveyed by an aerial tramway to the storage piles. Side tracks from the Louisville and Nashville Railroad extend to and under the storage piles. The gondolas in which the rock asphalt is shipped, are placed alongside the storage piles and loaded by steam shovels.

The main office and laboratory of the United Rock Asphalt Company are maintained at Bowling Green near the storage piles. The executive offices are in Louisville. Here only such business as is connected with the legal phases of the company is attended to. An office in connection with the commissary is maintained at Asphalt. All orders are filled through the Bowling Green office, from the storage piles.

Rockport and Other Centers along the Illinois Central Railroad. The Natural Rock Asphalt Corporation

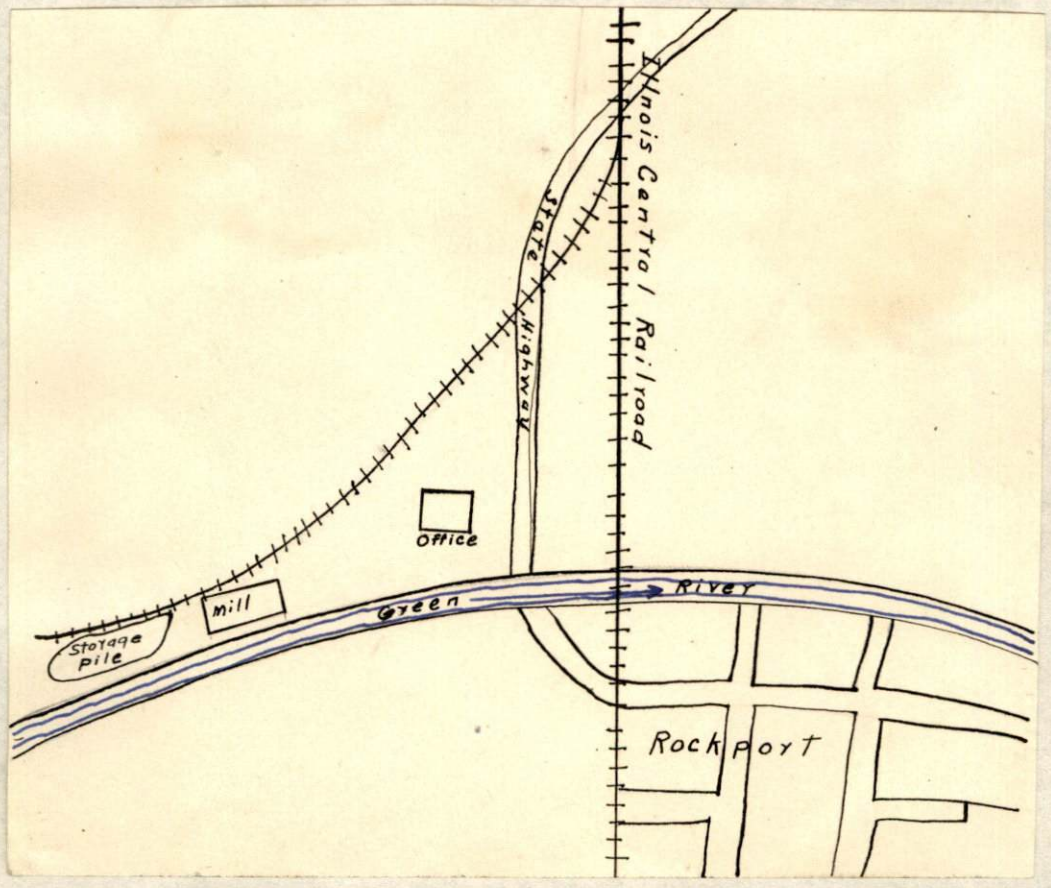

Fig. 46. Layout of plant of Natural Rock Asphalt Corporation at Rockport.

ships all of its rock from Rockport and over the Illinois Central Railroad. This plan involves a down river haul of about sixty-five miles. It will be remembered that rugged topography made it impractical to locate the finishing mill at Natural Rock and that space was not available at Bowling Green at the time the Natural Rock Asphalt Corporation began operations. A side-track, from the mainline just south of the Green River, extends to the mill. At the mill the cars on the siding can be loaded directly, as the milling process is completed, or from the storage pile (Fig. 48). Only a small amount of the rock asphalt ready for market is kept in storage by the Natural Rock Asphalt Corporation as that company prefers to ship it fresh from the mill. The Illinois Central Railroad gives excellent service both north and south.

