Milk Transportation Problems in the St. Louis Milkshed

By R. W. Bartlett and
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Acknowledgment is due various organizations and milk truckers in the St. Louis dairy district, who helped in supplying information for this study; and also the St. Louis Milk Market Administration, which, thru the interest of Mr. Fred L. Shipley, the Administrator, supplied a substantial part of the funds for the study.

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Milk Transportation Problems in the St. Louis Milkshed

With Suggested Solutions

By R. W. Bartlett and W. F. Caskey[1]

AS A SOURCE of income to Illinois farmers, milk ranks second in the list of farm commodities, only hogs ranking higher. Yet only about two-fifths of what consumers pay for milk and milk products actually reaches the farmers who produce the milk, more than three-fifths being absorbed in transportation, processing, selling, and distribution. If farmers are to receive a larger proportion of the consumer's dairy dollar, it is obvious that greater efficiency must be developed at some point in the chain of service from producer to consumer.

Of all the various steps in the marketing process, that of transportation not only is highly important from the standpoint of costs and the delivery to consumers of a satisfactory product, but it probably is the most readily subject to control and improvement by producers themselves thru their organizations. About 12 million dollars was paid by Illinois farmers in 1934 to have their milk and cream hauled to markets to be processed or used in manufactured products. Transportation costs to farmers in the St. Louis milkshed were nearly a million dollars in 1933-34, a sum equivalent to about one-sixth of the wholesale value of the milk before processing. In addition distributors in this area paid out more than $250,000 for the transportation of milk from the country to city plants. Together these costs were equivalent to more than one-fifth of the wholesale value of the milk at the St. Louis market. Owing to a higher milk price and a slight decrease in hauling rates, hauling costs were reduced in 1934-35 but still constituted one-sixth of the total market value of the milk.

Because a large proportion of the milk for the St. Louis market is produced on the Illinois side of the Mississippi river, and because economical transportation is a matter of high importance to the farmers in this area, the University of Illinois was asked to study the problem and suggest what could be done to bring about more efficient transportation in the area. The analysis made should be useful in other Illinois milk-producing areas also, since many of the problems of these areas are similar.

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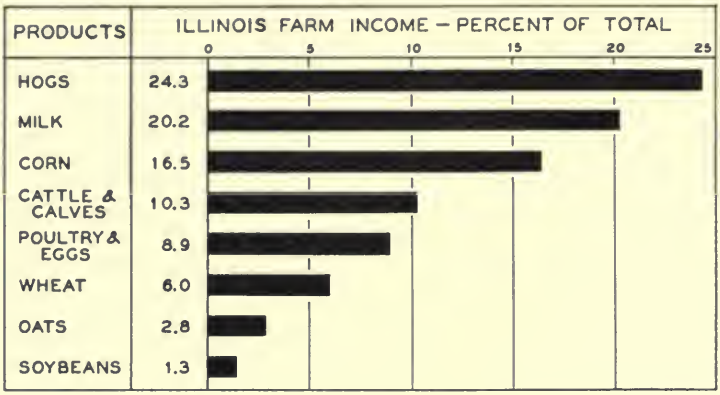

FIG. 1.—DISTRIBUTION OF CASH RECEIVED BY ILLINOIS FARMERS FOR PRINCIPAL PRODUCTS SOLD IN 1931-1934

Milk ranks second as a source of income to Illinois farmers. Of about 150 million dollars paid by consumers for Illinois dairy products in 1934, farmers received 58 million dollars. (Graph compiled from data in Circular 437, *Illinois Crop and Livestock Statistics*)

TABLE 1.—TRANSPORTATION COSTS ON MILK SHIPPED TO ST. LOUIS IN 1933-34 AND 1934-35, AND WHOLESALE VALUE OF THE MILK

	1933-34 June to May	1934-35 June to May
Transportation costs to farmers	$ 967 029	$ 954 458
Transportation costs to distributors	255 768	246 706
Total transportation costs	$1 222 797	$1 201 164
Wholesale value of milk f.o.b. St. Louis	$5 761 044	$7 152 812
Proportion that transportation costs were of wholesale value of milk	21.2%	16.8%

SCOPE OF INFORMATION OBTAINED

Information for making this study was obtained from the office of the St. Louis Milk Market Administrator and thru field contacts with truckers hauling milk in the St. Louis milkshed. The milk producers' association in Dayton, Ohio, was also very helpful in supplying information on conditions in that market. The principal items on which data were obtained were:

1. Volume of milk produced by each of more than 12,000 producers each month from June, 1933, to May, 1934, inclusive.

2. Hauling rate per 100 pounds of milk paid by each producer.

3. Name of each hauler and names of the producers for whom he hauled milk. (Records were obtained for a total of 491 routes.)

4. Location of each producer and information as to the route on which his milk was hauled.

5. Type and capacity of each truck.

6. Time each hauler usually arrived at the milk plant and time when he left the plant.

The work of mapping the locations of producers and hauling routes was done in July and August, 1934, by four field men. After the field investigation had been completed, the mileage of the different types of road in the 382 routes on which complete computations were made was ascertained by reference to published road maps.

Changes in the Transportation System

Changes in the methods by which milk has been brought from producing areas to consuming and manufacturing centers has been well described by Trumbower:

"In the early days milk was transported but short distances from the farms where it was produced to the consumers living in towns and cities. The area in which a city's milk supply was produced, known as its milkshed, was naturally restricted, as the horse and wagon was the customary means of bringing the milk into the city. Railroad shipments of milk did not begin until about 1838, when Boston began to be supplied by this new means of transportation. These railroad shipments began in almost all cases by the carrying of a few cans of milk on the front platform of a baggage car.

"The increase in the population of the larger cities was such that the farming territory from which the milk could be hauled by horse and wagon was no longer capable of furnishing all of the supply demanded by these large centers of population. Milk was still brought in over the country roads from nearby farms, but the larger portion of the supply came by rail from more distant production areas. After the advent of electric interurban railroads these were used in many cases to bring in milk which had formerly been hauled by the steam railroads or milk which had been taken to the city by wagon."[1]

Motor Truck Now Most Important

Twenty years ago very little milk was hauled by motor trucks. Today more than 90 percent of the milk transported from farms or country plants for city distribution is hauled by these trucks (Table 2), taking all the cities of the United States into consideration excepting two or three of the largest.

The steps in this shift from rail and wagon to motor truck are indicated by some statistics on the Baltimore milk market. In 1912, 80 percent of the milk received at this market was delivered by rail-

[1] TRUMBOWER, HENRY R. Transportation of milk by motor truck. U. S. Dept. Agr., Public Roads 5 (No. 5), 1. July, 1924.

TABLE 2.—PROPORTIONS THAT MOTOR TRUCK SHIPMENTS OF MILK WERE OF TOTAL MILK SHIPMENTS TO SPECIFIC MARKETS, 1934[a]

Cities with more than 500,000 population	Motor truck shipments, percent of total	Cities with less than 500,000 population	Motor truck shipments, percent of total
Baltimore	94	Columbus	100
Boston	10	Dayton	100
Buffalo	100	Hartford	98
Chicago	94	Indianapolis	95
Cleveland	100	Kansas City	100
Detroit	98	Louisville	100
Los Angeles	98	Richmond	100
Milwaukee	98	San Diego	100
New York	37	Washington, D.C.	99.5
Philadelphia	64		
Pittsburgh	97		
St. Louis	100		
San Francisco	98		
St. Paul-Minneapolis	100		

[a]Data for all markets except Boston, Buffalo, Cleveland, New York, and Philadelphia were obtained from the Automobile Manufacturers Association report, "Motor Truck Facts," 1935 edition, page 11. Data for Boston, New York, and Philadelphia were obtained from annual milk-market news service reports of the U. S. Department of Agriculture, and for Cleveland and Buffalo by correspondence with officials in those markets.

road and 20 percent by wagon. Shipments by motor truck commenced about 1915, comprizing then about 7 percent of the total deliveries. From 1915 to 1920 truck shipments gradually replaced wagon deliveries. By 1921 wagon shipments stopped altogether, and rail shipments had declined until they accounted for only 68 percent of the total milk receipts, the other 32 percent being hauled by motor truck. During the next few years motor truck shipments increased rapidly at the expense of rail shipments. By 1923 trucks were hauling 45 percent of the

TABLE 3.—COST OF TRUCKING MILK, AND AMOUNT BY WHICH THIS COST WAS LOWER THAN RAIL RATE PLUS TRANSFER CHARGE, IN THE NEW YORK MILKSHED, 1932-33; BASED ON A STUDY OF 92 TRUCK ROUTES

(Cornell University study[a])

Zone	Cost of truck hauling		Amount which trucking cost was lower than rail rate plus transfer charge[b]		
	Number of routes	Cost per 100 pounds hauled	Amount below l.c.l. rate on cans	Amount below carlot rate on cans	Amount below carlot rate in tanks
miles		*cents*	*cents*	*cents*	*cents*
21- 50	6	12.8	22.5	16.9	14.2
51- 80	21	14.5	24.8	18.4	15.3
81-110	22	18.4	24.3	17.3	13.7
111-140	12	24.5	21.2	13.6	9.7
141-170	8	27.8	21.0	12.7	8.6
171-200	13	41.6	10.1	1.3	−3.2
201-230	5	45.4	8.8	− .5	−5.2
231-260	0	....	....	....	....
261-290	5	53.0	5.7	−4.5	−9.7

[a]From Cornell University *Farm Economics*, No. 91, p. 2222, Tables 1 and 2. October, 1935.
[b]A uniform transfer charge of 7.5 cents per hundredweight has been added to the rail rate.

milk shipped to this market, and by 1934 they were hauling 94 percent of all milk deliveries.

At Buffalo, Cleveland, St. Louis, and St. Paul-Minneapolis in 1934 motor trucks were hauling all the milk received. At Detroit 98 percent of the total milk received was so hauled. Shipments to Pittsburgh in 1934 were 97 percent by motor; to Baltimore and Chicago, 94 percent; and to Philadelphia, 64 percent.

Railroads still continue to haul the major part of the milk received at Boston and New York, tho truck shipments to these markets have materially increased in recent years. In 1934 truck shipments to Boston constituted 10 percent, and those to New York 37 percent of the total shipments, whereas in 1927 truck shipments to New York constituted

FIG. 2.—ONE OF THE FIRST STREAMLINED MILK-TANK RAILROAD CARS

This car was first used in transporting milk to the New York market in 1935. The usefulness of this type of transportation is limited to areas in which milk must be transported long distances.

only 22 percent of the total. Most of the milk received at these markets is produced in remote areas and rail shipments have therefore been more economical.

Better transportation service at lower cost was the principal reason for the major change from rail and wagon to motor truck during the past few years. One large dairy company in Philadelphia in 1923 estimated that they saved 5 cents a hundred pounds of milk by shipping by motor truck instead of by rail.[1] Savings effected in different markets by changing to truck transportation have varied widely because of wide variations both in railroad rates and in trucking rates.

Most Favorable Distances for Truck and Rail

As stated, railroads still continue to haul the major part of the milk received at Boston and New York, tho truck shipments to these

[1]Page 10 of work cited on page 425.

markets have materially increased in recent years. For distances under 171 miles, costs of hauling milk by tank truck to New York City were found to be lower than tank-car shipments (Table 3). For distances greater than 171 miles, however, tank-car shipments were the more economical. Costs incurred in hauling milk various distances by tank trucks are shown in Fig. 3.

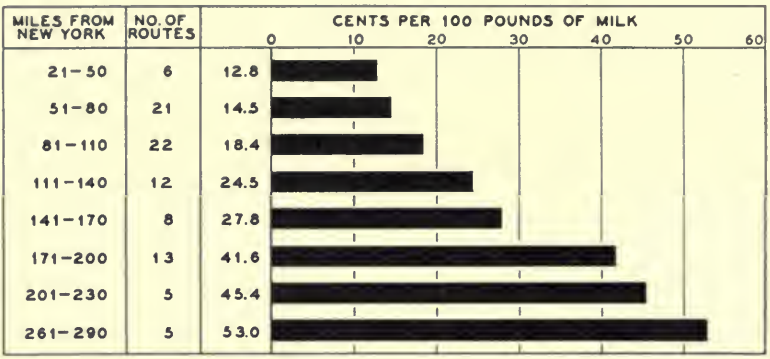

FIG. 3.—TANK-TRUCK COSTS FOR NINETY-TWO ROUTES IN THE NEW YORK MILKSHED, 1932-33

For distances of less than 171 miles the cost of hauling milk by tank truck from country plants to city plants was lower than by tank car. For distances of more than 171 miles, tank-car shipments were the more economical (Table 3).

TRANSPORTATION OF MILK IN ST. LOUIS MILKSHED

Broad changes in the milk transportation system in the St. Louis milkshed, as in other milksheds of the country, have taken place in the past twenty years as a result of the great increase in trunk-line highways and use of motor trucks. Most of the milk received in St. Louis in 1914 was shipped by rail, whereas in 1934 all of it was transported by trucks.

The extent to which the highway situation has changed in this area is further indicated in Table 4 and Fig. 5. Whereas in 1915 only one mile out of twenty was improved,—that is, passable with full loads thruout the year,—in 1935 one mile out of every three consisted of improved highways. A map of the improved highways in this area in 1935 is shown in Fig. 4.

The large increase in improved mileage has been accompanied by an even larger increase in number of motor trucks (Fig. 6). In 1935 there were 17 trucks operating in the St. Louis milkshed for each one operating in this area in 1915.