The Ohio Valley Rock Asphalt Company and the Crown Rock Company stand in marked contrast to the other companies in the fact that both mills and quarries of these companies are located along the Illinois Central Railroad and thus have no need of river transport. The Ohio Valley Rock Asphalt Company is located on the mainline of the Illinois Central Railroad at Summit in Hardin County and its loading facilities are very simple. The commercial rock may be loaded directly from the mill into the gondola

cars on the side track paralleling the main line of the railroad, or it may be loaded from the storage pile less than twenty feet away. The cars may then be picked up and taken either north or south. The Crown Rock Company, operating in Grayson County in the northeastern part of the region, has a short side-track extending to its plant about a half mile from the mainline of the Illinois Central.

From the standpoint of distribution, the Natural Rock Asphalt Corporation belongs in the group with the Ohio Valley Rock Asphalt Company and the Crown Rock Company. All three companies are served by the Illinois Central Railroad and the same local freight picks up the cars from them all. Through Louisville or Memphis freight connections may be had for any desired point.

Russellville. The Logan County operations will be served by the mainline of the Louisville and Nashville Railroad. The mill will be along-side the main track so only side-tracks to the storage piles will be necessary.

MARKETING DISTRIBUTION

Two factors largely control the distribution of Kentucky Rock Asphalt. They are the cost of transportation and the demand for the product.

Area of Distribution Related to Cost of Transportation. Although Kentucky rock asphalt can be shipped in open cars, freight rates by rail are quoted on a

finished product and are consequently quite high. This fact has practically limited its wholesale distribution to the area east of the Mississippi River. On foreign shipments the important factor so far has been the cost of shipment to the point of export. No attempts have been made to place it in inland cities in foreign countries. Rock asphalt is a desirable cargo for ocean-going vessels as it will go into the hold of the ship and does not shift. As a result marine rates are lower than otherwise would be the case. It can be used for ballast and practically all ports of any importance are provided with facilities suitable for loading and unloading it.

Area of Distribution Related to Demand, Proximity and Cost of Transportation. The demand for the product is greatest in states carrying on extensive road building, and in cities improving their streets. All of the central and eastern parts of the United States use considerable quantities but Ohio, Indiana, Pennsylvania, and West Virginia are the largest consumers. All of the states named are rapidly improving their road systems. Their proximity to the Kentucky rock asphalt producing area keeps the cost of transportation down. As a result, the total cost of Kentucky rock asphalt is not too great for it to compete with other surfacing materials.