About half the milk produced for the St. Louis milk market is hauled from farms to country plants, where it is cooled and hauled in

TABLE 4.—MILEAGE OF IMPROVED AND UNIMPROVED ROADS IN THE THIRTY PRINCIPAL COUNTIES IN THE ST. LOUIS MILKSHED, 1915-1935

Year	Miles of road			Percent improved road was of total mileage
	Improved	Unimproved	Total	
1915	1 436	26 516	27 952	5.1
1920	2 212	25 740	27 952	7.9
1925	3 556	24 396	27 952	12.7
1930	5 785	22 167	27 952	20.7
1935	8 995	18 957	27 952	32.2

FIG. 4.—IMPROVED ROADS IN THE ST. LOUIS MILKSHED IN 1935

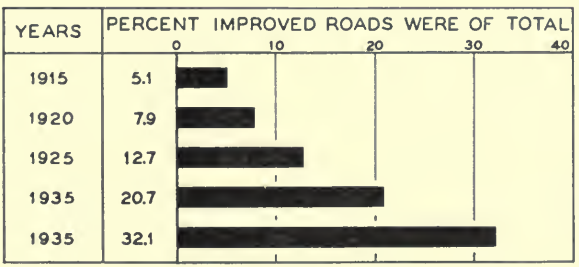

FIG. 5.—INCREASING PERCENTAGE OF IMPROVED ROADS IN THE ST. LOUIS MILKSHED

Only one mile out of twenty in this milkshed was improved in 1915. In 1935 one out of every three was improved.

tank trucks or in bottles to St. Louis. The other half is hauled from farms directly to city plants, and is termed "direct-shipped" milk in contrast to "country-plant" milk. In 1933-34 about 80 percent of the country-plant milk was hauled on a commercial basis, while 98 percent of direct-shipped milk was hauled on this basis. The majority of the commercial routes in the country-plant areas are operated by farmers, while full-time truckers haul most of the direct-shipped milk. Milk not hauled on commercial routes is hauled by individuals. On most

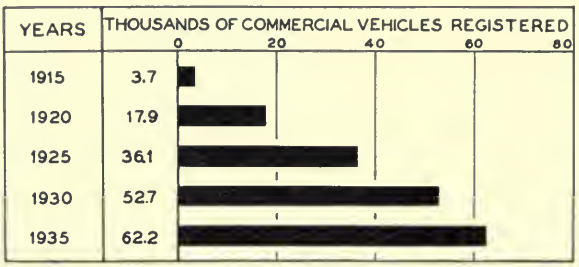

FIG. 6.—INCREASING NUMBER OF REGISTERED COMMERCIAL VEHICLES IN THE ST. LOUIS MILKSHED

About seventeen times as many commercial vehicles were registered in 1935 as in 1915.

TABLE 5.—ORIGIN OF MILK SHIPMENTS IN THE ST. LOUIS MILKSHED, BY MILEAGE ZONES, JUNE, 1933, TO MAY, 1934

Zone	Distance from St. Louis	Milk shipments in St. Louis milkshed					Percent of total	Cumulative percentages
		From farms to country plants		From farms to city plants		Total, millions of pounds		
		Total, millions of pounds	Percent of total	Total, millions of pounds	Percent of total			
	miles							
1	Under 21	17.4	8.2	17.8	8.7	35.2	8.4	8.4
2	21- 30	69.4	32.8	50.3	24.5	119.7	28.7	37.1
3	31- 40	21.4	10.1	53.3	25.9	74.7	17.9	55.0*
4	41- 50	32.4	15.3	28.9	14.0	61.3	14.7	69.7
5	51- 60	17.6	8.3	25.5	12.4	43.1	10.3	80.0
6	61- 70	8.2	3.9	11.7	5.7	19.9	4.8	84.8
7	71- 80	2.5	1.2	5.6	2.7	8.1	1.9	86.7
8	81- 90	6.4	3.0	4.3	2.1	10.7	2.6	89.3
9	91-100	23.5	11.1	4.4	2.1	27.9	6.7	96.0
10	101-110	....	....	3.5	1.7	3.5	.8	96.8
11	111-120	7.0	3.3	.4	.2	7.4	1.8	98.6
14	141-150	5.9	2.8	....	....	5.9	1.4	100.0
Total	.....	211.7	100.0	205.7	100.0	417.4	100.0	100.0

*This constitutes the mid-zone as to volume.

routes dairy companies hire the haulers and deduct the hauling cost from the price they pay for milk. Recently the producers' association has taken over the control of a small number of hauling routes.

Four-fifths of the milk in the St. Louis milkshed in 1933-34 was produced within 60 miles of the St. Louis market, the remainder on

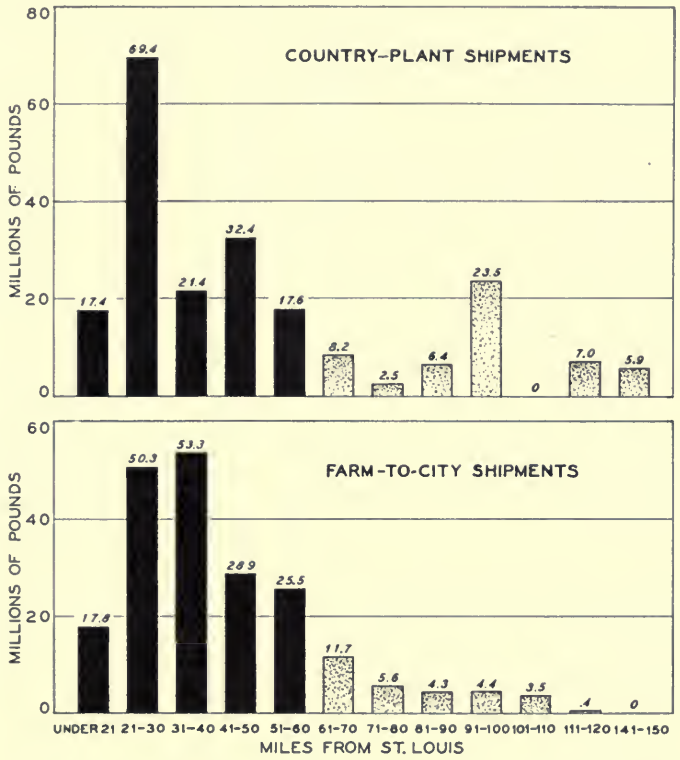

FIG. 7.—VOLUMES OF MILK SHIPPED TO COUNTRY PLANTS AND DIRECT FROM FARM TO CITY FROM DIFFERENT DISTANCES IN THE ST. LOUIS MILKSHED, 1933-34

Four-fifths of the milk in the St. Louis milkshed is produced within 60 miles of the city market, the rest in an area between 60 and 150 miles from St. Louis.

farms 60 to 150 miles from St. Louis (Table 5). The origin of country-plant shipments and farm-to-city shipments by mileage zones is shown graphically in Fig. 7.

Types of Hauling Routes

For convenience of analysis, trucking routes from farms to city plants have been divided into "main-line" routes and "short-line"

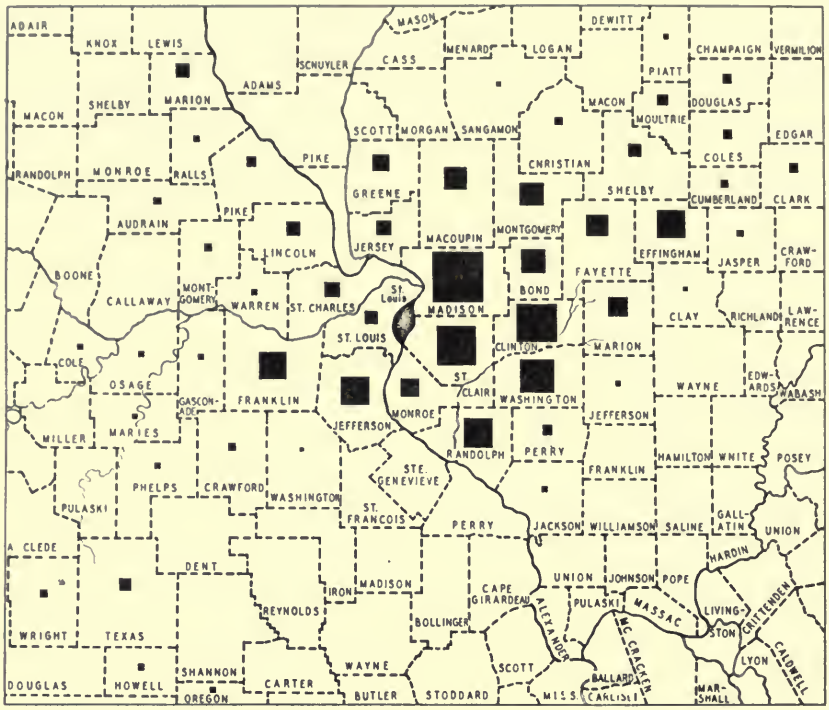

FIG. 8.—RELATIVE MILK PRODUCTION, BY COUNTIES, IN THE ST. LOUIS MILKSHED FROM JUNE, 1933, TO MAY, 1934

The four counties producing the greatest volumes of milk for the St. Louis market were Madison, St. Clair, Clinton, and Washington—all in Illinois. The entire milkshed produced approximately 417 million pounds of milk for this market during this period.

routes. Main-line routes are those on which milk is hauled long distances over trunk-line highways; short-line routes are those on which it is hauled short distances to small dairies just outside St. Louis. Of a total of 491 milk routes included in this study, 329 were farm-to-country-plant routes, 116 were main-line routes from farms to city plants, and 46 were short-line routes from farms to small dairies just outside St. Louis (Table 6). Complete data were available for 382 routes, or for more than three-fourths of the total number of commercial routes operating in the milkshed.

Usually a considerable proportion of the milk hauled by the larger trucks on main-line routes is picked up by "stub" haulers—that is, it is hauled by individuals to a pick-up point. Stub haulers (who usually are farmers located on the stub routes) operate on a commercial basis. Where there are stub haulers, the hauling rate usually includes both

TABLE 6.—NUMBER OF COUNTRY-PLANT, MAIN-LINE, AND SHORT-LINE MILK ROUTES IN THE ST. LOUIS MILKSHED, JULY, 1934

Kind of route	Total number	Routes used in detailed analysis	
		Number	Percent of total
Country-plant	329	244	74.2
Main-line to St. Louis	116	99	85.3
Short-line to St. Louis	46	39	84.8
Total	491	382	77.8

the amount paid to them and that paid to the main-line hauler. Hence in this analysis no attempt was made to separate the cost of stub haulers from the total hauling cost.

Equipment Used for Hauling Milk.—The equipment used for hauling milk on the 491 routes operating in the St. Louis milkshed was as follows: 419 trucks whose capacity was recorded; 16 wagons; 10 automobiles; 2 auto trailers; and 44 trucks whose capacity was not ascertained (Table 7).

About three-fifths (242) of the trucks with recorded capacity were one-and-one-half ton trucks. The other principal sizes were one-ton trucks (53), one-half ton trucks (30), three-ton trucks (30), two-ton trucks (29), and five-ton trucks (25). With two exceptions the three- and five-ton trucks were used in main-line routes to St. Louis.

TABLE 7.—EQUIPMENT USED IN TRANSPORTING MILK ON COMMERCIAL ROUTES FROM FARMS TO COUNTRY AND CITY PLANTS, ST. LOUIS MILKSHED, 1933-34

Equipment	Number of routes using equipment indicated			
	Country-plant routes	Main-line direct-shipper routes	Short-line direct-shipper routes	All routes
Trucks				
¼-ton	1	..	..	1
½-ton	24	..	6	30
¾-ton	3	..	..	3
1-ton	38	3	12	53
1½-ton	197	27	18	242
2-ton	13	14	2	29
3-ton	2	27	1	30
3½-ton	1	..	..	1
4-ton	1	3	..	4
5-ton	..	25	..	25
7-ton	..	1	..	1
Subtotal	280	100	39	419
Other vehicles				
Autos	6	..	4	10
Auto trailers	2	..	..	2
Wagons	16	..	..	16
Vehicles of unknown capacity	25	16	3	44
All vehicles, total	329	116	46	491

Most trucks used for country-plant hauling are of the open-body type; a small number have closed bodies. Horses and wagons have in recent years been rapidly passing out of use.

Most milk now going direct from farms to St. Louis city plants is hauled over main-line routes by three- or five-ton refrigerated trucks. A considerable part of the milk hauled by the heavier trucks is picked up at the farm by stub haulers and either loaded directly on a main-line truck, or placed on a platform, or taken to an unloading point where it is reloaded to a main-line truck. Some milk is hauled on the main-line routes in closed trucks which have no mechanical refrigeration but which use ice to keep the milk cool during the hot months. Photographs of some of these trucks are shown in Fig. 9.

FIG. 9.—A TYPICAL LINE-UP OF VEHICLES AT THE MILK RECEIVING STATION AT HIGHLAND, ILLINOIS

Most trucks used in country-plant hauling are of the open-body type, tho a small number of closed trucks are also on the road. Horses and wagons are still employed in a minor way.

Milk is hauled from country plants to the city by bulk either in tank trucks or in bottles in closed trucks. Frequently a tank truck with a trailer is used, the front tank having a larger capacity than the second. See illustrations in Fig. 11.

Types of Roads on Hauling Routes.—Since milk must be hauled daily without reference to season, the kind of road over which it must be hauled has an important bearing on the problem of transportation. The four principal types of roads, as classified by state highway departments are pavement, gravel and macadam, improved earth, and unimproved earth.

Most pavements in the St. Louis milkshed are constructed of concrete (Fig. 12); a small proportion are built with bricks having concrete shoulders. Most roads in this area classified as gravel or macadam are gravel roads, these for the most part being the typical farm-to-market roads of Missouri (Fig. 13, *top*).

Improved earth roads usually are state-aid roads which have been carefully graded and oiled (Fig. 13, *center*). Unimproved earth roads usually are township roads which have received less care than the

state-aid roads (Fig. 13, *bottom*). During certain seasons of the year earth roads usually are impassable with overloads which are possible on pavement, gravel, and macadam roads.

FIG. 10.—MILK AND MILK CANS IN TRANSIT BETWEEN FARMS AND A MAIN-LINE ROUTE

(Top) A main-line truck receiving milk from the truck of a stub hauler. *(Center left)* A truck on a main-line route picking up milk previously unloaded by stub haulers. *(Center right)* Some farmers do their own hauling to the main-line route, unloading their cans on small platforms. *(Bottom)* Empty cans left by a main-line trucker to be picked up by a stub hauler.

FIG. 11.—THREE TYPES OF MILK TRUCKS IN THE ST. LOUIS MILKSHED

(Top) A refrigerated truck that hauls milk from a country plant to a city plant. *(Center)* A closed truck that hauls bottled milk from Highland to St. Louis. *(Bottom)* A tank truck with trailer hauling milk from country plants to the city. These two tanks have respective capacities of 2,400 and 1,500 gallons.

Complete computations of the mileage and types of roads were made for each of the 382 milk routes analyzed in this study. For 244 country-plant routes the average distance per route was 20.3 miles (Table 8). About two-thirds of this distance was earth road; one-fifth was concrete pavement; and the remainder, about a mile, was gravel and macadam. It is interesting to note that the proportion of earth roads traveled by the hauling routes covered in this study was practically the same as the proportion of unimproved roads for the area as a whole (Tables 4 and 8).

The average distance per route of 99 main-line farm-to-city routes was 100.1 miles. Slightly less than three-fifths of this distance

FIG. 12.—A TRUNK-LINE HIGHWAY IN THE ST. LOUIS MILKSHED

About one-fifth of the roads in the country-plant areas of this milkshed consist of concrete pavement.

TABLE 8.—ONE-WAY MILEAGE OF DIFFERENT TYPES OF ROADS ON COUNTRY-PLANT ROUTES AND DIRECT FARM-TO-CITY ROUTES IN THE ST. LOUIS MILKSHED, 1933-34

Type of road	Country-plant shipments, average of 244 routes		Farm-to-city shipments			
			Average of 99 main-line routes		Average of 39 short-line routes	
	Total miles	Percent of total	Total miles	Percent of total	Total miles	Percent of total
Pavement	5.8	28.6	57.5	57.4	8.1	44.7
Gravel and macadam	.9	4.4	19.2	19.2	.5	2.8
Earth, improved	2.8	13.8	6.4	6.4	2.5	13.8
Earth, unimproved	10.8	53.2	17.0	17.0	7.0	38.7
Total	20.3	100.0	100.1	100.0	18.1	100.0

FIG. 13.—THREE TYPES OF UNPAVED ROADS IN THE COUNTRY-PLANT AREAS OF THE ST. LOUIS MILKSHED

(Top) Well-graveled roads are found mainly on the Missouri side of the river. In the entire milkshed about one mile in twenty is of this type. *(Center)* About one mile in seven is carefully graded and oiled. *(Bottom)* Over half the roads of the area are unimproved, like this one.

was pavement, about one-fifth gravel and macadam, while earth roads constituted over one-fifth of the total mileage.

Short-line routes hauling farm-to-city shipments of milk, while averaging about the same distance as the country-plant routes, had a much higher proportion of pavement. The average distance per route for 39 short-line routes was 18.1 miles. Pavement, gravel, and macadam roads made up three-fifths of this distance and earth roads two-fifths.

Problem Increased by Low Milk Production

The growth of the St. Louis milk market during the past fifteen or twenty years has been accompanied by a large increase in the size of the area from which milk has been procured. Since the selling of

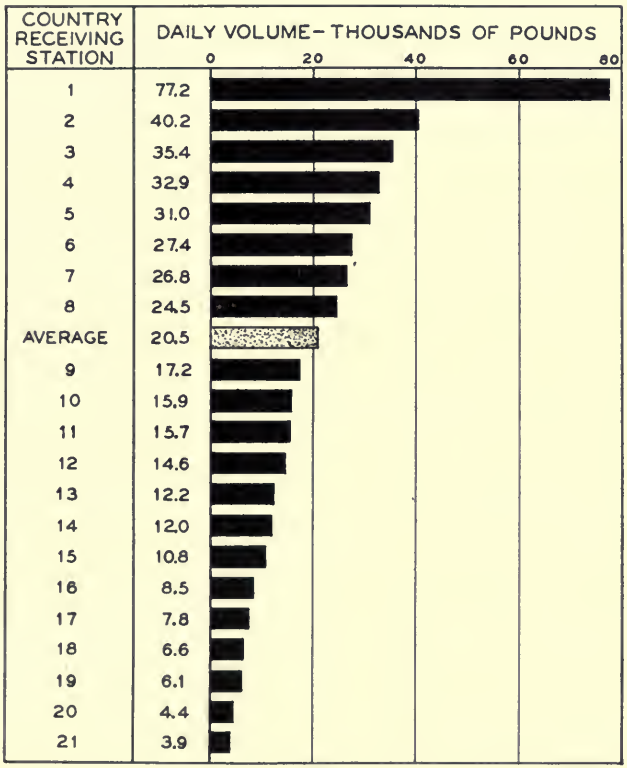

FIG. 14.—AVERAGE DAILY VOLUME OF MILK RECEIVED AT TWENTY-ONE COUNTRY STATIONS IN THE ST. LOUIS MILKSHED, 1933-34

A wide range exists in the volume of milk delivered to different receiving stations in this milkshed. The largest station handled nearly twenty times as much as the smallest stations.

TABLE 9.—DENSITY OF COW POPULATION AND MILK PRODUCTION IN THE ILLINOIS PARTS OF THE CHICAGO AND ST. LOUIS MILKSHEDS, 1935[a]

	Chicago milkshed	St. Louis milkshed	Percent that St. Louis was of Chicago
Average milk production per cow	5 293 pounds	4 075 pounds	77
Average number of cows per square mile	43	25	58
Total milk production per square mile	238 339 pounds	101 753 pounds	43

[a]From U. S. Census of Agriculture, 1935.

milk for market purposes is a new business in many parts of the area, many farmers have no dairy herds. In fact, for most farmers in the milkshed dairying is still a relatively small enterprise. In nearly three-fourths of the herds producing milk in this area there were 8 cows or less per herd in 1933-34, and there were only about half as many cows per square mile as in the Chicago area (Table 9). Likewise production per cow is low, being only about four-fifths of what it is in the Chicago milkshed. As a result of lower production per cow and sparser cow population, only about two-fifths as much milk is produced per square mile in this milkshed as in the Chicago area.

Because of this lack of concentration in milk production, the average volume of milk handled by most country stations in the St. Louis shed is low, averaging about 20,000 pounds daily per station. The range in volume of milk received at different stations is shown graphically in Fig. 14.

To get this small volume a wide area is covered, the average distance included in the country-plant routes being 20.3 miles. And

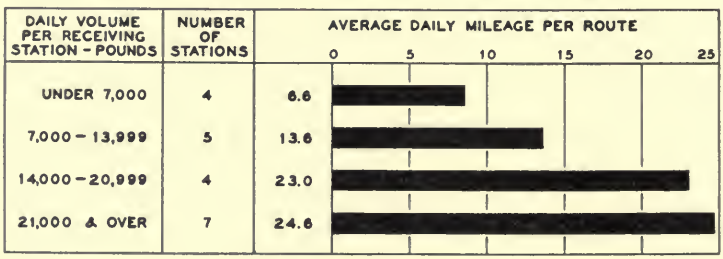

FIG. 15.—VOLUME OF COUNTRY STATION RECEIPTS AS RELATED TO MILEAGE PER ROUTE: TWENTY COUNTRY RECEIVING STATIONS, ST. LOUIS MILKSHED, 1933-34

Milk received at the large-volume stations was hauled a much longer distance than that received at the low-volume stations. Because of the sparse production in this area, long distances must usually be traveled in order to assemble a large volume of milk. (One station which also bottles milk was excluded from this graph.)

usually the higher the average volume per station the greater the average distance per route (Fig. 15). Country-plant routes to stations handling 21,000 pounds or more of milk daily averaged 24.6 miles a day. Routes to stations receiving less than 7,000 pounds daily averaged only 8.6 miles a day.

FIG. 16.—A TYPICAL COUNTRY-PLANT RECEIVING STATION IN THE ST. LOUIS MILKSHED

Most country plants in this milkshed handle a relatively small volume of milk, the average being about 20,000 pounds daily per station. Substantial savings in transportation costs would be made by diverting to these plants a large volume of milk now being sent to St. Louis for processing.

TRANSPORTATION COSTS TO PRODUCERS AND DISTRIBUTORS

Of a total cost of about 1.2 million dollars incurred in hauling milk in the St. Louis milkshed in 1933-34, about four-fifths, or $967,000, was borne directly by farmers (Table 10). The remaining one-fifth, or $255,700, was paid for by the dealers, but was borne indirectly by farmers thru a lower price for milk.

The average rate for hauling milk on 244 routes from farms to country plants was 17.7 cents per 100 pounds; on 99 main-line farm-to-city routes it was 29.3 cents; and on 39 short-line direct routes, 19.7 cents. A summary of the hauling costs paid by farmers and other factors relating to transportation of milk in the St. Louis milkshed is included in Table 11.

In computing hauling costs on routes for which certain data were missing, the hauling rate was assumed to be the same as for similar routes on which information was complete. An estimate of 15 cents per 100 pounds was allowed as the cost to individual farmers hauling to country plants and to main-line routes.

TABLE 10.—TRANSPORTATION COSTS OF MILK PRODUCERS AND DISTRIBUTORS IN THE ST. LOUIS MILKSHED, JUNE, 1933, TO MAY, 1934

	Volume	Rate per 100 pounds	Transportation costs
Cost to producers	*lbs.*	*cents*	
(*a*) From farms to country plants			
244 routes	117 648 957	17.7	$208 023
85 routes[a]	49 900 871	17.7[b]	88 325
Individuals hauling to country plants	44 136 625	15.0[b]	66 205
Subtotal	211 686 453	....	$362 553
(*b*) From farms to city plants			
99 main-line routes	157 583 172	29.3	$462 238
17 main-line routes[a]	20 330 319	32.4	65 964
Individuals hauling to main-line routes	(14 387 036)[c]	15.0[b]	21 581
Individuals hauling to city plants	4 558 258	19.7[b]	8 980
39 short-line routes	16 452 770	19.7	32 412
7 short-line routes[a]	6 751 909	19.7[b]	13 301
Subtotal	205 676 428	....	$604 476
Total transportation costs of producers	.....	....	$967 029
Cost to distributors[d]			
Class I milk	79 531 419	20.0	$159 063
Class II milk	20 417 954	20.0	40 836
Class III milk	111 737 080	5.0	55 869
Total transportation costs of distributors	.....	....	$255 768
Total transportation costs—producers and distributors	.....	....	$1 222 797

[a]Includes routes for which certain data were missing. [b]Estimated. [c]This volume is included in that for the main-line routes. [d]Based upon transportation rates by classes, prevailing in the 31-40-mile zone (Ill. Agr. Exp. Sta. Bul. 412, p. 152, Table 16).

TABLE 11.—SUMMARY OF FACTORS RELATING TO TRANSPORTATION OF MILK IN THE ST. LOUIS MILKSHED, 1933-34

	Country-plant shipments, 244 routes	Farm-to-city shipments	
		Main-line, 99 routes	Short-line, 39 routes
Average number of farm stops per day	15.7	41.4	11.0
Average distance per day	*miles*	*miles*	*miles*
To plant	20.3	100.1	18.1
Round trip	29.7	160.2	26.6
Average volume per day	*lbs.*	*lbs.*	*lbs.*
Per route	1 321	4 361	1 156
Per farm stop	84	105	103
Per mile	65	44	64
Hauling cost to producers			
Per route per day	$ 2.34	$12.79	$ 2.27
Per 100 pounds of milk	.177	.293	.197
Per farm stop per day	.149	.309	.199
Per mile	.079	.080	.085

Distributors' hauling costs were estimated from the transportation rates established for the different classes of milk in the 31-40 mile zone, which is the mid-zone in the St. Louis milkshed.

Under normal conditions hauling rates to farmers vary but little from year to year. In 1934-35 the rates in the St. Louis milkshed were only one-eighth of one percent less than in 1933-34. Because of this slow rate of change, the period during which a transportation study remains useful is materially extended.