Time of Distribution Related to Season. As road

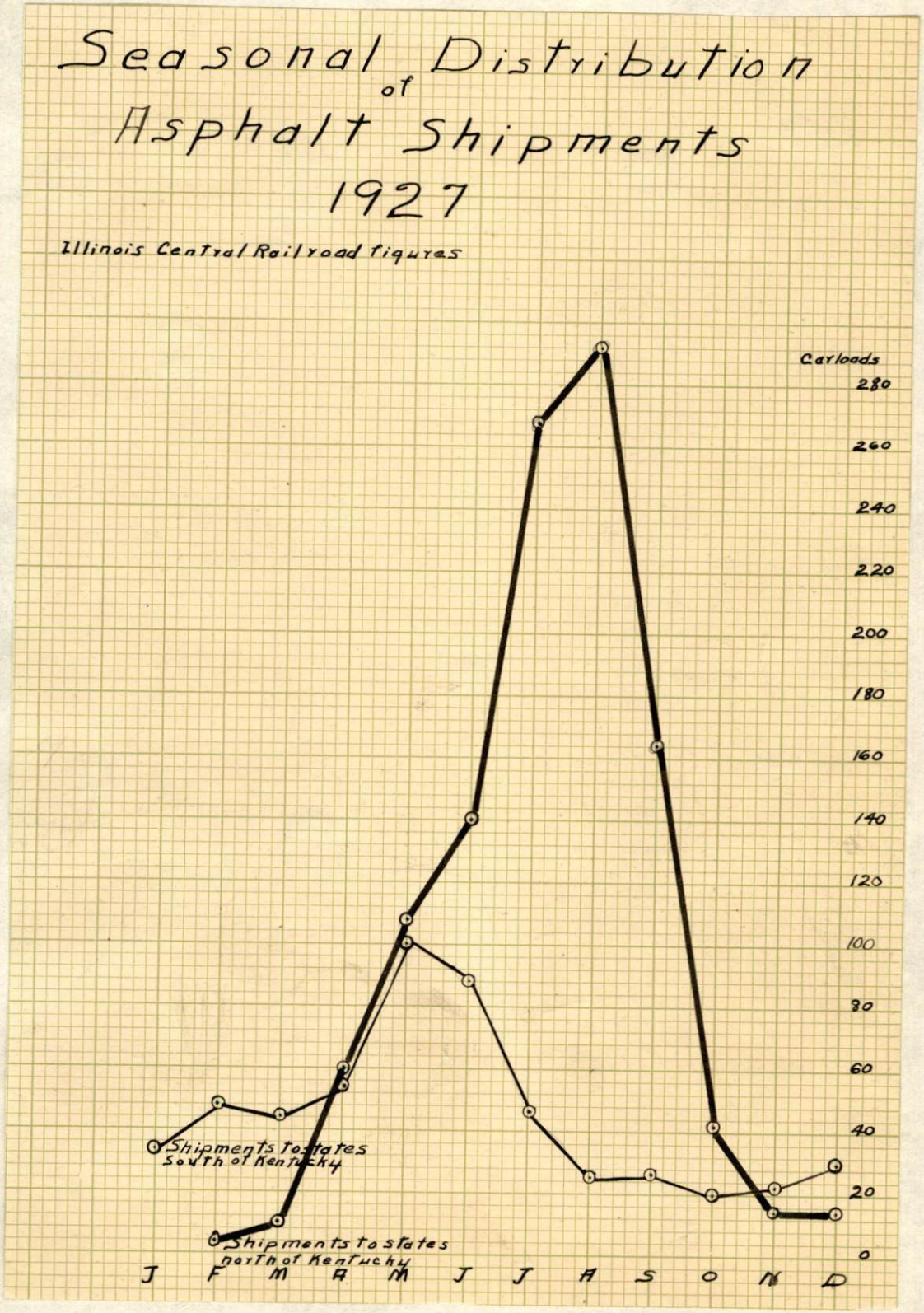

Fig. 47. Graph showing seasonal distribution of rock asphalt.

building is confined to a few summer months, there is a decided seasonal variation in the movements of rock asphalt. Of the rock asphalt shipped north, 77 per cent was moved during the months of June, July, August, and September of 1927. Of the total shipments, 63 per cent moved in June, July, August, and September. Practically none moved in December, January, and February. The shipments south are much less seasonal, being fairly well distributed throughout the year (Fig. 47). There are practically no shipments in Kentucky and the states having similar seasons during the winter. They begin their season earlier than the northern states, however, and continue later. May and October are among the months of heavy movement. In 1927, 80 per cent of the total shipments were made in May, June, July, August, September, and October.[1]

The use of Kentucky rock asphalt is not confined to the domestic market. Canada has imported some Kentucky rock asphalt, as has England. The Japanese government has sent a representative to investigate the use of Kentucky rock asphalt for surfacing roads, with a view to importing it to Japan.[2] This widespread demand for so bulky a commodity

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1. Illinois Central Railroad statistics.
2. Kentucky Rock Asphalt Company Salesman: Interview.

suggests that it possesses qualities sufficiently superior to other surfacing material, to make it worthwhile to transport it long distances. These qualities probably are its ability to endure for long periods of time with no maintenance cost and that it offers greater resistance to skidding than most other surfacing materials.[1]

BASIC PROBLEMS OF INDUSTRY

Very definite basic problems confront the future growth of the rock asphalt industry in Western Kentucky. Its use as a road surfacing material is assured. For wider distribution, it needs to be made known and conditions of marketing need to be improved.

Need of Making Rock Asphalt Known. One of the great needs of the industry is to make Kentucky rock asphalt known, not only to the road-building, but also to the road-using public. With a view to solving this problem extensive advertising is carried on. Demonstration roads are built in various parts of the United States and a few foreign countries.[2] Egypt, Brazil and England are among them.

Competition in Marketing. Another basic problem in marketing rock asphalt is the relatively large number of

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1. Sorenson, Leslie: Chicago Traffic Expert: Chicago Tribune November 10, 1929
2. Carmichael, H. St. C. T.: Interview.

producing companies. Competition has gone so far that one company frequently underbids another to get a contract. This not only cuts the profits of the company, but sometimes the divided interest makes it possible for another material to gain precedence. Some system of cooperation between the rock asphalt producing companies would certainly aid in the effective marketing of the natural product.