TABLE 12.—HAULING RATES PAID BY PRODUCERS ON 244 COUNTRY-PLANT ROUTES IN THE ST. LOUIS MILKSHED, 1933-34

Miles to plant[a]	Number of routes	Average rate on each route (*cents per 100 lbs.*)	Average rate per route
1	2	15, 15	15.0
3	5	5, 10, 15, 15, 15	12.0
4	8	10, 14, 15, 15, 15, 15, 20, 25	16.1
5	11	10, 10, 10, 11, 15, 20, 20, 20, 20, 25, 26	17.0
6	8	12, 12, 14, 15, 15, 15, 17, 25	15.7
7	3	15, 17, 24	18.7
8	6	12, 14, 15, 15, 16, 25	16.1
9	9	12, 15, 15, 15, 15, 20, 21, 25, 25	18.1
10	11	11, 12, 15, 15, 15, 15, 20, 20, 20, 22, 25	17.3
11	15	11, 14, 15, 15, 15, 17, 18, 19, 20, 20, 20, 20, 20, 20, 20	17.6
12	15	13, 13, 14, 14, 14, 15, 15, 16, 20, 20, 20, 21, 24, 30, 30	18.7
13	15	10, 13, 15, 15, 15, 15, 16, 17, 20, 20, 20, 20, 20, 21, 25	17.4
14	9	13, 14, 14, 15, 15, 15, 20, 21, 25	16.9
15	8	12, 15, 15, 19, 20, 20, 20, 22	17.8
16	7	14, 15, 17, 20, 20, 20, 25	18.7
17	3	14, 15, 20	16.4
18	5	10, 14, 17, 20, 20	16.3
19	4	13, 15, 20, 25	18.2
20	5	15, 15, 15, 16, 23	16.7
21	4	14, 15, 18, 20	16.8
22	6	15, 17, 20, 20, 24, 25	20.0
23	5	15, 20, 20, 20, 20	19.1
24	5	14, 19, 20, 20, 25	19.5
25	10	15, 18, 20, 20, 20, 21, 24, 25, 25, 25	21.3
26	3	15, 20, 20	18.3
27	3	15, 15, 20	16.7
28	7	15, 15, 17, 20, 20, 25, 25	19.5
29	6	16, 20, 20, 20, 20, 25	20.2
30	3	15, 15, 18	16.0
31	2	20, 20	20.0
32	2	15, 23	19.1
33	4	15, 15, 15, 19	15.9
34	1	25	25.0
35	2	14, 20	17.0
36	5	14, 15, 20, 25, 29	20.6
37	3	11, 25, 30	22.1
38	1	23	23.0
39	1	20	20.0
40	1	25	25.0
43	1	25	25.0
44	2	20, 25	22.2
45	1	10	10.0
46	1	24	24.0
52	1	15	15.0
53	1	20	20.0
54	1	10	10.0
55	2	18, 23	20.6
56	4	7, 15, 20, 25	16.6
59	1	25	25.0
60	1	20	20.0
63	1	29	29.0
65	1	17	17.0
67	1	20	20.0
75	1	20	20.0
90	1	22	22.0
Weighted average of all routes			17.7

[a]Each whole number includes fractional parts of a mile.

Wide Inequalities in Hauling Rates

Rates paid by farmers for hauling milk in the St. Louis milkshed vary widely without apparent reason. While the cost of operating a trucking route increases materially as mileage increases, rates paid for hauling milk long distances on the country-plant and short-line routes averaged only slightly higher than rates paid for short hauls.

The total distance per route in the 244 country-plant routes varied from 1 mile to 90 miles and averaged 20.3 miles. The average hauling rate per route varied from 5 cents to 30 cents per 100 pounds, the average being 17.7 cents. The gross inequalities existing between rates and the distance the milk is hauled are shown in Tables 12, 13 and 14. For example, on the 15 country-plant routes which traversed 12 miles

TABLE 13.—HAULING RATES PAID BY PRODUCERS ON 99 MAIN-LINE ROUTES IN THE ST. LOUIS MILKSHED, 1933-34

Miles to plant	Number of routes	Average rate on each route (*cents per 100 lbs.*)	Average rate per route
21- 30	1	40	40.0
31- 40	3	20, 25, 32	25.7
41- 50	7	15, 15, 21, 22, 24, 25, 25	21.0
51- 60	9	7, 19, 20, 25, 25, 25, 30, 30, 32	23.7
61- 70	13	15, 21, 22, 23, 25, 25, 25, 25, 28, 30, 30, 30, 32	25.5
71- 80	9	17, 21, 25, 25, 26, 27, 28, 29, 35	25.9
81- 90	10	24, 25, 25, 27, 29, 30, 30, 31, 31, 39	29.1
91-100	5	21, 25, 26, 30, 38	28.0
101-110	8	25, 28, 30, 30, 31, 34, 34, 36	31.0
111-120	2	31, 34	32.5
121-130	8	15, 22, 22, 35, 36, 40, 41, 41	31.5
131-140	7	24, 25, 26, 26, 30, 42, 55	32.6
141-150	4	27, 38, 40, 40	36.2
151-160	1	38	38.0
161-170	1	34	34.0
181-190	4	36, 42, 43, 49	42.5
191-200	1	25	25.0
201-210	4	30, 33, 43, 50	39.0
231-240	1	47	47.0
251-260	1	36	36.0
Weighted average of all routes			29.3

TABLE 14.—HAULING RATES PAID BY PRODUCERS ON 39 SHORT-LINE ROUTES IN THE ST. LOUIS MILKSHED, 1933-34

Miles to plant	Number of routes	Average rate on each route (*cents per 100 lbs.*)	Average rate per route
0- 4	2	10, 15	12.5
5- 9	9	10, 10, 13, 15, 15, 15, 20, 21, 25	16.0
10-14	9	15, 19, 20, 20, 20, 20, 25, 25, 25	21.0
15-19	5	15, 20, 20, 25, 25	21.0
20-24	4	15, 20, 20, 25	20.0
25-29	5	15, 19, 19, 20, 25	19.6
30-34	2	15, 16	15.5
35-39	1	10	10.0
50-54	1	24	24.0
65-69	1	28	28.0
Weighted average of all routes			19.7

TABLE 15.—CORRELATION COEFFICIENTS FOR HAULING RATE AND VOLUME OF MILK, MILEAGE, AND TYPE OF ROAD ON 382 MILK ROUTES IN THE ST. LOUIS MILKSHED, 1933-34

Factors	Coefficients of correlation*		
	Country-plant shipments 244 routes	Farm-to-city shipments	
		99 main-line routes	39 short-line routes
Mileage per route and hauling rate	.27 ± .04	.59 ± .04	.33 ± .09
Daily volume per route and hauling rate	−.20 ± .04	−.05 ± .07	.24 ± .10
Proportion of earth road and hauling rate per mile	.12 ± .04	.13 ± .07	−.07 ± .11

*If the factors compared were perfectly related, the correlation would be 1.00.

(Table 12), rates ranged from 13 cents to 30 cents per 100 pounds. Likewise there was practically no relation between mileage and hauling rate on the country-plant and short-line routes (Table 15).

Tho hauling rates were somewhat higher on the longer main-line routes, wide variations in the rates charged for the same distances existed on these routes also. In the 61-70 mile zone, for example, rates varied from 15 to 32 cents per 100 pounds (Table 13).

Rates Not Related to Type of Road or Load

One might expect that the higher the proportion of earth roads in the distance traveled, the higher would be the hauling rate. On the routes studied, however, practically no relation was found between hauling rate and proportion of earth road (Table 15).

Neither was any relation found between hauling rate and volume

TABLE 16.—MILES OF DIFFERENT TYPES OF ROAD TRAVELED BY TRUCKS OF VARIOUS CAPACITIES IN HAULING MILK FROM FARMS TO COUNTRY PLANTS, ST. LOUIS MILKSHED, 1933-34

Type of road	Miles traveled per truck				Percent of total mileage
	Trucks under 1½ tons (49)*	Trucks of 1½ tons (136)*	Trucks over 1½ tons (17)*	All trucks (202)*	
Pavement	2.3	7.6	6.7	6.2	28.3
Gravel and macadam	1.1	1.0	1.0	1.0	4.6
Earth, improved	2.1	3.0	4.4	2.9	13.2
Earth, unimproved	6.7	13.3	14.1	11.8	53.9
Total	12.2	24.9	26.2	21.9	100.0
Proportion earth-road mileage was of total	72.1%	65.5%	70.6%	67.1%	....

*Number of trucks.

of milk hauled. The most efficient (lowest-cost) routes are, of course, those on which full loads are hauled, yet practically no difference existed, on the average, between rates for full loads and rates for small loads (Table 15).

Rate Adjustments on Country Deliveries

On milk shipments made from farms to city plants, farmers pay directly the total transportation cost. On country-plant shipments they bear the cost to the plant, and the distributor the cost to the city plant and the cost of the country-plant operations. Milk prices paid at country plants by distributors are based on f.o.b. city prices less deductions made according to class of milk delivered and distance from country plant to city. These deductions are shown in Table 17.

TABLE 17.—ESTABLISHED DEDUCTIONS FROM DISTRIBUTORS' MILK PRICES f.o.b. ST. LOUIS FOR MILK DELIVERED TO COUNTRY PLANTS, 1936[a]

Zone	Distance from St. Louis	Deductions per 100 pounds	
		Class I milk	Class II milk
	miles	*cents*	*cents*
1	20	16	15
2	21- 30	18	15
3	31- 40	20	15
4	41- 50	21	15
5	51- 60	22	15
6	61- 70	23	15
7	71- 80	24	15
8	81- 90	25	15
9	91-100	26	15
10	101-110	27	15
11	111-120	28	15
12	121-130	29	15
13	131-140	30	15
14	141-150	31	15
15	151-160	32	15

[a]These differentials became effective in February, 1936.

Producers shipping milk to country plants receive the f.o.b. city price less established deductions. For distances of 31 to 40 miles from St. Louis, the mid-zone of the milkshed, the deductions from f.o.b. city price are (1936) 20 cents per 100 pounds for Class I milk and 15 cents for Class II milk. Deductions for Class I milk increase 1 cent for each additional 10 miles from St. Louis, whereas for Class II milk a deduction of 15 cents has been established for all distances.

During the first fourteen months of federal marketing agreements, milk in the St. Louis market was sold in three classifications. The deduction effective in August, 1934, for both Class I and Class II milk in the 31-40 mile zone was 20 cents per 100 pounds, and for Class III milk it was 5 cents.[1] In February, 1936, under the federal marketing

[1]Ill. Agr. Exp. Sta. Bul. 412, 1935, p. 152, Table 16.

order, Class II and III milk were combined into one class and a rate of 15 cents established for Class II milk in all country-plant zones.

As stated, a considerable part of the country-plant milk in the St. Louis milkshed is hauled by tank trucks to city receiving plants. The cost of tank-truck operations in the 31-40-mile zone of the New York milkshed averaged 12.8 cents per 100 pounds in 1932-33. The deduction in this zone was 20 cents. Assuming that the tank-truck operating costs in the St. Louis milkshed are about the same as in the New York shed, the net difference of 7.2 cents would be part of the deduction allowed toward the cost of country-plant operation (Table 18). The

TABLE 18.—DEDUCTIONS FOR CLASS I MILK DELIVERED TO COUNTRY PLANTS IN THE ST. LOUIS MILKSHED COMPARED WITH TANK-TRUCK OPERATING COSTS IN THE NEW YORK MILKSHED

Miles	Class I deductions from f.o.b. prices at St. Louis[a]	Cost of operating tank trucks in New York milkshed[b]	Net difference toward cost of country-plant operation
	cents per 100 lbs.	*cents per 100 lbs.*	*cents*
Up to 20	16	11.6	4.4
21- 30	18	12.2	5.8
31- 40	20	12.8	7.2
41- 50	21	13.4	7.6
51- 60	22	14.0	8.0
61- 70	23	14.5	8.5
71- 80	24	15.8	8.2
81- 90	25	17.1	7.9
91-100	26	18.4	7.6
101-110	27	20.4	6.6
111-120	28	22.5	5.5
121-130	29	24.5	4.5
131-140	30	25.6	4.4
141-150	31	26.7	4.3
Weighted average difference	....	....	6.6

[a]Table 17. [b]Table 3. Costs for smaller mileage zones were arrived at by interpolation.

difference between deductions on Class I milk and tank-truck costs, weighted by the volume of country-plant milk in each zone, averaged 6.6 cents per 100 pounds. The proportion of milk manufactured in the country plants in the more distant zones of the milkshed, however, is somewhat higher than in the nearer zones; hence the actual amount allowed for country-plant operations on Class I milk would probably be more than 6.6 cents.

COST OF OPERATING MILK TRUCKS

While milk producers are interested in hauling rates being kept low, since hauling costs absorb so large a proportion of their income from milk, it is also to their interest that truckers be paid a reasonable rate for their services, for a trucker whose charges do not cover his labor and operating costs is bound to be a discontented and disturbing influence in any market.

Ohio Area Furnishes Truck Cost Records

To establish rates at levels that are fair to both farmer and trucker, complete records of hauling costs are a necessity. A few truckers in the St. Louis milkshed keep such records, but these were not available for comparison and analysis. Records were available, however, on the cost of operating 25 trucks in the Dayton, Ohio, milkshed in 1934, and these were made accessible to the authors thru the courtesy of the milk producers' association in that area. The study was limited to an analysis of the factors influencing the operating costs of 19 one-and-one-half ton trucks.

The 19 trucks traveled a yearly distance of 28,144 miles, as an average, and hauled an average yearly load of 1,171,529 pounds of

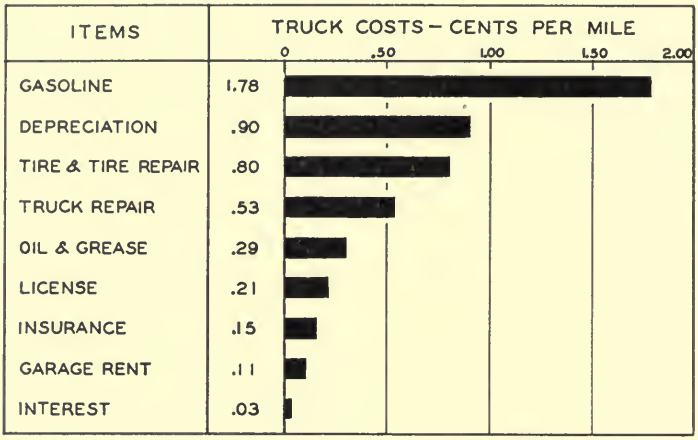

FIG. 17.—DISTRIBUTION OF OPERATING COSTS OF 19 ONE-AND-ONE-HALF-TON TRUCKS IN THE DAYTON MILKSHED IN 1934

Exclusive of driver costs, the average cost per mile to operate these 19 trucks was 4.8 cents. Gasoline made up 37 percent of the cost; depreciation and tire replacement and repair together about an equivalent percentage.

milk. The daily load averaged 3,210 pounds and the daily trip 77.1 miles. The average operating cost, exclusive of driver, was 4.8 cents a mile.

Gasoline, the largest single item, cost slightly less than 2 cents a mile, constituting about two-fifths of the total operating cost (Fig. 17). Depreciation was equal to half the gasoline cost, averaging nearly 1 cent a mile. Tires and truck repairs averaged 1⅓ cents a mile, constituting not quite one-fourth of the total operating cost. Truck repairs cost about ½ cent a mile; oil and grease slightly over ¼ cent a mile. Insurance, garage rent, and interest together absorbed about ½ cent a mile, or about one-tenth of the total cost.

Depreciation and Repairs Main Cost Differences

The cost of operating the Dayton trucks varied widely—from 2.9 cents to 6.1 cents a mile (Fig. 18). Depreciation and truck repairs were the most variable items, averaging for the six most efficient trucks nearly 1 cent a mile lower than for the six least efficient (Table 19). Gas, oil, and grease for the low-cost group averaged about ⅓ cent a

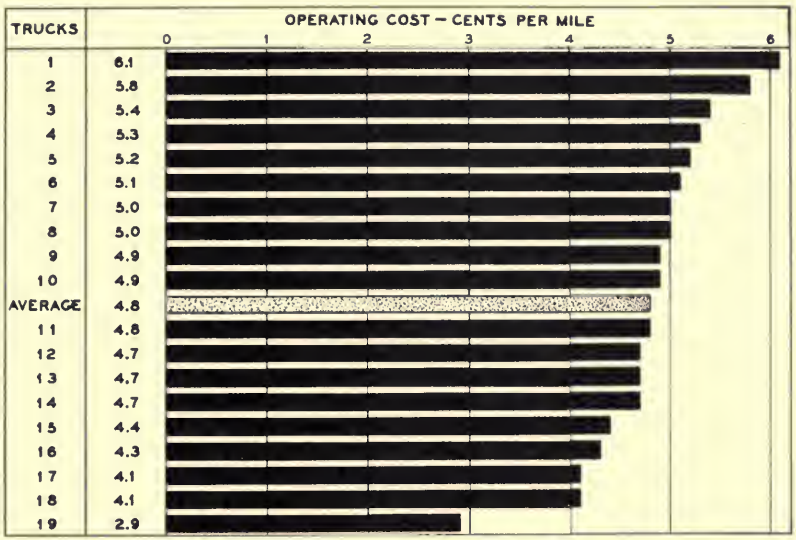

FIG. 18.—MILE COST OF OPERATING 19 ONE-AND-ONE-HALF-TON TRUCKS IN THE DAYTON MILKSHED IN 1934

The most efficient truck was operated at a cost of 2.9 cents a mile, or for less than half as much as the least efficient truck, which cost 6.1 cents a mile to operate.

TABLE 19.—COST OF OPERATING ONE-AND-ONE-HALF-TON TRUCKS IN THE DAYTON MILKSHED, 1934[a]

Expense item	Average cost per mile		
	6 least efficient trucks	6 most efficient trucks	Average of 19 trucks
	cents	*cents*	*cents*
Gas, oil, and grease	2.23	1.87	2.07
Depreciation and truck repair	1.87	.96	1.38
Tires, and tire repairs	.74	.74	.84
License, insurance, interest, and garage rent	.59	.46	.53
Total cost	5.43	4.03	4.82
Average annual distance per truck, miles	27 740	25 611	28 144

[a]Data for this table and for Figs. 17 and 18 obtained thru courtesy of Miami Valley Cooperative Milk Producers Association, Dayton, Ohio.

mile less than for the high-cost group. Fixed costs, such as license, insurance, interest, and garage rent, were slightly higher for the high-cost group of trucks.

Since certain important items of cost, such as depreciation, insurance, interest, and license are fixed, it might be expected that the unit cost of operation would be higher for the trucks traveling the shorter distances. As a matter of fact, however, the low-cost group averaged about 2,100 miles a year less than the high-cost group. Hence differences in distance traveled were not the cause of the differences in unit operating costs between the low-cost and high-cost groups of trucks.

Cost Records Needed in St. Louis Area

Costs for trucking have been shown to vary widely in the Dayton milkshed. Costs in the St. Louis milkshed probably vary just as widely as in the Dayton area, if not more widely, for there are fully as great differences in the factors causing these variations. Some complete records of truck-operating costs in the St. Louis area are necessary in order to ascertain how such costs can be lowered and as a guide to the determination of hauling rates that will be fair to both farmers and truckers.[1]

Pick-Up Charge Desirable on Small Shipments

A certain cost, comparable to the terminal cost of a railroad, is incurred for the daily hauling service rendered each producer on a trucking route regardless of the volume of milk procured. When a producer has a very small volume, the hauling charge at the usual hundred-pound rate frequently falls below the actual cost of the hauling service. To remedy this situation in the Dayton milkshed, a minimum pick-up charge of 10 cents is made whenever the daily average hauling charge at the regular rate drops below 10 cents a day.

While a fair minimum pick-up charge in the St. Louis milkshed might differ from that in the Dayton milkshed, it is recommended that consideration be given to establishing such a charge.

WAYS TO REDUCE HAULING COSTS

That material savings in hauling costs and greater economic stability in the transportation system can be effected by certain changes is indicated by the data obtained in this study.

These changes are: (*1*) reducing the distance that milk is hauled; (*2*) increasing the volume per load with present seasonal production; (*3*) increasing the volume per load by narrowing the present range in

[1]To facilitate the keeping of records of truck costs a book has been prepared by the Department of Agricultural Economics, University of Illinois, and will be sent on request with full information relative to the keeping and analyzing of such costs.

TABLE 20.—AVERAGE VOLUME OF MILK PER ROUTE (LOAD) AS RELATED TO NUMBER OF FARM STOPS: 244 COUNTRY-PLANT ROUTES IN THE ST. LOUIS MILKSHED, 1933-34

Number of farm stops per route	Number of routes	Average daily volume of each route (*hundreds of pounds*)	Average daily volume per route
1	4	.5, .9, 1.0, 1.3	.9
2	5	.9, 1.1, 1.9, 1.9, 3.3	1.8
3	7	1.9, 2.5, 2.7, 2.9, 3.2, 3.2, 9.7	3.7
4	10	1.7, 2.0, 2.5, 3.2, 3.3, 3.6, 3.9, 4.4, 4.6, 5.8	3.5
5	7	3.2, 3.4, 3.8, 4.2, 5.1, 6.0, 6.4	4.6
6	15	3.3, 3.3, 3.4, 3.5, 4.2, 4.6, 4.7, 5.4, 5.8, 6.5, 6.6, 6.7, 7.8, 7.9, 8.2	5.5
7	13	3.0, 4.5, 5.7, 6.0, 6.3, 6.6, 6.6, 7.0, 7.8, 10.2, 11.1, 13.7, 14.8	7.9
8	9	4.0, 6.1, 6.9, 7.1, 7.2, 8.0, 8.7, 9.0, 13.9	7.9
9	6	6.8, 8.6, 9.9, 10.0, 10.2, 10.2	9.3
10	10	6.5, 6.6, 7.7, 10.6, 12.7, 12.7, 13.3, 13.7, 13.8, 14.9	11.2
11	9	5.0, 9.0, 9.8, 9.9, 10.1, 10.8, 11.9, 14.9, 16.4	10.9
12	17	6.3, 6.7, 8.5, 8.7, 8.9, 8.9, 9.7, 10.1, 11.3, 11.5, 12.4, 13.3, 13.6, 14.1, 15.6, 17.1, 17.4	11.4
13	7	5.9, 8.6, 9.0, 9.5, 12.1, 12.3, 20.2	11.1
14	12	6.0, 7.8, 8.1, 8.5, 8.6, 9.2, 13.5, 15.0, 15.6, 16.7, 18.2, 19.0	12.2
15	10	10.8, 12.4, 12.7, 13.3, 16.3, 18.4, 18.7, 20.4, 23.2, 28.1	17.4
16	13	7.3, 10.8, 12.6, 13.4, 13.8, 14.8, 15.0, 15.1, 16.9, 17.9, 19.5, 20.6, 22.2	15.3
17	12	8.7, 11.7, 12.0, 12.7, 13.6, 13.8, 15.1, 15.4, 18.4, 18.4, 19.3, 22.1	15.1
18	8	7.4, 10.8, 11.8, 13.6, 13.8, 14.7, 16.6, 24.6	14.2
19	5	9.8, 10.2, 11.3, 17.5, 25.6	14.9
20	4	11.0, 11.4, 16.4, 27.2	16.5
21	11	10.8, 12.0, 12.3, 13.0, 13.2, 15.1, 15.5, 19.9, 23.4, 25.7, 31.0	17.4
22	6	10.1, 15.0, 16.4, 16.9, 21.8, 28.7	18.1
23	2	12.8, 15.2	14.0
24	3	13.2, 19.6, 26.7	19.8
25	3	16.3, 20.0, 22.8	19.7
26	6	12.8, 14.3, 14.7, 15.2, 20.8, 29.1	17.8
27	3	20.0, 20.4, 28.3	22.9
28	1	16.7	16.7
29	1	21.4	21.4
30	1	17.0	17.0
31	2	23.7, 28.9	26.3
32	2	23.5, 28.0	25.8
33	3	22.7, 23.6, 30.4	25.6
34	1	17.4	17.4
35	2	17.3, 34.1	25.7
36	1	22.6	22.6
39	2	16.9, 25.0	21.0
40	1	23.1	23.1
42	1	34.8	34.8
44	1	42.9	42.9
46	2	24.4, 25.8	25.1
47	2	33.4, 34.8	34.1
48	1	31.0	31.0
52	1	44.2	44.2
55	1	46.6	46.6
56	1	30.4	30.4
Weighted average of all routes			13.21

seasonal production; (*4*) keeping in the country the direct-shipped milk now used for manufacture; and (*5*) avoiding unnecessary delays in unloading milk at the receiving stations.

Reducing Mileage and Increasing the Load

The greatest opportunity for effecting savings and bringing about economic stability in the transportation of milk in the St. Louis milkshed lies in the first two directions indicated above; namely, reducing the distance that milk is hauled and increasing the volume of milk per

load. This fact is shown in a study of 382 routes operating in the St. Louis milkshed. Analysis of the factors upon which a high volume per load depends disclosed the following:

Larger Loads Usually on Routes With Most Stops.—On the majority of the 382 routes studied, the larger loads were obtained on the routes with the greatest number of farm stops, as shown in Tables 20 and 21.

The 244 country-plant routes with an average of 15.6 farm stops per route hauled an average daily load of 1,321 pounds. The five routes with the fewest stops averaged loads of less than 100 pounds daily, and the five with the most stops averaged 3,740 pounds. While the volume per load varied considerably on routes having the same number of farm stops, it was largely dependent upon the number of stops made rather than upon average production per stop. This is shown by the statistical analysis in Table 21. If the volume per load were entirely dependent upon the number of farm stops made, the coefficient of correlation would be 100. The actual coefficients were: for the 244 country-plant routes, 81 percent; for the 99 main-line routes, 82 percent; and for the 39 short-line routes, 92 percent (Table 21), all showing a high degree of correlation between number of farm stops and volume per load.

Larger Loads Usually on Longer Routes.—On the majority of country-plant and short-line routes, the volume of milk per load showed definite relation to the distance traveled (Tables 21 and 22). As stated, the loads on the 244 country-plant routes averaged 1,321 pounds a day. Five routes traveling 3 miles or less a day averaged 172 pounds daily, whereas the five routes traveling the longest distance averaged 3,330 pounds.

On the 39 short-line routes the volume per load was even more closely associated with distance traveled than it was on the country-

TABLE 21.—CORRELATION COEFFICIENTS FOR VOLUME OF MILK AND NUMBER OF FARM STOPS AND MILEAGE, ON 382 MILK ROUTES IN THE ST. LOUIS MILKSHED, 1933-34

Factors	Coefficients of correlation[a] for—		
	Country-plant shipments on 244 routes	Farm-to-city shipments	
		99 main-line routes	39 short-line routes
Farm stops per day and daily volume per route	.81 ± .01	.82 ± .02	.92 ± .02
Farm stops per mile and daily volume per mile	.69 ± .02	.54 ± .06	.78 ± .04
Mileage per route and daily volume per route	.63 ± .03	.47 ± .05	.81 ± .04

[a] If the factors compared were perfectly related, the correlation would be 1.00.