Another problem in competition is that between natural rock asphalt and the manufactured product generally known as "sheet asphalt". The latter is made by mixing sand and asphaltum, and has a decided advantage in the cost of transportation. The sand, which is 93 per cent of the natural rock asphalt does not have to be transported any great distance. Local supplies of sand are available in many places. There are many parts of the country, however, in which sand of the desired quality is not found nearby. The fact that the nature-made rock asphalt is more thoroughly mixed than the artificial, makes its appeal to places where the sand as well as the asphaltum has to be brought some distance. Lower freight rates on rock asphalt would give it a fairer chance in this competition. This is particularly true in competition between domestic and foreign products. The first natural rock asphalt used in this country was along the Atlantic seaboard, in New York, Baltimore, and Washington. The asphalt was imported from

Europe, much of it coming from Sicily. Trinidad asphalt can now be brought into the Atlantic Seaboard area and the presence of much sand makes sheet asphalt sufficiently cheap to make it difficult for the companies producing rock asphalt to compete. No such competition is met in the interior of the country.

Possibilities of Increased Production. An appreciable increase in the demand for rock asphalt would naturally make necessary an increase in the production. At the present rate of production, there is sufficient bituminous rock which meets the states' requirements of 7 per cent bitumen content, to last more than fifty years. If the bitumen content were lowered to five and a half per cent, and rock of that sort will make good roads, the amount of rock available is vastly increased.[1]

The output of all mills could be considerably increased at little additional cost if the demand justified. An increase in output would necessitate an increase in transportation facilities. The building of a railroad into the area of Edmonson County would provide transportation and also make accessible by rail deposits of bituminous rock that are inaccessible to the river. The cost of building a railroad into so rugged an area would be great and freight rates by rail as compared with those by water would be

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1. Logan, Judge M. M.: Interview.

high. While all companies operating in the area disclaim any advantage to be derived from the presence of a railroad, surveys have been made into the area. The most recent one, in 1927 by Caldwell & Company, owners of the Kentucky Rock Asphalt Company, was made for a line leaving the Illinois Central near Leitchfield and extending the entire length of the present producing area./

Advantages of Continental Position. The Kentucky rock asphalt area is located near the center of a great continental region. The breadth, length and comparative flatness of this region, encourage communication between its widely separated sections. These qualities of the area reflect a two-fold advantage of the rock asphalt industry. First, there is created a demand for durably surfaced highways, and second, easy shipment of the rock asphalt is facilitated. The northern part of the region has already made much progress on its road building program. The southern part will soon follow suit. An adjustment of freight rates will be necessary for the rock asphalt industry to benefit materially from the development of the region beyond the Mississippi River. The occurence of frequent rain, freezing and thawing of winter, and excessive heat of summer make a weatherproof surfacing desirable. The presence of Kentucky rock asphalt, a practically weatherproof material in the midst of a region in which need for

such material is great, will eventually lead to its recognition as a superior road surfacing material.

SUMMARY

While the solution of all problems connected with the rock asphalt industry in Western Kentucky entails economic aspects beyond the scope of this study, it also involves the recognition of the geographic relationships of which the industry, as developed at present, is an expression. The first of these geographic relationships may be termed the productive performance of the industry. The present rate of production has been attained through more than thirty years of experience and experimentation and represents the extent to which, through careful adjustment, the natural productive capacity of the area is being utilized. In this respect the industry has attained a satisfactory degree of stability and gives promise of steady growth in the future. The major problems of production have been solved. The second of these geographic relationships may be termed the marketing performance. In order to realize fully upon the productive capacity of the area, the marketing should be adapted as effectively as possible to the problem of placing a heavy, bulky, but non-perishable product at as low a cost as possible in mid-continent and seaboard markets. The rock asphalt occurs in

a comparatively small, locally isolated area in a great continental interior. The producing part of the industry has developed in areas of rugged topography connected with each other, and with the market centers, by navigable streams. A separate company operates in each isolated section. So far as the marketing aspect of the rock asphalt industry is concerned, the continental quality of its location is a decided asset, while the local isolation is a liability but not a great handicap. The marketing performance of the industry is now to some extent, and in the future should be adapted more closely to these fundamental geographic conditions. The marketing phase of the industry as yet is not developed as well as could be desired. Cooperation of some sort is needed if the rock asphalt is to obtain as wide use as its inherent qualities warrant. Whether this will be accomplished by cooperation in marketing among the companies now operating, by the merger of the operating companies into one or more large corporations, or by some system yet unknown, time alone will tell.

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