TABLE 22.—AVERAGE VOLUME OF MILK PER ROUTE (LOAD) AS RELATED TO MILES PER ROUTE: 244 COUNTRY-PLANT ROUTES IN THE ST. LOUIS MILKSHED, 1933-34

Miles	Number of routes	Average daily volume of each route (*hundreds of pounds*)	Average daily volume per route
1	1	2.0	2.0
2	1	.5	.5
3	3	.9, 1.9, 3.3	2.0
4	10	1.3, 1.9, 2.7, 3.2, 3.3, 4.4, 4.7, 5.1, 6.5, 8.2	4.1
5	6	1.0, 3.2, 3.3, 3.4, 3.6, 3.9	3.1
6	13	.9, 1.7, 2.9, 3.2, 3.4, 3.8, 4.6, 6.0, 7.0, 7.8, 7.9, 14.8, 14.9	6.1
7	3	5.4, 9.9, 12.7	9.3
8	7	3.0, 5.8, 6.5, 11.1, 17.4, 18.4, 25.4	12.5
9	4	2.5, 6.3, 6.6, 8.6	6.0
10	16	1.9, 4.5, 6.7, 7.3, 7.7, 8.9, 9.2, 9.7, 9.8, 10.6, 11.9, 12.7, 13.3, 13.7, 13.8, 18.7	10.0
11	11	3.4, 3.5, 4.2, 5.0, 5.7, 6.1, 6.8, 7.8, 9.0, 10.8, 16.7	7.2
12	18	1.2, 6.7, 6.9, 8.5, 8.6, 8.7, 8.7, 9.0, 9.7, 10.1, 10.8, 12.0, 12.7, 13.6, 16.3, 18.4, 19.5, 22.1	11.3
13	4	9.5, 12.4, 12.4, 16.9	12.8
14	20	3.2, 4.0, 4.2, 4.6, 6.0, 6.6, 7.2, 8.9, 9.8, 10.2, 10.2, 11.5, 13.7, 14.7, 15.6, 18.2, 19.3, 25.7, 27.2, 42.9	13.2
15	5	5.8, 10.1, 10.9, 15.1, 20.4	12.5
16	10	6.5, 8.5, 10.8, 12.8, 13.3, 13.6, 14.1, 16.4, 17.5, 20.6	13.4
18	8	8.6, 9.9, 12.3, 13.9, 17.1, 19.6, 20.2, 25.6	15.9
19	1	23.2	23.2
20	9	5.9, 10.1, 11.3, 13.8, 13.8, 15.0, 22.2, 23.7, 24.6	15.6
21	3	6.0, 10.8, 13.8	10.2
22	7	8.0, 9.0, 12.8, 23.5, 23.5, 26.7, 28.1	18.8
23	2	6.3, 18.4	12.4
24	9	7.9, 12.7, 15.0, 15.1, 15.4, 17.0, 20.5, 21.4, 29.1	17.1
25	5	8.5, 10.2, 12.1, 15.2, 16.9	12.6
26	9	11.4, 12.0, 12.3, 13.0, 13.3, 15.1, 16.3, 28.9, 31.0	17.0
27	3	8.7, 15.6, 20.8	15.0
28	6	6.6, 13.2, 13.3, 15.0, 20.0, 31.0	16.5
29	2	23.6, 25.0	24.3
30	7	11.3, 13.5, 16.4, 16.7, 19.0, 22.6, 22.8	17.5
31	1	28.0	28.0
32	4	11.7, 13.6, 16.6, 21.8	15.9
33	1	22.7	22.7
34	2	10.1, 25.8	17.9
35	1	14.7	14.7
36	6	6.6, 7.1, 11.9, 13.4, 19.9, 28.7	14.6
38	4	7.4, 14.3, 15.2, 16.9	13.4
39	1	11.0	11.0
40	1	24.0	24.0
44	3	10.1, 16.4, 17.4	14.6
45	1	34.1	34.1
46	1	12.6	12.6
52	1	20.0	20.0
54	2	14.8, 34.8	24.8
55	2	17.3, 28.3	22.8
56	2	30.4, 30.5	30.4
59	1	19.5	19.5
60	1	33.4	33.4
61	1	15.5	15.5
63	1	34.8	34.8
66	1	23.1	23.1
67	1	17.9	17.9
75	1	46.6	46.6
90	1	44.2	44.2
Weighted average of all routes			13.21

plant routes. On the 99 main-line routes it was less dependent upon distance traveled than it was on either the country-plant or the short-line routes. This contrast is explained by the fact that a considerable proportion of the milk hauled by the larger trucks on the main-line routes is picked up by stub haulers. Many of these main-line routes are controlled by a company that makes definite effort to obtain full loads on each truck and to reduce to the minimum the duplication of

routes. This has tended to keep low the distance traveled by truckers in the areas closer to St. Louis without reducing the size of the load.

While volume per load on these routes depended principally upon the number of farm stops made, and the number of farm stops depended in turn upon distance traveled, stops per mile were much more concentrated on certain sections of these routes than on others.

Since a full load is dependent primarily upon a large number of farm stops, and since the number of farm stops per mile on the different routes has averaged about the same, two ways for effecting savings are: (*1*) to increase, when possible, the number of farm stops per mile; and (*2*) to increase the number of farm stops per route so that each route will operate more nearly at full capacity. Thoro revision of hauling routes, as discussed on pages 460 to 464, is the answer to the question as to how these two steps might be accomplished.

More Even Seasonal Production

Increasing hauling efficiency by reducing the distance milk is hauled and increasing the volume of milk per load has been discussed. It has

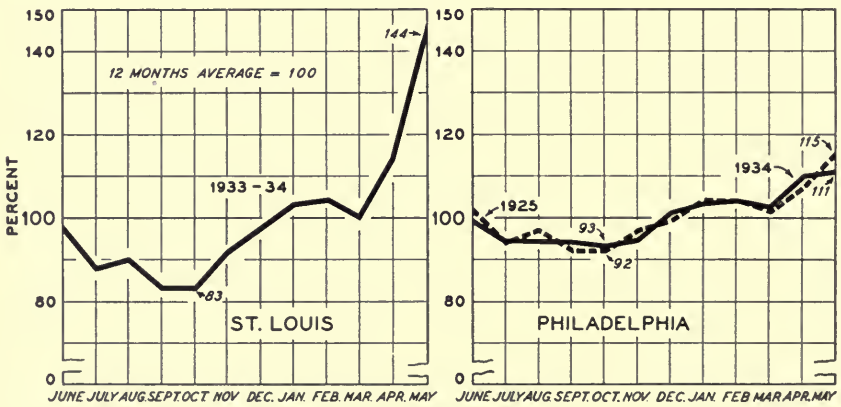

FIG. 19.—MONTHLY VARIATION IN MILK PRODUCTION IN THE ST. LOUIS AND PHILADELPHIA MILKSHEDS

The low seasonal variation in the Philadelphia milkshed shows what can be done to smooth out the peaks and slumps in the milk production of an area. In the St. Louis milkshed the seasonal range is nearly two and one-half times that in the Philadelphia area.

been indicated that the volume per load in the St. Louis area could be increased even with the present wide seasonal variation in production.

Further savings in transportation costs can be made, however, by narrowing the seasonal fluctuations in the volume of milk marketed. Since trucks must have sufficient capacity to carry each day's volume

in the month of highest production, it follows that a wide seasonal variation in volume marketed is bound to result in idle truck capacity during many months of the year. When seasonal fluctuations are narrowed, the average volume per load can be increased.

High Seasonal Variation in St. Louis Area.—More than fifteen years ago in the Philadelphia milkshed definite plans were started to narrow the fluctuations in the seasonal production of milk. Such rapid progress was made that a difference of 54 points between the index for the month of high production and that for the month of low production in 1921 was narrowed to 23 points in 1925[1] and to 18 points in 1934.[2]

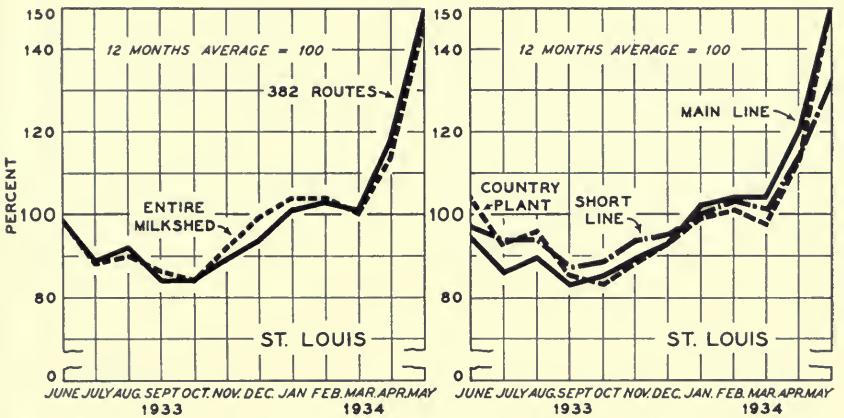

FIG. 20.—MONTHLY VARIATIONS IN MILK PRODUCTION IN THE ST. LOUIS MILKSHED

(Left) Changes on 382 milk routes included in this study and changes in the entire milkshed, showing how representative the sample routes were. *(Right)* Data for the 382 routes broken down to show variations in different types of routes. On the short-line routes the seasonal range was somewhat narrower than on either of the other two types of routes.

In contrast production in the St. Louis milkshed ranged in 1933-34 from 83 percent of the year's average in October to 144 percent in May, a net spread of 61, which is more than three times the spread in the Philadelphia area in 1934. In 1935-36 the spread between the high month and the low month in the St. Louis milkshed was 54, and in the high month (May, 1936) it was somewhat lower than usual because of the drouth. These facts are shown graphically in Fig. 19.

Idle Truck Capacity Results From Uneven Production.—In order to show the extent of the idle truck capacity in the St. Louis milkshed

[1]Penn. Agr. Exp. Sta. Bul. 208, 1926, p. 27, Table 11. [2]Penn. Agr. Exp. Sta. Bul. 327, 1936, p. 37, Table 19.

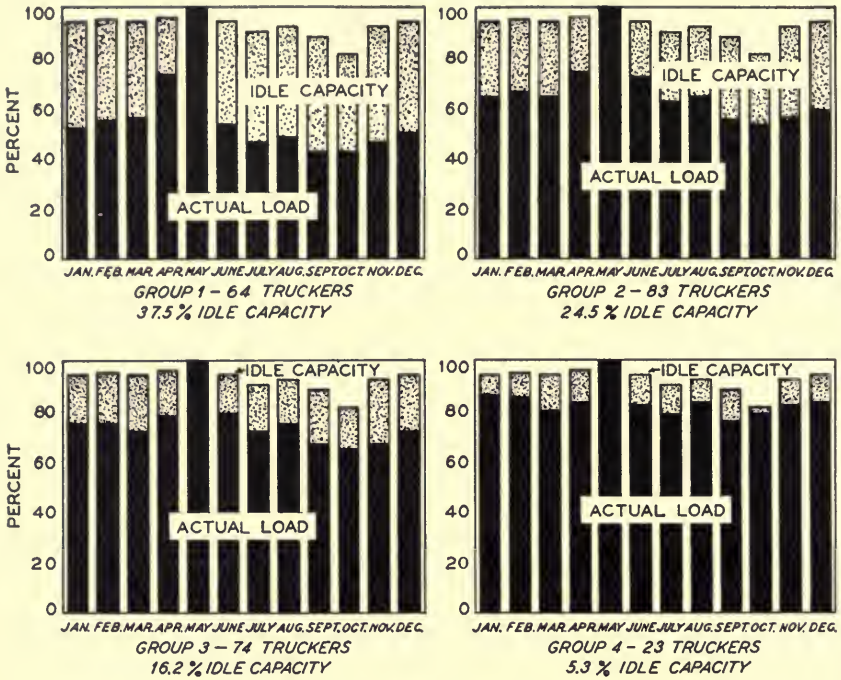

FIG. 21.—IDLE CAPACITY ON FOUR GROUPS OF TRUCKS IN THE ST. LOUIS COUNTRY PLANT AREA, 1933-34

A wide seasonal variation in milk production results in much waste of truck capacity. The 64 truckers included in Group 1 failed to use 37.5 percent of their practical seasonal capacity. In contrast, the 23 truckers included in Group 4, which had relatively even loads thruout the year, had an idle capacity of only 5.3 percent.

that results from the wide seasonal variation in milk production in this area, a measure has been set up termed "practical seasonal capacity." This term, as used in this study, assumes a seasonal variation in milk production in the St. Louis area similar to that in the Philadelphia milkshed in 1925[1] and a maximum truck capacity equal to the volume hauled on each route in the month of highest production.[2] "Idle capacity" is then the difference between the practical seasonal capacity and the actual load hauled on each route.

[1]The 1934 data on milk production were not published until April, 1936, when most of the computations on this study had been made.

[2]"Practical seasonal capacity" should not be confused with the total operating capacity of the truck. Trucks which had an average volume of 1,523 pounds and an idle truck capacity of 5.3 percent (Table 24) had a total operating capacity of nearly twice this volume.

TABLE 23.—PERCENTAGE OF IDLE TRUCK CAPACITY ON 382 MILK ROUTES IN THE ST. LOUIS MILKSHED, 1933-34

Kind of route	Number of routes	Percentage idle capacity was of practical seasonal capacity
		perct.
Main-line	99	23.5
Short-line	39	13.1
Country-plant	244	23.6
Total	382	....
Weighted average	...	22.8

Applying these measures to the 382 routes analyzed in this study, it was found that 22.8 percent of the trucking equipment was idle for the year as a whole (Table 23). Since these routes are typical of the milkshed as a whole (Fig. 20), it may be concluded that at least one out of every five routes now operating in the area could be eliminated if the seasonal fluctuation in milk production in this milkshed were reduced to that in the Philadelphia shed and the volume of each of the remaining routes were increased to practical seasonal capacity.

The idle capacity of the 244 country-plant routes studied was about 24 percent of practical seasonal capacity. One group of 64 trucks, with an actual volume of 1,061 pounds of milk a day, had an idle capacity of 37.5 percent of the practical seasonal capacity (Fig. 21 and Table 24). In contrast, that of a group of 23 trucks with the most even production was only 5.3 percent. Actual loads for the group of trucks with the least idle capacity averaged nearly 50 percent higher than for those having the most idle capacity.

The 99 main-line routes had practically the same idle capacity as the country-plant routes (Table 23). Producers living near to St.

TABLE 24.—IDLE TRUCK CAPACITY ON 244 COUNTRY-PLANT ROUTES IN THE ST. LOUIS MILKSHED, 1933-34

Percentage idle capacity was of practical seasonal capacity	Number of routes	Volume per day			Average percentage idle capacity
		Practical seasonal capacity	Actual load	Idle capacity	
		lbs.	*lbs.*	*lbs.*	*perct.*
Over 30 percent	64	1 698	1 061	637	37.5
21-30 percent	83	1 820	1 373	447	24.5
11-20 percent	74	1 699	1 424	275	16.2
10 percent and under	23	1 609	1 523	86	5.3
Total	244	.....	.....	...	....
Weighted average	...	1 731	1 321	410	23.6

Louis, however, who ship milk on the short-line routes, have a more even flow of milk thruout the year (Fig. 20) and their idle capacity was only slightly more than half that of the country-plant and main-line routes.

Premiums for More Even Production.—At present (1936) no premiums are paid to producers in the St. Louis area for maintaining an even production of milk. The question of the advisability of doing this is likely to be raised from time to time. When it is raised, savings in transportation costs made possible thru more even production of milk should be considered along with other factors in its favor.

Diversion of More Milk to Country Plants

It is clearly uneconomic to haul milk long distances to be manufactured into butter or other products whose market values do not include the high transportation costs involved. In spite of this fact, however, 45.1 million pounds of milk, or about one-fifth of the total farm-to-city shipments, were manufactured into butter or other dairy products in St. Louis in 1933-34. The hauling of this milk to city plants cost farmers $176,000, or 39 cents per 100 pounds (Table 25). The milk had a market value of $420,000, or 93 cents per 100 pounds. Had this milk gone to St. Louis via country plants, the total hauling cost to farmers would have been $102,000, assuming that hauling to the country plant would have cost the average rate of 17.7 cents plus 5 cents, the rate allowed Class III milk from country plants to city plants. This would have meant a net saving to farmers of $74,000, or 16.3 cents per 100 pounds on the volume of milk manufactured in city plants.

In February, 1936, Class II milk (milk used as cream) and Class

TABLE 25.—ORIGIN OF MILK SHIPPED FROM THE MORE DISTANT PARTS OF THE ST. LOUIS MILKSHED BY MAIN-LINE ROUTES TO BE MANUFACTURED AT CITY PLANTS, 1933-34

Zone	Volume of farm-to-city shipments[a]	Rate per 100 pounds[b]	Producers' hauling costs
miles	*lbs.*	*cents*	
51- 60	17 335 000	35.7	$61 882
61- 70	10 331 000	39.1	40 394
71- 80	5 328 000	41.9	22 324
81- 90	4 074 000	40.5	16 500
91-100	4 431 000	44.1	19 541
101-110	3 281 000	41.8	13 715
111-120	345 000	41.6	1 435
Total	45 125 000	....	$175 791
Weighted average	.....	39.0	.....

[a]The volume in each mileage zone includes the sum of the volumes of each producer on main-line routes in this zone. Zones are based upon air-line distance from St. Louis and not upon distances covered by the hauling routes.

[b]These are weighted averages and are based upon rates and volumes within zones that are specified air-line distances from St. Louis; hence they do not correspond with the average rates included in Table 13, which are based upon the actual mileage in the hauling routes.

III milk (milk used for manufacturing purposes) were combined by federal marketing order, as stated on pages 446-447, and payment for the combined classification was established at the condensery level plus 15 cents per 100 pounds when the milk was hauled to St. Louis. If this classification and price arrangement continues, distributors will be encouraged to establish their manufacturing plants in the country. Competition on manufactured dairy products is keen, and an extra hauling cost of 15 cents per 100 pounds would take too large a part of the profit on these products to justify continuing large-scale manufacturing operations in the city for any length of time.

Eliminating Delays in Unloading Milk

The longer the time spent collecting milk and delivering it, the greater the total cost of hauling it. Hence delays in unloading milk at receiving plants add materially to trucking costs.

Assuming that under efficient conditions a truck could be unloaded in 15 minutes after its arrival at the plant, delays in unloading the milk from 491 routes in the St. Louis dairy district in 1934 represent an average daily loss of 200 man and truck hours, or a total annual loss of about 73,000 man and truck hours. In July, 1934, the time required for unloading milk after the truck arrived at the plant averaged 31 minutes per route both for the 329 country-plant routes and for the 93 nonrefrigerated trucks, and 1 hour and 28 minutes per route for the 69 refrigerated trucks included in Table 26. Thirteen nonrefrigerated country-plant trucks and 4 nonrefrigerated city-plant

TABLE 26.—TIME REQUIRED FOR UNLOADING MILK AT RECEIVING PLANTS IN THE ST. LOUIS MILKSHED, JULY, 1934: DATA FROM 491 HAULING ROUTES

Nonrefrigerated trucks					Refrigerated trucks		
Minutes at receiving plant	Number of routes delivering to—				Minutes at receiving plant	Number of routes delivering to city-receiving plants	
	Country-receiving plants		City-receiving plants				
	Total	Percent of total	Total	Percent of total		Total	Percent of total
0- 9	21	6.4	7	7.5	0- 20	11	15.9
10-19	107	32.5	33	35.5	21- 40	..	....
20-29	45	13.7	15	16.1	41- 60	6	8.7
30-39	72	21.9	11	11.8	61- 80	6	8.7
40-49	34	10.3	9	9.7	81-100	14	20.3
50-59	9	2.7	4	4.3	101-120	19	27.5
60-69	23	7.0	8	8.6	121-140	4	5.8
70-79	5	1.5	2	2.2	141-160	5	7.3
80 and over	13	4.0	4	4.3	Over 160	4	5.8
Total	329	100.0	93	100.0	Total	69	100.0

trucks spent over 80 minutes at the receiving plants, while milk on 4 refrigerated trucks was not unloaded until nearly three hours after the trucks arrived at the receiving plant (Table 26).

Bunching of trucks at a receiving plant is the principal cause for delays in unloading milk at country plants and at city plants receiving milk from nonrefrigerated trucks. This difficulty has been largely overcome in the Dayton and other milksheds by arranging a schedule for the arrival of trucks at the plant. While in certain seasons, particularly when the roads are muddy, some trucks are unable to meet a schedule, the use of a schedule has greatly reduced time losses resulting from hit-or-miss arrivals.

Inadequate plant facilities for receiving milk are the major cause for delays in receiving milk hauled by refrigerated trucks and a secondary cause for delays in country and city plants receiving milk from nonrefrigerated trucks. The rerouting to country plants of milk which is being sent to St. Louis and there manufactured into butter and other products will materially reduce delays in unloading milk at city plants. In addition, the rerouting to country plants of some direct-shipped milk used as market milk would help to reduce delays in unloading milk at city plants. With a reduced volume, accompanied by a schedule for the arrival of trucks, delays in unloading milk at city plants from refrigerated trucks should be materially reduced.

REVISION OF HAULING ROUTES THE KEY TO MORE ECONOMICAL TRANSPORTATION

In considering methods for increasing the efficiency of milk transportation, a practical question is how and by whom can this be done. One answer is found in the operations of the milk producers' association in Dayton, Ohio, which commenced a rerouting program in the spring of 1930 and completed it in the early part of 1931. As a result of this program "17 trucks were eliminated, and the hauling rate was reduced on an average of almost ten cents per hundred pounds, which meant a saving of over $50,000 to the farmers in the very first year that this rerouting was accomplished."[1]

Since the producers' association in the Dayton market accomplished one of the things desired in the St. Louis market—a lowering of the hauling rate—careful analysis was made of a selected area in the Dayton milkshed to ascertain what the various changes were that led to this result, the producers' association cooperating in the study. A similar study was made of a selected area in the St. Louis milkshed. The main facts are shown in Table 27 and the following summary.

[1]From paper by C. W. Lawrence, General Manager of the Miami Valley Cooperative Milk Producers Association, at the annual meeting of the National Cooperative Milk Producers Federation, 1935.

TABLE 27.—ACTUAL SAVINGS TO PRODUCERS IN THE DAYTON MILKSHED AND POSSIBLE SAVINGS IN THE ST. LOUIS MILKSHED BY REVISION OF HAULING ROUTES

Factors affected by change	Direct-to-city shipments of 506 producers in the Dayton milkshed[a]			Country-plant shipments of 458 producers in St. Louis milkshed[b]		
	Before routes were revised 1930	After routes were revised 1931	Net change	As routes were in 1933-34	If possible revisions were made	Net potential change
			perct.			*perct.*
Number of routes	14	9	−36	26	13	−50
Average number of farm stops per route	36	56	+56	17.6	35.2	+100
	miles	*miles*		*miles*	*miles*	
Round-trip distance in all routes	847	526	−38	852	541	−37
Average distance per route	60.5	58.4	− 3.5	32.8	41.6	+27
	lbs.	*lbs.*		*lbs.*	*lbs.*	
Average daily milk volume						
Per route	1 835	2 855	+56	1 332	2 664	+100
Per farm stop	51	51	0	76	76	0
Per mile per route	30	49	+63	41	64	+56
Average hauling costs to producers						
Per 100 pounds of milk	$ .40	$ .30[c]	−25	$ .211	$ .156	−26
Per route per day	7.34	8.56	+17	2.81	4.16	+48
Per farm stop per day	.20	.15	−25	.16	.12	−25
Per mile	.121	.147	+21	.086	.10[d]	+16

[a]Data and maps from which the Dayton section of the above table was compiled were obtained thru courtesy of C. W. Lawrence, General Manager of the Miami Valley Cooperative Milk Producers Association of Dayton, Ohio.

[b]Data and maps for the St. Louis section of the above table were obtained in a study of a country-plant area in the St. Louis milkshed.

[c]Further reductions in hauling rates were made in the Dayton milkshed after 1931 in addition to those effected by increasing the volume per load and decreasing the total mileage.

[d]This estimate is based on an average operating cost of 5.2 cents a mile for 25 routes in the Dayton milkshed in 1934, plus an estimated return for labor. Since hauling costs differ in different areas, they should be computed separately for each area in which they are to apply.

SUMMARY OF SAVINGS THRU REVISION OF HAULING ROUTES

Dayton, Ohio

An *actual* rerouting program in a selected *direct-shipper area* in the Dayton milkshed, including 506 producers, resulted in:

1. Eliminating 5 of 14 hauling routes.
2. A net reduction of 38 percent in round-trip mileage.
3. A net increase of 56 percent in the average volume of milk per load.
4. A net increase of 63 percent in the average volume of milk assembled per mile.
5. A net reduction of 25 percent in the average hauling rate paid by producers.
6. A net increase of 21 percent in the average income per mile to haulers.

St. Louis, Missouri

A *possible* rerouting program in a selected *country-plant area* in the St. Louis milkshed, including 458 producers, would result in:

1. Eliminating 13 of 26 hauling routes.
2. A net reduction of 37 percent in round-trip mileage.
3. A net increase of 100 percent in the average volume of milk per load.
4. A net increase of 56 percent in the average volume of milk assembled per mile.
5. A net reduction of 26 percent in the average hauling rate paid by producers.
6. A net increase of 16 percent in the average income per mile to haulers.

The rerouting program in the Dayton milkshed was accomplished in the following ways: First, at the request of producers in a given area a careful study of existing conditions was made by the producers' association, and hauling routes were mapped as they were and as they would be if rearranged on an economic basis (Figs. 22 and 23). A series of meetings was then held in the local area, at which the maps

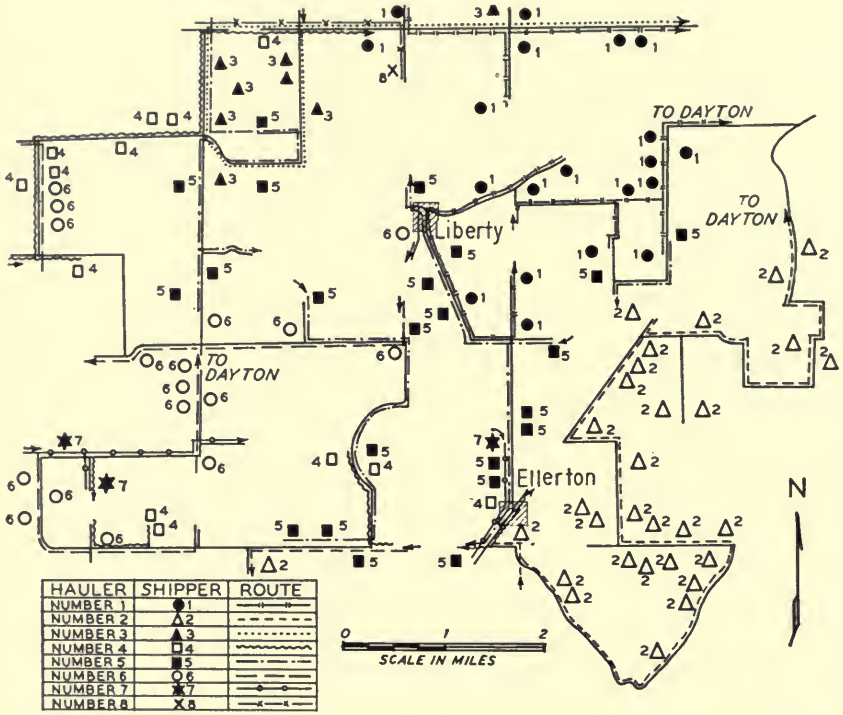

FIG. 22.—HAULING ROUTES IN ONE PART OF THE DAYTON MILKSHED IN 1930

One hundred fifteen producers shipped milk over the eight routes shown in the above map. The inefficiency of the system is indicated by the number of places where two or more routes parallel each other.

were shown and discussed until the producers became thoroly familiar with the proposed changes. Following these meetings the association, with the assistance of a local committee, made arrangements for eliminating certain routes in spite of the many objections from the truckers. Frequently a trucker was paid to give up his route and agree not to truck milk for a five-year period. Producers benefiting by the elimination of the routes paid for this item—usually within six months—with the savings effected by the change. All negotiations were made by the association at the request of local member groups. Centralized authority in the rerouting program was essential to its success.

A question that arises in connection with efforts to increase the volume of milk per route is whether it is possible to haul a high-volume load when a large proportion of the road is unimproved. The fact is that among the 244 country-plant routes covered in this study, those

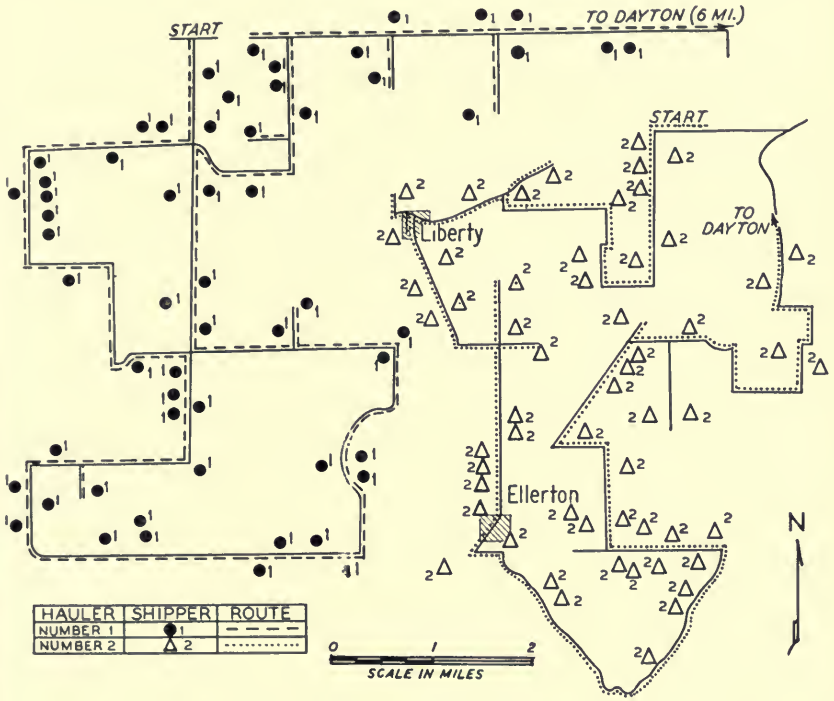

FIG. 23.—AFTER REVISION OF THE DAYTON HAULING ROUTES IN 1931

By combining into two routes the parts of the eight routes shown in Fig. 22, trucking mileage was reduced and volume of milk per load increased. In the territory now covered by Hauler 1, eight haulers formerly operated.

TABLE 28.—MILES OF EARTH ROAD IN ROUTE AND VOLUME OF MILK PER ROUTE, FOR 244 COUNTRY-PLANT ROUTES IN THE ST. LOUIS MILKSHED, 1933-34

Pounds daily per route	Number of routes	Average daily volume per route	Percent earth roads were of total mileage
		lbs.	
Up to 1,000	96	573	69.7
1,001 to 1,500	64	1 248	64.2
1,501 to 2,000	40	1 714	62.7
Over 2,000	44	2 758	70.3
Total	244	....	....
Weighted average	....	....	67.0

with a high volume included about the same proportion of earth roads as those with a smaller volume (Table 28). Earth roads made up 70.3 percent of the total mileage on 44 routes that had an average daily volume of 2,758 pounds, and 69.7 percent on 96 routes having a volume of 573 pounds (Table 28). Slightly less than two-thirds of the total mileage of the routes in the two intermediate groups consisted of earth roads. Earth roads averaged 67 percent of the total mileage of the 244 routes.

Benefits in St. Louis Area From a Rerouting Program

A saving of about $250,000 annually, or $24 per farmer, would result in the St. Louis milkshed from a 25-percent reduction in hauling costs (computed from Table 10, page 442). Opportunities for reducing mileage, increasing the volume per load, and lowering hauling costs on the country-plant and short-line routes in this milkshed as a whole are as great as, if not greater than, those that existed in the Dayton milkshed in 1930-31 and in the St. Louis sample area that supplied the data given in Table 27. The average daily volume of milk per load in the St. Louis country-plant areas in 1933-34, for example, was 1,321 pounds daily, whereas the more efficient routes in the area averaged loads in excess of 2,855 pounds, the average of the selected revised routes in the Dayton area. The most efficient routes in the St. Louis area were operating under average conditions as to proportion of earth roads and volume of milk available per mile.

While main-line hauling routes in the St. Louis milkshed have been operated somewhat more efficiently than the country-plant and short-line routes, most of this advantage has been offset by unnecessary costs incurred in hauling into St. Louis a large volume of milk for manufacturing purposes (pages 458-459). Hence the opportunities for reducing hauling costs on the main-line routes would seem to be about as great as those on the other routes.

Another way to bring about greater stability in the transportation service in the St. Louis milkshed would be an increase in the daily income to haulers. At least part of the troubles in the St. Louis country-plant areas during the past few years were caused by discontented haulers whose labor and operating costs were higher than their incomes.

EARLIER DELIVERIES WOULD IMPROVE MILK QUALITY

Early delivery to a cooling station is one of the essential steps in a milk-improvement program. City ordinances designed to improve the quality of milk have placed additional costs on producers of market milk in the St. Louis milkshed. From the viewpoint of those producers who are conscientiously trying to comply with such an ordinance, strict

enforcement is highly desirable in order that better-quality milk will not be forced to compete with low-quality milk. Furthermore milk that has been well produced should not have its quality lowered after it leaves the producer, and earlier deliveries would help to prevent this.

Records of the 491 routes shipping milk to the St. Louis market in July, 1934, show that by 10 o'clock in the morning one-fourth of the country-plant milk had not been unloaded, two-fifths of the city-plant milk hauled on nonrefrigerated trucks was still en route, while nearly all of the city-plant milk hauled on refrigerated trucks was not unloaded (Table 29). In fact, over four-fifths of the milk hauled in

TABLE 29.—TIME OF DAY MILK WAS UNLOADED AT RECEIVING PLANTS IN THE ST. LOUIS MILKSHED IN JULY, 1934: DATA FROM 491 HAULING ROUTES

Time	Number of routes delivering to—					
	Country-receiving plants		City-receiving plants			
			Nonrefrigerated trucks		Refrigerated trucks	
	Total	Percent of total	Total	Percent of total	Total	Percent of total
a.m.						
7:00- 7:59	63	19.1	2	2.2	0	0
8:00- 8:59	87	26.5	24	25.8	0	0
9:00- 9:59	97	29.5	30	32.2	2	2.9
10:00-10:59	54	16.4	26	28.0	3	4.4
11:00-11:59	28	8.5	8	8.6	7	10.1
12:00 *m.* or later	0	0	3	3.2	57	82.6
Total	329	100.0	93	100.0	69	100.0

refrigerated trucks was not unloaded until after 12 o'clock in the morning. Late unloading of milk from refrigerated trucks would be of minor importance if these trucks actually kept milk cold. However, the usual temperature in these trucks on arrival at St. Louis during the hot summer months has been not lower than 70° F. and sometimes it has been considerably higher. Hence they are not very useful in cooling milk, and of only limited usefulness in holding it at a low temperature.

Earlier deliveries to country plants and by short-line routes to city plants can be brought about along with the program outlined for reducing mileage and increasing the volume of milk per load (pages 460-464). The rerouting program in the Dayton milkshed resulted in an hour earlier delivery of milk to distributors' plants. Prevention of delays in unloading milk, as outlined above, also would materially speed up the time at which milk is unloaded.

Rerouting to country plants of milk received in the more distant

parts of the milkshed and which is manufactured in St. Louis, as outlined on page 458, would also help materially in effecting earlier deliveries on main-line routes to city plants. If stringent quality requirements are enforced, it is doubtful whether it is practical to ship milk from farms to city plants when the distance to the city plants is much over 60 miles. Even at this distance the use of ice or of efficient mechanical refrigeration usually will be necessary during the hot summer months.

SUMMARY OF THE SITUATION

1. Farmers in the St. Louis milkshed paid nearly $1,000,000 in 1933-34 to have milk valued at $5,760,000 wholesale transported from their farms to receiving plants. More than four-fifths of these farmers were on the Illinois side of the Mississippi river.

2. The development of trunk-line highways and the use of motor trucks has greatly changed the milk transportation system in the St. Louis area in the past twenty years. Whereas most of the milk shipped to St. Louis in 1914 was shipped by rail, in 1934 all of it was transported by truck.

3. About half the milk produced for the St. Louis market is hauled in cans directly from farms to city plants and about half is hauled from farms to country plants, where it is cooled and hauled by trucks to St. Louis. The equipment used for the commercial hauling of milk from farms to receiving plants on the 491 routes operating in the St. Louis milkshed in July, 1934, consisted of 463 trucks, 16 wagons, 10 automobiles, and 2 auto trailers.

4. Tank cars for rail shipments have not come into use in the St. Louis area. In the New York City area shipments by tank truck were found by Cornell University investigators to be cheaper than by tank car for distances of less than 171 miles. For more than 171 miles, tank-car shipments were more economical. Since all the milk in the St. Louis market is obtained within a radius of 150 miles, rail shipments are not likely to be reestablished here.

5. The average distance from farm to milk plant on 244 country-plant routes was 20.3 miles. Two-thirds of the distance was earth road, one-fifth was concrete pavement, and the remainder, about a mile, was gravel or macadam. The average distance in 99 main-line farm-to-city routes was 100.1 miles. Slightly less than three-fifths of this distance was pavement, about one-fifth was gravel or macadam, and over one-fifth was dirt. About 10 percent of the farm-to-city shipments were hauled on short-line routes 18.1 miles in length.

6. Low production per cow and sparse cow population increase the transportation problem in the St. Louis milkshed. In this area milk production per square mile is only about two-fifths as great as in the

Chicago area. Hence, in order to get an average daily volume of even 20,000 pounds of milk per station, it has been necessary to draw it from a wide radius.

7. Wide inequalities exist in rates paid by farmers for hauling milk in the St. Louis milkshed. The average rate on 244 routes from farms to country plants in 1934 was 17.7 cents per 100 pounds; on 99 main-line farm-to-city routes, 29.3 cents; and on 39 short-line routes, 19.7 cents per 100 pounds. Rates for long hauls on the country-plant and short-line routes averaged only slightly higher than rates for short hauls. Also wide variations exist in rates for the same distance. On 15 country-plant routes each of which traversed 12 miles, rates ranged from 13 cents to 30 cents per 100 pounds. Differences on country-plant and short-line routes were not due to varying proportions of earth roads or to varying volumes of milk hauled.

8. Most truckers in the St. Louis milkshed do not keep complete records of their operating costs. Such costs are indicated, however, by records from the Dayton milkshed. A group of 19 one-and-one-half-ton trucks averaged an expense of 4.8 cents a mile, tho there were wide variations from this average. The most efficient truck was operated at a cost of 2.9 cents a mile, or at less than half the mile cost (6.1 cents) of the least efficient truck.

9. What a rerouting program might do in the St. Louis area to reduce transportation costs is indicated by what was done in the Dayton milkshed in 1930-31. By eliminating 3 miles of every 8 over which milk was hauled and by increasing by about 56 percent the average volume of milk per load, the Dayton farmers netted a 25-percent reduction in hauling costs and the haulers on the revised routes benefited by an increase in income of 21 percent.

10. In the St. Louis milkshed at least one truck out of every five could be eliminated if seasonal fluctuations in milk production were reduced to those in the Philadelphia milkshed and the volume of each of the remaining routes increased to a practical seasonal capacity.

11. A large volume of milk is hauled unnecessarily long distances in the St. Louis milkshed. About one-fifth of the milk hauled to St. Louis in 1933-34—about 45.1 million pounds—was manufactured into butter or other dairy products in St. Louis. Farmers could have saved about $74,000 (16.3 cents per 100 pounds) had they marketed this milk thru country plants.

12. Unnecessary delays in unloading milk at receiving plants in the St. Louis area resulted in an average daily loss of 196 man and truck hours in 1934 or an annual loss of more than 70,000 man and truck hours. By 10 o'clock in the morning, one-fourth of the country-plant milk had not been unloaded, two-fifths of the milk hauled on nonrefrigerated trucks was still en route, while nearly all of the milk

hauled on refrigerated trucks had not been unloaded. The usual temperature of refrigerated trucks on arrival in St. Louis in hot weather was not lower than 70° F. and sometimes it was considerably higher. Such temperatures indicate that there is a limit to the usefulness of these trucks as a means of keeping milk cool.

RECOMMENDATIONS

The foregoing analysis of the transportation situation in the St. Louis milkshed indicates that substantial savings to producers, better pay to haulers, and more efficient service to distributor and to consumer can be developed in this area by certain changes in present practices. The authors therefore make the following recommendations, believing not only that they are warranted but that they are susceptible to immediate practical application.

1. In order to avoid unnecessary hauling costs, milk now manufactured at city plants should be diverted to country plants. It is clearly uneconomic to haul milk long distances to be manufactured into butter or other products whose market values do not include the high transportation costs involved.

2. Careful consideration should be given to market policies which will encourage a more even production of milk, since this will make it possible to bring about substantial savings in transportation costs.

3. Hauling routes from farms to milk plants in the St. Louis milkshed should be gradually rearranged to reduce the distance that milk is hauled and to increase the volume of milk per load. Farmers in this area could save approximately $250,000, or $24 per farmer yearly, if routes were rearranged on an economic basis.

4. Along with a rerouting program, schedules for truck arrivals at receiving stations should be made in order to prevent unnecessary delays in unloading milk at receiving plants and in order to insure earlier delivery to these plants.

5. Since hauling charges paid by small-volume producers in this milkshed frequently fall below the actual cost incurred, it is recommended that careful consideration be given to establishing a minimum pick-up charge. In the Dayton milkshed, when the daily average hauling charge at the regular rate drops below 10 cents, a minimum pick-up charge of 10 cents a day is made.

6. Complete records of the costs of operating milk trucks should be kept by truckers since these are essential in order to determine how trucking costs in this area can be lowered and in establishing hauling rates that will be fair to both farmers and truckers.

INDEX TO TABLES AND FIGURES

THREE MAJOR ADJUSTMENTS in transportation and production practices in the St. Louis milkshed would save farmers in this area many thousands of dollars yearly. These are:

Rearrangement of hauling routes, so as to reduce mileage and increase volume per load.

Marketing more milk thru country plants.

Narrowing the seasonal variations in milk production.

Furthermore it is reasonable to believe that similar adjustments in other Illinois milk-producing areas would effect similar savings since the problems met in the St. Louis milkshed are typical of those found at present in most milk-producing areas both within and without the state.

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